

# **PASSENGER CARS & LIGHT DUTY TRUCKS**

# UNIT REPAIR MANUAL (OVERHAUL)



ST 333-77



## **IMPORTANT SAFETY NOTICE**

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by Chevrolet and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Warnings, and Cautions which should be carefully read in order to minimize the risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It also is important to understand that these Warnings, and Cautions are not exhaustive. Chevrolet could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Chevrolet has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Chevrolet must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.



**1977  
OVERHAUL MANUAL  
covering  
CHEVROLET, CHEVELLE,  
MONTE CARLO, NOVA,  
Camaro, CORVETTE  
and  
LIGHT DUTY  
(SERIES 10-30)  
CHEVROLET TRUCKS**

**FOREWORD**

This manual includes procedures involved in disassembly and assembly of major components of 1977 Chevrolet, Chevelle, Monte Carlo, Nova, Camaro, Corvette and Light Duty Trucks. Information on diagnosis, maintenance and adjustments, minor service operations, and removal and installation for these components is contained in either the 1977 Passenger Car or the Light Duty Truck Service Manuals.

The Section Index on this page enables the user to quickly locate any desired section. At the beginning of each section containing more than one major subject is a Table of Contents, which gives the page number on which each major subject begins. An index is placed at the beginning of each major subject within the section.

Summaries of Special Tools, when required, are found at the end of major sections.

The manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better service the owners of Chevrolet built vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

**CAUTION**

*This vehicle contains some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your Chevrolet dealer.*

**SECTION INDEX**

SECTION	NAME
<b>1B</b>	<b>AIR CONDITIONING COMPRESSOR</b>
<b>3B</b>	<b>STEERING</b>
<b>4B</b>	<b>REAR AXLE</b>
<b>4C</b>	<b>4-WHEEL DRIVE</b>
<b>5</b>	<b>BRAKES</b>
<b>6C</b>	<b>FUEL SYSTEMS</b>
<b>6D</b>	<b>ENGINE ELECTRICAL</b>
<b>7A</b>	<b>AUTOMATIC TRANSMISSION</b>
<b>7B</b>	<b>MANUAL TRANSMISSION</b>
<b>7C</b>	<b>CLUTCH</b>



## SECTION 1B

## A/C COMPRESSORS

## CONTENTS

Axial Six Cylinder Compressor .....	1B-1
Radial Four Cylinder Compressor .....	1B-22
Leak Testing .....	1B-33

## AXIAL SIX-CYLINDER COMPRESSOR

For Compressor REMOVAL AND INSTALLATION, refer to the ON CAR SERVICE Section of this Service Manual.

For all Axial Six Cylinder compressor applications, the compressor mechanism is basically the same. Actual differences between compressors are found in their mounting brackets, pulleys, connector assemblies and compressor capacities, none of which will affect the following Overhaul Procedures.

## MINOR REPAIR PROCEDURES

The following operations to the Compressor Clutch Plate and Hub, Pulley and Bearing, and Coil Housing are covered as "Minor" because they may be performed WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE PURGED of Refrigerant.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to Fig. 1 and Fig. 2 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Parts Tray J-9402 (see Fig. 33) should be used for all parts being removed, as well as for replacement parts.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described herein are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components.

Pad fender/skirt and secure compressor near top of fender skirt with wire, rope, etc.

**CAUTION:** Do not kink or place excessive tension on lines or hoses.

When a compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then

be discarded and new 525 viscosity refrigerant oil added to the compressor.

## CLUTCH PLATE AND HUB ASSEMBLY

## Remove

1. Place Holding Fixture J-9396 in a vise and clamp the compressor in the Holding Fixture.

2. Keep clutch hub from turning with Clutch Hub Holder J-25030 or J-9403, and remove locknut from end of shaft using Thin Wall Socket J-9399 (Fig. 3).

**CAUTION:** To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the Clutch Plate and Hub assembly OR on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.

3. Thread Clutch Plate and Hub assembly Remover J-9401 into hub. Hold body of Remover with a wrench and tighten center screw to remove Clutch Plate and Hub assembly (Fig. 4).

4. Remove square drive key from shaft or drive plate hub.

5. Remove hub spacer retainer ring using Snap-Ring Pliers J-5403 (#21), and then remove hub spacer (Fig. 5).

6. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (Fig. 6).

If the frictional surface shows signs of damage due to excessive heat, the clutch plate and hub and pulley and bearing should be replaced. Check further for the underlying cause of the damage (i.e. low coil voltage - coil should draw 3.2 amps at 12 volts) or binding of the compressor internal mechanism, clutch air gap too wide, broken drive plate to hub asm. springs, etc.

## Replace

1. Insert the square drive key into the hub of driven plate; allow it to project approximately 3/16" out of the keyway.

2. Line up the key in the hub with keyway in the shaft (Fig. 7).

3. Position the Drive Plate Installer J-9480-1 on the threaded end of the shaft. The Spacer J-9480-2 should be in place under the hex nut on the tool. This tool has a left hand thread on the body. (Fig. 8).

4. Press the driven plate onto the shaft until there is approximately 3/32" space between the frictional faces of the clutch drive plate and pulley.

**CAUTION:** Make certain key remains in place when pressing hub on shaft.

A ZERO thrust race is approximately 3/32" thick and

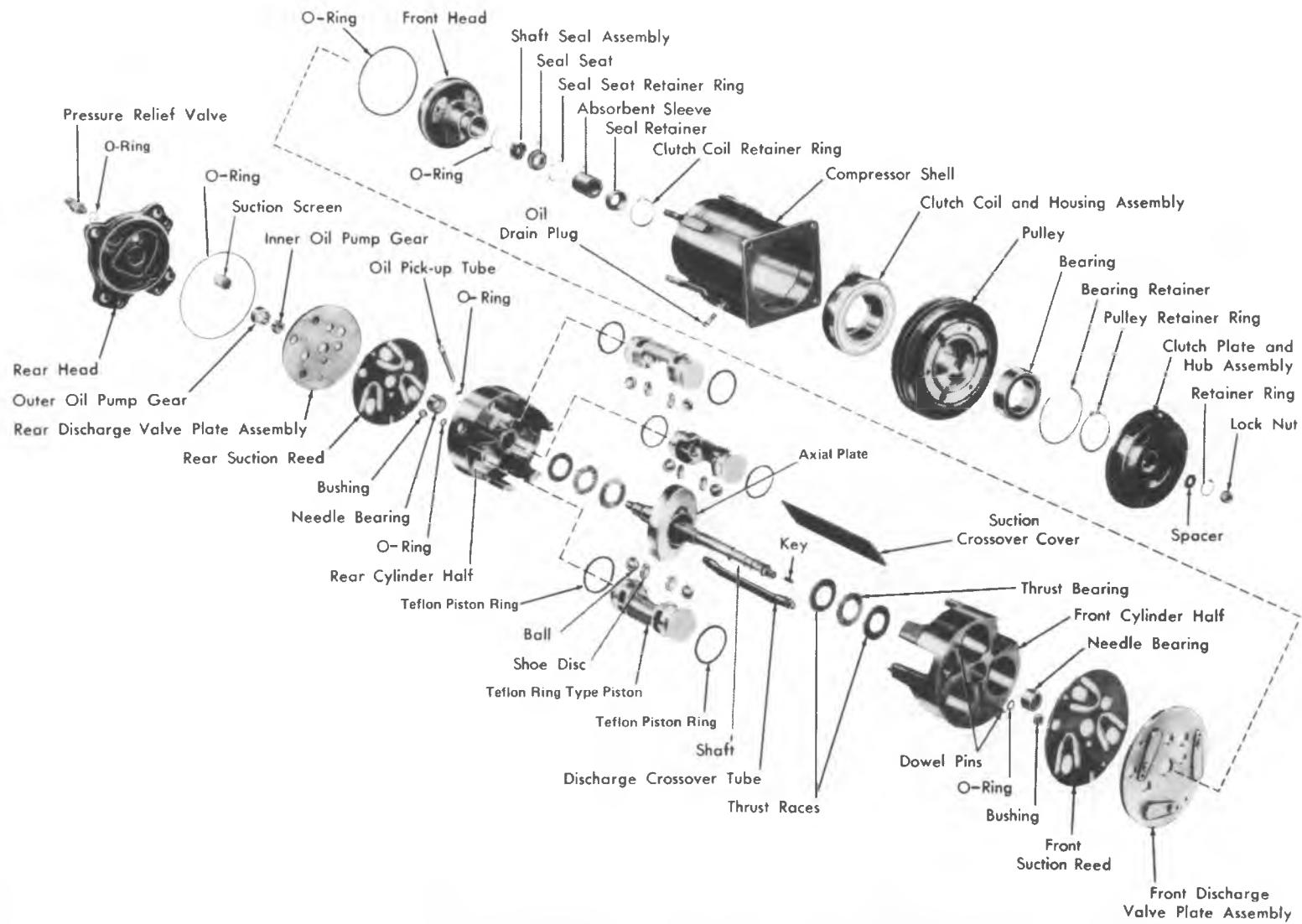


Fig. 1-Exploded View of A-6 Compressor

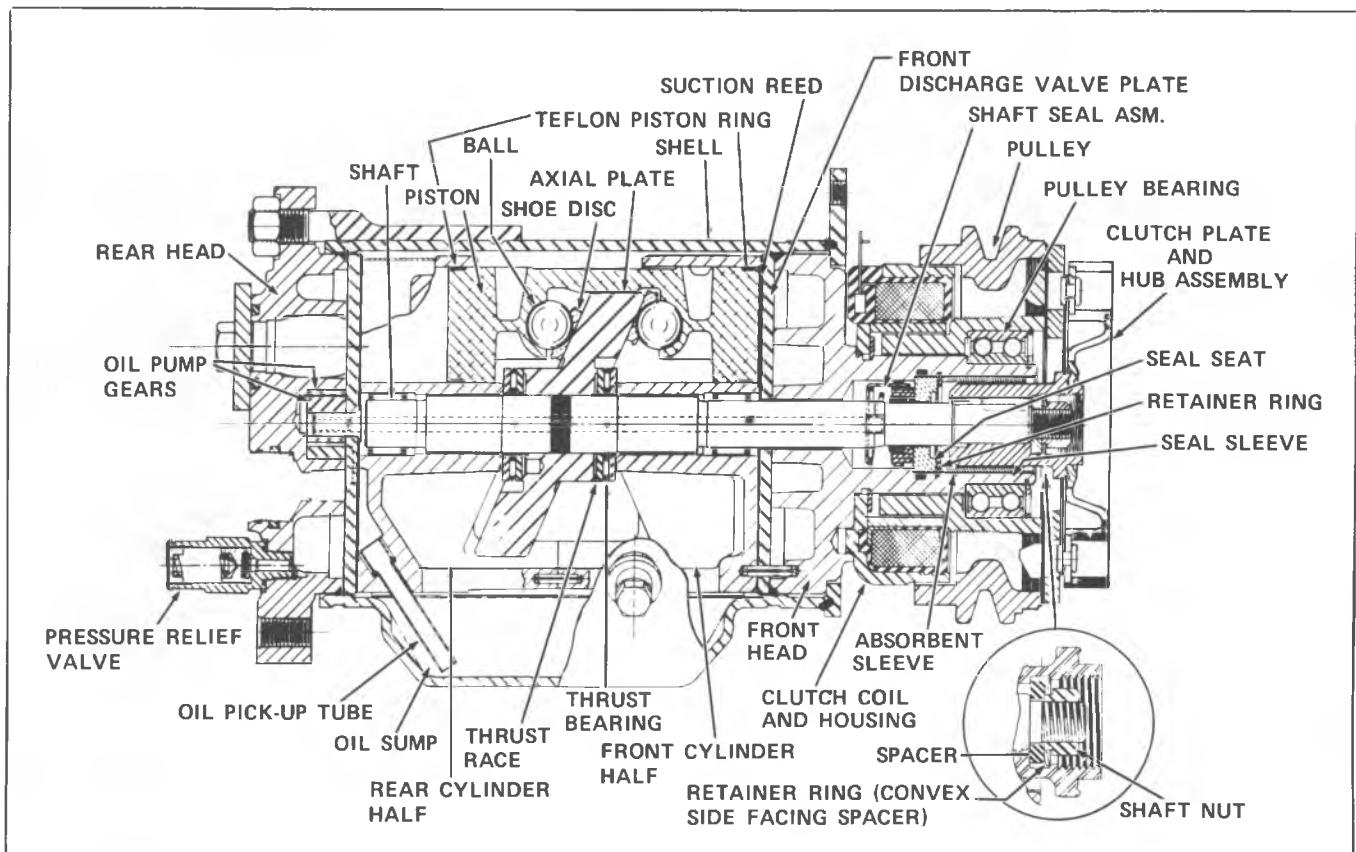


Fig. 2-A-6 Compressor Cross Section

may be used to roughly gage this operation. Use Clutch Hub Holder J-25030 or J-9403 to hold clutch plate and hub if necessary.

5. Install the hub spacer and, using Snap-Ring Pliers J-5403 (#21), install the retainer ring (see installed Retainer Ring in inset of Fig. 2), with convex side of ring facing spacer.

6. Use Thin-Wall Socket J-9399 and Clutch Hub Holder J-25030 or J-9403 to install a new shaft locknut **with shoulder or circular projection on the locknut facing towards retainer ring**. Tighten the nut to 14-26 lb. ft. torque. Air gap between the frictional faces should now be .022" to .057" (Fig. 9). If not, check for

mispositioned key or shaft.

7. The pulley should now rotate freely.

8. Operate the refrigeration system under MAXimum load conditions and engine speed at 2000 RPM. Rapidly cycle the clutch by turning the air conditioning on-and-off at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

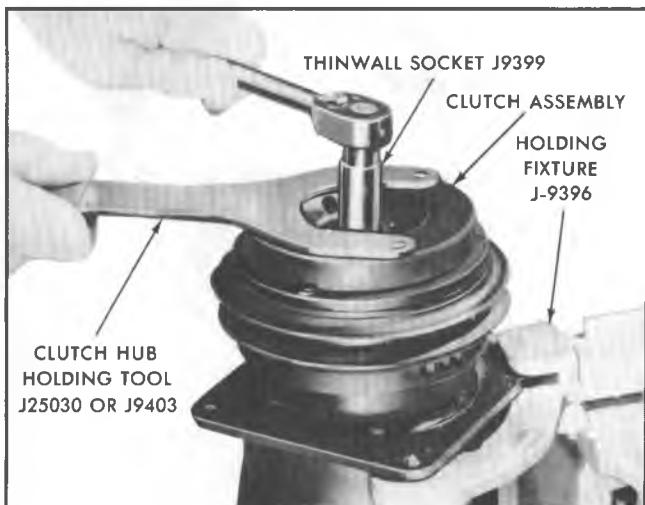


Fig. 3-Removing Shaft Lock Nut



Fig. 4--Removing Clutch Plate and Hub Assembly

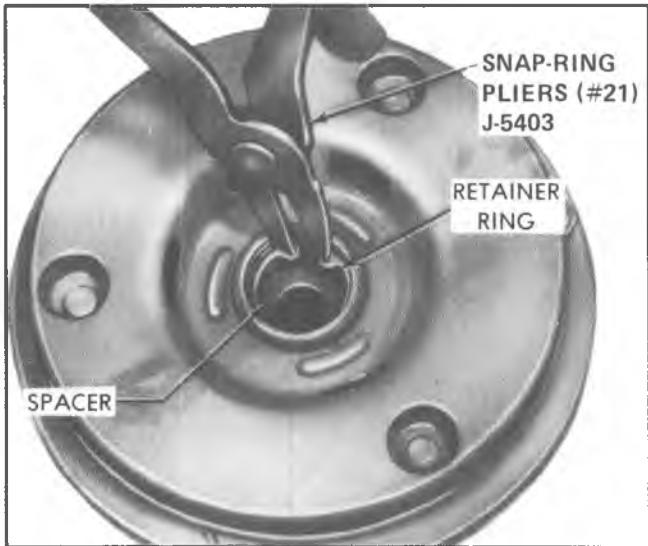


Fig. 5--Removing or Installing Retainer Ring in A-6 Clutch Drive Plate

## PULLEY AND BEARING ASSEMBLY

### Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.
2. Remove pulley retainer ring using Snap-Ring Pliers J-6435 (#26), Fig. 10.
3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.
4. Place Puller Pilot J-9395 over end of compressor shaft.

**CAUTION:** It is important that Puller Pilot J-9395 be used to prevent internal damage to compressor when removing pulley. Under no circumstances should Puller be used DIRECTLY against drilled end of shaft.

5. Remove Pulley and Bearing Assembly using Pulley Puller J-8433 (Fig. 11).

### Inspection

Check the appearance of the pulley and bearing assembly. See Fig. 6. The frictional surfaces of the pulley and bearing assembly should be cleaned with a suitable solvent before reinstallation.

### Replace

1. If original pulley and bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the pulley and bearing should be replaced.
2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. See "Compressor Pulley Bearing" Replacement Procedure.
3. Press or tap pulley and bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J-9481 with Universal Handle J-8092 (Fig. 12). The Installer will apply force to inner race of bearing and prevent damage to bearing.
4. Check pulley for binding or roughness. Pulley should rotate freely.
5. Install retainer ring, using Snap Ring Pliers J-6435 (#26).
6. Install absorbent sleeve in compressor neck.
7. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J-23128, install retainer so that outer edge is recessed 1/32" from compressor neck face.
8. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement Procedure.

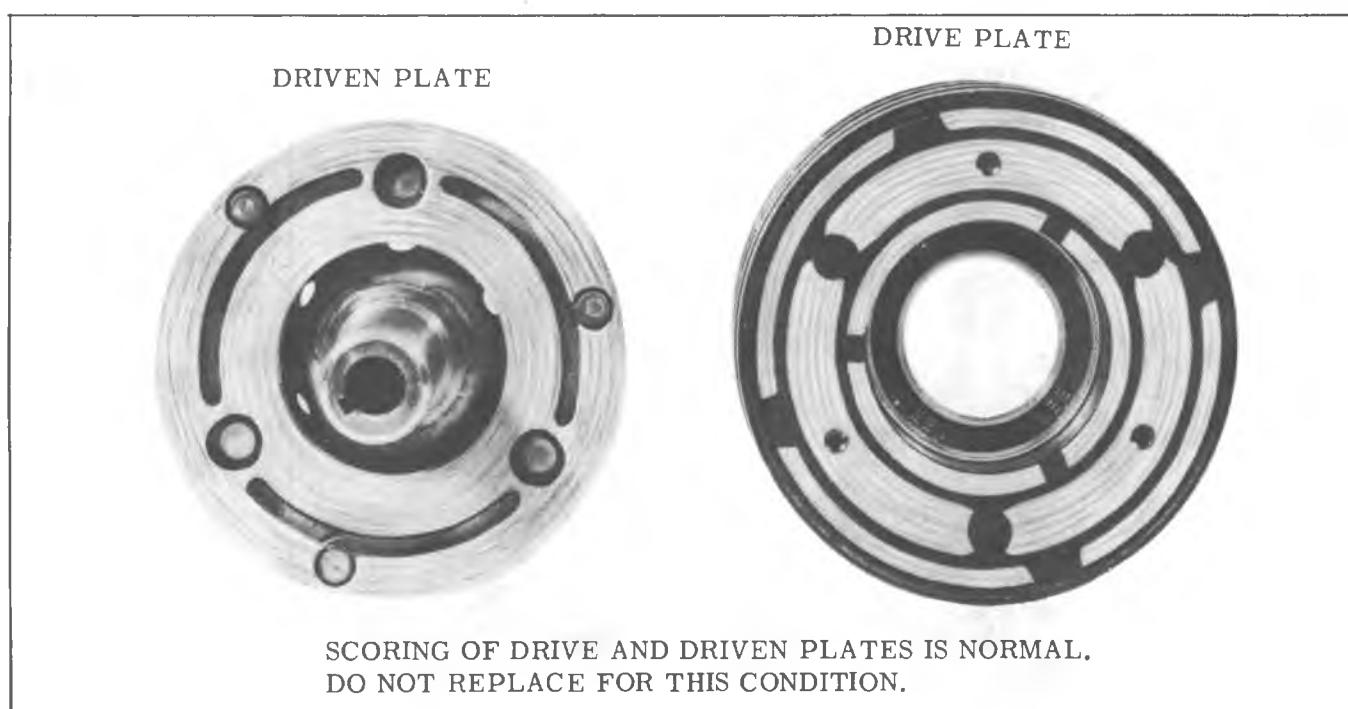


Fig. 6--Clutch Driven Plate and Drive Plate

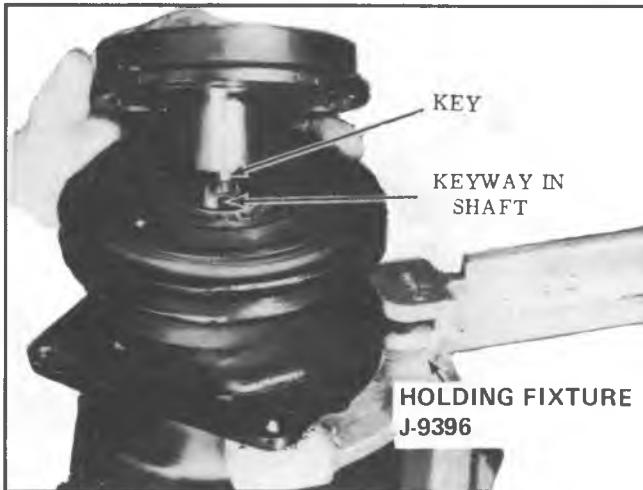


Fig. 7-Alining Drive Plate Key

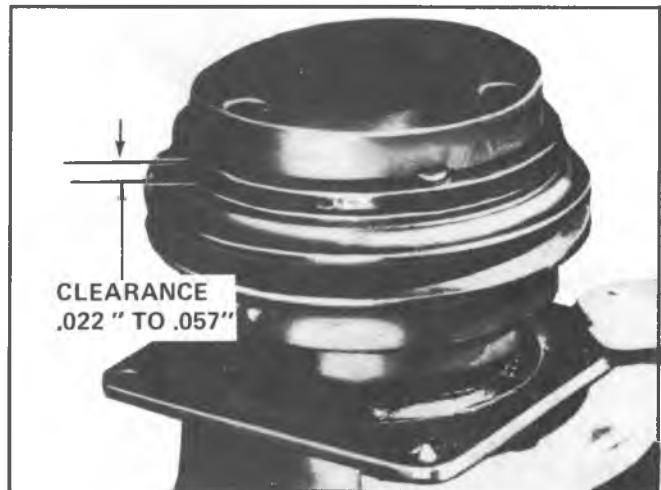


Fig. 9--Checking Air Gap

## PULLEY BEARING

### Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.
2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Removal procedure.
3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (Fig. 13).
4. Place pulley and bearing assembly on inverted Support Block J-21352 and, using Pulley Bearing Remover J-9398 with Universal Handle J-8092, drive Bearing assembly out of pulley (Fig. 14).

### Replace

1. Install new bearing in pulley using Pulley and Bearing Installer J-9481 with Universal Handle J-8092 (Fig. 15). The Installer will apply the force to the outer race of the bearing.

**CAUTION: DO NOT CLEAN NEW BEARING ASSEMBLY WITH ANY TYPE OF SOLVENT.**

Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.



Fig. 8--Installing Drive Plate

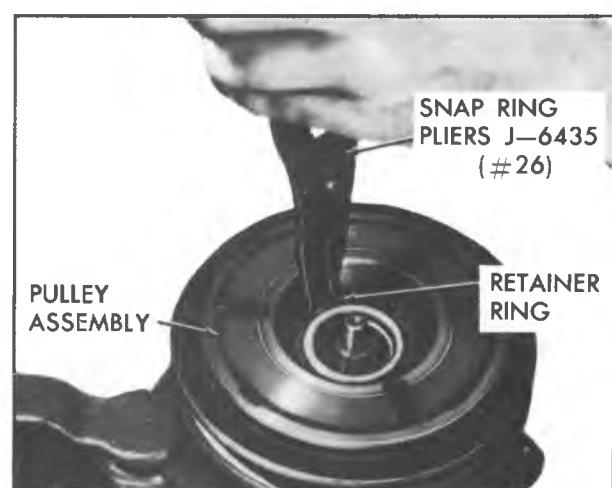


Fig. 10--Removing Pulley Retainer Ring

3. Install pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Replacement procedure.

4. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

## CLUTCH COIL AND HOUSING ASSEMBLY

### Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.
2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Removal procedure.
3. Note position of terminals on coil housing and scribe location on compressor front head casting.
4. Remove coil housing retaining ring using Snap-Ring Pliers J-6435 (#26) (Fig. 16).
5. Lift Coil and Housing assembly off compressor.

### Replace

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (Fig. 17).
2. Align locating extrusions on coil housing with holes

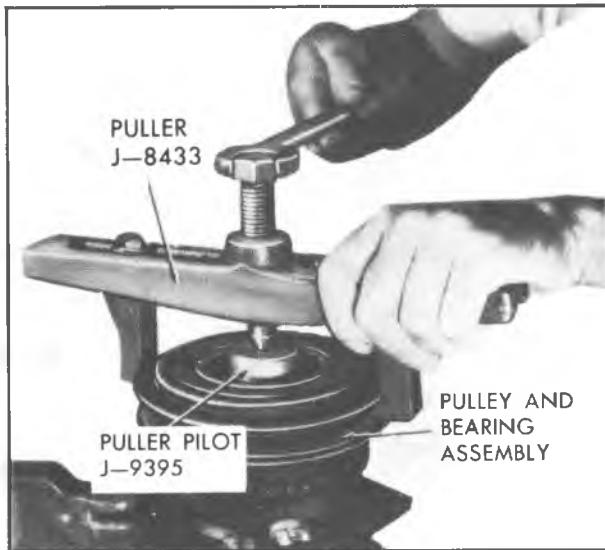


Fig. 11--Removing Pulley and Bearing Assembly

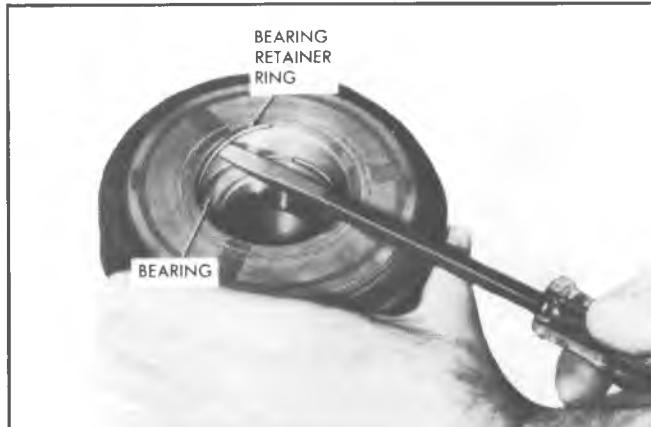


Fig. 13--Removing Pulley and Bearing Retainer Ring

replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available.

All parts required for servicing are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the mechanism assembly just as they are removed from the service package.

Piston shoe discs and shaft thrust races will be identified by "number" on the parts themselves for reference to determine their size and dimension (see Fig. 41).

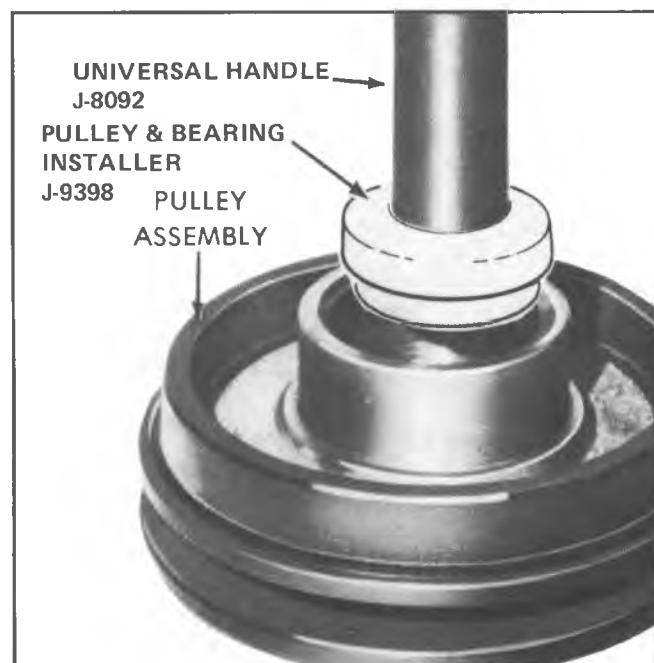


Fig. 12--Installing Pulley and Bearing Assembly

Fig. 14--Removing Bearing from Pulley Assembly

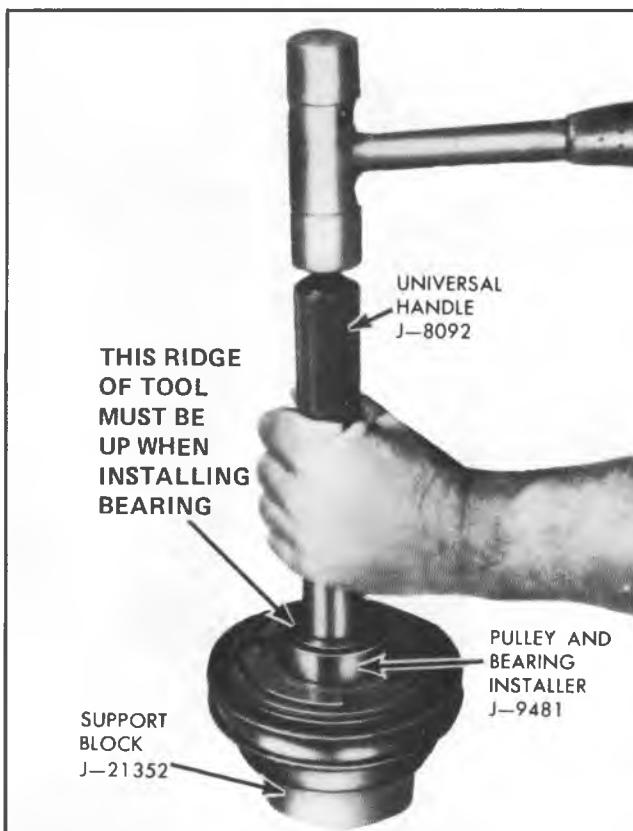


Fig. 15--Installing Bearing on Pulley

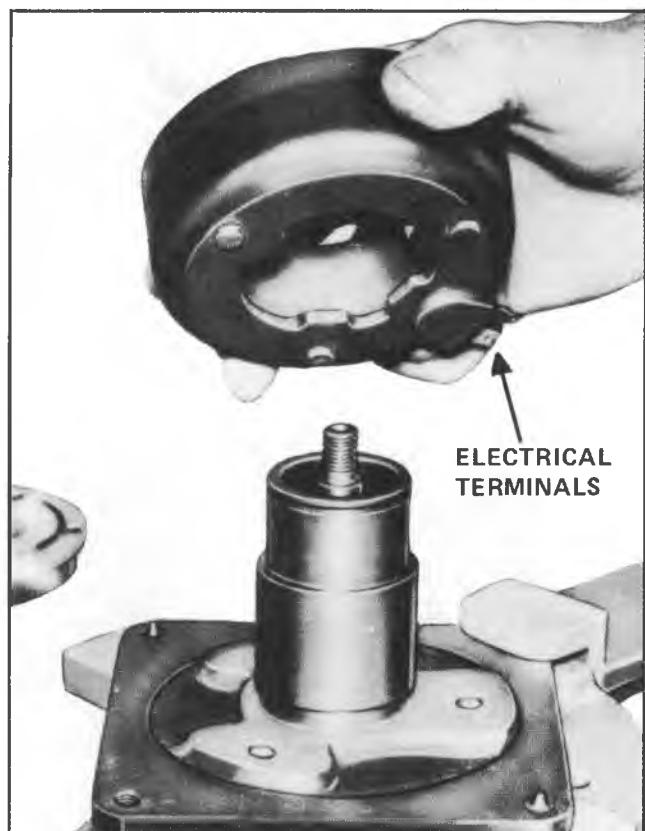


Fig. 17--Installing Coil Housing

## SHAFT SEAL

### Seal Leak Detection

**A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR.** The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by the following procedure.

When refrigerant system components other than the compressor are replaced, the compressor must be removed and oil drained from the compressor if oil was sprayed in large amounts due to leaks or a broken shaft seal.

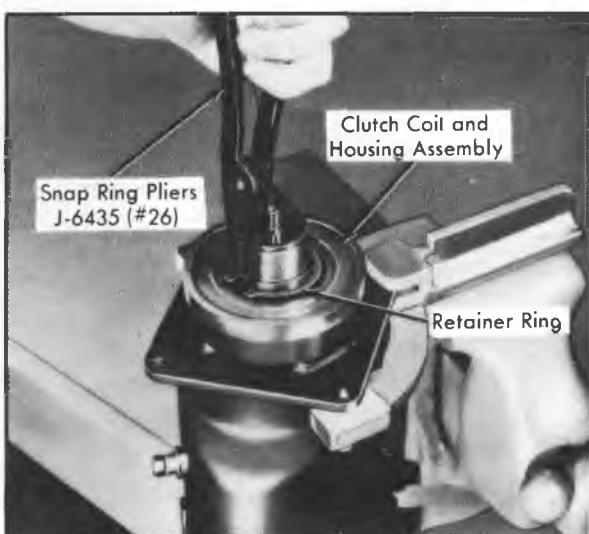


Fig. 16--Removing Coil Housing Retainer Ring

Compressor shaft seals, unless replaced during a compressor overhaul, are to be replaced only on the basis of actual refrigerant leakage as determined by test with leak detector.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY, even if the compressor remains on the vehicle during the operation, IT WILL BE NECESSARY TO PURGE THE SYSTEM OF REFRIGERANT as outlined earlier in the Service Manual.

### Remove

1. After first purging the system of refrigerant, remove the clutch plate and hub assembly and shaft key as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring, using Snap-Ring Pliers J-5403 (#21). See Fig. 18.

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

4. Place Seal Protector J-22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J-23128 into the recessed portion of the seal seat by turning the handle **clockwise**. Lift the seat from the compressor with a rotary motion (Fig. 19).

**CAUTION: DO NOT tighten the handle with a wrench or pliers; however, the handle must be hand-tightened securely to remove the seat.**

5. With Seal Protector J-22974 still over the end of the shaft, engage the tabs on the seal assembly with the tangs

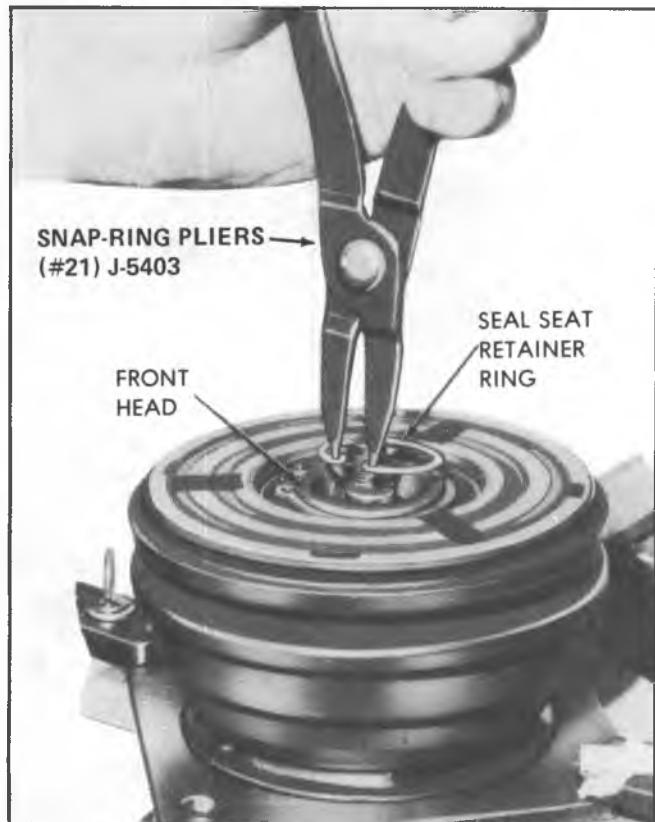


Fig. 18--Removing or Installing Shaft Seal Seat Retaining Ring

on Seal Installer J-9392 by twisting the tool **clockwise**, **while pressing the tool down**. Then lift the seal assembly out (see Fig. 20).

6. Remove the seal seat O-ring from the compressor neck using O-Ring Remover J-9533 (See Fig. 19).

7. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

#### Inspection

**SEALS SHOULD NOT BE REUSED. ALWAYS USE A NEW SEAL KIT ON REBUILD.** Be extremely careful that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

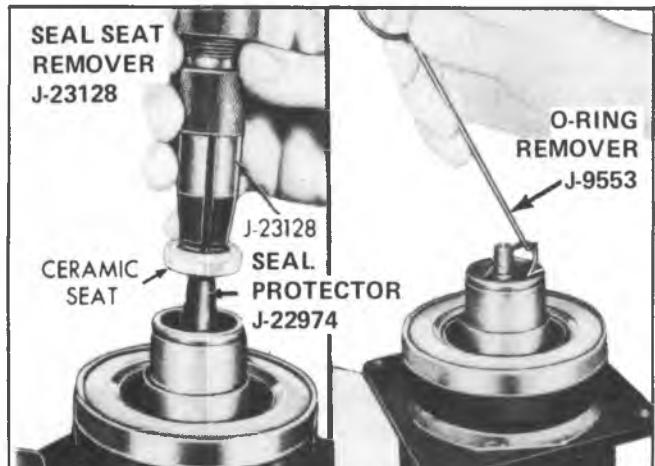


Fig. 19--Removing Shaft Seal Seat and O-Ring

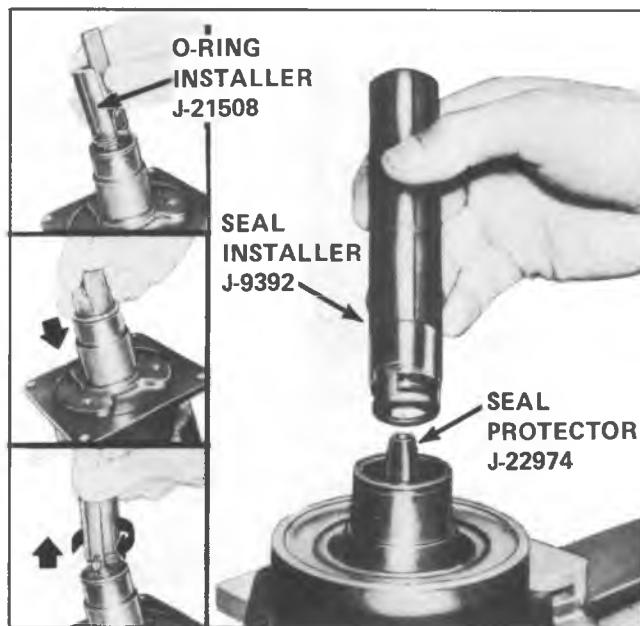


Fig. 20--Replacing Seal and O-Ring

#### Replace

1. Coat new seal seat O-ring with clean 525 viscosity refrigerant oil and install in compressor neck, **making certain it is installed in bottom groove** (Fig. 20 and Fig. 21). Top groove is for retainer ring. Use O-Ring Installer J-21508.

2. Coat the O-ring and seal face of the new seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the seal assembly to Seal Installer J-9392 by engaging the tabs of the seal with the tangs of the tool (Fig. 20).

3. Place Seal Protector J-22974 (Fig. 20) over end of shaft and **carefully slide the new seal assembly onto the shaft. Gently twist the tool CLOCKWISE, while pushing the seal assembly down the shaft** until the seal assembly engages the flats on the shaft and is seated in place. Disengage the tool by pressing downward and twisting tool counterclockwise.

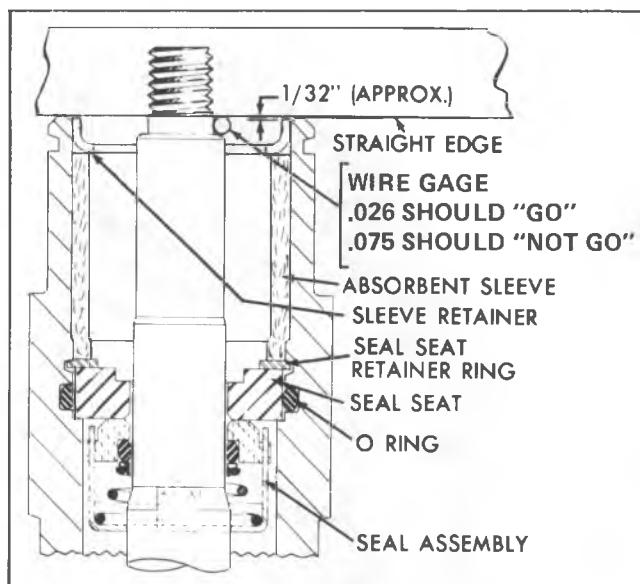


Fig. 21--Compressor Shaft and Seal

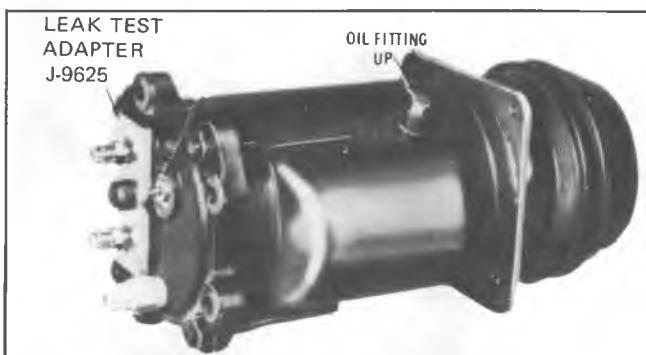


Fig. 22--Leak Testing A-6 Compressor

4. Coat the seal face of the new seal seat with clean 525 viscosity refrigerant oil. Mount the seal seat on Seal Seat Remover-Installer J-23128 and install it in the compressor neck, taking care not to dislodge the seal seat O-ring and being sure the seal seat makes a good seal with the O-ring. Remove Seal Protector J-22974 from the end of the shaft (see Fig. 19).

5. Install the new seal seat retainer ring **with its flat side against the seal seat**, using Snap-Ring Pliers J-5403 (#21). See Fig. 18. Use the sleeve from Seal Seat Remover-Installer J-23128 (Fig. 19) to press in on the seal seat retainer ring so that it snaps into its groove.

6. Install Compressor Leak Test Fixture J-9625 on rear head of compressor and connect gage charging lines as shown for bench test in Fig. 22 or pressurize SUCTION SIDE of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal with a Leak Detector. Correct any leak found. Remove and discard the shaft nut.

7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

8. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor. With a small screwdriver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

9. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Pulley Puller Pilot J-9395 (See Fig. 11) may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately  $1/32"$  from the face of the compressor neck). See Fig. 21.

10. Reinstall the clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

**Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft.** The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be

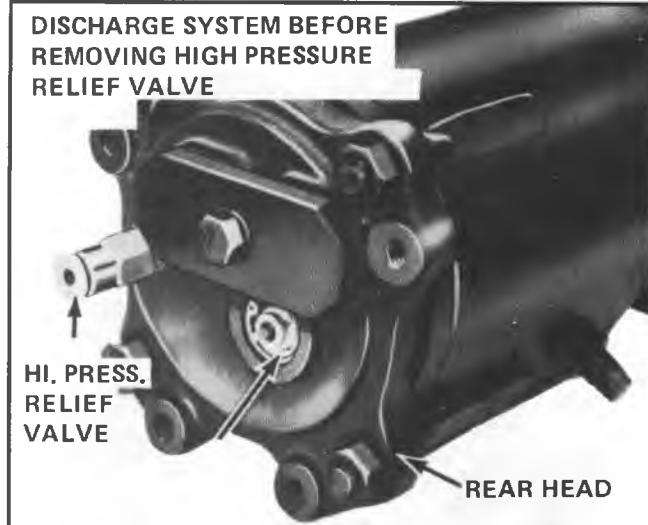


Fig. 23--Hi. Press. Relief Valve Location

damaged.

If there appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the carbon seal is not seating against the seal seat, it will not be possible to completely evacuate the system.

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in Fig. 21. To measure this distance, use a wire gage (**the clearance should be between .026" and .075"**). If the shaft has been pushed back in the axial plate (measurement greater than .075"), disassemble the compressor and replace the shaft and axial plate assembly rear thrust races and thrust bearing.

#### 11. Evacuate and charge system.

#### PRESSURE RELIEF VALVE

When necessary to replace the pressure relief valve, located in the compressor rear head casting, the valve assembly should be removed after PURGING THE SYSTEM OF REFRIGERANT and a new valve and gasket installed. The entire system should then be "Evacuated and Recharged." (Fig. 23).

#### INTERNAL MECHANISM

Service operations to the rear head or internal mechanism of the compressor **should be performed with the compressor removed from the vehicle** to insure that the necessary degree of cleanliness may be maintained. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the internal mechanism assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is economically feasible to replace them.

#### Remove

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.

2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. **Record the amount of oil drained from the compressor.**

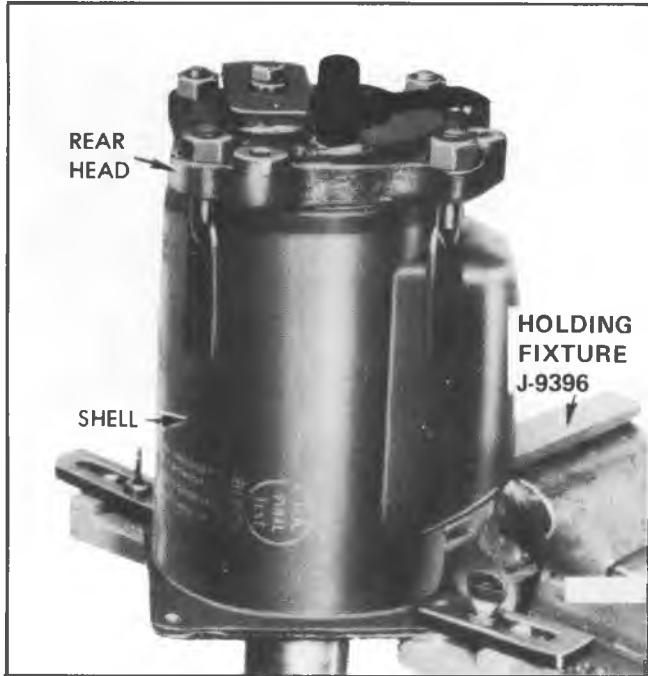


Fig. 24--Compressor Installed in Holding Fixture

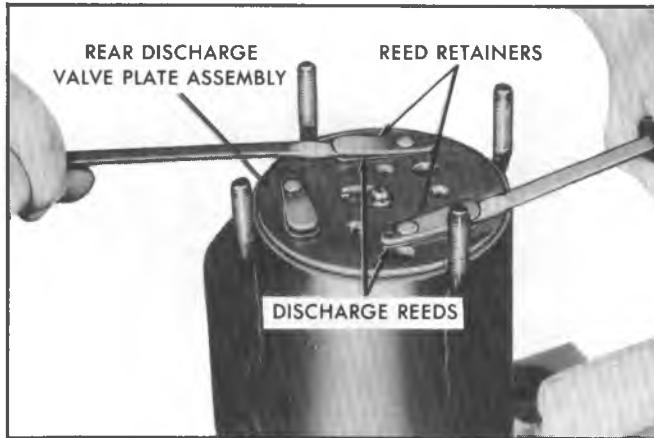


Fig. 26--Removing Rear Discharge Valve Plate

on identical position.

8. Remove and discard rear head to shell O-ring.

9. Carefully remove rear discharge valve plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (Fig. 26). **Do not position screwdrivers between reeds and reed seats**.

10. Examine valve reeds and seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove rear suction reed (Fig. 27). **Do not pry up on horseshoe-shaped reed valves**.

12. Examine reeds for damage, and replace if necessary.

13. Using Oil Pick-Up Tube Remover J-5139 (Fig. 28), remove oil pick-up tube. Remove O-ring from oil inlet.

14. Loosen compressor from Holding Fixture J-9396, place Internal Assembly Support Block J-21352 over oil pump end of shaft and, holding Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor and position on bench with Internal Assembly Support Block resting on bench.

15. Lift front head and compressor shell assembly up, leaving internal mechanism resting on Internal Assembly Support Block.

**CAUTION:** To prevent damage to shaft, DO NOT TAP ON END OF COMPRESSOR SHAFT to remove internal mechanism. If mechanism will not slide out of compressor shell, tap on front head with a plastic hammer.

16. Rest compressor shell on its side and push front head assembly through compressor shell, **being careful not to damage sealing areas on inner side of front**

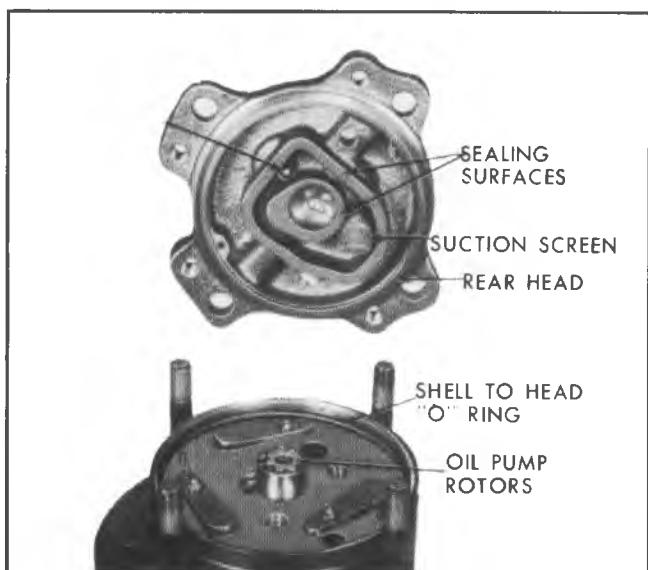


Fig. 25--Rear Head Removal



Fig. 27--Removing Rear Suction Reed

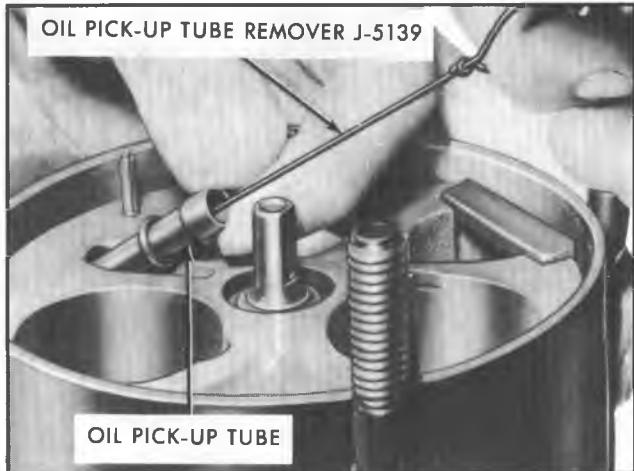


Fig. 28--Removing Oil Pick-Up Tube

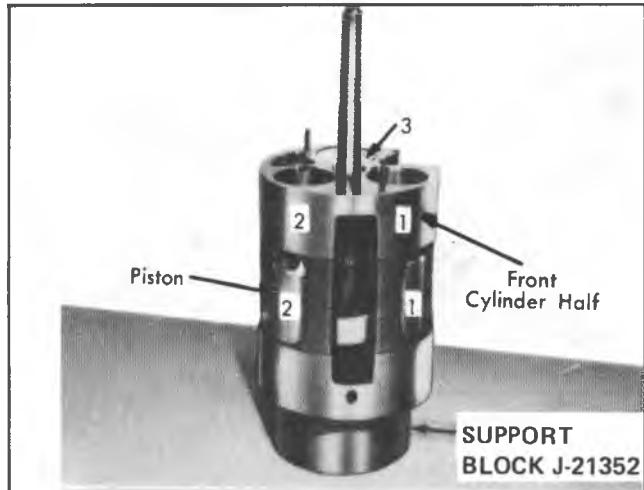


Fig. 30--Numbering Piston and Cylinder Bores

#### **head.** Discard O-ring.

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

18. Remove front discharge valve plate assembly and front suction reed plate. Examine reeds and seats. Replace necessary parts.

19. Remove suction cross-over cover by prying with screwdriver between cylinder casting and cover (Fig. 29).

20. Examine internal mechanism for any obvious damage. If internal mechanism has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use the Service internal mechanism Assembly rather than replace individual parts.

### **INTERNAL MECHANISM**

#### **Disassembly**

Use Parts Tray J-9402 (Fig. 33) to retain compressor parts during disassembly.

1. Remove internal mechanism from compressor as

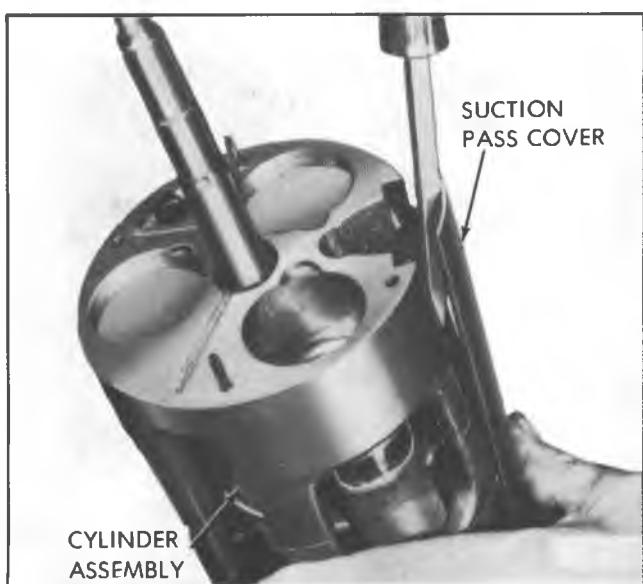


Fig. 29--Removing Suction Cross Over Cover

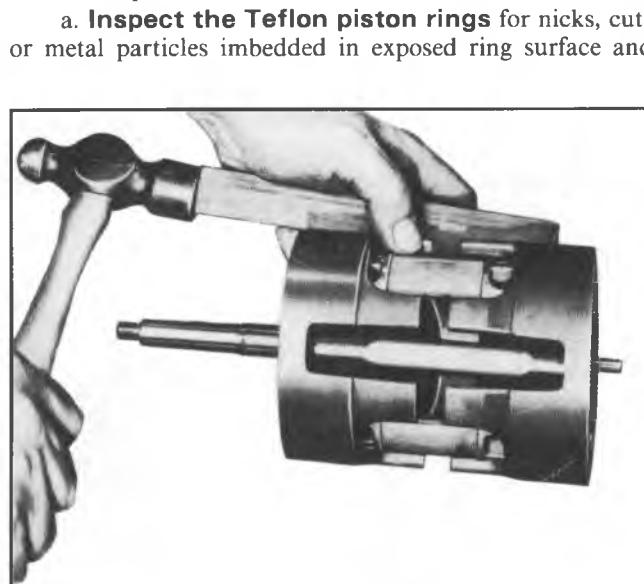


Fig. 31--Separating Cylinder Halves

described in "Compressor Internal Mechanism" Removal procedure.

2. Identify by pencil mark, or some other suitable means, each piston numbering them as 1, 2, and 3 (Fig. 30).

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (Fig. 31). Make certain that discharge cross-over tube does not contact axial plate when separating cylinder halves (a new Service discharge cross-over tube will be installed later).

**CAUTION: UNDER NO CIRCUMSTANCES SHOULD SHAFT BE STRUCK AT EITHER END in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.**

4. Carefully remove the rear half of the cylinder from the pistons and set the front cylinder half, with the piston, shaft and axial plate in Compressing Fixture J-9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

a. **Inspect the Teflon piston rings** for nicks, cuts or metal particles imbedded in exposed ring surface and

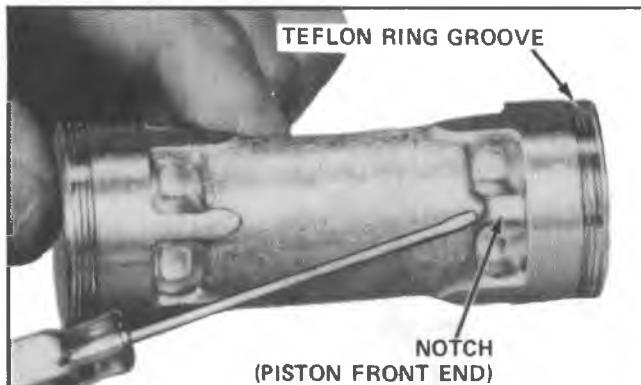


Fig. 32--Notch Identifying Front End of A-6 Piston

replace the piston rings as required if either condition exists. See "Teflon Piston Ring" Replacement procedure.

6. Remove and discard the piston shoe discs.
7. Remove and examine piston balls, and if satisfactory for re-use, place balls in No. 1 compartment of Parts Tray J-9402 (Fig. 33).

8. Place piston in No. 1 compartment of Parts Tray J-9402, with notch in casting web at front end of piston (Fig. 32) into the dimpled groove of Parts Tray compartment.

9. Repeat Steps 5 through 9 for Pistons No. 2 and No. 3.

10. Remove rear combination of thrust races and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the discharge cross-over tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing.

13. Examine surface of axial plate and shaft. Replace as an assembly, if necessary.

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

14. Remove discharge cross-over tube from cylinder half, using self-clamping pliers.

**This is necessary only on original factory equipment,** as ends of the tube are swedged into cylinder halves. The discharge cross-over tube in internal mechanism assemblies that have been previously serviced have an O-ring and bushing at EACH END of the tube, and can be easily removed by hand (see Fig. 53).

15. Examine piston bores and needle bearings in front

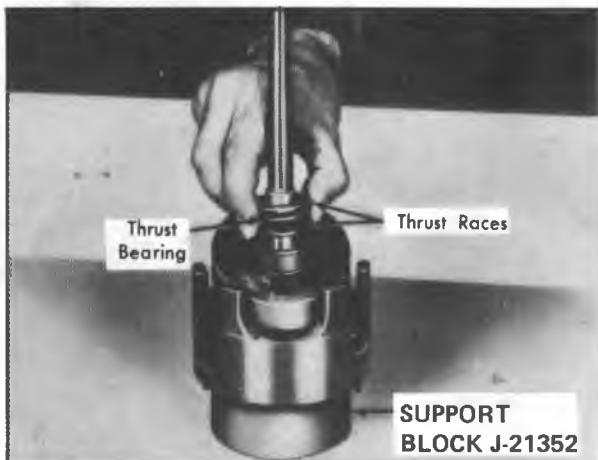


Fig. 34--Removing Front Thrust Races and Bearings

and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J-9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out. To install needle bearing, place cylinder half on Support Block J-21352, and insert bearing in end of cylinder head with bearing **identification marks UP**. Use Needle Bearing Installer J-9432 and drive bearing into cylinder head (Fig. 35), until tool bottoms on the cylinder face.

Two different width needle bearings are used in Production compressors - a 1/2" size and a 5/8" size. **The bearings ARE interchangeable.** Service replacement bearings are all 1/2".

17. Wash all parts to be re-used with trichlorethylene, stoddard solvent, kerosene, or a similar solvent. Air-dry parts using a source of clean, dry air.

Compressor internal components may be identified by referring to Fig. 1 and Fig. 2.



Fig. 35--Installing Needle Bearing

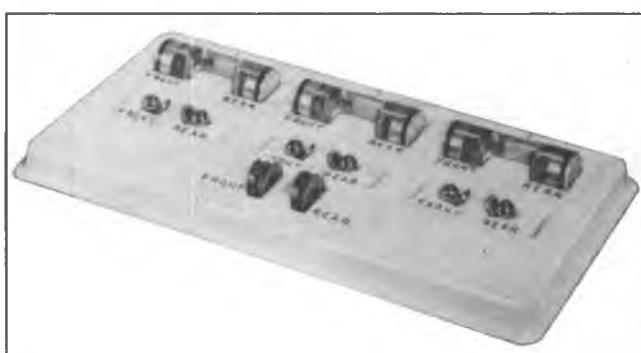


Fig. 33--A-6 Parts Tray

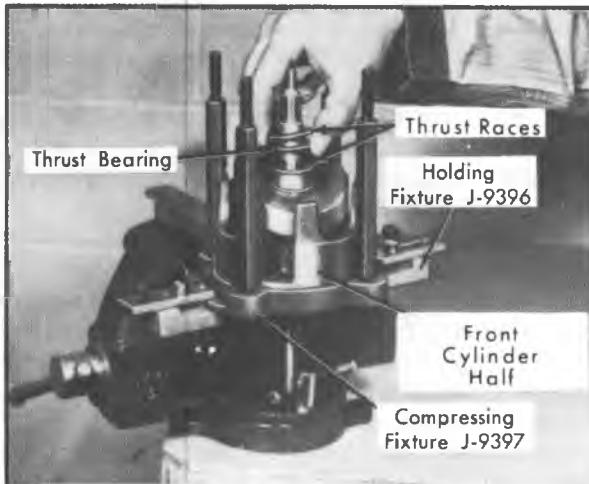


Fig. 36--Installing Rear Thrust Races and Bearings

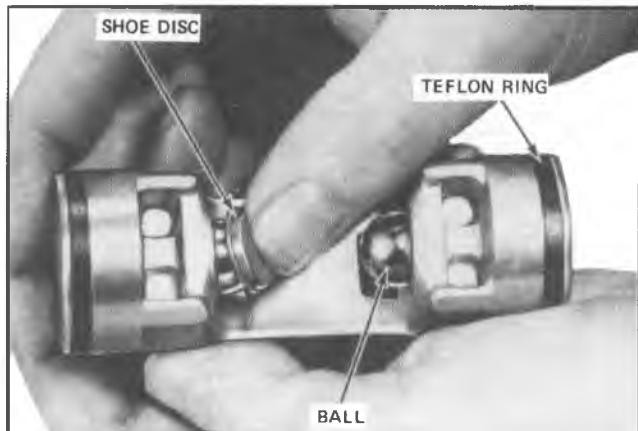


Fig. 37--Installing FRONT Shoe Disc

## INTERNAL MECHANISM

### Gaging Operation

1. Install Compressing Fixture J-9397 on Holding Fixture J-9396 in vise. Place front cylinder half in Compressing Fixture, flat side down. Front cylinder half has long slot extending out from shaft hole.

2. Secure from Service parts stock **four** ZERO thrust races and **three** ZERO shoe discs.

3. Install a ZERO thrust race, thrust bearing, and a second ZERO thrust race on front end of compressor shaft. Lubricate races and bearing with petrolatum.

4. Insert threaded end of shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly to rest on hub of cylinder.

5. Now install a ZERO thrust race on rear end of compressor shaft (Fig. 36), so that it rests on hub of axial plate. Then install thrust bearing and a second ZERO thrust race. Lubricate races and bearing with petrolatum.

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they are to be re-used.

7. Lubricate cavity of a ZERO shoe disc with 525 viscosity refrigerant oil and place shoe disc over ball in **front end** of piston (Fig. 37). **Front end of piston has an identifying notch in casting web** (Fig. 32).

**CAUTION:** Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.

**Shoe discs should not be installed on rear of piston during following "Gaging" operation.**

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

9. Lift shaft assembly up and hold front thrust race and bearing assembly against axial plate hub.

10. Position piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow piston to drop into its bore (Fig. 38).

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

12. Install rear cylinder half on pistons, aligning cylinder with discharge cross-over tube hole in front cylinder. Tap into place using a plastic mallet or piece of

clean wood and hammer (Fig. 39).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J-9397. Tighten nuts to 15 lb. ft. torque using a 0-25 lb. ft. torque wrench.

### Gaging Procedure (Steps 15 thru 18)

The gaging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

**The first** is made to choose the proper size shoe discs to provide, at each piston, a .0016" to .0024" total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate at the tightest plate. The bronze shoe discs are provided in .0005" variations, including a basic ZERO shoe.

**The second**, performed at the rear shaft thrust bearing and race pack, is designed to obtain .0025" to .0030" preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total of 14 steel thrust races, including a basic ZERO race, are provided in increments of .0005" thickness to provide the required fit.

Feeler Gage Set J-9564 or J-9661-01 may be used for gaging proper shoe disc size. Feeler Gage Set J-9564-01 or

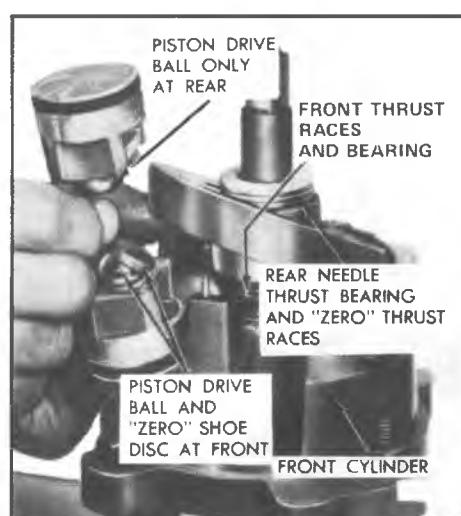


Fig. 38--Installing Piston During Gaging Operation

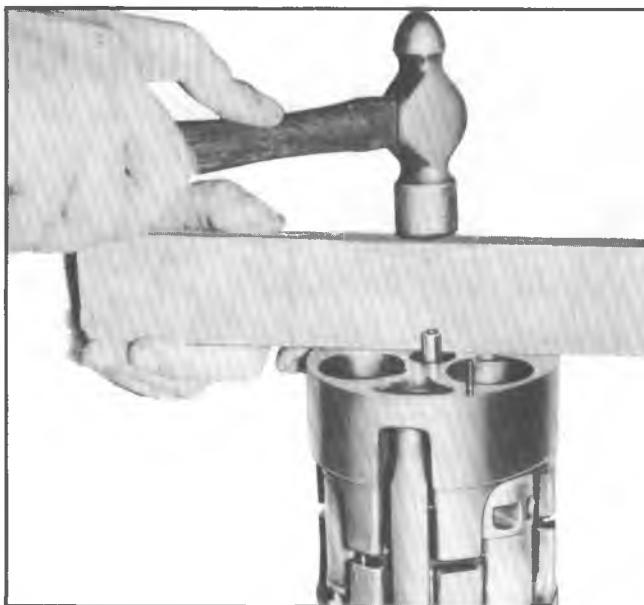


Fig. 39--Assembling Cylinder Halves

Dial Indicator Set J-8001-3 may be used to determine proper thrust race size.

#### PROPER SELECTION OF THRUST RACES AND BALL SEATS IS OF EXTREME IMPORTANCE.

15. Measure clearance between rear ball of No. 1 Piston and axial plate, in following manner:

a. Select a suitable combination of well-oiled Feeler Gage leaves to fit snugly between ball and axial plate.

b. Attach a spring scale, reading in 1-ounce increments, to the feeler gage. A distributor point checking scale or Spring Scale J-544 may be used.

c. Pull on Spring Scale to slide Feeler Gage stock out from between ball and axial plate, and note reading on Spring Scale as Feeler Gage is removed (Fig. 40). **Reading should be between 4 and 8 ounces.**

d. If reading in Step c. above is under 4 OR over 8 ounces, reduce or increase thickness of Feeler Gage leaves and repeat Steps a. through c. above until a reading of 4 to

8 ounces is obtained. Record clearance between ball and axial plate that results in the 4 to 8-ounce pull on Spring Scale.

16. Now rotate shaft 120° and repeat Step 15 between same ball and axial plate. Record this measurement.

If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

18. Select a "numbered" shoe disc corresponding to minimum feeler gage reading recorded in the three checks above. (See example in Fig. 42). Place shoe discs in Parts Tray J-9402 compartment corresponding to Piston No. 1 and rear ball pocket position.

Shoe discs are provided in .0005" (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc size Chart in Fig. 41 above.)

**Once a proper selection of the shoe has been made, THE MATCHED COMBINATION OF SHOE DISC TO REAR BALL AND SPHERICAL CAVITY IN PISTON MUST BE KEPT IN PROPER RELATIONSHIP during disassembly after gaging operation, and during final assembly of internal mechanism.**

19. Repeat in detail the same gaging procedure outlined in Steps 15 through 18 for Piston No. 2 and No. 3.

20. Mount Dial Indicator J-8001-3 on edge of Compressing Fixture J-9397 with Clamp J-8001-1 and Sleeve J-8001-2 (Fig. 43). Position Dial Indicator on rear end of shaft and adjust to "zero".

Apply full hand-force at end of mainshaft a few times before reading clearance. This will help squeeze the oil out from/between mating parts. Push upward and record measurement. Dial Indicator increments are .001"; therefore, reading must be estimated to nearest .0005".

An alternate method of selecting a proper race is to use Gage Set J-9661-01, selecting a suitable feeler gage leaf until the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (Fig. 44). If the pull is just less than 4 ounces, add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .0005" from the thickness of the feeler stock. **Select a race TWO (2) FULL SIZES LARGER than feeler gage thickness** (If feeler gage is .007", select a No. 9 or 090 race).

21. **Select a thrust race with a "number" corresponding to TWO (2) FULL SIZES LARGER than Dial Indicator or feeler gage measurement of the amount of end play shown. (If measurement is .007", select a No. 9 or 090 race). Place thrust race in right-hand slot at bottom center of Parts Tray J-9402.**

Fifteen (15) thrust races are provided in increments of .0005" (one-half thousandths) thickness and one ZERO gage thickness, providing a total of 16 sizes available for field service. Thrust races are identified on the part by their thickness in thousandths, in excess of the thickness of the ZERO thrust race.

This "number" also corresponds to the last three digits of the piece part number. See Thrust Race size Chart in Fig. 41.

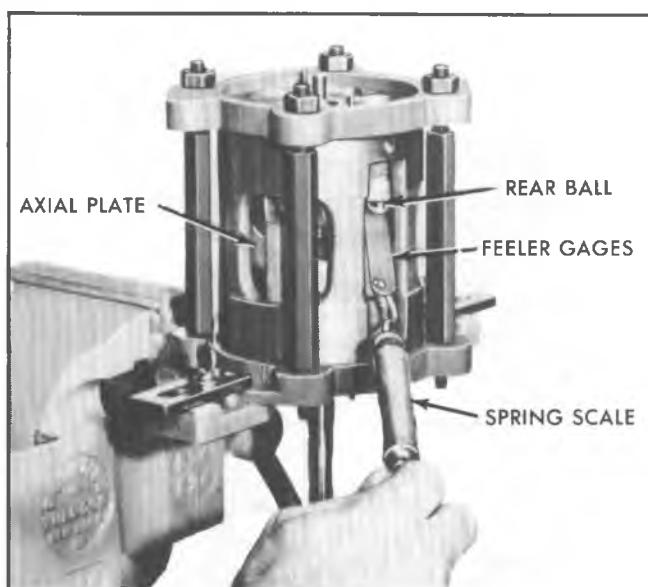


Fig. 40--Gaging Rear Piston Ball

SHOE DISC			THRUST BEARING RACE		
PART NO. ENDING IN	IDENTIFICATION STAMP	MIN. FEELER GAGE READING	PART NO. ENDING IN	IDENTIFICATION STAMP	DIAL INDICATOR READING
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
			120	12	.0120

Fig. 41--Available A-6 Service Shoes and Thrust Races

22. Remove nuts from top plate of Compressing Fixture J-9397, and remove top plate.

23. Separate cylinder halves while unit is in Fixture. It may be necessary to use a wood block and mallet.

24. **Remove rear cylinder half and carefully remove one piston at a time from axial plate and front cylinder half. DO NOT LOSE THE RELATIONSHIP of the front ball and shoe disc and rear ball. Transfer each piston, ball, and shoe disc to its proper place in Parts Tray J-9402.**

25. **Remove rear outer ZERO thrust race from shaft and install thrust race just selected.**

The ZERO thrust race may be put aside for re-use in additional gaging or rebuilding operations.

#### A-6 Teflon Piston Ring Replacement

The Teflon piston ring installing, sizing and gaging tools are shown in Fig. 95.

1. Remove the old piston rings by CAREFULLY slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston OR piston groove in cutting to remove the ring.

**WARNING: Exercise personal care in cutting the piston ring for removal.**

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

Fig. 42--Selection of Proper A-6 Shoe Disc

2. Clean the piston and piston ring grooves with a recommended cleaning solvent and blow the piston dry with dry air (Trichlorethylene, stoddard solvent, kerosene, or equivalent).

3. Set the piston on end on a clean, flat surface and install the Ring Installer Guide J-24608-2 on the end of the piston (Fig. 45).

4. Install a Teflon ring on the Ring Installer Guide J-24605-2 as shown in Fig. 45, **with the dished or dull-side down and glossy-side up.**

5. Push the Ring Installer J-24608-5 down over the Installer Guide J-24608-2 to install the Teflon ring in the piston ring groove (Figs. 46 and 47). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J-24608-5 will retain the Installer Guide J-24608-2 internally when the Teflon ring is installed on the piston. Remove the Installer Guide from the Ring Installer and **DO NOT STORE THE INSTALLER GUIDE IN THE RING INSTALLER, as the Ring**

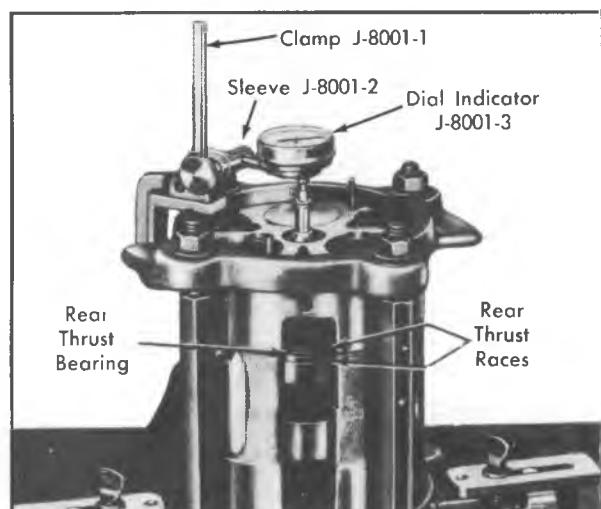


Fig. 43--Gaging Rear Thrust Race

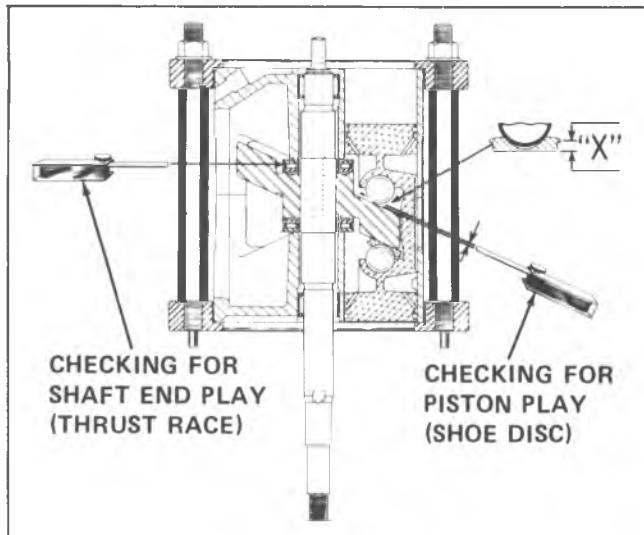


Fig. 44--Checking Piston and Shaft End Play

**Installer Segment Retainer O-Ring J-24608-3 will be stretched and possibly weakened during storage.** This could result in the O-Ring J-24608-3 not holding the Ring Installer segments tight enough to the Installer Guide J-24608-2 to properly install the Teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the Piston and Ring Assembly into the Ring Sizer J-24608-6 **at a slight angle** (Fig. 48). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J-23608-6.

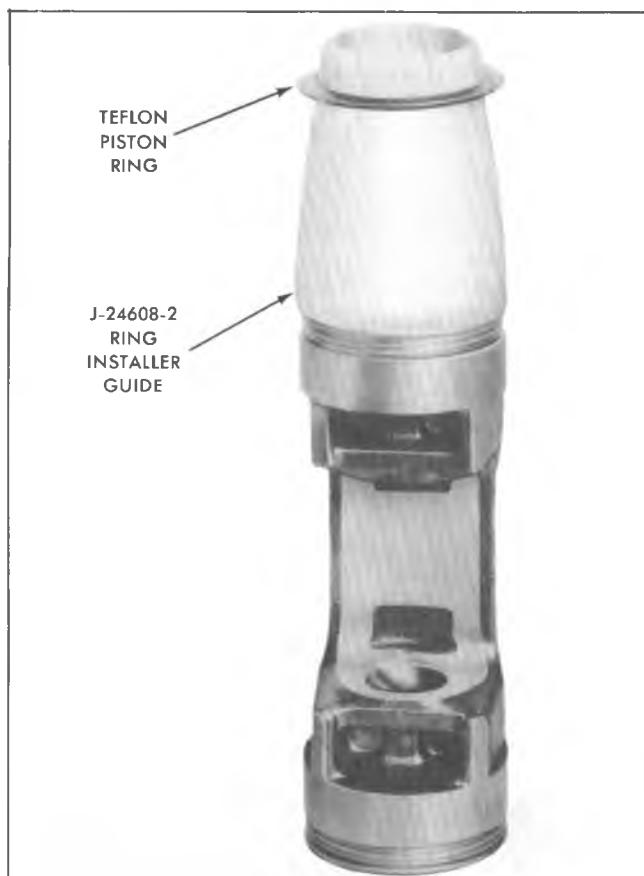


Fig. 45--Teflon Piston Ring Positioned on Ring Installer Guide

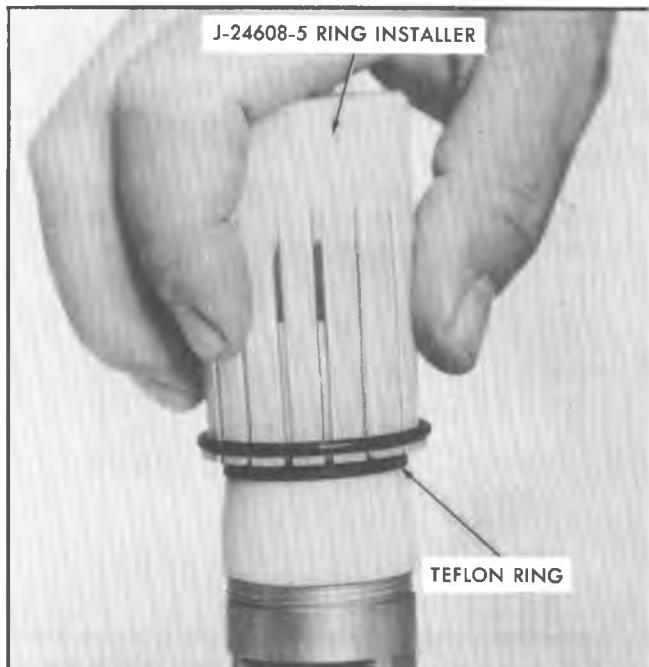


Fig. 46--Installing Teflon Piston Ring

**CAUTION: DO NOT push the Piston and Ring Assembly into the Ring Sizer J-24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the Ring Sizer may damage the end of the piston.**

7. Rotate the Piston and Ring Assembly in the Ring Sizer J-24608-6 several COMPLETE turns, until the Assembly rotates relatively free in the Ring Sizer (Fig. 48).

8. Remove the Piston and Ring Assembly, wipe the end of the piston and ring area with a clean cloth and then push the Piston and Ring Assembly into the Ring Gage J-24608-1 (Fig. 49). The piston should go through the Ring Gage with a 6-lb. force or less without lubrication. If not, repeat Steps 6 and 7.

9. Repeat the procedure for the opposite end of the piston.

**CAUTION: DO NOT lay the piston down on a dirty surface where dirt or metal chips might become imbedded in the Teflon ring surface.**

10. Lubricate BOTH ENDS of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

**CAUTION: Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the Teflon ring.**

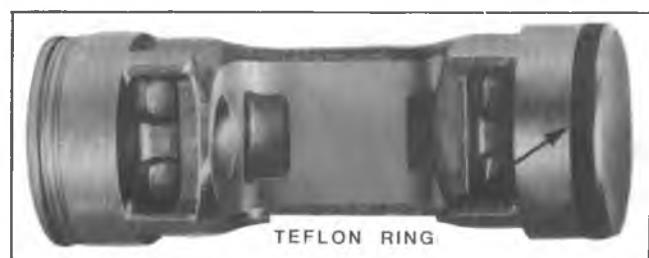


Fig. 47--Teflon A-6 Piston Ring Installed in Piston Groove



Fig. 48--Turning Piston and Ring Asm. into Ring Sizing Tool

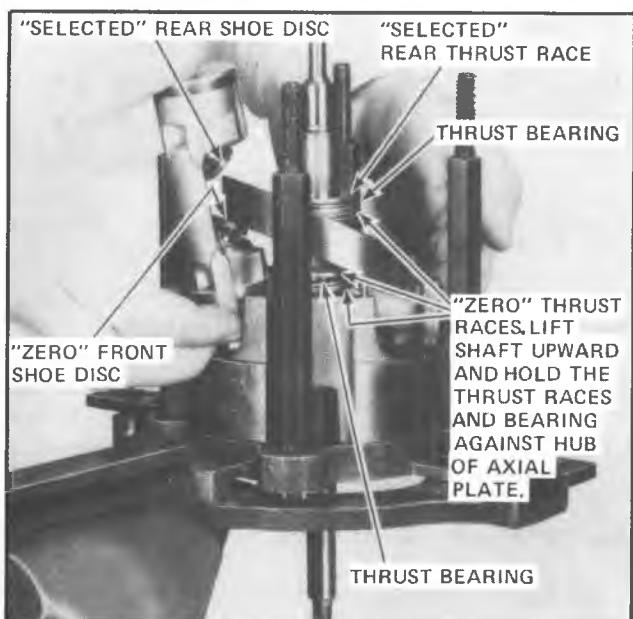


Fig. 50--Installing 1st A-6 Piston Assembly Into Front Cylinder Half

## A-6 COMPRESSOR INTERNAL MECHANISM

### Assembly

After properly performing the "Gaging Procedure", choosing the correct shoe discs and thrust races, and installing any needed Teflon Piston Rings, the cylinder assembly may now be reassembled. Be sure to install all NEW seals and O-rings. All are included in the compressor O-Ring Service Kit.

Assembly procedure is as follows:

1. Support the FRONT half of the cylinder assembly on Compressing Fixture J-9397. Install the shaft and axial plate, threaded end **down**, with its front bearing race pack (ZERO race, bearing NUMBERED race), if this was not already done at the end of the "Gaging Procedure".

2. Apply a light smear of petroleum jelly to the "numbered" shoe discs chosen in the gaging procedure and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1. Carefully assemble Piston No. 1, complete with ball and ZERO shoe disc on the **front** AND ball and NUMBERED shoe disc on the **rear**, over the axial plate. Hold front thrust bearing pack tightly against axial plate hub while lifting hub. Insert the Piston Assembly into

the front cylinder half (Fig. 50).

4. Repeat this operation for Pistons No. 2 and No. 3 (Fig. 51).

5. Without installing any O-rings or bushings, assemble one end of the new Service discharge cross-over tube into the hole in the front cylinder half (Fig. 52 and 53). Be sure the flattened portion of this tube faces the **inside** of the compressor to allow for axial plate clearance (Fig. 53).

6. Now rotate the shaft to position the pistons in a stair-step arrangement; then **carefully** place the rear cylinder half over the shaft and start the pistons into the cylinder bores (Fig. 54).

7. When all three Piston and Ring assemblies are in their respective cylinders, align the end of the discharge

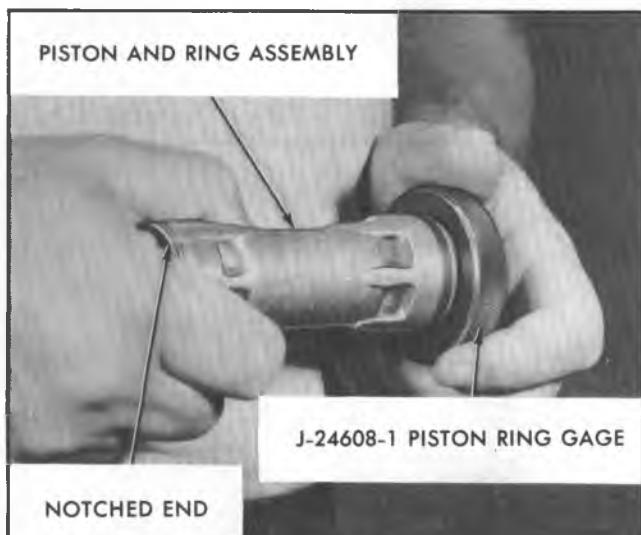


Fig. 49--Gaging Piston Ring Size

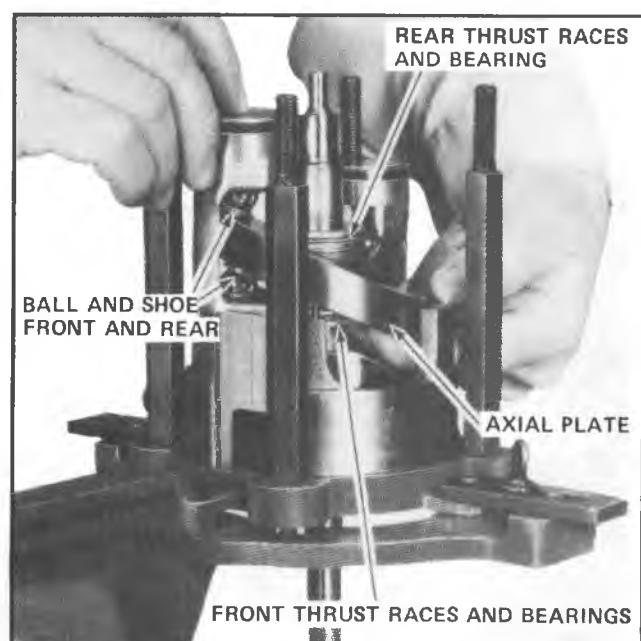


Fig. 51--Installing 2nd A-6 Piston

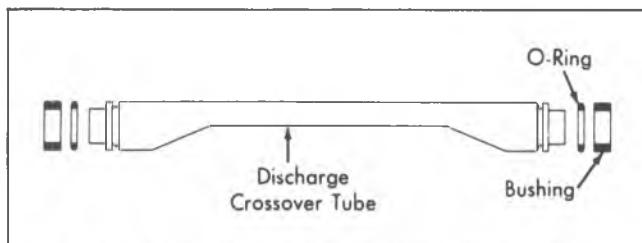


Fig. 52--Service-Type A-6 Discharge Cross-Over Tube

cross-over tube with the hole in the rear half of the cylinder.

8. When all parts are in proper alignment, tap with a clean wood block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Compressing Fixture J-9397, to complete drawing the cylinder halves together.

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

10. Replace the suction cross-over cover (Fig. 55). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

## A-6 COMPRESSOR INTERNAL MECHANISM

### Re-Install

1. Place internal mechanism on Internal Assembly Support Block J-21352, with **rear-end** of shaft in block hole.

2. Now install new O-ring and bushing on **front-end** of discharge cross-over tube (Fig. 56). The O-ring and bushing are Service parts only for internal mechanisms that have been disassembled in the field (see Fig. 52).

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install front suction reed plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube (Fig. 57).

5. Install front discharge valve plate assembly, aligning holes with dowel pins and proper openings in front suction reed plate (Fig. 58).

Front discharge plate has a large diameter hole in the center (Fig. 59).

6. Coat sealing surfaces on webs of compressor front head casting with 525 viscosity refrigerant oil.

7. Determine **exact** position of front head casting in

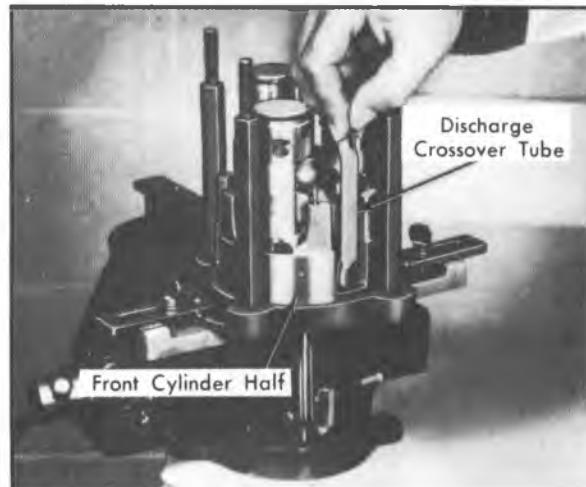


Fig. 53--Installing Discharge Crossover Tube

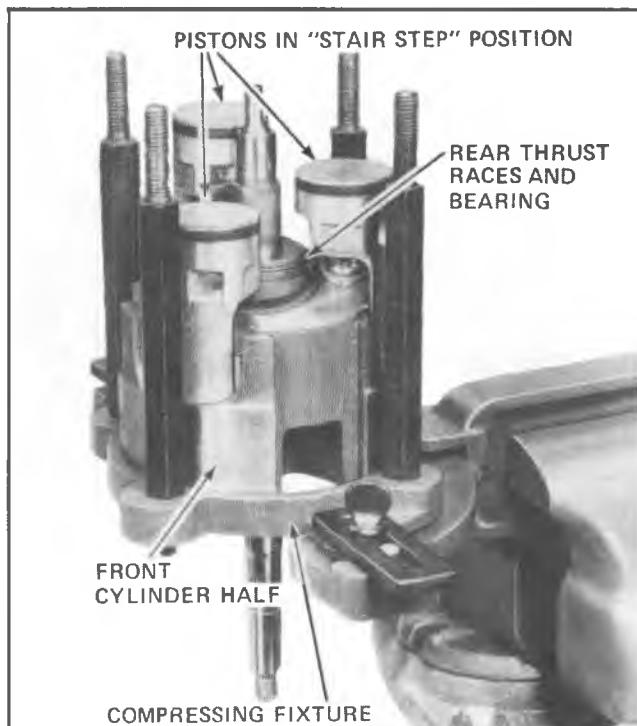


Fig. 54--A-6 Pistons Positioned in Stair-Step Arrangement

relation to dowel pins on internal mechanism. Mark position of dowel pins on sides of front head assembly and on sides of internal mechanism with a grease pencil. Carefully lower front head casting into position (Fig. 61), **making certain that sealing area around center bore of head assembly does not contact shaft** as head assembly is lowered. **Do not rotate head assembly** to line up with dowel pins, as the sealing areas

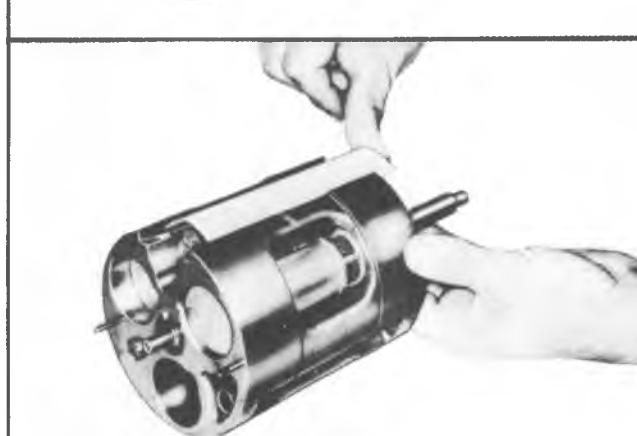
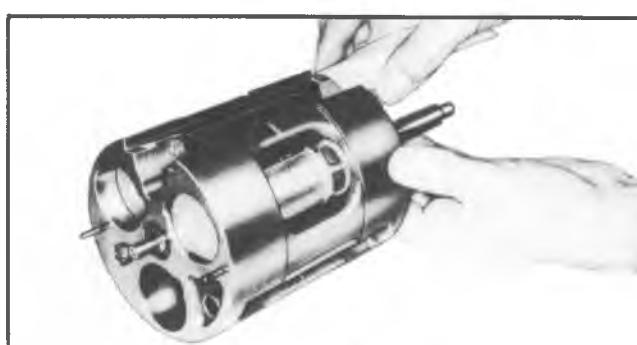


Fig. 55--Installing Suction Cross-over Cover



Fig. 56--Installing O-Ring On Discharge Cross-over Tube

would contact reed retainers.

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (Fig. 62).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on internal mechanism, resting on O-ring seal.

10. Using flat-side of a small screwdriver, gently position O-ring in around circumference of internal mechanism until compressor shell slides down over internal mechanism. As shell slides down, line up oil sump with oil intake tube hole (Fig. 62).

11. Holding Support Block, invert assembly and place back into Holding Fixture with front end of shaft down.

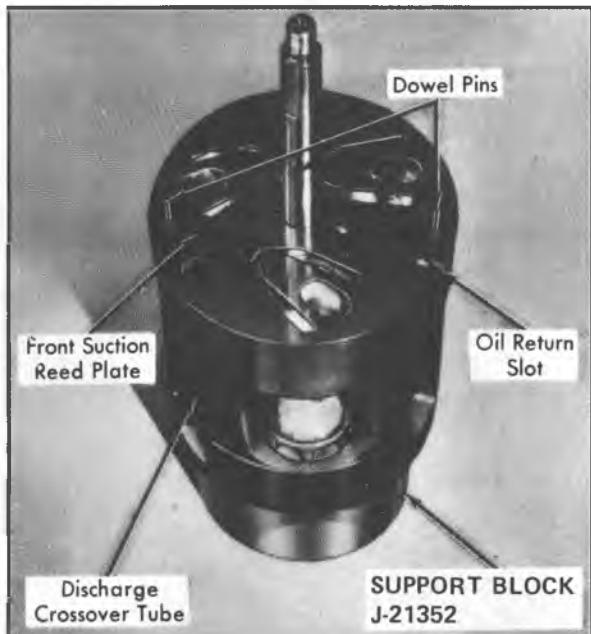


Fig. 57--Installing Front Suction Reed

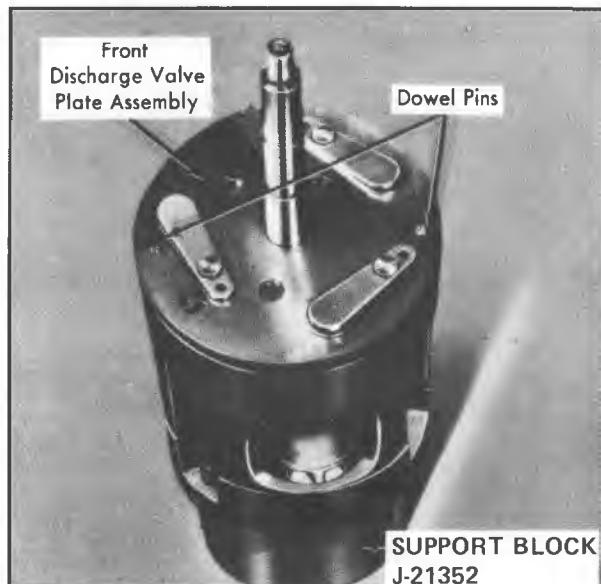


Fig. 58--Installing Front Discharge Valve Plate

Remove Support Block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate oil pick-up tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (Fig. 63).

15. Install new O-ring and bushing on **rear-end** of discharge cross-over tube (See Fig. 52).

16. Install rear suction reed over dowel pins, **with slot TOWARDS sump**.

17. Install rear discharge valve plate assembly over dowel pins, **with reed retainers UP**.

18. Position inner oil pump gear over shaft with previously applied identification **mark UP**.

19. Position outer oil pump gear over inner gear with previously applied identification **mark UP** and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9-o'clock position, and resulting cavity between gear teeth is then at 3-o'clock position (Fig. 64).

20. Generously oil rear discharge valve plate assembly

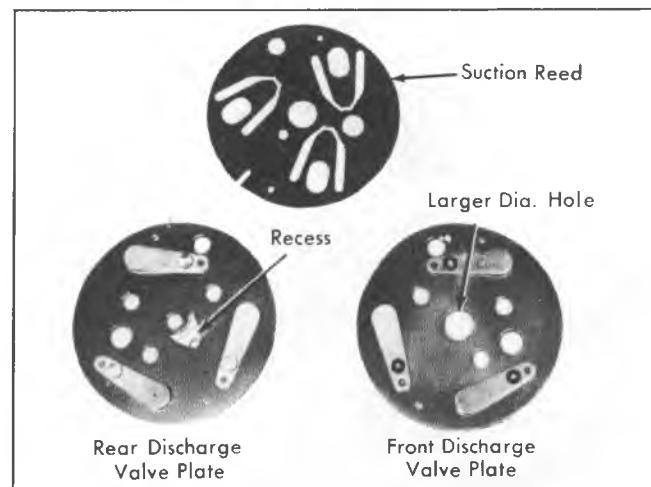


Fig. 59--Front and Rear Discharge Valve Plates



Fig. 60--Installing Front Head Casting

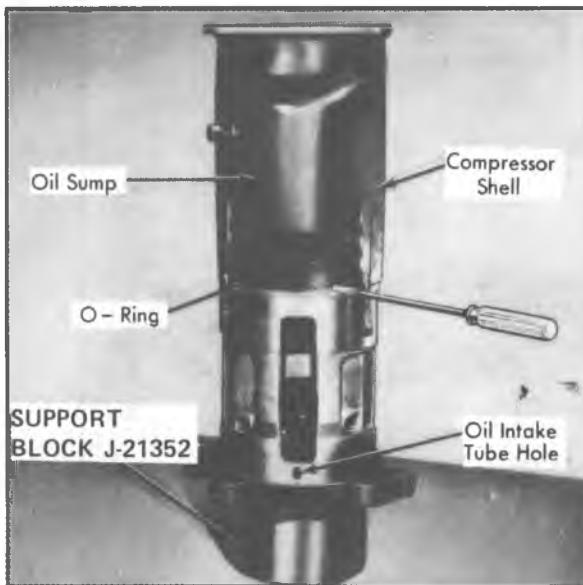


Fig. 62--Installing A-6 Compressor Shell

with 525 viscosity refrigerant oil around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact rear discharge valve plate.

21. Using the 525 oil, lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell (Fig. 65).

22. Install suction screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting with 525 viscosity refrigerant oil.

24. Install rear head assembly over studs on compressor shell. **The two lower threaded compressor mounting holes should be in alignment with the compressor sump.**

Make certain that suction screen does not drop out of place when lowering rear head into position (Fig. 66).

If rear head assembly will not slide down over dowels in internal mechanism, twist front head assembly back-and-forth very slightly by-hand until rear head drops over dowel

pins.

25. Install nuts on threaded shell studs and tighten evenly to 19-25 lb. ft. torque using a 0-50 lb. ft. torque wrench.

26. Invert compressor in Holding Fixture and install compressor shaft seal as described in "Compressor Shaft Seal" Replacement procedure.

27. Install compressor clutch coil and housing assembly as described in "Compressor Clutch Coil and Housing Asm." Replacement procedure.

28. Install compressor pulley and bearing assembly as described in "Compressor Pulley and Bearing" Replacement procedure.

29. Install compressor clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

30. Add required amount of 525 viscosity refrigerant oil. Refer to compressor oil charge, Figure 5 Section 1B, of the 1977 Service Manual.

31. Check for external and internal leaks as described in the "Compressor Leak Testing" procedure at the end of this section.

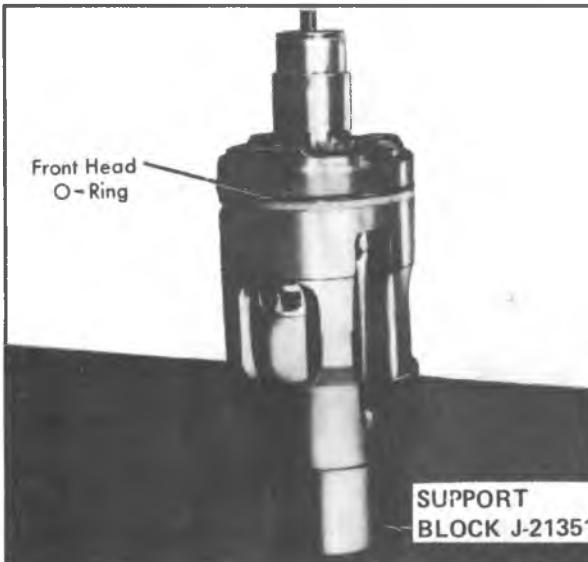


Fig. 61--Front Head O-Ring Installed



Fig. 63--Installing Oil Pick-Up Tube

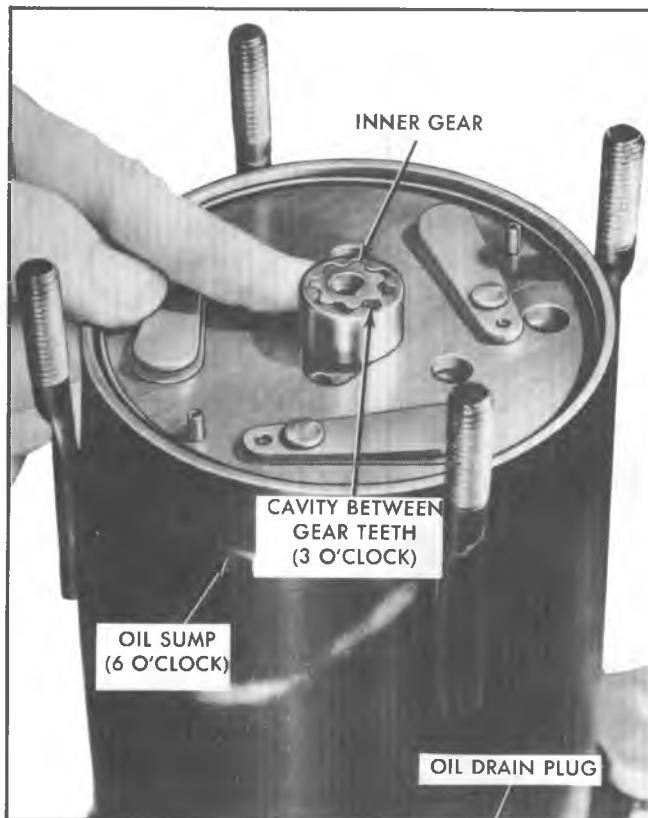


Fig. 64—Positioning Oil Pump Gears

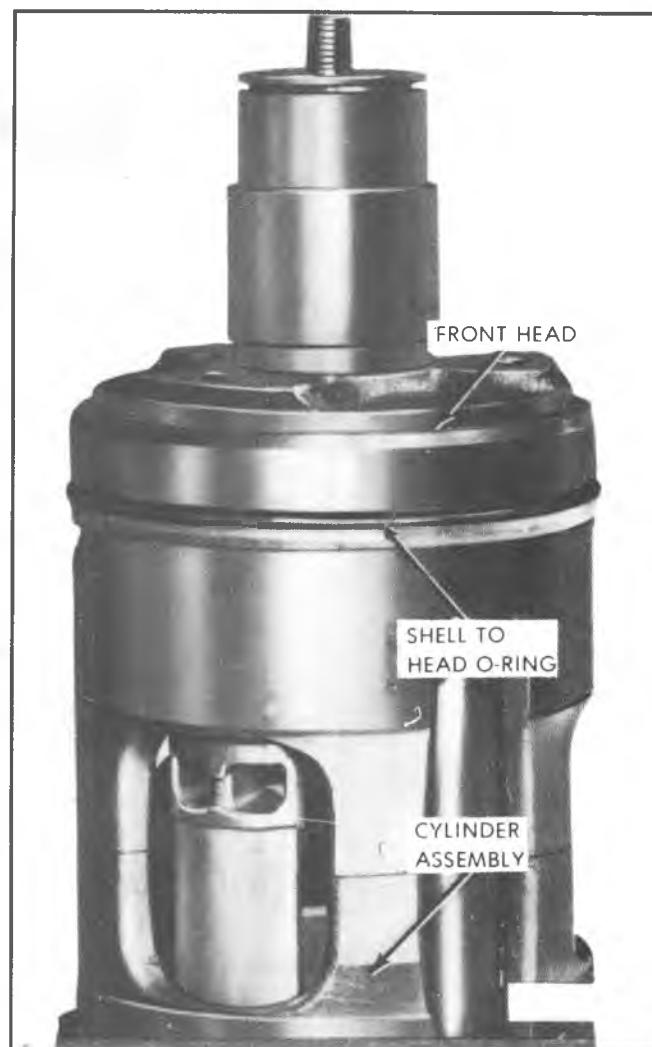


Fig. 65-A-6 Shell-To-Front Head O-Ring Installation



Fig. 66--Installing Rear Head

## R4-COMPRESSOR OVERHAUL

### GENERAL

When servicing a compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into compressor parts and system during disassembly or reassembly of compressor. Clean tools, a clean workbench and a clean work area are very important for proper service. The compressor connection areas and exterior of compressor should be cleaned off as much as possible prior to any "on vehicle" repairs or removing compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with clean solvent (trichlorethylene, or stoddard solvent) and dried with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type. Refer to Figure 67 for the exploded view of the compressor parts and nomenclature.

When a compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained through compressor suction-discharge ports and measured. This oil should then be discarded and new oil added to the compressor before compressor is again placed in operation on vehicle. Refer to the Diagnosis Section for compressor oil charge.

If for any reason the R-4 compressor air conditioning hose assembly is removed from the compressor, care must be taken to insure that the hose plate is fully seated to the compressor during re-installation. Should the plate be cocked and the retainer bolt driven, metal flanges in the O-Ring cavities could damage the seal surface of the compressor.

Some service operations can be performed without disturbing the internal mechanism, completely removing the compressor from vehicle or discharging the system.

Among them are replacement of the clutch drive plate and hub assembly, clutch rotor and bearing assembly and clutch coil and pulley rim where "on vehicle" space permits. The system must be discharged, evacuated and charged to replace the compressor shaft seal, and pressure relief valve whether the compressor is removed from vehicle or not. The service operations shown in the following procedure are based on bench overhaul with compressor removed from vehicle.

For those operations possible to be performed with compressor "on the vehicle", the procedure is essentially the same. The procedures are basically in order of the normal sequence of removal for the accessibility of the components.

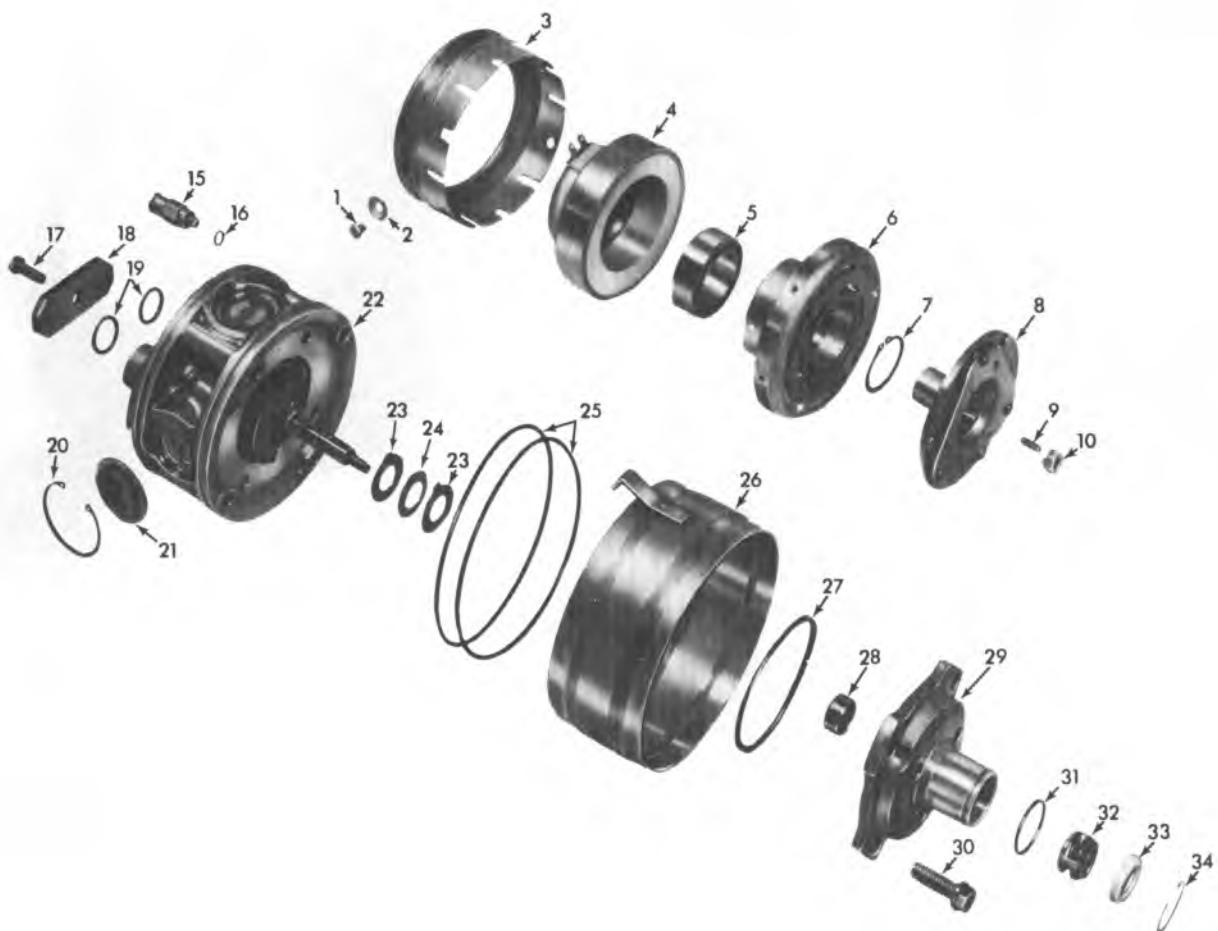
When necessary to adjust the compressor belt tension, DO NOT pry on the compressor shell, lift at square hole on the compressor mounting bracket.

It is recommended that compressor holding fixture J-25008-1 (Fig. 68) be used for all "workbench" procedures to keep the compressor assembly off the workbench and help prevent any possible dirt contamination of parts. The compressor holding fixture may be clamped in a vise with shaft end of compressor in a vertical, horizontal or down position for service, depending on service to be performed.

### COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

#### Removal

1. Attach compressor to holding fixture, J-25008-1 (Fig. 68) and clamp fixture in a vise.
2. Keeping clutch hub from turning with clutch hub holding tool J-25030, remove and discard shaft nut using Thin Wall Socket J-9399 (Fig. 69).
3. Thread clutch plate and hub assembly remover J-



- |                            |                              |                            |
|----------------------------|------------------------------|----------------------------|
| 1. Screw                   | 15. Pressure Relief Valve    | 24. Belleville Washer      |
| 2. Locking Washer          | 16. O-Ring                   | 25. O-Ring                 |
| 3. Pulley Rim              | 17. Screw                    | 26. Shell Assy.            |
| 4. Coil and Housing Assy.  | 18. Shipping Plate           | 27. Ring Seal              |
| 5. Rotor Bearing           | 19. O-Ring                   | 28. Main Bearing           |
| 6. Rotor and Bearing Assy. | 20. Retaining Ring           | 29. Front Head Assy.       |
| 7. Retaining Ring          | 21. Valve Plate Assy.        | 30. Screw and Washer Assy. |
| 8. Clutch Drive Assy.      | 22. Cylinder and Shaft Assy. | 31. O-Ring                 |
| 9. Clutch Hub Key          | 23. Thrust Washer            | 32. Shaft Seal             |
| 10. Shaft Nut              |                              | 33. Seal Seat              |
|                            |                              | 34. Retaining Ring         |

Fig. 67--Radial Four Cylinder Compressor - Exploded View

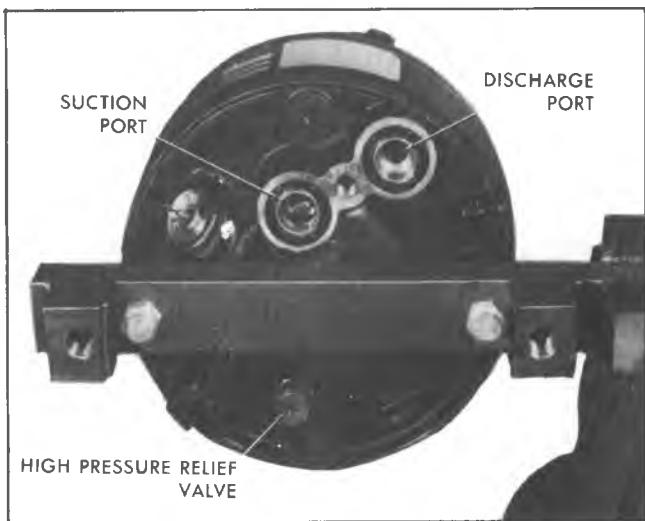


Fig. 68--Installing Holding Fixture

9401 into hub. Hold body of tool with a wrench and turn center screw into J-9401 remover to remove clutch plate and hub assembly (Fig. 70).

**4. Remove the shaft key.**

**Installation**

1. Install shaft key into hub key groove (Fig. 71). Allow key to project approximately  $3/16$ " out of keyway. Shaft key is curved slightly to provide an interference fit in shaft key groove, to permit key projection without falling out.

2. Be sure frictional surface of clutch plate and clutch rotor are clean before installing clutch plate and hub assembly.

3. Align shaft key with shaft keyway and assemble clutch plate and hub assembly on compressor shaft.

**CAUTION:** *To avoid internal damage to compressor, do not drive or pound on clutch hub or shaft.*

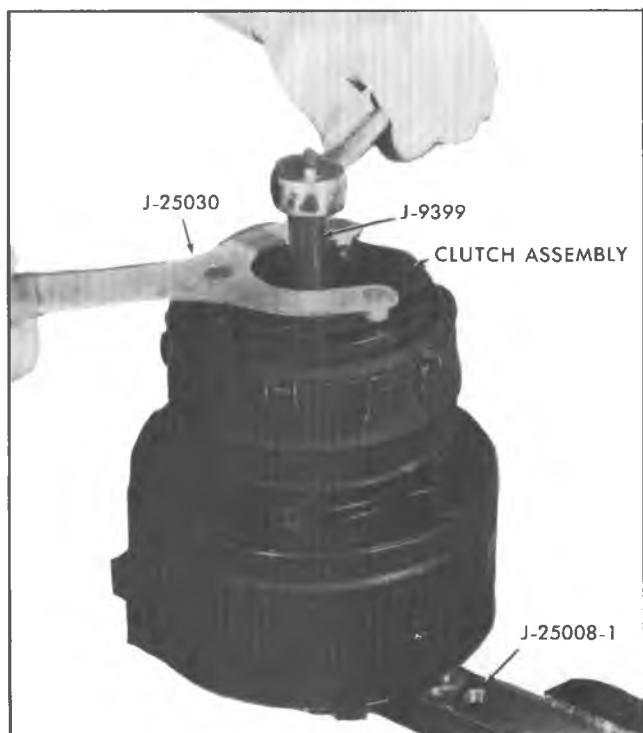


Fig. 69--Removing Shaft Locknut



Fig. 70--Removing Clutch Plate and Hub Assembly

4. Place spacer bearing J-9480-2 on hub and insert end of clutch plate and hub assembly installer J-9480-1 through spacer J-9480-2 and thread tool onto end of compressor shaft (Fig. 72).

5. Hold hex portion of tool body with a wrench and tighten center screw to press hub onto shaft until there is a .020 to .040 inch air gap between the frictional surfaces of clutch plate and clutch rotor (Fig. 72).

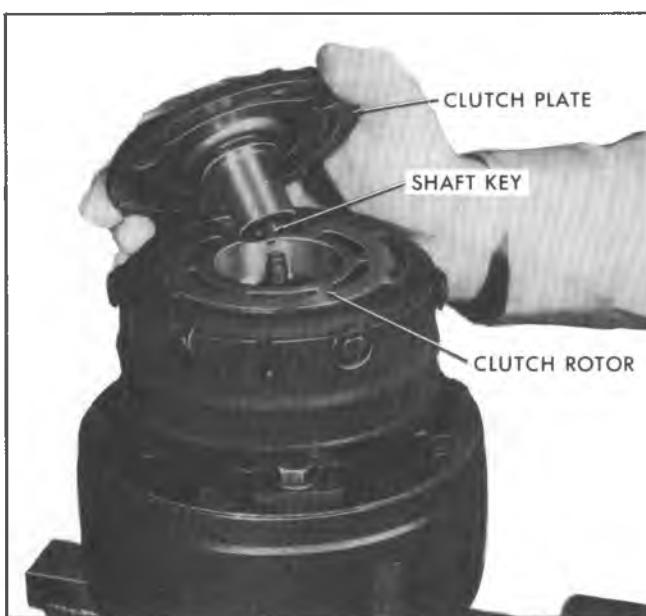


Fig. 71--Installing Shaft Key

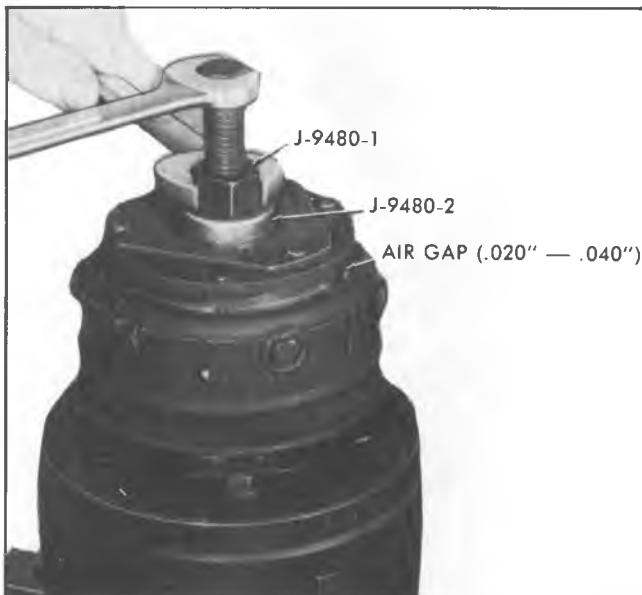


Fig. 72--Installing Clutch Plate and Hub Assembly

6. Install a new shaft nut with the small diameter boss of nut against crankshaft shoulder, using special thin wall socket J-9399. Hold clutch plate and hub assembly with clutch hub holding tool J-25030 and tighten to 8-12 foot pounds torque.

## COMPRESSOR SHAFT SEAL ASSEMBLY

### Removal

When replacing shaft seal assembly, it will be necessary to discharge the refrigerant from the system before replacing shaft seal assembly or removing compressor from vehicle.

1. Discharge the system and remove clutch plate and hub assembly as described under "Compressor Clutch Plate and Hub Assembly".

2. Remove shaft seal seat retainer ring using snap ring pliers J-5403.

3. Thoroughly clean the inside of compressor neck area surrounding compressor shaft, seal seat and shaft, to remove all dirt and foreign material before removing seal seat.

4. Insert seal seat remover and install tool J-23128 (Fig. 73) over the shaft into the recessed area of seal seat and tighten tool clockwise to securely engage knurled tangs of tool with the seal seat. Remove seal seat with a twisting and pull motion. Discard seat.

5. Insert seal remover and installer J-9392 (Fig. 74) over shaft and engage shaft seal by pressing downward on tool to overcome shaft seal spring pressure and turn tool clockwise to engage seal assembly tabs with tangs of tool. Remove seal assembly by pulling straight out from compressor shaft (Fig. 74). Discard seal.

6. Remove seal seat "O" ring from compressor neck using tool J-9553. Discard "O" ring.

### Installation

Inspect the inside of compressor neck and shaft area for any lint, dirt or foreign material and be sure these areas are perfectly clean before installing new seal parts. Be sure seal remover and installer J-9392, seal protector J-22974 and "O" ring installer J-21508 are clean internally and externally. The seal seat "O" ring, shaft seal and seal seat should be dipped in clean 525 Viscosity oil and not handled any more than is absolutely necessary by hand, particularly the mating surfaces. Any dirt or lint on sealing surfaces



Fig. 73--Removing Seal Seat

could cause a seal leak or seal damage.

1. Dip new seal seat "O" ring in clean 525 Viscosity oil and assemble onto "O" ring installer J-21508 (Fig. 75).

2. Insert "O" ring installer J-21508 into the compressor neck until the tool "bottoms". Lower the movable slide of "O" ring installer to release "O" ring into seal seat "O" ring groove. Rotate installer tool to seat "O" ring and remove tool. Inspect the internal neck area for cleanliness and proper "O" ring positioning.

3. Dip new shaft seal "O" ring and seal face in clean 525 Viscosity oil and carefully engage shaft seal assembly with locking tangs of seal remover and installer J-9392 (Fig. 75).



Fig. 74--Removing Shaft Seal



Fig. 75--Installing Seal Seat "O" Ring



Fig. 76--Removing Bearing Retaining Ring

4. Install shaft seal protector J-22974 over the end of compressor shaft and slide shaft seal onto compressor shaft. Slowly turn the tool clockwise while applying light pressure until seal engages the flats of compressor shaft and can be seated into place. Rotate tool J-9392 counterclockwise to disengage from seal tabs and remove tool.

5. Attach ceramic seal seat to the seal seat remover and installer J-23128 and dip ceramic seat in clean 525 viscosity oil to coat seal face and outer surface. Carefully install seat over compressor shaft and seal protector J-22974 and push seat into place with a rotary motion. Remove tools J-23128 and J-22974.

6. Install new seal seat retainer ring with snap ring pliers J-5403.

7. Leak test compressor as described under "Leak Testing the Compressor" and correct any leaks found.

8. Reinstall clutch plate and hub assembly as described under "Compressor Clutch Plate and Hub Assembly".

### **COMPRESSOR CLUTCH ROTOR & BEARING ASSEMBLY, CLUTCH COIL AND PULLEY RIM**

#### **Compressor Clutch Rotor & Bearing Assembly Removal**

1. Remove the clutch plate and hub assembly as described under "Compressor Clutch Plate and Hub Assembly".

2. Remove rotor and bearing assembly retaining ring using snap ring pliers J-6083 (Fig. 76). Mark the location of clutch coil terminals. If clutch rotor and/or rotor bearing only are to be replaced, bend the lockwashers away from pulley rim mounting screws (Fig. 77) and remove the six mounting screws and special lockwashers before proceeding with Step 3. Discard special lockwashers.

3. Install rotor and bearing puller guide J-25031-1 over the end of compressor shaft and seat on the front head of compressor (Fig. 77).

4. Install rotor and bearing puller J-25031-2 down into

rotor until the puller arms engage the recessed edge of rotor hub. Hold puller and arms in place and tighten puller screw against puller guide to remove clutch rotor and assembly parts (Fig. 78). If pulley rim mounting screws and washers were removed in Step 2, only clutch rotor and bearing assembly will be removed for replacement.

The clutch coil and housing assembly is pressed onto front head of compressor with an interference fit and will not be removed unless pulley rim mounting screws are left securely in place and pulley rim pulls coil and housing assembly off with total clutch rotor and pulley rim assembly (Fig. 80).

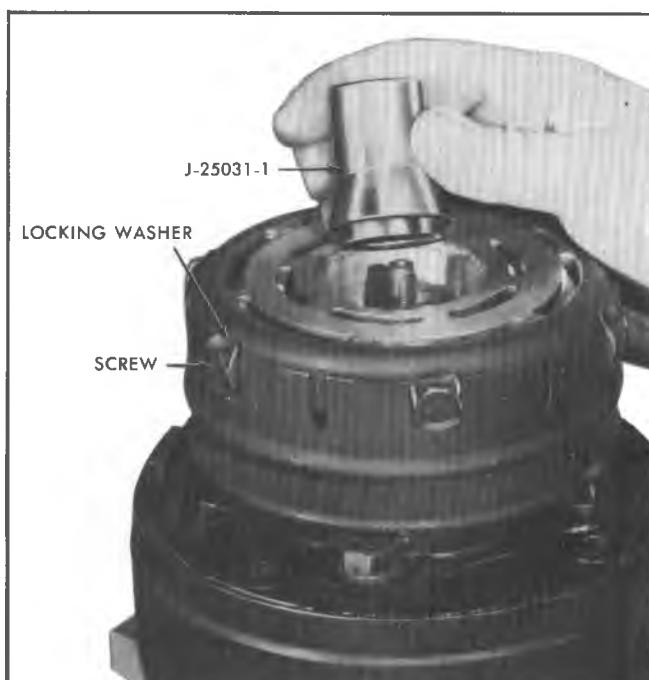


Fig. 77--Installing Rotor and Bearing Puller Guide

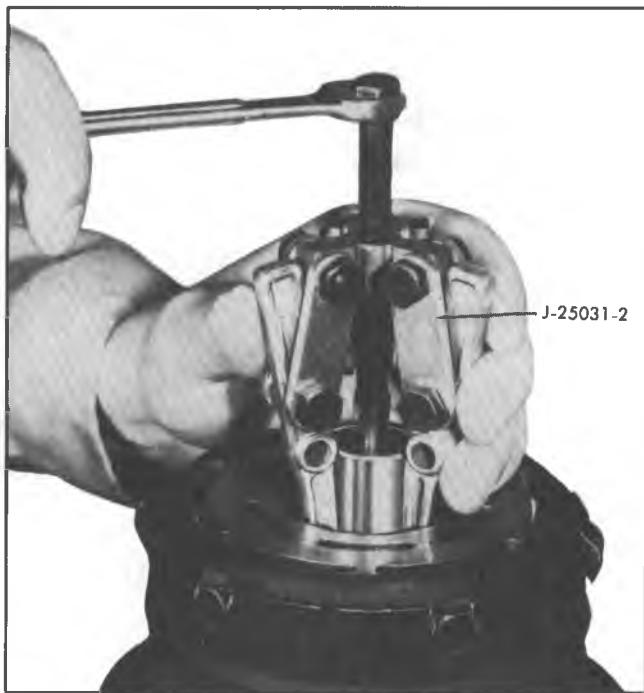


Fig. 78--Installing Rotor and Bearing Puller

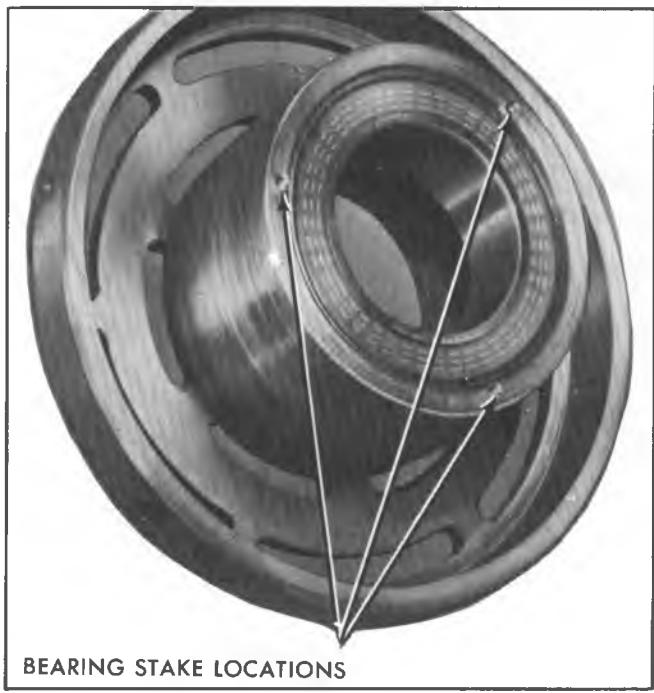


Fig. 80--Bearing Stake Locations

## CLUTCH ROTOR BEARING REPLACEMENT

### Removal

1. Perform "Compressor Clutch Rotor and Bearing Assembly Removal" and remove the pulley rim mounting screws as described in Step 2.
2. Place rotor and bearing assembly on blocks (Fig. 81) and drive bearing out of rotor hub with rotor bearing remover and rotor assembly installer J-25029. It will not be necessary to remove the staking at the rear of the rotor hub to remove the bearing. See Figure 80.



Fig. 79--Clutch Coil and Housing Assembly

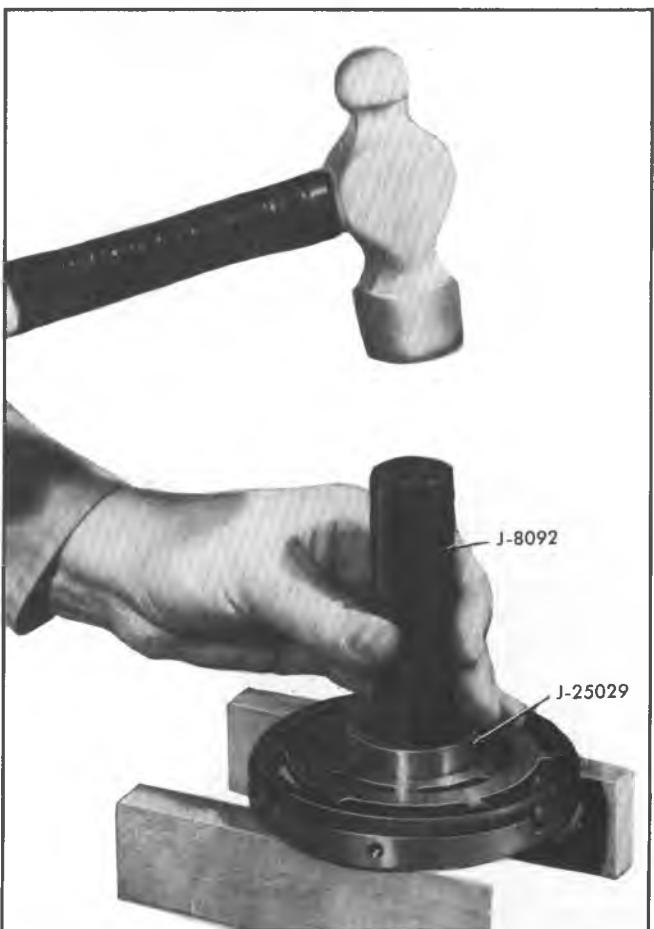


Fig. 81--Removing Clutch Rotor Bearing

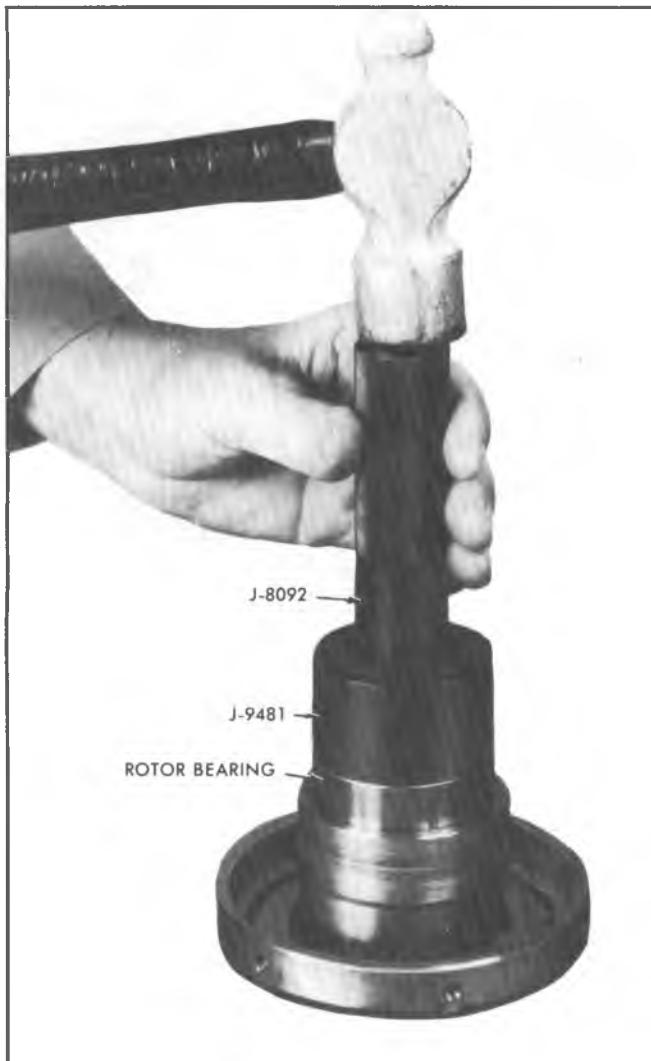


Fig. 82--Installing Clutch Rotor Bearing

### Installation

1. Place rotor and hub assembly face down on a clean, flat and firm surface (Fig. 82).
2. Align new bearing squarely with hub bore and using pulley and bearing installer J-9481 with Universal Handle J-8092, drive bearing fully into hub. The tool will apply force to outer race of bearing.
3. Stake bearing in place with a 45° angle punch (Fig. 80) but do not stake too deep (.045 - .055 inch) and possibly distort the outer race of bearing. Use new stake locations 120° apart. Do not use old stake locations.

#### 4. Recommended Method

Press rotor and bearing assembly onto the front head of the compressor, using Rotor and Bearing Assembly Installer J-25029 (Fig. 83). The Installer will apply force to the inner race of the rotor bearing when installing the assembly onto the front head.

#### Alternate method

**Reassemble the rotor and bearing assembly to the front head of the compressor using Rotor Bearing Remover and Rotor Assembly Installer J-25029. With Installer assembled to the Universal Handle J-8092 as shown in Fig. 84, force will be applied to the inner race of the bearing when**

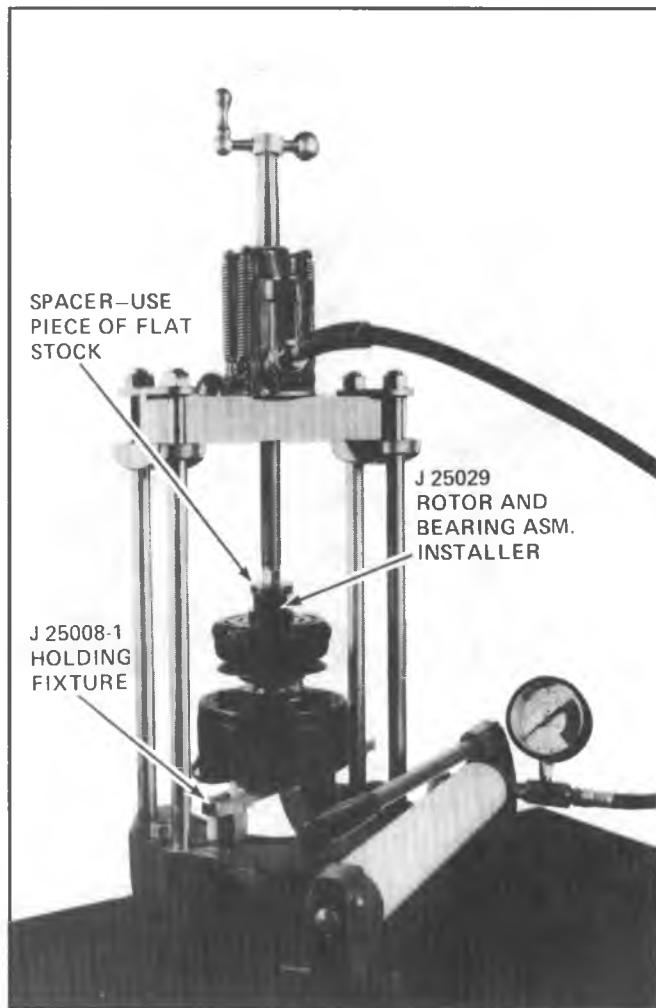


Fig. 83--Installing Rotor and Bearing Assembly

### installing the assembly on the front head of the compressor.

5. Install rotor and bearing using Snap Ring Pliers J-6083.
6. Assemble and fully seat pulley rim to clutch rotor and bearing assembly as shown in Figure 84, using Loctite RC-75 or equivalent on screw threads and use new lockwashers. Do not torque mounting screws to final torque limits until pulley rim is checked to be rotating "in line".
7. Tighten pulley rim mounting screws to a 100 inch pounds torque and lock screw heads in place as shown in Figure 83.

8. Assemble clutch plate and hub assembly as described under "Compressor Clutch Plate and Hub Assembly".

## CLUTCH COIL AND PULLEY RIM REPLACEMENT

### Removal

1. Perform "Compressor Clutch Rotor and Bearing Assembly Removal" but do not loosen or remove pulley rim mounting screws until clutch rotor, coil and pulley rim assembly have been removed from front head in Step 4.

2. Remove pulley rim mounting screws and slide pulley rim off rotor and hub assembly. The pulley rim and clutch coil are replaceable at this point.



Fig. 84--Alternate Installation of R-4 Rotor and Bearing Assembly

### Installation

1. Assemble clutch coil, pulley rim and clutch rotor and bearing assembly as shown in Figure 79, using Loctite RC-75 or equivalent on screw threads and using new lockwashers, but do not lock screw heads in place.
2. Place assembly on neck of front head and seat into place using rotor bearing remover and rotor assembly installer J-25029 as shown in Figure 83. Before fully seating the assembly on front head, be sure the clutch coil terminals are in the proper location in relation to compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in front head.
3. Install rotor and bearing assembly retaining ring and reassemble clutch plate and hub assembly.
4. Rotate pulley rim and rotor to be sure pulley rim is rotating "in line" and adjust or replace as required. Tighten pulley rim mounting screws to 100 inch pounds torque and lock screw heads in place.

## FRONT HEAD AND MAIN BEARING ASSEMBLY

### Removal

1. Remove clutch rotor and bearing assembly but do not loosen or remove pulley rim mounting screws and remove clutch rotor, coil and pulley rim assembly as a total assembly.
2. Remove compressor shaft seal.
3. Remove the four front head mounting screws (Fig. 85) and remove front head assembly and discard seal ring. At this point front head and bearing assembly, front head

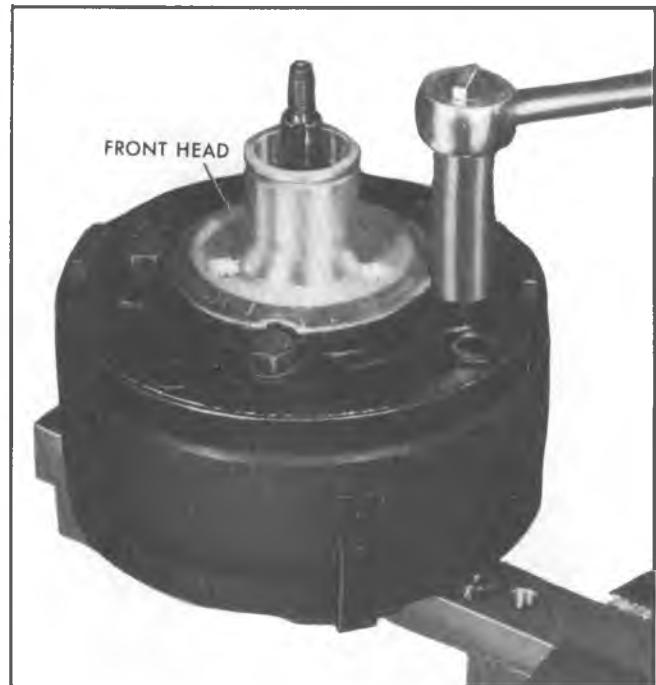


Fig. 85--Remove Front Head Assembly

seal ring (Fig. 86) or the Belleville and thrust washers may be replaced.

### Installation

1. Check front head and compressor cylinder area for any dirt or lint and install a new thrust washer kit if required.
2. Dip new front head seal ring in 525 Viscosity oil and install seal in seal groove of front head (Fig. 86).
3. Position oil hole in front head to be "up" when assembled to compressor cylinder to correspond with "up" position of compressor. Install front head on compressor shaft. Be sure seal ring stays in place and front head seats

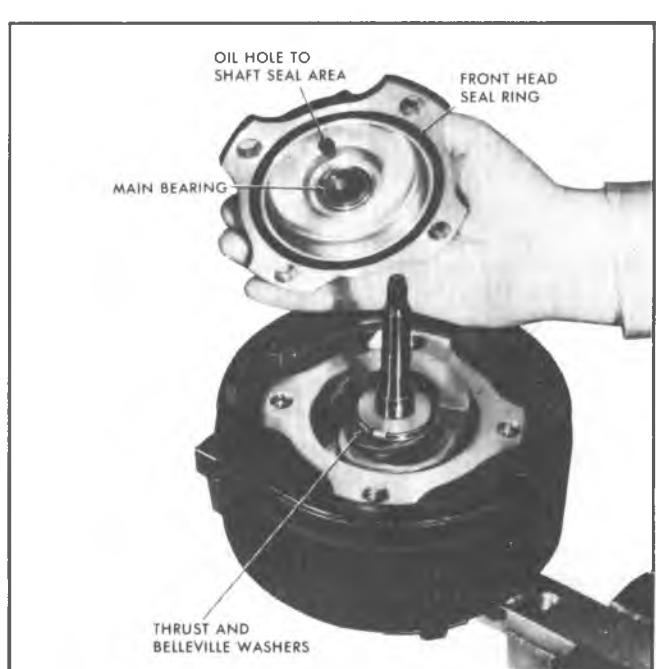


Fig. 86--Installing Front Head



Fig. 87--Replacing Thrust and Belleville Washers

correctly to cylinder. Tighten front head mounting screws to 18-22 foot pounds.

4. Install a new compressor shaft seal.

5. Install clutch rotor and bearing assembly, clutch coil and pulley rim assembly to front head (Fig. 83). Before fully seating the assembly on front head be sure clutch coil terminals are in the proper location in relation to compressor and that the three protrusions on rear of clutch coil align with the locator holes in front head.

6. Install rotor and bearing assembly retaining ring and reassemble clutch plate and hub assembly.

7. Leak test compressor as described under "Leak Testing the Compressor" and correct any leaks found.

#### **THRUST AND BELLEVILLE WASHER REPLACEMENT**

1. Remove two thrust and one belleville washer from compressor shaft. Note the assembled position of the washers.

2. Install a new thrust washer on compressor shaft with thrust washer tang pointing up (Fig. 88).

3. Install the new belleville washer on shaft with the high center of the washer up (Fig. 87).

4. Install the remaining thrust washer on shaft with the tang pointing down (Fig. 87).

5. Lubricate the three washers with clean oil (525 Viscosity) and assemble front head to cylinder.

#### **MAIN BEARING REPLACEMENT**

##### **Removal**

1. Remove front head assembly.

2. Place front head assembly on two blocks (Fig. 88) and using main bearing remover J-24896 drive bearing out of front head.

##### **Installation**

1. Place front head with neck end down on a flat, solid surface.

2. Align new bearing and bearing installer J-24895 squarely with bearing bore of front head and drive bearing

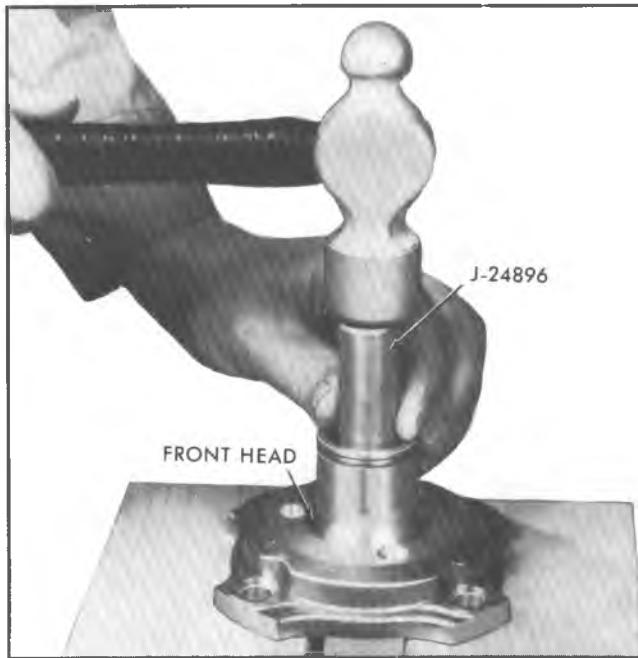


Fig. 88--Removing Main Bearing

into front head (Fig. 89). The tool J-24895 must seat against front head to insert bearing to proper clearance depth.

3. Assemble front head to cylinder and complete the assembly.

#### **COMPRESSOR SHELL, CYLINDER "O"**

#### **RING AND VALVE PLATE REPLACEMENT**

The clutch plate and hub assembly, the clutch rotor and bearing assembly, the clutch coil and pulley rim must be removed before compressor shell can be removed or replaced. The location of clutch coil terminals should be marked for reference on reassembly. Allow compressor to cool to room temperature before attempting to remove compressor shell as greater force will be required to remove the compressor shell when hot due to metal expansion difference between the aluminum cylinder and steel compressor shell.

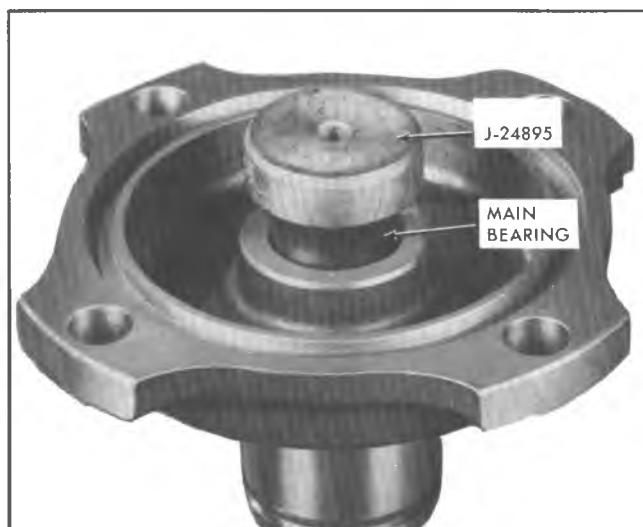


Fig. 89--Installing Main Bearing



Fig. 90--Releasing Retaining Strap

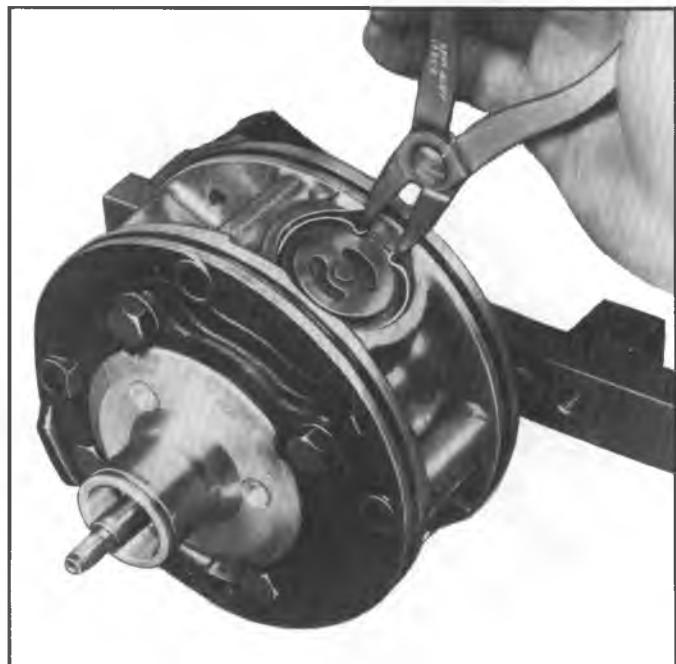


Fig. 92--Removing Valve Plate

1. Pry shell retaining strap away from cylinder and position the strap high enough to clear cylinder as shell is removed (Fig. 89).

2. Remove compressor holding fixture J-25008-1 and reverse holding fixture step block protrusions engaging compressor shell. Install medium length bolts through holding fixture and thread them into compressor cylinder until the step of the fixture protrusions contact compressor shell, finger tight, both sides (Fig. 91). Check to be sure the step protrusions do not overlap the cylinder but will pass both sides.

3. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push shell free of "O" rings on cylinder.

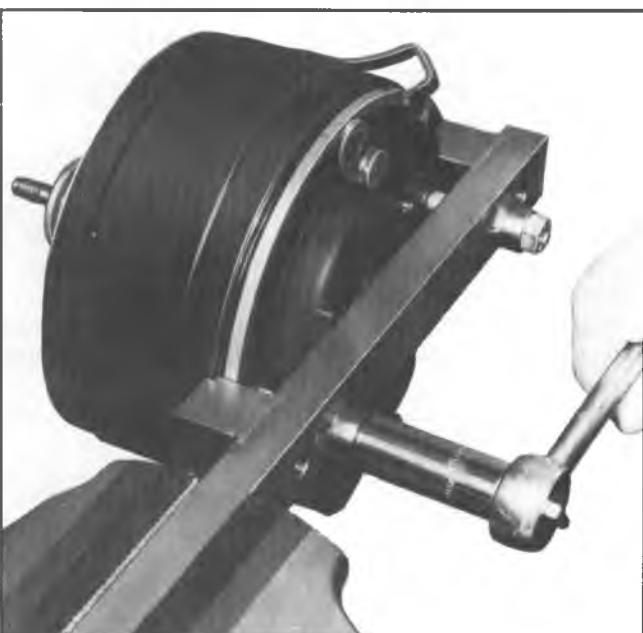


Fig. 91--Removing Shell Assembly

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in step or the shell will be cocked and made more difficult to remove. Normal removal does not require much force on wrench if the screws are kept in step while turning. The shell can be removed by hand as soon as shell is free of shell to cylinder "O" rings. Do not turn screws any further than necessary to release shell.

4. Remove compressor shell, remove holding fixture J-25008-1 from compressor, reverse fixture to again hold compressor by the opposite side using the short length screws.

At this point the valve plate retainer ring may be removed using internal snap ring pliers, J-4245 (Fig. 92) and remove the compressor valve plate (Fig. 93) for replacement or piston inspection.

#### Installation

1. Remove old cylinder to shell "O" rings and discard. Check compressor assembly and interior of compressor shell to be sure they are free of lint or dirt.

2. Dip a cylinder to shell "O" ring in 525 Viscosity oil and install in rear "O" ring groove of cylinder. Be careful in moving "O" ring across cylinder surface to prevent damaging "O" ring.

3. Dip remaining cylinder to shell "O" ring in oil and install it in front "O" ring groove of cylinder.

4. Place compressor shell on cylinder and rotate retaining strap to its original location (Fig. 91).

5. Attach shell installing fixture J-25008-2 to the holding fixture J-25008-1, using the long bolts and plate washers of tool set.

Align the step projections of shell installing fixture J-25008-2 to contact compressor shell evenly both sides.

6. Push compressor shell as close to "O" ring (Fig. 94) as possible by hand and check for equal alignment of shell around cylinder. Tighten fixture screws finger tight.

7. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push compressor shell over "O"

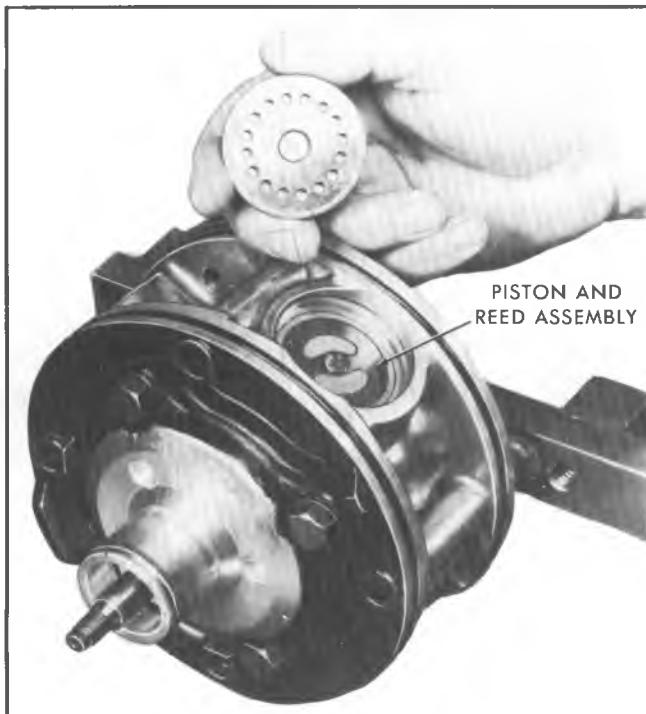


Fig. 93--Inspecting Piston and Reed Assembly

rings and back against shell stop flange at the rear of compressor cylinder.

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in step or the shell will be cocked and made more difficult to install. Normal installation does not require much force on wrench if screws are kept in step while turning.

8. When shell is seated against the stops, bend shell retaining strap down into place by tapping gently with a hammer.

9. Remove shell installing fixture J-25008-2 and leak test compressor.

#### OIL CHARGE

The radial four cylinder compressor is charged with 6.0 ounces of 525 viscosity oil. During normal operation a certain amount of oil will circulate with the Refrigerant 12 (R-12) in the system.

When necessary to replace a system component it is recommended that oil be added to the system in accordance to the following procedure.

If compressor is operable, idle vehicle for 10 minutes with the A/C controls set for Maximum Cooling and High Blower prior to discharging the system.

Add additional oil as indicated in Diagnosis Section of this Service Manual.

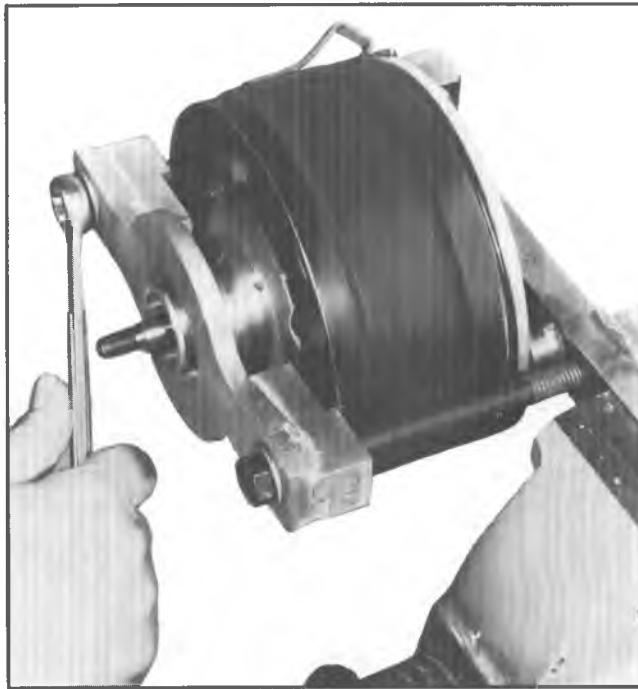


Fig. 94--Installing Shell Assembly

#### Oil Charge-Compressor Replacement

1. Gravity drain oil from a new compressor.

Position compressor with shaft end "up" and drain compressor suction and discharge ports. The compressor should gravity drain for 10 minutes.

Add additional oil as indicated in Section 1B of the Service Manual.

When necessary to flush system with R-11, drain assembly and blow dry with air prior to the installation of a new compressor. It is not necessary to drain oil from the replacement compressor.

2. The refrigerant 12 (R-12) is to be slowly discharged from the system.

3. Remove original compressor from vehicle, gravity drain the oil from compressor as in Step 1 and determine the amount of oil drained from the original compressor. Refer to the oil usage chart in section 1B of the Service manual for proper amount of oil to be added.

#### SYSTEM PERFORMANCE EVALUATION

When system performance, efficiency and proper oil charge is in doubt and must be evaluated accurately, it is recommended that the system be flushed with R-11 and the exact oil charge (6 ounces) of 525 viscosity oil be added to the compressor prior to any further checks of the system.

# COMPRESSOR LEAK TESTING - EXTERNAL AND INTERNAL

## A-6 and R-4 Compressors

### Bench-Check Procedure

1. Install Test Plate J-9625 on rear head of compressor.
2. Attach center hose of gage manifold set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.
3. Connect Charging Station HIGH and LOW pressure lines to corresponding fittings on Test Plate J-9625, using J-5420 Gage Adapters.
- NOTE:** Suction port of compressor has large internal opening. Discharge port has small internal opening into compressor.
4. Open LOW pressure control, HIGH pressure control and REFRIGERANT control on Charging Station to allow refrigerant vapor to flow into compressor.
5. Using Leak Detector, check for leaks at pressure relief valve, compressor shell to cylinder, compressor front head seal (and also rear head seal and oil charge port on A-6 compressor), and compressor shaft seal. After checking, shut off LOW pressure control and HIGH pressure control on Charging Station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the manifold gage hose connections to the Gage Adapters J-5420 connected to the LOW and HIGH sides and allow the vapor pressure to release from the compressor.
8. Disconnect both Gage Adapters J-5420 from the Test Plate J-9625.

9. Rotate the complete compressor assembly (**not the crankshaft or drive plate hub**) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station HIGH pressure line or a HIGH pressure gage and Gage Adapter J-5420 to the Test Plate J-9625 HIGH side connector.
13. Attach a Adapter J-5420 to the suction or LOW pressure port of the Test Plate J-9625 to open the schrader-

type valve.

**NOTE:** Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port down.

14. Attach the compressor to the Holding Fixture J-25008-1, (R-4 compressor) and J-9396 (A-6 compressor), and clamp the fixture in a vise so that the compressor can be manually turned with a wrench.

15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10 complete revolutions at a speed of approximately one revolution per second.

**NOTE:** Turning the compressor at less than one revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.

16. Observe the reading on the HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 50 p.s.i. or above for the R-4 and 60 p.s.i. or above for the A-6 compressor. **A pressure reading of less than 45 p.s.i. for the R-4 or 50 p.s.i. for the A-6 would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak.** Repair as needed, reassemble and repeat the pump-up test. Externally leak test.

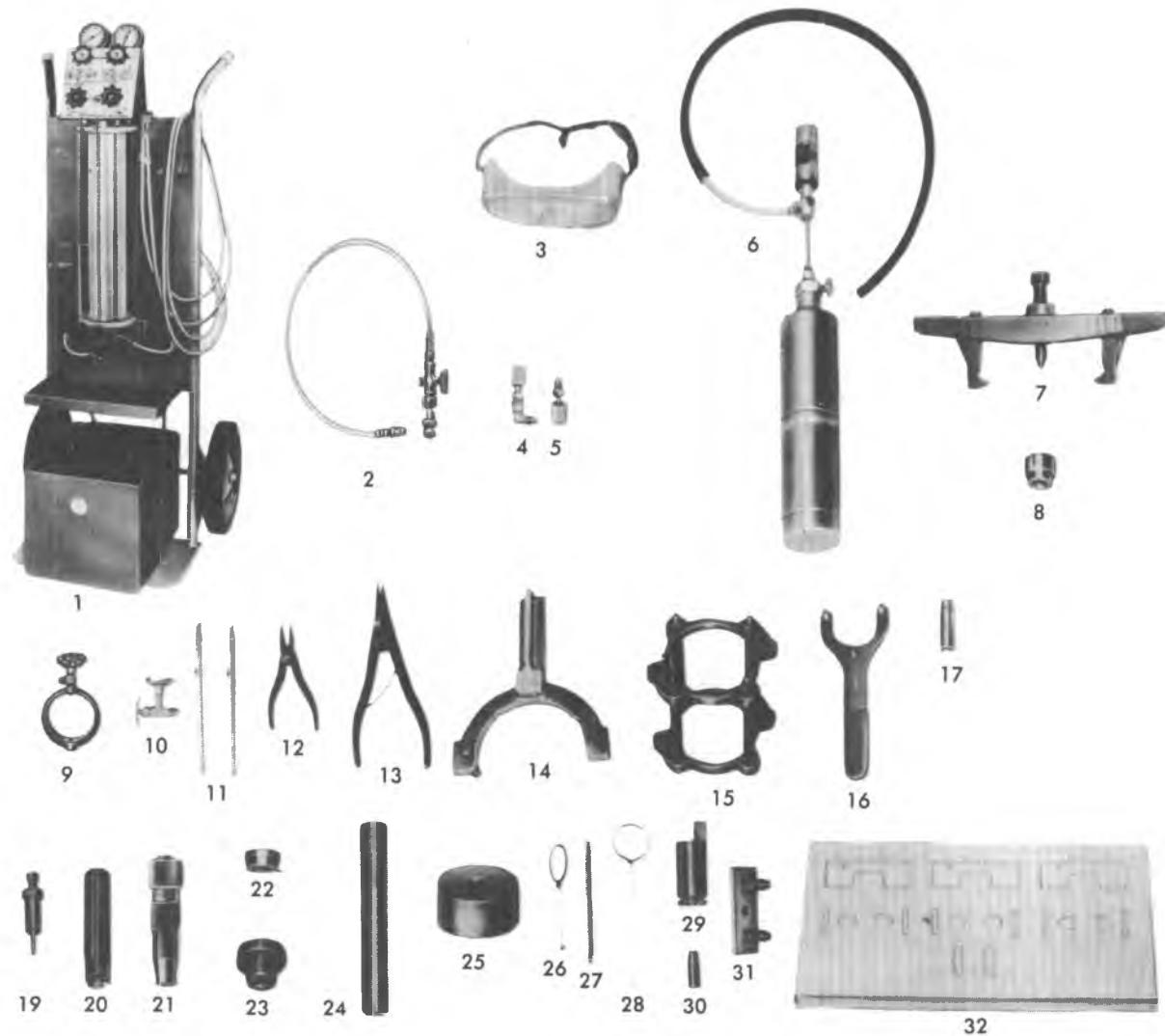
17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J-5420 and Test Plate J-9625.

18. On the R-4, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.

On the A-6, remove oil charge screw and drain the oil sump.

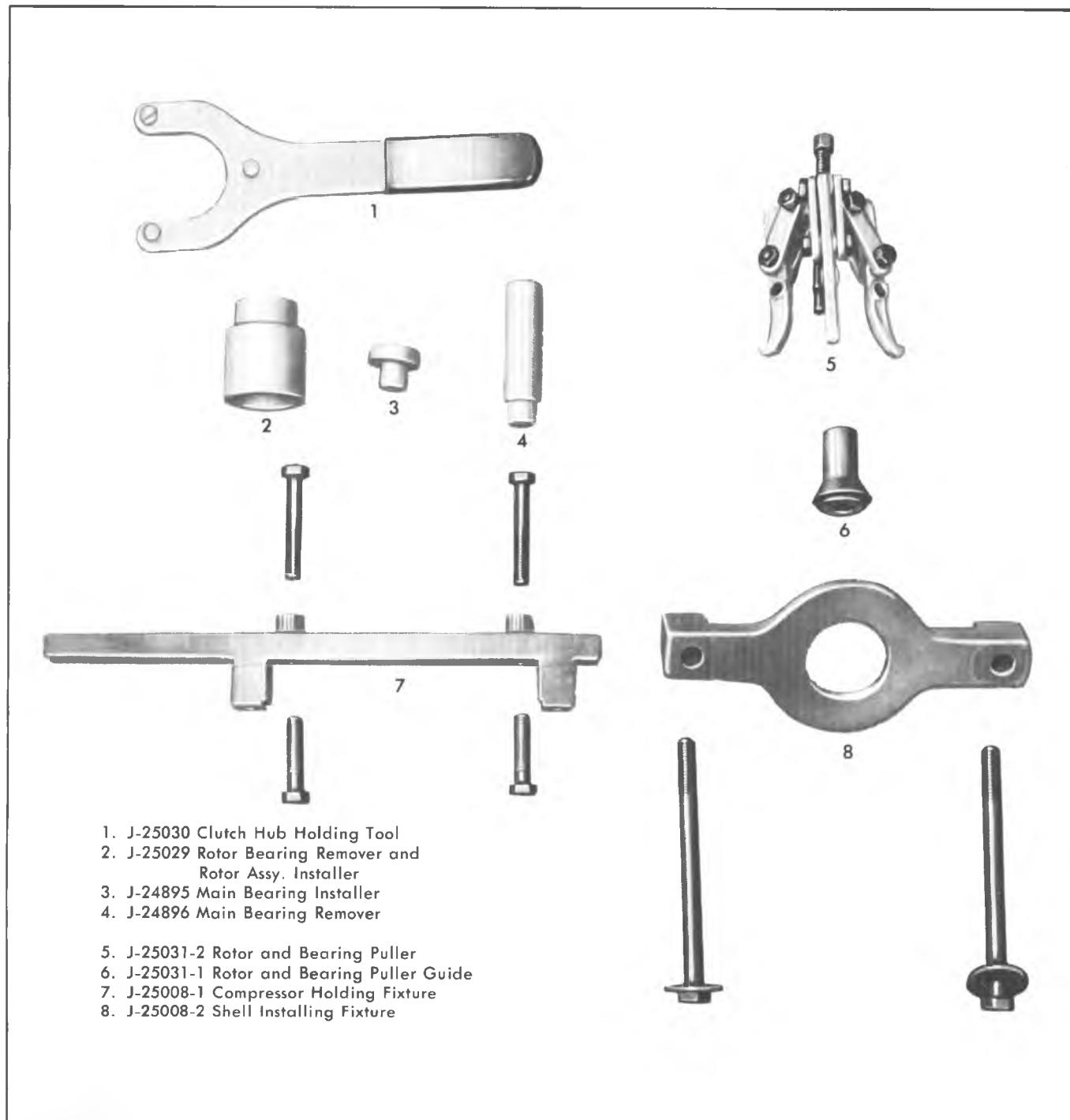
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

**NOTE:** If further assembly or processing is required, a shipping plate or Test Plate J-9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



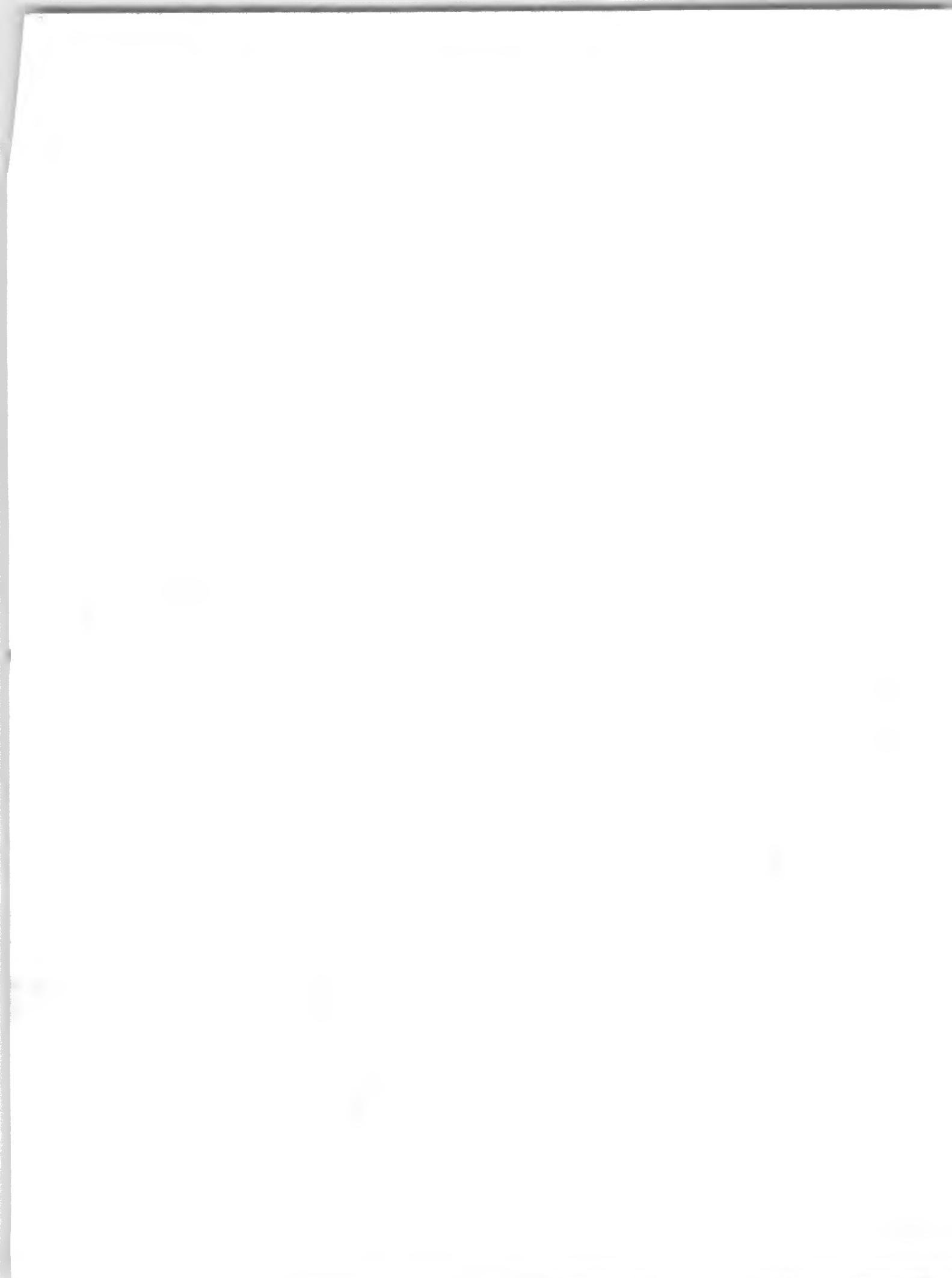
- |               |                                     |               |                         |               |                              |
|---------------|-------------------------------------|---------------|-------------------------|---------------|------------------------------|
| 1. J-8393     | Charging Station                    | 11. J-5421-02 | Pocket Thermometers (2) | 22. J-9398    | Pulley Bearing Remover       |
| 2. J-24095    | Oil Inducer                         | 12. J-5403    | No. 21 Snap Ring Pliers | 23. J-9481    | Pulley and Bearing Installer |
| 3. J-5453     | Goggles                             | 13. J-6435    | No. 26 Snap Ring Pliers | 24. J-8092    | Handle                       |
| 4. J-9459     | 7/16"-20 90° Gauge Line             | 14. J-9396    | Compressor Holding      | 25. J-21352   | Internal Assembly            |
| J-25499       | 3/8"-24 Adapter                     |               | Fixture                 |               | Support Block                |
| 5. J-5420     | 7/16"-20 Straight Gauge Line        | 15. J-25030   | Compressing Fixture     | 26. J-5139    | Oil Pickup Tube Remover      |
| J-25498       | 3/8" Adapter                        | 16. J-9403    | Clutch Hub Holding Tool | 27. J-9432    | Needle Bearing Installer     |
| 6. J-6084     | Leak Detector                       | 17. J-9399    | 9/16" Thin Wall Socket  | 28. J-9553-01 | Seal Seat "O" Ring           |
| 7. J-8433     | Puller                              | 18. J-9401    | Hub and Drive Plate     | 29. J-21508   | Remover                      |
| 8. J-9395     | Puller Pilot                        | 19. J-9480-01 | Assembly Remover        | 30. J-22974   | Seal Seat "O" Ring           |
| 9. J-23595    | Refrigerant Can Valve<br>(Side-Tap) | 20. J-9392    | Hub and Drive Plate     | 31. J-9625    | Installer                    |
| 10. J-6271-01 | Refrigerant Can Valve<br>(Top-Tap)  | 21. J-23128   | Assembly Installer      | 32. J-9402    | Shaft Seal Protector         |
|               |                                     |               | Seal Remover            |               | Pressure Test Connector      |
|               |                                     |               | Seal Seat Remover       |               | Parts Tray                   |

Fig. 95-Special Tools



1. J-25030 Clutch Hub Holding Tool
2. J-25029 Rotor Bearing Remover and Rotor Assy. Installer
3. J-24895 Main Bearing Installer
4. J-24896 Main Bearing Remover
5. J-25031-2 Rotor and Bearing Puller
6. J-25031-1 Rotor and Bearing Puller Guide
7. J-25008-1 Compressor Holding Fixture
8. J-25008-2 Shell Installing Fixture

Fig. 96 -Special Tools



## SECTION 3B

# STEERING

### CONTENTS OF THIS SECTION

Manual Steering Gears.....	3B-1
Power Steering Pump.....	3B-7
Integral Power Steering Gear.....	3B-12
Control Valve - Corvette.....	3B-24
Power Cylinder--Corvette.....	3B-29
Special Tools.....	3B-30

## MANUAL STEERING GEARS

### INDEX

Overhaul Operations.....	3B-1	Side Cover Bushing Replacement.....	3B-3
Disassembly .....	3B-1	Wormshaft Bearing Race Replacement .....	3B-3
Inspection .....	3B-2	Ball Nut Servicing.....	3B-3
Repairs.....	3B-3	Assembly.....	3B-5
Pitman Shaft/Wormshaft Seal Replacement .....	3B-3	Adjustment on Bench .....	3B-7
Pitman Shaft Bushing Replacement.....	3B-3		

## OVERHAUL OPERATIONS

### Disassembly (Figs. 3B-1 through 3B-4)

As with any ball bearing unit the steering gear parts must be kept free of dirt. Clean paper or rags should be spread on the workbench before starting disassembly of the steering gear.

1. Place the steering gear in a vise, clamping onto one of the mounting tabs. The wormshaft should be in a horizontal position.
2. Rotate the wormshaft from stop to stop, counting the total number of turns. Then turn back exactly half way, placing the gear on center (the wormshaft flat should be at

the 12 o'clock position). Loosen locknut.

3. Place a pan under the assembly to catch the lubricant and remove the three self locking bolts attaching the side cover to the housing.

4. Tap lightly on the end of the pitman shaft with a plastic hammer and lift the side cover and pitman shaft assembly from the gear housing (fig. 3B-5).

**NOTE:** If the pitman shaft sector does not clear the opening in the housing easily, turn the wormshaft by hand until the sector will pass through the opening in the housing.

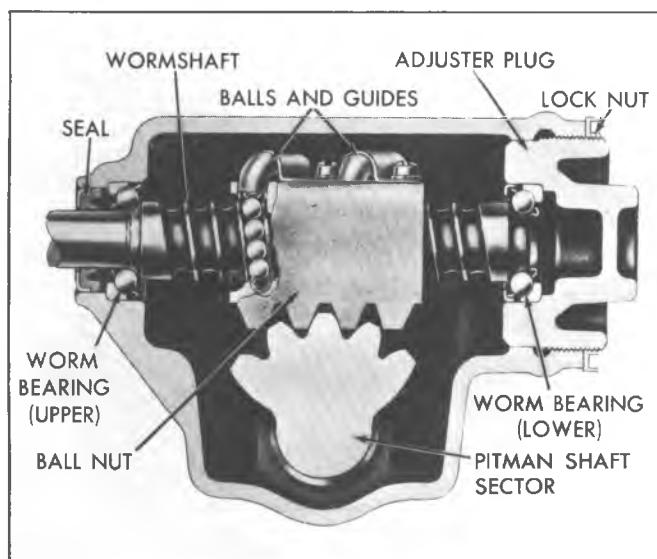


Fig. 3B-1—Steering Gear (Except Corvette)

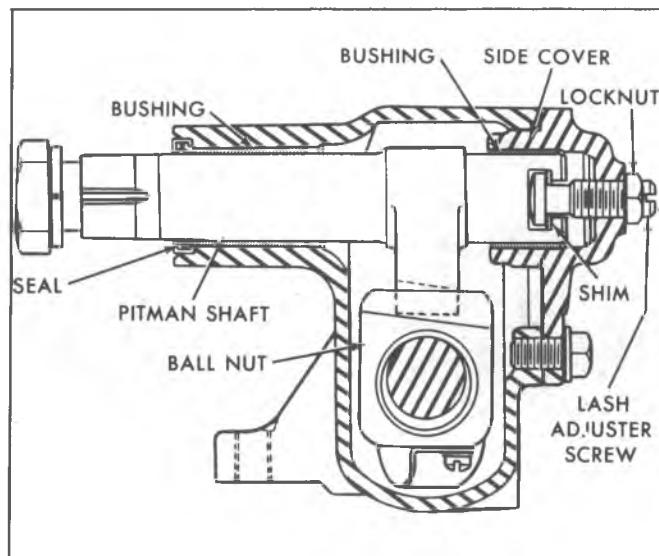


Fig. 3B-2—Steering Gear (Except Corvette and G10-30 Series Trucks)

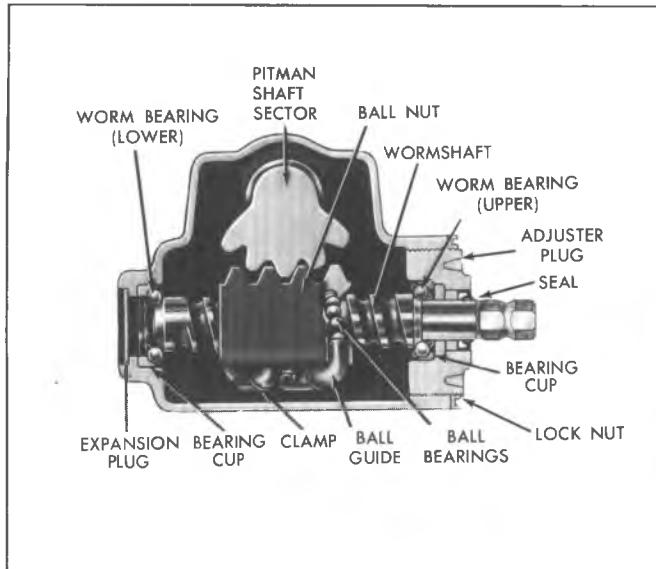


Fig. 3B-3--Steering Gear--Corvette

5. Remove the adjuster plug and locknut assembly (incorporates the lower wormshaft bearing and race on all except Corvette - upper wormshaft bearing race on Corvette).

6. Draw the wormshaft and ball nut assembly from the housing (fig. 3B-6).

**CAUTION:** Use care that the ball nut does not run down to either end of the worm. Damage will be done to the ends of the ball guides if the nut is allowed to rotate until stopped at the end of the worm.

7. **All Except Corvette**-- Remove the upper bearing from the wormshaft.

**Corvette**-- Remove lower bearing from inside the gear housing.

8. **All except Corvette**-- Using a suitable size screw driver, pry the lower bearing retainer from the adjuster plug housing and remove the bearing (fig. 3B-7).

9. Remove the locknut from the lash adjuster screw in

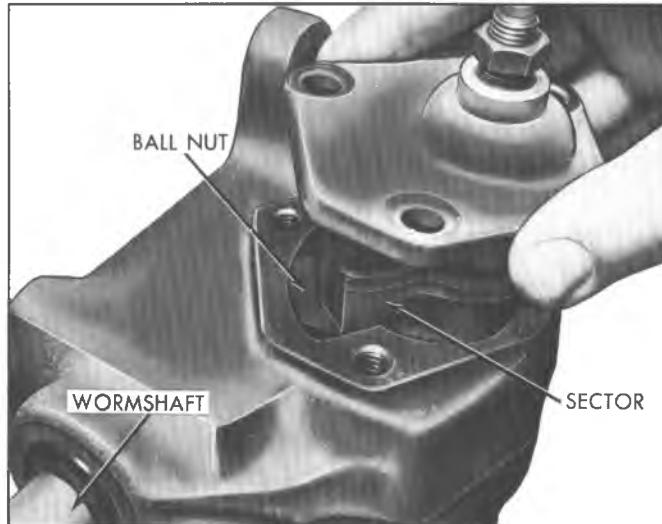


Fig. 3B-5--Removing Pitman Shaft Assembly--Typical

the side cover. Remove the lash adjuster screw from the side cover by turning the screw clockwise. Slide the adjuster screw and shim out of the slot in the end of the pitman shaft.

10. Pry out and discard both the pitman shaft and wormshaft seals.

#### Inspection

With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air. With a magnifying glass inspect the bearings and bearing races for signs of indentation. Also check for any signs of chipping or breakdown of the surface. Any parts that show signs of damage should be replaced

Inspect all seals. Any seal that is worn or has been removed should be replaced.

Inspect the fit of the pitman shaft in its bushing in the side cover. If this bushing is worn, a new side cover and bushing assembly should be installed.

Check steering gear wormshaft assembly for being bent or damaged in any way. Never attempt to salvage steering parts by welding or straightening.

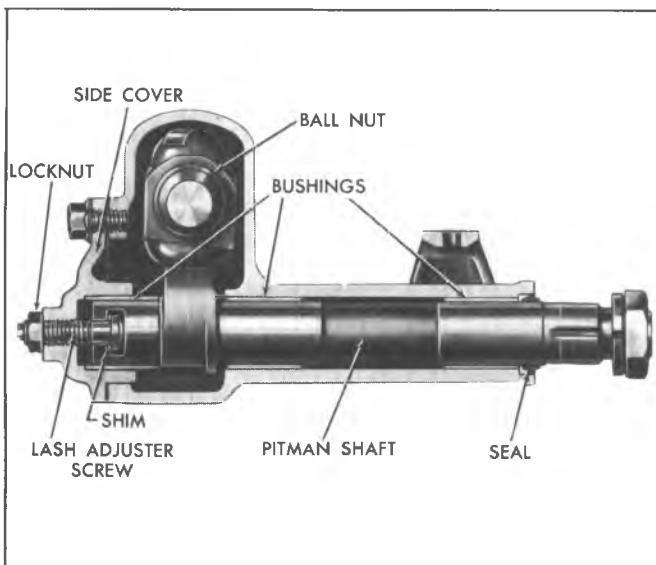


Fig. 3B-4--Steering Gear (Corvette and G10-30 Series Trucks)

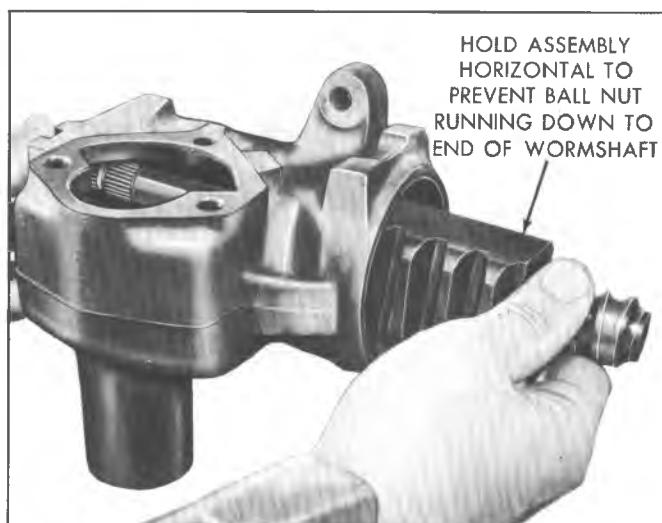


Fig. 3B-6--Removing the Wormshaft and Ball Nut--Typical

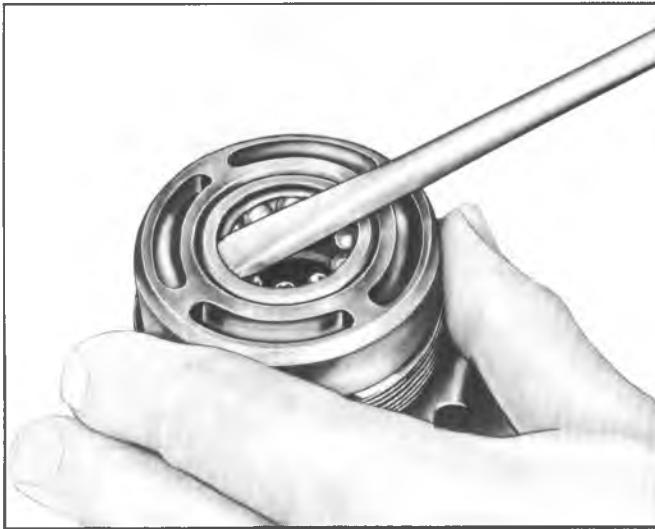


Fig. 3B-7--Removing Lower Bearing Retainer--Except Corvette

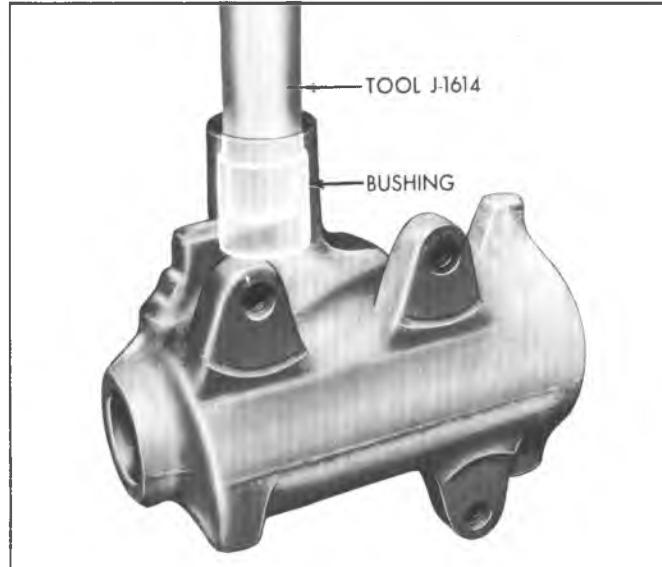


Fig. 3B-8--Removing Pitman Shaft Bushing--Typical

## Repairs

### Pitman Shaft and/or Wormshaft Seal Replacement

The double lipped pitman shaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is disassembled.

1. If the seals were not removed at disassembly, pry out the old seals using a suitable size screw driver.

**CAUTION:** Before installing new seals, check the condition of the pitman shaft bushing(s) and the upper wormshaft bearing race.

2. A suitable size socket, pressing on the outer diameter of the seal, may be used to install new seals.

**CAUTION:** Care should be taken to insure that the new seals are not assembled in a cocked position.

### Pitman Shaft Bushing Replacement

1. Support the steering gear housing in an arbor press and press the pitman shaft bushing (2 bushings on Corvette and G10-30 Series Trucks) from the housing using Tool J-1614, inserted from the lower end of the housing (fig. 3B-8).

2. Press the new bushing(s) into position using Tool J-1614. Position the Corvette and G10-30 Series Truck bushings as shown in Figure 3B-4.

**NOTE:** Service bushings are diamond bored to size and require no further reaming.

### Side Cover Bushing Replacement

The entire side cover assembly, including bushing, is serviced as a unit and should be replaced when it is desired to replace the bushing.

### Wormshaft Bearing Race Replacement

#### ADJUSTER PLUG RACES

1. **All Except Corvette**-- Remove the wormshaft bearing race using Tool J-5822 and a Slide Hammer as shown in Figure 3B-9.

**Corvette**-- Using a hammer and punch, drive the bearing race out of the adjuster plug.

2. Press the new bearing race into position using Tool J-5755.

#### HOUSING RACES

1. **Corvette only**-- Using a drift or punch (inserted into the housing from the adjuster plug end) drive the sheet metal

expansion plug out of the lower end of the housing.

2. All Series - Using a drift or punch, drive the bearing race out of the housing.

3. Press the new bearing race into position using Tool J-5755 (fig. 3B-10).

4. **Corvette only**-- Install a new expansion plug into the lower end of the housing. Press on the center of the plug to deform it inward and secure it in the housing. Make sure the plug is tight or lubricant leakage could result.

### Ball Nut Servicing

As a rule, disassembly of the ball bearing nut will not be necessary if it is perfectly free with no indication of binding or tightness when rotated on the worm. However, if there is any indication of binding or tightness, the unit should be disassembled, cleaned and inspected as follows:

1. Remove screws and clamp retaining the ball guides in nut. Draw guides out of nut.

2. Turn the nut upside down and rotate the wormshaft back and forth until all the balls have dropped out of the nut into a clean pan. With the balls removed, the nut can be pulled endwise off the worm.

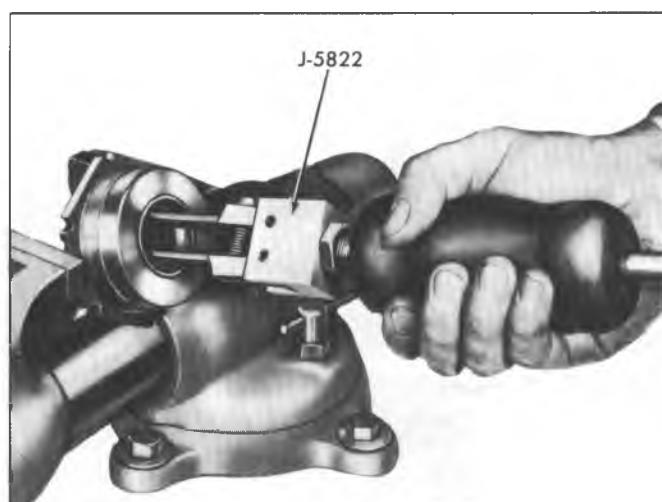


Fig. 3B-9--Removing Adjuster Plug Bearing Race

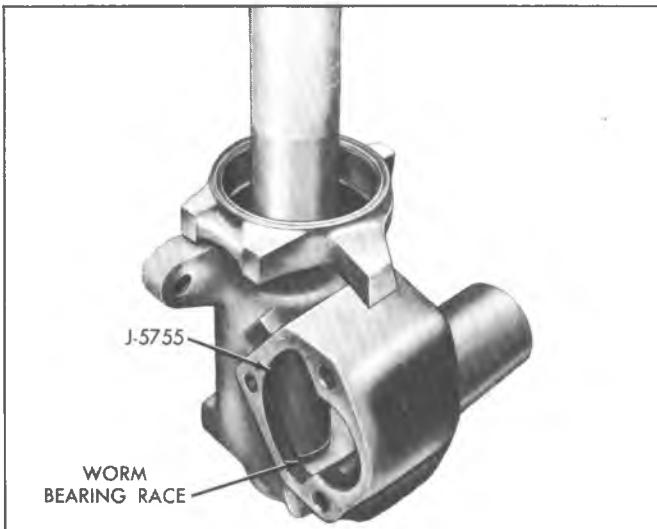


Fig. 3B-10--Installing Wormshaft Bearing Race-Typical

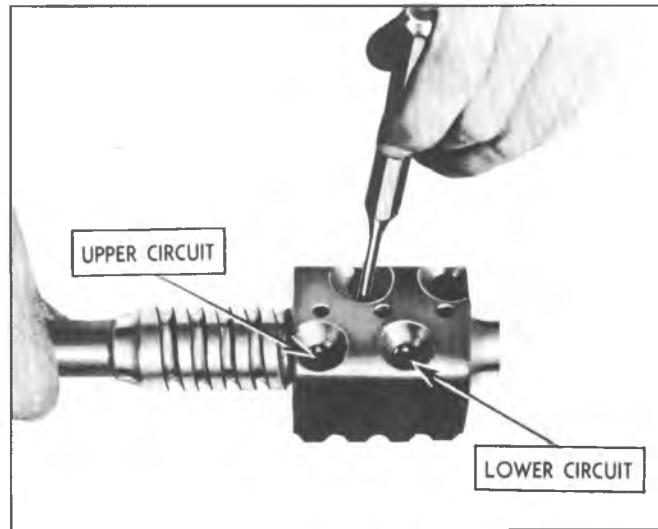


Fig. 3B-12--Filling Ball Circuits--Corvette

3. Wash all parts in cleaning solvent and dry them thoroughly with air. Using a magnifying glass inspect the worm and nut grooves and the surface of all balls for signs of indentation. Check ball guides for damage at ends where they deflect or pick up the balls from the helical path. Any parts that show signs of damage should be replaced.

#### 4. All Except Corvette (fig. 3B-11):

a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.

b. Place two ball guide halves together and insert them into the upper circuit in the ball nut. Place the remaining two guides together and insert them in the lower circuit.

c. Count 24 balls into a suitable container. This is the proper number of balls for one circuit.

d. Load the balls into one of the guide holes while turning the wormshaft gradually away from that hole. When all of the balls have been installed, the circuit is complete.

e. Fill the remaining ball circuit in the same manner as described for the first circuit in Steps c and d above.

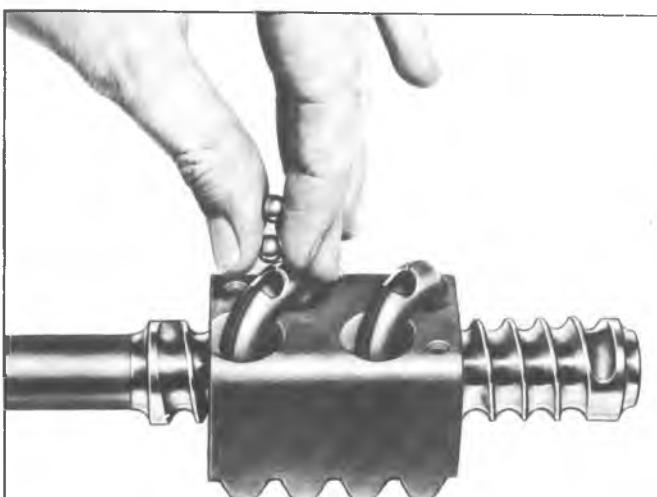


Fig. 3B-11--Filling Ball Circuits--Except Corvette



Fig. 3B-13--Filling Ball Guides--Corvette

#### 5. Corvette only (figs. 3B-12 and 3B-13):

a. Place the wormshaft flat on the bench and slip the nut over the worm with the ball guide holes up and the shallow end of the rack teeth to the left from the steering wheel position. Align the grooves in the worm and nut by sighting through the ball guide holes.

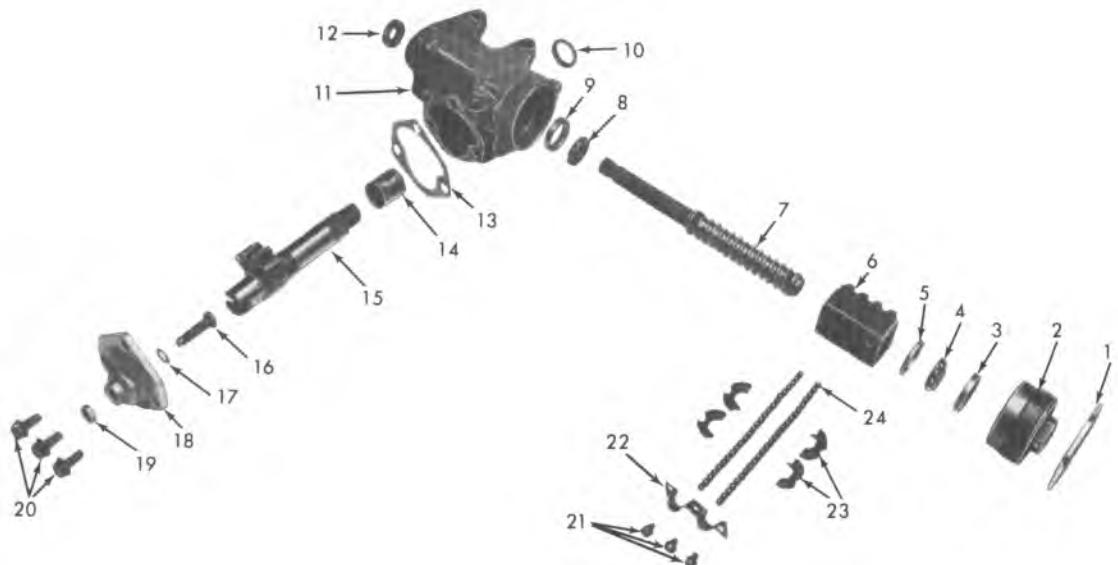
b. Count 27 balls into a suitable container. This is the proper number of balls for half the circuit. Place these balls into one of the guide holes while turning the worm gradually away from that hole.

c. Lay one-half of the ball guide, groove up, on the bench and place the remaining balls from the count container in it.

d. Close this half of guide with the other half. Hold the two halves together and plug each open end with petroleum jelly so that balls will not drop out while installing the guide.

e. Push the guide into the guide holes of the nut. This completes one circuit of balls. If the guide does not push all the way down easily, tap it lightly into place with the wooden handle of a screw driver.

f. Fill the second ball circuit in the same manner. Continue until the ball circuit is full from the bottom of one



- Fig. 3B-14—Steering Gear—Except Corvette
- |                                  |  |   |
|----------------------------------|--|---|
| 1. Worm Bearing Adjuster Locknut | 9. Upper Worm Bearing Race                                       | 16. Lash Adjuster                           |
| 2. Worm Bearing Adjuster         | 10. Pitman Shaft Seal  | 17. Lash Adjuster Shim                      |
| 3. Lower Worm Bearing Race       | 11. Housing  | 18. Housing Side Cover and Bushing Assembly |
| 4. Lower Ball Bearing            | 12. Wormshaft Seal   | 19. Lash Adjuster Locknut                   |
| 5. Lower Bearing Retainer        | 13. Side Cover Gasket  | 20. Side Cover Bolts                        |
| 6. Ball Nut                      | 14. Pitman Shaft Bushing<br>(2 Bushings on G10-30 Series Trucks) | 21. Ball Guide Clamp Screws                 |
| 7. Wormshaft                     | 15. Pitman Shaft   | 22. Ball Guide Clamp                        |
| 8. Upper Ball Bearing            |  | 23. Ball Guides                             |
|                                  |  | 24. Balls                                   |

Fig. 3B-14—Steering Gear—Except Corvette

guide hole to the bottom of the other or until stopped by reaching the end of the worm.

**NOTE:** In cases where the balls are stopped by the end of the worm, hold down those balls already dropped into the nut with the blunt end of a clean rod or punch (fig. 3B-12) and turn the worm in the reverse direction a few turns. The filling of the circuit can then be continued. It may be necessary to work the worm back and forth, holding the balls down first in one hole and then the other, to close up the spaces between the balls and fill the circuit completely and solidly.

6. Assemble the ball guide clamp to the ball nut and tighten the screws to specified torque.

Check the assembly by rotating the nut on the worm to see that it moves freely. Do not rotate the nut to the end of the worm threads as this may damage the ball guides. If there is any "stickiness" in the motion of the nut, some slight damage to the ends of the ball guides or to other gear components may have been overlooked.

#### Assembly (Fig. 3B-14 and 3B-15)

After a major service overhaul, steering gear lubricant meeting GM Standard GM 4673M (or equivalent) should be

applied to the pitman shaft and bearings, wormshaft and bearings and the ball nut teeth.

1. Place the steering gear housing in a vise with the wormshaft bore horizontal and the side cover opening up.

2. With the pitman shaft and wormshaft seals, pitman shaft bushings and wormshaft bearing races installed, and the ball nut installed on the wormshaft, proceed to Step 3 or 4.

#### 3. All Except Corvette--

a. Slip the upper ball bearing over the wormshaft and insert the wormshaft and nut assembly into the housing, feeding the end of the shaft through the upper ball bearing race and seal.

b. Place a ball bearing in the adjuster race and press the stamped retainer into place with a suitable socket.

c. Install the adjuster and locknut into the lower end of the housing (being careful to guide the end of the wormshaft into the bearing) until nearly all end play has been removed from the wormshaft.

#### 4. Corvette--

a. Place a wormshaft bearing in the housing race. Slide the other bearing and the adjuster plug assembly over the upper end of the wormshaft.

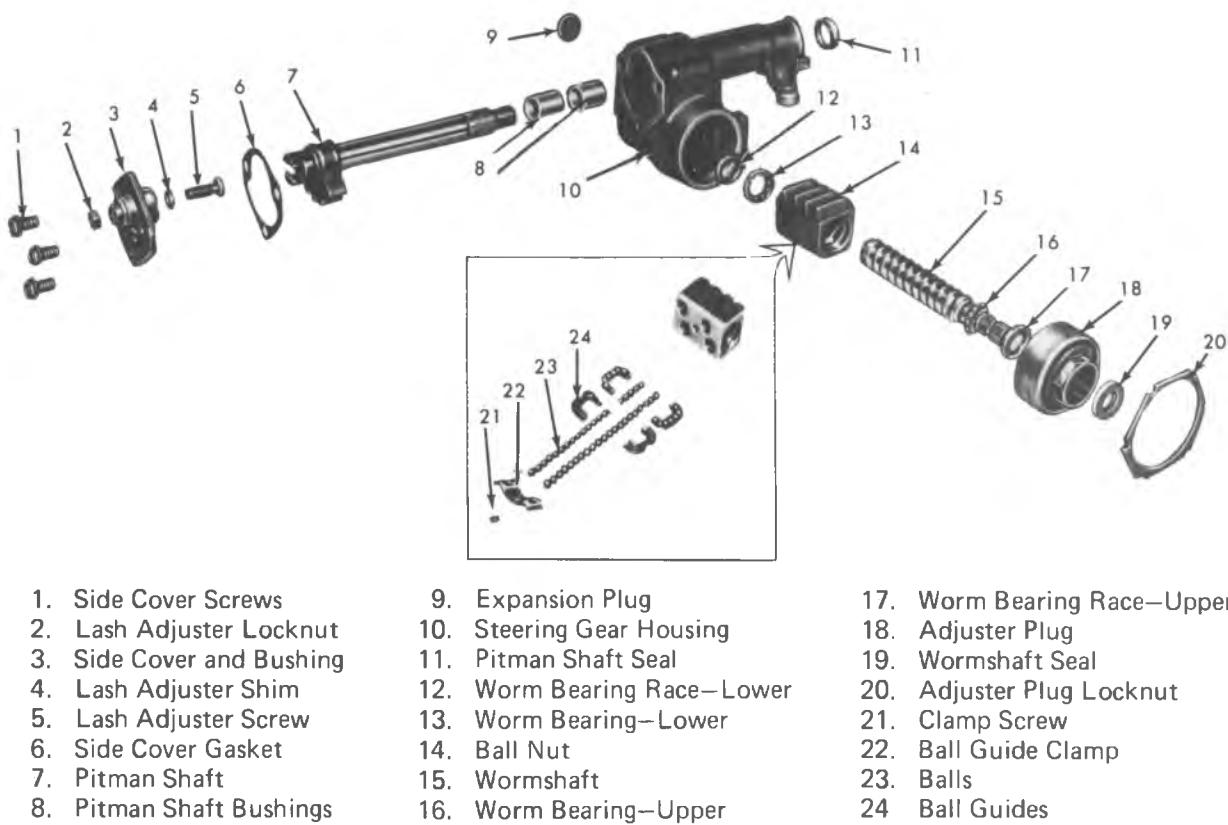


Fig. 3B-15—Steering Gear—Corvette

b. Insert the wormshaft, nut and adjuster assembly into the housing, guiding the lower end of the wormshaft into the housing bearing.

c. Thread the adjuster into the housing until nearly all end play is removed from the wormshaft.

5. Position the lash adjuster (with shim) in the slotted end of the pitman shaft. Check the end clearance, which should not be greater than .002" (fig. 3B-16). If clearance is greater than .002", a steering gear lash adjuster shim unit is available. It contains four shims--.063", .065", .067" and .069" thick.

6. Lubricate the steering gear with 11 oz. of lubricant meeting GM Specification GM 4673 (or equivalent). Rotate the wormshaft until the ball nut is at the end of its travel and then pack as much new lubricant into the housing as possible without losing it out the pitman shaft opening. Rotate the wormshaft until the ball nut is at the other end of its travel and pack as much lubricant into the opposite end as possible.

7. Rotate the wormshaft until the ball nut is about in the center of travel. This is to make sure that the pitman shaft sector and ball nut will engage properly, with the center tooth of the sector entering the center tooth space in the ball nut.

8. Insert the pitman shaft assembly (with lash adjuster

screw and shim but without side cover) into the housing so that the center tooth of the pitman shaft sector enters the



Fig. 3B-16—Checking Lash Adjuster End Clearance

center tooth space of the ball nut.

9. Pack the remaining portion of lubricant into the housing.

10. Place the side cover gasket on the housing.

11. Install the side cover onto the pitman shaft by reaching through the side cover with a screwdriver and turning the lash adjuster screw counterclockwise until the screw bottoms; back the screw off one-half turn. Loosely install a new locknut onto the adjuster screw.

12. Install and tighten the side cover bolts to specifications.

**CAUTION:** If new side cover bolts are used at installation, be sure to use specified bolts which are self locking.

#### Adjustment on Bench

1. Tighten the adjuster plug until all end play has been removed and then loosen one-quarter turn.

2. Using an 11/16" 12-point socket and an in. lb. torque wrench, carefully turn the wormshaft all the way to the right

turn stop and then turn back about one-half turn.

3. Tighten the adjuster plug until the proper thrust bearing preload is obtained; (See the Specifications at the rear of this Manual). Tighten the adjuster plug locknut to specifications.

4. Turn the wormshaft from one stop all the way to the other, counting the number of turns. Then turn the shaft back exactly half the number of turns to the center position.

5. Turn the lash adjuster screw clockwise to remove all lash between the ball nut and sector teeth. Tighten the locknut.

6. Again using the 11/16" 12-point socket and an in. lb. torque wrench, observe the highest reading while the gear is turned through center position. See the Specifications Section for proper over-center adjustment.

7. If necessary, readjust lash adjuster screw to obtain proper torque. Tighten the locknut to 23 ft. lb. torque and again check torque reading through center of travel.

## POWER STEERING PUMP

### INDEX

Overhaul Operations.....	3B-7
Disassembly .....	3B-7
Inspection.....	3B-7
Assembly .....	3B-8

## OVERHAUL OPERATIONS

**CAUTION:** If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.

#### Disassembly (Fig. 3B-17)

Clean the outside of the pump in a Nontoxic Solvent before disassembly.

1. Remove pump pulley by using tool J-25034 as shown in Figure 3B-18.

2. Place the pump in a vise and remove the union and "O" ring seal assembly.

**CAUTION:** In clamping pump in vise, be careful not to exert excessive force on the pump front hub as this may distort the shaft bushing.

3. Remove the pump reservoir retaining studs.

4. Remove the reservoir from the pump housing by tapping lightly on the outer edge of the reservoir with a soft hammer. Remove the "O" ring seal from the pump housing and discard seal.

5. Remove magnet from housing assembly.

6. Remove the mounting stud square ring seals and the flow control valve square ring seal and discard.

7. On Corvette, remove filter and filter cage; discard filter element.

8. Remove the end plate retaining ring. Compress the end plate retaining ring by inserting a small punch in the 1/8" diameter hole in the pump housing. When the ring is in compressed position, remove with a screw driver as shown in Figure 3B-19.

9. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level. If sticking should occur, a slight rocking action or light tapping with a soft hammer will free the plate. Remove the end plate spring.

10. With the pump still in a vise, remove the shaft woodruff key and tap end of shaft gently with a soft hammer until the shaft pressure plate, pump ring, rotor assembly and thrust plate can be removed as a unit (fig. 3B-20).

11. Separate the parts removed in Step 9 above. If inspection shows the shaft to be defective, separate it from the rotor by removing the retainer snap ring. Discard the snap ring.

12. Remove the end plate and pressure plate "O" rings from the pump housing and discard "O" rings.

13. Remove the dowel pins.

14. Remove the flow control valve and spring assembly.

15. Pry the shaft seal out of the pump housing being careful not to damage the housing bore, discard the shaft seal.

#### Inspection

Clean all metal parts in a nontoxic solvent and inspect as follows:

1. Flow control valve must slide freely in housing bore. If sticking is observed, check for dirt and burrs.

2. Check cap screw in the end of the flow control valve for looseness; if loose, tighten, being careful not to damage machined surfaces.

3. Be sure that pressure plate and pump plate surfaces are flat and parallel with pump ring. Check all of these parts for cracks and scoring.

**NOTE:** A high polish is always present on rotor pressure

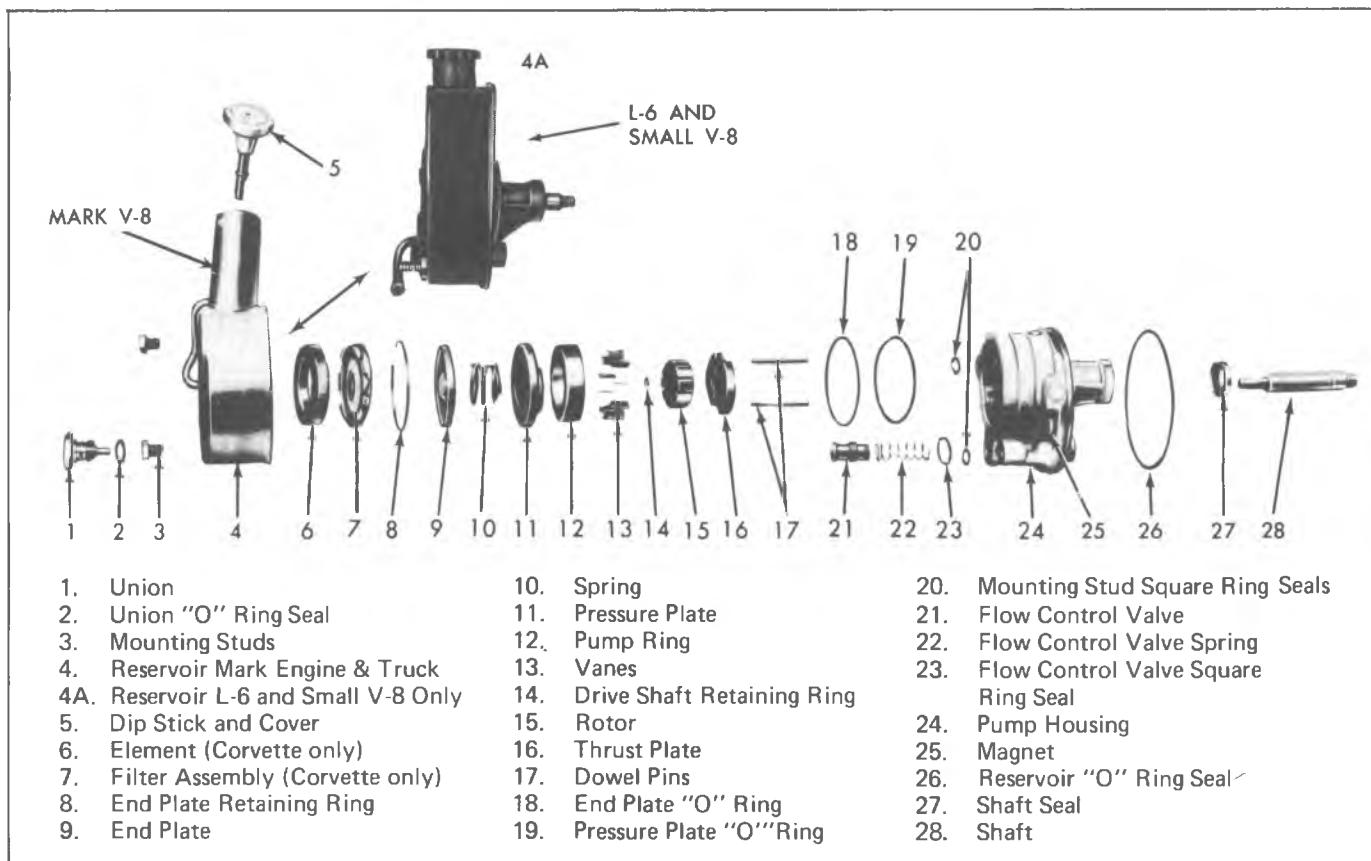


Fig. 3B-17--Power Steering Pump--Exploded View

plate and thrust plate as a result of normal wear. Do not confuse this with scoring.

4. Make certain vanes were installed with rounded edge toward pump ring and see that they move freely in rotor slots.

5. If the flow control plunger is determined to be faulty, install a new part. This part is serviced as a unit only and is factory calibrated.

6. Check drive shaft for worn splines, breaks, bushing material pickup, etc.

7. Always replace all rubber seals and "O" rings when

pump is dismantled.

8. Check reservoir, studs, casting, etc. for burrs and other faults which would impair proper operation.

#### Assembly (Fig. 3B-21)

Be sure all parts are clean during reassembly.

**NOTE:** In the following text, Power Steering Fluid is noted for use in lubricating components upon reassembly.

1. Install a new shaft seal in the pump housing, using Tool J-22670 as shown in Figure 3B-22.

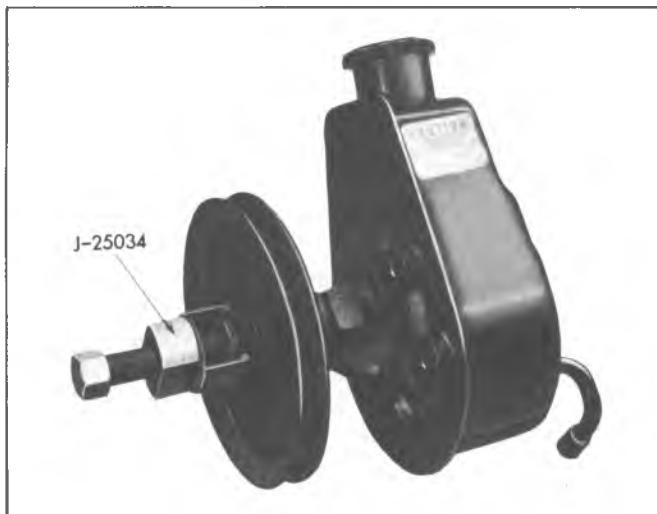


Fig. 3B-18--Power Steering Pump Pulley-Removal



Fig. 3B-19--Removing End Plate Ring



Fig. 3B-20--Impeller Unit Removal

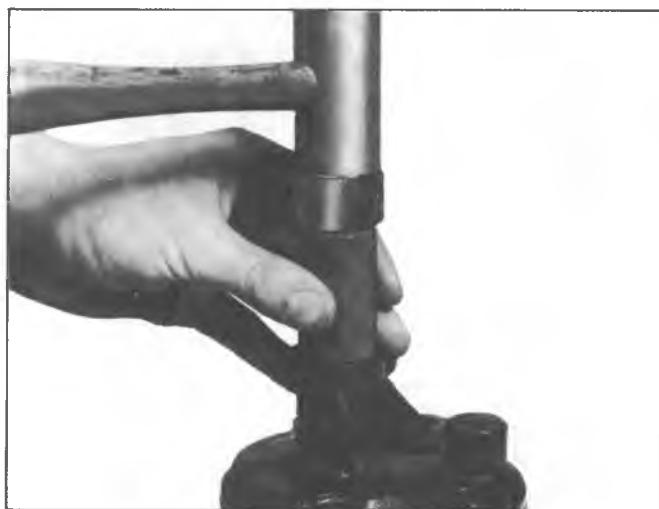


Fig. 3B-22--Installing Seal Using Tool J-22670

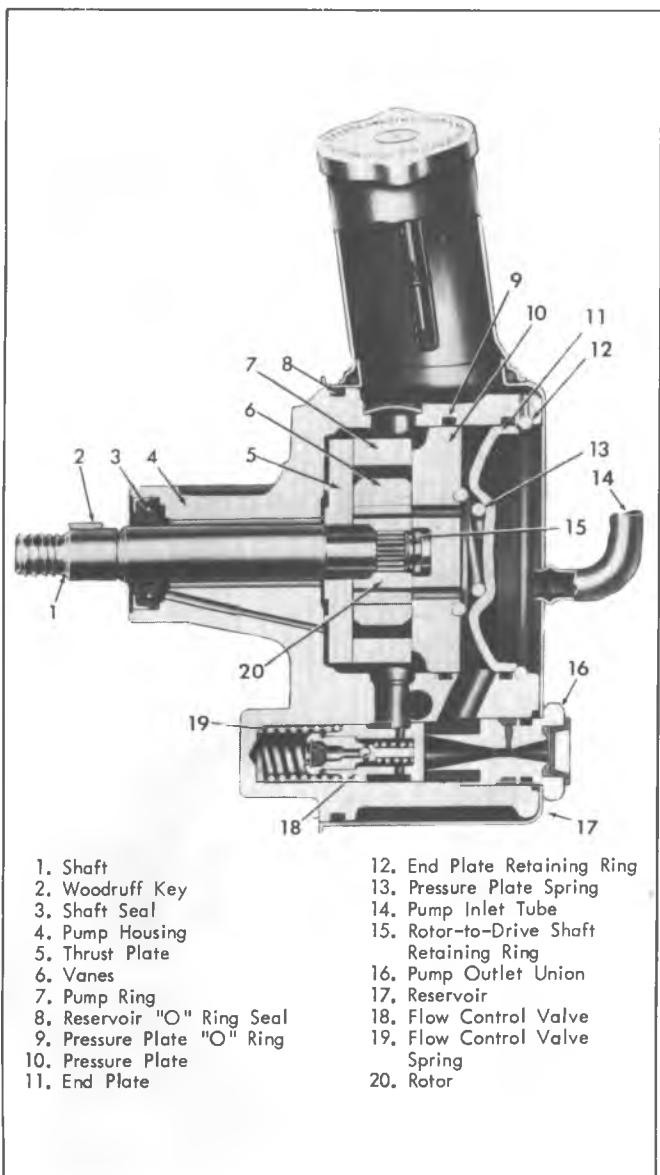


Fig. 3B-21--Power Steering Pump--Typical



Fig. 3B-23--Installing Thrust Plate

2. Install both dowel pins in the pump housing and install a new pressure plate "O" ring lubricated with Power Steering Fluid.

**CAUTION:** Do not use a "C" ring to replace the full diameter ring. Be sure the retaining ring is firmly seated in the shaft groove before proceeding.

3. Install the thrust plate on the shaft with the ported face towards the splined end of the shaft (fig. 3B-23).

4. Install the rotor, which must be free on the shaft splines, with the countersunk side towards the thrust plate.

5. Install a new shaft retaining ring by placing the ring on the end of the shaft and using first a drift and then a 3/8" socket to tap the NEW ring into place (fig. 3B-24).

6. Place pump housing in a vise and install shaft, thrust plate and rotor assembly into housing, aligning the holes in the thrust plate with the dowel pins as shown in Figure 3B-25.

7. Install the pump ring onto the dowel pins with the direction of rotation arrow to the rear of the housing (fig. 3B-26). Rotation is clockwise as viewed from the pulley end of the shaft.

8. Install the vanes into the rotor slots with the radius edge towards the pump ring and the square edge towards the

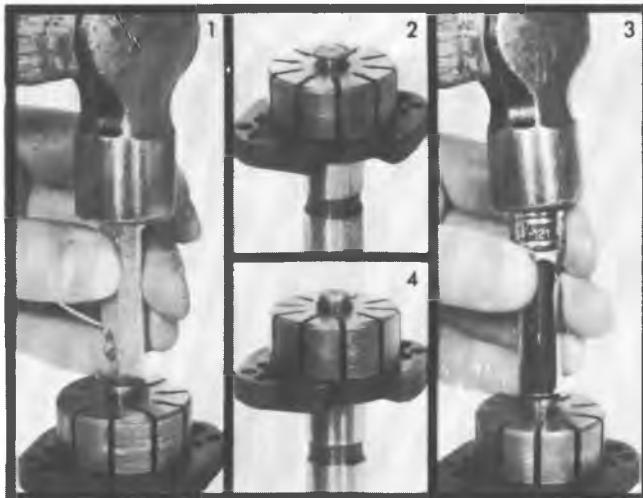


Fig. 3B-24--Installing Shaft Snap Ring

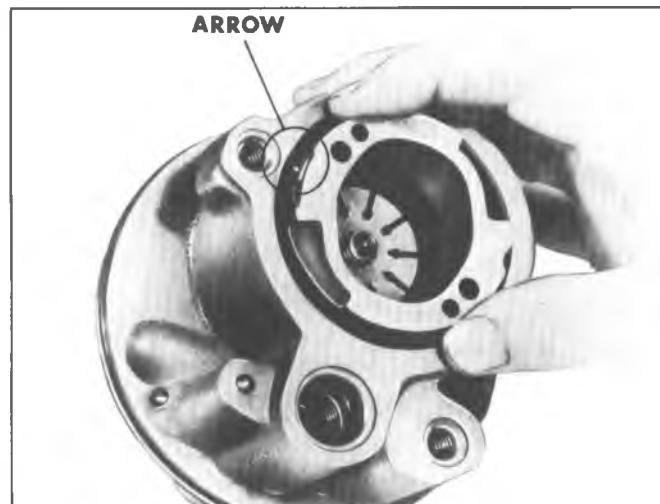


Fig. 3B-26--Installing Pump Ring

rotor as shown in Figures 3B-27 and 3B-28.

9. Lubricate the outside diameter and chamfer of the pressure plate with Power Steering Fluid, to ensure against damaging the pressure plate "O" ring, and install the pressure plate onto the dowel pins with the ported face towards the pump ring. Seat the pressure plate by placing a large socket on top of the plate and pressing down by hand (pressure plate will travel approximately 1/16" to seat).

10. Install the pressure plate spring in the center groove of the pressure plate (fig. 3B-29).

11. Lubricate a new end plate "O" ring with Power Steering Fluid and install in housing groove.

12. Lubricate the outside diameter and chamfer of the end plate with Power Steering Fluid, to ensure against damaging the "O" ring, and install into the housing using an arbor press as shown in Figure 3B-30.

**NOTE:** Place the end of the ring so that it is near the valve bore in the housing.

13. Install the flow control spring and flow control plunger. Be sure the hex head screw goes into the bore first (fig. 3B-31).

14. On Corvette, install cage and a new filter.

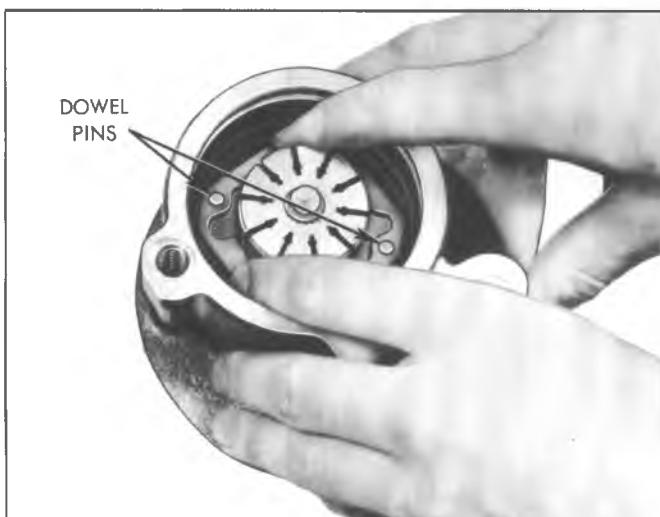


Fig. 3B-25--Installing Shaft, Thrust Plate, and Rotor Assembly



Fig. 3B-27--Installing Vanes

15. Place magnet into proper position on housing assembly (Fig. 3B-17).

16. Install new mounting stud and union square ring seals.

17. Install a new reservoir "O" ring seal, lubricated with Power Steering Fluid, onto housing.

18. Lubricate reservoir sealing edge with Power Steering Fluid and place reservoir onto housing in the normal position. Press down on reservoir until it seats onto housing; check position of stud and union seals.

19. Place a new "O" ring seal, lubricated with Power Steering Fluid, onto union and install union assembly and studs.

20. Install pump pulley by inserting tool J-25033 through pulley hub and threading the bolt into the power steering pulley shaft as shown in figure 3B-32.

**NOTE:** Pulley must be flush with end of shaft.

**CAUTION:** DO NOT hammer on pump shaft. Use special tools to prevent possible damage to internal pump components.

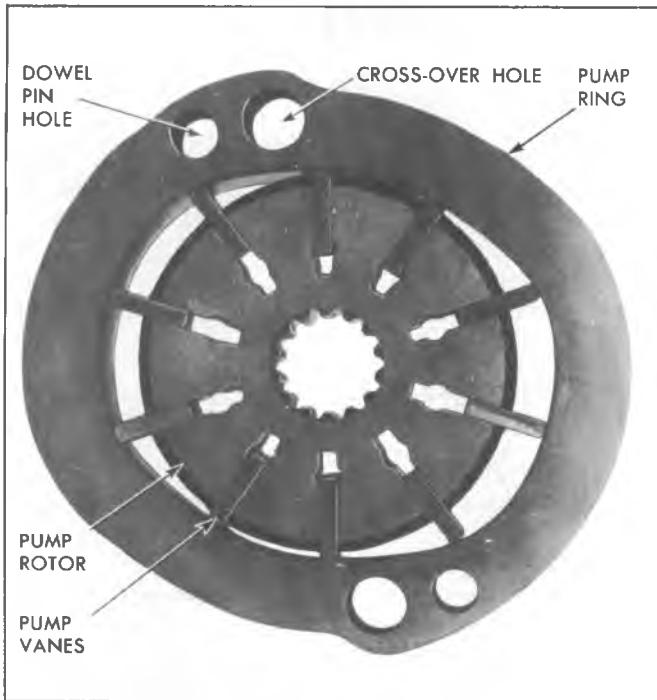


Fig. 3B-28--Correct Vane Assembly



Fig. 3B-30--Installing End Plate Retaining Ring



Fig. 3B-29--Installing Pressure Plate Spring



Fig. 3B-31--Installing Flow Control Valve

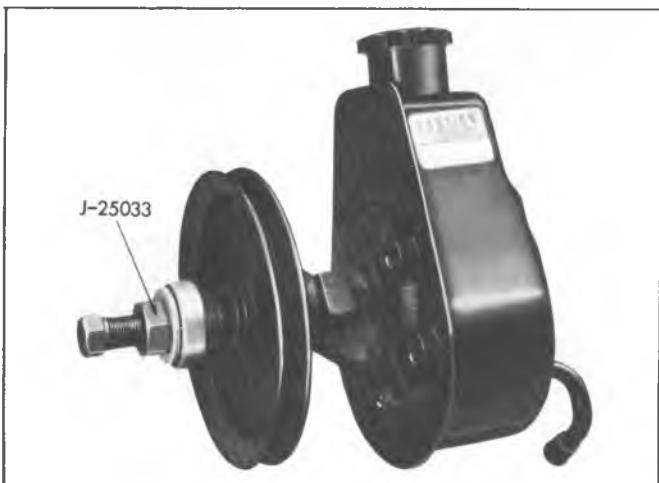


Fig. 3B-32--Power Steering Pump Pulley - Installation

# INTEGRAL POWER STEERING GEAR

## INDEX

Overhaul Operations .....	3B-12	Rack-Piston .....	3B-18
Disassembly .....	3B-12	Hose Connector Inverted Flares .....	3B-19
Overhauling Individual Units.....	3B-15	Pitman Shaft Needle Bearing and Seals.....	3B-19
Adjuster Plug Assembly .....	3B-15	Pitman Shaft Seal Removal .....	
Valve and Stub Shaft Assembly .....	3B-16	With Gear in Vehicle .....	3B-20
Pitman Shaft and Side Cover .....	3B-17	Gear Assembly .....	3B-20

## OVERHAUL OPERATIONS

**NOTE:** In the following text, Power Steering Fluid is noted for use in lubricating components upon reassembly.

**CAUTION:** If when overhauling a power steering gear or pump, broken components or foreign material are encountered, the remaining components of the entire hydraulic system should be disassembled, inspected, thoroughly cleaned and flushed before servicing is completed.

### Disassembly (Fig. 3B-33)

In many cases, complete disassembly of the gear will not be necessary since most of the components can be removed without complete disassembly.

**NOTE:** Disassembly of the major components within the gear must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

1. Rotate end cover retainer ring so that one end of the ring is over the hole in the side of the housing. Force the end of the ring from its groove and remove ring (fig. 3B-34).

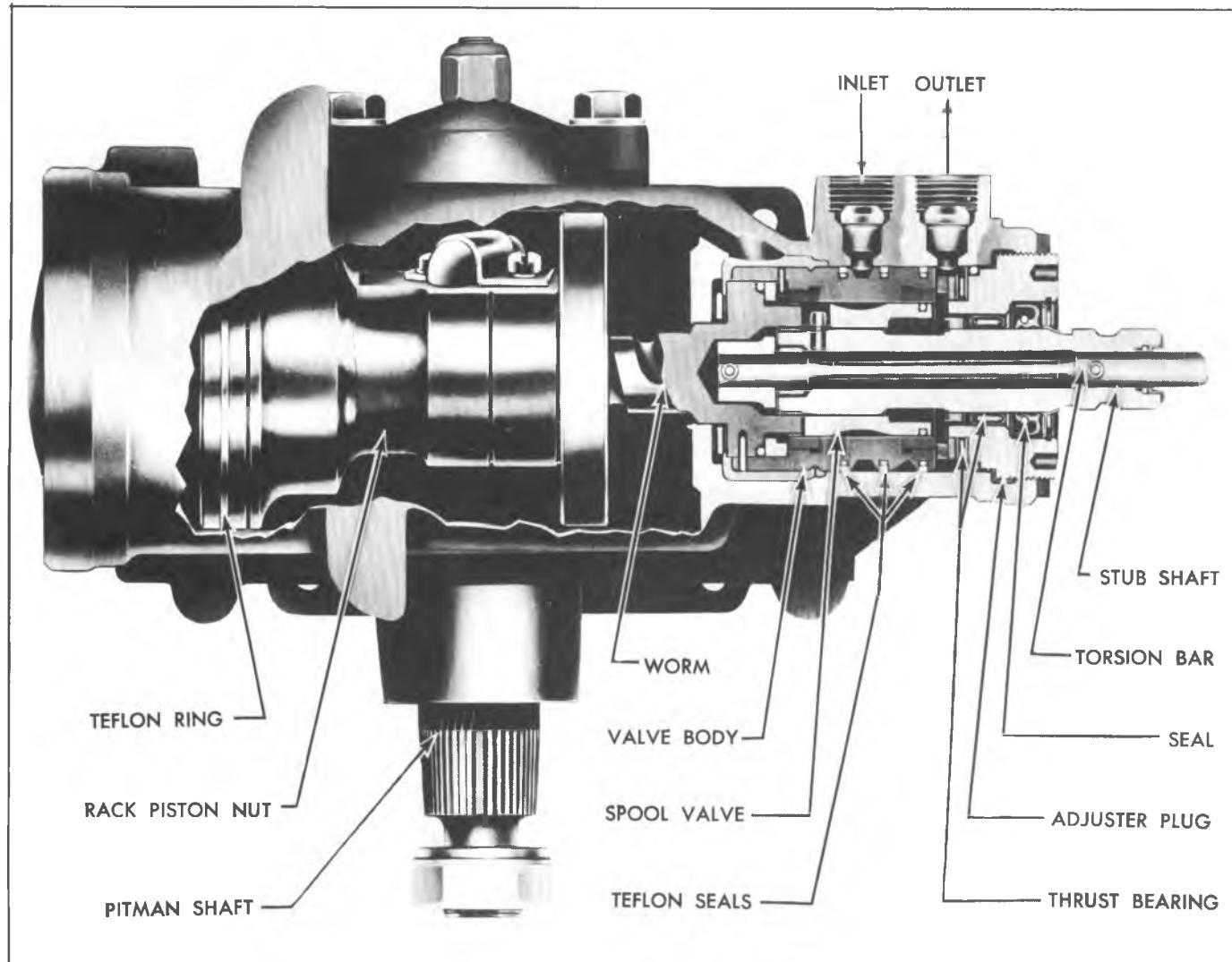


Fig. 3B-33—Power Steering Gear—Typical

2. Turn the stub shaft counter-clockwise until the rack-piston just forces end cover out of housing. Remove cover and discard "O" ring.

**CAUTION:** *DO NOT turn the stub shaft any further than absolutely necessary to remove the end plug, or balls from rack-piston and worm circuit may escape and lay loose inside the rack-piston chamber.*

3. Remove the rack-piston end plug as shown in Figure 3B-35.

**NOTE:** To aid in loosening end plug, strike end plug with a brass drift.

4. Remove the pitman shaft and side cover as follows:

- a. Loosen the over-center adjusting screw locknut and remove the 4 side cover attaching bolts and lock washers.
- b. Rotate the side cover until the rack-piston and pitman shaft teeth are visible, then turn the stub shaft until the pitman shaft teeth are centered in the housing opening. Tap the pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing. Remove the side cover "O" ring and discard.

5. Remove the rack-piston as follows:

- a. Insert Ball Retainer Tool J-7539 into the rack-piston bore with pilot of tool seated in the end of the worm (fig. 3B-37). Turn the stub shaft counter-clockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool.

- b. Remove the rack-piston with Ball Retainer Tool J-7539 from gear housing.

6. Remove the adjuster plug as follows:

- a. Loosen the adjuster plug locknut and remove.

- b. Remove adjuster plug assembly with Spanner Wrench J-7624 (fig. 3B-38). Remove and discard the plug "O" ring.

7. Grasp the stub shaft and pull the valve and shaft assembly from the housing bore. Separate worm and shaft and remove the stub shaft cap "O" ring and discard.

8. If the worm or the lower thrust bearing and race remained in the gear housing, remove them at this time.

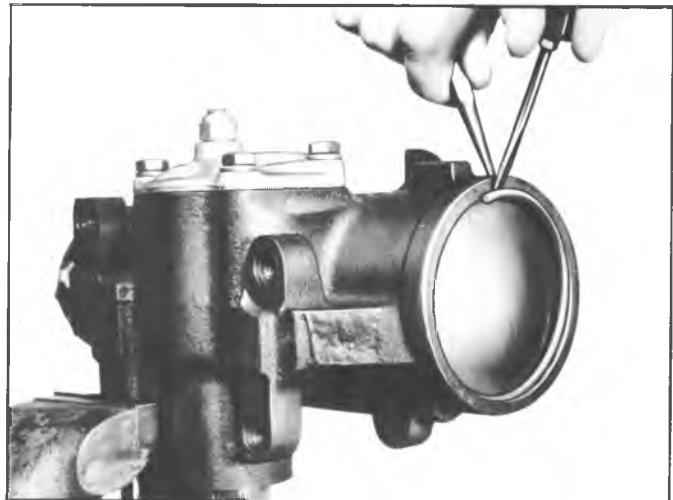


Fig. 3B-34--Removing End Cover Retaining Ring

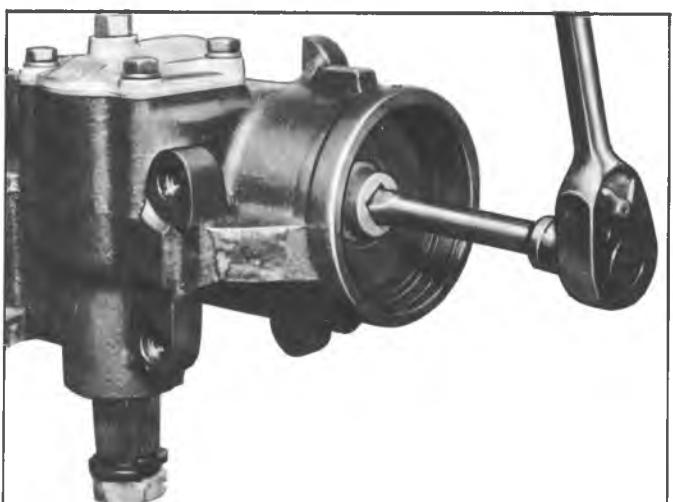


Fig. 3B-35--Removing End Plug

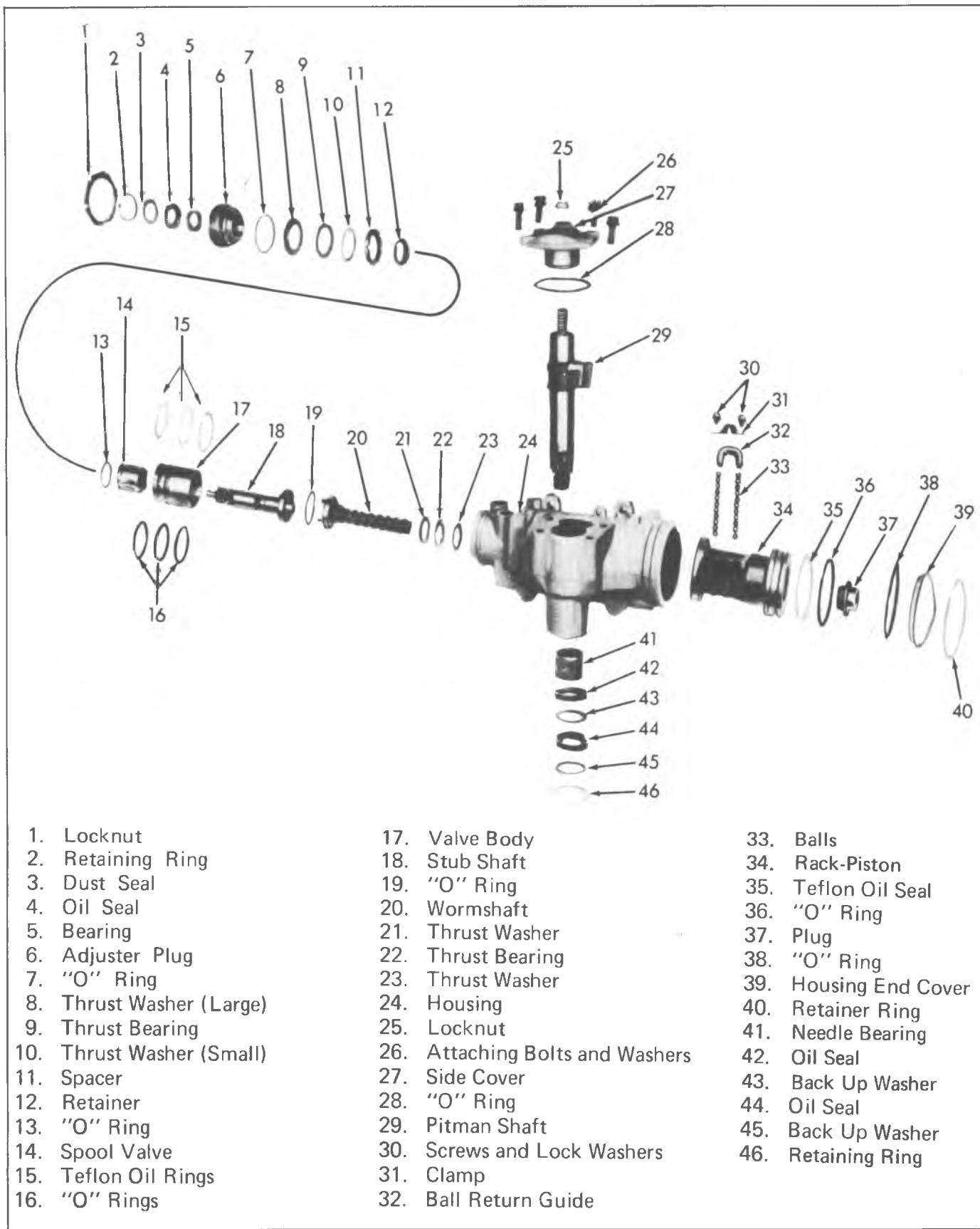


Fig. 3B-36—Power Steering Gear—Exploded View



Fig. 3B-37--Removing Rack-Piston

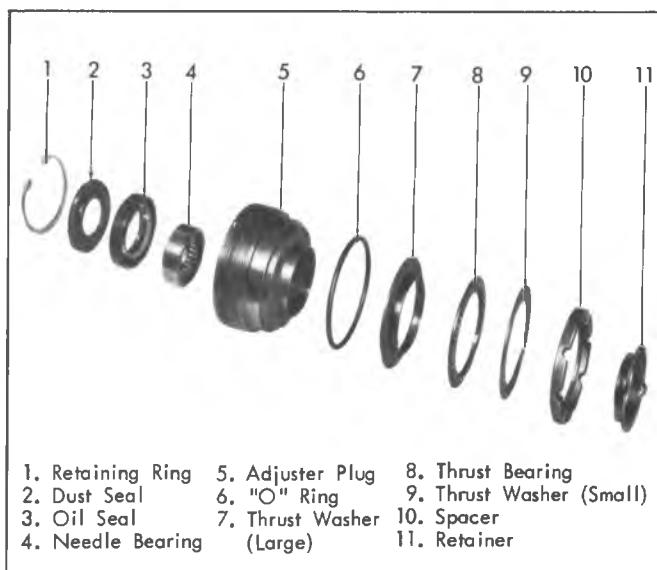


Fig. 3B-39--Adjuster Plug--Exploded View

## OVERHAULING INDIVIDUAL UNITS

### Adjuster Plug Assembly Disassembly

1. If the oil seal ONLY is to be replaced, and not the bearing, install the adjuster plug loosely in the gear housing. Remove the retaining ring with Internal Pliers J-4245. With a screw driver, pry the dust seal and oil seal from the bore of the adjuster plug being careful not to score the needle bearing bore (fig. 3B-39). Discard the oil seal.

2. If the thrust bearing ONLY is to be removed, pry the thrust bearing retainer at the two raised areas with a small screw driver (fig. 3B-40). Remove the spacer, thrust bearing race, thrust bearing and the flanged thrust bearing race.

3. If the needle bearing is to be replaced, remove the retaining ring using Internal Pliers J-4245. Remove thrust bearing as outlined in Step 2 above. Drive needle bearing, dust seal and oil seal from adjuster plug using Bearing Remover J-8524-2 and Driver J-7079-2 as shown in Figure 3B-41. Discard the oil seal.

4. Wash all parts in clean solvent and dry parts with

compressed air.

5. Inspect thrust bearing spacer for wear or cracks. Replace if damaged.

6. Inspect thrust bearing rollers and thrust races for wear, pitting or scoring. If any of these conditions exist, replace the bearing, thrust races, spacer and retainer.

### Assembly

**CAUTION:** Place a block of wood under the adjuster plug to protect the thrust bearing surface.

1. If the needle bearing was removed, place new needle bearing over Tool J-8524-1 and J-7079-2, with the bearing manufacturer's identification toward the tool, and drive the bearing into the adjuster plug until the tool bottoms in the housing (fig. 3B-42).

2. Place dust seal and a new oil seal on Tool J-8524-1 (lip of seal away from tool). Lubricate seal with Power Steering Fluid and drive or press seals into adjuster plug until seated (fig. 3B-43). When properly installed, the stub shaft seal under the dust seal and the inner dust seal lip is not

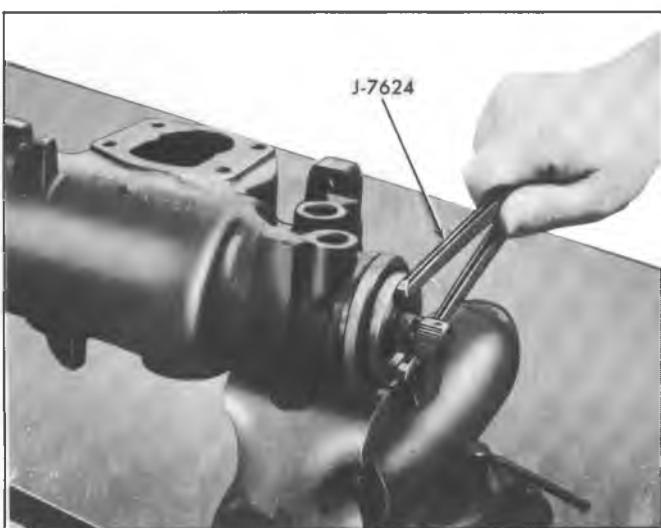


Fig. 3B-38--Removing Adjuster Plug

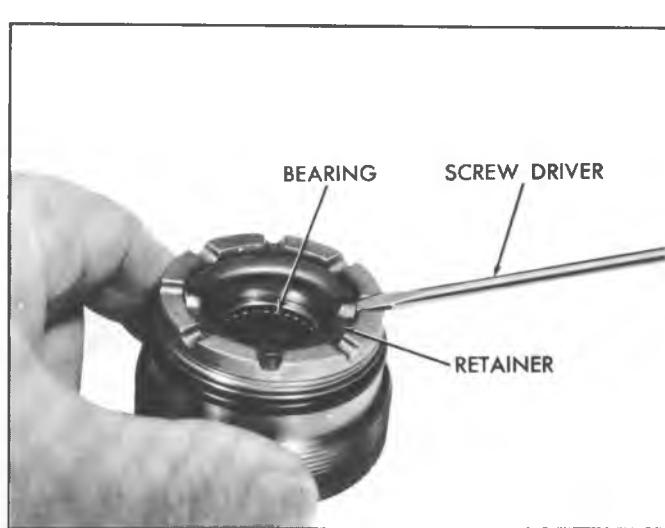


Fig. 3B-40--Removing Retainer

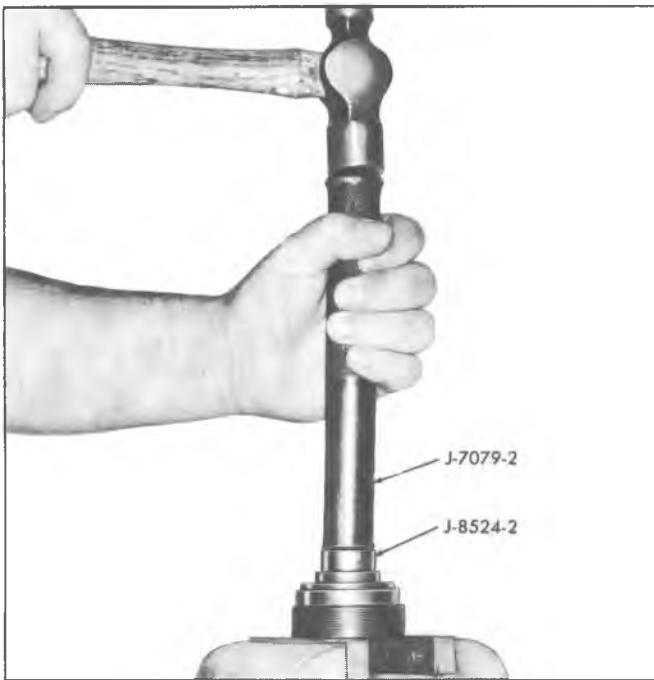


Fig. 3B-41--Removing Bearing and Seal

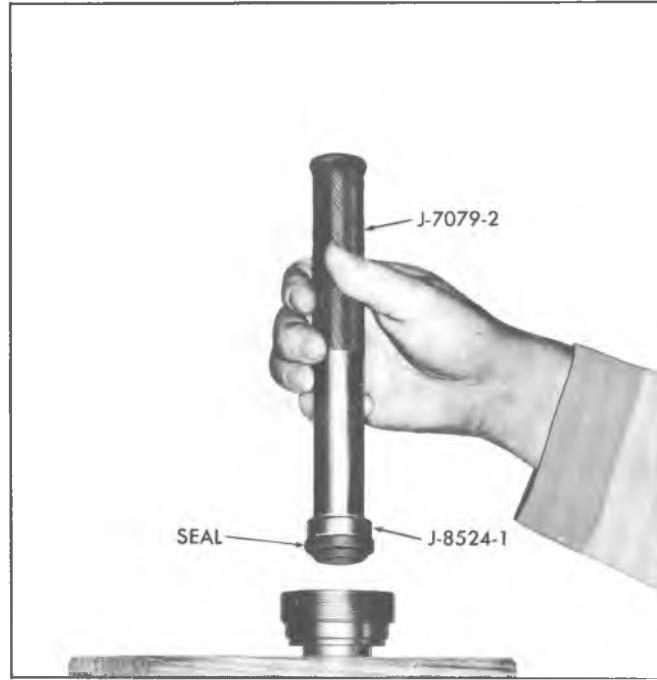


Fig. 3B-43--Installing Adjuster Plug Seal

bottomed on the stub shaft assembly.

3. Install retaining ring with Internal Pliers J-4245.
4. Lubricate the thrust bearing assembly with Power Steering Fluid. Place the flanged thrust bearing race on the adjuster plug hub, then install the thrust bearing, small bearing race (flanged side up) and spacer (grooves of spacer away from bearing).
5. Install a new bearing retainer on the adjuster plug by carefully tapping on the flat surface of the retainer (fig. 3B-44).

**NOTE:** The projections must not extend beyond the spacer when the retainer is sealed to prevent interference with the valve body. The spacer must be free to rotate.

### Valve and Stub Shaft Assembly Disassembly

1. Remove and discard the "O" ring in the shaft cap end of the valve assembly.
2. To remove the lower shaft assembly from the valve body, proceed as follows:
  - a. While holding the assembly (stub shaft down), lightly tap the stub shaft against the bench until the shaft cap is free from the valve body (fig. 3B-45).
  - b. Pull the shaft assembly out of the spool valve until the shaft cap clears the valve body approximately 1/4".
  - c. Carefully disengage the shaft pin from the valve spool and remove the shaft assembly (fig. 3B-45).

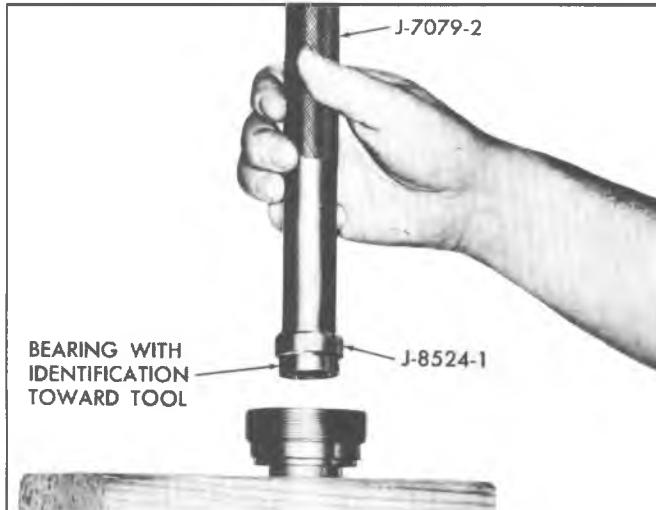


Fig. 3B-42--Installing Bearing



Fig. 3B-44--Installing Retainer

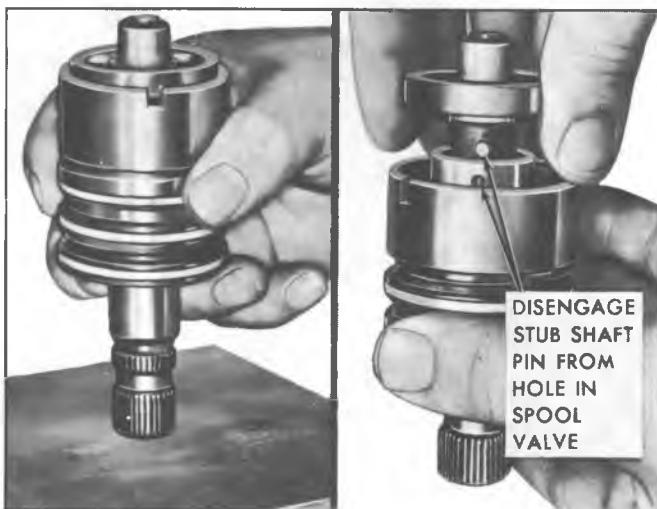


Fig. 3B-45--Removing Stub Shaft Assembly

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed, then carefully pull the spool from the valve body, while rotating the valve (fig. 3B-46). If the spool valve becomes cocked, carefully realign the spool valve, then remove.

4. Remove the dampener "O" ring from the spool valve and discard.

5. If the teflon oil rings are to be replaced, cut the 3 teflon oil rings and "O" rings from the valve body and discard.

#### Cleaning and Inspection

1. Wash all parts in clean solvent and blow out all oil holes with compressed air.

2. If the drive pin in the stub shaft or valve body is cracked, excessively worn or broken, replace the complete valve and shaft assembly.

3. If there is evidence of leakage between the torsion bar and the stub shaft, or scores, nicks, or burrs on the ground surface of the stub shaft that cannot be cleaned up with crocus cloth, the entire valve and shaft assembly must be replaced.

4. Check the outside diameter of the spool valve and the inside diameter of the valve body for nicks, burrs, or bad wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will

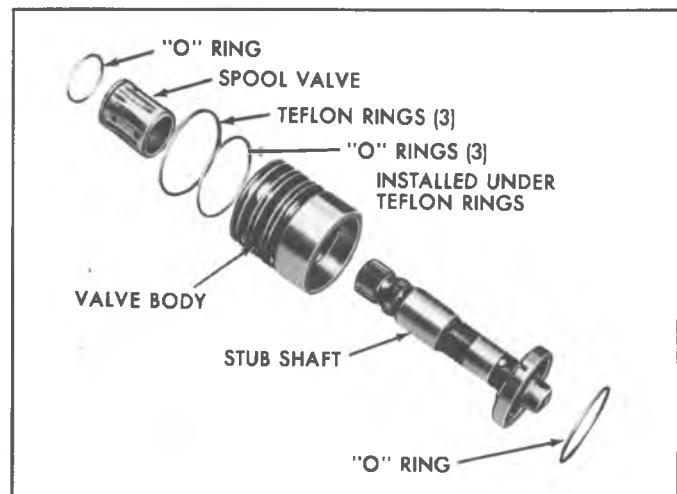


Fig. 3B-47--Valve Body and Shaft Assembly - Exploded

have to be replaced.

5. If the small notch in the skirt of the valve body is excessively worn, the complete valve and shaft assembly will have to be replaced.

6. Lubricate the spool valve with Power Steering Fluid and check the fit of the spool valve in the valve body (with the spool valve dampener "O" ring removed). If the valve does not rotate freely without binding, the complete valve and shaft assembly will have to be replaced.

#### Assembly (Fig. 3B-47)

1. If valve body "O" rings and teflon rings were removed, install new "O" rings in the oil ring grooves and lubricate with Power Steering Fluid.

2. Lubricate the 3 new teflon oil rings with Power Steering Fluid and install in grooves over "O" rings.

**NOTE:** The teflon rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.

3. Lubricate the spool valve dampener "O" ring with Power Steering Fluid and install over the spool valve.

4. Lubricate the spool valve and valve body with Power Steering Fluid and slide the spool valve into the valve body. Rotate the spool valve while pushing it into the valve body. Push the spool valve on through the valve body until the shaft pin hole is visible from the opposite end (spool valve flush with shaft cap end of valve body).

5. Lubricate the shaft assembly with Power Steering Fluid and carefully install it into the spool valve until the shaft pin can be placed into the hole in the spool valve.

6. Align the notch in the shaft cap with the pin in the valve body and press the spool valve and shaft assembly into the valve body (fig. 3B-48).

**CAUTION:** Make sure that the shaft cap notch is mated with the valve body pin before installing valve body into the gear assembly.

7. Lubricate a new "O" ring with Power Steering Fluid and install it in the shaft cap end of the valve body assembly.

#### Pitman Shaft and Side Cover Disassembly

Remove the locknut and unscrew the side cover from the adjusting screw. Do not attempt to disassemble pitman shaft. Discard locknut.



Fig. 3B-46--Removing Spool Valve

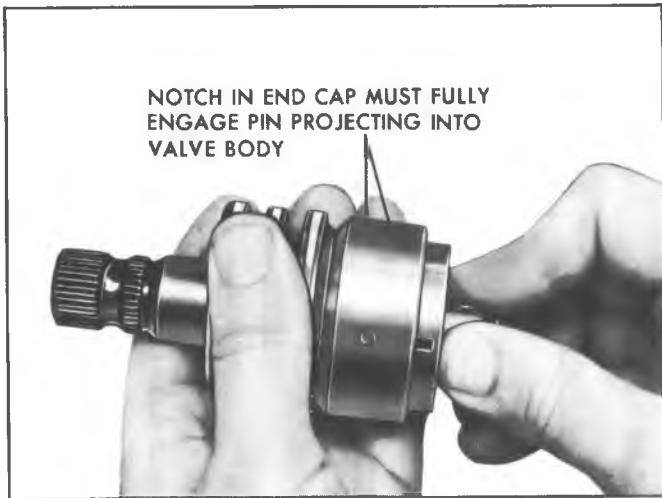


Fig. 3B-48--Installing Stub Shaft Assembly



Fig. 3B-49--Installing Ring on Rack-Piston

### Cleaning and Inspection

1. Wash all parts in clean solvent and dry parts with compressed air.
2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover.
3. Check the sealing and bearing surfaces of the pitman shaft for roughness, nicks, etc. If minor irregularities in surface cannot be cleaned by use of crocus cloth, replace the pitman shaft.
4. Replace pitman shaft assembly if teeth are damaged or if the bearing surfaces are pitted or scored.
5. Check pitman shaft lash adjusting screw. It must be free to turn with no perceptible end play. If adjusting screw is loose replace the pitman shaft assembly.

### Assembly

Thread the side cover onto the pitman shaft adjusting screw until it bottoms and then turn in one-half turn. Install a new adjusting screw locknut, but do not tighten.

### Rack-Piston

#### Disassembly

1. Remove tool J-7539 from the rack-piston.
2. Remove the ball return guide clamp, ball guide and balls.
3. If necessary to replace the teflon oil seal and "O" ring, remove at this time.

#### Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.
2. Inspect the worm and rack-piston grooves and all the balls for scoring. If either the worm or rack-piston needs replacing, both must be replaced as a matched assembly.
3. Inspect ball return guide halves, making sure that the ends where the balls enter and leave the guides are not damaged.
4. Inspect lower thrust bearing and washers for scores or excessive wear. Check bearing washers to make sure they are not flat but conical in shape to provide proper bearing preload adjustment when reinstalled in the steering gear. If any of these conditions are found, replace the thrust bearing and washers.
5. Inspect rack-piston teeth for scoring or excessive wear. Inspect the external ground surfaces for wear, scoring

or burrs.

### Assembly

1. If the teflon oil seal and "O" ring were removed, lubricate a new "O" ring and seal with Power Steering Fluid and install in groove on rack-piston. The teflon ring may be slightly loose after assembly, but will tighten up when subjected to the hot oil in the system (fig. 3B-49).
2. Slide the worm all the way into the rack-piston. It is not necessary to have the thrust bearing assembly on the worm at this time.
3. Turn the worm until the worm groove is aligned with the lower ball return guide hole (fig. 3B-50).
4. Lubricate the balls with Power Steering Fluid, then feed 17 balls into the rack-piston, while slowly rotating the worm counter-clockwise.
5. Alternately install 7 balls into the return guide and retain with chassis lubricant at each end of guide. Install the return guide assembly onto the rack-piston. Install the return guide clamp and tighten the 2 clamp screws to 10 ft. lbs.
6. Insert Bearing Retainer Tool J-7539 into the rack-

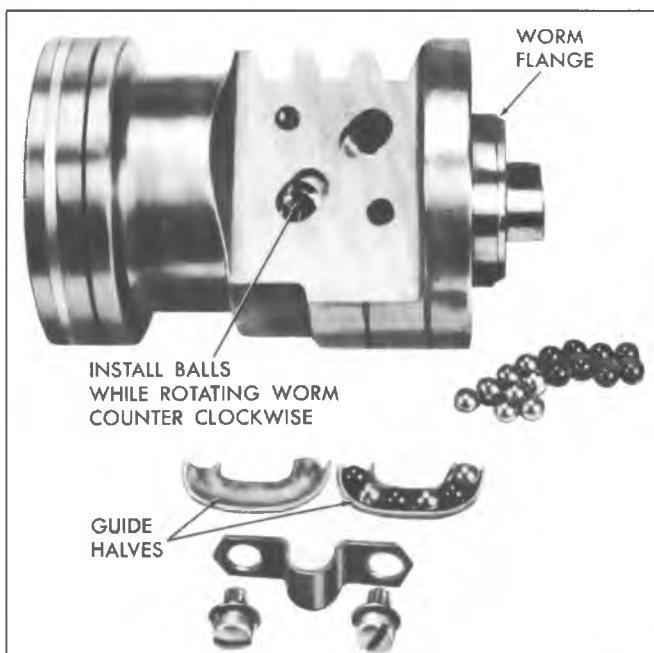


Fig. 3B-50--Installing Balls in Rack-Piston

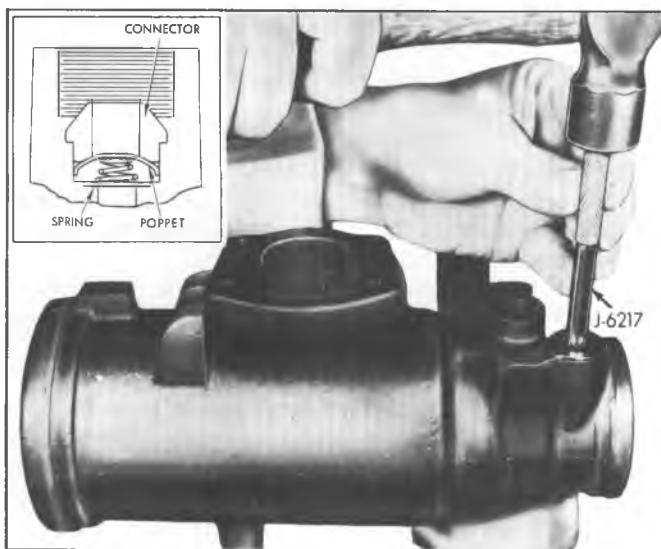


Fig. 3B-51--Installing New Connector in Housing

piston, then while holding tool tightly against end of worm, thread worm out of the rack-piston.

### Hose Connector Inverted Flares

If the brass inverted flare connectors show need of replacement, proceed as follows:

1. Tap threads into the center hole of the connector with a 5/16-18 tap.

**CAUTION:** Do not tap the threads too deep in the pressure hose connector seat as the tap will bottom the poppet valve against the housing and damage it. It is necessary to tap only two or three threads deep.

2. Thread a 5/16-18 bolt, with a nut and flat washer attached, into the tapped hole so that the washer rides against the face of the port boss and the nut rides against the washer.

3. Hold the bolt from rotating while turning the nut off of the bolt. This will force the washer against the bolt boss and will back out the bolt, drawing the connector from the housing. Discard the connector.

4. Clean the housing thoroughly to remove any tapping chips.

5. Drive the new connector against the housing seat using Tool J-6217, being careful not to damage either the connector or housing seat (fig. 3B-51).

### Pitman Shaft Needle Bearing and Seals

#### Removal

1. If pitman shaft seals ONLY are to be replaced, remove the seal retaining ring with Internal Pliers J-4245 and remove outer steel washer. Pry out the outer seal. Remove the inner steel washer, then pry out the inner seal (fig. 3B-52). Discard seals.

**CAUTION:** When prying out seals, be extremely careful not to score the housing bore.

2. If pitman shaft needle bearing replacement is necessary, remove with Tool J-6278. Since this bearing is shouldered, it must be pressed out the pitman shaft end of the housing.

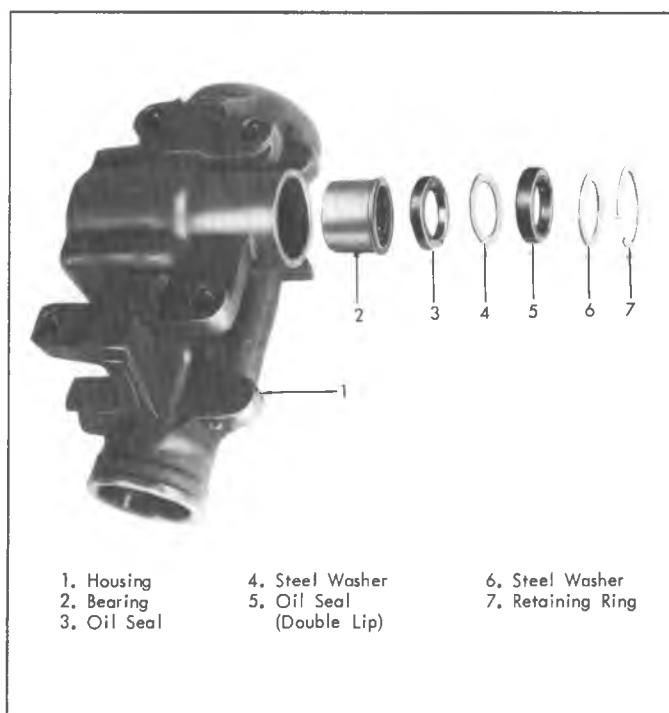


Fig. 3B-52--Pitman Shaft Bearing and Seals

#### Installation

1. If the pitman shaft needle bearing was removed, place bearing Installer Tool J-22407 onto Handle J-8092. Place needle bearing (shouldered end first) on to Tool J-22407. Press bearing into gear housing until Tool bottoms on housing. The bearing is now correctly positioned (fig. 3B-53).

**CAUTION:** Do not drive the bearing further into the housing after removing Tool J-22407, since damage to the bearing would result.

2. Lubricate the lips of the oil seals with Power Steering Fluid.

3. Install the pitman shaft oil seals as follows:

a. Place Adapter J-6278-2 over Tool J-6278, then install the outer seal (double lip), inner steel washer, and inner seal with the lips of the seals facing away from the adapter.

b. Drive the seals into the housing until the top of

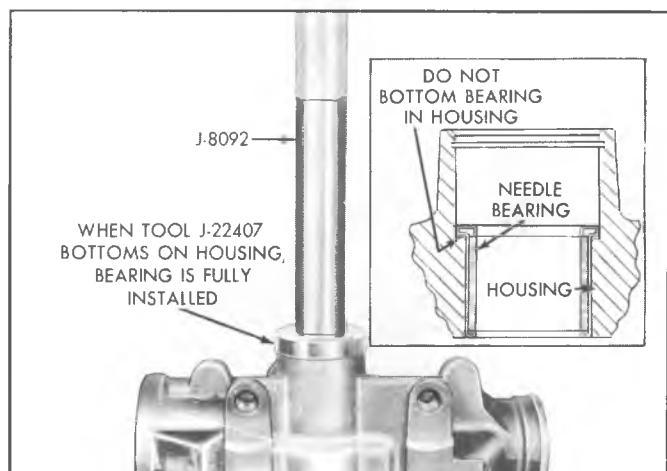


Fig. 3B-53--Installing Pitman Shaft Bearing

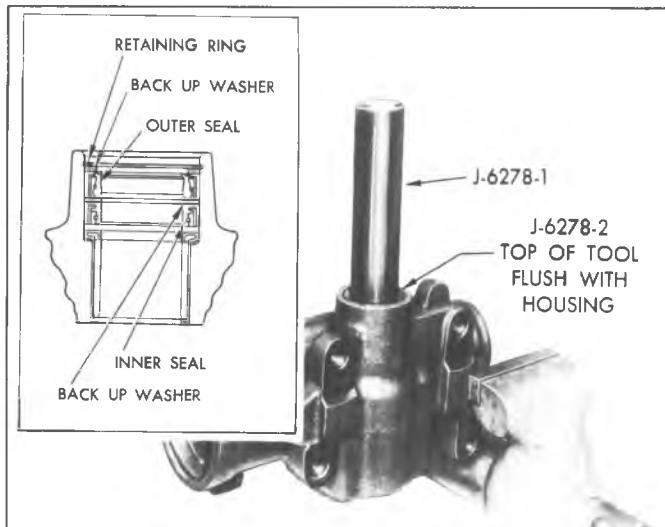


Fig. 3B-54--Installing Pitman Shaft Seals (On Bench)

Adapter J-6278-2 is flush with the housing (fig. 3B-54).

c. Remove the tool and adapter, then install the outer steel washer and seal retaining ring. The retaining ring will not seat in the groove at this time.

d. Reinsert Tool J-6278 with Adapter J-6278-2 and continue driving the seals until the retaining ring seats in its groove (Refer to Inset, Figure 3B-54), then remove the tool and adapter.

### Removal and Installation of Pitman Shaft Seals with Steering Gear in Vehicle (fig. 3B-55)

If upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may often be replaced without removing the gear assembly from the vehicle as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller J-6632.

**CAUTION:** Do not hammer on the end of Puller Tool J-6632.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

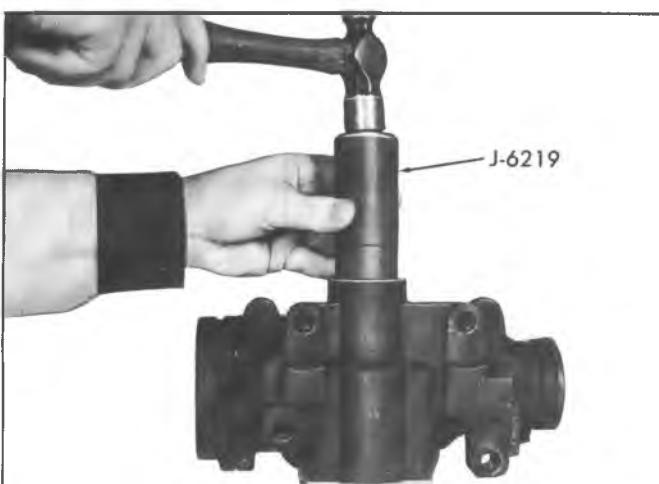


Fig. 3B-55--Installing Pitman Shaft Seals

**NOTE:** Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

**NOTE:** Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, turn off engine, remove the steering gear and remove the seals as outlined previously in this section.

5. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

6. Lubricate the seals thoroughly with Power Steering Fluid to install seals with Installer J-6219. Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the outer seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

7. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

8. Remove tape and reconnect pitman arm.

**CAUTION:** The pitman arm to steering gear nut is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

### GEAR ASSEMBLY

1. Lubricate the worm, lower thrust bearing and the two thrust washers with Power Steering Fluid, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm (fig. 3B-56).

2. Lubricate the valve body teflon rings and a new stub shaft cap "O" ring with Power Steering Fluid. Install the stub shaft cap "O" ring in the valve body so it is seated against the stub shaft cap. Align the NARROW NOTCH in the valve body with the pin in the worm, then install the valve and stub shaft assembly in the gear housing (fig. 3B-57). Apply pressure to the VALVE BODY when installing. If pressure is applied to the stub shaft during installation, the stub shaft may be forced out of the valve body (fig. 3B-58).

**NOTE:** The valve body is properly seated when the oil return hole in the housing is entirely uncovered (fig. 3B-59).

3. Lubricate a new adjuster plug "O" ring with Power Steering Fluid and install in groove on adjuster plug. Place Seal Protector J-6222 over the stub shaft, then install the adjuster plug assembly in the housing until it seats against the valve body (fig. 3B-60). Remove Seal Protector.

4. Adjust the thrust bearing preload as follows:

- a. Drain power steering fluid from gear by rotating the

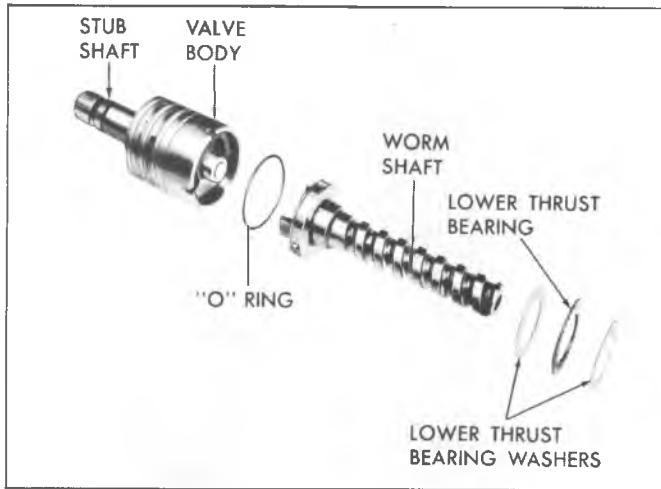


Fig. 3B-56--Worm and Valve Body--Exploded View



Fig. 3B-58--Installing Valve Body

stub shaft full travel in both directions several times.

b. Loosen and remove adjuster plug locknut (fig. 3B-61 and 3B-62).

c. Using spanner wrench J-7624, turn the adjuster plug in (clockwise) until the plug and thrust bearings are firmly bottomed, approximately 20 ft. lbs. (Fig. 3B-63).

d. Mark the housing even with one of the holes in the face of the adjuster plug (Fig. 3B-64).

e. Measure back (CCW direction) 1/2 inch (12.5mm) and place a second mark on the housing (fig. 3B-65).

f. Turn adjuster plug counterclockwise until the hole in the face of the adjuster plug, which was even with the first mark, is in line with second mark (fig. 3B-66).

g. Tighten lock nut securely. Hold (or have held) adjuster, plug to maintain alignment of hole with mark (fig. 3B-67).

##### 5. Install the rack-piston as follows:

a. Lubricate the rack-piston teflon seal with Power Steering Fluid.

b. Position Seal Compressor J-8947 (Passenger Cars) J-7576 (Trucks) against the shoulder in the housing.

c. With Ball Retainer J-7539 in place in the rack-piston,

push the rack-piston (with teeth toward pitman shaft opening), into the housing until Tool J-7539 contacts the center of worm (fig. 3B-68).

d. Turn the stub shaft clockwise with a 3/4" twelve point deep socket or box end wrench to thread the rack-piston onto the worm while holding Tool J-7539 against the end of the worm.

e. When the rack-piston is completely threaded on the worm, remove Ball Retainer J-7539 and Seal Compressor J-8947 (Cars) or J-7576 (Trucks).

6. Install the pitman shaft and side cover as follows:

a. Install a new "O" ring in the pitman shaft side cover and retain with chassis lubricant.

b. Turn the stub shaft until the rack-piston teeth are centered in the pitman shaft opening, then install the pitman shaft and side cover so that the center tooth of the pitman shaft engages the center groove of the rack-piston.

c. Install the side cover bolts and lock washers and tighten to 30 ft. lbs.

7. Install the rack-piston plug in the rack-piston and torque to 75 ft. lbs.



Fig. 3B-57--Valve to Worm Alignment



Fig. 3B-59--Valve Body Position in Housing

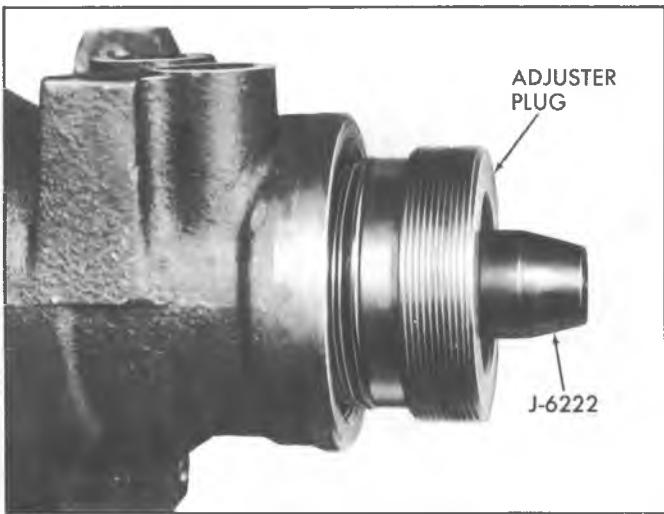


Fig. 3B-60--Installing Adjuster Plug

8. Install a new housing end cover "O" ring and lubricate it with Power Steering Fluid. Install the end cover and retaining ring.

9. Adjust the over-center preload (Fig. 3B-69) as follows:

a. Make sure the over-center adjusting screw is backed all the way out and then turned back in one-half turn.

b. Install an inch-lb. torque wrench with a 3/4", 12-point socket on the stub shaft splines.

c. Rotate the stub shaft from one stop to the other. Count the number of turns and locate the center of travel, then check the combined seal drag and thrust bearing preload by rotating the torque wrench through the center of travel. Note

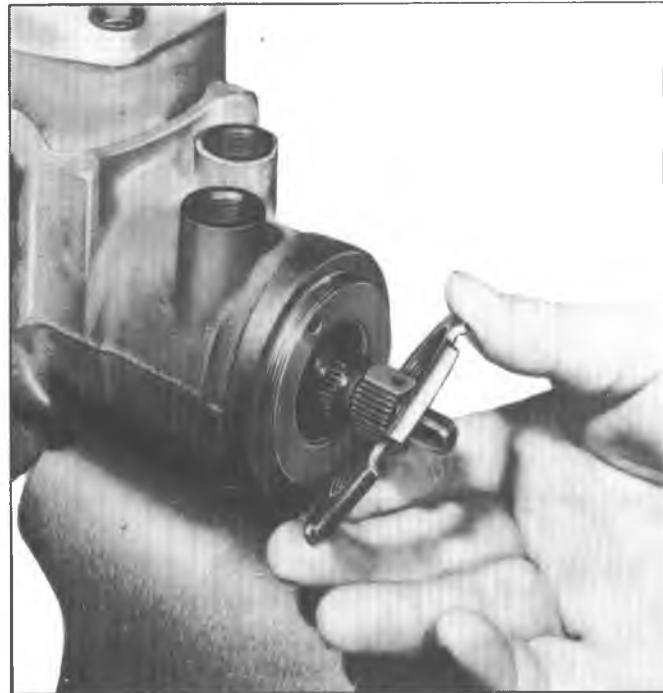


Fig. 3B-62--Removing Lock Nut

the highest reading.

d. Tighten the pitman shaft over-center adjusting screw until the torque wrench reads 4-8 in. lbs. higher than the reading noted in Step c. The total reading should not exceed 14 in. lb. for a used (400 mi. or more) gear.

e. While holding the adjusting screw, tighten the locknut to 35 ft. lbs. using Adapter J-5860 (fig. 3B-70) and recheck the adjustment.

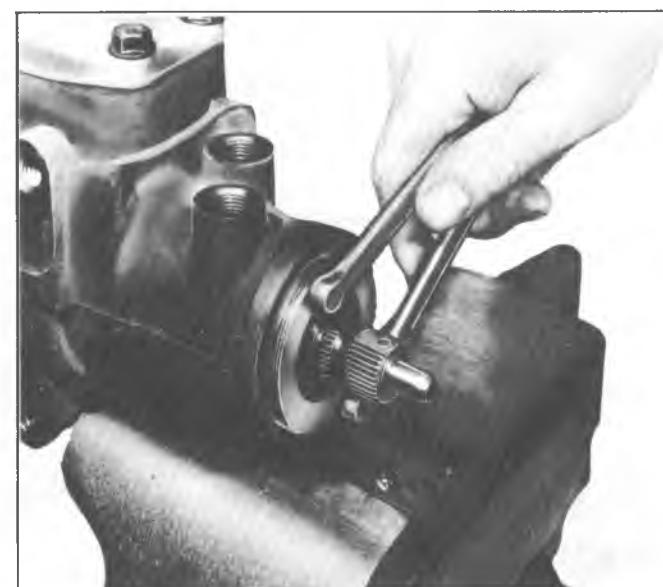


Fig. 3B-63--Bottoming Adjuster Plug



Fig. 3B-61--Loosening Lock Nut



Fig. 3B-64--Marking Housing



Fig. 3B-66--Align Hole With Second Mark



Fig. 3B-65--Measure Back and Remark Housing



Fig. 3B-67--Tighten Lock Nut

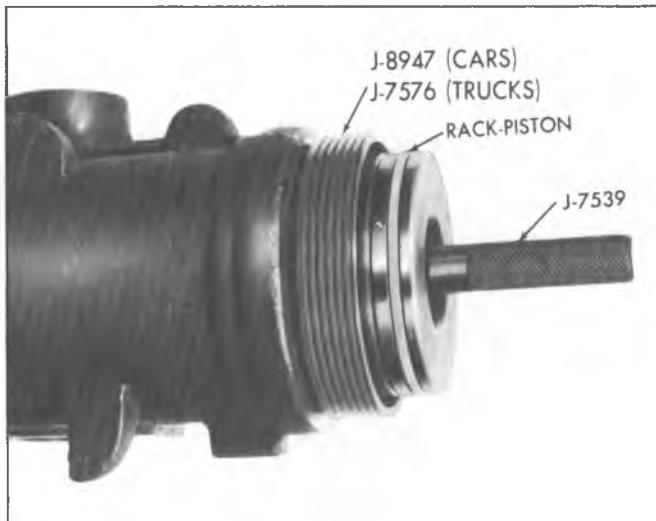


Fig. 3B-68--Installing Rack Piston

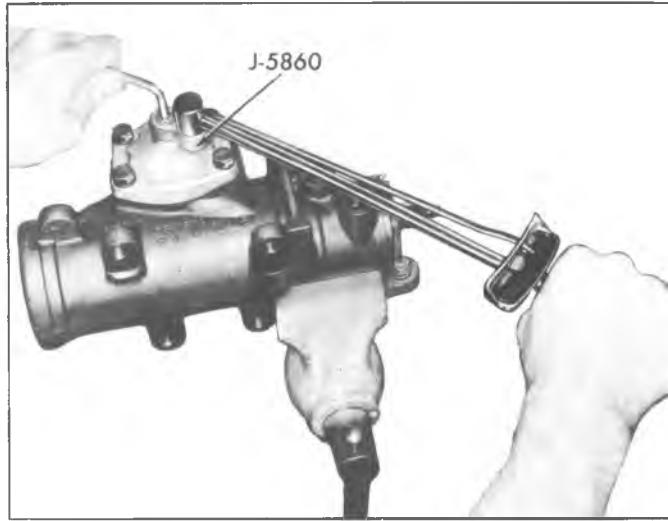


Fig. 3B-70--Torquing Over-Center Locknut

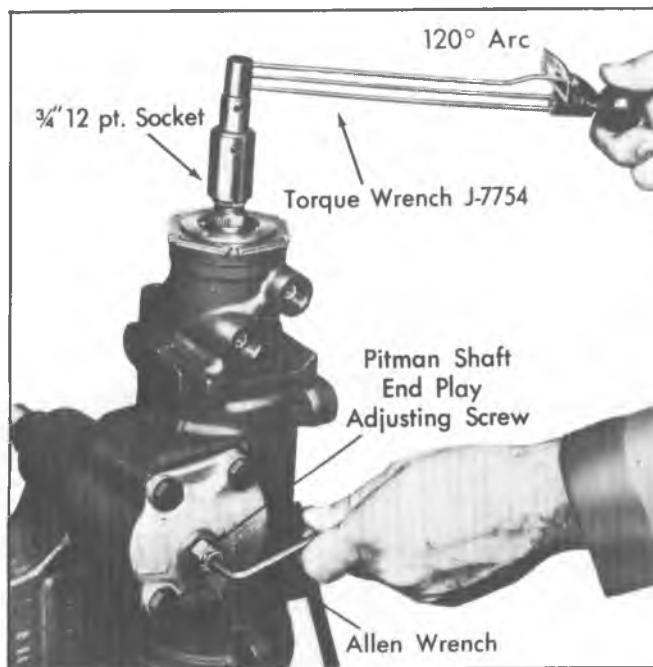


Fig. 3B-69--Adjusting Over Center Preload

## CONTROL VALVE--CORVETTE INDEX

Overhaul Operations.....	3B-25
Disassembly.....	3B-25
Inspection.....	3B-25
Repairs .....	3B-25
Assembly .....	3B-25
Valve Balancing.....	3B-26

## OVERHAUL OPERATIONS

### Disassembly

1. Place the valve in a vise as shown and remove dust cover (fig. 3B-71).
2. Remove adjusting nut (fig. 3B-72).
3. Remove valve to adapter bolts and remove valve housing and spool from adapter.
4. Remove spool from the housing (fig. 3B-73).
5. Remove spring, reaction spool, washer reaction spring, spring retainer, and seal (fig. 3B-74). "O" ring may now be removed from the reaction spool.
6. Remove the annulus spacer valve shaft washer and plug to sleeve key (See Figure 3B-75).
7. Remove clamp by removing nut, bolt and spacer or, if crimped type clamp is used, straighten clamp end and pull clamp and seal off end of stud (fig. 3B-76).
8. Carefully, so as not to nick the top surface, turn adjuster plug out of sleeve (fig. 3B-77).
9. Remove the adapter from the vise and invert, permitting the spring and one of the two ball seats to fall free.
10. Remove the ball stud and the other ball seat and the sleeve will fall free.

### Inspection

1. Wash all metal parts in nontoxic solvent and blow dry with compressed air.
2. Inspect all parts for scratches, burrs, distortion, evidence of wear and replace all worn or damaged parts, including mating parts when necessary.
3. Replace all seals, gaskets, covers with approved service parts.

### Repairs

**NOTE:** The Corvette valve incorporates a 40 lb. centering spring. The Corvette valve incorporating this spring is identified by an "C" stamped on the dust cover. In case a connector seat becomes damaged, proceed as follows:

To remove connector seat, tap threads in center hole using a 5/16-18 tap. Thread a bolt with nut and flat washer attached into tapped hole so that the washer rides against the face of the port boss and the nut rides against the washer.

Hold the bolt from rotating while turning the nut off the bolt. This will force the washer against the port boss face and will back out the bolt thus drawing the connector seat from the top cover housing (fig. 3B-78). Discard the connector seat. Clean the housing out thoroughly to remove any tapping chips.

Drive new connector seat against housing seat, using Tool J-6217, being careful not to damage either the connector seat or the housing seat (fig. 3B-79).

### Assembly (Fig. 3B-81)

1. Replace the sleeve and ball seat in the adapter, then the ball stud, and finally the other ball seat and the spring, small coil down.
2. Clamp the adapter in vise, put the shaft through the seat in the adjuster plug and screw adjuster plug in sleeve (fig. 3B-80).
3. Turn the plug in until it is tight, then back it off until the slot lines up with notches in the sleeve.
4. Install new seal and clamp over stud so lips on seal mate with clamp. (A nut and bolt attachment type clamp replaces the crimped type for service fig. 3B-76).
5. Center the ball stud, seal and clamp at opening in adapter housing, then install spacer, bolt and nut.
6. Insert the key, making sure that the small tangs on the ends of the key fit into the notches in the sleeve (fig. 3B-82).
7. Install the valve shaft washer, annulus spacer, and the reaction seal (lip up), spring retainer, reaction spring and spool, washer and adjustment spring. (Install "O" ring seal on reaction spool before installing spool on shaft.) Install the washer with the chamfer "up".
8. Install the seal on the valve spool (lip down), then install spool in housing being careful not to jam spool in housing.
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.
10. Depress the valve spool and turn the locknut onto the shaft about four turns with a clean wrench or socket.



Fig. 3B-71--Dust Cap Removal



Fig. 3B-72--Removing Adjusting Nut



Fig. 3B-73--Removing Spool from Housing

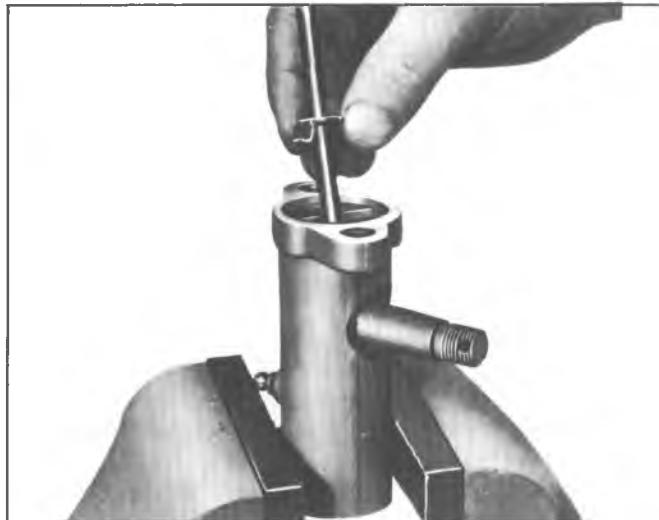


Fig. 3B-75--Removing Plug-to-Sleeve Key

**NOTE:** Always use a new nut.

#### Valve Balancing (Fig. 3B-83)

The control valve must be adjusted, after being disassembled, as outlined in the following procedure. The same procedure may be followed to correct a complaint of harder steering effort required in one direction than the other. See Figure 3B-83.

1. Install valve in vehicle. Connect all hoses and fill the pump reservoir with oil. Do not connect the piston rod to the frame bracket. If the vehicle is already in operation, it will be necessary to detach the piston rod from the frame bracket.

2. With the car on a hoist, start the engine. One of the following two conditions will exist.

- a. If the piston rod remains retracted, turn the adjusting nut clockwise until the rod begins to move out. Then turn the nut counter-clockwise until the rod just begins to move in. Now turn the nut clockwise to exactly one-half the rotation needed to change the direction of the piston rod movement.

- b. If the rod extends upon starting the pump, move the nut counter-clockwise until the rod begins to move in. Now position the nut exactly one-half the rotation needed to change the direction of the piston rod movement.

**CAUTION:** *Do not turn the nut back and forth more than is absolutely necessary to balance the valve.*

3. With the valve balanced it should be possible to move the rod in and out manually.

4. Turn off the engine and connect the cylinder rod to the frame bracket.

5. Restart the engine. If the front wheels (still on the hoist) do not turn in either direction from center, the valve has been properly balanced. Correct the valve adjustment if necessary.

6. When the valve is properly adjusted, grease end of valve and install dust cap.

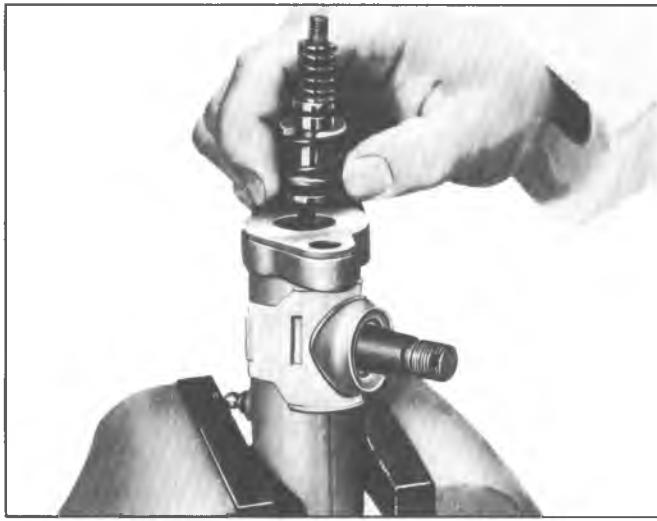


Fig. 3B-74--Removing Valve Parts from Shaft

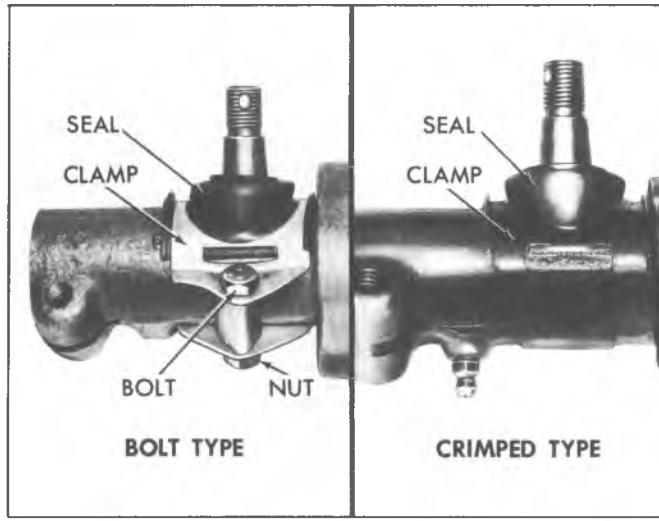


Fig. 3B-76--Seal with Clamp Attachment

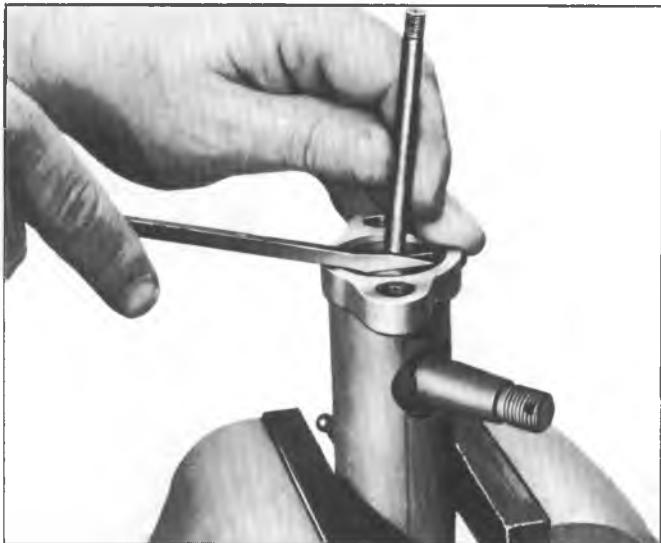


Fig. 3B-77--Turning Adjuster Plug out of Sleeve

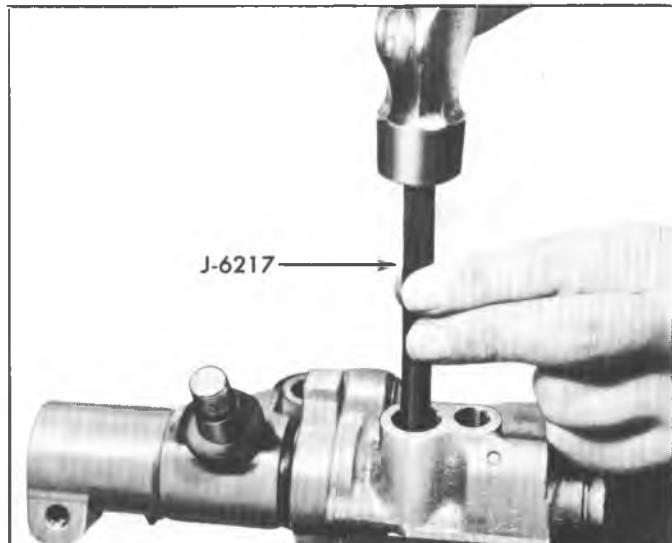


Fig. 3B-79--Installing Connector Seat

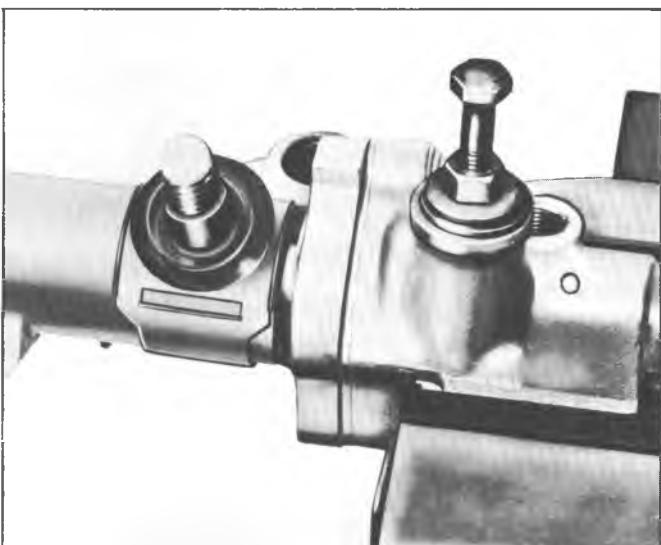


Fig. 3B-78--Removing Connector Seat



Fig. 3B-80--Replacing Adjuster Plug and Shaft

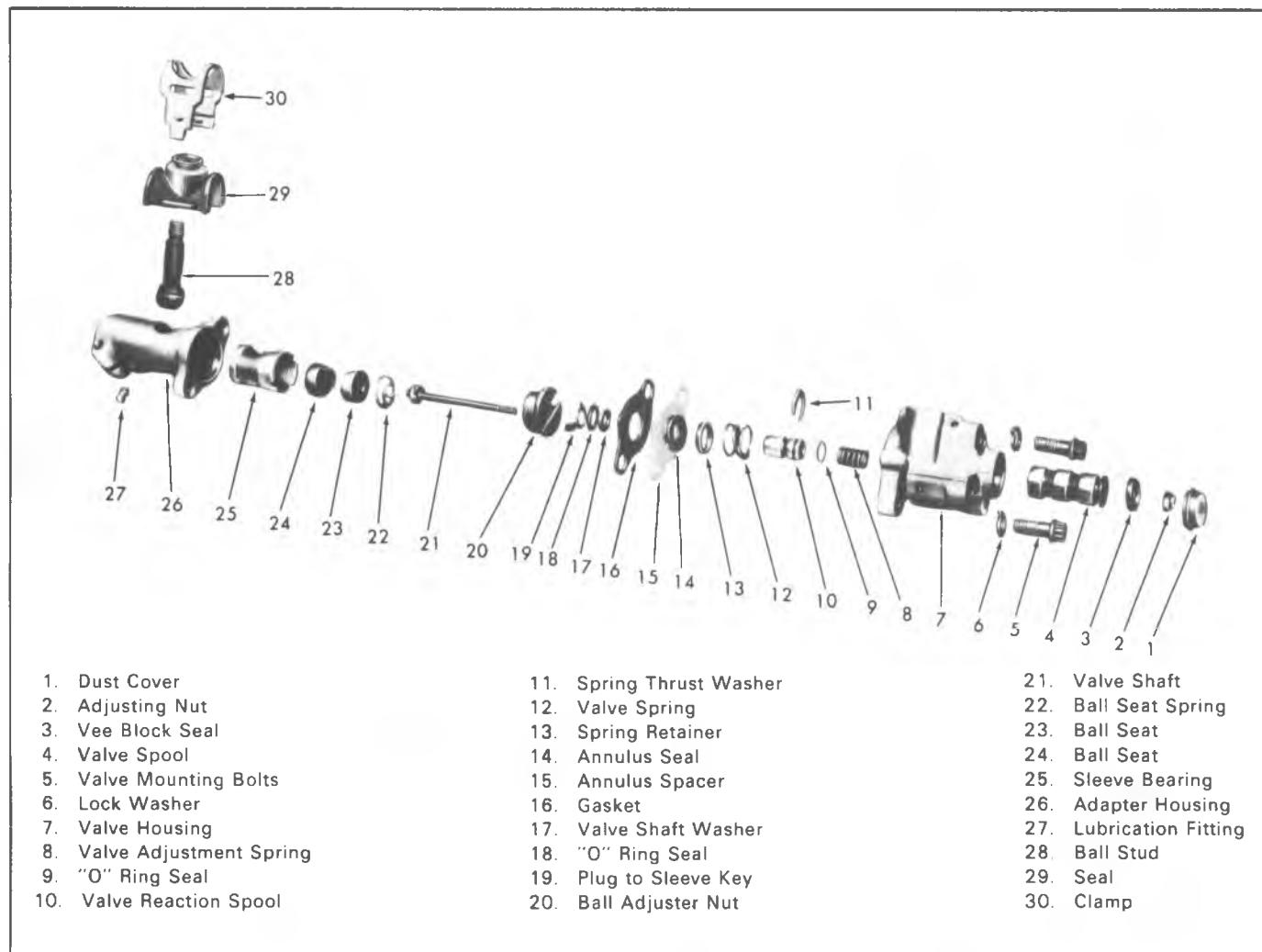


Fig. 3B-81--Power Steering Control Valve and Adapter--Exploded

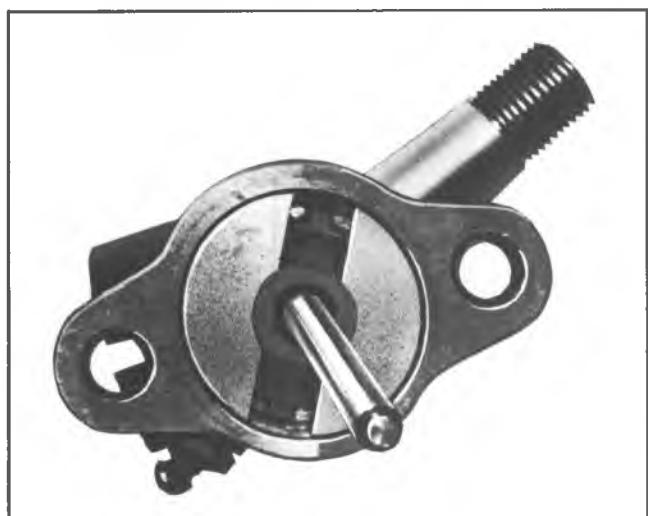


Fig. 3B-82--Proper Key Installation

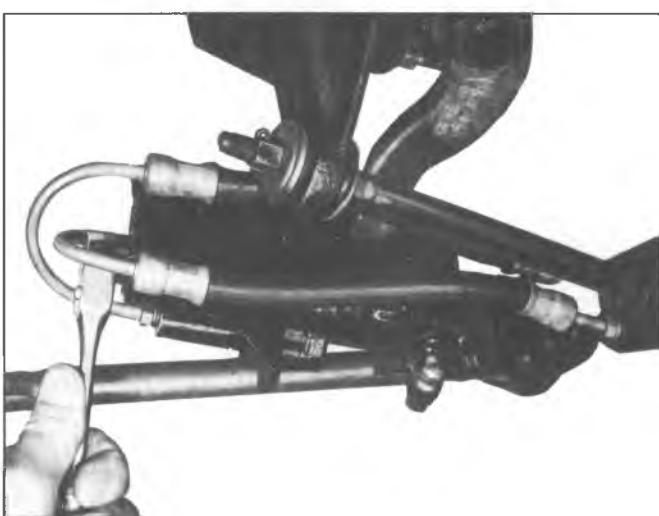


Fig. 3B-83--Balancing Valve

## POWER CYLINDER-CORVETTE OVERHAUL OPERATIONS

### Disassembly (Fig. 3B-84)

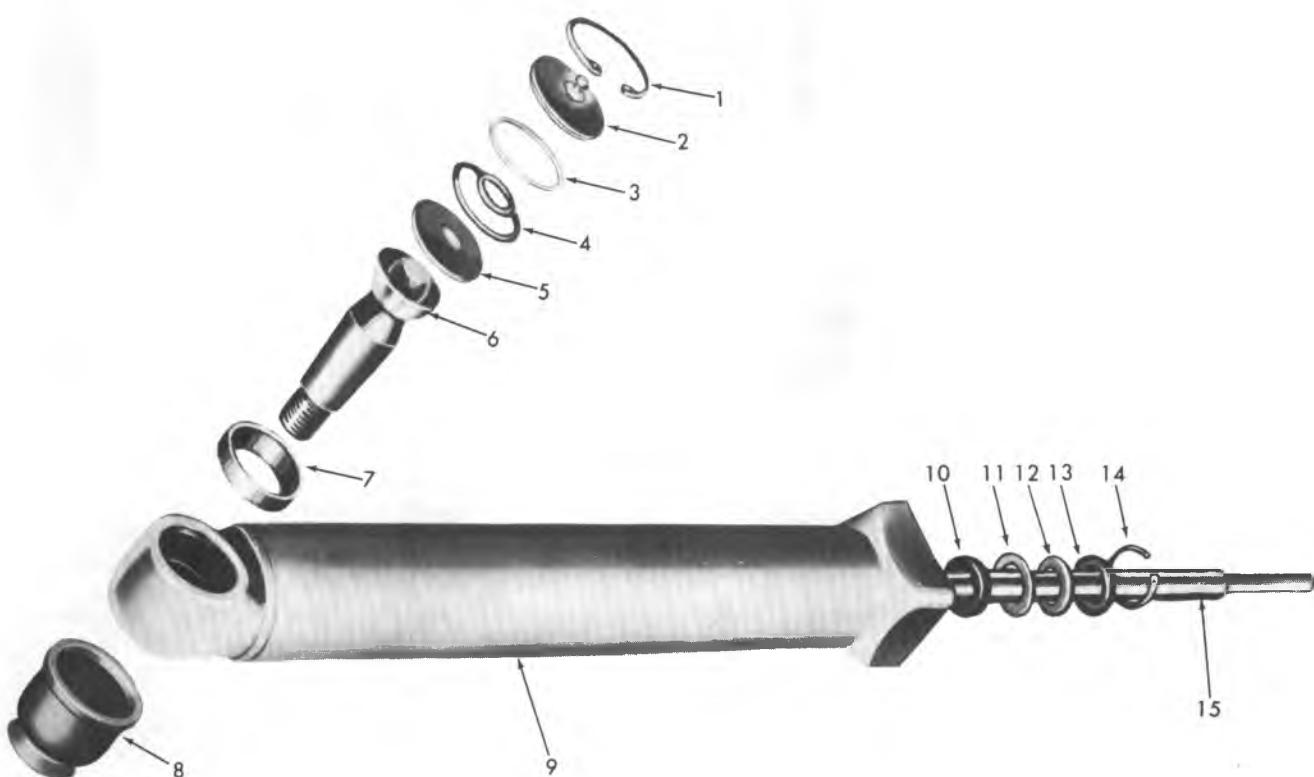
1. To remove the piston rod seal, remove the snap ring; then pull out on rod, being careful not to spray oil.
2. Remove the piston rod scraper and scraper element, back up washer and piston rod seal from the rod.
3. At the ball stud end of the cylinder, remove the ball stud seal.
4. Remove the snap ring retaining the end plug and lube fitting.
5. Push on the end of the ball stud and remove the end plug, spring, spring seat and ball stud.
6. Remove the "O" ring seal from the top lip of the power cylinder ball stud opening.
7. If the ball seat is to be replaced, it must be pressed

out using Tool J-8937.

### Assembly

1. Reassemble the piston rod seal components by reversing the disassembly procedure. Apply power steering fluid on the inner surfaces of the seal and scraper before assembly.
2. Reverse the disassembly procedure when reassembling the ball stud.
3. In each case be sure that the snap ring is securely seated in the ring groove.

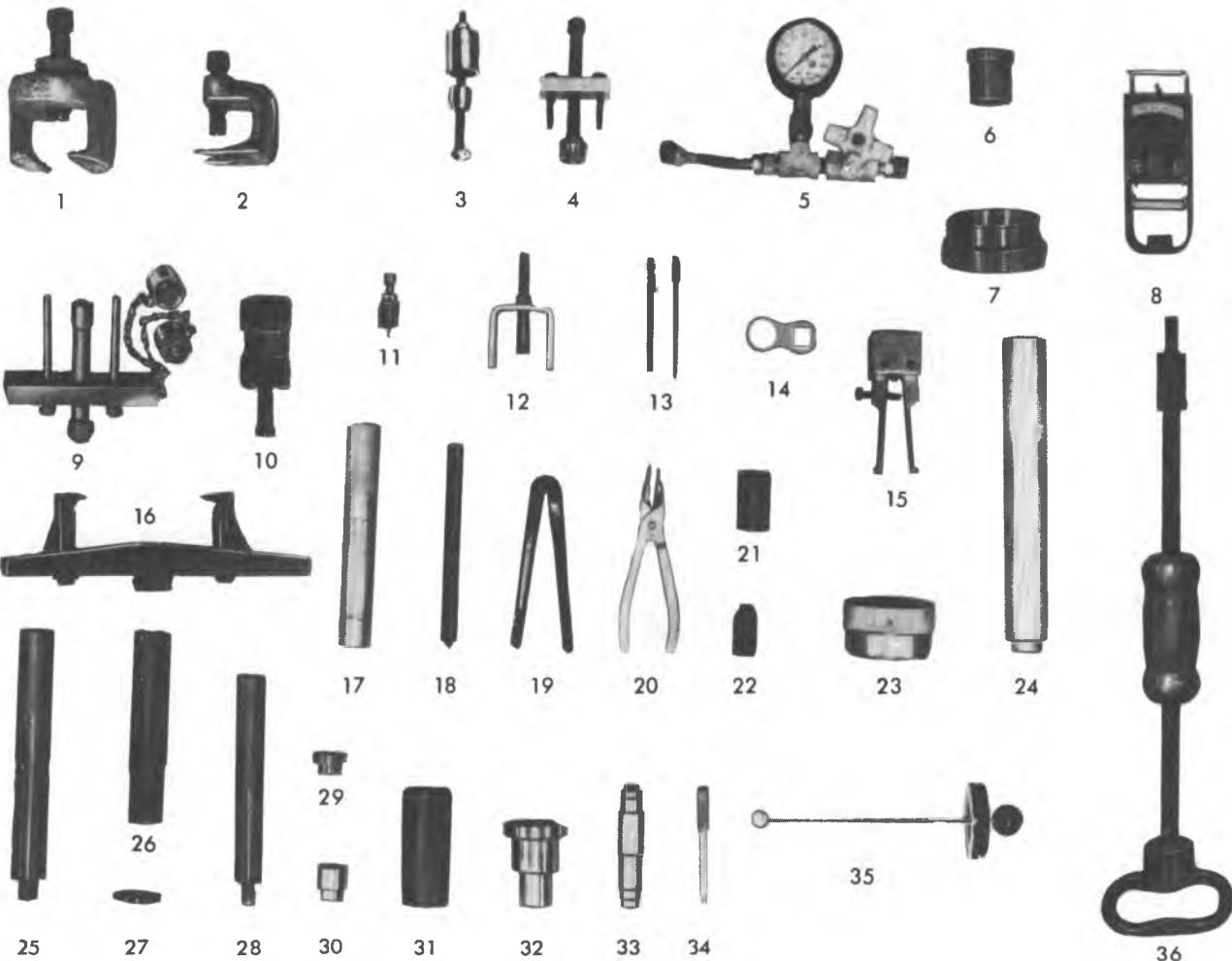
**NOTE:** Be sure to use new seals and "O" rings when re-assembling cylinder.



- |                              |                     |                        |
|------------------------------|---------------------|------------------------|
| 1. Snap Ring                 | 6. Ball Stud        | 11. Backup Washer      |
| 2. End Plug and Lube Fitting | 7. Ball Seat        | 12. Scraper Element    |
| 3. "O" Ring                  | 8. Ball Stud Seal   | 13. Piston Rod Scraper |
| 4. Spring                    | 9. Piston Body      | 14. Snap Ring          |
| 5. Spring Seat               | 10. Piston Rod Seal | 15. Piston Rod         |

Fig. 3B-84—Power Steering Power Cylinder Exploded

## SPECIAL TOOLS



- |             |   |              |                                     |
|-------------|---|--------------|-------------------------------------|
| 1. J-6632   | Pitman Arm Puller                       | 18. J-7539   | Ball Retainer                       |
| 2. J-5504   | Pitman Arm Puller                       | 19. J-7624   | Spanner Wrench                      |
| 3. J-23073  | Shift Tube Installer                    | 20. J-4245   | No. 23 Internal Pliers              |
| 4. J-23072  | Shift Tube Remover                      | 21. J-22670  | Pump Shaft Seal Installer           |
| 5. J-5176   | Oil Pressure Gauge                      | 22. J-6222   | Shaft Seal Protector                |
| 6. J-9226   | Pitman Shaft Bushing Replacer (Truck)   | 23. J-8947   | Rack-Piston Seal Compressor         |
| 7. J-7576   | Rack-Piston Seal Compressor (Truck)     | 24. J-5755   | Wormshaft Bearing Race<br>Installer |
| 8. J-23600  | Belt Tension Gauge                      | 25. J-8092   | Handle                              |
| 9. J-2927   | Steering Wheel Puller                   | 26. J-6278   | Pitman Shaft Bearing Remover        |
| 10. J-21239 | Pump Pulley Remover (Stamped<br>Pulley) | 27. J-6278-2 | Pitman Shaft Seal Installer         |
| 11. J-21854 | Column Pivot Pin Remover                | 28. J-7979-2 | Handle                              |
| 12. J-23653 | Lock Plate Compressor                   | 29. J-8524-1 | Adjuster Plug Bearing Installer     |
| 13. J-5421  | Thermometer                             | 30. J-8524-2 | Adjuster Plug Bearing Remover       |
| 14. J-5860  | Torque Wrench Adapter                   | 31. J-6219   | Pitman Shaft Seal Installer         |
| 15. J-5822  | Wormshaft Bearing Race<br>Remover       | 32. J-22407  | Pitman Shaft Bearing Installer      |
| 16. J-8433  | Pump Pulley Remover (Cast<br>Pulley)    | 33. J-6217   | Connector Seat Installer            |
| 17. J-1614  | Pitman Shaft Bushing Remover            | 35.          | Torque Wrenches                     |
|             |   | 36. J-2619   | Slide Hammer                        |

Fig. 3B-85--Manual and Power Steering Special Tools

## SECTION 4B

# REAR AXLE DIFFERENTIAL CARRIER

### CONTENTS OF THIS SECTION

General Information .....	4B-1	Limited Slip Units .....	4B-37
Alternate Pinion Setting Depth Setting Procedure .....	4B-1	Truck - Chevrolet 10-1/2" Ring Gear .....	4B-46
7-1/2", 8-1/2 and 8-3/4" Ring Gear.....	4B-2	Truck - Dana 10-1/2" and 9-3/4" Ring Gear.....	4B-54
Truck 8-7/8 Ring Gear .....	4B-15	Truck - Chevrolet 12-1/4" Ring Gear .....	4B-68
Corvette .....	4B-27	Eaton Positive Locking Differentials .....	4B-73

## GENERAL INFORMATION

### AXLE IDENTIFICATION

It is important to know which axle is being serviced, in order to use the correct overhaul procedure. The manufacturing code number on Passenger Car axles may be found on the axle tube close to the carrier. It is the third letter of the axle code. For example, if an axle had this axle number: HKP 218 DW, the manufacturer could be determined from the third letter, P. Truck axles are identified in this section by ring gear size.

The following chart lists pertinent information needed on Passenger Car and Series 10-30 Truck axles.

### ALTERNATE PINION DEPTH SETTING PROCEDURE

A new pinion depth coding system facilitates the use of Pinion Setting Gauge J-21777-01, as outlined in later portions of this section. The coding system is used on passenger car differentials with 8-1/2 inch and 8-7/8 ring gears, on Corvette, and on truck models with 8-7/8 inch ring gears.

However, if J-21777-01 is **not** used in determining pinion depth shim requirements, the following tools and procedures are recommended. Only the steps of the procedures that differ from the J-21777-01 method are mentioned.

VEHICLE SERIES	RING GEAR SIZE			
	8-1/2	8-3/4	7-1/2	8-3/8
CHEVROLET	X	X	X	
CHEVELLE	X			
MONTE CARLO	X			
CAMARO	X			
NOVA			X	
CORVETTE				X

Fig. 4B-1A--Axle Useage Passenger Car

MODEL	SOURCE	TYPE/CAPACITY	RING GEAR SIZE
C10	Chevrolet	Salisbury/3750#	8-7/8"
K10	Chevrolet	Salisbury/3750#	8-7/8"
K10	Chevrolet	Salisbury/4000#	8-7/8"
P10	Chevrolet	Salisbury/3500#	8-7/8"
G10	Chevrolet	Salisbury/3100#	8-7/8"
G10	Chevrolet	Salisbury/3100#	8-1/2"

C20 (Except Crew Cab)	Chevrolet	Salisbury/5700#	10-1/2"
C20 (Crew Cab)	Chevrolet	Salisbury/7500#	10-1/2"
K20	Chevrolet	Salisbury/5700#	10-1/2"
P20	Chevrolet	Salisbury/5700#	10-1/2"
G20	Chevrolet	Salisbury/3500#	8-7/8"

C30 (Except Dual Wheel Camper)	Chevrolet	Salisbury/7500#	10-1/2"
C30 (Dual Wheel Camper)	Dana	Salisbury/7500#	10-1/2"
P30	Chevrolet	Salisbury/7900#	10-1/2"
P30 (With H22/H23)	Chevrolet	Banjo/11,000#	12-1/4"
G30	Chevrolet	Salisbury/5700#	10-1/2"
G30 (Dual Wheel)	Dana	Salisbury/6200#	9-3/4"
G30 (Dual Wheel)	Dana	Salisbury/7500#	10-1/2"

Fig. 4B-2A--Axle Usage Truck

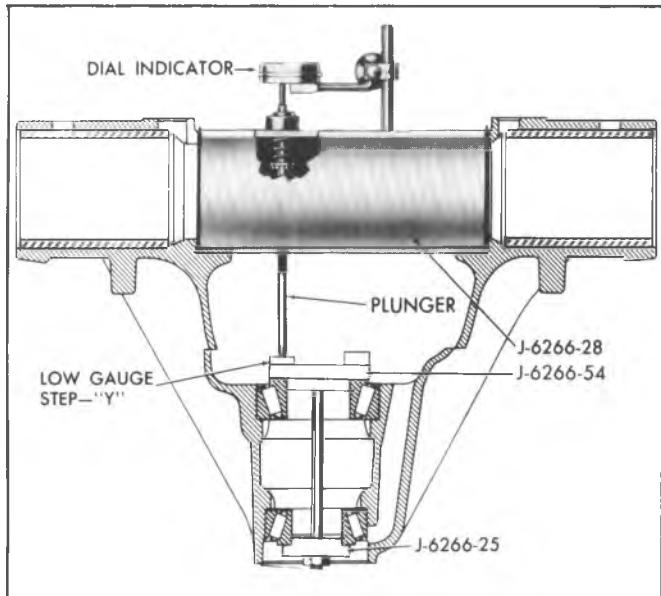


Fig. 4B-3A--Pinion Gauging Tools - 8 1/2" Ring Gear

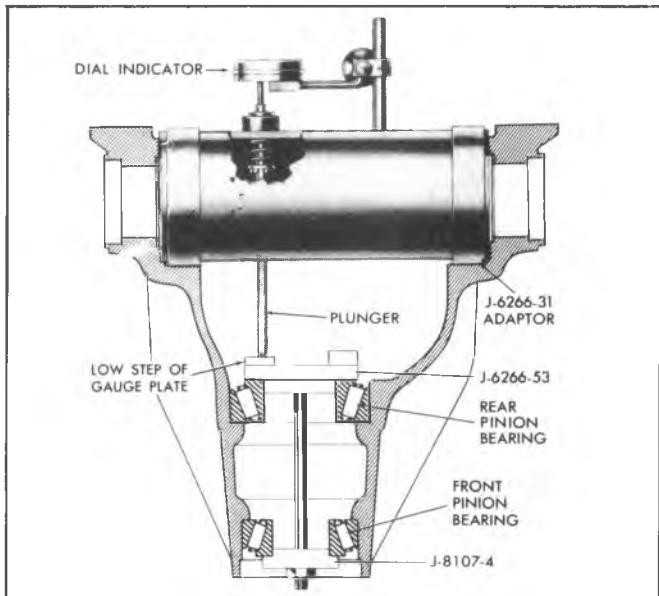


Fig. 4B-4A--Pinion Gauging Tools - Corvette

4. "Zero" the indicator on the highest spot of the gauging surface.

5. Swing the plunger off the plate and read the dial indicator. This reading is the required shim thickness for a nominal pinion.

6. If a pinion is coded +2, +1, -1, or -2, alter the shim thickness that many thousandths of an inch.

For example, if the indicator reading was .028, and the pinion code is -1, the required shim would be .028-.001 = .027 inch.

#### Corvette and 8-7/8" Ring Gear - Truck

1. Set up the tools as shown in figures 4B-4A, and 4B-5A.

2. "Zero" the dial indicator **off** the gauge plate.

3. Swing the plunger across the plate until the highest reading is obtained. Record the result.

4. Combine the pinion code number with "45", which represents a nominal pinion. From that number, subtract the dial indicator reading. The result is the required shim thickness.

For example, if the reading was .016, and the pinion code was +2, the correct shim could be determined as follows: 45 + 2 = 47; .047 -.016 = .031 inch.

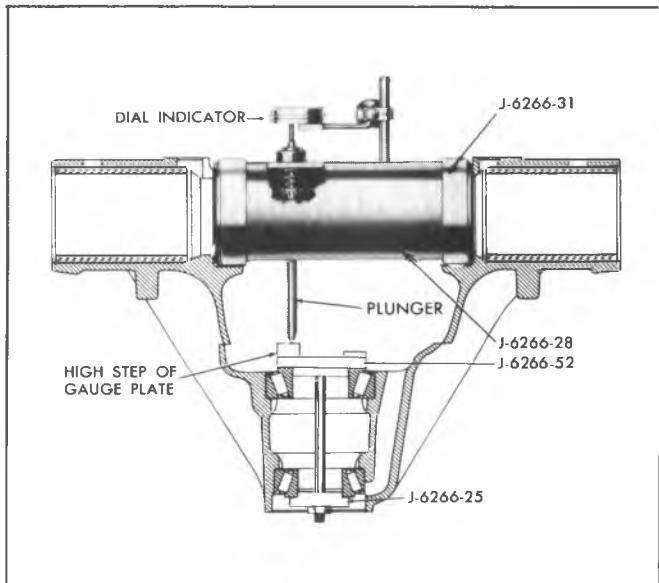
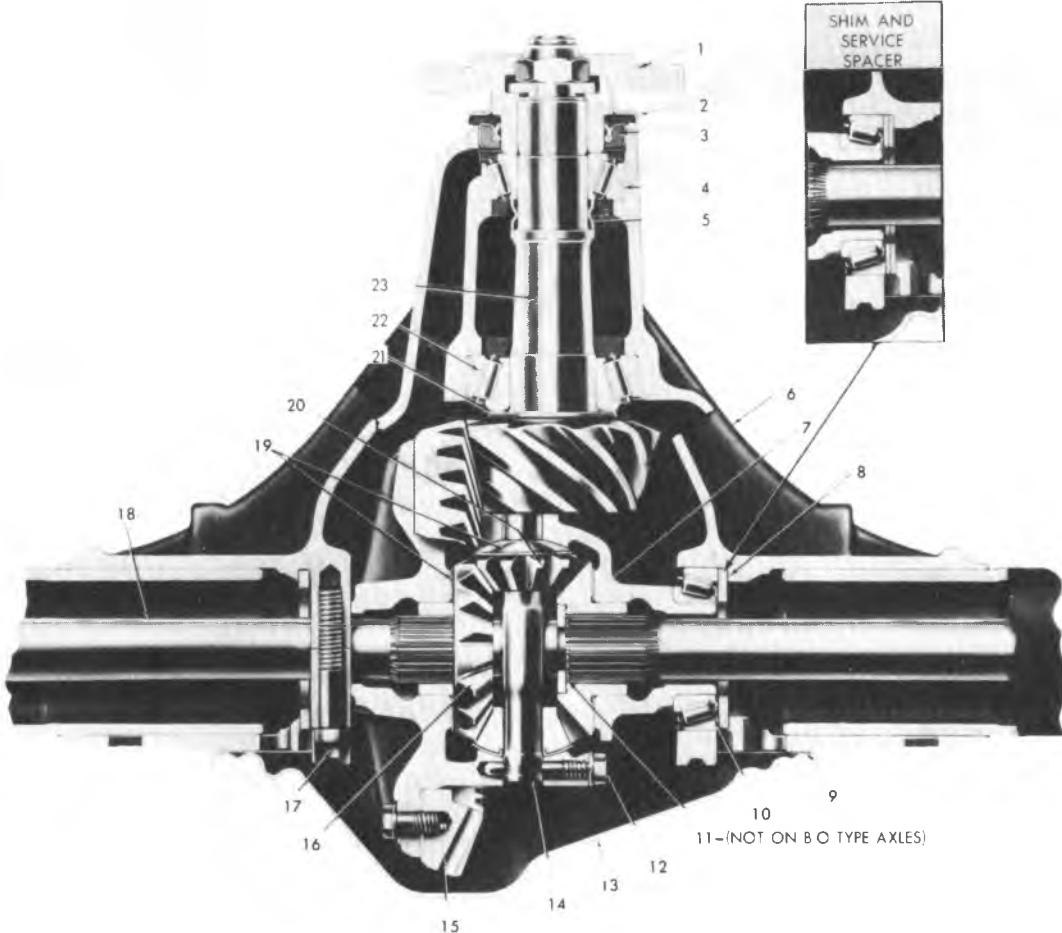


Fig. 4B-5A--Pinion Gauging Tools - 8-7/8" Ring Gear - Truck

## 7-1/2", 8-1/2" and 8-3/4" RING GEAR

### INDEX

Differential Case .....	4B-3	Setting Pinion Depth .....	4B-9
Removal and Disassembly.....	4B-3	Installation and Adjustment.....	4B-11
Inspection .....	4B-4	Checks and Adjustments .....	4B-12
Side Bearing Replacement .....	4B-4	Pinion Bearing Preload.....	4B-12
Ring Gear Replacement .....	4B-4	Side Bearing Preload.....	4B-12
Installation and Adjustment.....	4B-5	Pinion Depth and Backlash.....	4B-13
Drive Pinion.....	4B-6	Gear Tooth Contact Pattern Check.....	4B-13
Removal.....	4B-6		
Bearing Replacement .....	4B-8		



1. Companion Flange  
2. Deflector  
3. Pinion Oil Seal  
4. Pinion Front Bearing  
5. Pinion Bearing Spacer  
6. Differential Carrier

7. Differential Case  
8. Shim  
9. Gasket  
10. Differential Bearing  
11. "C" Lock  
12. Pinion Shaft Lock Screw

13. Cover  
14. Pinion Shaft  
15. Ring Gear  
16. Side Gear  
17. Bearing Cap  
18. Axle Shaft

19. Thrust Washer  
20. Differential Pinion  
21. Shim  
22. Pinion Rear Bearing  
23. Drive Pinion

Fig. 4B-1--Cross Section of Typical Differential

## DIFFERENTIAL CASE

### Removal and Disassembly

**NOTE:** Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft and remove pinion shaft.
2. Remove rear axle shaft.
3. Roll out the differential pinions and thrust washers; then remove side gears and thrust washers. Mark the pinions and side gears so they can be reassembled in their original

positions.

4. Mark side bearing caps for installation in same position during reassembly. Loosen bolts holding differential side bearing caps to housing.

**CAUTION:** Do not attempt to pry caps off as this may damage machined face of caps.

5. Using a pry bar as shown in figure 4B-2, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing cups may be loosely installed, as shown in figure 4B-2, to prevent case from falling.

6. Place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

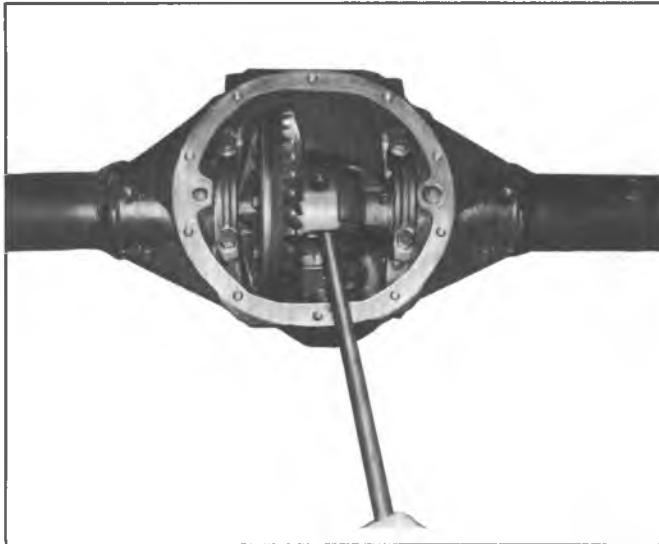


Fig. 4B-2--Differential Case Removal

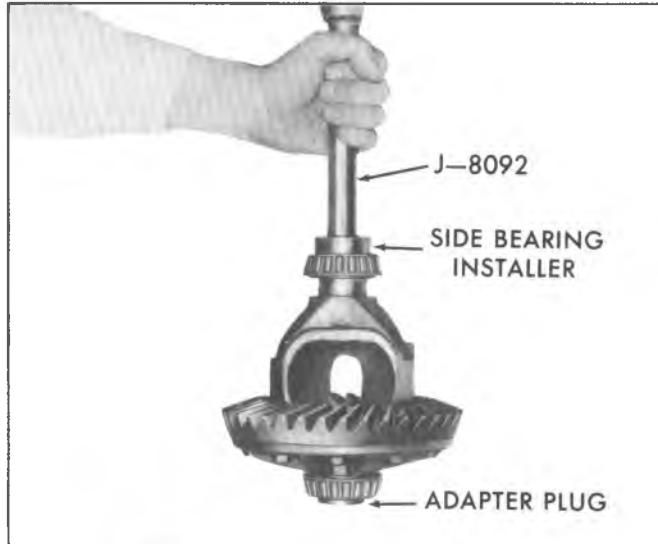


Fig. 4B-4--Differential Bearing Installation

### Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

### Differential Bearing Replacement

1. Install side bearing remover and proper adapter plug tool J-22888-02 shown in figure 4B-3. Make sure that the puller legs are fitted securely in case notches, against inner race.
2. Tighten puller screw to remove bearing.
3. Place new bearing onto hub, with the thick side of the inner race toward the case. Drive the bearing into place, using J-22761 for 8-1/2" ring gear J-22175 for the 8-3/4" ring

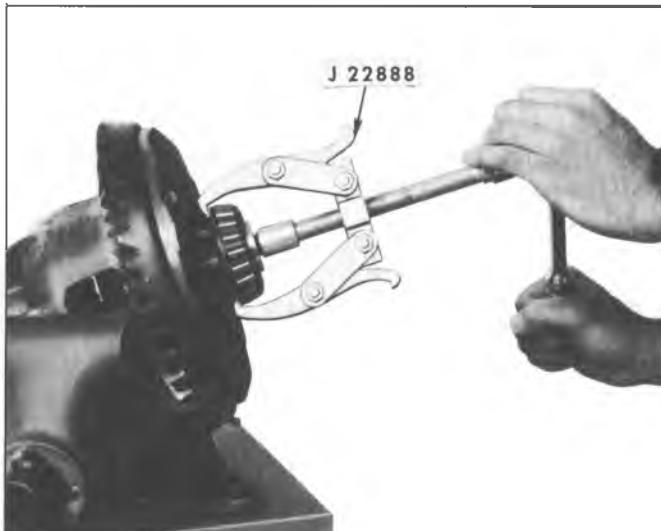


Fig. 4B-3--Differential Side Bearing Removal

gear, or J-25299 for 7-1/2" ring gear, as shown in figure 4B-4.

4. Before bearing installation on opposite hub, support differential case on proper adapter plug. This allows differential case to rest on adapter plug instead of bearing cage. Install other bearing as done in Step 3.

### Ring Gear or Differential Case Replacement

1. Remove the ring gear screws (L.H. thread) and, using a soft drift and a hammer, tap ring gear off the case.
- NOTE:** Do not attempt to pry ring gear from case. To do so may damage machined surfaces.
2. Remove any nicks or imbedded dirt from case flange surface which mates with ring gear. Clean all surfaces.
3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes and press against proper adapter plug to initially start ring gear on case pilot, as shown in figure 4B-5.
4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.

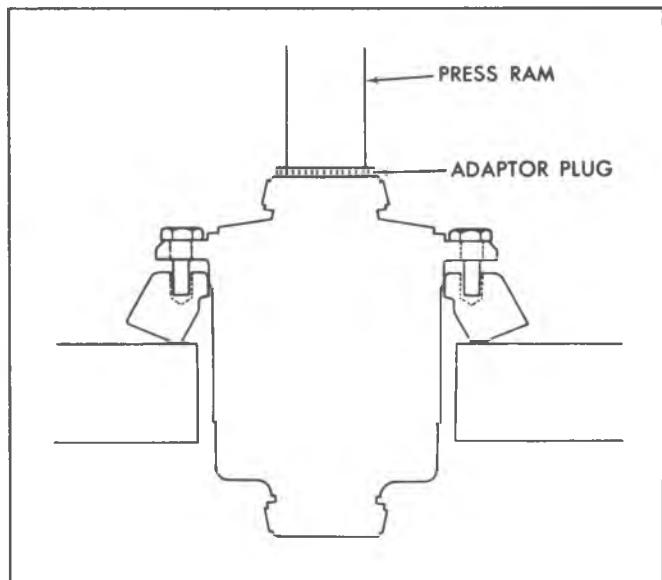


Fig. 4B-5--Ring Gear to Case Installation

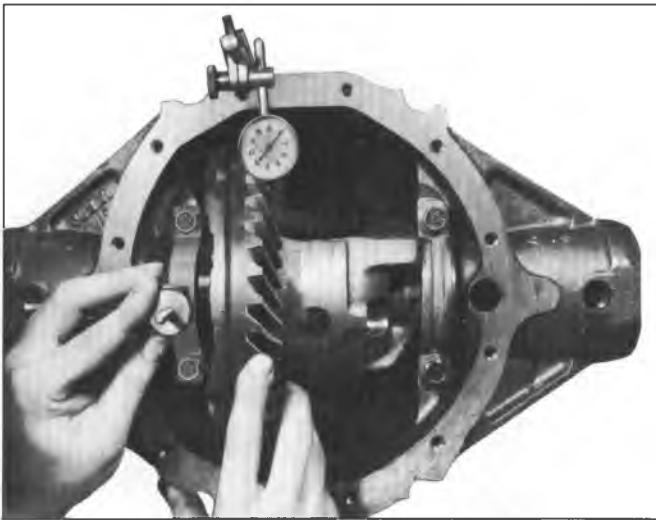


Fig. 4B-6-Installing Gauging Tool

5. Insure that gear is seated firmly against the case, then torque all bolts to 50 lb. ft.

#### Reassembly

1. Install thrust washers and side gears into case. If original parts are being reused, replace in original positions.

2. Position pinions and thrust washers through loading hole in case 180° apart so that they engage side gears.

3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.

4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.

5. Differential may be installed in carrier now, or after service is performed on the drive pinion.

#### Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.

2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.

3. For 8-1/2" and 8-3/4" ring gear:

a. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.

With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gauging Tool J-22779 between the left bearing cup and carrier housing. See Figure 4B-6.

While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.

Tighten lock bolt on side of tool.

b. For 7-1/2" ring gear:

Position the ring gear tightly against the drive pinion (zero backlash). Being sure that the bearings are properly seated, install a Service Spacer A (.160 inch), Service Shim B and Feeler Gauge C, as shown in the ring gear side of Figure 4B-7. The thickness of the Feeler Gauge must be sufficient to produce a slight "drag" when moved between the carrier and the Service Shim.

4. Between the right bearing and carrier, install Service Spacer A (.170 for the 8-1/2" and 8-3/4" ring gear, .160 for the 7-1/2" ring gear, Service Shim B, and Feeler Gauge C. Thickness of Feeler Gauge must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.

Now measure the above dimensions as shown in Figure 4B-8, for 8-1/2" and 8-3/4" ring gear, figure 4B-7 for the 7-1/2" ring gear.

5. For the 8-1/2" and 8-3/4" ring gear: Using a micrometer as in Figure 4B-9, measure the thickness of J-22779 in a minimum of three places and average these readings. Record the result.

Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result.

For the 7-1/2" ring gear: Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result for each side.

6. Use the sample procedure in Figure 4B-8 for the 8-1/2" and 8-3/4" ring gear, Figure 4B-7 for the 7-1/2" ring gear to determine the proper thickness for each shim pack.

**NOTE:** Production preloading of the differential bearings is accomplished by the use of cast iron preload shims. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.

For proper bearing preload, the shims must not be installed loosely, nor should they require undue force for installation.

7. Install left shim first, then wedge right shim between bearing cup and spacer (position shim so that chamfered side is outward or next to spacer). If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.

8. If difficulty is encountered in installing shim, partially remove case slide case and shim into position. Tap shim into position, using soft faced hammer, while rotating differential case with free hand. See Figure 4B-10.

9. Install bearing caps in original position and torque to 60 ft. lbs. for the 8-1/2" and 8-3/4" ring gear, 55 ft. lbs. for the 7-1/2" ring gear.

**NOTE:** At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure that preload remains established. If backlash is changed, be sure that total thickness of two shim packs does not change.

10. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 4B-11. The backlash should be within the range of .005"-.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed .002".

**NOTE:** Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

11. If variation in backlash readings exceeds .002", measure ring gear and case runout as shown in Figure 4B-12. Gear runout should not exceed .003", should runout exceed this limit check ring gear and case for deformation and/or foreign matter between case and gear.

12. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim the same amount. Total shim thickness must be maintained at all times to maintain proper preload.

13. Backlash changes approximately .002" for each .003" change in shim dimensions. If backlash exceeds .008", increase the shim thickness on ring gear side, while decreasing shim thickness on opposite side an equal amount. If backlash is less than .005", decrease the shim thickness on ring gear side, while increasing shim thickness on opposite

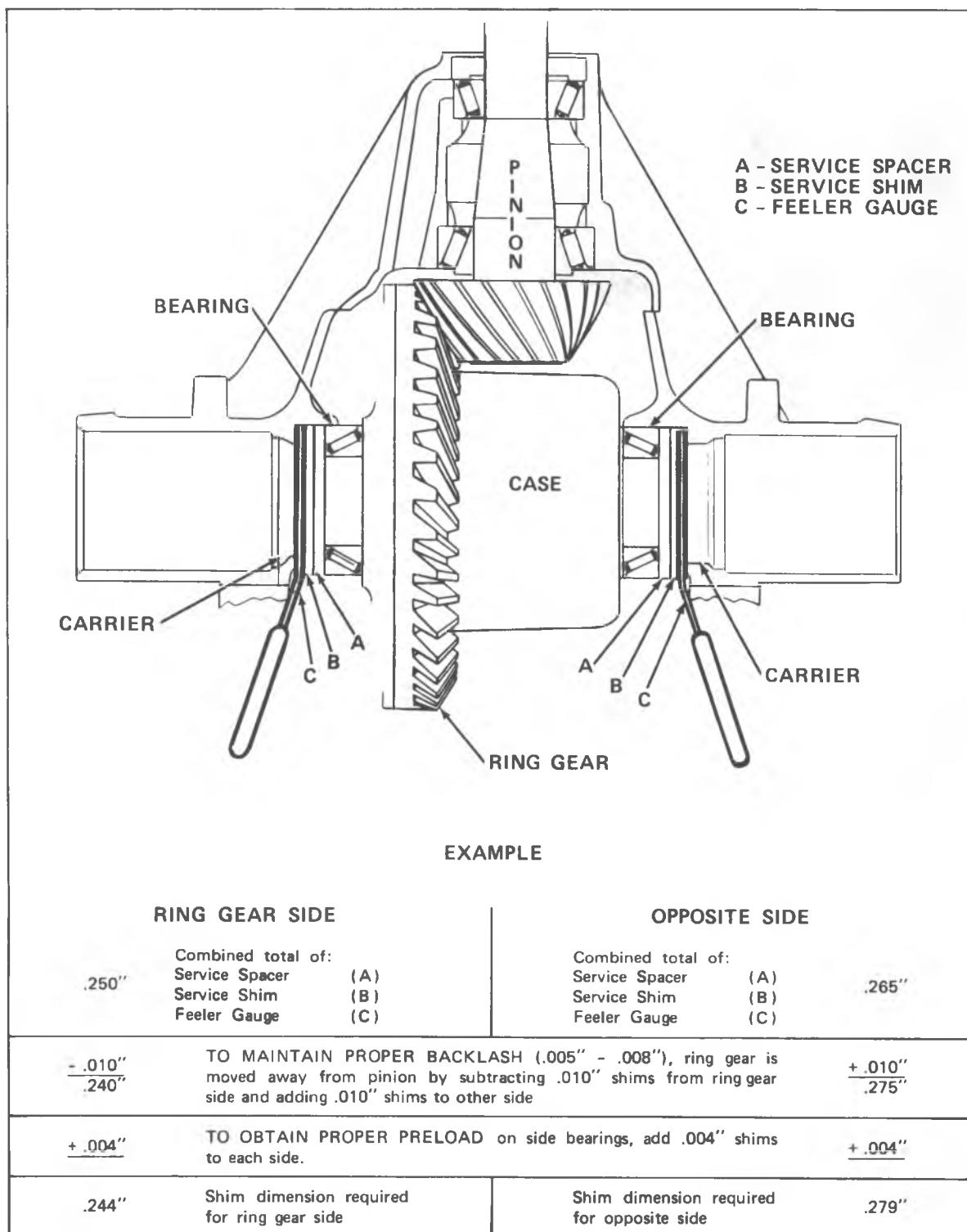


Fig. 4B-7--Determining Side Bearing Shim Requirements 7-1/2"

side an equal amount.

### DRIVE PINION

#### Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion as described under "Drive Pinion - Installation and Adjustment". If there is no torque reading, check for looseness of pinion assembly by shaking (push-pull) the

companion flange. Looseness indicates the need for bearing replacement.

3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 4B-13. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position.

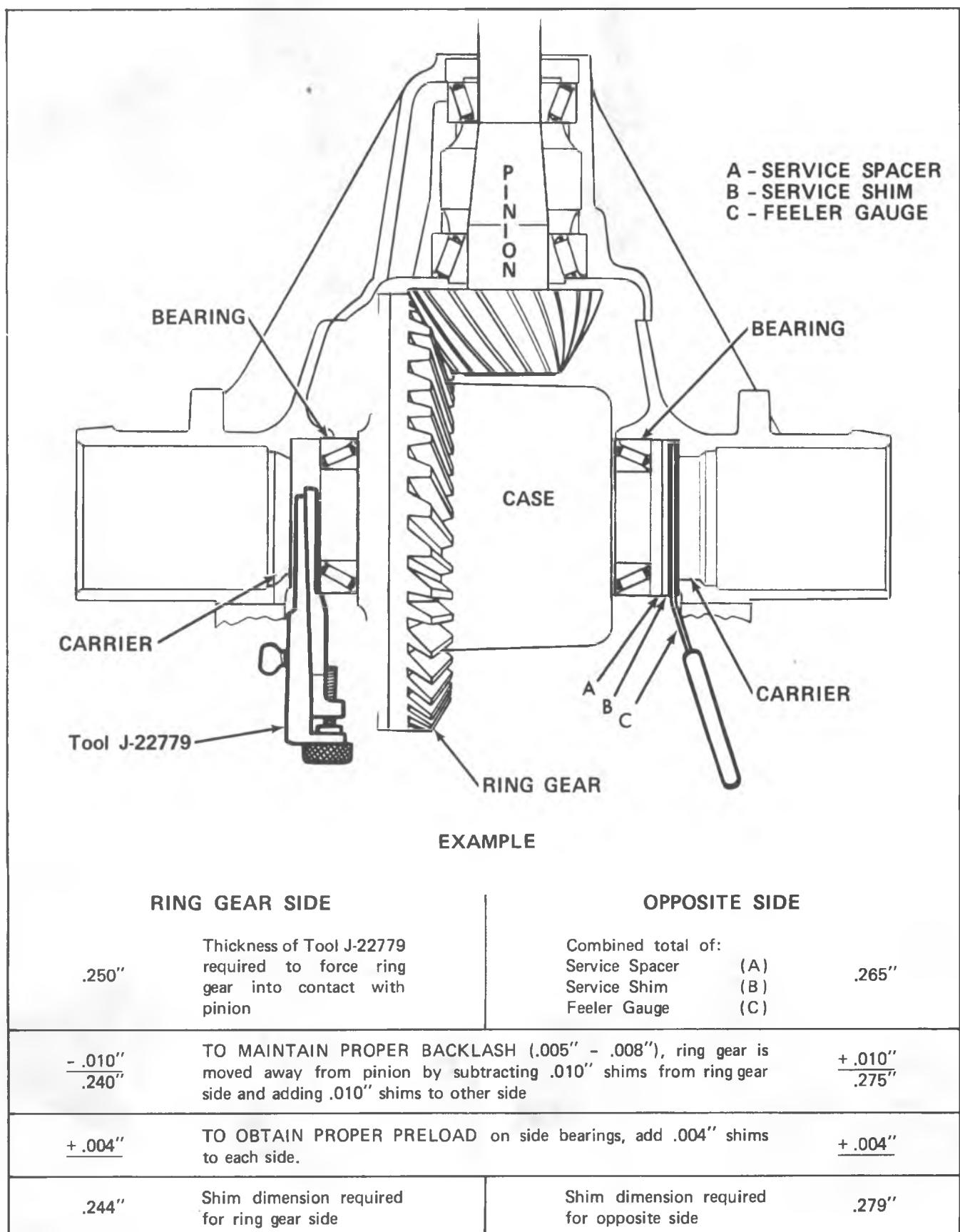


Fig. 4B-8-Side Bearing Shim Requirements 8-1/2" and 8-3/4"



Fig. 4B-9—Measuring Gauge Thickness

Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B-14.

6. To remove the drive pinion, first thread the original pinion nut half-way on the pinion, for thread protection.
7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.
8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 4B-15.

**NOTE:** Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion from the housing. Discard the pinion oil seal, nut and collapsible spacer. Use a new seal, nut and spacer on reassembly.

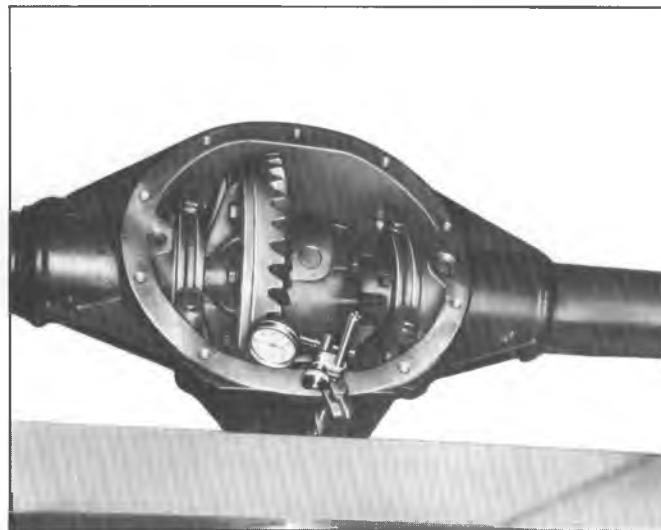


Fig. 4B-11—Checking Ring Gear Backlash

#### Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using drift in slots provided for this purpose. Tap alternately on opposite sides of bearing cup to avoid cocking.
2. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.
3. Remove rear pinion bearing from pinion shaft using rear pinion bearing remover J-8612 for the 8-1/2" ring gear, and the 8-3/4" ring gear, and J-25320 for the 7-1/2" ring gear. See figure 4B-16.
4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.



Fig. 4B-10—Installing Differential Shim

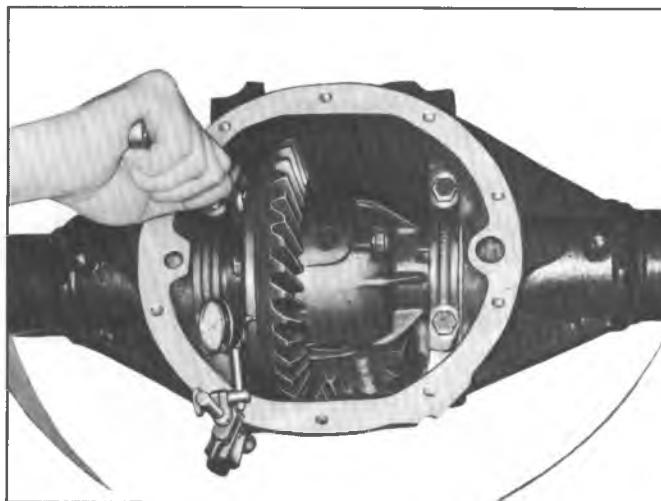


Fig. 4B-12—Checking Ring Gear Runout

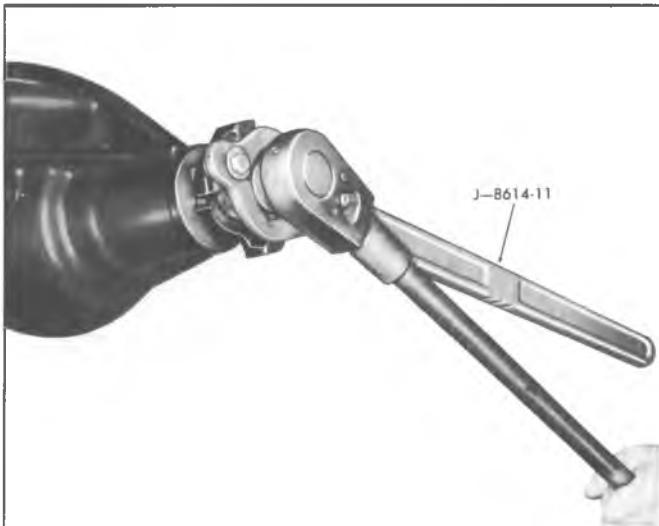


Fig. 4B-13--Drive Pinion Nut Removal

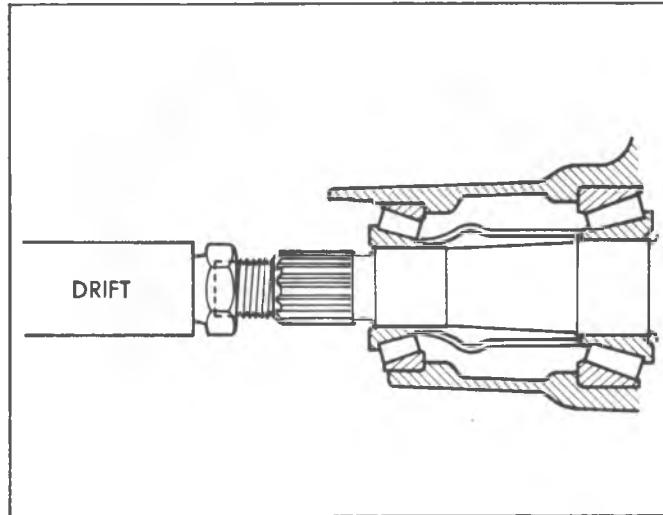


Fig. 4B-15--Removing Drive Pinion

5. Lubricate both outer cups with liberal amounts of hypoid lubricant.
6. Install the rear cup, with the large end against the bore shoulder, using Rear Pinion Bearing Cup Installer J-8608 for the 8-1/2" ring gear and the 8-3/4" ring gear, J-7818 for the 7-1/2" ring gear, as shown in figure 4B-17.
7. Install the front cup, with the large end against the bore shoulder, using Installer J-7137 as shown in figure 4B-18.
8. Check both bores to make sure cups are fully seated.

#### **Setting Pinion Depth and Installing Pinion Bearings**

**NOTE:** If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly

from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gauging the carrier and shimming the pinion has been developed. After gauging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gauge J-21777-01 for the 8-1/2" and 8-3/4" ring gear, gauge J-23597-01 for the 7-1/2" ring gear.

1. Clean the housing assembly and all gauge parts to insure accurate measurements.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.

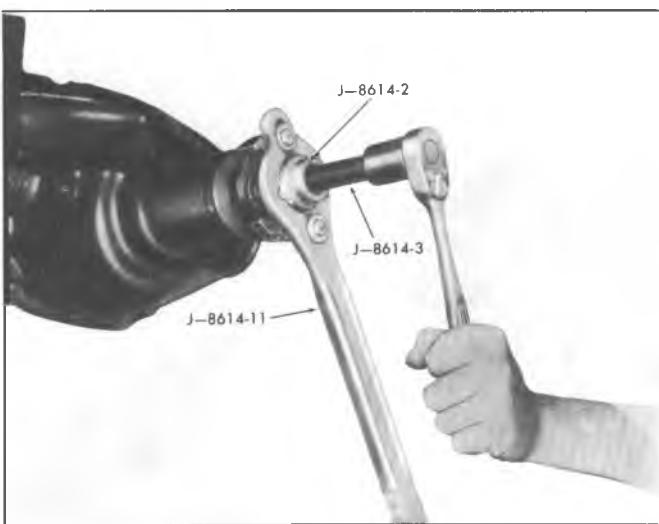


Fig. 4B-14--Drive Pinion Flange Removal

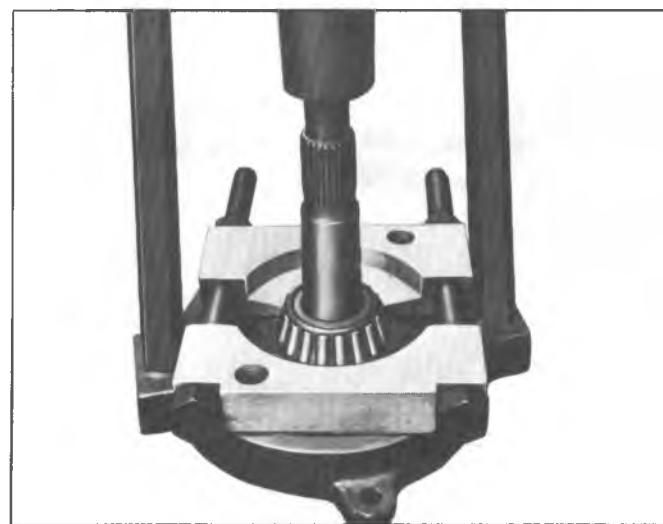


Fig. 4B-16--Removing Drive Pinion Rear Bearing Typical

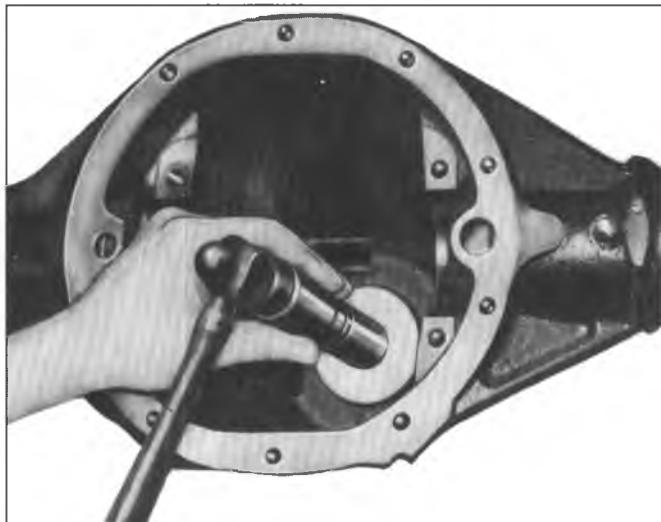


Fig. 4B-17--Installing Pinion Rear Bearing Cup

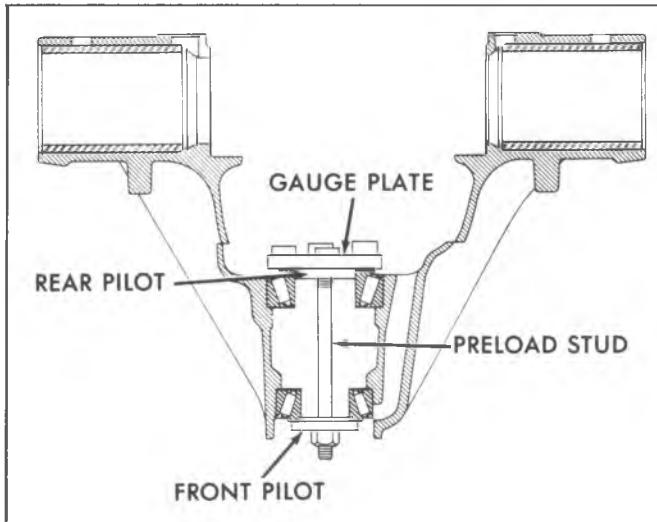


Fig. 4B-19--Gauge Plate Installed

3. Position gauge plate J-21777-29 on preload stud J-21777-43 (8-1/2" and 8-3/4" ring gear) J-23597-11 on preload stud J-21777-43 (7-1/2" ring gear), insert stud through rear bearing and pilot J-21777-35 (8-1/2" and 8-3/4" ring gear) J-23597-12 (7-1/2" ring gear) and through front bearing and pilot J-21777-42. Insert the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 4B-19 for illustration of proper positioning.

4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate the bearings as shown in figure 4B-20.

5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1 (8-1/2" and 8-3/4" ring gear). Side bearing discs J-21777-45 on the ends of arbor J-23597-1 (7-1/2" ring gear), using the step of the disc that corresponds to the base of the carrier.

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.

7. Install the bearing caps finger tight to prevent the discs from moving.

8. Position dial indicator J-8001 on the mounting post

of the arbor with the contact button resting on the top surface of the plunger.

9. Preload the dial indicator one half revolution and tighten in this position.

10. Place the plunger onto the guage plate. For 8-1/2" and 8-3/4" ring gear select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.

11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shwon in figure 4B-21.

**NOTE:** Select the gauging button that corresponds to the ring gear size for the 8-1/2" and 8-3/4" ring gear.

It is important to use a dial indicator correctly when determining pinion depth requirements. Be sure to record the number indicated by the indicator needle; do not record the amount of travel of the needle.

After "zeroing" the dial indicator on the highest point of deflection on the gauge plate, the indicator probe is swung off the gauge plate, allowing the needle

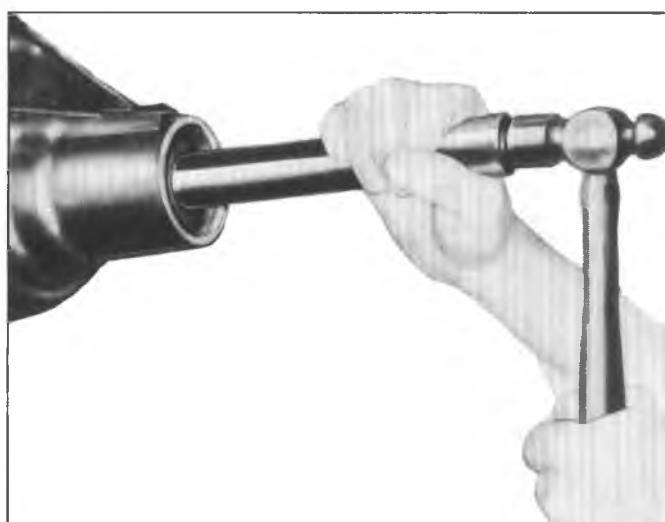


Fig. 4B-18--Installing Pinion Front Bearing Cup

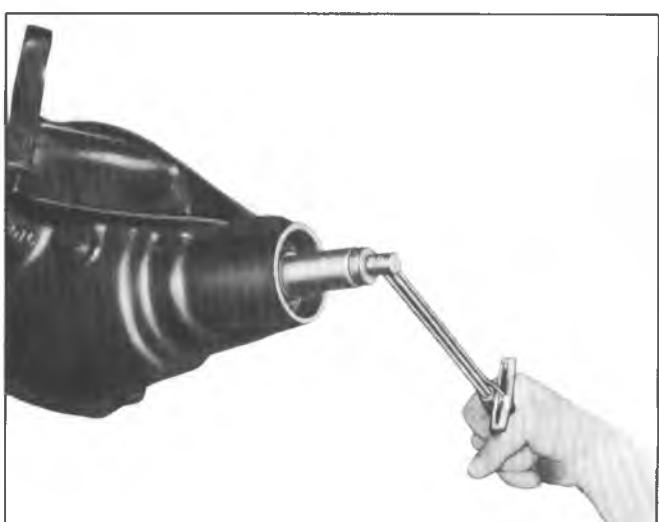


Fig. 4B-20--Measuring Rotating Torque

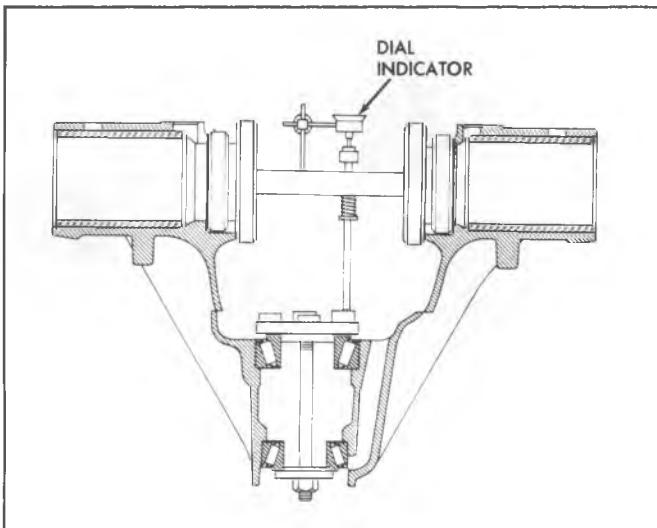


Fig. 4B-21--Depth Gauge Installed in Position Typical

to move. The number which the needle points toward is the correct shim thickness required for a nominal pinion. See figure 4B-22.

12. Repeat the rocking action of the plunger several times to verify the setting.

13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this size.

14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.

a. If the pinion is stamped with a plus + number, add that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked +2, the correct depth shim for installation will be  $.019 + .002 = .021$  inch.

b. If the pinion has no plus + or minus - number, use the indicator reading as the correct shim thickness.

c. If the pinion is stamped with a minus (-) number, subtract that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be  $.031 - .003 = .028$  inch.

15. Remove bearing caps and depth gauging tools from carrier.

16. Position the shim selected in step 14 on the pinion shaft against pinion head.

17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing onto pinion using J-8609-01 (8-1/2" and 8-3/4" ring gear) J-5590 (7-1/2" ring gear) as shown in figure 4B-23.

#### Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.

2. Place a new pinion oil seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier, as shown in figure 4B-24.

3. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube.

4. Install a new pinion bearing spacer onto the drive

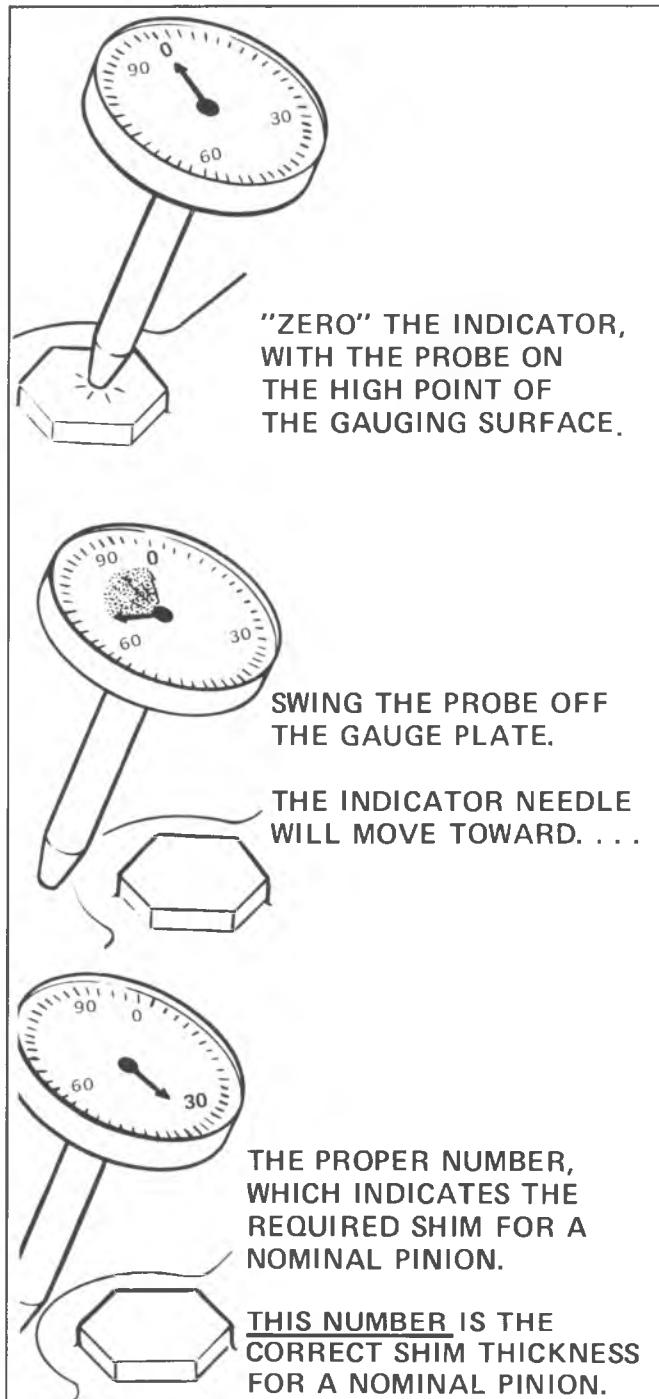


Fig. 4B-22--Use of Dial Indicator

pinion.

5. Remove nut and sleeve from Companion Flange Installer J-9458. Screw J-9458 onto drive pinion and insert assembly into housing.

6. Position companion flange onto drive pinion. Install sleeve and nut onto J-9458.

7. Install Companion Flange Holding Tool J-8614-11. See Figure 4B-25.

8. Tighten nut on Tool J-9458 which draws drive pinion through front bearing and companion flange. Tighten only until end play is removed from drive pinion then remove Tool J-9458.

**NOTE:** When no further end play is detectable, and

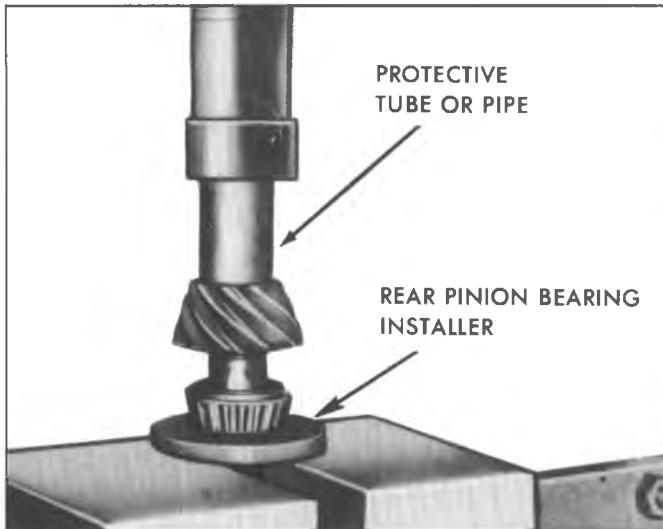


Fig. 4B-23--Drive Pinion Rear Bearing Installation

when Holder J-8614-11 will no longer pivot freely as pinion is rotated, bearing preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked with a torque wrench.

9. Lubricate cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) and install washer. Lubricate new nut threads with a liberal amount of hypoid lubricant, and install on pinion snugly.

10. Check preload by using an inch pound torque wrench such as J-5853 as shown in Figure 4B-26.

**NOTE:** After torque has been checked, final tightening should be done very cautiously. For example, if when checking, torque was found to be 5 inch pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight

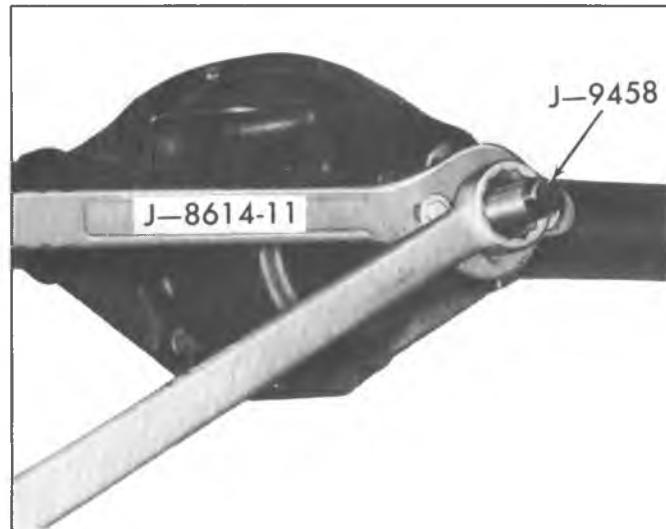


Fig. 4B-25--Drive Pinion Flange Installation

amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

11. While observing the preceding caution, carefully set preload drag at 20-25 in lb. on new bearings or 10-15 in. lb. on reused bearings.

12. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.

#### CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a)Pinion Bearing Preload, b)Side Bearing Preload c)Pinion Depth and d)Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 11 of "Drive Pinion- Installation and Adjustment".

Side Bearing Preload is set to specifications in step 6 of "Differential Case-Installation and Adjustment".

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check must be made to verify the accuracy of the work in setting

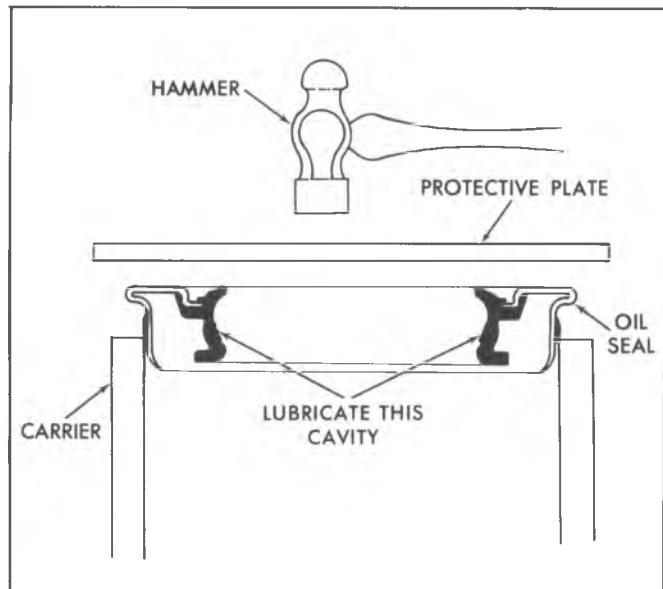


Fig. 4B-24--Installing Pinion Oil Seal

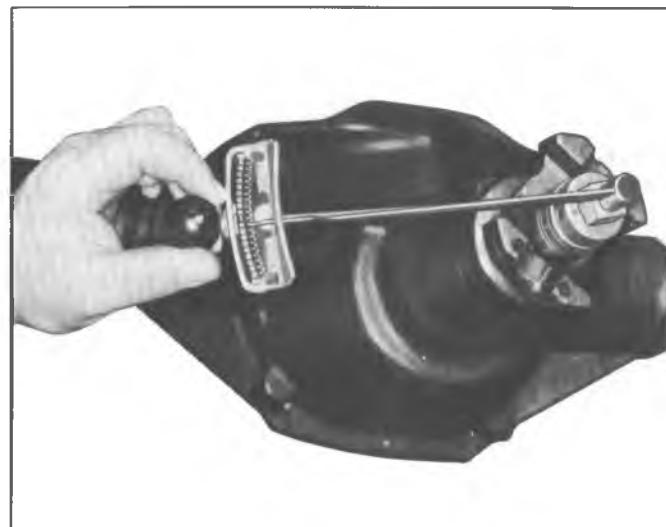


Fig. 4B-26--Measuring Rotating Torque

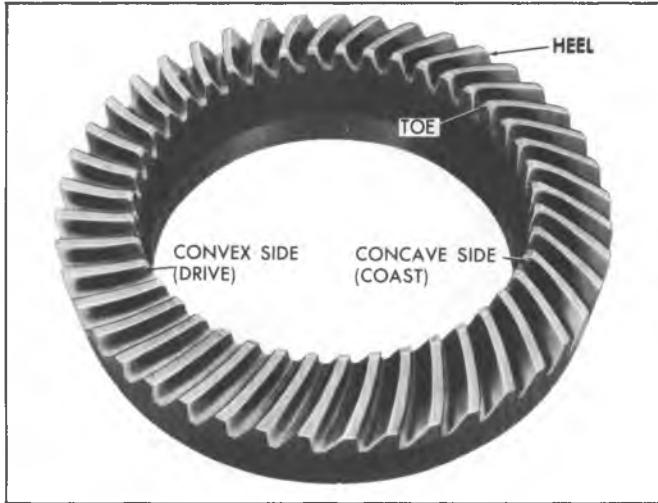


Fig. 4B-27—Gear Tooth Nomenclature

the pinion depth and ring gear-to-pinion backlash.

### Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4B-27.

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

2. Use gear marking compound and apply this mixture sparingly to all ring-gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

3. Tighten bearing cap bolts to 55 lb. ft.

4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 4B-28.

### Adjustments Affecting Tooth Contact

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

**NOTE:** It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

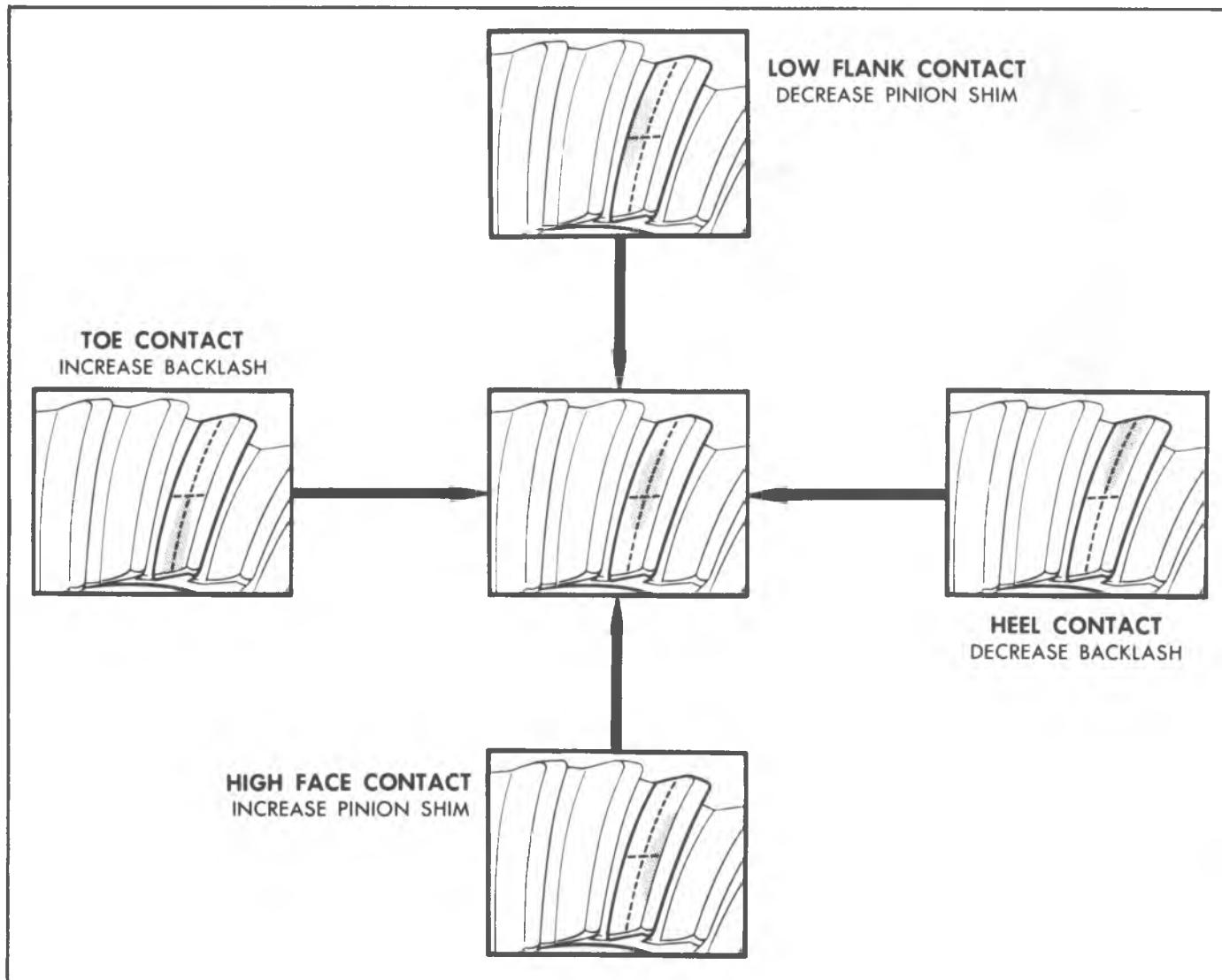


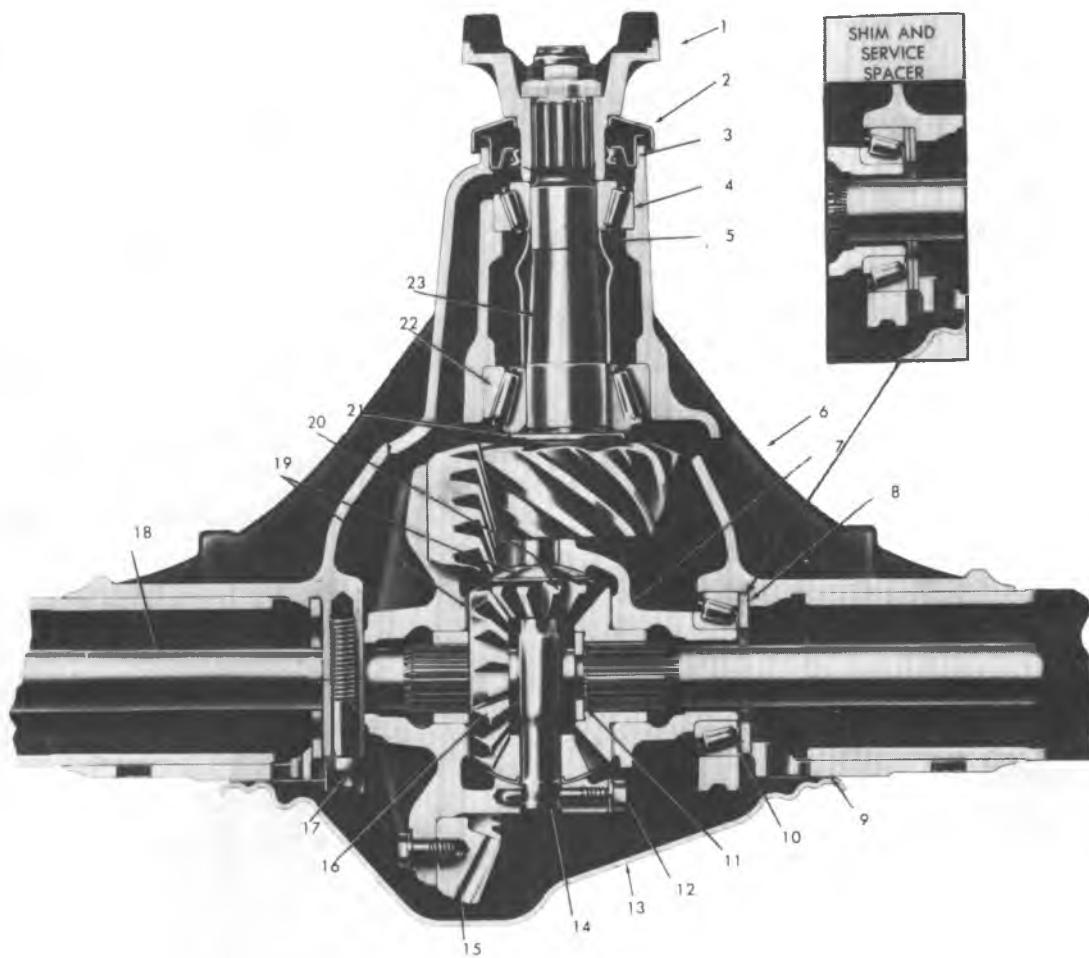
Fig. 4B-28—Gear Teeth Contact Pattern Check

# SERIES 10 TRUCK DIFFERENTIAL

## 8-7/8" RING GEAR

### INDEX

Differential Case	Drive Pinion	Checks and Adjustments
Removal and Disassembly .....	Removal .....	Pinion Bearing Preload .....
Inspection .....	Bearing Repl. ....	Side Bearing Preload .....
Side Bearing Repl. ....	Setting Pinion Depth .....	Pinion Depth and Backlash .....
Ring Gear Repl. ....	Installation and Adjustments .....	Gear Tooth Contact Pattern
Installation and Adjustment .....		Check .....
		4B-25



- |                          |                             |                  |                         |
|--------------------------|-----------------------------|------------------|-------------------------|
| 1. Companion Flange      | 7. Differential Case        | 13. Cover        | 19. Thrust Washer       |
| 2. Deflector             | 8. Shim                     | 14. Pinion Shaft | 20. Differential Pinion |
| 3. Pinion Oil Seal       | 9. Gasket                   | 15. Ring Gear    | 21. Shim                |
| 4. Pinion Front Bearing  | 10. Differential Bearing    | 16. Side Gear    | 22. Pinion Rear Bearing |
| 5. Pinion Bearing Spacer | 11. "C" Lock                | 17. Bearing Cap  | 23. Drive Pinion        |
| 6. Differential Carrier  | 12. Pinion Shaft Lock Screw | 18. Axle Shaft   |                         |

Fig. 1B—Cross Section of Differential with 8 7/8" Ring Gear

## DIFFERENTIAL CASE

### Removal and Disassembly

**NOTE:** Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.
2. Remove rear axle shafts as outlined in the Service Manual.
3. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.
4. Mark the bearing caps and housing for reassembly in same position. Loosen bearing cap bolts. Tap surface of bearing caps to loosen.
- CAUTION:** Do not attempt to pry caps off as this may damage machined face of caps.
5. Using a pry bar as shown in Figure 2B, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing caps may be loosely installed, as shown in Figure 2B, to prevent case from falling.
6. Place left and right bearing cups with bearing caps so that they may be reinstalled in original positions. Place shims with appropriate cups.

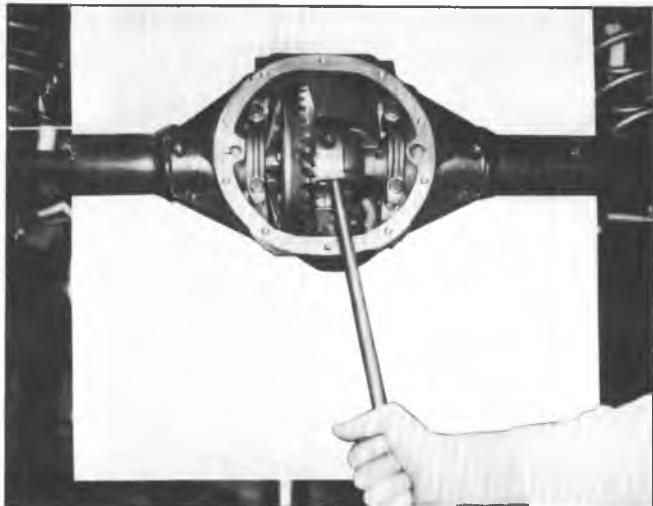


Fig. 2B—Differential Case Removal

### Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear splines for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions, side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

### Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-4, assuring puller legs are fitted securely in notches in case and against bearing cone, as shown in figure 3B.
2. Tighten puller screw to remove bearing.
3. Place new bearing on hub with thick side of inner race toward case and drive into place, using J-22175 and Driver Handle J-8092, as shown in figure 4B.
4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4. This allows differential case to rest on adapter instead of bearing cage. See Figure 4B. Install remaining bearing as instructed in Step 3.

### Ring Gear or Differential Case Replacement

1. Remove the ring gear bolts (L.H. thread on passenger car applications) and, using a soft drift and a hammer, tap ring gear off the case.
- NOTE:** Do not attempt to pry ring gear from case. To do so may damage machined surfaces.
2. Remove any nicks or imbedded dirt from case

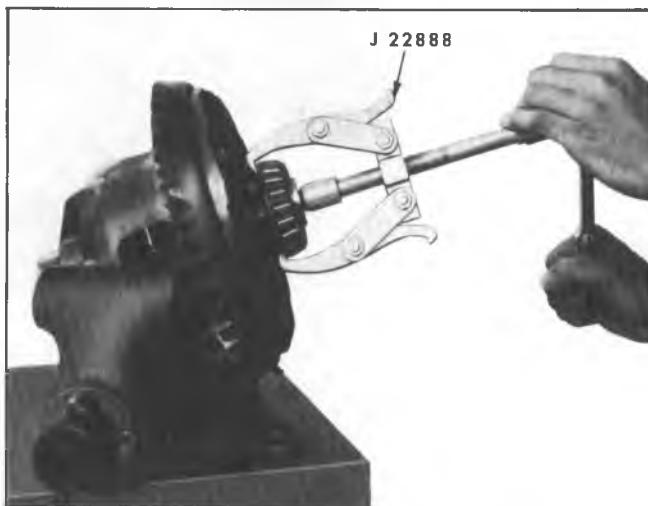


Fig. 3B—Differential Bearing Removal

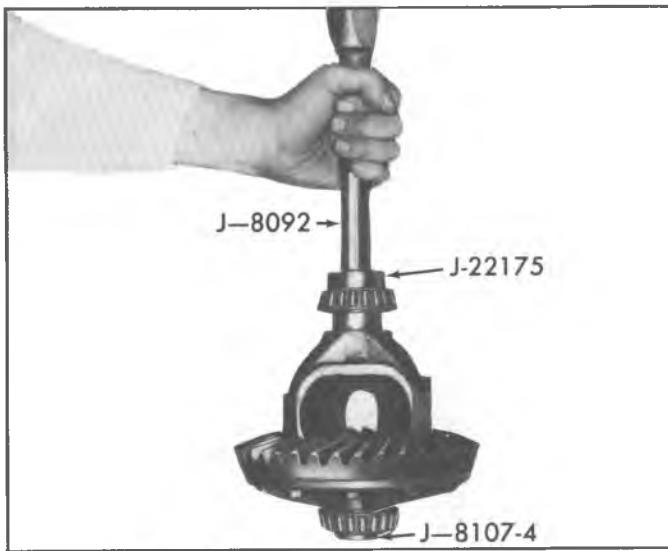


Fig. 4B—Differential Bearing Installation

- flange surface which mates with ring gear. Clean all surfaces.
3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes, and press on adaptor plug J-8107-4 to initially start ring gear on case pilot, as shown in figure 5B.
  4. Start all ring gear bolts during initial assembly to maintain bolt hole alignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.
  5. Insure that the gear is seated firmly against the case, then torque the bolts to 90 ft. lbs. for passenger cars, and 60 ft. lbs. for truck models.

#### Reassembly

1. Install thrust washers and side gears into case. If original parts are being reused, replace in original positions.

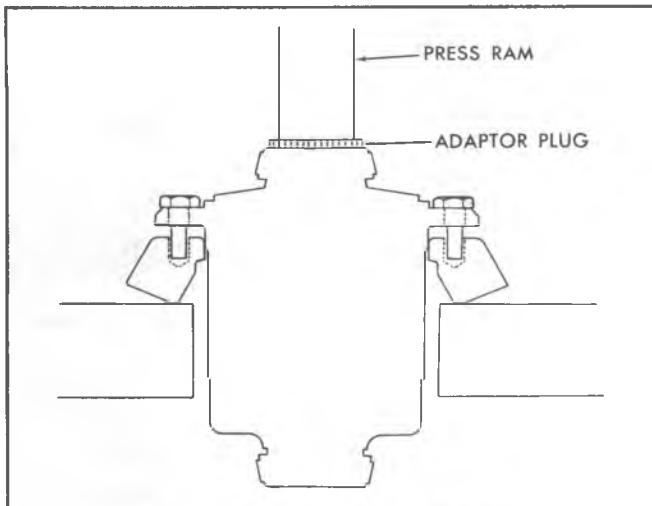


Fig. 5B—Ring Gear-to-Case Installation

2. Position pinions and thrust washers through loading hole in case 180° apart so they engage side gears.
3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.
4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.
5. Differential may be installed in carrier now, or after service is performed on the drive pinion.

#### Installation and Adjustment

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.
3. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.
4. With the ring gear tight against the pinion gear (.000" to .001" backlash) insert gauging Tool J-22779 between the left bearing cup and carrier housing as shown in Figure 6B.
5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.
6. Tighten lock bolt on side of tool.
7. Between the right bearing and carrier, install Service Spacer A (.170"), Service Shim B and Feeler Gauge C. Thickness of Feeler Gauge must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.
8. Now measure the above dimensions as shown in Fig. 7B.
  - a. Using a micrometer as in Figure 8B measure the thickness of J-22779 in a minimum of three

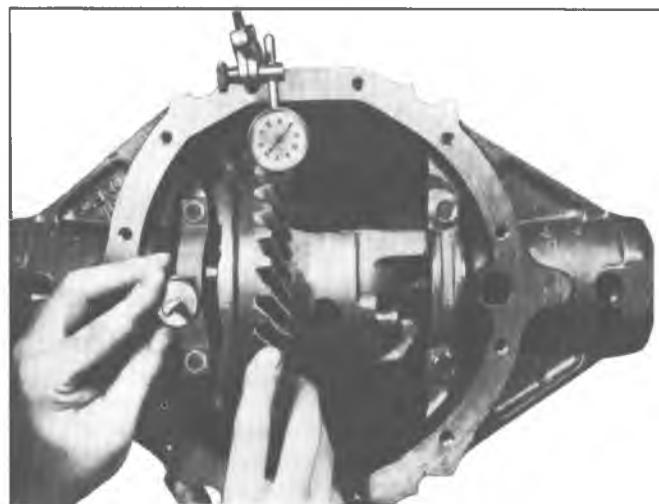
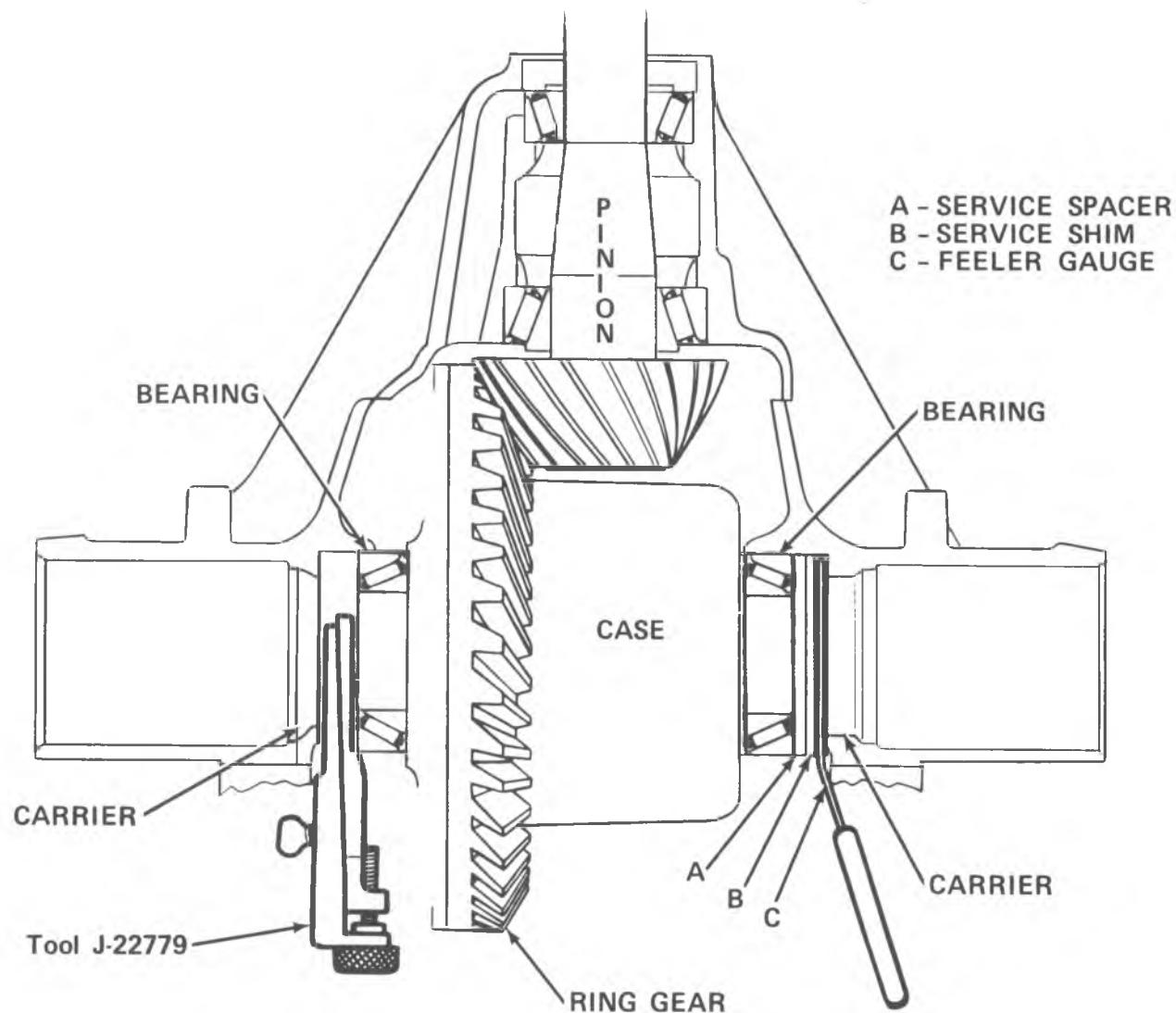


Fig. 6B—Installing Gauging Tool



## EXAMPLE

## RING GEAR SIDE

.250" Thickness of Tool J-22779 required to force ring gear into contact with pinion

## OPPOSITE SIDE

Combined total of:  
 Service Spacer (A) .265"  
 Service Shim (B)  
 Feeler Gauge (C)

-.010"	TO MAINTAIN PROPER BACKLASH (.005" - .008"), ring gear is moved away from pinion by subtracting .010" shims from ring gear side and adding .010" shims to other side	+.010"
.240"		<u>.275"</u>

+.004"	TO OBTAIN PROPER PRELOAD on side bearings, add .004" shims to each side.	+.004"
--------	--	--------

.244" Shim dimension required for ring gear side	Shim dimension required for opposite side .279"
--	---

Fig. 7B—Determining Side Bearing Shim Requirements

places and average these readings. Record the result.

- b. Add together the dimensions of the Service Shim, Service Spacer and Feeler Gauge. Record the result.
9. Use the sample procedure in Figure 7B to determine the proper thickness for each shim pack.

**NOTE:** Production preloading of the differential bearings is accomplished by the use of cast iron preload shims. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.

10. Install left shim first, then wedge right shim between bearing cup and spacer. Position shim so that chamfered side is outward or next to spacer. If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.
11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap shim into position, using a soft faced hammer, while rotating differential case with free hand as shown in Figure 9B.
12. Install bearing caps in original position and torque to 60 ft. lbs.

**NOTE:** At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure the preload remains as established in step 9. If backlash is changed in later steps, be sure the **total** thickness of the two shim packs does not change.

13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in Figure 10B. The backlash should be within the range of 0.005"-0.008". Check gear lash



Fig. 9B—Installing Differential Shim

at four different equally spaced positions around the gear. Variation in readings should not exceed .002".

- NOTE:** Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.
14. If variation in backlash readings exceeds .002"; measure ring gear and case runout as shown in Figure 11B. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.
  15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim **the same amount**. Total shim thickness must be maintained at all times to maintain proper preload.
  16. Backlash changes approximately .002" for each .003" change in shim dimensions.



Fig. 8B—Measuring Gauge Plate Thickness

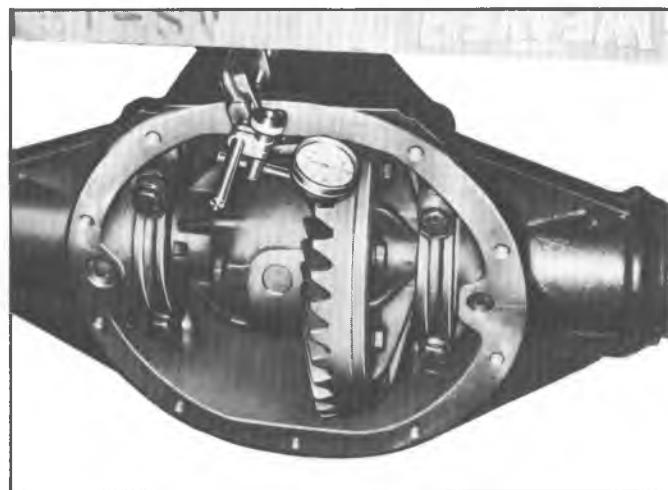


Fig. 10B—Checking Ring Gear Backlash

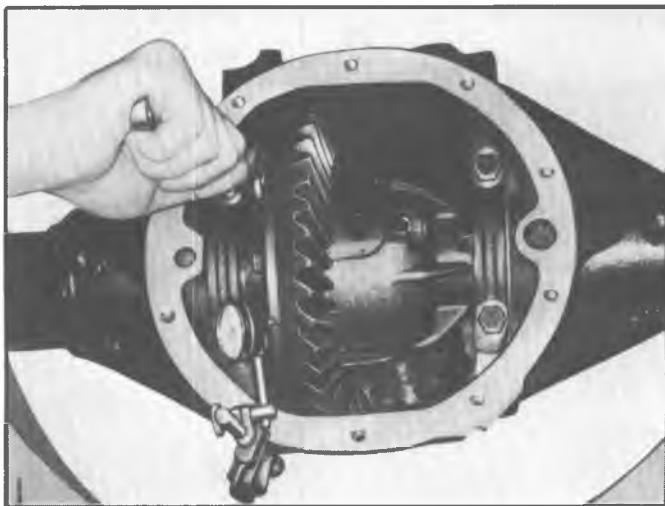


Fig. 11B—Checking Ring Gear Runout

If backlash exceeds .008", increase the shim thickness on the ring gear side, while decreasing the shim thickness on the opposite side **an equal amount**. If backlash is less than .005", decrease the shim thickness on the ring gear side, while increasing the shim thickness on the opposite side **an equal amount**.

## DRIVE PINION

### Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion, as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 12B. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 13B.
6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.
7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.
8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 14B.

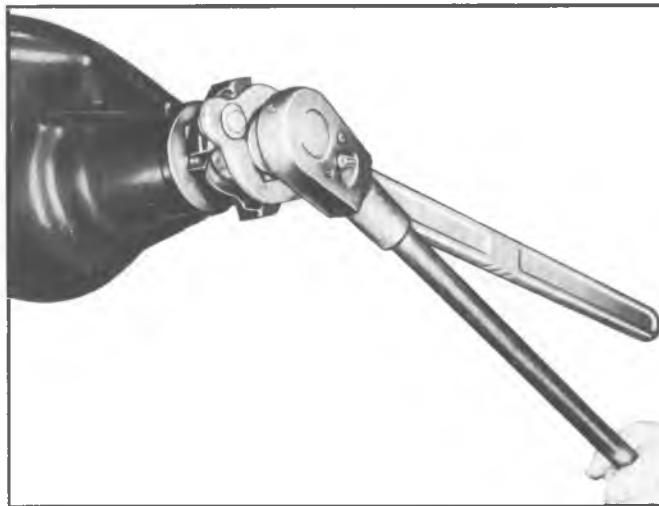


Fig. 12B—Drive Pinion Nut Removal

**NOTE:** Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.

9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion from the housing. Discard the pinion oil seal, nut, and collapsible spacer. Use a new oil seal, nut and spacer on reassembly.

### Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose. Tap alternately on opposite sides of the bearing cup to avoid cocking.
2. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

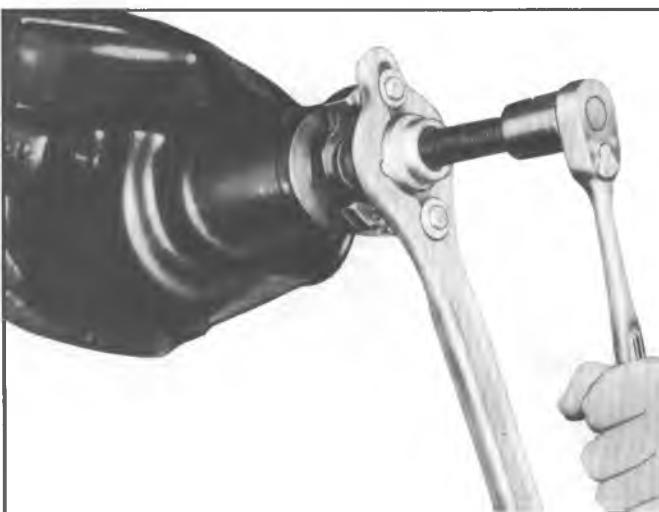


Fig. 13B—Drive Pinion Flange Removal

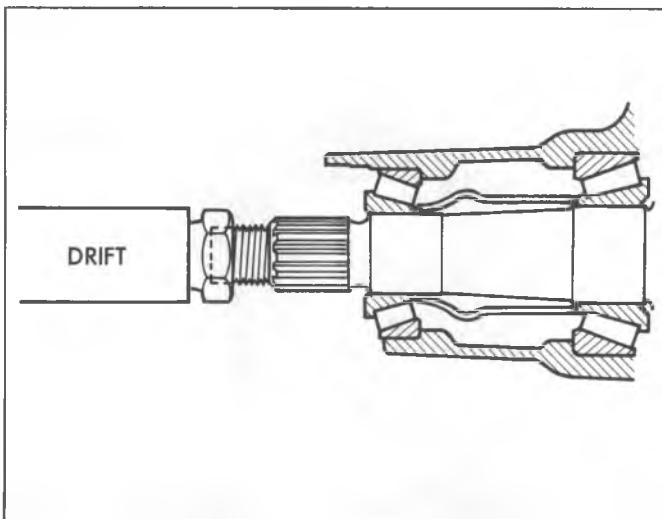


Fig. 14B—Removing Drive Pinion

3. Remove rear pinion bearing from pinion shaft using Press Plate J-22912, as shown in figure 15B.

Tighten nuts on tool until plates are under the bearing inner race. Then set the tool on a press. Make sure the plates straddle the opening on the press. Do not position bolts across the opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record the thickness of shim removed from between bearing and pinion head.

4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.
5. Lubricate both bearing cups with liberal amounts of hypoid lubricant.
6. Install the rear cup, with the large end against the bore shoulder, using Installer J-0270-14 for Truck models, and J-9745 for Passenger Car, as shown in figure 16B.

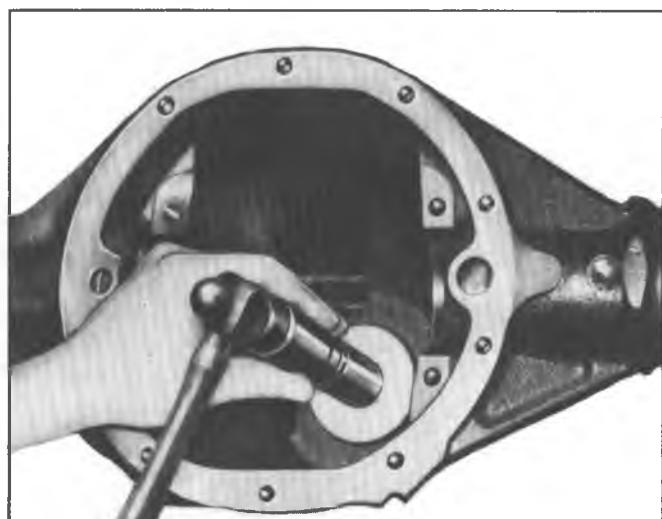


Fig. 16B—Installing Pinion Rear Bearing Cup

7. Install the front cup, with the large end against the bore shoulder, using Installer J-7137 as shown in figure 17B.
8. Check both bores to make sure cups are fully seated.

#### Setting Pinion Depth and Installing Pinion Bearings

**NOTE:** If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or



Fig. 15B—Removing Drive Pinion Rear Bearing

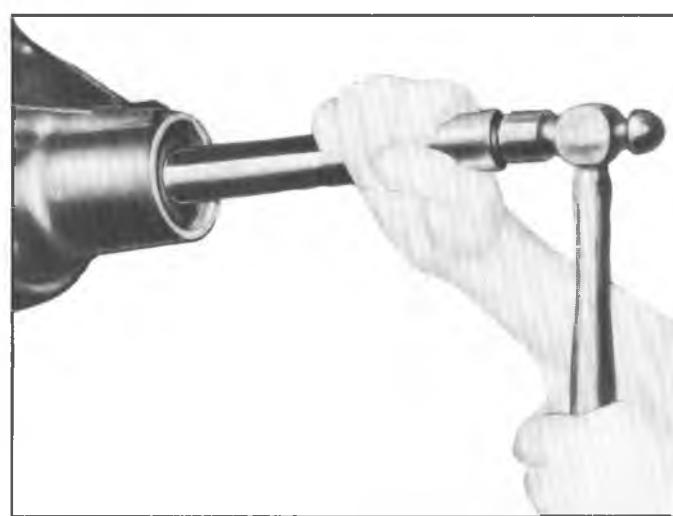


Fig. 17B—Installing Pinion Front Bearing Cup

"nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gauge J-21777-01.

1. Clean the housing assembly and all gauge parts to insure accurate measurements.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3. a. **For Passenger Car** use cloverleaf gauge plate J-21779-29 mounted on preload stud J-21777-43.  
b. **For Truck Models** use cloverleaf gauge plate J-21779-36 mounted on preload stud J-21777-43.  
c. For all models, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figures 18B and 19B for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut. Tighten until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 20B.
5. Mount the side bearing discs J-21777-45 on the

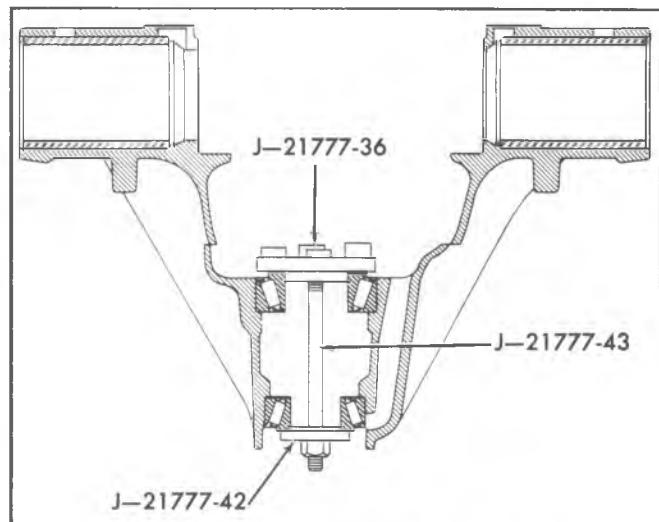


Fig. 19B—Gauge Plate Installed—Truck

ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.

6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.
7. Install the bearing caps finger tight to hold the discs from movement.
8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.
9. Preload the dial indicator one-half revolution, and tighten in this position.
10. Select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest

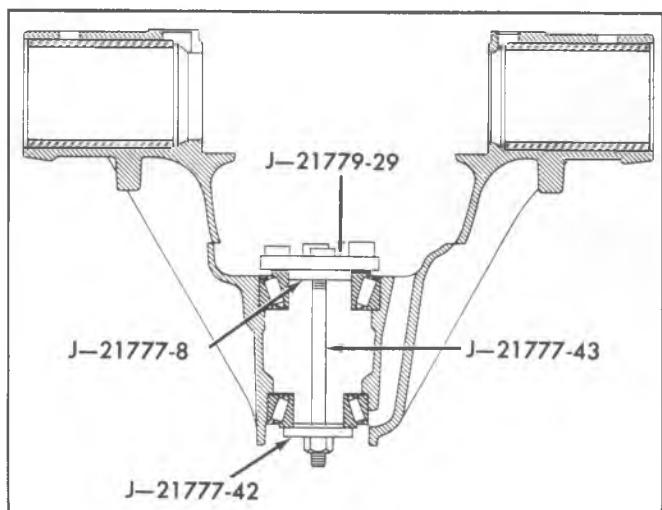


Fig. 18B—Gauge Plate Installed—Passenger Car

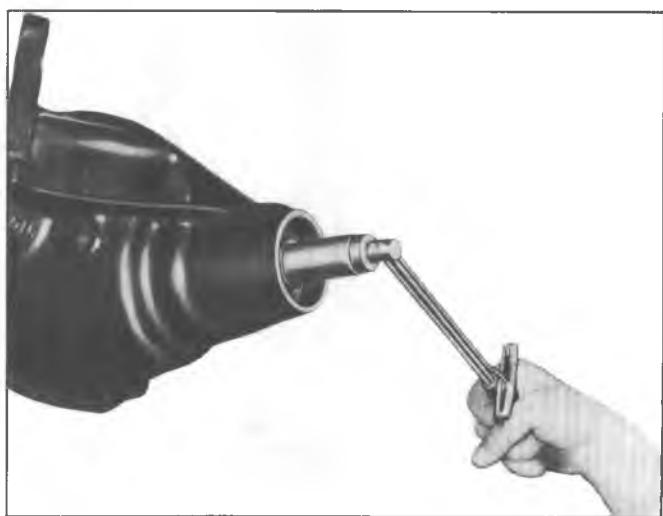


Fig. 20B—Measuring Rotating Torque

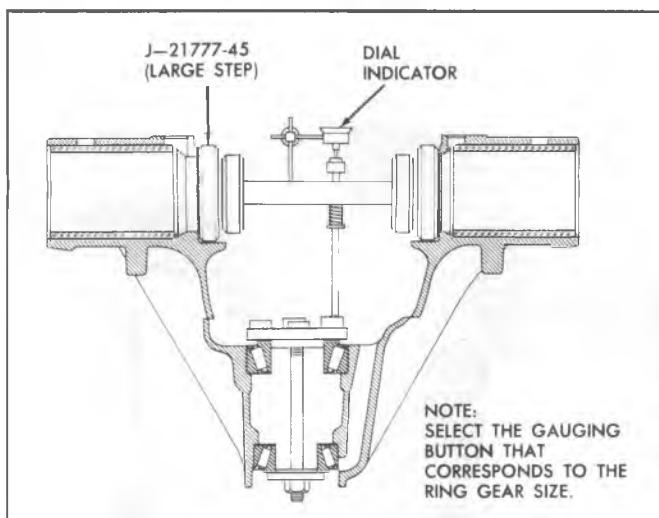


Fig. 21B—Gauging Tools Installed in Carrier—  
Passenger Car

deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figures 21B and 22B.

12. Repeat the rocking action of the plunger several times to verify the setting.
13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button. The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this figure.
14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.
  - a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the

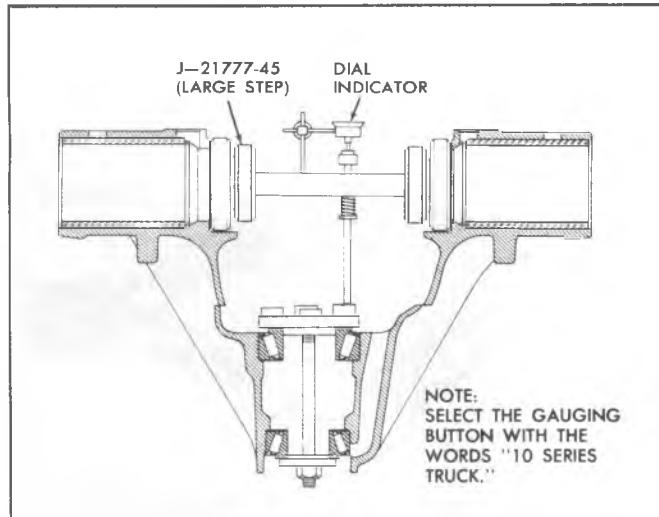


Fig. 22B—Gauging Tools Installed in Carrier—Truck

indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be  $.019 + .002 = .021$  inch.

- b. If the pinion has no plus (+) or minus (-) number, use the indicator reading as the correct shim thickness.
- c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be  $.031 - .003 = .028$  inch.
15. Remove bearing caps and depth gauging tools from carrier.
16. Position the shim selected in step 14 on the pinion shaft against pinion head.
17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing. Use J-6547 as shown in figure 23B for passenger car models. Use J-5590 for truck models, as shown in figure 24B.

#### Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.
2. **For Passenger Car** place a new pinion oil seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier, as shown in figure 25B.
3. **For Truck Models** position seal in bore and place gauge plate J-22804-2 over seal and against flange. Gauge plate insures proper seating of seal in carrier bore. See figure 26B. Use J-23911 to press seal into bore until gauge plate is flush with the

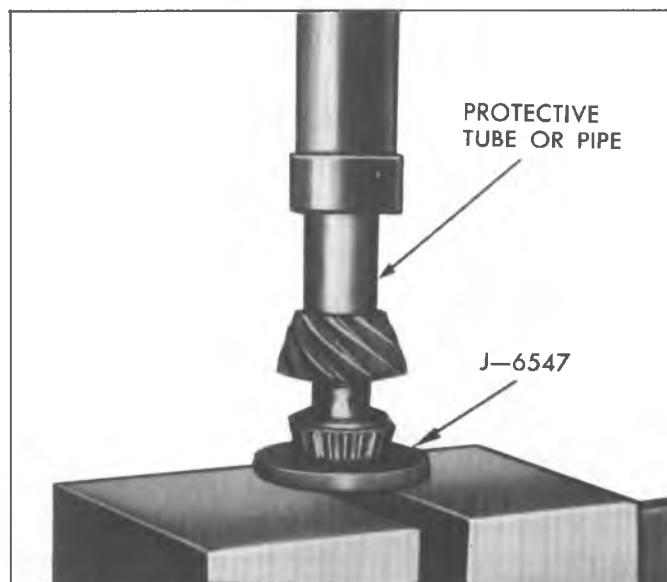


Fig. 23B—Installing Rear Bearing—Passenger Car

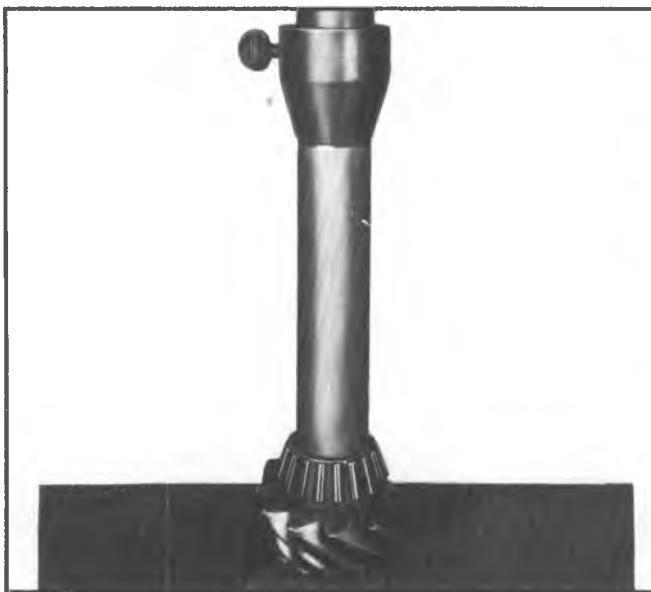


Fig. 24B—Installing Rear Bearing—Truck

- carrier shoulder and seal flange. Turn gauge plate 180°; seal must be square in carrier to seal properly.
4. Coat lips of pinion oil seal and seal surface of pinion flange with hypoid lubricant.
  5. Install a new pinion bearing spacer onto drive pinion.
  6. **For Passenger Car**, position companion flange onto drive pinion, using J-9458 and companion flange Holding Tool J-8614-11, as shown in figure 26B. Tool J-9458-1 is threaded onto pinion shaft, and nut tightened against J-9458-2 to pull flange onto shaft. Remove J-9458 after flange is seated.
  7. **For Truck models**, place drive pinion into position, and mount a suitable thick washer or sheet metal plate over the pinion stem. Install the original

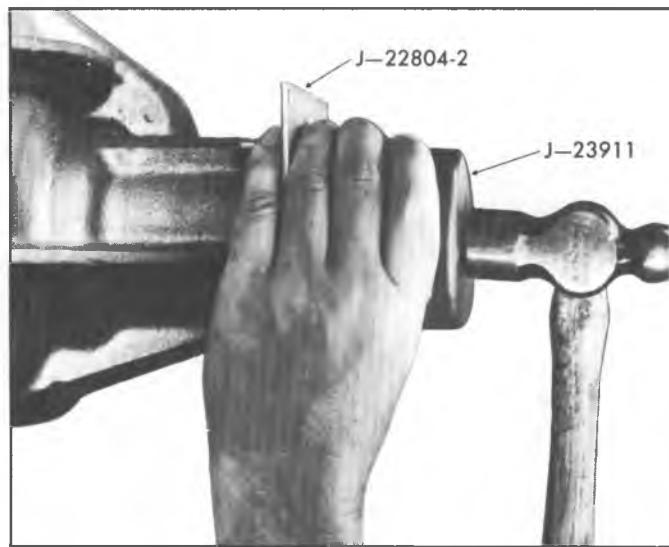


Fig. 26B—Installing Pinion Oil Seal—Truck

pinion nut and tighten sufficiently to draw pinion through the front bearing far enough to leave threads exposed when the companion flange is placed into position. Remove the washer and install the companion flange, using J-8614-11.

**For all models**, tighten nut until all end play is removed from drive pinion.

**NOTE:** When no further end play is detectable, and when Holder J-8614-11 will no longer pivot freely as pinion is rotated, preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked.

9. While observing the preceding caution, carefully set preload drag at 20-25 inch pounds on new bearings,

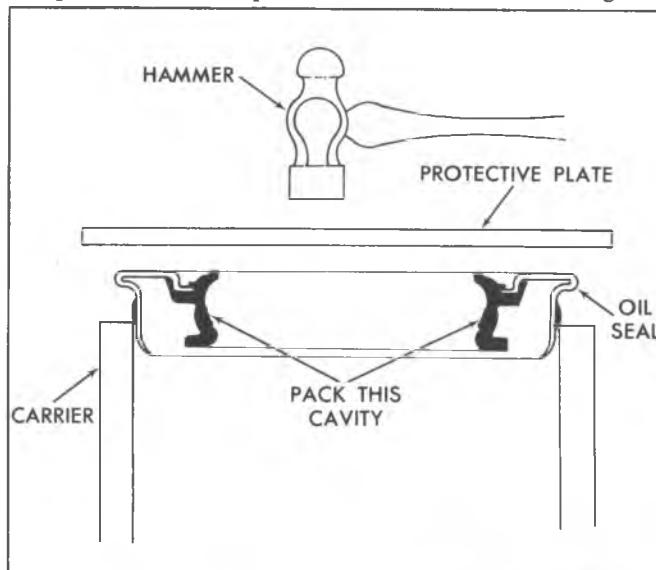


Fig. 25B—Installing Pinion Oil Seal—Passenger Car

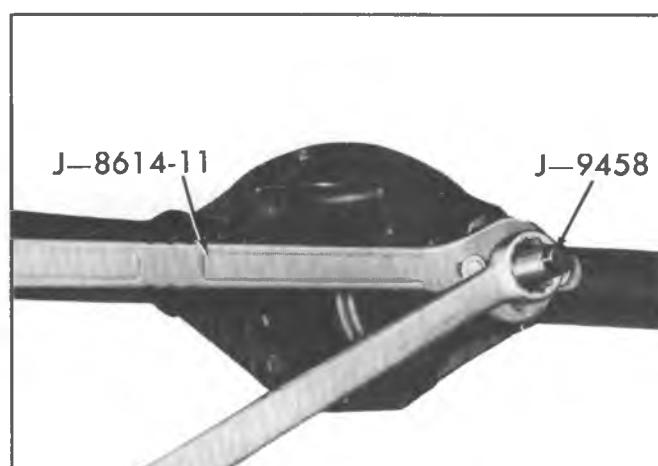


Fig. 27B—Installing Companion Flange—Passenger Car

or 10-15 inch pounds on reused bearings. Use an inch-pound torque wrench such as J-5853, as shown in figure 28B, to measure the rotating torque.

**NOTE:** After torque has been checked, final tightening should be done very cautiously. For example, if when checking, torque was found to be 5 inch-pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

10. Rotate the pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced, re-set preload to specifications.

## CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 8 of "Drive Pinion-Installation and Adjustment".

Side Bearing Preload is set to specifications in step 9 of "Differential Case-Installation and Adjustment".

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made to verify the accuracy of the work in setting the pinion depth and the ring gear-to-pinion backlash.

### Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth



Fig. 28B—Measuring Rotating Torque

Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

### GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 29B.

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.
4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 29B.

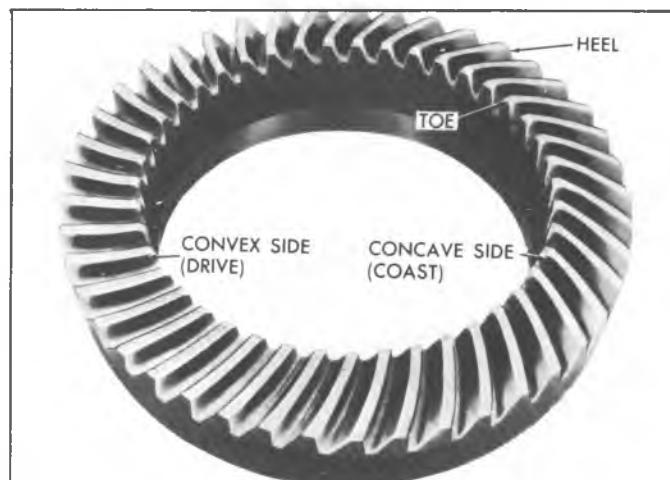


Fig. 29B—Gear Tooth Nomenclature

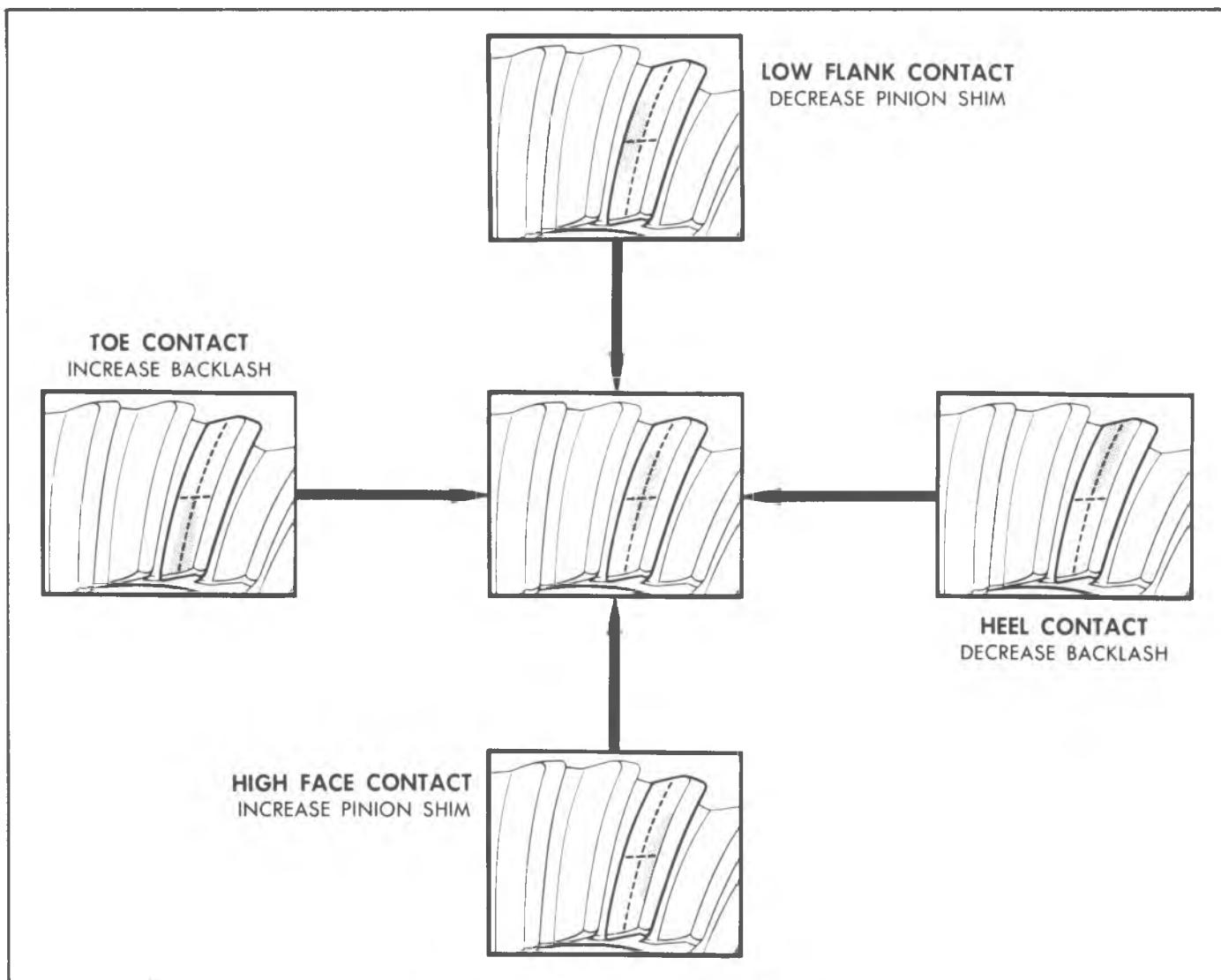


Fig. 30B—Gear Tooth Contact Pattern Check

#### Adjustments Affecting Tooth Contact

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

**NOTE:** It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing

tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

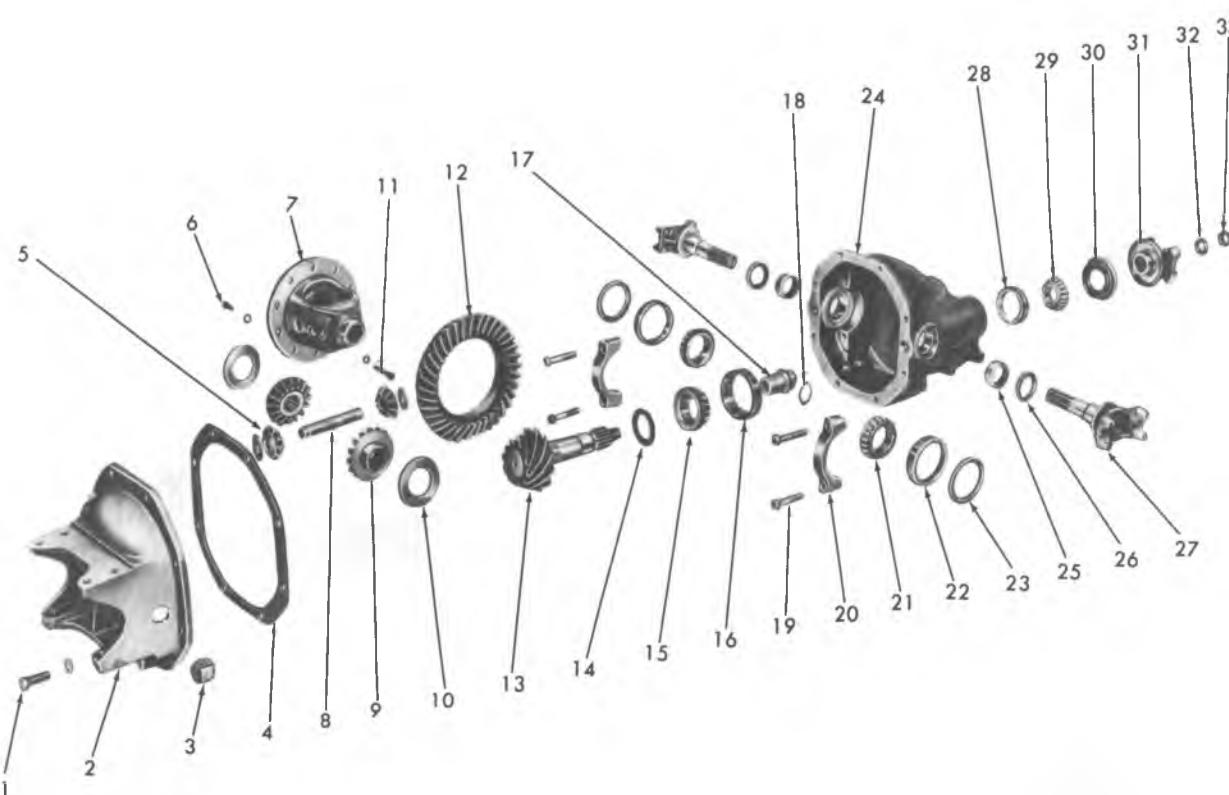
Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

# CORVETTE DIFFERENTIAL

## INDEX

Differential Case	Drive Pinion	Checks and Adjustments
Removal and Disassembly .....	Removal .....	Pinion Bearing Preload .....
Side Bearing Repl. ....	Inspection .....	Side Bearing Preload .....
Ring Gear or Case Repl. ....	Bearing Repl. ....	Pinion Depth and Backlash .....
Reassembly .....	Setting Pinion Depth .....	Gear Tooth Contact Pattern
Drive Yoke Bearing Repl. ....	Installation and Adjustment .....	Check .....
Installation and Adjustment .....		4B-35



1. Cover Bolt
2. Carrier Cover
3. Filler Plug
4. Cover Gasket
5. Differential Pinion
6. Ring Gear Bolt
7. Differential Case
8. Pinion Shaft
9. Differential Side Gear
10. Side Gear Thrust Washer
11. Differential Pinion Pin Retainer
12. Hypoid Ring Gear
13. Hypoid Drive Pinion
14. Pinion Bearing Shim
15. Pinion Rear Bearing
16. Pinion Rear Bearing Cup
17. Pinion Bearing Spacer
18. Side Gear Yoke Snap Ring
19. Side Bearing Cap Bolt
20. Side Bearing Cap
21. Differential Side Bearing
22. Side Bearing Cup
23. Side Bearing Shim and Spacer
24. Differential Carrier
25. Side Gear Yoke Bearing
26. Side Gear Yoke Bearing Seal
27. Side Gear Yoke
28. Pinion Front Bearing Cup
29. Pinion Front Bearing
30. Pinion Oil Seal
31. Companion Flange
32. Pinion Washer
33. Pinion Nut

Fig. 1C—Carrier Assembly—Exploded View

## DIFFERENTIAL CASE

### Removal and Disassembly

1. Clamp carrier in Holding Fixture J-3289.
2. Remove snap rings securing side gear yokes and pull yokes out of carrier. See Figure 1C.
3. Mark differential bearing caps for reassembly in same relative location and remove caps.
4. Pull differential assembly out of carrier, taking care not to damage machined mounting surface on carrier. See Figure 2C. Remove differential bearing shims and mark for future reference.
5. To disassemble, and reassemble, follow procedures outlined in "Positraction Differential Unit" section.

### Inspection

1. Clean all gears and bearings in cleaning solvent and blow dry.
2. Inspect gears for scoring, pitting or cracks.
3. Inspect bearings for spalling, pitting or scoring. Discard all parts that show excessive wear or failure.
4. Inspect side gear driveshaft yokes closely for spline wear or yoke cracking. If equipment is available, use magnetic penetrant method to check for minute fractures in yokes or gears.

### Differential Bearing Replacement

1. Place Puller J-22888 over differential bearing using Adapter Plug J-8107-4 in side gear bore. Tighten puller screw to remove bearing as in Figure 3C.
2. Install new bearing on hub using Installer J-22175. See Figure 4C.
3. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4. This allows differential case to rest on plug instead

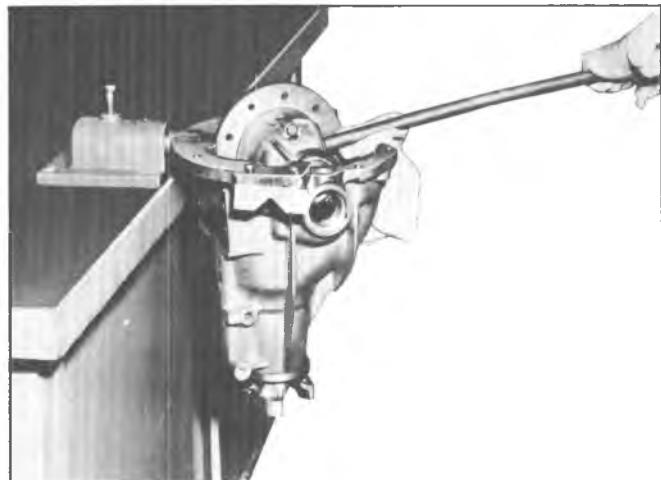


Fig. 2C—Removing Differential Case

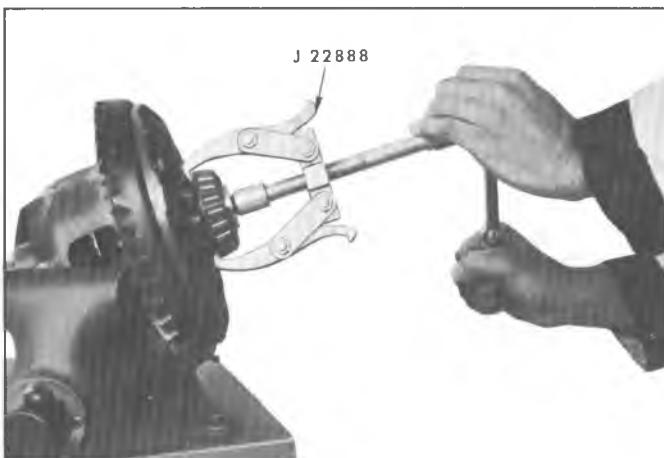


Fig. 3C—Removing Differential Bearing

of bearing cage. See Figure 4C. Install remaining bearing.

### Ring Gear or Differential Case Replacement

1. Remove ring gear bolts and tap ring gear off differential case.
2. Install guide pins fabricated from 3/8-24 x 1 1/2" bolts with heads removed and ends slotted as shown in Figure 5C.
3. Clean ring gear mounting surface and mounting flange on case. Place ring gear on pilot case diameter.

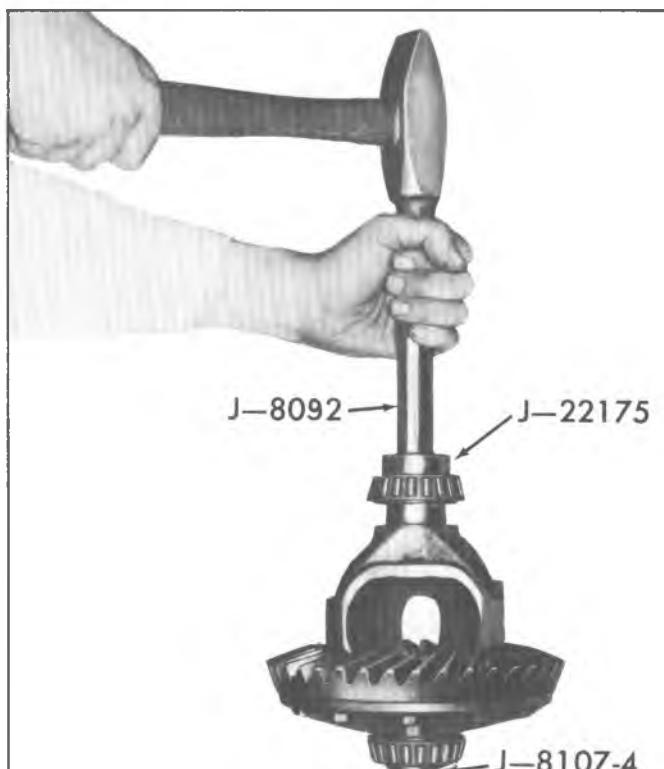


Fig. 4C—Differential Bearing Installation

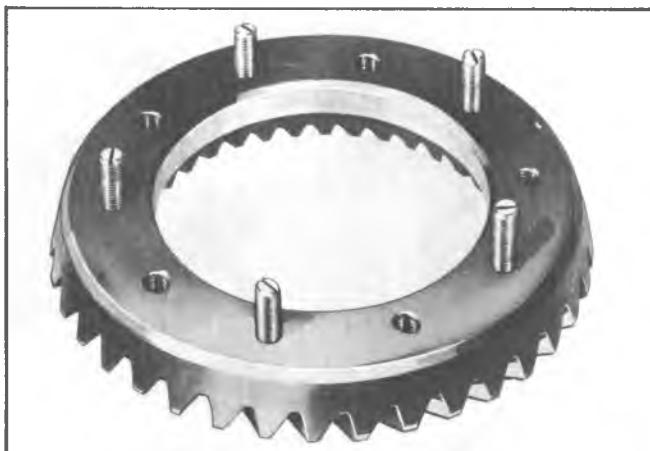


Fig. 5C—Ring Gear Guide Pins Installed

4. Install every other ring gear bolt and draw ring gear up evenly until gear is seated against flange.
5. Remove guide pins and install remaining ring gear bolts. Torque bolts to specifications.

#### Side Gear Yoke Bearing and/or Seal Replacement

1. Place new yoke bearings on Installer J-9773 and install bearing into carrier bore using Handle J-7079-2. See Figure 6C. Drive bearing until it is fully seated.
2. Place a new seal on Installer J-9774 and install into seal bore outboard of bearing as in Figure 7C.

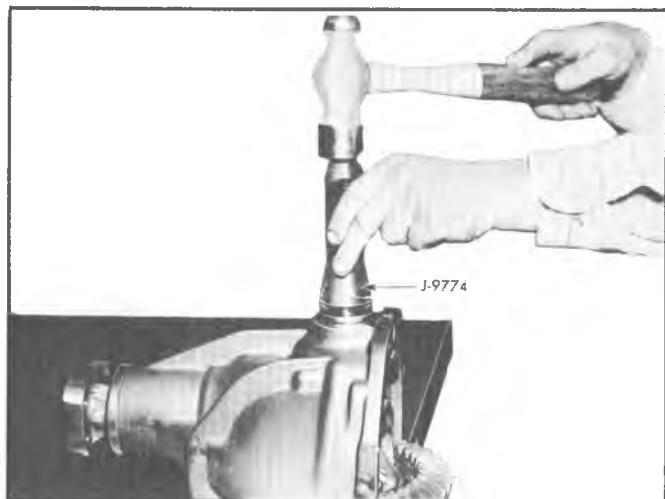


Fig. 7C—Installing Side Gear Yoke Seal

#### Installation and Adjustment

1. Check condition of bearing cups, cup seat in carrier and carrier caps to make sure they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant. Position cups on proper bearings then install differential assembly in carrier as shown in Figure 8C. Install right bearing cap, tightening the bolts to a snug fit.
3. Service spacers are available in one thickness only—.170" plus or minus .001". Steel service shims are used with the service spacer. See following Shim Chart for shim availability and identification.

**NOTE:** Production preloading of the differential bearings is accomplished by the use of cast iron shims. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.

4. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to a snug fit.

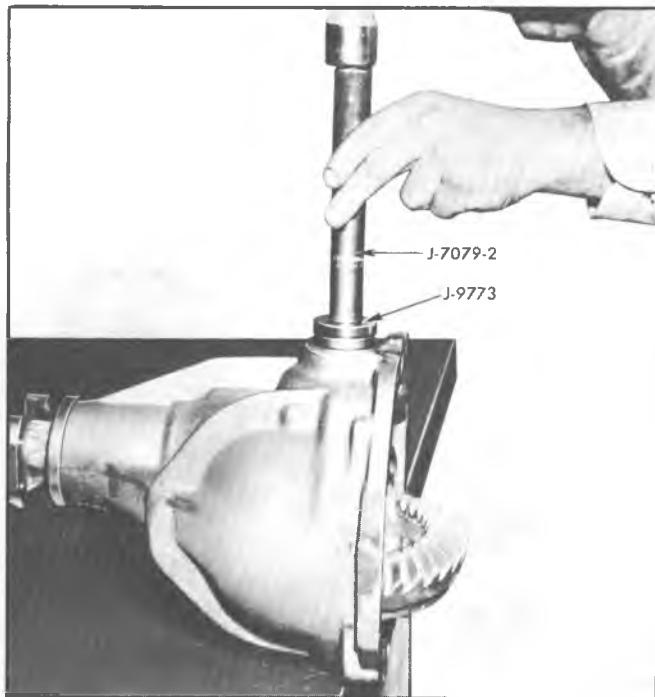


Fig. 6C—Installing Side Gear Yoke Bearings



Fig. 8C—Installing Differential Assembly

Shim Thickness	Shim Identification	
	Notches	
	I.D.	O.D.
.040	0	0
.042	4	1
.044	4	2
.046	4	3
.048	4	4
.050	5	0
.052	5	1
.054	5	2
.056	5	3
.058	5	4
.060	6	0
.062	6	1
.064	0	2
.066	0	3
.068	0	4
.070	1	0
.072	1	1
.074	1	2
.076	1	3
.078	1	4
.080	2	0
.082	2	1
.084	2	2
.086	2	3
.088	2	4
.090	3	0
.092	3	1
.094	3	2
.096	3	3
.098	3	4
.100	4	0

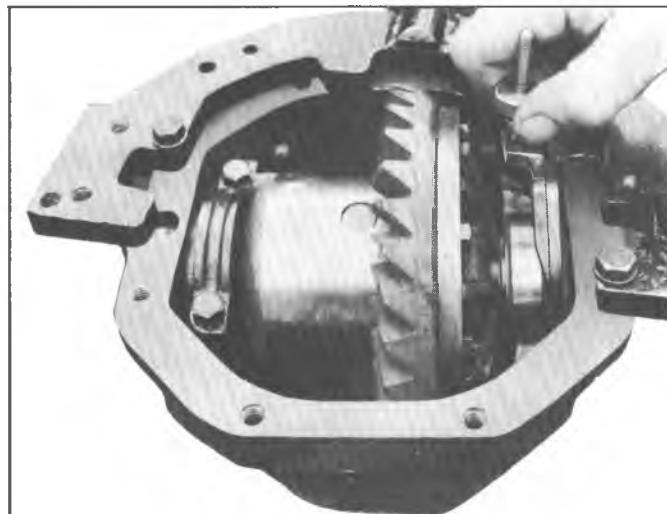


Fig. 9C—Measuring Differential Shim Requirement

5. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gauging Tool J-22779 between the left bearing cup and carrier housing. See Figure 9C. Turn adjusting nut clockwise while oscillating the tool until a noticeable drag is produced.
6. Tighten lock bolt on side of the tool, then remove tool.
7. Using a micrometer, measure the thickness of the gauging plates in a minimum of three places as shown in Figure 10C. Average these readings and record the result.
8. Turn the ring gear 90 degrees and repeat Steps 5, 6 and 7.
9. The required thickness of the service shim is determined by subtracting the thickness of the service spacer from the **higher** of the two averaged readings obtained in Steps 7 and 8.
10. Install the selected shim between the service spacer and bearing. Remove strap J-22779-6 and install left bearing cap. Torque bearing cap bolts to specifications.
11. Remove right-hand bearing cap and install Tool J-22779 between right bearing cup and carrier housing.
12. Turn adjusting nut clockwise while oscillating tool until a noticeable drag is produced (bearing outer race rotates with tool). Remove tool and measure the thickness of the gauging plate in a minimum of three places. Average these readings and record the results.
13. Turn the ring gear 90 degrees and repeat Steps 11 and 12.
14. The required thickness of the service shim is determined as in Step 9; however, an additional .008" must be added to obtain proper side bearing preload.



Fig. 10C—Measuring Gauge Plate Thickness

**EXAMPLE:**

Gauge thickness (higher reading) ..... 254"

Service spacer ..... minus .170"

Service shim size (left side) ..... .084"



Fig. 11C—Installing Differential Shim

**EXAMPLE:**

Gauge thickness (higher reading) .....	.226"
Service spacer used.....	minus .170"
Difference.....	.056"
For preload.....	add .008"
Service shim size.....	.064"

**NOTE:** Service shims are available in increments of .002 in.—if the shim measurement falls between the available shims, select a shim thinner by .001 inch.

15. Install the selected shim between the service spacer and bearing, using a soft face hammer. See Figure 11C.
16. Install the right bearing cap and torque both bearing caps to specifications.
17. Mount a dial indicator on the carrier and check backlash between the ring gear and pinion, as shown in Figure 12C. Backlash should be within the range of .003" to .010" with a reading of .005" to

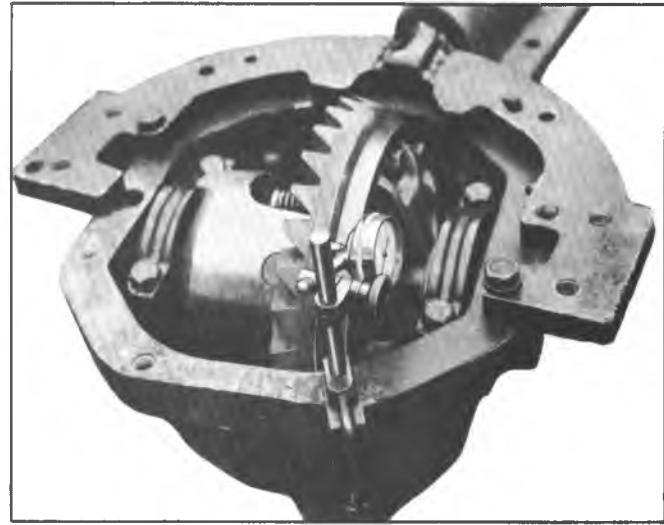


Fig. 13C—Checking Ring Gear Runout

.008" preferred. Check reading at four equally spaced positions around the ring gear. Variation in reading should not exceed .003".

**NOTE:** Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.

18. If variation in backlash exceeds .003", measure ring gear and case runout as shown in Figure 13C. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.
19. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of the other shim the same amount. Total shim thickness must be maintained to maintain proper preload.

**EXAMPLE:** By decreasing shim on the right side .003" and increasing shim thickness on the left side by .003", backlash will decrease by .002".

**DRIVE PINION****Removal**

1. Remove differential case as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Turn holding fixture over and install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 14C. Position J-8614-11 on flange so that the four notches are toward the flange.

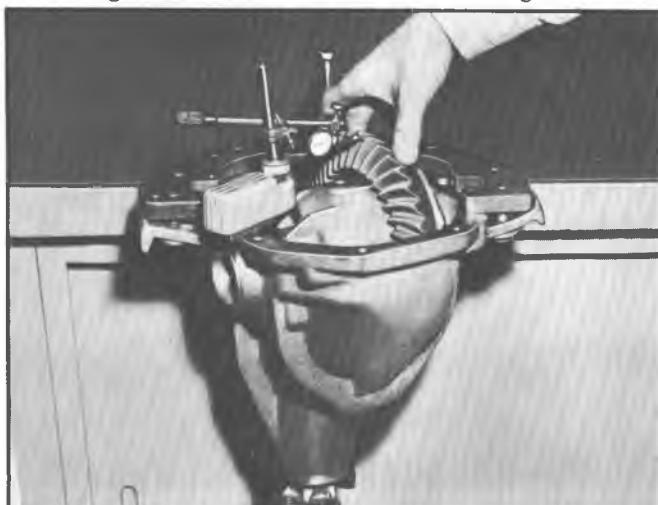


Fig. 12C—Checking Backlash

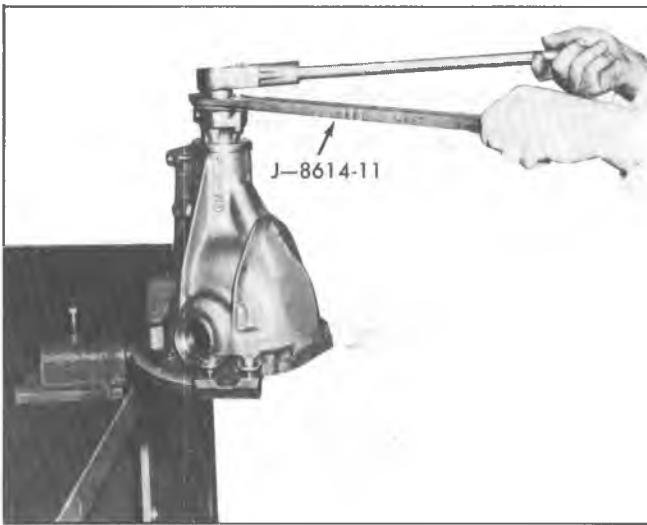


Fig. 14C—Removing Companion Flange Nut

4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 15C.
6. With companion flange removed, drive pinion and rear bearing assembly can be removed from carrier.
7. Pry companion flange seal out of carrier using screw driver and discard seal. Remove pinion front bearing assembly.
8. Pry differential side gear yoke seals out of carrier and discard seals. Using a piece of 1 3/4" O.D. pipe of suitable length, tap yoke bearings out of bore.

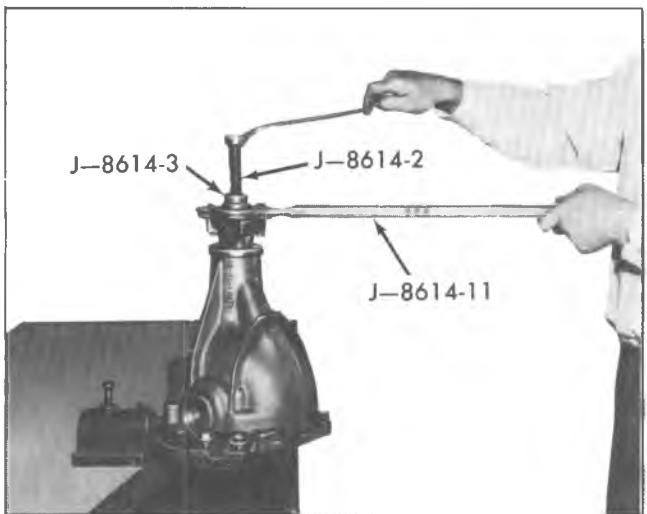


Fig. 15C—Removing Companion Flange

### Inspection

1. Clean all gears and bearings in cleaning solvent and blow dry.

**NOTE:** Do not spin bearings during drying process. The extremely fast spinning and lack of lubrication may quickly result in the failure of an otherwise reusable bearing.

2. Inspect gears for scoring, pitting or cracks.
3. Inspect bearings for spalling, pitting or scoring. Discard all parts that show excessive wear or failure.

### Pinion and/or Bearing Replacement

1. If necessary to replace pinion bearings, tap old cups out of carrier using a brass drift. See Figure 16C. Tap alternately on opposite sides of cup to prevent cups from cocking in carrier. Inspect cup seats and bore for any nicks or burrs and remove as necessary before installing new bearing cups.
2. Select front and rear pinion bearings and drive cups into carrier using Drive Handle J-8092 and Cup Installers J-8608 for the rear cup and J-7137 for front cup. See Figures 17C and 18C. Seat cups securely and squarely against shoulders in carrier.
3. Remove pinion rear bearing using Press Plates J-9771 in Holder J-0358-1 as shown in Figure 19C. Remove and discard shim between bearing and gear head.

### Setting Pinion Depth

**NOTE:** If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the



Fig. 16C—Removing Pinion Bearing Cup

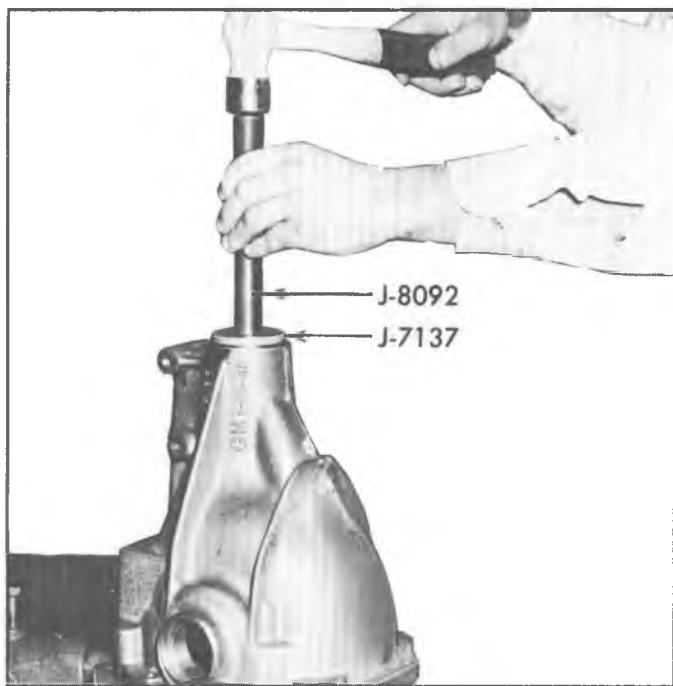


Fig. 17C—Installing Pinion Front Bearing Cup

centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. When a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

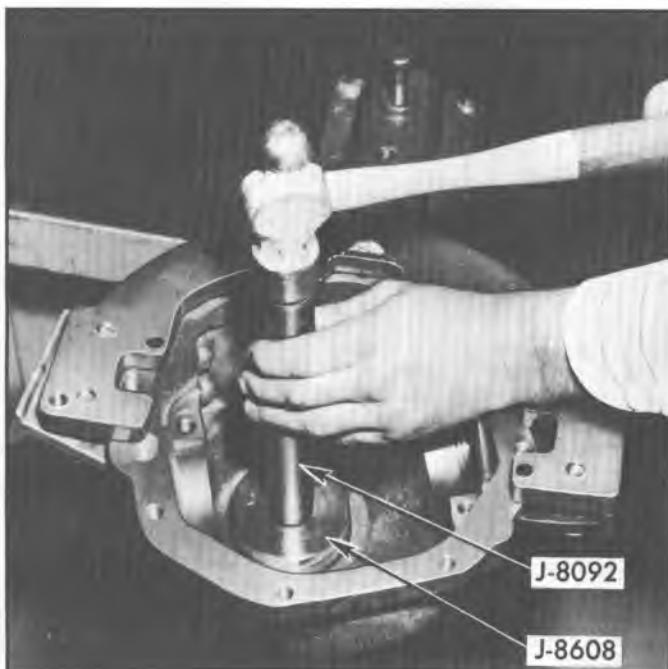


Fig. 18C—Installing Pinion Rear Bearing Cup

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and the rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with pinion setting Gauge J-21777-01.

1. Clean the housing assembly and all gauge parts to insure accuracy of measurements.
2. Lubricate the front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3. With cloverleaf gauge plate J-21777-36 mounted on preload stud J-21777-43, insert stud through rear bearing and pilot J-21777-35, and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 20C for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut until 20 in. lbs. of torque are required to rotate the bearings, as shown in figure 21C.
5. Mount the side bearing discs J-21777-45 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.
6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.
7. Install the bearing caps finger tight to hold the discs from movement.
8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.



Fig. 19C—Removing Pinion Rear Bearing

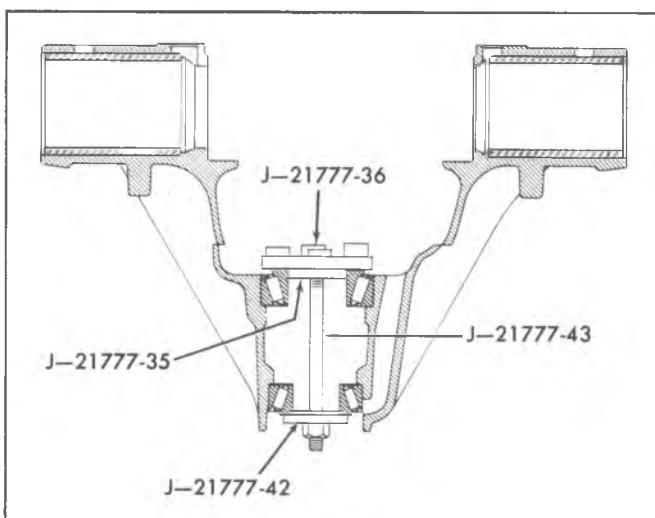


Fig. 20C—Gauge Plate Installed

9. Preload the dial indicator one half revolution, and tighten in this position.
10. Select the button on the gauge plate that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 22C.
12. Repeat the rocking action of the plunger several times to verify the setting.
13. Once the zero reading is obtained, swing the plunger until it is removed from the gauging plate button.

The dial indicator will now read the required pinion shim thickness for a "nominal" pinion.

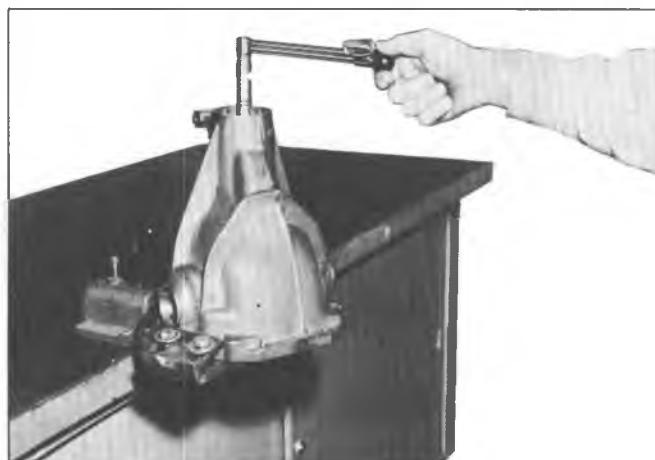


Fig. 21C—Measuring Rotating Torque

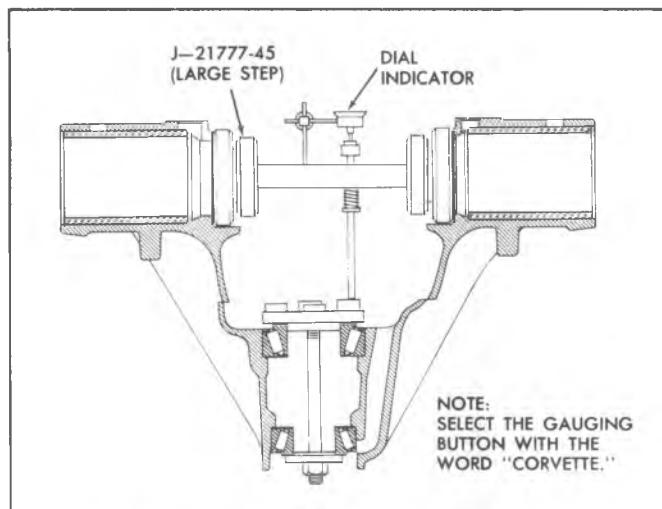


Fig. 22C—Pinion Depth Gauging Tools Installed

14. Check the rear face of the pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.
  - a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be  $.019 + .002 = .021$  inch.
  - b. If the pinion has no plus (+) or minus (-) number, use the indicator reading as the correct shim thickness.
  - c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be  $.031 - .003 = .028$  inch.
15. Remove bearing caps and depth gauging tools from carrier.
16. Position the shim selected in step 14 on the pinion shaft against the pinion head.
17. Install the rear bearing on drive pinion, using J-8609 as shown in figure 23C.

#### Installation and Adjustment

1. Lubricate pinion bearings and outer races and place drive pinion in carrier.
2. Place a new pinion bearing spacer over pinion so it seats on inner race of rear bearing.
3. Slide pinion front bearing cone and roller assembly over pinion shaft so it seats against spacer.
4. Pack the cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant.
5. Place oil seal in carrier bore and tap into position

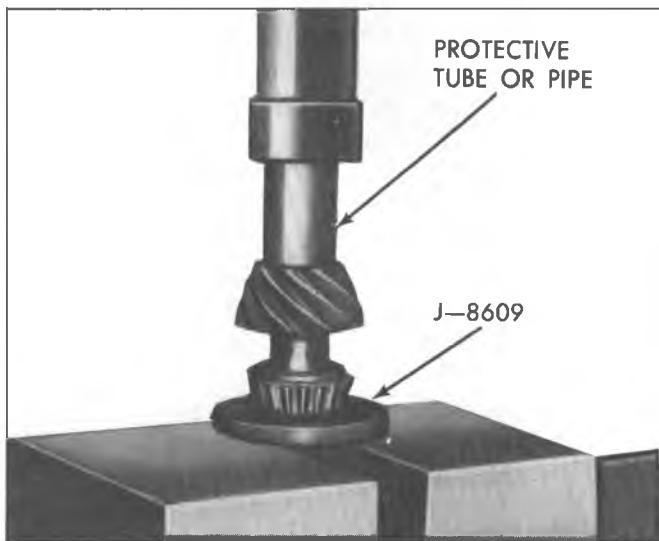


Fig. 23C—Installing Pinion Rear Bearing

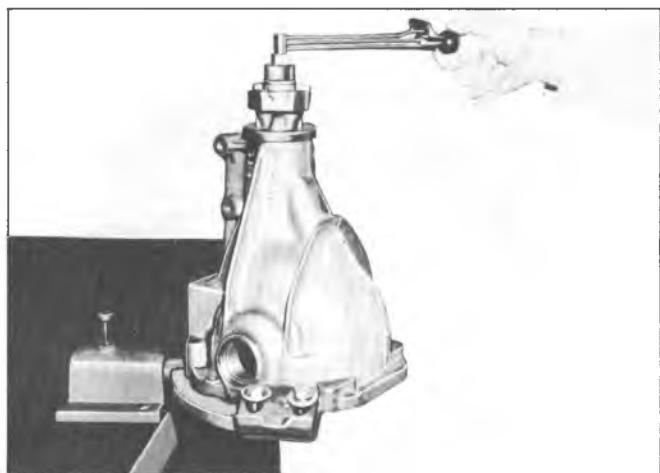


Fig. 25C—Measuring Rotating Torque

with a hammer and drift, until oil seal flange seats against the carrier.

6. Install companion flange using Holder J-8614-11 and Installer J-5780. See Figure 24C.
7. Pack the cavity between end of pinion splines and pinion flange with a nonhardening sealer (such as Permatex Type A or equivalent) prior to installing washer and nut on pinion.
8. Install a new nut on pinion shaft. Tighten nut to remove end play—continue alternately tightening in small increments, and checking preload with torque wrench J-5853 and adapter J-5810 until torque required to rotate pinion is 20-30 in. lbs. for new bearings and seal, or 5-15 in. lbs. when used parts are reinstalled. See Figure 25C.

## CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments

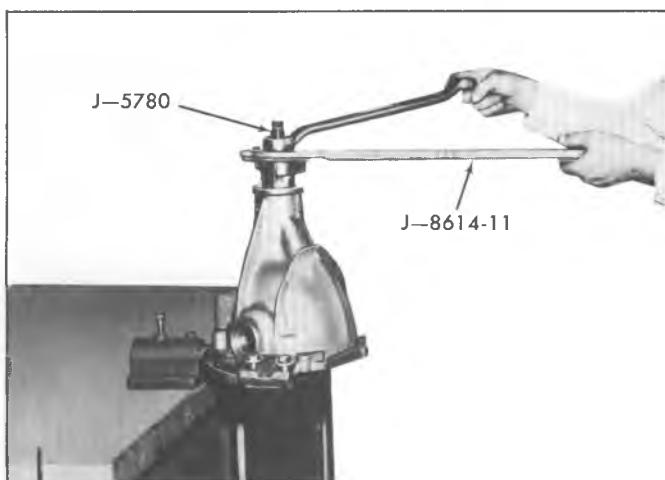


Fig. 24C—Installing Companion Flange

are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 8 of "Drive Pinion—Installation and Adjustment."

Side Bearing Preload is set to specifications in step 14 of "Differential Case—Installation and Adjustment."

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made to verify the accuracy of the work in setting the pinion depth and the Ring Gear-to-Pinion backlash.

### Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 26C.

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.

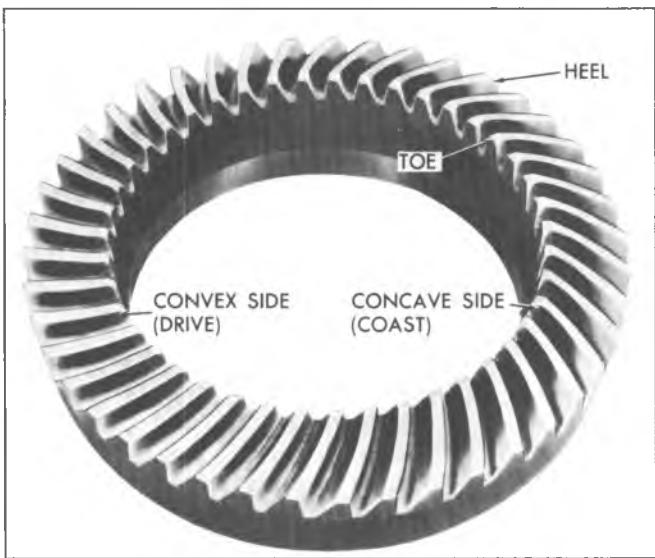


Fig. 26C—Gear Tooth Nomenclature

4. Expand brake shoes until a torque of 20-30 lb. ft. is required to turn the pinion.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 27C.

#### Adjustments Affecting Tooth Contact

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

**NOTE:** It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

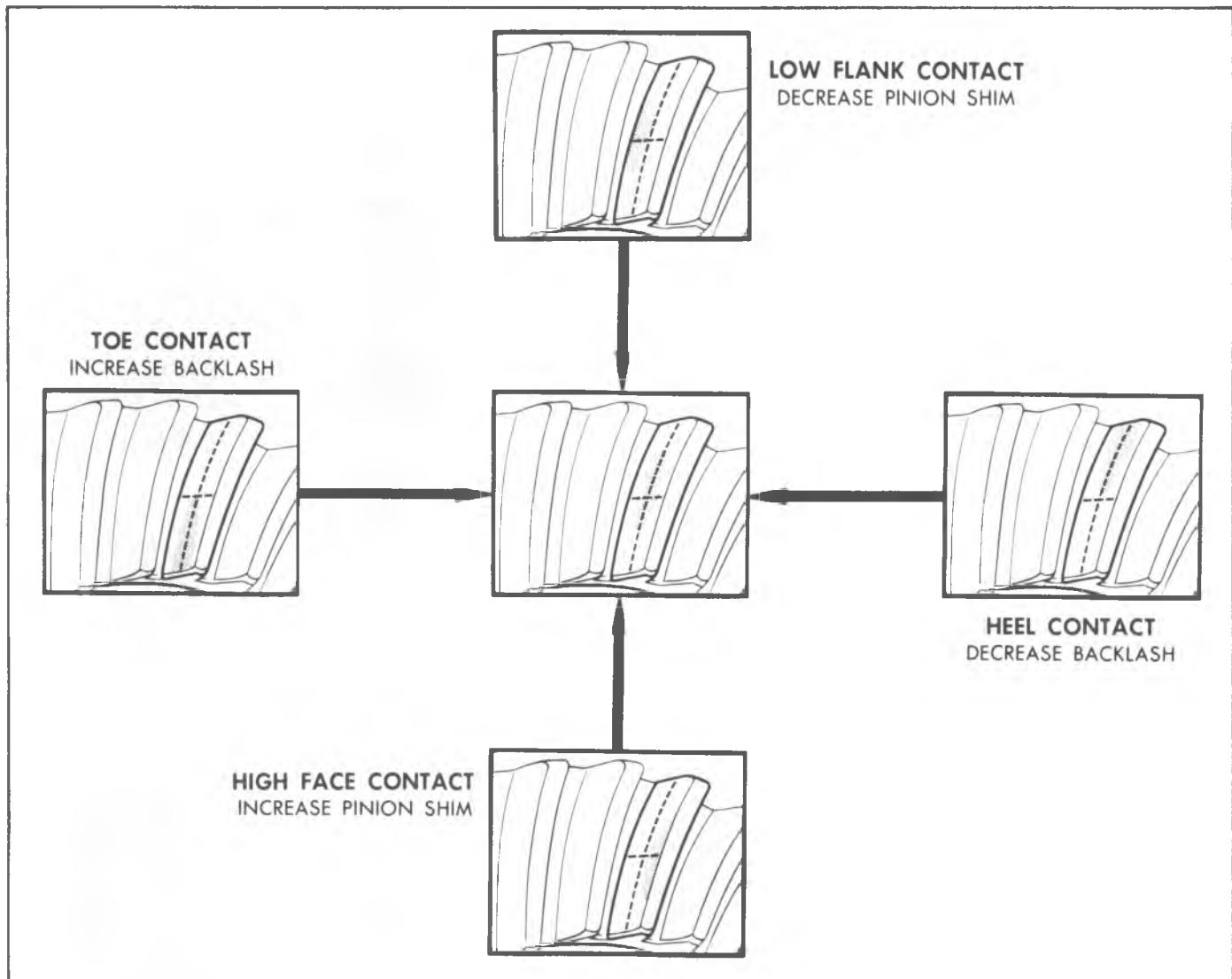


Fig. 27C—Gear Tooth Contact Pattern

## LIMITED SLIP DIFFERENTIAL UNITS

### INDEX

General Description .....	4B-38
Eaton Positraction .....	4B-39
Disassembly .....	4B-39
Inspection .....	4B-40
Reassembly .....	4B-40
Chevrolet Positraction .....	4B-42
Disassembly .....	4B-42
Inspection .....	4B-42
Reassembly .....	4B-42
Power-Lok Differential .....	4B-44
Disassembly .....	4B-44
Inspection .....	4B-44
Assembly .....	4B-45
Testing Procedure .....	4B-45

## GENERAL DESCRIPTION

Vehicles with 8 1/2" ring gear or 8 7/8" ring gear axles use three optional limited slip differentials, namely Chevrolet, Eaton and Borg Warner. Corvette uses only the Eaton unit.

The Borg Warner unit is not repairable except for differential side bearings and must be replaced with either a Chevrolet or an Eaton Positraction differential unit, if service is necessary. See figure 1D.

All truck 10 1/2" ring gear axles produced by Chevrolet use an optional Eaton Positive Locking differential that is serviced as an assembly only. Truck 10 1/2" ring gear axles produced by Dana use only the optional Dana Power-Lok, shown in figure 17D.

Overhaul procedures for limited slip axles are the same as for standard axles, except for the following operations.

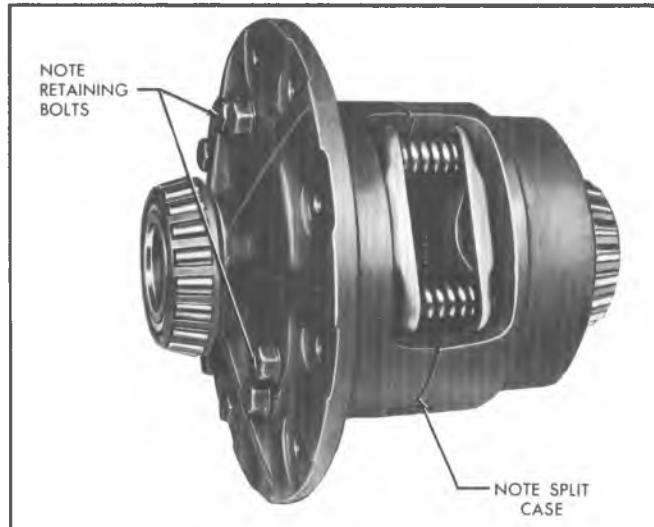


Fig. 1D—Borg Warner Positraction Identification

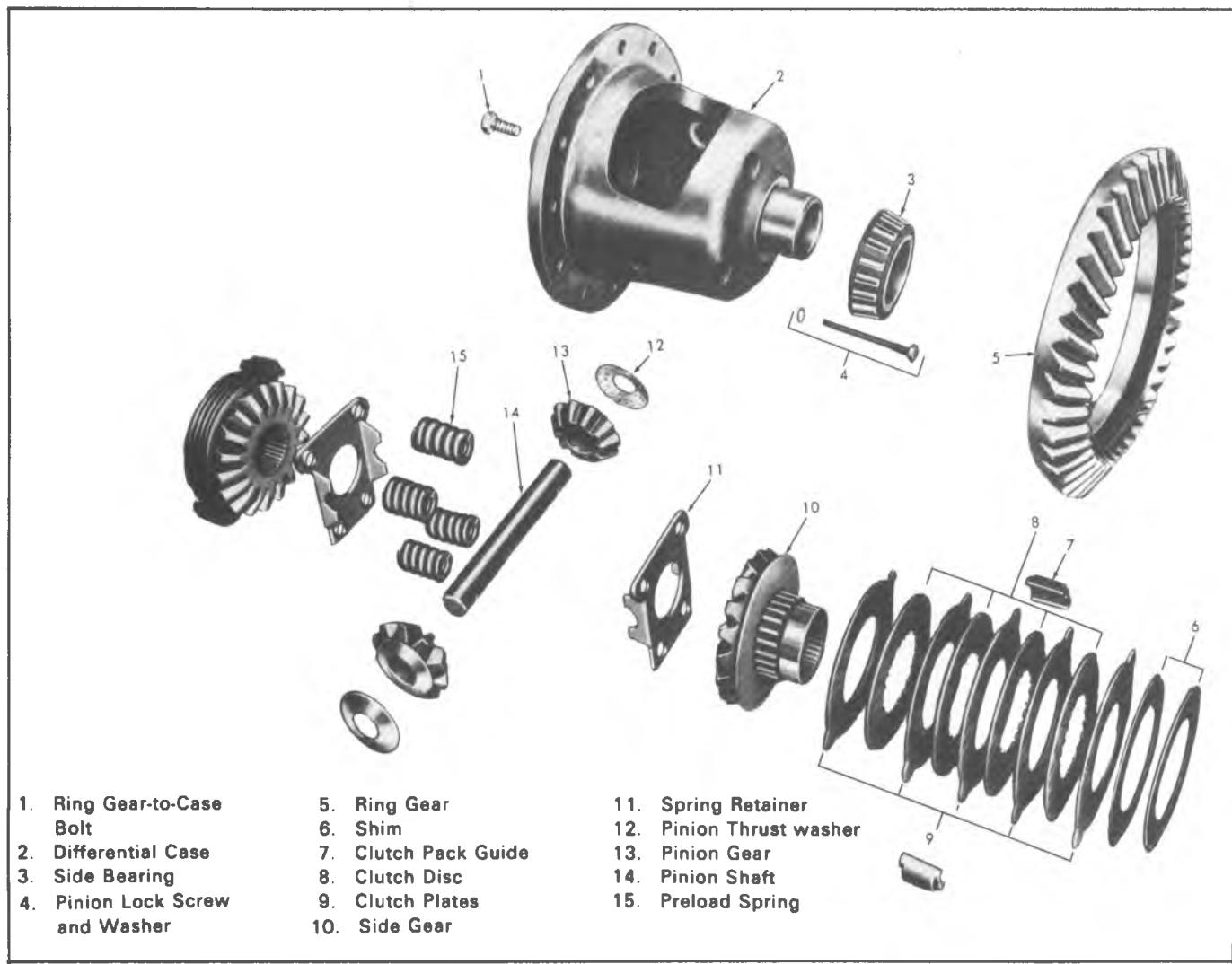


Fig. 2D—Eaton Positraction Exploded View

## EATON POSITRACTION—FIGURE 2D

## Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit.
2. **For all models except Corvette**, remove the preload spring retainer and springs by tapping on the spring retainer through the observation hole in the case. See Figure 3D. Drive the spring retainer from the case sufficiently to allow insertion of a 1/4 inch bolt in each of the two front springs. Secure each bolt with a nut as in Figure 4D.

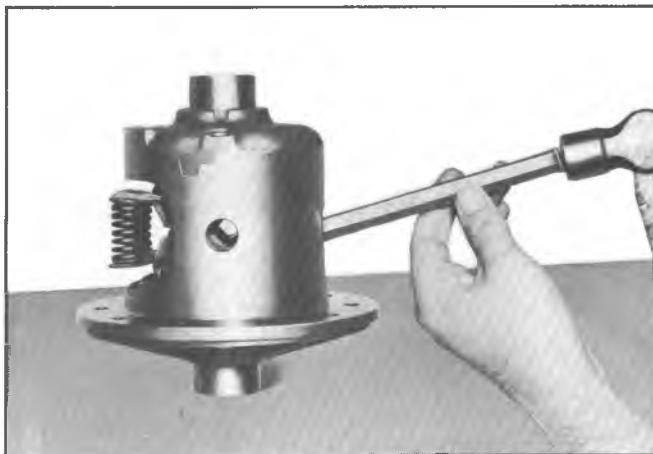


Fig. 3D—Removing Preload Spring Pack (Typical)

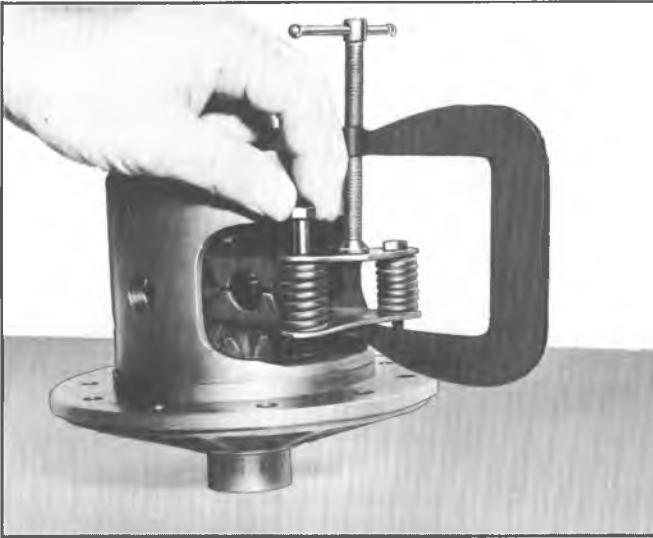


Fig. 4D—Installing Bolts to Retain Springs

3. **On Corvette** it will be necessary to raise the spring retainers slightly to clear the shoulder on the side gears. Install Tool J-22311 to clutch pack so that slotted ends are equally engaged at front and rear of spring retainer. See Figure 5D.



Fig. 5D—Removing Preload Spring Pack (Corvette)

4. After installing the retaining bolts continue to drive spring retainer from the case until enough of the retainer is exposed to permit installation of bar stock and "C" clamp as shown in Figure 6D. Center the bar stock over the axle shaft hole in the spring retainer, then compress "C" clamp sufficiently to permit withdrawal of spring pack.

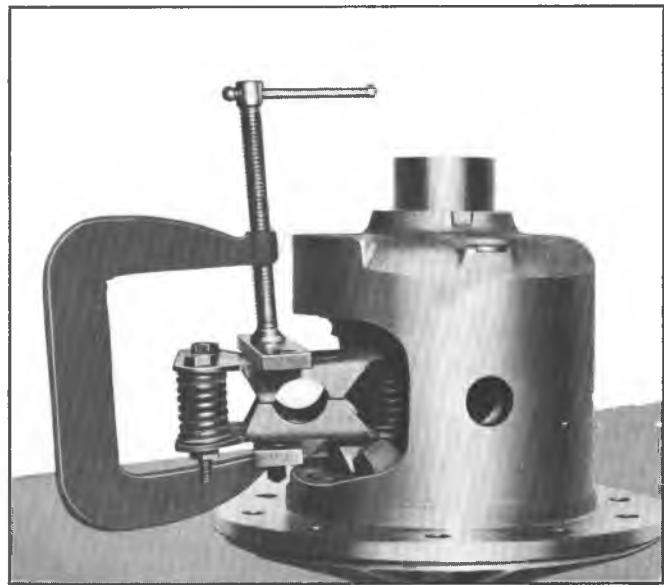


Fig. 6D— C-Clamp and Bar Stock Installed for Spring Removal

5. Position spring pack in vise and remove 1/4 inch bolts. Alternately relieve "C" clamp pressure and vise pressure until spring compression is relieved. See Figure 7D.

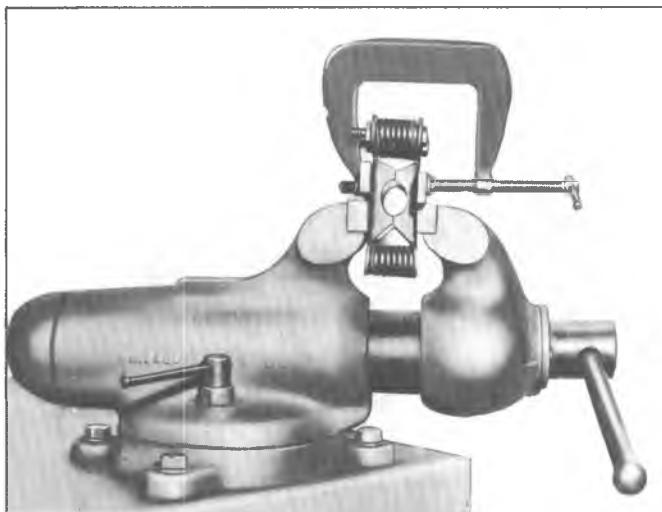


Fig. 7D—Removing Preload Springs from Pack



Fig. 9D—Removing Side Gear

6. **For Truck Models** roll out the differential pinions and thrust washers.

**For Passenger models**, pinion gears can be removed by rotating them in one direction only. Using Figure 8D as a reference, rotate differential case clockwise to remove the first gear, then rotate case counter-clockwise to remove the second gear. To remove second gear, it may be necessary to assist pinion gear upon its seat by prying on gear through observation holes on case. Mark pinions and side gears for reassembly in original position.

7. Remove side gear, clutch pack, shims and guides from case. Tap the assembly from the case, using a brass drift as shown in Figure 9D. Repeat removal on opposite gear.

8. Separate clutch pack assembly from side gear. Retain clutch pack assembly with original side gear.

#### Inspection

1. Check clutch plates and discs for excessive wear and signs of overheating.

NOTE: Clutch plates and discs are not serviced separately. If replacement is required, clutch pack must be replaced as an assembly.

2. Inspect preload springs for distortion and other defects.
3. Compress springs and determine if they are capable of properly preloading the clutch pack, replace springs that are weak or questionable.
4. Examine spring retainer for alignment between the retainer halves and for excessive wear at spring seats.

#### Reassembly

1. Lubricate clutch plates and discs with special positraction lubricant.
2. Alternately position clutch plate and clutch disc on side gear, beginning and ending with clutch plate, until assembly of clutch pack is complete. See Figure 10D.
3. Install clutch pack guides on the clutch plate lugs. Make sure that the clutch disc lugs engage with side gear teeth.
4. Select shims of equal thickness as those removed from the case, or if old shims are suitable, reinstall them over the side gear hub.
5. Lubricate and assemble opposite side gear as above.
6. Install one side gear, clutch pack assembly and shim(s) in the differential case.

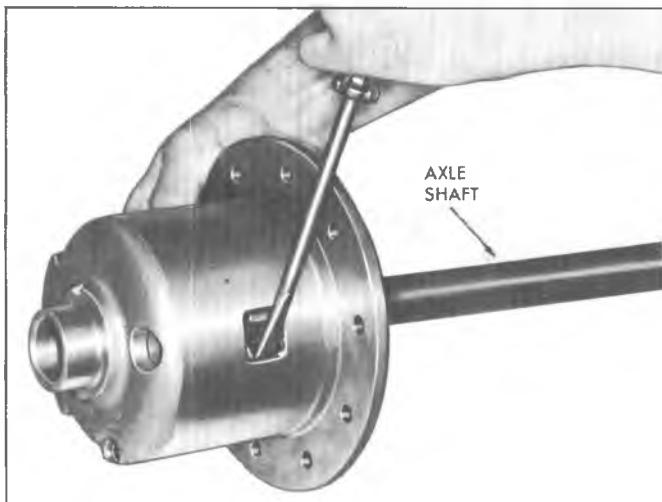


Fig. 8D—Removing Differential Pinion Gears



Fig. 10D—Assembling Clutch Pack

7. Position pinion gears and thrust washers on side gears. Install pinion shaft through case and gears.
8. Install dial indicator in case so that contact button rests against pinion gear as shown in Figure 11D.
9. Compress clutch pack, using a screwdriver as shown in Figure 11D. Move the pinion gear to obtain tooth clearance.
10. Tooth clearance should be .001" to .008". If required, change shims to obtain proper tooth clearance.
11. Remove side gear assembly and repeat tooth clearance procedure for other side gear on opposite side of case.
12. Remove pinion shaft, gears and thrust washers.
13. Install remaining side gear, clutch pack assembly and shims in case.
14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.

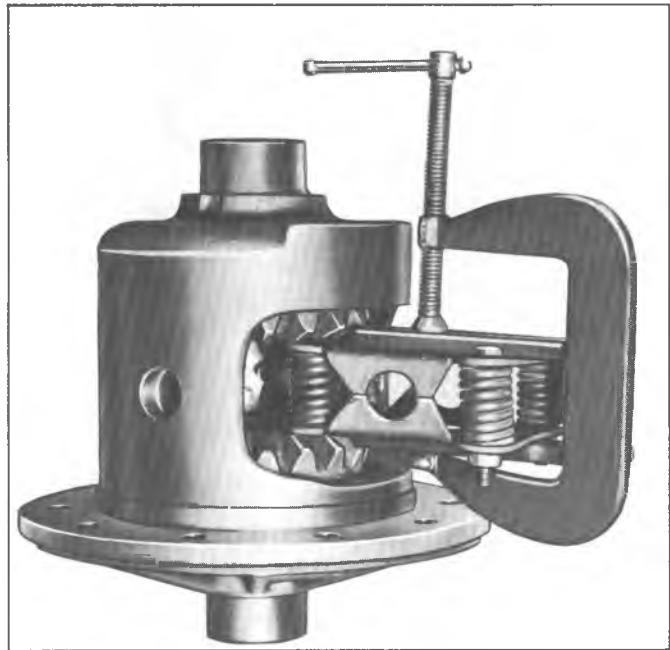


Fig. 12D—Spring Pack Compressed for Installation

15. **For all except Corvette** assemble springs in spring retainer and clamp assembly in vise. Install "C" clamp and bar stock on spring retainer then install a 1/4 inch bolt and nut in each front spring. See Figure 12D.
16. Position spring pack between side gears and remove bar stock and "C" clamp.
17. **On Corvette**, install Tool J-22311 to compress clutch pack, secure pack with 1/4" bolts as shown in Figure 13D. Partially install pack then remove bolts and complete pack installation. Remove tool.
18. Drive spring pack into side gears sufficiently to retain front springs, then remove 1/4 inch bolts from springs. Drive spring pack into position. See Figure 14D.
19. Install the pinion shaft and lock screw to retain side gears until axle shafts are installed.

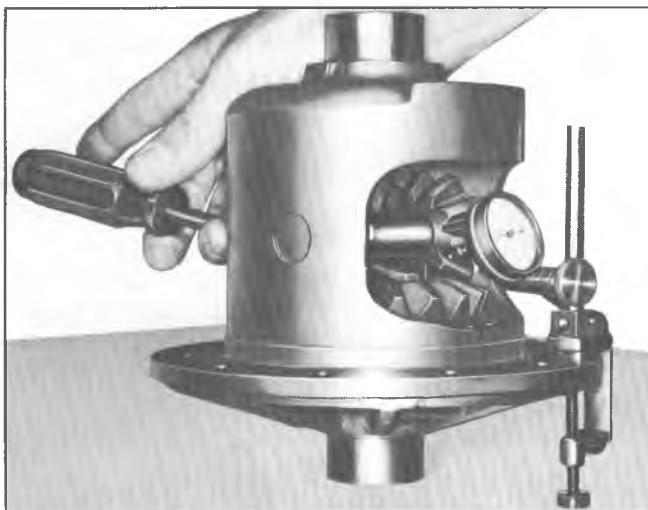


Fig. 11D—Measuring Pinion Gear Tooth Clearance

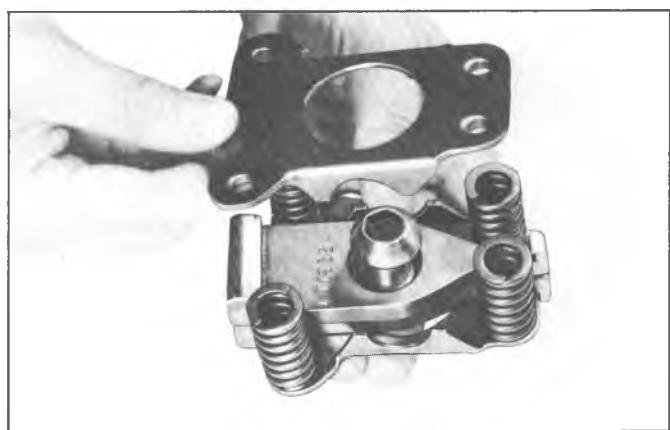


Fig. 13D—Installing Spring Pack Compression Tool (Corvette)

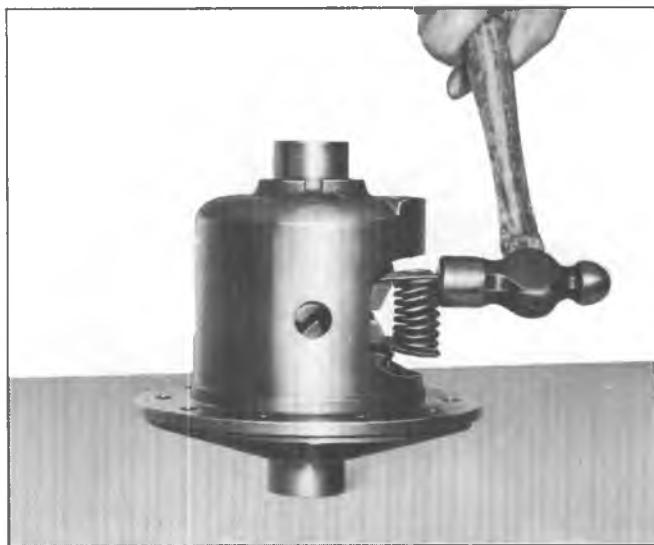


Fig. 14D—Installing Spring Pack

20. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.
21. Install side bearings and ring gear to case using procedure outlined for the conventional differential.
22. Place differential in carrier and adjust bearings and backlash as outlined for the conventional differential.
23. Check operation of unit as follows:
  - a. Raise rear of vehicle until rear wheels are off the ground, and remove one wheel and tire assembly.
  - b. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter, shown in Figure 15D.
  - c. With wheel and tire assembly still on vehicle held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a 0-150 lb. torque wrench attached to J-5748. Torque required to rotate axle shaft should be no less than 40 ft-lbs.

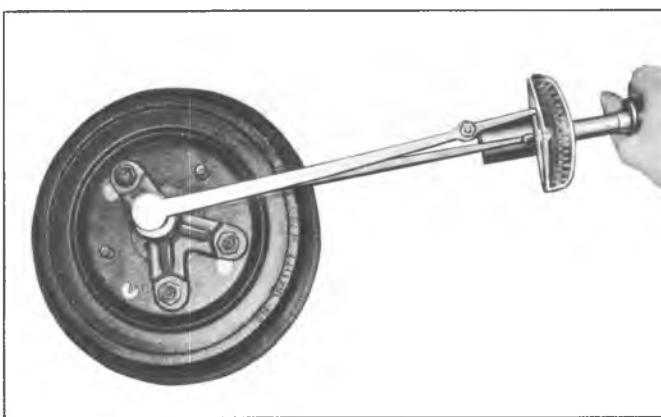


Fig. 15D—Measuring Positraction Rotating Torque

## CHEVROLET POSITRACTION—FIGURE 16D

A Chevrolet produced Positraction differential unit is used optionally in 8 1/2 inch ring gear axles. Individual components of this positraction unit are not interchangeable with other design units.

### Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit. Remove pinion shaft.
  2. Using a wide, blunt instrument such as a drift or block of wood, drive the preload spring from the case.
  3. Support an axle shaft in a vise, and slide the case into the shaft; then turn the case to remove both pinions and thrust washers.
- NOTE:** The pinion shaft may be partially installed to aid in rotating the case.
4. Remove the case from the axle shaft and remove both side gears, clutch packs and shims. Mark the gears, clutch packs and shims for reinstallation in same positions.

### Inspection

Check the clutch plates and discs for wear and signs of overheating. Check the condition of the preload spring. Check the gear teeth for signs of wear. Replace parts as needed. Clean all parts to be used for assembly.

**NOTE:** The force required to compress the preload spring to 1-5/16 inches should be 300 lbs.  $\pm$  30 lbs.

### Reassembly

1. Lubricate the clutch discs and plates with positraction lubricant.
2. Alternately position clutch plates and discs on a side gear, beginning and ending with a clutch plate.
3. Position the side gear, clutch pack and original shim into the case.
4. Install both pinion gears and thrust washers into the case, and install pinion shaft.
5. Place the case onto an axle shaft supported in a vise.
6. Insert a screwdriver between the pinion shaft and the face of the side gear. Force the screwdriver in until the clutch pack is compressed.
7. Check the backlash between side gear and pinion gears. If backlash does not fall into the range of .005" to .008", adjust the shim dimension as required. Increasing shim thickness will decrease backlash; to increase backlash, decrease the thickness of the shim.

NOTE: Service shims are available from .070" to .122" in increments of .004".

8. Remove the pinion shaft, pinion gears, side gear, clutch pack and shim from the case.
9. Install the opposite gear, clutch pack and original shim into the opposite side of the case. Place both pinion gears, and thrust washers into position, and install the pinion shaft.
10. Follow the procedure in steps 5, 6 and 7 to determine the proper shim dimension.
11. When the proper shims have been determined to achieve .005" to .008" backlash between both pinion gears and both side gears, install shims, clutch packs and side gears into case.

12. Mount the case onto the axle shaft locked in a vise. Place both pinions and thrust washers into position—180° apart—and carefully "roll in" by turning the case on the shaft.

NOTE: A large "C" clamp may be used to apply slight compression against pinion gears to aid the "rolling in" procedure.

13. Tap the preload spring into place with a hammer.
14. Install the pinion shaft and lock screw.
15. Install the side bearings and ring gear using the procedure outlined for conventional units.
16. Place the differential unit in the carrier and adjust ring gear and pinion backlash, and gear tooth pattern.

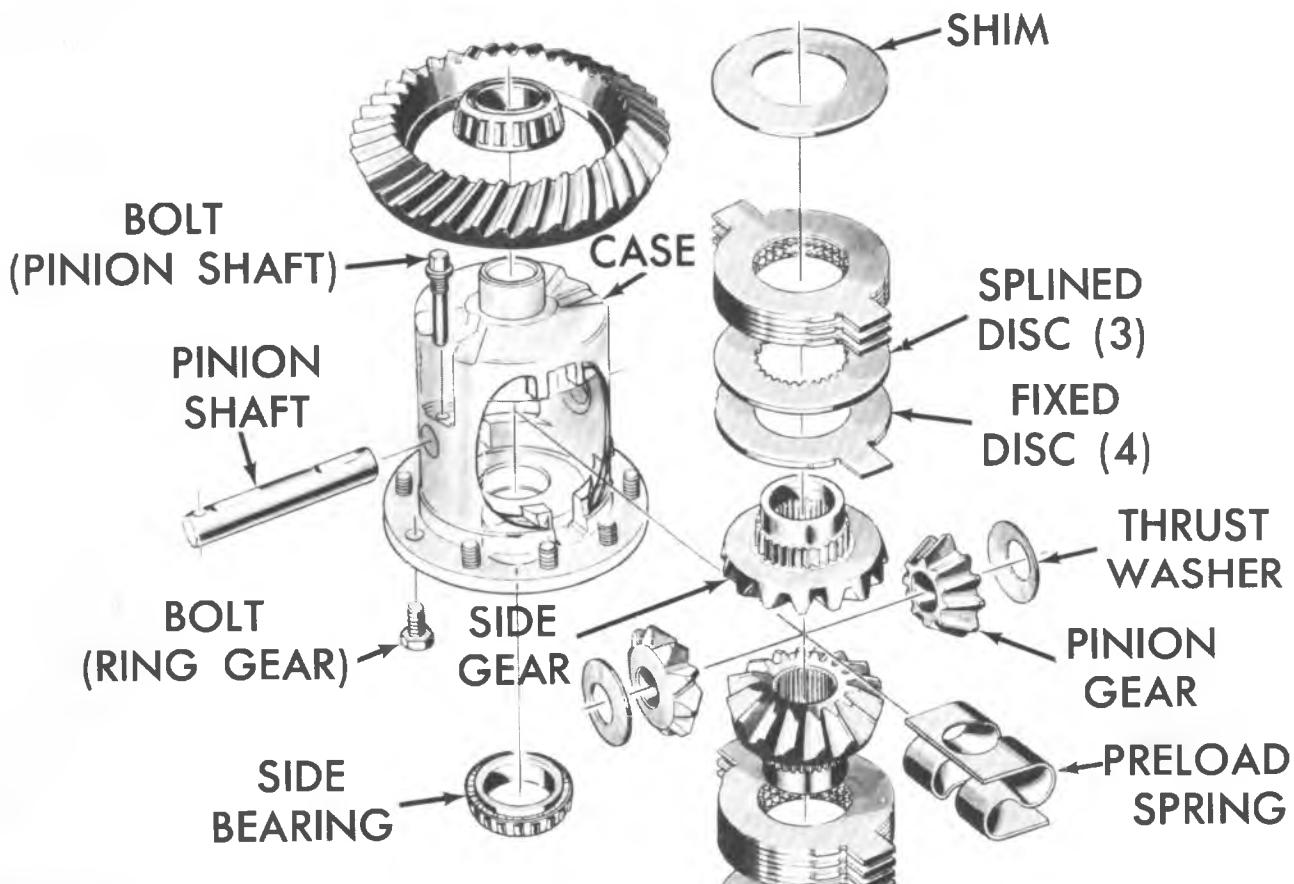


Fig. 16D—Chevrolet Positraction—Exploded

## POWER-LOK DIFFERENTIAL

The Power-Lok differential shown in Figure 17D is a unit which is installed as optional equipment in place of the standard differential. The locking differential permits the major driving force to be transmitted to the wheel with better traction. This means that the vehicle can be operated on ice, snow, sand or under other adverse conditions with a minimum amount of slippage through one wheel.

### Disassembly

1. Remove differential bearing cups and tag for reassembly reference.
2. Remove differential bearing cones, using Puller Tool J-22888.
3. Tag each bearing cone and shim for reassembly reference, as they should be replaced in their original locations.
4. Scribe mark on both halves of differential so they can be reassembled in their original locations.
5. Remove eight bolts attaching two halves of case together.
6. Separate plain half of differential case from flanged half.

7. Remove five plates and discs from side gear ring.

NOTE: A series of clutch plates and dished (Belleville) friction plates on each side of differential side gears transmits drive from differential case to axle shafts. Carefully observe the order in which the plates are used, since they must be replaced in the same order. Refer to Figure 17D.

8. Remove side gear ring and side gear.
9. Remove two cross shafts and pinion gears.
10. Remove side gear, side gear ring, and five plates and discs from the opposite side. Observe the order in which the plates are used.

### Inspection

1. Inspect cross shafts and pinions for scoring, wear, pitting, etc. If the center lands of either cross shaft show signs of wear, examine ends of axle shafts to determine if the axle shaft is rubbing against cross shaft. This rubbing condition may cause a whine or howl that is similar to a pinion bearing noise, at 40 to 50 MPH. This condition can be corrected by grinding 1/32" off the end of the axle shaft.

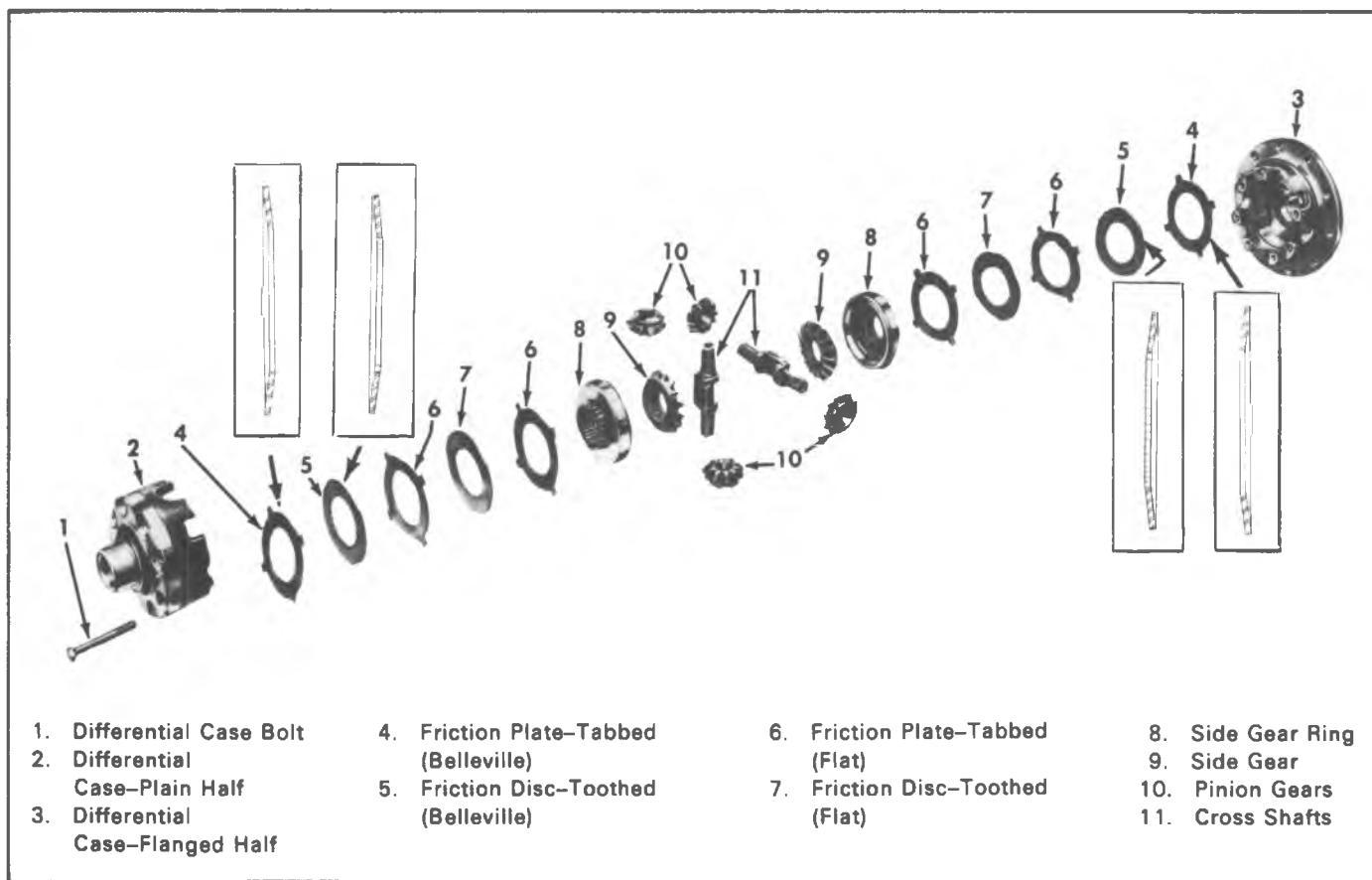


Fig. 17D—Power-Lok Differential

2. Inspect clutch discs and plates for wear, cracked, or distorted condition. Refer to "Specifications" section.
3. Inspect side gear rings, side gears, and differential cases for worn, cracked, or distorted condition that would render these parts unfit for further services.

### Assembly

During assembly operations, all parts should be kept clean and free of dirt or other foreign material. As each part is assembled in its proper position, it is necessary that it be lightly coated with the correct lubricant.

1. Place tabbed Belleville friction plate (4) in flanged differential case, being extremely careful that convex (bulged) side is toward the side gear. See Figure 17D.
2. Assemble remaining plates and discs to splines of side gear ring, being sure they are assembled in the same order of removal. The convex (bulged) side of the Belleville friction disc (5) should be toward the side gear and it should nest into the Belleville friction plate (4).
3. Place assembled side gear ring with plates and discs in flanged half of differential case.
4. Install side gear and cross shafts with pinions.
5. In the order listed install the following: (1) side gear, (2) side gear ring, (3) flat plate with tabs, (4) flat disc with teeth, (5) flat plate with tabs, (6) Belleville disc with convex (bulged) side up, or toward side gear, (7) Belleville plate, with convex (bulged) side up, or side toward gear.
6. Position plain half of differential case over previously assembled parts with scribe markings on both halves of case in alignment.
7. Install differential case bolts, but do not tighten at this time.

8. Before tightening bolts, use axle shafts and align splines of the side gear and side gear ring, on each side. Tighten bolts evenly and alternately. Remove axle shafts.
9. Observe if Power-Lok components have been assembled properly. Each pinion cross shaft can be tight on its ramp or if there is clearance it should be only a few thousandths, and it should be equal at all four cross shaft ends.

### Testing Procedure

The Power-Lok can be effectively tested for correct operation by placing one rear wheel on good dry pavement and the other on ice, snow, mud, gravel, grease, etc.

It can easily be determined whether or not the non-slipping wheel is providing pulling power. The procedure should then be repeated with the opposite wheels on the dry and slippery surfaces.

The above testing procedure is a rough test that can be made by the owner of the vehicle. However, if it is suspected that the unit is not operating properly, it can be checked by the following procedure.

Be sure the transmission is in neutral. Raise one wheel off the floor and place a block in the front and rear of the opposite wheel. Remove the hub cap and install a special tool across two wheel studs. Apply a torque wrench to special tool. Disregard breakaway torque and observe only the torque required to continuously turn the wheel smoothly.

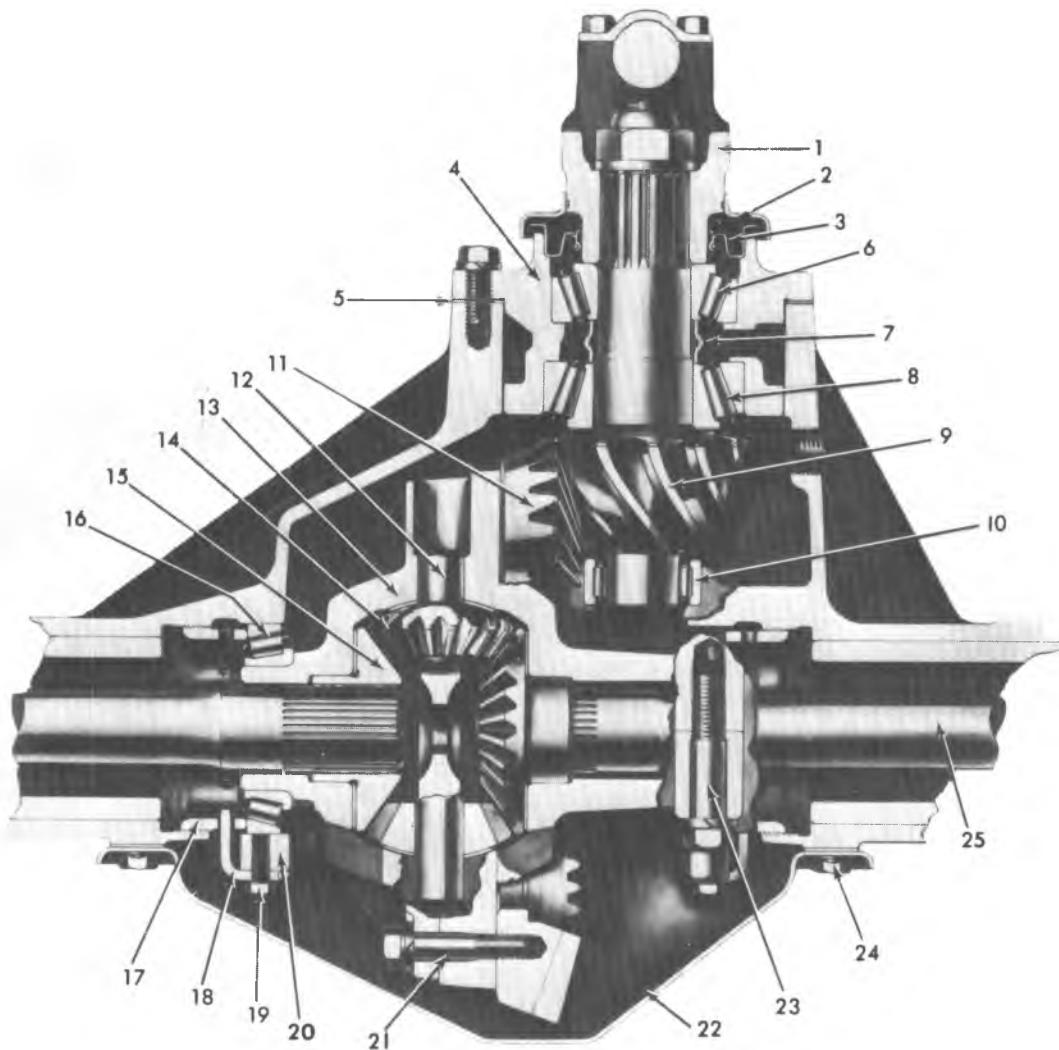
If the torque reading is less than 40 foot-pounds or more than 200 ft. lb., the unit should be disassembled and the necessary repairs made.

# CHEVROLET SERIES 20-30 TRUCK DIFFERENTIAL

## 10-1/2" RING GEAR

### INDEX

Differential Case	Drive Pinion Assembly	Checks and Adjustments
Removal .....	Removal .....	Pinion Bearing Preload .....
Side Bearing Repl. ....	Disassembly .....	Side Bearing Preload .....
Ring Gear Repl. ....	Inspection .....	Pinion Depth and Backlash .....
Disassembly and Reassembly ....	Reassembly .....	Gear Tooth Contact Pattern Check
Installation and Adjustment ....	Installation and Adjustment .....	4B-47
4B-47	4B-49	4B-51
4B-47	4B-49	4B-51
4B-47	4B-49	4B-51
4B-48	4B-50	
4B-48	4B-51	



- |                         |                                |                            |
|-------------------------|--------------------------------|----------------------------|
| 1. Companion Flange     | 10. Straddle Bearing           | 19. Retainer Screw         |
| 2. Oil Deflector        | 11. Ring Gear                  | 20. Bearing Cap            |
| 3. Oil Seal             | 12. Differential Spider        | 21. Case-to-Ring Gear Bolt |
| 4. Bearing Retainer     | 13. Differential Case          | 22. Differential Cover     |
| 5. Shim                 | 14. Differential Pinion        | 23. Bearing Cap Bolt       |
| 6. Pinion Front Bearing | 15. Differential Side Gear     | 24. Cover Screw            |
| 7. Collapsible Spacer   | 16. Side Bearing               | 25. Axle Shaft             |
| 8. Pinion Rear Bearing  | 17. Side Bearing Adjusting Nut |                            |
| 9. Drive Pinion         | 18. Adjusting Nut Retainer     |                            |

Fig. 1E—Cross Section of Chevrolet Truck Differential with 10 1/2" Ring Gear

## DIFFERENTIAL CASE

### Removal

1. Mount axle assembly in a bench vise or holding fixture.
2. Remove cover bolts and cover, as seen in figure 2E, and allow lubricant to drain into pan.
3. Remove axle shafts as outlined in Truck Service Manual.

**NOTE:** Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described in Step 9 of "Differential Case—Installation." This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, then may be reinstalled at original lash to avoid changing gear tooth contact.

4. Remove adjusting nut lock retainers from bearing caps.
5. Mark bearing caps for reinstallation in the same position, and remove caps.
6. Loosen side bearing adjusting nuts, using J-24429 as shown in figure 3E.
7. Remove differential from carrier.

### Side Bearing Replacement

1. Install bearing puller J-8107 onto one side bearing, with puller screw centered on pilot plug as shown in figure 4E. Be sure to install puller fingers into notches of case, in order to pull on inner race only.
2. Tighten puller screw, while rotating bearing to insure that bearing cage is not being distorted.
3. Remove the other bearing in the same manner.



Fig. 2E—Cover Removed from Carrier

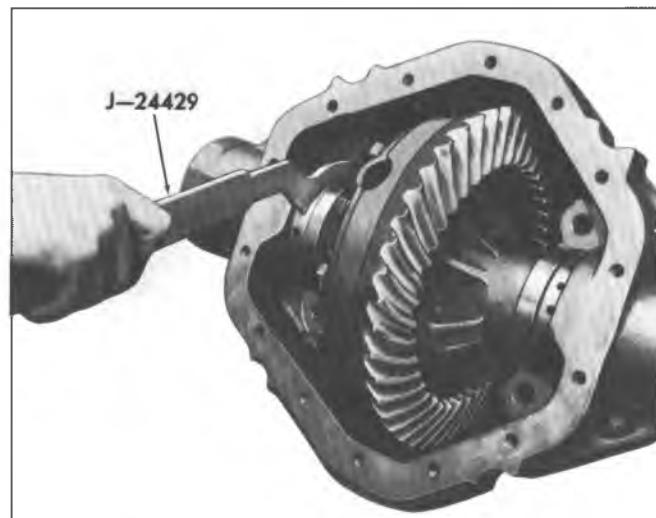


Fig. 3E—Loosening Adjusting Nuts



Fig. 4E—Differential Bearing Removal

4. Inspect bearings and hub for nicks, burrs or evidence of abnormal wear.
5. To install bearings, place bearing onto hub, and use driver handle J-8092 and bearing installer J-24430 to drive bearing onto hub until it seats against the shoulder.
6. When installing the second bearing, support case on pilot plug as shown in figure 5E to prevent damage to first bearing installed.

### Ring Gear Replacement

1. Remove the ring gear bolts and lock washers, and use a soft faced hammer to tap the ring gear from the case.
2. Place new ring gear into position on case and install lock washers and bolts.
3. Torque bolts alternately to specifications.



Fig. 5E—Differential Bearing Installation

#### Disassembly of Case

1. Mark the case and cover halves with a scribe line for reassembly in the same position.
2. With ring gear removed, separate case and cover.
3. Remove the internal parts and keep separated so they may be installed in the same relative positions.

#### Inspection

1. Inspect the differential gears, pinions, thrust washers, spider and all mating surfaces for evidence of abnormal wear.
2. Clean all parts thoroughly in suitable solvent.
3. Replace parts as necessary.

#### Reassembly of Differential

1. Lubricate internal parts with hypoid gear lubricant.
2. Place differential pinions and thrust washers onto spider.
3. Assemble differential gears and washers to case and cover.
4. Assemble differential case and cover making sure scribe marks align.
5. Install ring gear and attaching bolts and lockwashers, and torque alternately to specifications.
6. The differential may be installed into the carrier at this point, or may be installed after servicing the drive pinion.

#### Installation and Adjustment

1. Place bearing cups over side bearings and lift the differential assembly into the carrier. Install bearing caps, making sure marked caps are installed in original positions. Secure the cap bolts snugly.

2. Loosen the right side adjusting nut and tighten the left side nut, using J-24429 as shown in figure 3E, until the ring gear contacts the drive pinion. Do not force the gears into contact so as to bind them. At this point, zero lash is obtained.
3. Back off the left adjusting nut approximately two slots. Install locking fingers into holes and fasten fingers to bearing cap.
4. Tighten right adjusting nut firmly to force the case into solid contact with the left adjusting nut.
5. Loosen right adjusting nut until it is free from its bearing, then retighten until it contacts the bearing.
6. Tighten right adjusting nut approximately two slots if used bearings are being installed, or three slots if new bearings are being installed.
7. Install locking retainer into holes and attach fingers to bearing cap.
8. Torque bearing cap bolts to specification.

NOTE: At this point the differential bearings are properly preloaded. If any additional adjustments are required in the following procedures make sure that the preload remains as established. If one adjusting nut is loosened the other nut must be tightened **an equal amount** to maintain this preload.

9. Mount a dial indicator on the housing and measure the backlash between the ring gear and pinion. Backlash should be from .003" to .012" with .005" to .008" preferred. Refer to figure 6E.

NOTE: If backlash is more than .012" loosen the right adjusting nut one slot and tighten left adjusting nut one slot. If backlash is less than .003" loosen the left adjusting nut one slot and tighten the right adjusting nut one slot.

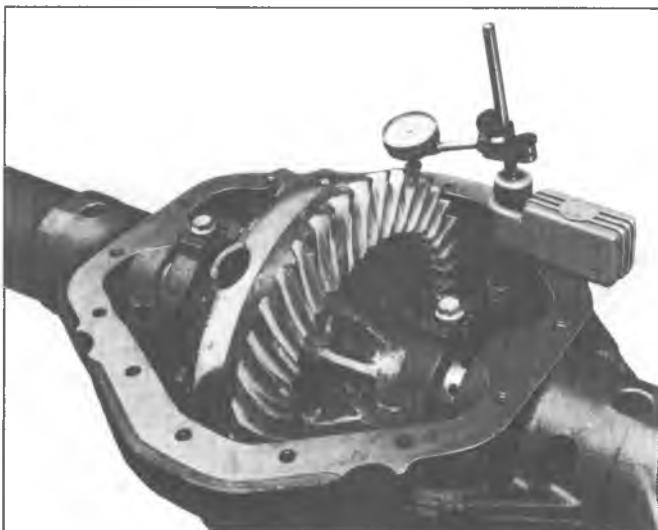


Fig. 6E—Measuring Backlash

## DRIVE PINION ASSEMBLY

### Removal

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Reassembly". Record the result. If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Remove the pinion bearing retainer bolts from the housing as shown in figure 7E.
4. Remove the pinion and bearing retainer assembly. It may be necessary to rap on the pilot end of the pinion to assist the assembly from the carrier.
5. Record the thickness of the shims removed from between the bearing retainer flange and the carrier housing.

### Disassembly

1. Clamp the pinion assembly in vise.
2. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 8E. Position J-8614-11 on flange so that the four notches are toward the flange.
3. Use a suitable sized socket to remove the pinion nut and washer. Discard the pinion nut and use a new one upon reassembly.
4. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 2, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 9E.
5. Support the bearing retainer as shown in figure 10E and press out the drive pinion. Do not allow drive pinion to fall onto the floor.



Fig. 7E—Removing Retainer Bolts

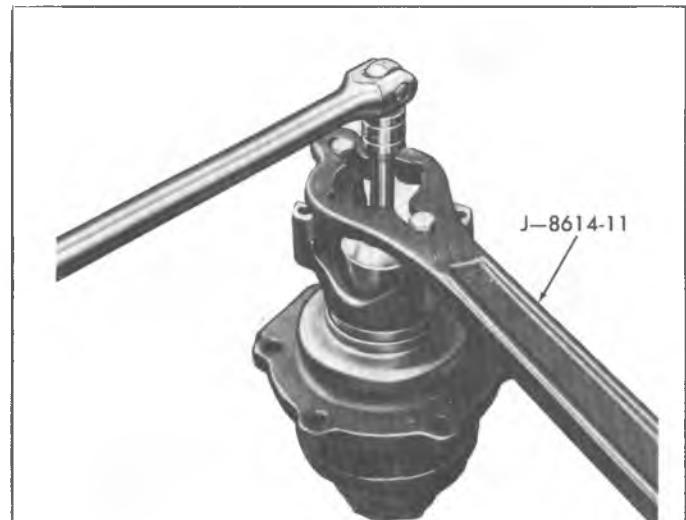


Fig. 8E—Removing Pinion Nut

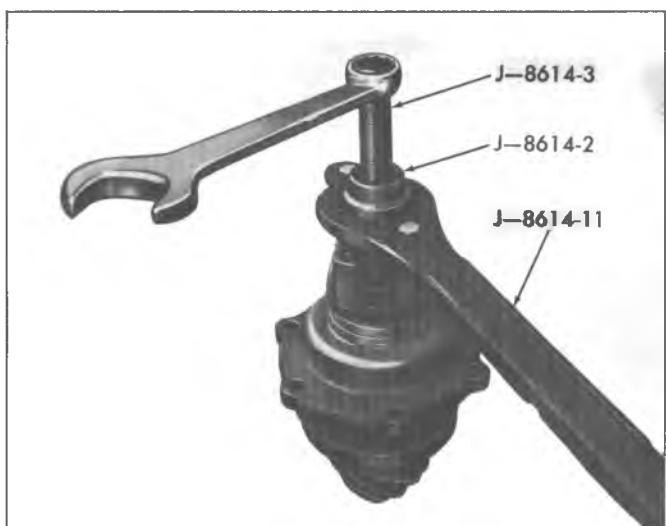


Fig. 9E—Removing Flange

6. Separate the pinion flange, the oil seal, the front bearing and the bearing retainer. The oil seal may have to be driven from the bearing retainer if it is being replaced.
7. Drive the pinion front and rear bearing cups from the bearing retainer, using a drift.
8. To remove the rear bearing, use J-22912 as shown in figure 11E.
9. Drive the pinion straddle bearing from the carrier housing, using a drift as shown in figure 12E.

### Inspection

1. Clean all parts in a suitable solvent and dry with air.
2. Inspect the drive pinion for chipped, cracked or excessively worn teeth and inspect the splines for wear.
3. Inspect the bearings for worn or pitted rollers or races. Inspect the pinion flange splines for wear.

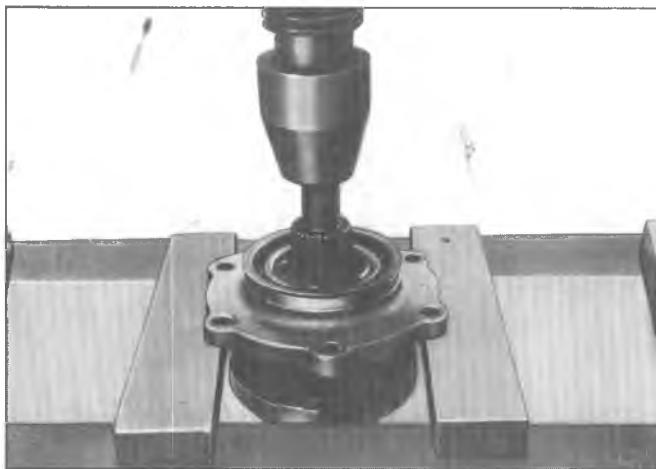


Fig. 10E—Pressing Drive Pinion from Bearing Retainer

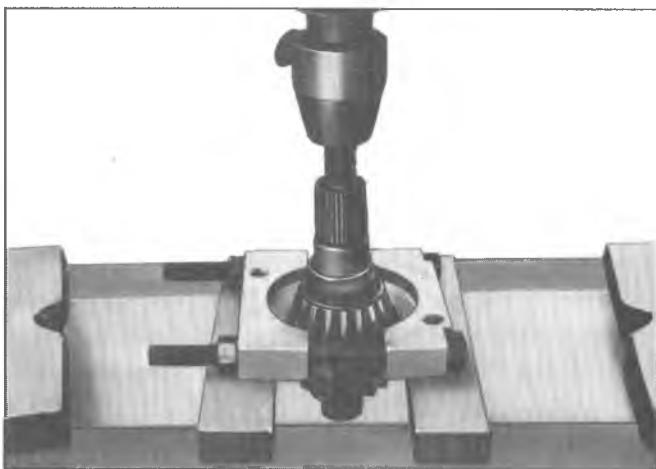


Fig. 11E—Removing Pinion Rear Bearing

4. Inspect the bearing retainer for cracks, imperfections, corrosion, pits and grooves.
5. Replace parts as required.

#### Reassembly

1. Lubricate all parts with hypoid lubricant.
2. Press pinion rear bearing onto drive pinion as shown in figure 13E, using J-24433.
3. Install the front and rear pinion bearing cups into the bearing retainer, using driver handle J-8092 on J-8608 for the front cup, and on J-24432 for the rear cup.
4. Install the pinion straddle bearing into the carrier housing, using driver handle J-8092 and installer J-23322, as shown in figure 14E.
5. Place bearing retainer, with cups in position, onto

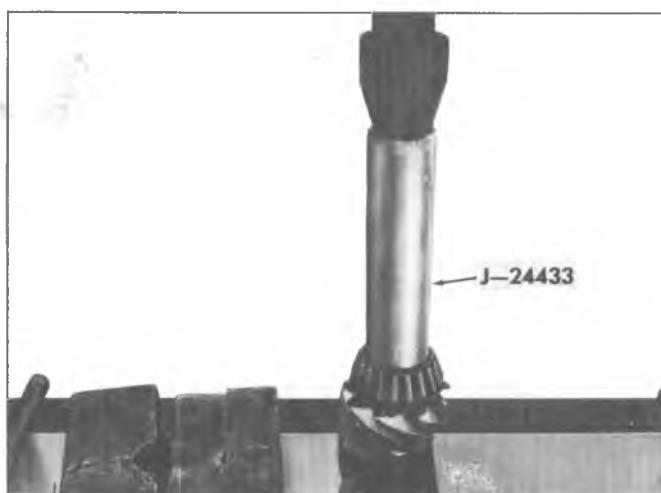


Fig. 13E—Installing Pinion Rear Bearing

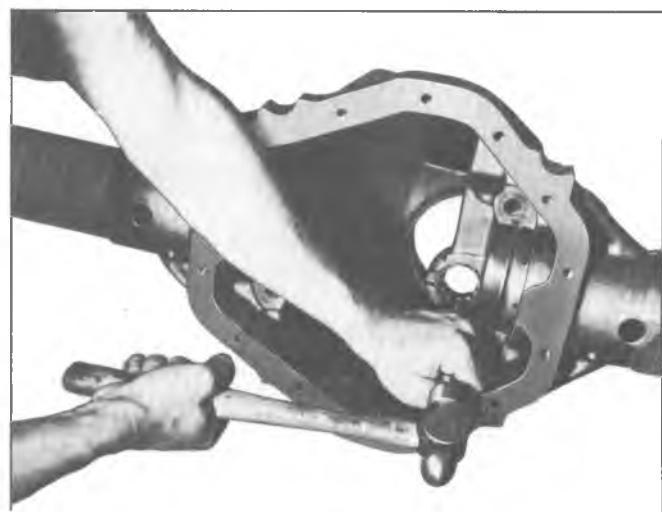


Fig. 12E—Removing Straddle Bearing

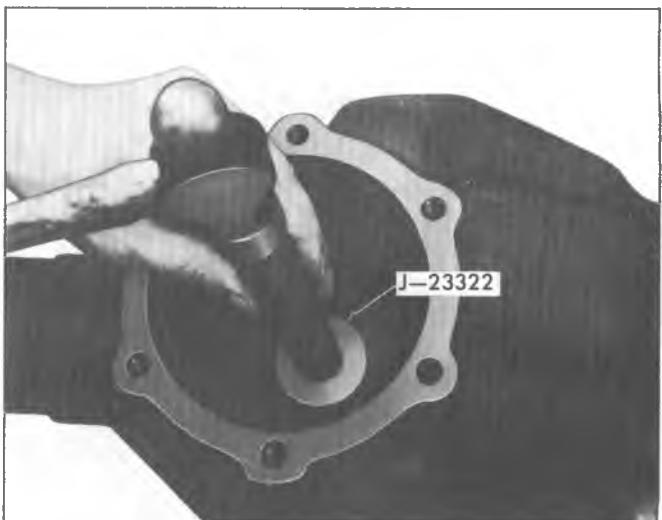


Fig. 14E—Installing Straddle Bearing

the drive pinion. Install a new collapsible spacer into position.

6. Press front bearing onto drive pinion.
7. Lubricate the oil seal lips with a lithium-base extreme pressure lubricant, and install the seal in the retainer bore. Use J-24434 with driver handle J-8092. Press the seal into the bore until it seats against internal shoulder.
8. Install pinion flange and oil deflector onto the splines, then install lock washer and new pinion nut.
9. Clamp the pinion flange into a vise. Install J-8614-11 as in figure 8E. Tighten the nut to achieve proper bearing preload.
  - a. Proper preload is attained when rotational torque required to rotate the pinion is 25-35 in. lbs. for new bearings, or 5-15 in. lbs. for used bearings.
  - b. Tighten pinion nut to approximately 350 ft. lbs., then take a torque reading as shown in figure 15E, using J-5853.
  - c. Continue tightening pinion nut in small increments until proper preload is attained.

**CAUTION:** Over-tightening of pinion nut may collapse spacer too much, requiring its replacement.

#### Installation and Adjustment

1. Examine the head of the drive pinion for a pinion depth code number.
2. Compare the depth code number with the number on the original pinion. Use the following chart to select the proper shim for preliminary setting of pinion depth.
3. Refer to the thickness of the shim recorded earlier in Pinion Removal procedures. Increase or decrease

		CODE NUMBER ON ORIGINAL PINION				
		+2	+1	0	-1	-2
CODE NUMBER ON SERVICE PINION	+2	—	ADD .001	ADD .002	ADD .003	ADD .004
	+1	SUBT. .001	—	ADD .001	ADD .002	ADD .003
	0	SUBT. .002	SUBT. .001	—	ADD .001	ADD .002
	-1	SUBT. .003	SUBT. .002	SUBT. .001	—	ADD .001
	-2	SUBT. .004	SUBT. .003	SUBT. .002	SUBT. .001	—

Fig. 16E—Pinion Depth Codes

the shim dimension as indicated by the chart in figure 16E.

- a. For example, if original shim measured .014 inch, original code was -1 and new code is +2, the correct shim would be .014 inch plus .003 = .017 inch.
- b. If original shim was .012 inch, original code +2, and new code is -2, the correct shim would be .012 minus .004 = .008 inch.
4. Place the pinion shim as determined in step 3 onto the carrier housing, making sure the bolt holes align with those of carrier, and that the mating surfaces are clean and free from foreign material.
5. Place the pinion retainer assembly into position, and align bolt holes to carrier. Install retaining bolts and tighten in a crosswise manner. Torque to specifications.
6. Following drive pinion service, a Contact Pattern Check must be made.

#### CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 9 of "Drive Pinion Reassembly".

Side Bearing Preload is set to specifications in step 6 of "Differential Case—Installation and Adjustment".

Following service to the Differential assembly or to the Drive Pinion, the Pinion Depth and the Ring-Gear-to-Pinion Backlash **must** be checked, using a Gear Tooth Contact Pattern Check as outlined below.

#### Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth

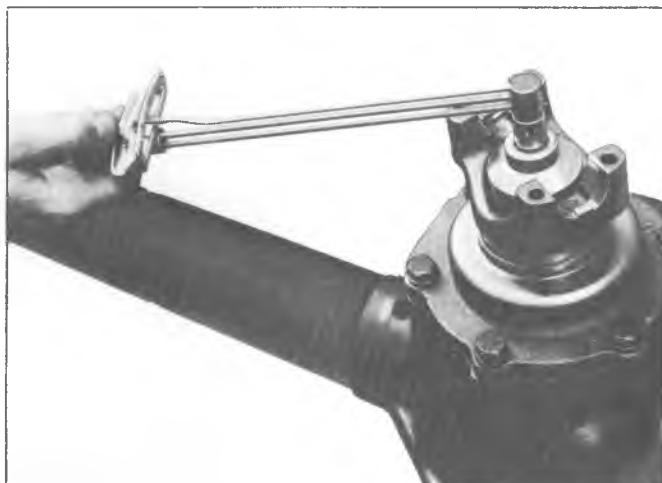


Fig. 15E—Measuring Rotating Torque

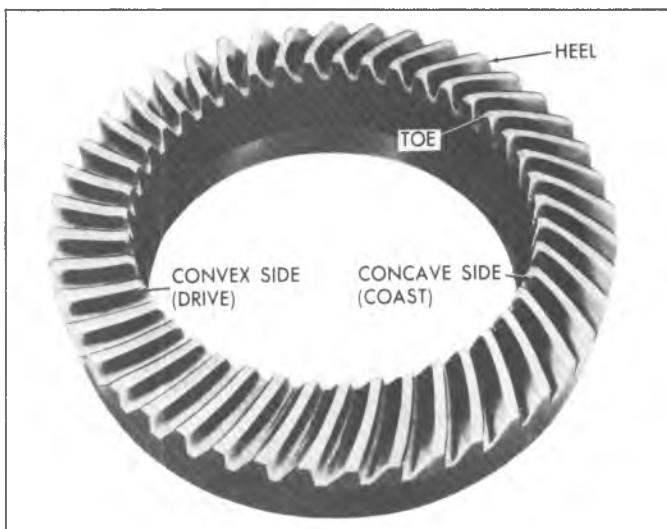


Fig. 17E—Gear Tooth Nomenclature

Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desireable contact between ring gear and drive pinion for low noise level and long life can be assured.

#### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 17E.

#### Pattern Check

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture to ring gear

teeth. When properly applied, the area of tooth contact will be clearly visible after load is applied.

3. Tighten bearing cap bolts to specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with figure 18E. Make adjustments as outlined below.
6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

#### Pinion Depth Adjustment

1. The pinion depth shim may be replaced as necessary to place the drive pinion at the correct depth. See figure 18E.
2. Depth shims are available from .006 inch to .024 inch, in increments of .001 inch.

#### Backlash Adjustment

1. Remove locking retainers from side bearing adjusting nuts.
2. Move adjusting nuts **an equal amount** in or out to achieve proper backlash.
  - a. To increase backlash, loosen the left adjusting nut and tighten the right adjusting nut **an equal amount**.
  - b. To decrease backlash, loosen the right adjusting nut and tighten the left adjusting nut **an equal amount**.

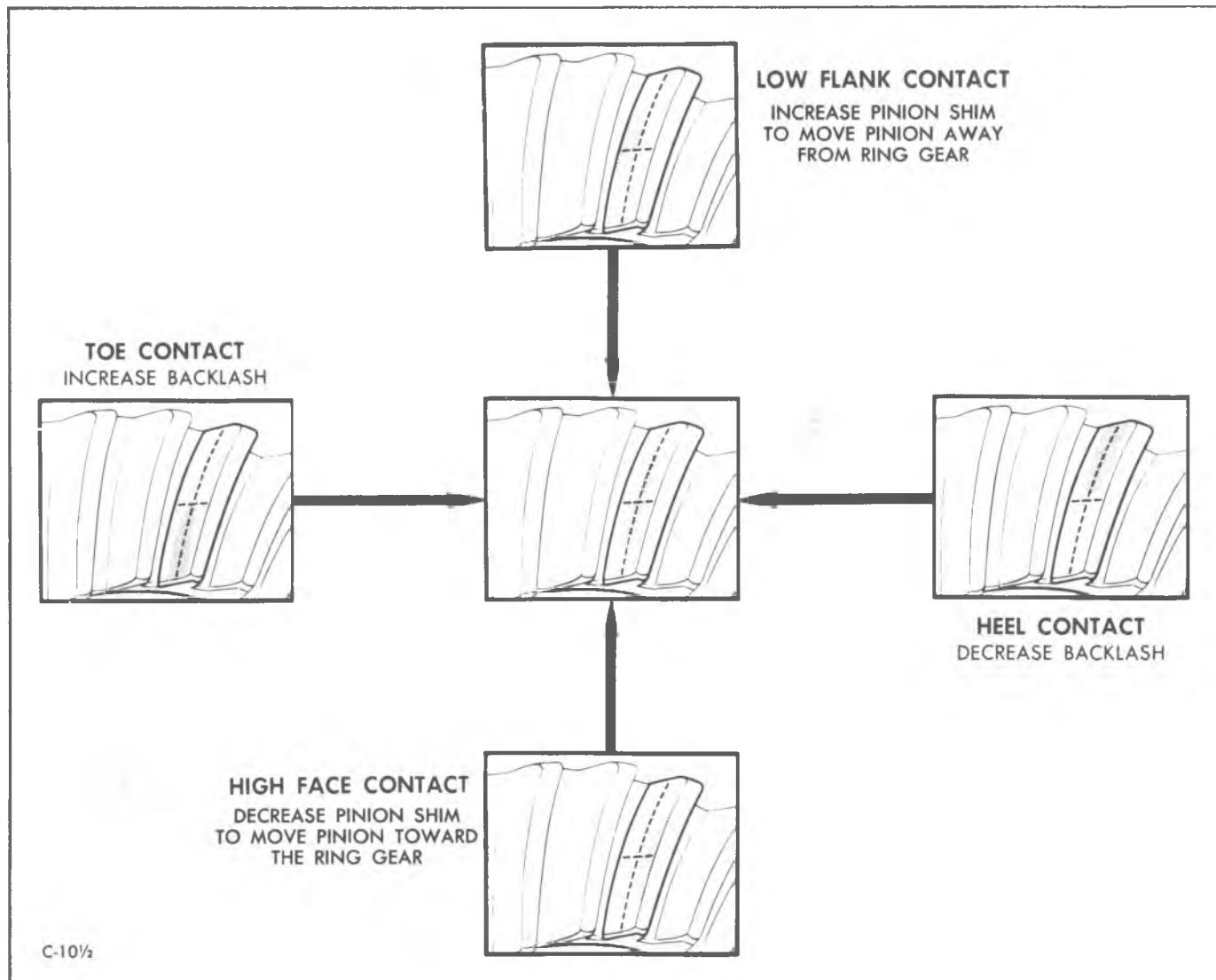


Fig. 18E—Gear Teeth Contact Pattern Check

# DANA DIFFERENTIALS

## 10-1/2" RING GEAR

### INDEX

Differential Case—Removal and Disassembly .....	4B-55
Drive Pinion—Removal and Disassembly .....	4B-56
Differential Case—Reassembly .....	4B-56
Shim Requirements—Gauging Procedures .....	4B-57
Drive Pinion—Assembly and Installation .....	4B-58
Differential Case—Installation and Adjustment .....	4B-59
Checks and Adjustments .....	4B-59

#### GENERAL DESCRIPTION

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

1. In order to remove the differential case, the carrier must be spread.

2. The drive pinion assembly incorporates an inner and outer bearing shim pack. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearings.

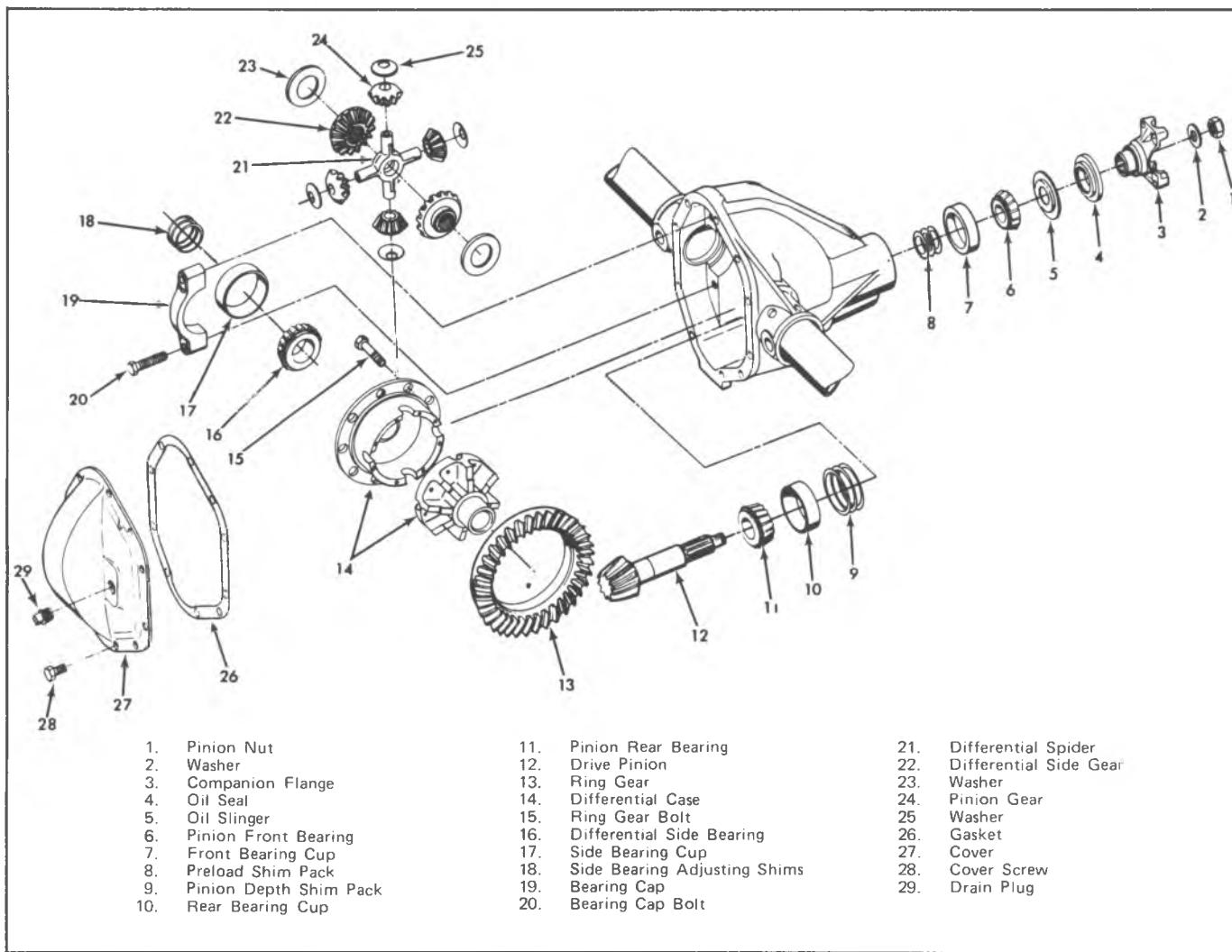


Fig. 1F — Dana Differential with 10 1/2" Ring Gear

## DIFFERENTIAL CASE

### Removal

1. Place vehicle on hoist with rear axle hanging free.
  2. Remove wheel and tire assemblies.
  3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
    - a. Remove axle shaft to hub attaching nuts.
    - b. Rap on axle shaft to loosen shaft from hub and remove shafts.
  4. Remove plug in carrier and drain lubricant.
  5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
  6. Mark one side of carrier and matching cap for reassembly in the same position. Remove bearing caps.
  7. Using spreader tool J-24385, and a dial indicator as shown in figure 2F, spread carrier a maximum of .015 inch.
- CAUTION:** Do not exceed this dimension, as carrier may be permanently damaged.
8. Remove the dial indicator and use a prybar to remove the differential case from the carrier. Record the dimensions and location of the side bearing shims. Remove the spreader tool.

### Disassembly

1. Remove differential side bearings by placing J-22912 under bearings and supporting plates on a press bed. Apply force to pilot plug J-8107-3 to drive the case from the bearing.

NOTE: Use care not to damage case hubs with tool J-22912.

2. Remove the ring gear bolts and the ring gear. Tap

the ring gear with a soft-faced hammer to free it from the case.

3. Scribe both case halves for reassembly in same position.
4. Remove bolts holding case halves together, as shown in figure 3F.
5. Tap lightly on top half of case to free it from the bottom half. Remove top half of case.
6. Lift out all internal parts.

### Inspection

1. Clean all gears and bearings in solvent. Inspect cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect ring gear teeth and machined surfaces. Examine fit of internal gears.
3. Inspect pinion cross-shaft.
4. Replace parts as required.



Fig. 3F—Separating Case Halves

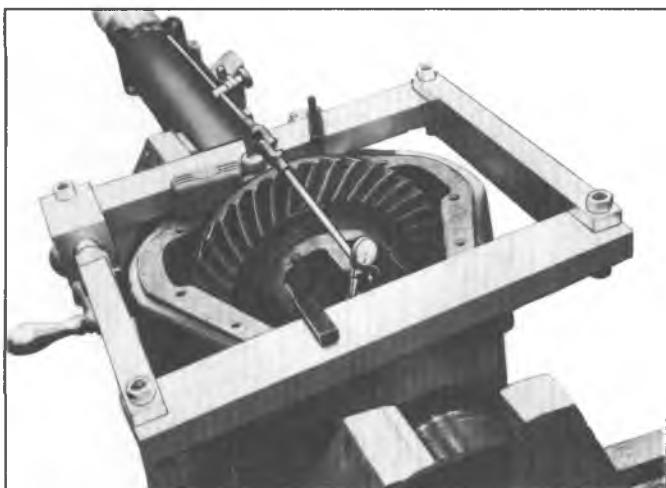


Fig. 2F—Spreading the Carrier

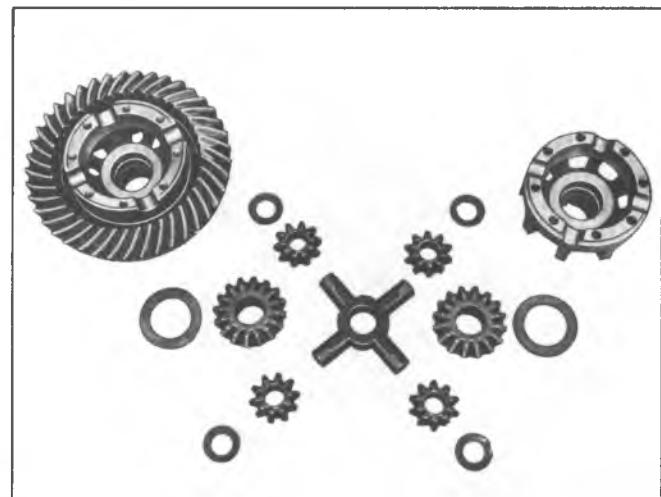


Fig. 4F—Internal Parts Inspection

## DRIVE PINION

### Removal and Disassembly

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment." If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 5F. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 6F.
6. Remove drive pinion from carrier. It may be necessary to tap on the pinion with a soft faced hammer.
7. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
8. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
9. Remove rear pinion bearing using J-22912, and an arbor press.

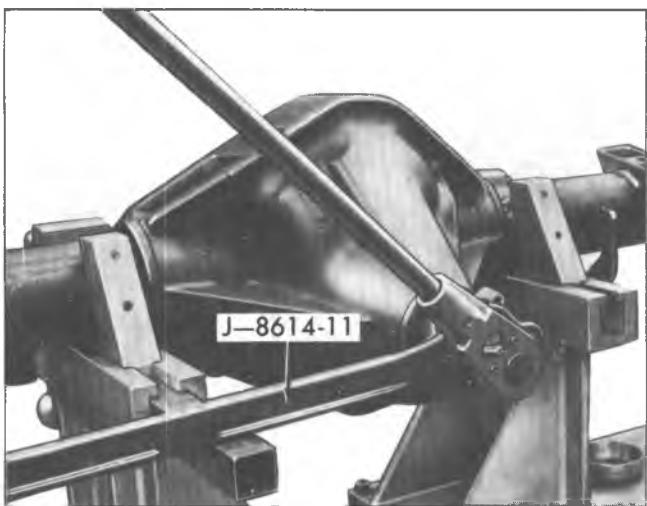


Fig. 5F—Removing Pinion Nut

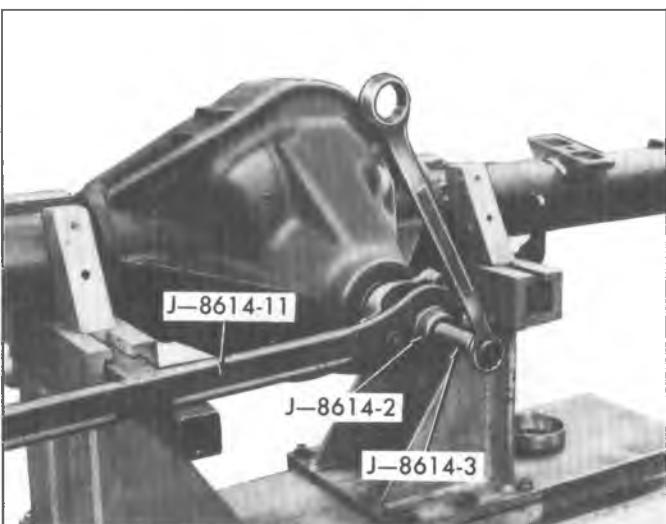


Fig. 6F—Removing Companion Flange

### Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.
2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores or side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

## DIFFERENTIAL CASE

### Reassembly

1. Assemble new washers to side gears. Apply a small amount of hypoid lubricant on the side gear hubs.
2. Assemble pinion gears and new washers onto cross shaft.
3. Place side gears, pinion gears, cross shaft and washers into flanged half of case.
4. Assemble top half of case to bottom half, making sure scribe marks are aligned.
5. Assemble body bolts finger tight. Then tighten bolts alternately to specifications.
6. Install ring gear to differential case.
7. Install ring gear-to-case bolts finger tight, then tighten alternately to specifications.
8. Place side bearing into position and install, using

tools J-8092 and bearing installer J-24383 as shown in figure 7F.

- Install bearing on opposite side in the same manner. Be sure to support differential case on pilot plug J-8107-3.

## SHIM REQUIREMENTS—GAUGING PROCEDURES

### Side Bearing Shims

- With the pinion removed from the carrier, place the bearing cups over the side bearings, and install the differential case into the carrier.
- Place the shim which was originally installed on the ring gear side into its original position.
- Install the bearing caps lightly in their marked positions. Tighten the caps just enough to keep the bearings in place.
- Mount a dial indicator on the carrier with the tip of the indicator on the back face of the ring gear.
- Position two screwdrivers between the bearing shim and carrier on the ring gear side of the case. Pull on the screwdrivers and force the differential case as far as possible away from the dial indicator.
- With force still applied, set the indicator dial to "zero", being sure the probe is still in contact with the ring gear.
- Reposition the screwdrivers to the opposite side of the differential case as shown in figure 8F.
- Pull on the screwdrivers and force the differential case back toward the dial indicator. Repeat several times until the same indicator reading is obtained.
- To the dial indicator reading, add the thickness of the shim. Record the result, as this figure will be used during determination of side bearing shim requirements.



Fig. 7F—Installing Side Bearing

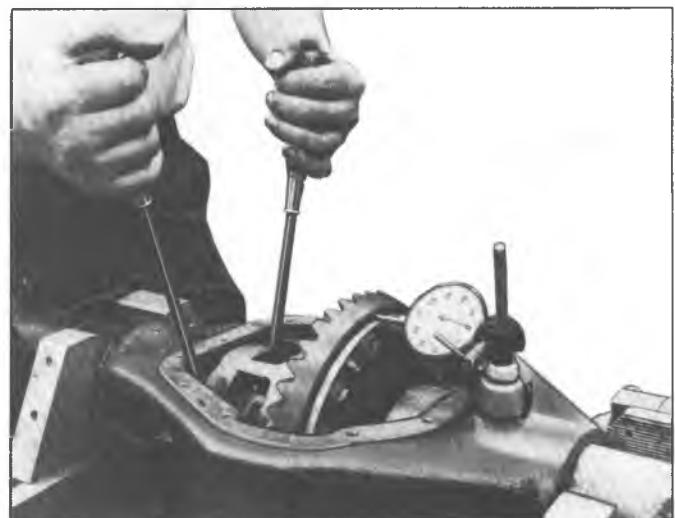


Fig. 8F—Screwdrivers Against Case

### Pinion Shims

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring gear before proceeding with assembly.

On the rear face of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: if a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3 we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated. Refer to figure 10F.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

**NOTE:** If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 9F—Dana Pinion Code Chart



Fig. 10F—Pinion Code Location

thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original shim pack.

## DRIVE PINION

### Assembly and Installation

- Determine the correct pinion depth shim by using the chart in figure 9F.
- Install the pinion depth shim in rear cup bore.
- Install rear bearing cup by using driver handle J-8092 and installer J-24381.
- To the outer shim pack (for setting preload) add or

remove an equal amount as was added or removed from the inner shim pack.

- Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.
  - Press rear pinion bearing onto pinion shaft, using installer J-24433.
  - Install drive pinion and bearing into the differential carrier.
  - Install preload shims and front pinion bearing. Do not install oil seal at this time.
  - Install flange and holding bar J-8614-11 as shown in "Drive Pinion—Removal".
  - Install washer and nut onto pinion shaft. Torque nut to 250 lbs. ft.
  - Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.
- NOTE: Torque reading to start shaft turning must be disregarded.
- If torque requirements (preload) are not to specifications, adjust shim pack as necessary.
    - To increase preload, decrease the thickness of preload shims.
    - To decrease preload, increase the thickness of preload shims.
  - When bearing preload meets specifications, remove nut, washer and flange from pinion shaft.
  - Install new pinion oil seal into housing as shown in figure 11F, using J-24384.
  - Install flange, washer and nut. Using holder bar J-8614-11, torque nut to 250 lbs. ft.



Fig. 11F—Installing Pinion Oil Seal

## DIFFERENTIAL CASE

### Installation and Adjustment

1. Place the differential case, with side bearings and cups installed, into position in the carrier.
2. Select the smallest of the original shims as a "gauging" shim and place it between the bearing cup and the carrier on the ring gear side of the case.
3. Install bearing caps and bearing screws finger tight. Make sure bearing caps are in correct marked position.
4. Mount a dial indicator on the ring gear side of the carrier, with the indicator probe in contact with the back face of the ring gear.
5. Position two screwdrivers between the bearing cup and the carrier on the side opposite the ring gear.
6. Pull on the screwdrivers and force the differential case as far as possible toward the indicator. With force still applied, set the dial indicator to zero.
7. Reposition the screwdrivers on the ring gear side of the case. Force the ring gear into mesh with the drive pinion and observe the dial indicator. Repeat this operation several times until the same reading is obtained.
8. Add the indicator reading to the "gauging" shim thickness to determine the correct shim dimension for installation on the ring gear side of the case.

For example, if the gauging shim was .155 inch, and the indicator reading in step 7 was .017 inch, the correct shim would be  $.155 + .017 = .172$  inch.

9. Remove the "gauging" shim and install the correct size shim into position between the bearing cup and the carrier on the ring gear side of the case.
10. To determine the correct dimension for the remaining shim, first refer to the dimension obtained in step 8 of "Gauging Procedures—Side

Bearing Shims". From that figure, subtract the size of the shim installed in step 9 above; then add .006 inch for preload and backlash.

For example, if the reading in step 18 was .329 inch, and the shim just installed on the ring gear side of the case was .172 inch, the correct shim dimension would be  $.329 - .172 = .157 + .006 = .163$  inch.

11. Spread the differential carrier as shown in figure 2F.
12. Assemble the shim determined in step 10 into place between the bearing cup and the carrier.
13. Remove the spreader and the dial indicator.
14. Install the bearing caps in marked positions and torque cap screws to specifications.
15. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
16. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
  - a. Low backlash is corrected by decreasing the shim on the ring gear side and increasing the opposite side shim **an equal amount**
  - b. High backlash is corrected by increasing the shim on the ring gear side and decreasing the opposite side shim **an equal amount**
17. Check gear tooth contact, using yellow lead method, as described in "Gear Tooth Contact Pattern Check".
18. Using a new gasket, install housing cover and torque bolts to specifications.
19. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.
20. Install axles into carrier and axle flange over hub studs.
21. Torque hub stud nuts to specifications.
22. Fill differential with lubricant.
23. Install wheel and tire assembly.

### CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 12 of "Drive Pinion—Assembly and Installation". Side Bearing Preload is set to specifications in step 10 of "Differential Case—Installation and Adjustment". Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must** be made, to verify the accuracy of the work

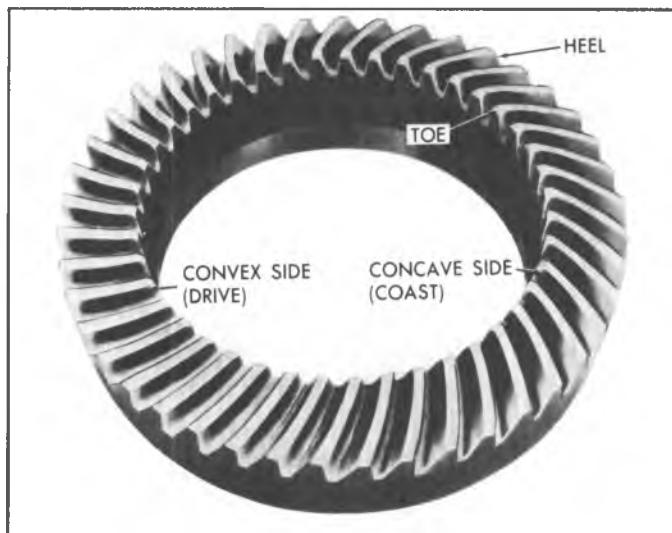


Fig. 12F—Gear Tooth Nomenclature

in setting the pinion depth and the ring gear-to-pinion backlash.

## GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 12F.

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

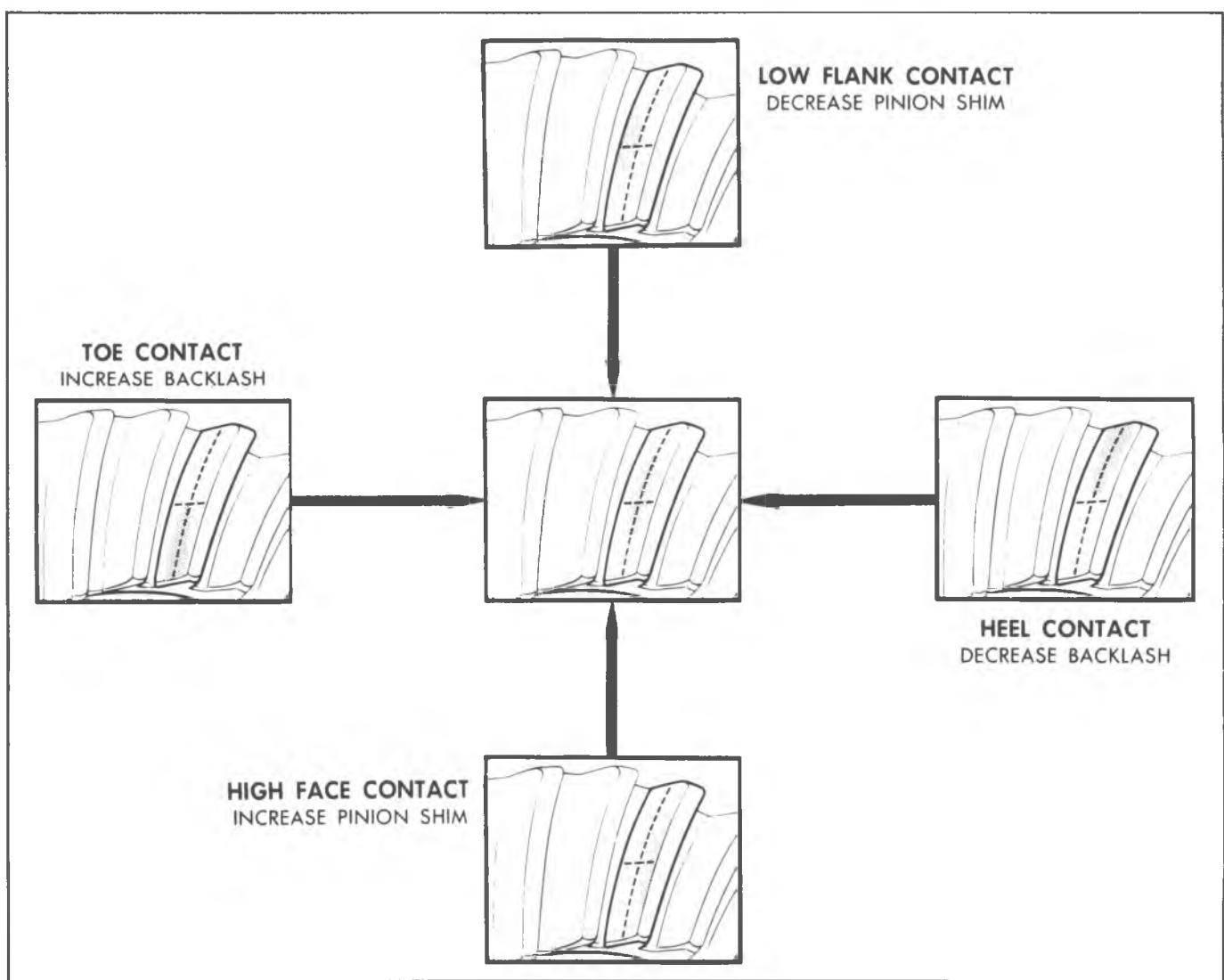


Fig. 13F—Gear Teeth Contact Pattern Check

2. Use gear marking compound (yellow lead chromate or equivalent) and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with figure 13F. Make adjustments as necessary.
6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

#### Adjustments Affecting Tooth Contact

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

**NOTE:** It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness of the inner shim, located between the rear bearing cup and the carrier housing. Increasing the shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

## DANA 9-3/4" RING GEAR

### INDEX

General Description .....	4B-61
Differential Case—Removal and Disassembly .....	4B-62
Drive Pinion—Removal and Disassembly.....	4B-63
Differential Case—Reassembly .....	4B-64
Drive Pinion—Installation and Adjustment.....	4B-64
Differential Case—Installation and Adjustment.....	4B-66

## GENERAL DESCRIPTION

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

1. The differential side bearing shims are located between the side bearing cone and roller assembly and the differential case. See figure 14F. These bearings are of the tapered roller design and are

preloaded. In order to remove the differential case the carrier must be spread.

2. The pinion assembly incorporates an inner and outer bearing shim. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearing.

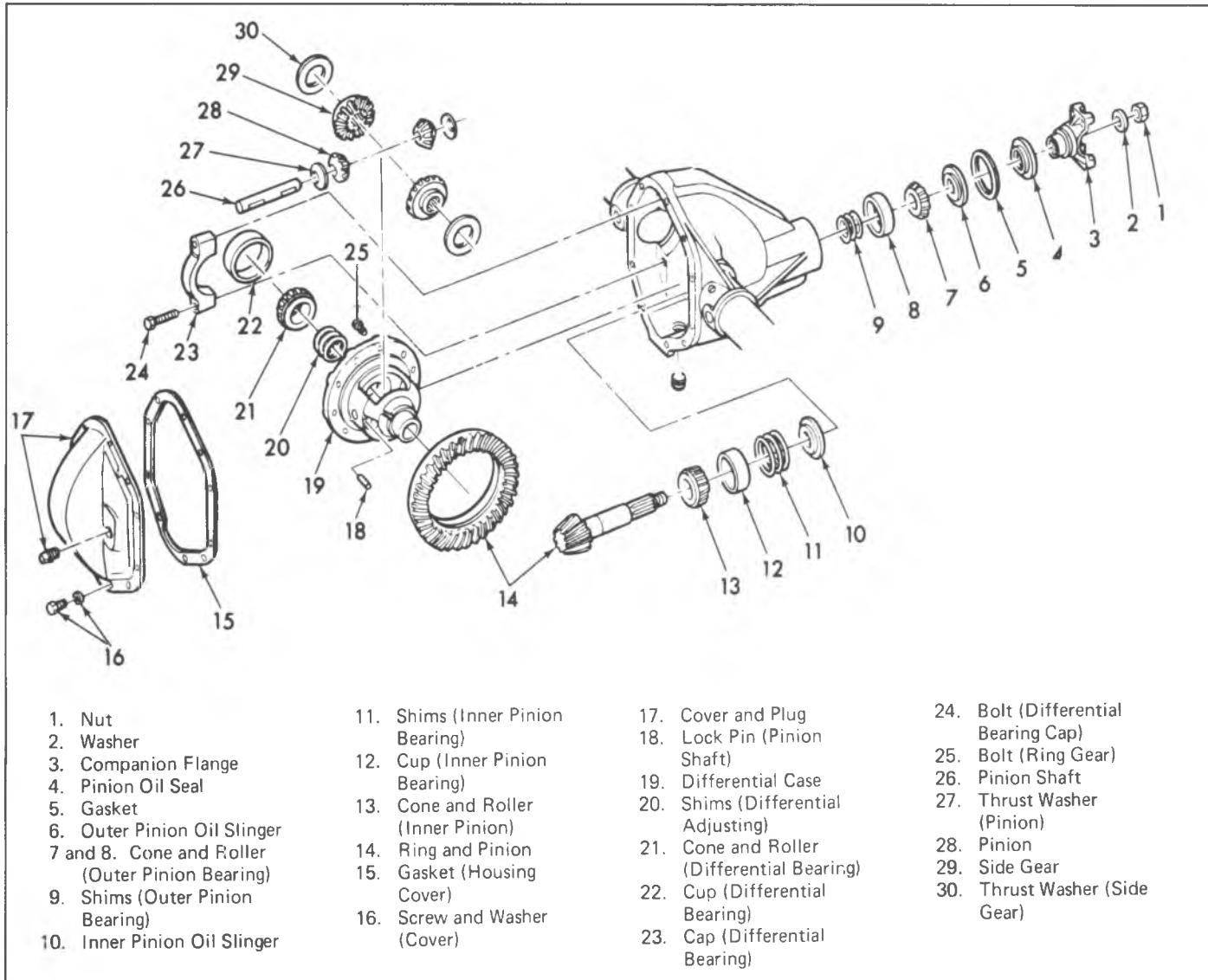


Fig. 14F—Dana Differential With 9-3/4" Ring Gear—Exploded View

## DIFFERENTIAL CASE

### Removal

1. Place vehicle on hoist with rear axle hanging free.
2. Remove wheel and tire assemblies.
3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
  - a. Remove axle shaft to hub attaching nuts.
  - b. Rap on axle shaft to loosen shaft from hub and remove shafts.
4. Remove plug in carrier and drain lubricant.
5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
6. Mark one side of carrier and matching cap for reassembly. Remove cap screws attaching bearing caps to carrier.

7. Using spreader Tool J-24385 and dial indicator as shown in figure 15F, spread carrier a maximum of .020".

**CAUTION:** Do not exceed this dimension as carrier may be permanently damaged.

8. Remove dial indicator and with the use of a pry bar remove differential case from carrier. Remove spreader.

### Disassembly

1. Remove differential bearing cups and identify with a tag for reassembly.
  2. Place differential in vise and drive out pinion shaft lock pin.
  3. Remove differential bearing cone and roller using Puller J-22888, with Plug J-8107-3, as in figure 16F. Tag cone and rollers for assembly.
- NOTE:** If ring gear and pinion are to be reassembled, note position of shims and replace accordingly.

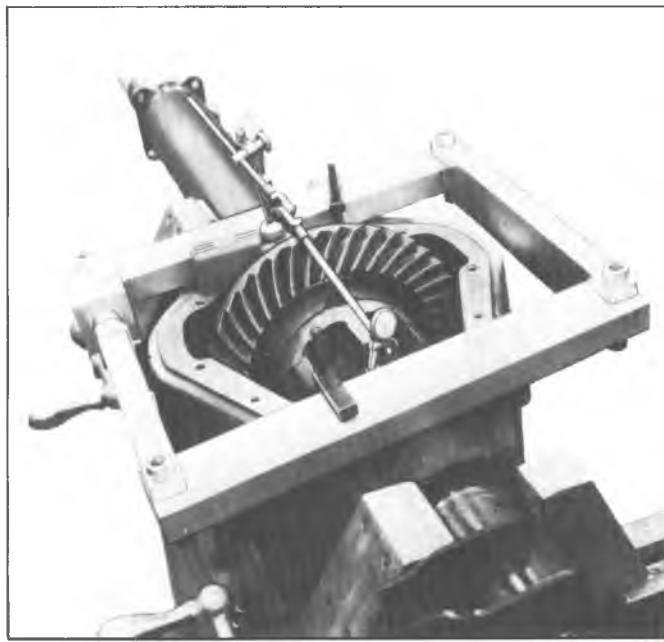


Fig. 15F—Tool J-24385 Mounted on Carrier

4. Remove spacer, pinion shaft, pinions, side gears and thrust washers from differential case.
5. Remove screws attaching ring gear to differential case. Remove gear.

## DRIVE PINION

### Removal

1. Separate rear universal joint, tape trunnion bearings to joint, position propeller shaft to one side and tie propeller shaft to frame side rail.
2. Using Holding Bar J-8614-11, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

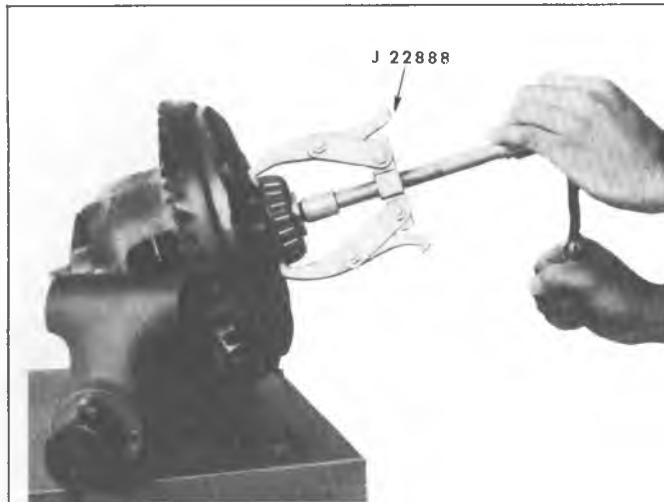


Fig. 16F—Removing Differential Side Bearings

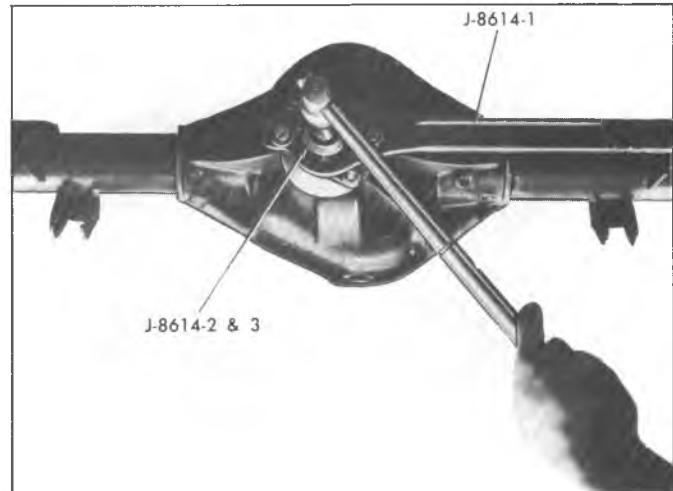


Fig. 17F—Removing Pinion Flange

3. Install Tool J-8614-2, and 3 into holding bar as shown in figure 17F and remove flange from drive pinion. Remove drive pinion from carrier.
4. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
5. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
6. Remove inner pinion cone and roller using Tool J-22912, installed as shown in figure 18F, and press pinion from bearing.

### Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for



Fig. 18F—Removing Inner Pinion Bearing Cone and Roller

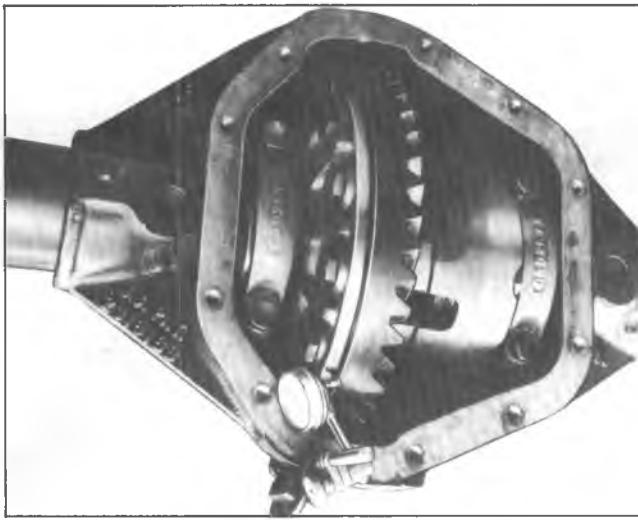


Fig. 19F—Checking Runout

scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

**NOTE:** The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does not indicate a defective bearing.

2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores. Inspect side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

## DIFFERENTIAL CASE

### Reassembly

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.
5. With an arbor press, press differential side bearings onto case using Tool J-21051. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F. Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from the case. Again install differential case and check runout at differential case flange.
8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.
9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "O".
10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.
11. Remove differential from carrier.

## DRIVE PINION

### Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "O". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3 we would want to add .003" more shims than would be required if the pinions were etched "O". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated. See figure 20F. If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 21F—Dana Pinion Code Chart

same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

NOTE: If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart in figure 21F.
2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.
3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092 as shown in figure 22F.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in figure 23F.
6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.
7. Install shims and outer pinion cone and roller on



Fig. 20F—Marking From Nominal on Pinion

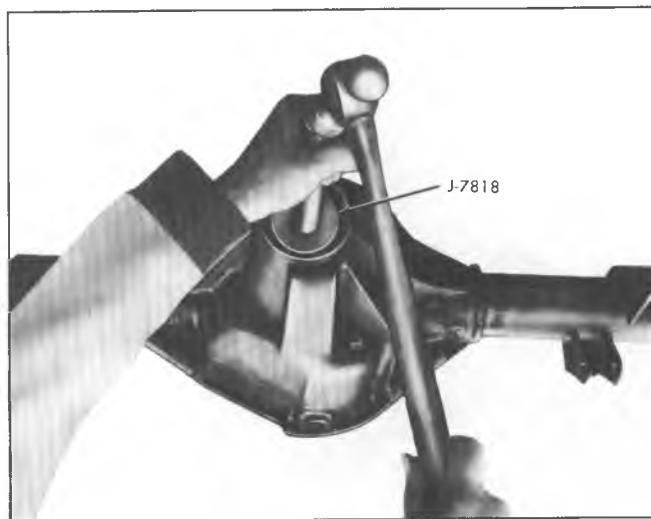


Fig. 22F—Installing Outer Pinion Bearing Cup

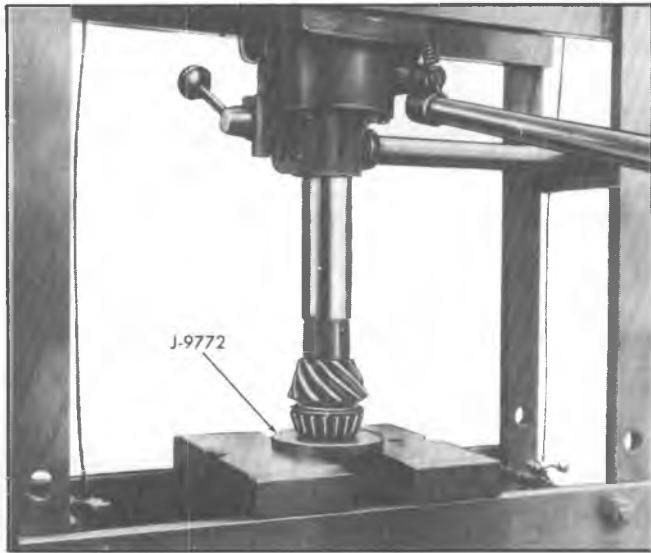


Fig. 23F—Installing Inner Pinion Cone and Roller

pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion, as in figure 24F.

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.
9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.
- NOTE: Torque reading to start shaft turning must be disregarded.
10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.
11. Remove nut, washer and flange from pinion shaft.
12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

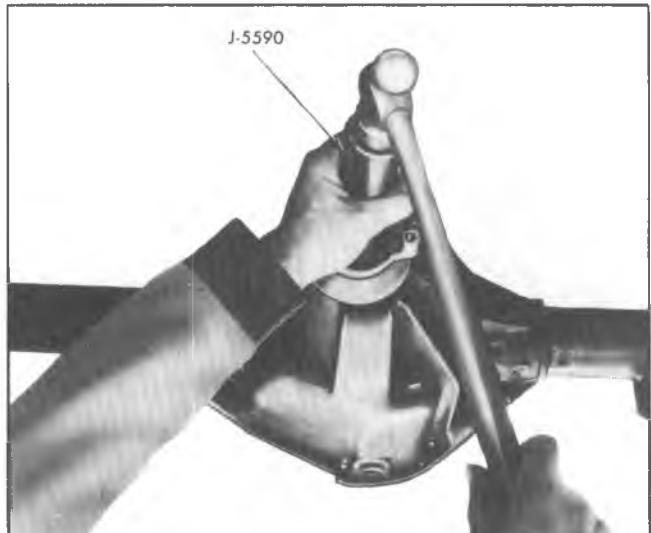


Fig. 24F—Installing Pinion Flange

13. Install flange, washer and nut. Torque nut to specifications.

## DIFFERENTIAL CASE

### Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.
2. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 19F.
3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "O".
4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.
5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.
  - a. Subtract the size of shim pack just installed on ring gear side of case from the reading obtained and recorded in step 10 of Differential Case—Reassembly.
  - b. To this figure, add an additional .015" shims to compensate for preload and backlash.

Example: If reading in step 10 of Differential Case—Reassembly was .085", and the shims installed on ring gear side of case was .055", the correct amount of shim will be  $.085" - .055" + .015" = .045"$ .

6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

### Installation

1. Spread differential carrier, using spreader as shown in figure 15F.
2. Install differential bearing outer races in their correct location, then install differential case into carrier.
3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft faced hammer to ensure proper seating of case in carrier.
4. Remove spreader and torque cap bolts to specifications.

5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
7. Check gear tooth contact, using yellow lead method, as described earlier in "Dana 10-1/2" Ring Gear" section, under "Gear Tooth Contact Pattern Check". Refer to figure 25F.
8. Using a new gasket, install housing cover and torque bolts to specifications.
9. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.
10. Install axles into carrier and axle flange over hub studs. Torque hub stud nuts to specifications.
11. Fill differential with lubricant.
12. Install wheel and tire assembly.

**CAUTION:** See Caution on page 1 of this section regarding the fasteners referred to in the above steps.

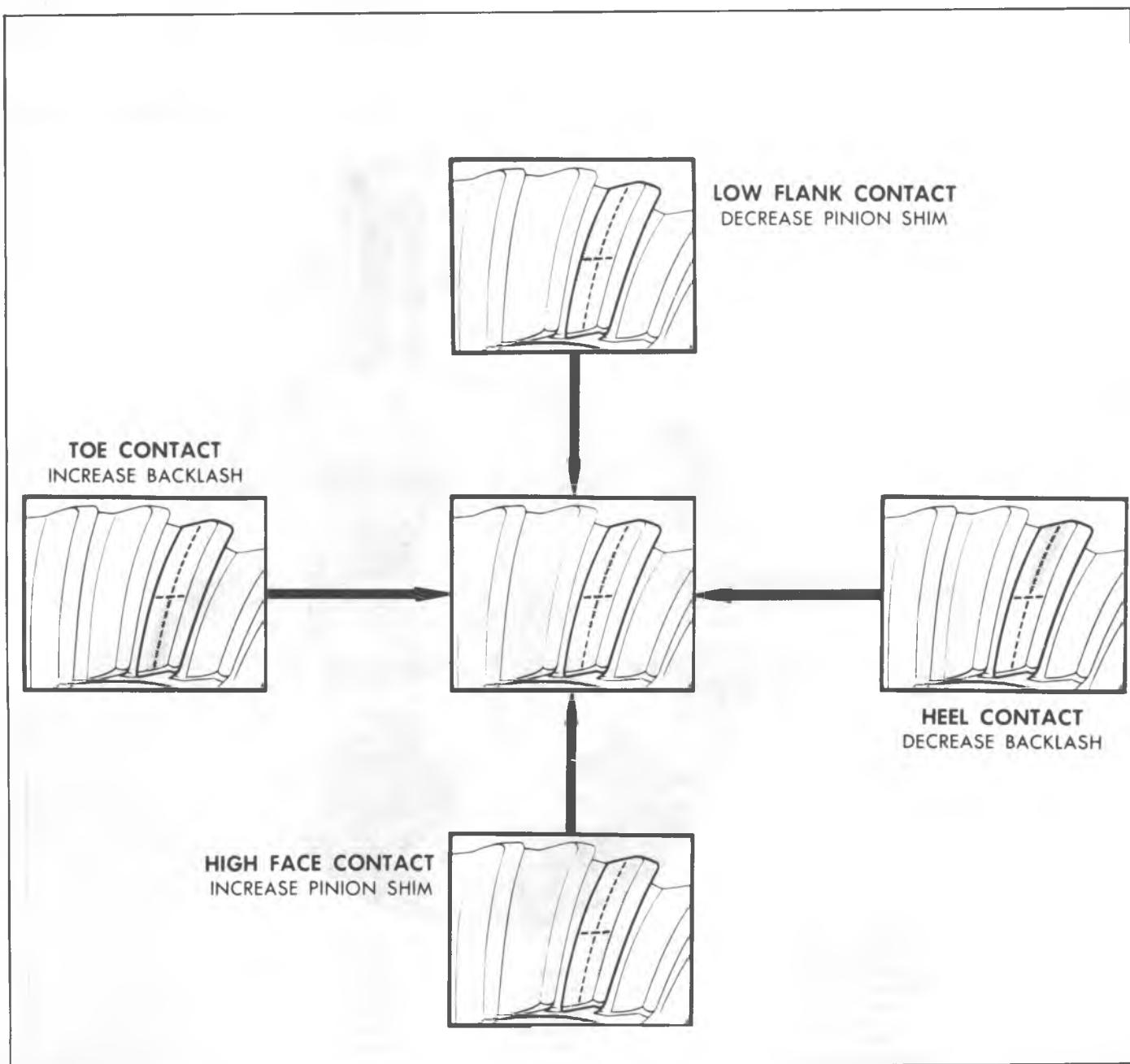
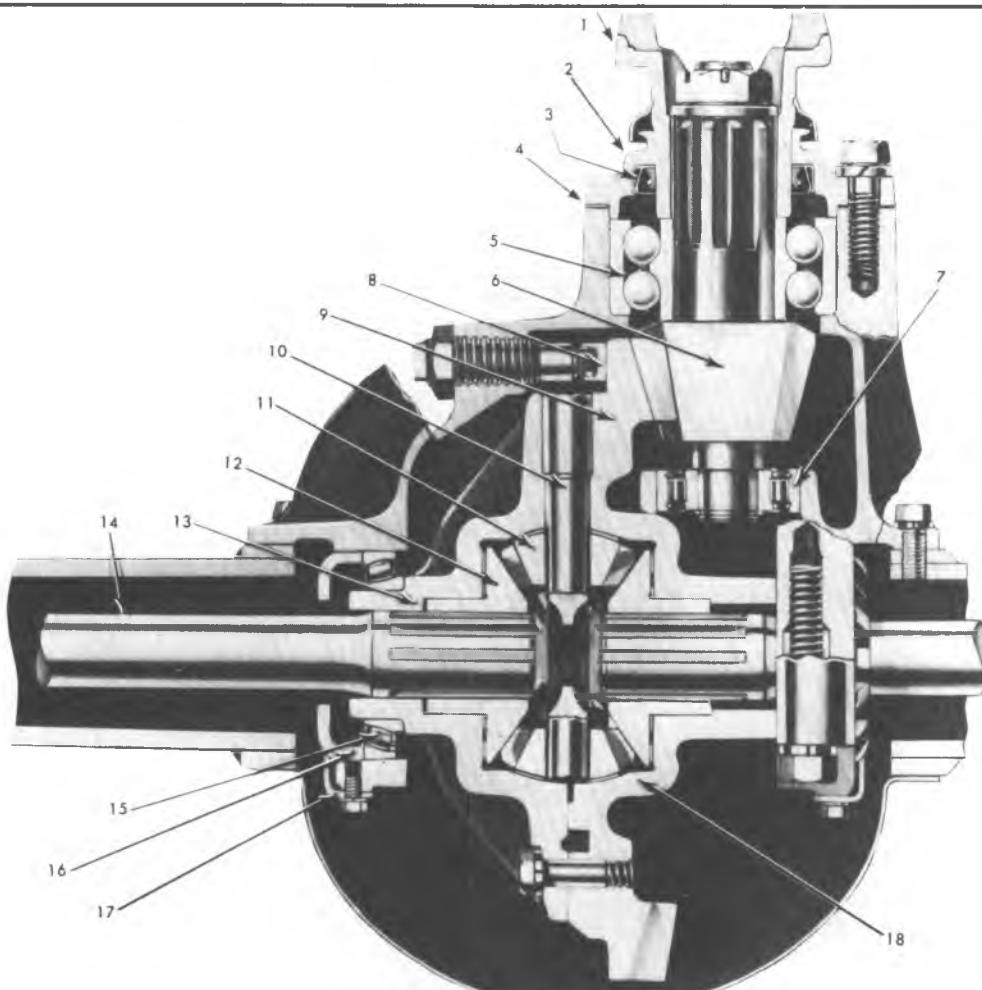


Fig. 25F—Gear Teeth Contact Pattern Check

# CHEVROLET TRUCK DIFFERENTIAL 12-1/4" RING GEAR

## INDEX

Case and Drive Pinion .....	4B-69	Ring Gear Replacement .....	4B-70
Removal .....	4B-69	Differential Bearing Replacement .....	4B-71
Disassembly .....	4B-69	Differential Reassembly .....	4B-71
Repairs .....	4B-69	Reassembly .....	4B-71
Pinion Disassembly .....	4B-69	Ring Gear and Pinion Adjustment .....	4B-71
Pinion Inspection .....	4B-69	Backlash and Preload Adjustment .....	4B-71
Pinion Reassembly .....	4B-70	Ring Gear Thrust Pad Adjustment .....	4B-72
Differential Disassembly .....	4B-70	Installation .....	4B-72
Differential Inspection .....	4B-70		



- |   |                                       |  |
|---|---------------------------------------|--|
| 1. Universal Joint Yoke                 | 8. Ring Gear Thrust Pad               | 14. Axle Shaft                         |
| 2. Pinion Bearing Oil Seal and Retainer | 9. Ring Gear                          | 15. Differential Bearing               |
| 3. Oil Seal                             | 10. Differential Spider               | 16. Differential Bearing Adjusting Nut |
| 4. Oil Seal Gasket                      | 11. Differential Pinion (Spider) Gear | 17. Adjusting Nut Lock                 |
| 5. Front Pinion Bearing                 | 12. Differential Side Gear            | 18. Differential Case-Right Half       |
| 6. Drive Pinion                         | 13. Differential Case-Left Half       |  |
| 7. Rear Pinion Bearing                  |                                       |  |

Fig. 1G—Cross Section of Truck Differential with 12 1/4" Ring Gear

## CASE AND DRIVE PINION

### Removal

1. Drain lubricant from differential, remove axle shaft as outlined in Truck Service Manual. See "Axle Shaft Removal".
2. Remove two trunnion bearing "U" bolts from the rear yoke and split the rear universal joint.
- NOTE: The bearings can be left on the trunnion and held in place with tape.
3. Swing propeller shaft to one side and tie to the frame side rail.
4. Remove bolts and lock washers which retain the carrier assembly to the axle housing. Support the differential housing with a floor jack and roll it from under truck.

### Disassembly

1. Mount carrier assembly in a bench vise or holding fixture.
2. Loosen ring gear thrust pad locknut and remove thrust pad.
3. Remove differential adjusting nut locks and bearing cap bolts and lock washers.
4. Mark bearing caps and carrier for reassembly in same position. Remove bearing caps and adjusting nuts by tapping on bosses of caps with a soft faced hammer until caps are free from dowels.

**CAUTION:** Do not attempt to pry cap off as this may damage machined face of cap.

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

**CAUTION:** Exercise care that differential bearing outer races are not dropped while removing assembly from carrier.

6. Remove the bolts which attach the pinion bearing retainer to the carrier.
7. Remove the pinion and bearing assembly from the carrier.

NOTE: It may be necessary to drive this unit from carrier. Use brass drift against pilot end of pinion.

### Repairs

#### Pinion Disassembly

1. Clamp pinion drive flange in bench vise.
2. Remove cotter pin, nut and washer from end of pinion.
3. Remove drive flange and bearing retainer assembly from pinion.
4. Drive oil seal from retainer. Discard seal as new parts should be used at assembly.
5. Remove pinion rear bearing snap ring and press

bearing from pinion, using Tool J-1453, as shown in figure 2G.

6. Position drive pinion in an arbor press so that the bearing is supported by two pieces of flat steel stock as shown in Figure 3G. Place flat stock parallel to each other and against pinion so as to pick up a large area of bearing outer race. Press pinion from bearing making sure pinion is supported to prevent damage when removed from bearing.

#### Pinion Inspection

1. Wash all parts in cleaning solvent.
2. Inspect pinion for scored, cracked, chipped or worn teeth.
3. Inspect splines on pinion shaft for excessive wear.
4. Inspect pinion bearing assemblies for roughness, defects or excessive wear.

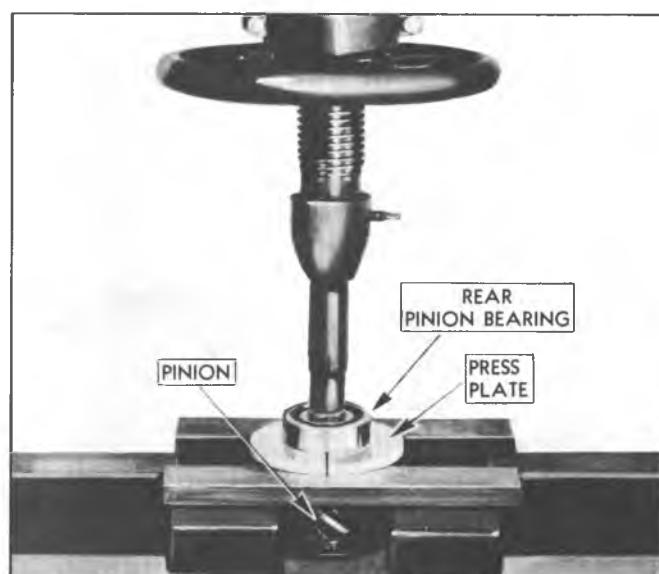


Fig. 2G—Pinion Rear Bearing Removal

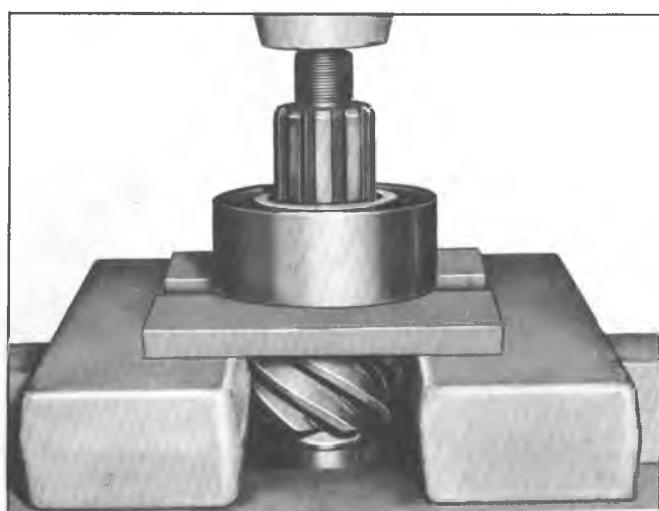


Fig. 3G—Drive Pinion Front Bearing Removal

**Pinion Reassembly**

1. Pack the cavity between the pinion oil seal lips with a lithium-base EP lubricant to provide initial lubrication and to aid in inserting pinion flange.
2. Press the oil seal into the retainer. Position seal lips toward the pinion bearing, using Tool J-22281 as shown in Figure 4G.
3. Install the pinion rear bearing assembly on pinion shaft making sure that chamfered side of inner race seats against shoulder on pinion shaft. Then install pinion bearing lock ring using Tool J- 1364 as shown in Figure 5G.
4. To install pinion front bearing, position the one-piece double row ball bearing on pinion shaft, so that extended portion of inner race is toward pinion head. Then, using a suitable length of 2 inch pipe, press bearing onto shaft until it seats against the pinion head.

**CAUTION:** When pressing bearing on pinion,



Fig. 4G—Pinion Oil Seal Installation

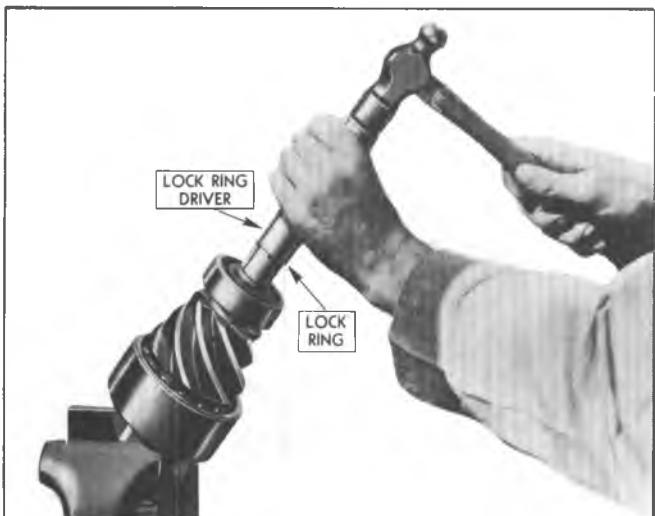


Fig. 5G—Pinion Rear Bearing Lock Ring Installation

exercise care to prevent damage to ground surface of pilot.

5. Slide oil seal retainer on pinion shaft, then tap drive flange onto pinion splines.
6. Clamp drive flange in a bench vise and install flange washer and nut. Torque nut to specifications and install cotter pin without backing off on nut.

**Differential Disassembly**

1. Check differential case to make sure that the two halves are marked so they may be reassembled in same relation. See Figure 6G.
2. Remove bolts holding case and cover together.  
NOTE: Ring gear is mounted on the case.
3. Separate cover from case and remove differential side gears and thrust washers, pinion gears with thrust washers and differential spider.

**Differential Inspection**

1. Wash all parts thoroughly in cleaning solvent.
2. Inspect ring gear for chipped, scored or worn teeth.
3. Check radial clearance between differential side gears and differential case, also fit of differential pinions on spider.
4. Inspect spider arms for wear and distortion.
5. Inspect splines and teeth of differential side gears and pinions for chipping or excessive wear.
6. Check thrust washers for wear and replace if even slight wear is indicated.
7. Check differential side bearings and cups for broken races, discoloration or roughness.
8. Inspect differential case for cracks or distortion.

**Ring Gear Replacement**

1. Remove ring gear from case by tapping the back of the gear with a soft faced hammer.

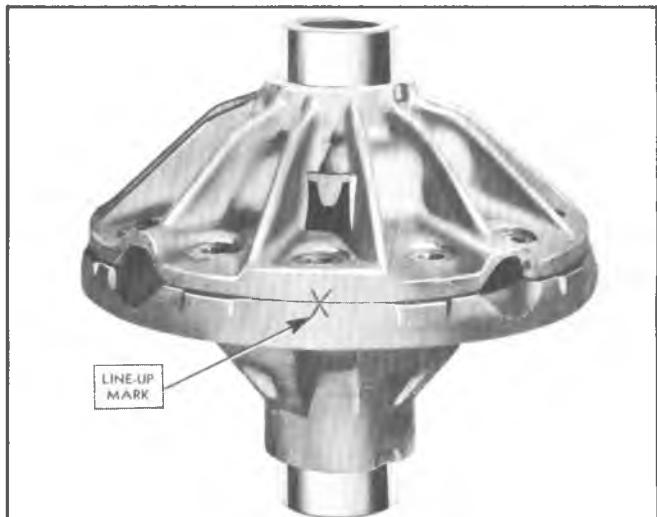


Fig. 6G—Differential Case Line-Up Marks

2. Inspect ring gear pilot case flange and back of ring gear for dirt or burrs.
3. Install two guide pins (made from cap screws with heads cut off and ends slotted) to new gear diametrically opposite each other.
4. Start guide pins through case flange and tap ring gear on case.

#### Differential Bearing Replacement

1. Install Tool J-8107 making sure puller legs are fitted securely in notches in case and tighten retaining yoke as shown in Figure 7G.
2. Tighten puller screw to remove bearing.
3. Place new bearing on hub with thick side of inner race toward case and install bearing using J-1488 as shown in Figure 8G.

NOTE: The side bearing tool is counterbored

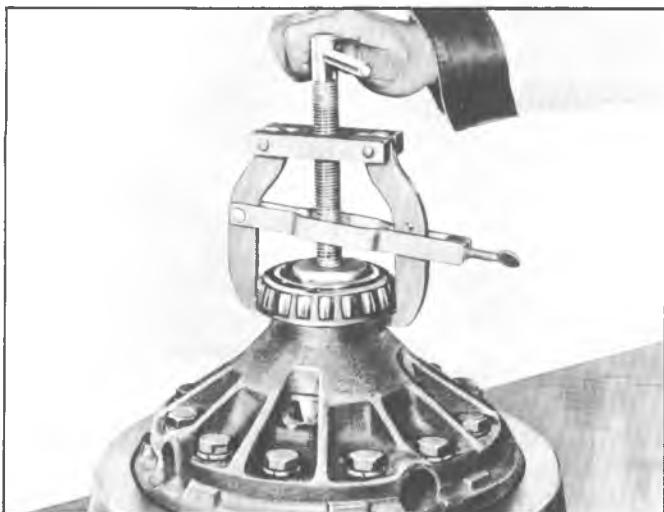


Fig. 7G—Differential Bearing Removal



Fig. 8G—Differential Bearing Installation

and has pilot to assure proper installation and seating of bearing.

#### Differential Reassembly

1. Lubricate differential side gears, pinions and thrust washers.
2. Place differential pinions and thrust washers on spider.
3. Assemble side gears and pinions and thrust washers to left half of differential case.
4. Assemble right half of case to left half being sure to line up marks on the two halves.
5. Install differential-to-ring gear bolts and lock washers and tighten evenly until ring gear is flush with case flange.
6. Remove two guide pins and install remaining two bolts. Torque all bolts alternately and evenly to specifications.

#### Reassembly

1. Place new pinion bearing retainer gasket on the retainer and install pinion assembly in carrier.
- NOTE: The pinion assembly should be pressed into the carrier to prevent the possibility of damaging the shims.
2. Install pinion bearing retainer bolts and lock washers and torque bolts to specifications.
  3. Lubricate differential bearing rollers with engine oil and place outer races over them.
  4. Install differential assembly in carrier and install adjusting nuts.

**CAUTION:** Carefully slide adjusting nuts alongside the bearings so that threads on nuts fit into threads in carrier.

5. Install differential bearing caps making sure the marks on the caps line up with the marks on the carrier.
6. Install bearing cap bolts and lock washers and tighten until lock washers just flatten out.

#### Backlash and Preload Adjustment

1. With differential bearing cap bolts loosened just enough to permit turning the bearing adjustment nuts with Tool J-0972, remove all lash between ring gear and pinion. See Figure 9G.
2. Back off left hand adjusting nut one to two notches to a locking position.
3. Tighten right hand adjusting nut firmly to force differential in solid contact with left hand adjusting nut.
4. Back off right hand adjusting nut until free of bearing; then retighten snugly against bearing.
5. Tighten right hand nut from one to two additional notches to a locking position.

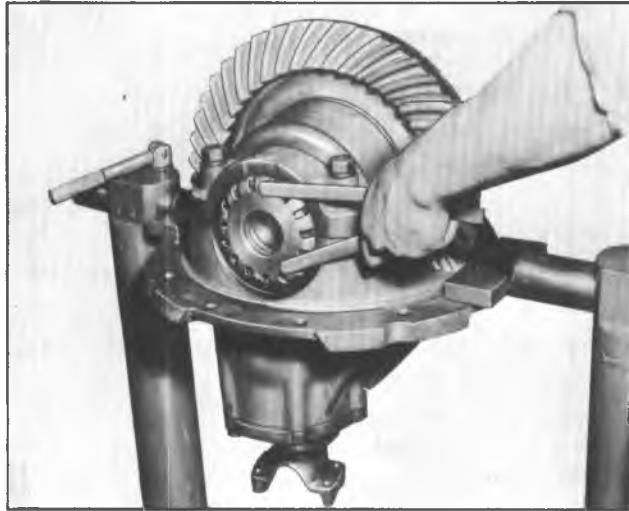


Fig. 9G—Backlash and Preload Adjustment

**NOTE:** This method of adjustment provides for proper preload of bearings.

6. Mount a dial indicator on the carrier and check the backlash between ring gear and pinion as shown in Figure 10G. Backlash should be from .003" to .012" (.005" to .008" preferred).

**NOTE:** If backlash is more than .012 inch, loosen the right hand adjusting nut one notch and tighten left hand adjusting nut one notch. If backlash is less than .003 in. loosen the left hand adjusting nut one notch and tighten right hand nut one notch.

7. Tighten bearing cap bolts to specifications.
8. Install side bearing adjusting nut locks and torque to specifications.

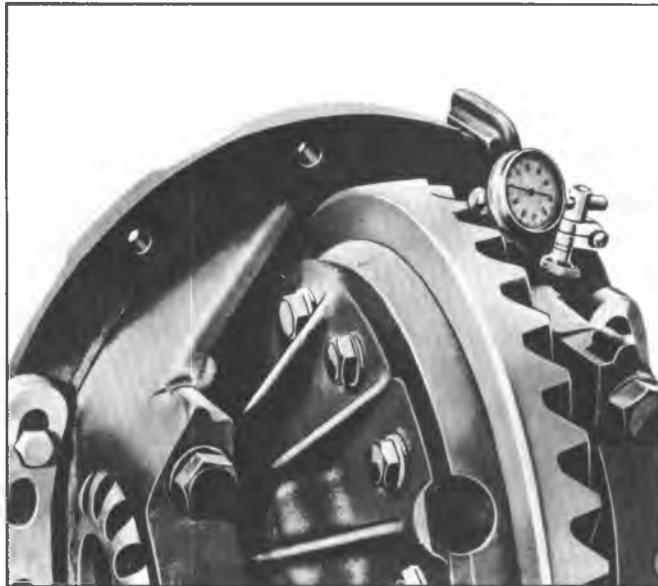


Fig. 10G—Checking Backlash

### Ring Gear Thrust Pad Adjustment

1. Inspect bronze tip of thrust pad and if worn install a new one.
2. Install thrust pad and tighten screw until bronze tip engages back face of ring gear while rotating gear.
3. Back off screw one-twelfth (1/12) turn and tighten locknut to specifications. See Figure 11G.

**NOTE:** Make sure screw does not turn during locking process. This adjustment provides .005 in. to .007 in. clearance between thrust pad and ring gear face.

### Installation

1. Clean out axle housing and cover and place new gasket over axle housing.
2. Assemble differential carrier to axle housing, install lockwashers and bolts and tighten securely.
3. Replace axle housing inspection cover, if removed, using new gasket.
4. Assemble rear universal joint.

**CAUTION:** This propeller shaft to pinion flange fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

5. Install axle shafts as outlined in applicable axle installation procedure in Service Manual.
6. Fill axle with lubricant to a level even with bottom of filler hole. See Section 0 in the Truck Service Manual for proper lubricant.

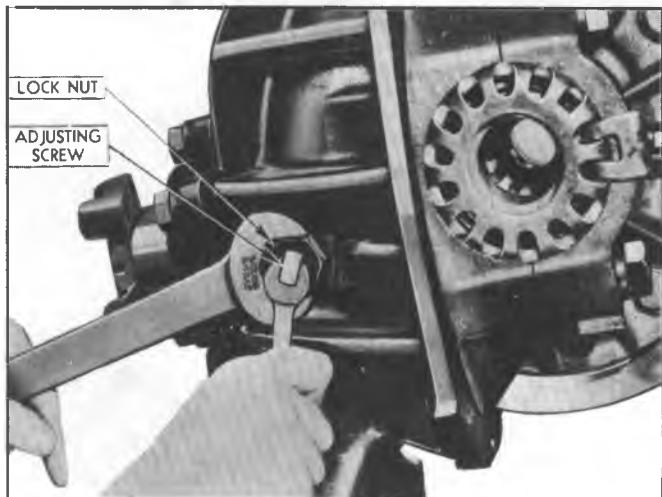


Fig. 11G—Ring Gear Thrust Pad Adjustment

# EATON POSITIVE LOCKING DIFFERENTIAL

## INDEX

General Description.....	4B-73	3/4 Ton Units .....	4B-77
Service Test Procedure .....	4B-74	Disassembly .....	4B-78
1/2 Ton Units .....	4B-74	Inspection .....	4B-78
Disassembly .....	4B-76	Cam/Clutch Service.....	4B-78
Inspection .....	4B-76	Reassembly .....	4B-78
Cam/Clutch Service.....	4B-76		
Reassembly .....	4B-77		

## GENERAL DESCRIPTION

Chevrolet Trucks equipped with locking differentials use one of the Eaton locking units in Figure 4B-1H, 2H. These differentials provide true differential action and also incorporates a speed sensitive device which automatically and positively locks both rear wheels together if either wheel should spin excessively during slow vehicle operation.

Locking is accomplished through the use of a flyweight governor mechanism, cam system, and multi-disc clutch. The flyweights on the governor mechanism move outward to

engage a latching bracket whenever the wheel-to-wheel speed varies by approximately 100 rpm or more. This action retards a cam which, in turn, compresses a multi-disc clutch locking one side gear to the case. At wheel-to-wheel differentials of less than approximately 100 rpm, the unit operates as a standard or open differential.

**NOTE:** At vehicle speeds above approximately 20 mph, the latching bracket overcomes a spring preload and swings away from the flyweights. At this vehicle speed

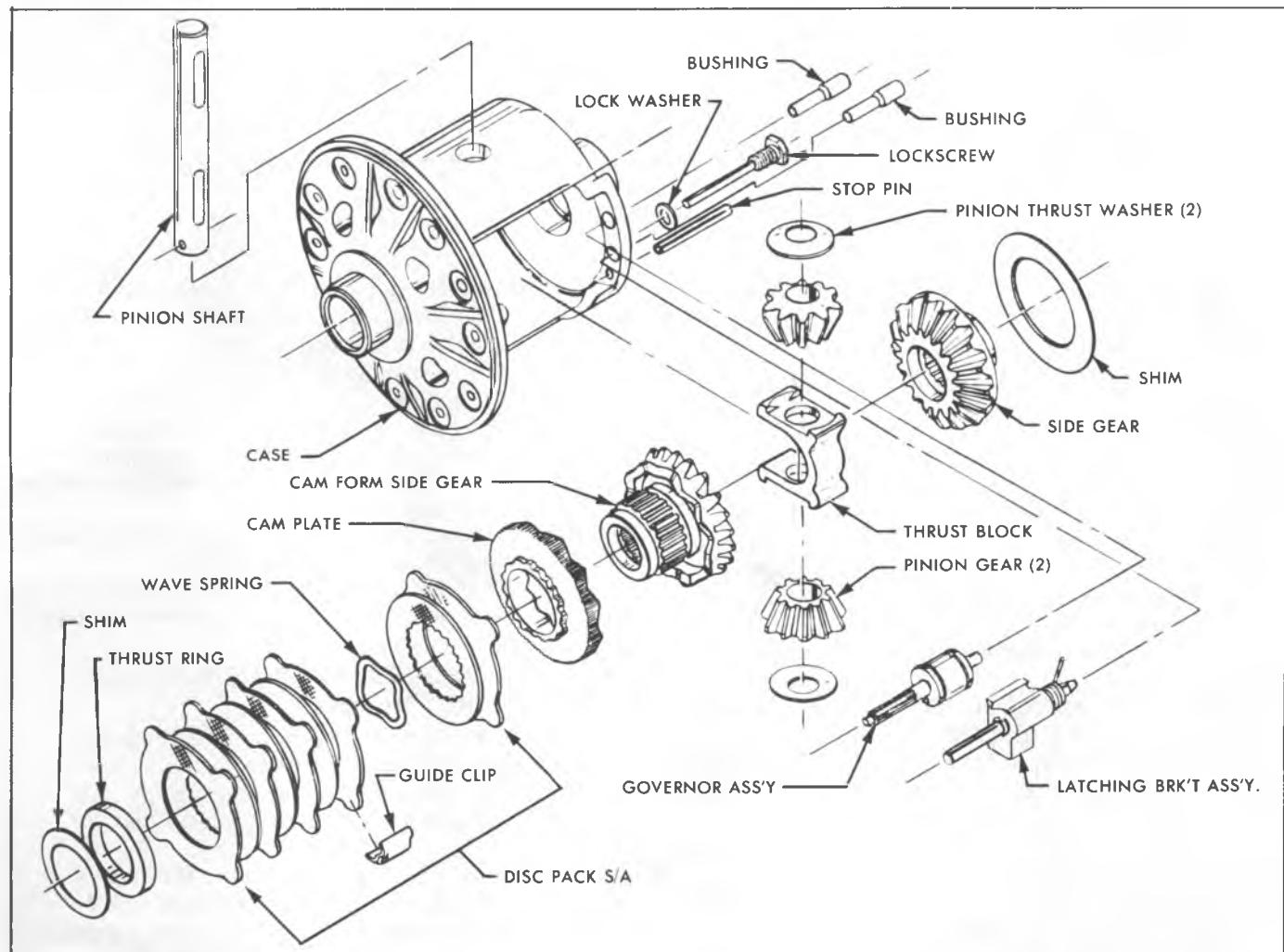


Fig. 4B-1H--1/2 Ton Unit

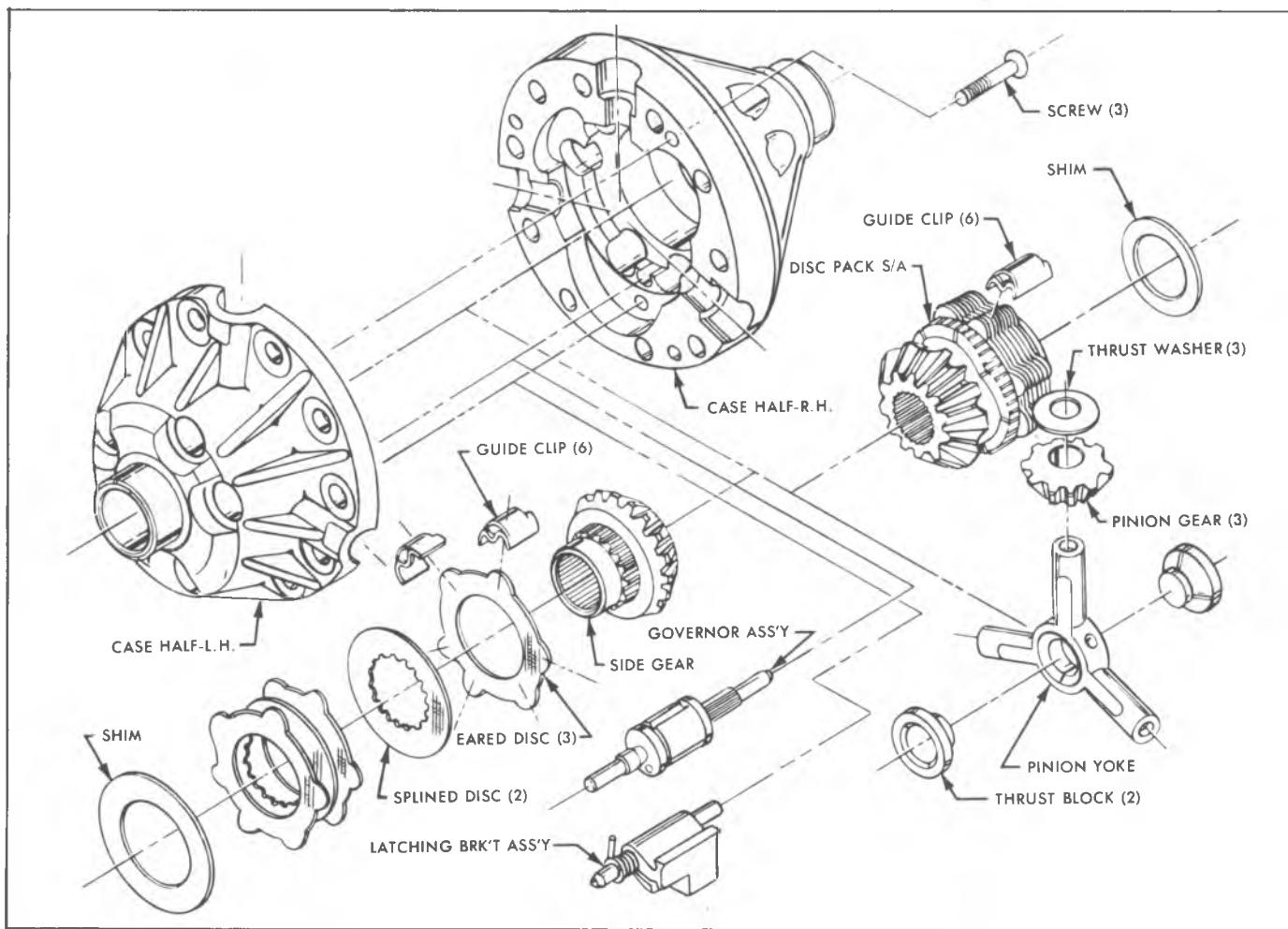


Fig. 4B-2H--3/4 Ton Unit

or greater, the differential will not lock as the added traction is not necessary.

#### Service Test Procedure

1. Place the Truck on a frame-contact hoist, allowing free rotation of the rear wheels.

2. Raise hoist until wheels clear floor. Holding one wheel stationary, slowly rotate other wheel approximately 1/2 revolution per second, in both the forward and reverse directions. Wheel should rotate freely. If both wheels attempt to turn together, the differential is locking and is defective.

**NOTE:** Rapid wheel rotation will cause a properly operating differential to lock and both wheels will rotate in the same direction.

3. Raise hoist to maximum height with one person in vehicle.

4. Start engine making sure that carburetor is set to provide a low idle speed of 600-800 rpm.

5. Place transmission in drive range and apply brakes. With manual transmission, depress clutch and place transmission in first gear.

6. Lock one rear wheel by pulling one parking brake cable from under the vehicle.

7. With engine at low idle, slowly release brakes. With manual transmission, slowly engage clutch.

8. Locked rear wheel will remain stationary and free wheel will begin turning. It is important that brakes or clutch be released slowly enough to start the free wheel turning and

allow the free wheel to gradually increase in speed. As speed of the free wheel is increased, the differential will lock causing the rotating wheel to stop or both wheels to turn at the same speed. The engine may stall if equipped with a manual transmission. It may be necessary to accelerate engine until approximately 10 mph is indicated on vehicle speedometer to cause differential lock. If indicated speed can be increased beyond 20 mph without causing differential lock, the unit is not functioning properly.

**NOTE:** Rapid release of brakes or clutch, or rapid acceleration of engine will invalidate test.

9. Lock opposite rear wheel and repeat procedure. The following chart provides guidelines for diagnosis and repair of differential complaints.

#### OVERHAUL PROCEDURES 8-7/8 RING GEAR AXLE 1/2 TON TRUCKS

**CAUTION:** Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found, the entire differential must be replaced.

Internal clearances are such that shims, reaction block, and thrust rings should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction block, or thrust ring must be replaced due to damage, correct measurement and replacement procedures must be

### DIFFERENTIAL DIAGNOSIS

Complaint	Possible Cause	Correction
Does not lock:	A. Little or no spring preload on the latching bracket. B. Flyweights on governor assembly stuck closed. C. Broken Drive teeth on governor and/or cam gear assembly. D. Broken clutch plates in cam gear assembly.	A. Replace governor assembly and latching bracket. B. Replace governor assembly and latching bracket. C. Replace cam plate, governor assembly and latching bracket. D. Replace clutch plates and wave spring.
Locks in turns:	A. Governor assembly tight in case. B. Broken or weak governor flyweight spring. C. Flyweight in governor assembly stuck open. D. Broken cam plate and/or governor drive teeth.	A. Free up governor assembly. B. Replace governor assembly and latching bracket. C. Replace governor assembly and latching bracket. D. Replace cam plate, governor assembly and latching bracket.
Noisy:		
NOTE:	In addition to normal axle noise (see section on standard differential), the locking differential exhibits some clutch noise upon engagement and disengagement.	
	A. Broken clutch plates. B. Broken reaction block. C. Broken differential gears.	A. Replace clutch plates and wave spring. B. Replace reaction block.* Check closely for other damage. Replace entire unit if housing, side gear, or pinion gears are damaged. C. Replace entire unit.

\*Reaction blocks must be replaced with blocks of identical thickness.

Fig. 4B-3H--Diagnosis Chart



Fig. 4B-4H--Governor and Latching Bracket

*followed. Failure to do so may disturb critical clearances and could result in differential complaints.*

*Internal components can be inspected through the windows of the differential housing.*

*If the governor assembly and latching bracket are the only items to be replaced, proceed only through step No. 2 of the disassembly procedure. To install new governor and latching bracket, begin at step No. 6 of the reassembly procedure.*



Fig. 4B-5H-Bearing Puller J-26252

### Disassembly

1. Note position of governor and latching bracket assembly, Figure 4B-4H. Remove ring gear and side bearings following procedures established for the standard differential.
2. Using bushing puller tool No. J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 4B-5H. Pull the latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage. Remove the stop pin by driving through the case with a drive pin punch.
3. Remove lock screw and pinion shaft, and roll out differential pinion gears.
4. Remove thrust block and pinion thrust washers.
5. Remove cam gear, disc pack assembly and disc pack guide clips.
6. Remove plain side gear and shims.

### Inspection

1. Clean all parts with solvent. Inspect all bearing for chipping or evidence of excessive wear. Replace parts as needed.
2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring and stop pin.
- Cam plate.
- Clutch disc pack with guides and guide clip.
- Pinion cross-shaft.
- Pinion gears.
- Pinion thrust washers.
- Reaction block (4 sizes).
- Thrust ring.
- Flange end shim (4 sizes).

**CAUTION:** Attempts to service other components may disturb critical clearances and could result in differential complaints.

*If reaction block or flange end shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.*

### CAM/CLUTCH SERVICE

#### Disassembly

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassemble unit if thrust ring is replaced. **DO NOT REPLACE THRUST RING UNLESS NECESSARY.** If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.
2. With gear hub end up, compress disc pack and install jaws of split ring bearing remover (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.
3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.
4. Install a 1-1/2" to 1-3/4" diameter plug similar to (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order, Figure 4B-6H.

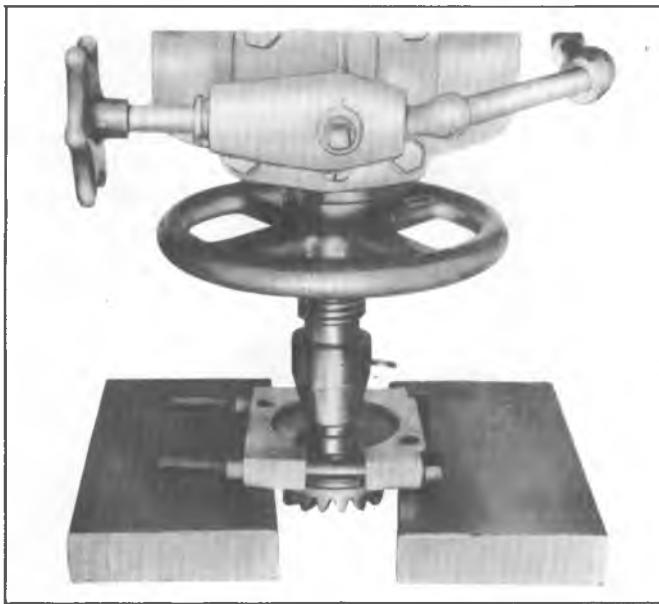


Fig. 4B-6H--Bearing Remover J-22912

### Reassembly

Replace cam plate and wave spring or clutch discs as necessary and reassemble as follows: See Fig. 4B-1H.

1.?Place gear on bench with hub end up.

2.?Assemble cam plate with cam form down to mate with cam form on gear.

3.?Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown.

4.?Assemble on to gear hub (3) splined discs and (3) eared discs alternately as shown. Begin with a splined disc and end with an eared disc.

5.?Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.

**NOTE:** Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

### Reassembly

1. Install (4) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.

2. Install cam gear assembly and original shim in flange end of case. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step A of cam gear service section. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

**NOTE: INCORRECT SHIMMING WILL DISTRUB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN DIFFERENTAIL FAILURE.**

3. Lock an axle shaft in vise, in a vertical position. Mount the differential case over the end of the axle shaft engaging the spline of the side gear with the shaft. Grease the two pinion gear thrust washers and locate them in their proper

position. Install the opposite end side gear and original shim.

**NOTE: ORIGINAL SHIM MUST BE USED TO MAINTAIN PROPER CLEARANCE DIMENSIONS.**

4. Insert one pinion gear through the small window opening in the case while at the same time inserting the reaction block and other pinion gear through the large window opening. Rotate the two pinion gears and thrust block 90° so as to position the reaction block with the open side towards the small window opening in the case. Be sure the two pinion gears and thrust washers are in their proper location.

**NOTE: REACTION BLOCK MUST BE REPLACED WITH A BLOCK OF THE IDENTICAL THICKNESS. INCORRECT BLOCK THICKNESS WILL DISTURB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN DIFFERENTIAL FAILURE.**

5. Install shaft and lock screw.

6. Insert governor assembly and latching bracket into case, Figure 4B-4H. Place straight end of latching bracket spring over and to the outside of the engagement shaft to preload the latching bracket against the governor assembly. Press bushing and 1/4" stop pin into case. Press bushing for governor assembly into case to give .004 to .020 shaft end play. Press bushing for latching bracket into case to remove end play. A 3/8 diameter plug or socket will aid in pressing the bushings into the housing. Press stop pin flush with top of case.

**NOTE:** For the latching bracket use bushing with the tapered hole. The bushing for the governor assembly has a straight hole.

7. Install ring gear and side bearings using the procedure outlined for conventional differentials.

8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the conventional differential section.

9. Check operation as outlined in the Service Test Procedure.

**NOTE: USE STANDARD DIFFERENTIAL LUBRICANT. DO NOT USE LUBRICANT DESIGNED FOR "LIMITED SLIP" DIFFERENTIALS.**

### 10-1/2" RING GEAR AXLE 3/4 TON AND 1-TON TRUCKS

**CAUTION:** Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found, the entire differential must be replaced.

Internal clearances are such that shims, reaction blocks, and thrust ring should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction blocks, or thrust ring must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.



Fig. 4B-7H-3/4 Ton Unit

### Disassembly

1. Remove ring gear and side bearings following procedures established for the standard differential.
2. Remove (3) screws on front face of ring gear flange.
3. Set unit on right side case half and gently pry apart at yoke hole locations Fig. 4B-7H.
4. Remove left side case half. To prevent side gear from falling out, hold thumb against inside of gear hub while separating case halves.
5. Inspect components for damage. If the governor assembly and latching bracket are the only items to be replaced, remove and proceed to Step 7 of reassembly procedure. Pry under pinion yoke and remove and proceed with detailed inspection if further damage is observed.

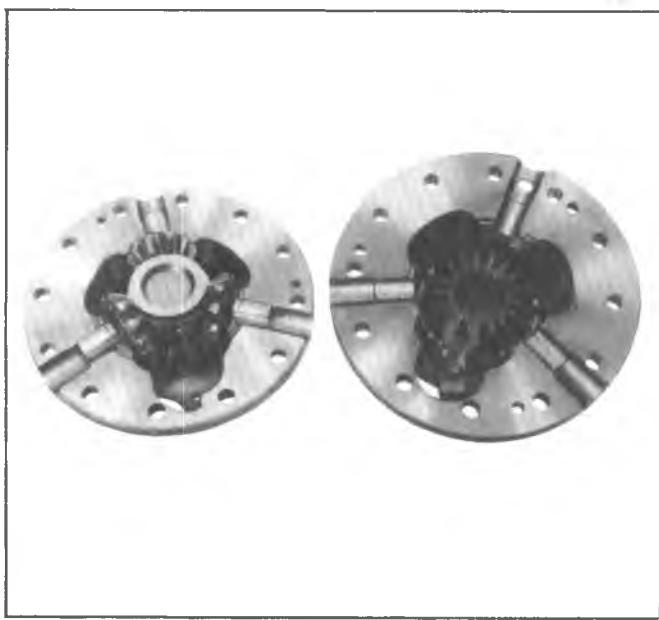


Fig. 4B-8H-3/4 Ton Assembly

### Inspection

1. Clean all parts with solvent. Inspect all bearings for chipping or evidence of excessive wear. Replace parts as needed.

2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. THE FOLLOWING ARE SERVICEABLE COMPONENTS FOR THIS DIFFERENTIAL.

- Governor assembly and latching bracket with spring.
- Cam Plate.
- Clutch disc pack with wave spring and guide clips.
- Pinion yoke.
- Pinion gears.
- Pinion thrust washers.
- Reaction blocks (4 sizes).
- Thrust ring.
- Right side shim (4 sizes).
- Left side guide clips.

Attempts to service other components will disturb critical clearances and may result in differential failure. If reaction blocks or right side shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.

### CAM/CLUTCH SERVICE

#### Disassembly

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows: Refer to Figure 4B-9H.

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassemble unit if thrust ring is replaced. DO NOT REPLACE THRUST RING UNLESS NECESSARY. If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.

2. With gear hub end up, compress disc pack and install jaws of split ring bearing removed (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.

4. Install a 1-1/2" to 1-3/4" diameter plug (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order.

#### Reassambly

Replace cam plate and/or clutch discs as necessary and reassemble as follows:

1. Place gear on bench with hub end up.  
2. Assemble cam plate with cam form down to mate with cam form on gear.

3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown, Fig. 4B-9H.

4. Assemble onto gear hub: (4) eared discs and (3) splined discs alternately as shown. Begin and end with an eared disc.

5. Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.

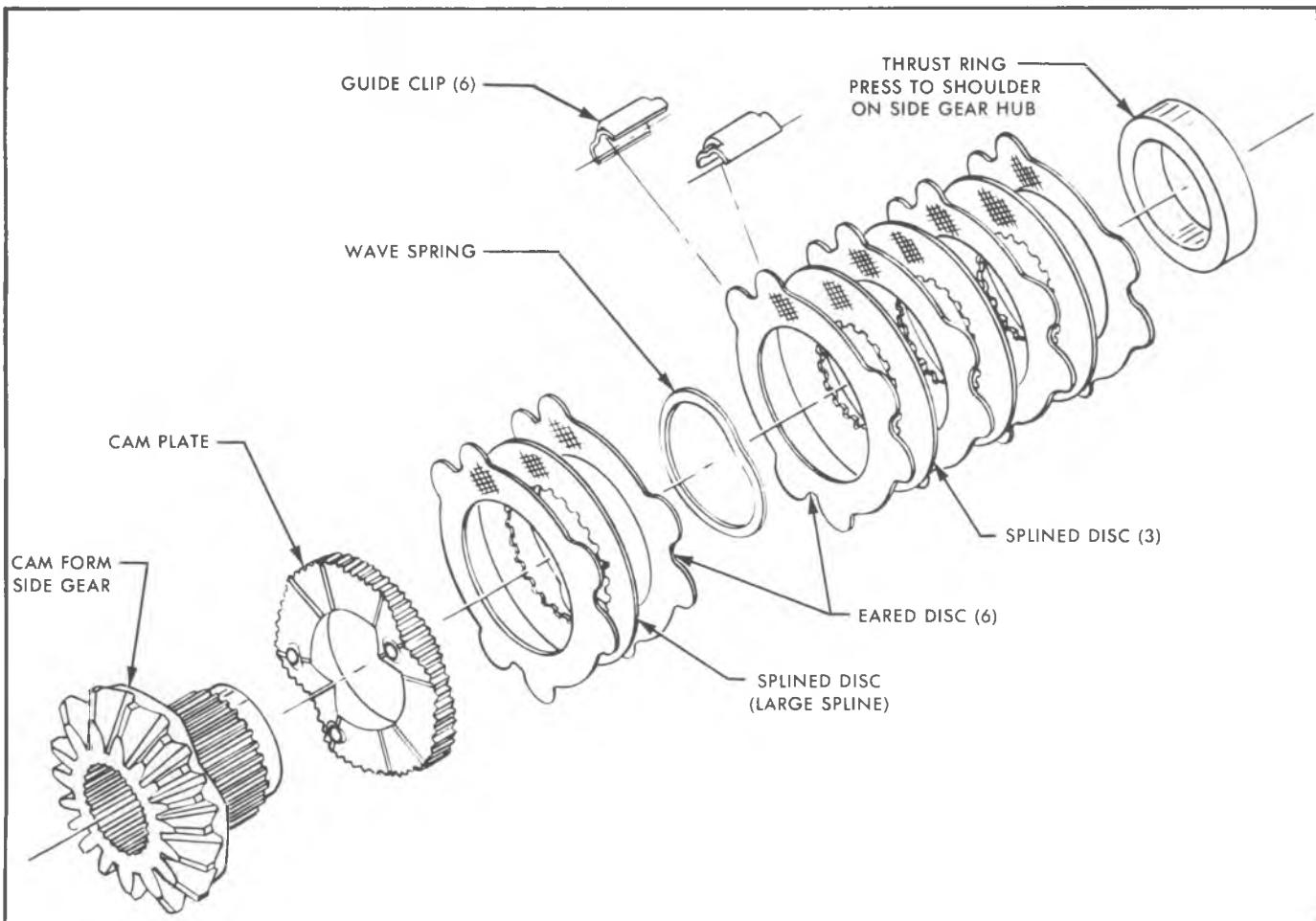


Fig. 4B-9H--Cam Plate and Clutch Disc

**NOTE:** Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

#### Reassembly

1. Install (6) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.

2. Install cam gear assembly and original shim in right side case half. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step A of cam gear service section. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

**NOTE: INCORRECT SHIMMING WILL DISTURB CRITICAL CLEARANCE DIMENSIONS AND MAY RESULT IN DIFFERENTIAL FAILURE.**

3. Install right side reaction block on gear face with button side of block facing up. Use original block unless severely scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.

**NOTE: INCORRECT BLOCK THICKNESS WILL DISTURB CRITICAL CLEARANCES AND MAY**

#### RESULT IN DIFFERENTIAL FAILURE.

4. Preassemble pinions and pinion thrust washers on pinion yoke. Index yoke to proper position and install in housing with center over button end of reaction block. A light tap on the yoke may be needed to seat it in the housing.

5. Install left side reaction block unless severely scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.

**NOTE: Right and left side reaction blocks may not be the same thickness. If blocks are broken or cannot be accurately measured for thickness, the entire differential must be replaced. Incorrect block thickness will disturb critical clearances and may result in differential failure.**

6. Install governor assembly and latching bracket in their respective locations. Place straight end of latching bracket spring over and to the outside of the governor shaft to preload the latching bracket against the governor assembly.

7. Install the original (3) eared and (2) splined clutch plates on the left side gear alternately, starting and ending with an eared disc.

**NOTE: ORIGINAL DISCS MUST BE USED. ATTEMPS TO INSTALL OTHER THAN ORIGINAL DISCS WILL DISTURB CRITICAL CLEARANCES AND MAY RESULT IN DIFFERENTIAL FAILURE.**

8. Install (6) clutch pack guide clips on the left side disc pack assembly using grease for retention.

9. Install original shim in left side case half.

**NOTE:** ORIGINAL SHIM MUST BE USED. ATTEMPS TO INSTALL OTHER THAN ORIGINAL SHIM WILL DISTURB CRITICAL CLEARNCES AND MAY RESULT IN DIFFERENTIAL FAILURE. Slight polishing or scuffing on discs and shims is normal.

10. Remove disc pack from side gear and carefully lower disc pack assembly into left side case half. Make sure car guide clips are in their proper position.

11. Install side gear in left side case half. Rotate gear to engage spline with splines on discs.

12. Being careful not to dislodge side gear assembly (hold thumb on inside of side gear spline), lower the left hand case assembly onto the right hand case. Index left hand case so holds in housing will line up for the governor assembly and latching bracket shafts.

13. Turn entire unit over and install three (3) screws.

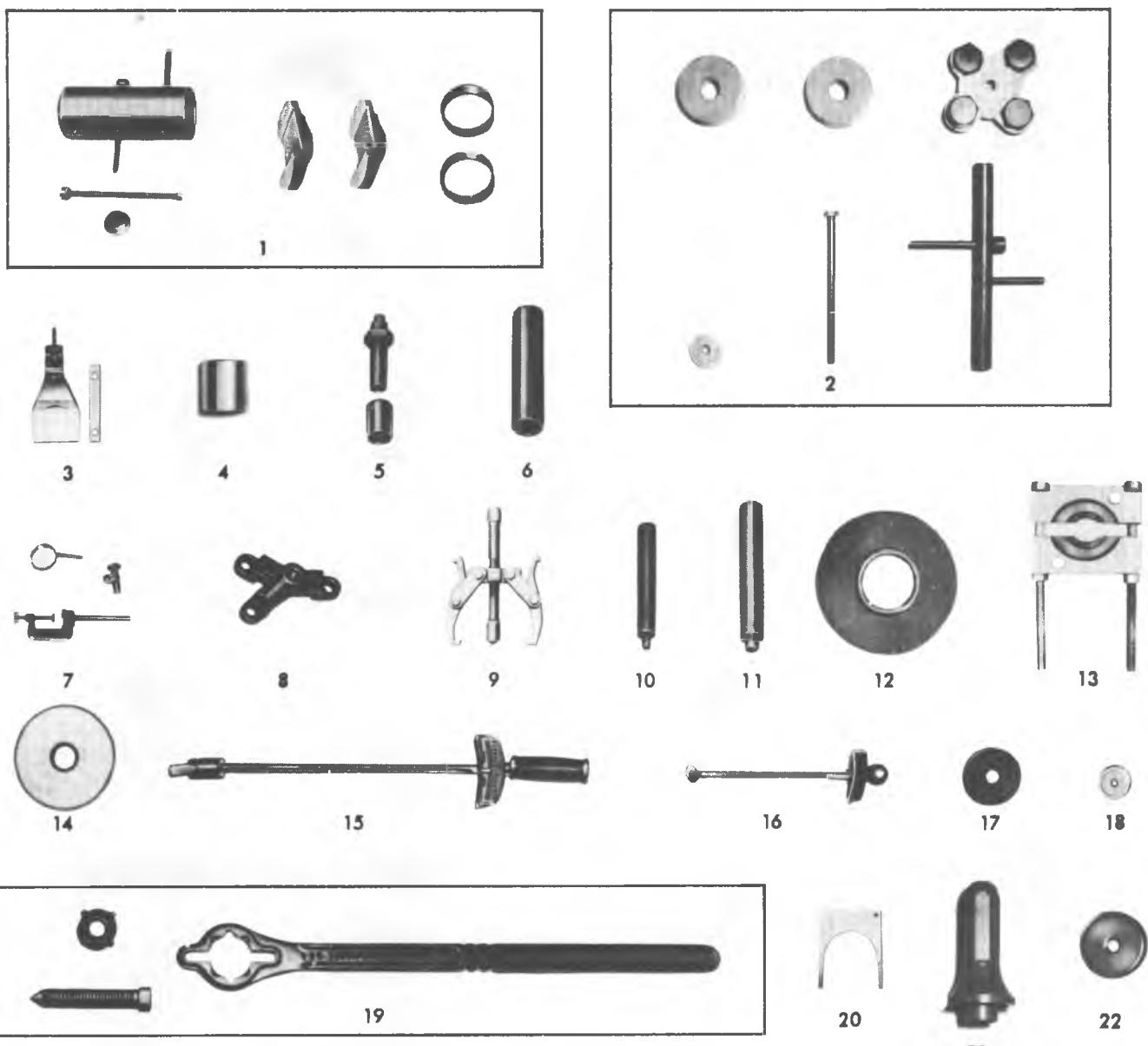
14. Lock an axle shaft in a vise in a vertical position. Install differential assembly on axle shaft engaging the spline of the axle with a side gear. Rotate unit slowly. A short shaft held in pinion yoke hole will aid in rotating. The unit should turn smoothly without binding or locking up.

**NOTE:** Differential will lock if turned rapidly—50 rpm or greater.

15. Install ring gear and side bearings using the procedure outlined for conventional differentials.

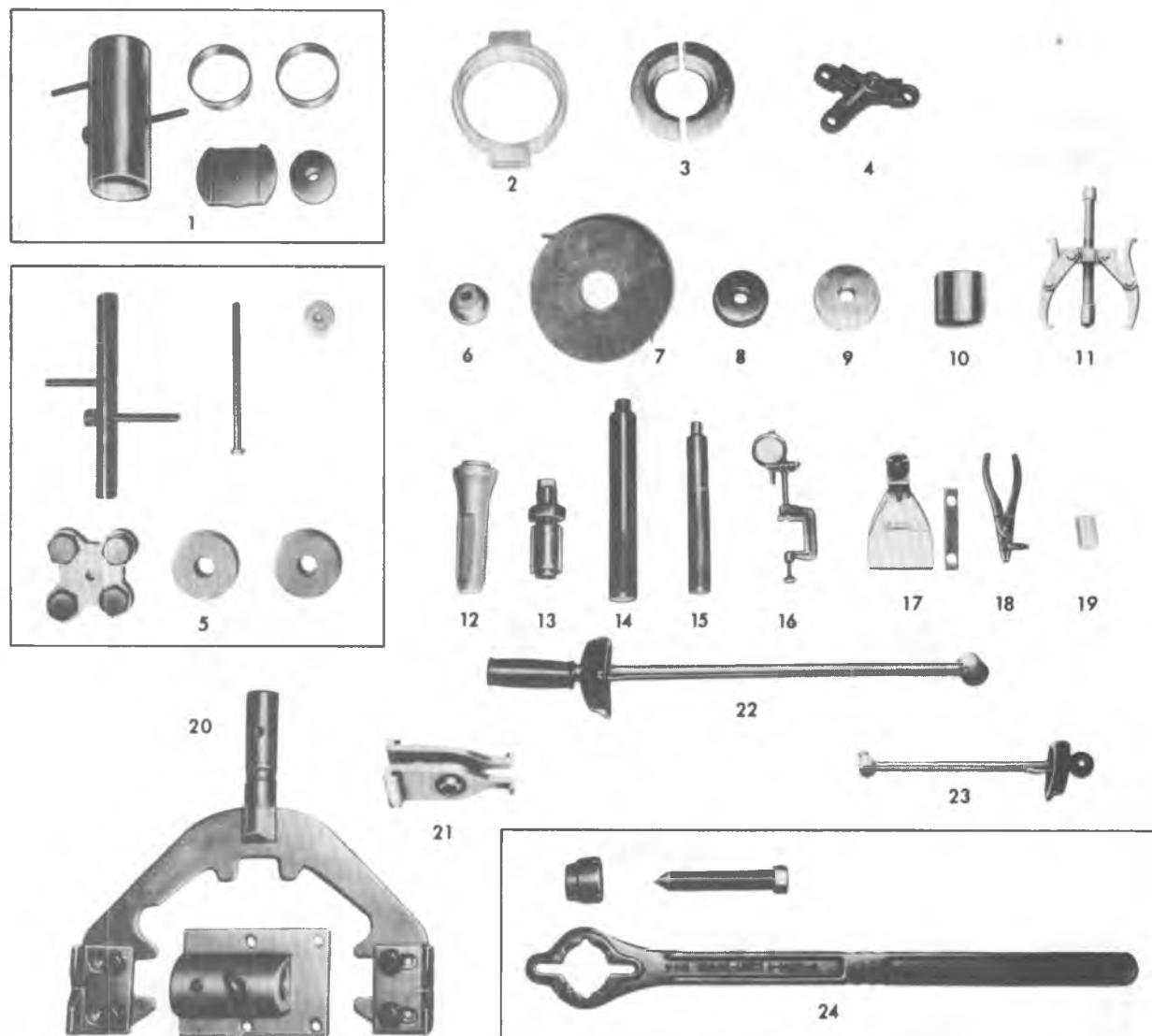
16. Place differential unit in carrier and adjust ring gear to pinion backlash and gear tooth pattern as outlined in the conventional differential section.

**NOTE:** Use standard differential lubricant. DO NOT use lubricants specifically designed for "limited slip".



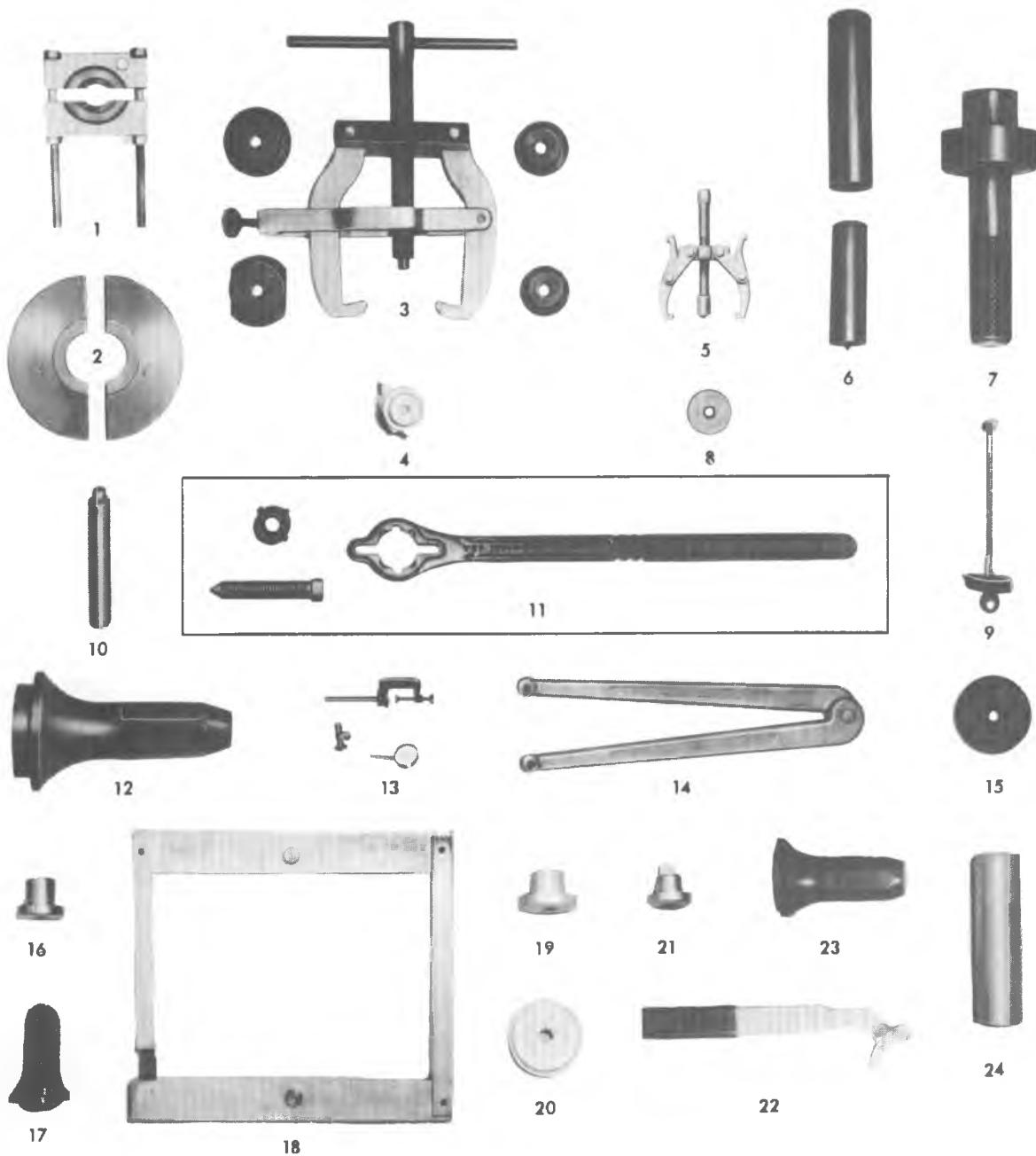
- |              |  |                  |  |
|--------------|--|------------------|--|
| 1. J-6266    | Pinion Setting Gauge                           | 9. J-22888       | Differential Bearing Remover   |
| J-6266-28    | Barrel Adapter                                 | 10. J-7079-2     | Driver Handle (Insert Type)  |
| J-6266-25    | Plug   | 11. J-8092       | Driver Handle (Threaded Type)  |
| J-6266-52    | Gauge Plate                                    | 12. J-8609-01    | Pinion Rear Bearing Installer - Passenger Car                              |
| J-6266-53    | Gauge Plate                                    | J-5590           | (7-1/2")   |
| J-6266-31    | Adapter Rings                                  | 13. J-8612       | Rear Pinion Bearing Remover  |
| 2. J-23597-1 | Pinion Setting Gauge (7-1/2")                  | J-253200         | (7-1/2")   |
| J-21777-1    | Arbor  | 14. J-8608       | Pinion Rear Bearing Cup Installer  |
| J-21777-45   | Side Discs                                     | J-7817           | (7-1/2")   |
| J-21777-29   | Gauge Plate                                    | 15. J-1313       | 0-150 Ft. Lbs. Torque Wrench   |
| J-21777-42   | Front Bearing Plug                             | 16. J-5853       | In. Lbs. Torque Wrench   |
| J-21777-43   | Stud   | 17. J-7137       | Pinion Front Bearing Cup Installer<br>(Used with J-8092)                   |
| 3. J-22779   | Side Bearing Shim Gauge                        | J-7817           | (7-1/2")   |
| J-22779      | Strap  | 18. J-8107-4     | Differential Bearing Remover - Installer<br>(Used with J-9537 and J-22779) |
| 4. J-22175   | Side Bearing Installer (8-3/4")-(8-7/8")       | 19. J-8614       | Companion Flange Holder  |
| J-22761      | (8-1/2")                                       | 20. J-22864-1, 2 | Pinion Seal Gauge Plate (7-1/2", 8-1/2", 8-7/8")                           |
| J-25299      | (7-1/2")                                       | 21. J-23911      | Pinion Oil Seal Installer (7-1/2", 8-1/2", 8-7/8")                         |
| 5. J-9458    | Companion Flange Installer - Passenger Car     | 22. J-0270-14    | Pinion Rear Bearing Cup Installer<br>Truck Axle (Used with J-8092)         |
| J-5590       | Pinion Rear Bearing Cup Installer - Truck Axle |                  |  |
| 7. J-8001    | Dial Indicator Set                             |                  |  |
| 8. J-5748    | Positraction Torque Measuring Adapter          |                  |  |

Fig. 1T—Special Tools—7 1/2", 8 1/2", 8 3/4", 8 7/8" Ring Gear Differentials



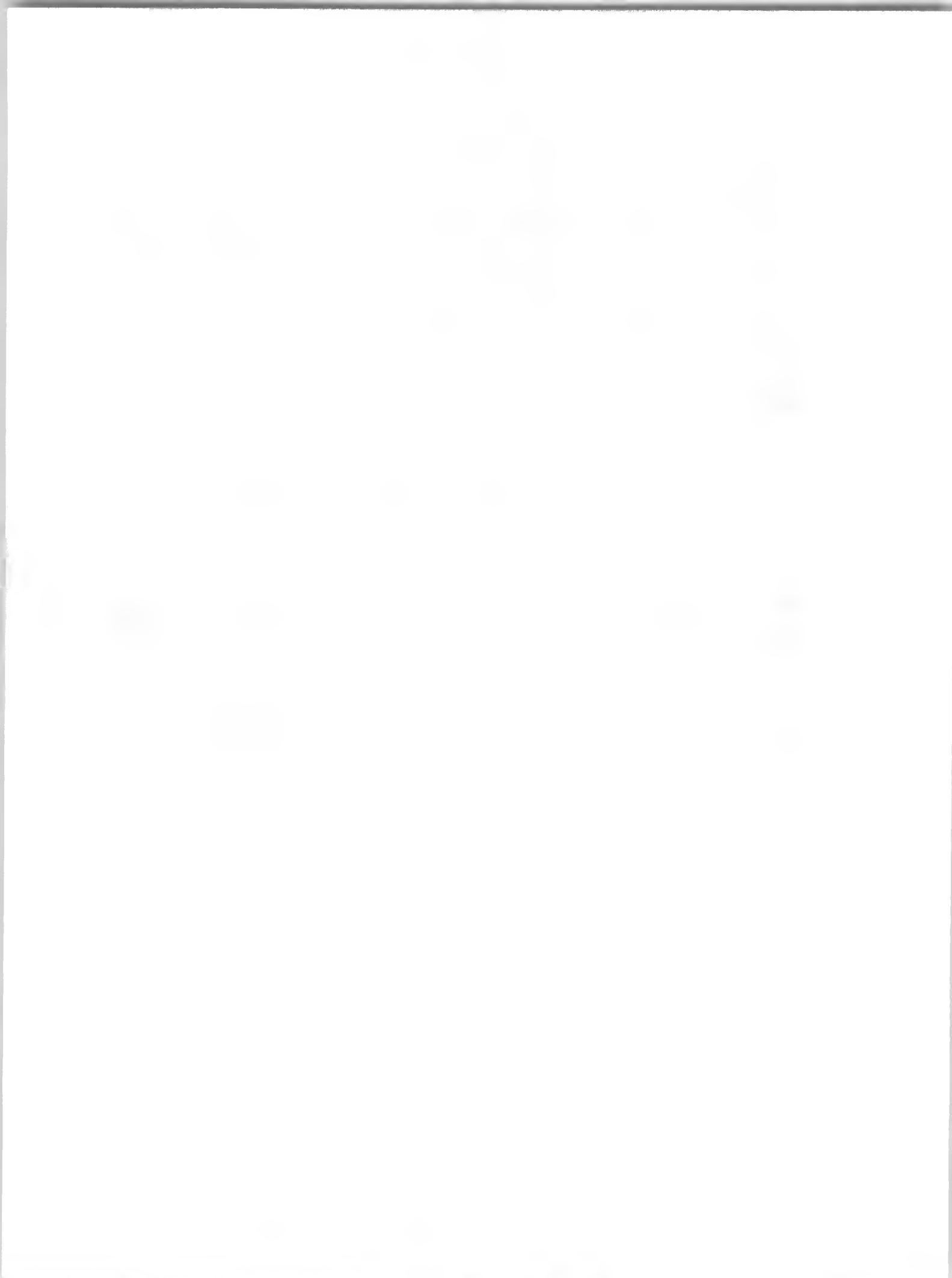
- |               |  |              |  |
|---------------|--|--------------|--|
| 1. J-6266     | Pinion Setting Gauge<br>J-6266-28 Barrel Gauge<br>J-6266-31 Sleeves<br>J-6266-53 Gauge Plate   | 10. J-22175  | Differential Bearing Installer                       |
| 2. J-0358-1   | Press Plate Holder   | 11. J-22888  | Differential Bearing Remover (Used with<br>J-8107-4) |
| 3. J-9771     | Drive Pinion Bearing Cone and Roller Assembly<br>Remover (Used with J-0358-1)  | 12. J-9774   | Differential Yoke Bearing Seal Installer             |
| 4. J-5748     | Positraction Torque Measuring Adapter  | 13. J-5780   | Companion Flange Installer                           |
| 5. J-21777-01 | Pinion Setting Gauge<br>J-21777-45 Side Discs<br>J-21777-29 Gauge Plate<br>J-21777-42 Front Bearing Pinion<br>J-21777-43 Stud<br>J-21777-1 Arbor | 14. J-8092   | Driver Handle (Threaded Type)                        |
| 6. J-9773     | Differential Yoke Bearing Installer<br>(Used with J-7079-2)  | 15. J-7079-2 | Driver Handle (Insert Type)                          |
| 7. J-8609     | Positraction Torque Measuring Adapter  | 16. J-8001   | Dial Indicator Set                                   |
| 8. J-7137     | Drive Pinion Front Bearing Cup Installer<br>(Used with J-8092)   | 17. J-22779  | Side Bearing Shim Gauge<br>J-22779-6 Strap           |
| 9. J-8608     | Drive Pinion Rear Bearing Cup Installer<br>(Used with J-8092)  | 18. J-4880   | Snap Ring Pliers                                     |
|               |  | 19. J-5810   | Torque Wrench Adapter (3/4" Male to 3/8"<br>Female)  |
|               |  | 20. J-3289   | Differential Carrier Holding Fixture                 |
|               |  | 21. J-22311  | Positraction Clutch Pack Remover and Installer       |
|               |  | 22. J-1313   | Ft.-Lb. Torque Wrench                                |
|               |  | 23. J-5853   | In.-Lb. Torque Wrench                                |
|               |  | 24. J-8614   | Companion Flange Holder and Remover                  |

Fig. 2T—Special Tools—Corvette Differentials



- |             |   |             |                                   |
|-------------|---|-------------|-----------------------------------|
| 1. J-22912  | Press Plate   | 13. J-8001  | Dial Indicator Set                |
| 2. J-1453   | Pinion Bearing Press Plate                                    | 14. J-0972  | Differential Nut Wrench           |
| 3. J-8107   | Differential Bearing Puller Set                               | 15. J-24381 | Pinion Rear Bearing Cup Installer |
| 4. J-8107-3 | Adapter Plug  | 16. J-24383 | Side Bearing Installer            |
| 5. J-22888  | Differential Side Bearing Remover                             | 17. J-24384 | Pinion Oil Seal Installer         |
| 6. J-1364   | Pinion Bearing Ring Drive                                     | 18. J-24385 | Case Spreader Tool                |
| 7. J-1488   | Differential Side Bearing Replacer                            | 19. J-24430 | Side Bearing Installer            |
| 8. J-8608   | Drive Pinion Rear Bearing Cup Installer<br>(Used with J-8092) | 20. J-24432 | Pinion Rear Cup Installer         |
| 9. J-5853   | In.-Lbs. Torque Wrench  | 21. J-23322 | Pinion Straddle Bearing Installer |
| 10. J-8092  | Drive Handle  | 22. J-24429 | Adjusting Nut Wrench              |
| 11. J-8614  | Companion Flange Holder and Remover                           | 23. J-24434 | Pinion Oil Seal Installer         |
| 12. J-22281 | Pinion Flange Oil Seal Installer                              | 24. J-24433 | Pinion Rear Bearing Installer     |

Fig. 3T—Special Tools—10-1/2" and 12-1/4" Ring Gear Truck Differentials



## SECTION 4C

FRONT AXLE DIFFERENTIAL  
(4-WHEEL DRIVE)

## CONTENTS

Front Axle Differential.....	4C-1	Drive Pinion.....	4C-5
Differential Case .....	4C-1	Installation and Adjustment.....	4C-5
Removal.....	4C-1	Differential Case .....	4C-6
Oil Seal Replacement.....	4C-1	Preload and Adjustment.....	4C-6
Disassembly .....	4C-1	Installation.....	4C-6
Drive Pinion .....	4C-1	Gear Tooth Contact Pattern Check.....	4C-7
Removal.....	4C-1	Gear Tooth Nomenclature .....	4C-7
Inspection .....	4C-4	Test .....	4C-7
Differential Case .....	4C-4	Adjustments.....	4C-7
Reassembly .....	4C-4	Special Tools .....	4C-9

## FRONT AXLE DIFFERENTIAL

## Differential Case

## Removal (Fig. 4C-1)

1. If front axle assembly is removed from vehicle, mount assembly in suitable holding fixture and remove axle shafts as outlined in Axle Shaft Removal, Truck Service Manual.

2. Remove cover attaching bolts and lock washers and the metal tag secured by one of the attaching bolts. Remove cover and gasket.

**NOTE:** The tag shows the number of teeth on pinion and drive gear.

3. Remove differential side bearing caps, making sure

they are marked for reassembly in the same position.

4. Position Spreader Tool J-5231-01 so the two dowels on tool fit into recesses in carrier, install two hold down bolts and install a dial indicator at one end of opening in carrier to indicate width of opening.

5. Expand spreader tool to spread carrier a maximum of .020".

**CAUTION:** *Do not attempt to remove differential without using the spreader tool. Do not expand carrier more than .020 in. or it may be damaged and take a permanent set.*

6. Remove dial indicator and, using a pry bar, lift out differential assembly. Remove and tag bearing cups so they may be reinstalled in their original positions. Relieve pressure on spreader tool and remove tool.

## Oil Seal Replacement

The axle shaft inner oil seals are located just outboard of the differential bearings, item 28, Fig. 4C-2. They can be replaced only after the differential is removed from the carrier, using tool J-25111.

## Disassembly

1. Remove bearing cups from differential case and identify for reassembly.

2. Remove bearing cones from case, using puller J-22888 and correct plug (fig. 4C-4) and remove shims from case. Identify all parts so they may be reassembled in their original location.

3. Drive the pinion shaft lock pin out of case.

4. Remove ring gear bolts from case and separate ring gear from case.

5. Remove pinion shaft, pinions, side gears and thrust washers from case.

## DRIVE PINION

## Removal

1. Using Holding Bar J-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

2. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 4C-5 and remove flange from drive pinion. Remove

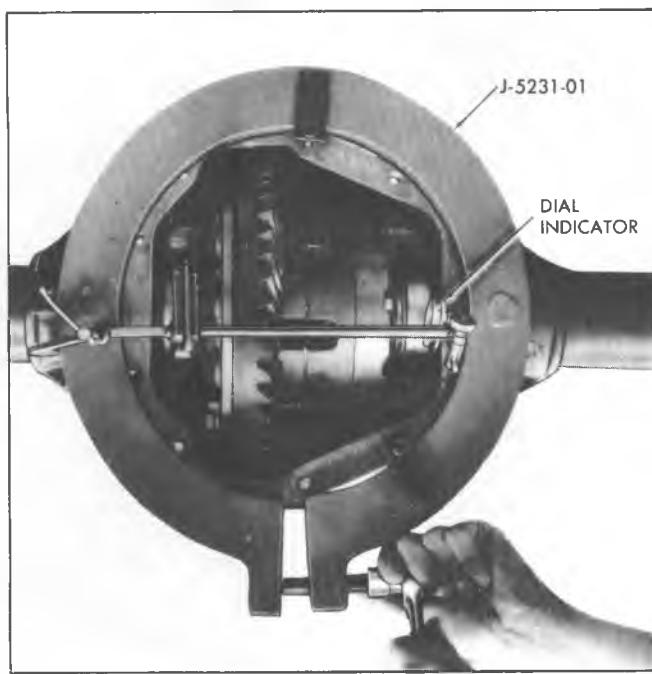
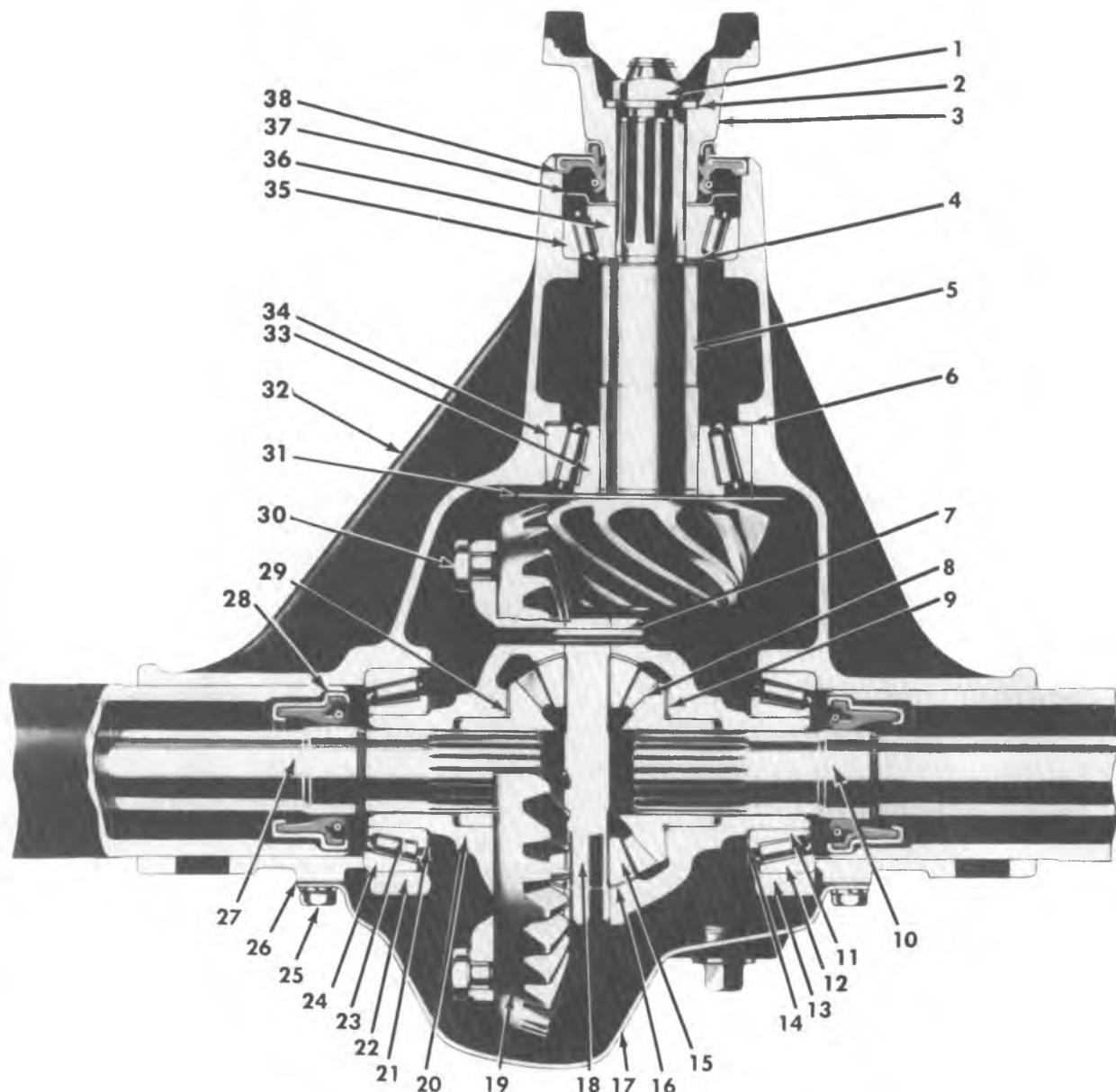
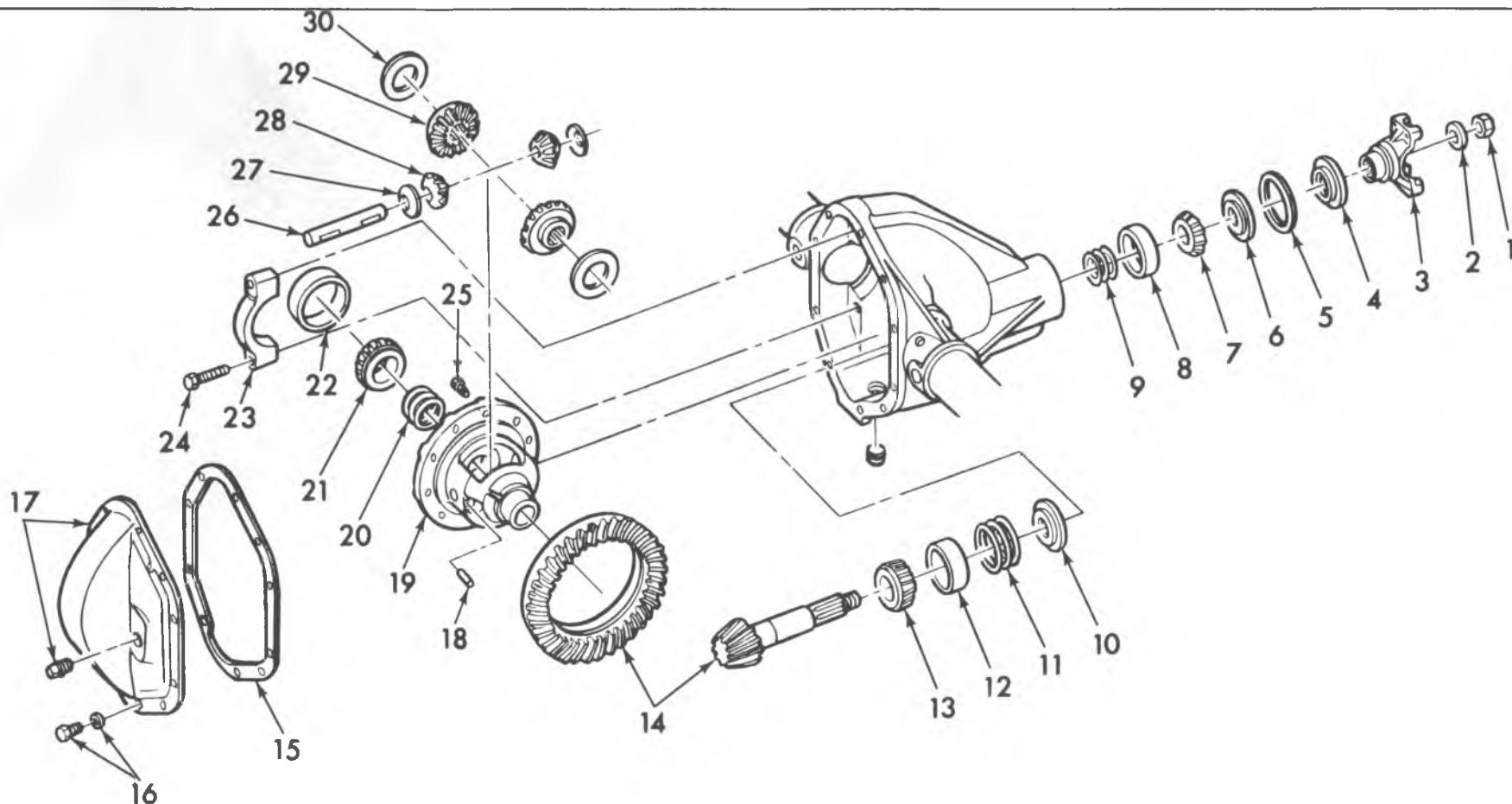


Fig. 4C-1--Spreading Case With J-5231-01



- |                           |  |  |                          |
|---------------------------|--|--|--------------------------|
| 1. Nut                    | 11. Differential Bearing Cone            | 20. Differential Case                    | 29. Thrust Washer        |
| 2. Washer                 | 12. Differential Bearing Cup             | 21. Differential Bearing Adjusting Shims | 30. Ring Gear Bolt       |
| 3. Pinion Flange          | 13. Bearing Cap                          | 22. Differential Bearing Cap             | 31. Oil Slinger          |
| 4. Outer Bearing Shims    | 14. Differential Bearing Adjusting Shims | 23. Differential Bearing Cone            | 32. Differential Carrier |
| 5. Drive Pinion           | 15. Differential Pinion                  | 24. Differential Bearing Cup             | 33. Inner Bearing Cone   |
| 6. Inner Bearing Shims    | 16. Thrust Washer                        | 25. Cover Bolt                           | 34. Inner Bearing Cup    |
| 7. Lock Pin               | 17. Cover                                | 26. Gasket                               | 35. Outer Bearing Cup    |
| 8. Differential Side Gear | 18. Pinion Cross Shaft                   | 27. Axle Shaft                           | 36. Outer Bearing Cone   |
| 9. Thrust Washer          | 19. Ring Gear                            | 28. Oil Seal                             | 37. Oil Slinger          |
| 10. Axle Shaft            |  |  | 38. Oil Seal             |

Fig. 4C-2--Front Axle Differential Assembly



- |   |                                    |                                     |
|---|------------------------------------|-------------------------------------|
| 1. Nut  | 11. Shims (Inner Pinion Bearing)   | 24. Bolt (Differential Bearing Cap) |
| 2. Washer                                       | 12. Cup (Inner Pinion Bearing)     | 25. Bolt (Ring Gear)                |
| 3. Companion Flange                             | 13. Cone and Roller (Inner Pinion) | 26. Pinion Shaft                    |
| 4. Pinion Oil Seal                              | 14. Ring and Pinion                | 27. Thrust Washer (Pinion)          |
| 5. Gasket                                       | 15. Gasket (Housing Cover)         | 28. Pinion                          |
| 6. Outer Pinion Oil Slinger                     | 16. Screw and Washer (Cover)       | 29. Side Gear                       |
| 7 and 8. Cone and Roller (Outer Pinion Bearing) |                                    | 30. Thrust Washer (Side Gear)       |
| 9. Shims (Outer Pinion Bearing)                 |                                    |                                     |
| 10. Inner Pinion Oil Slinger                    |                                    |                                     |

Fig. 4C-3 Differential - Exploded View

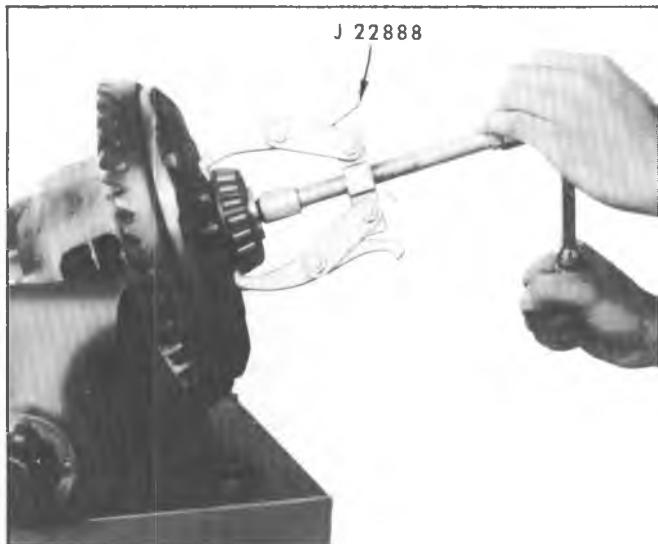


Fig. 4C-4--Removing Side Bearing

drive pinion from carrier.

3. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

4. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.

5. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 4C-6, and press pinion from bearing.

#### Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

**NOTE:** The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does

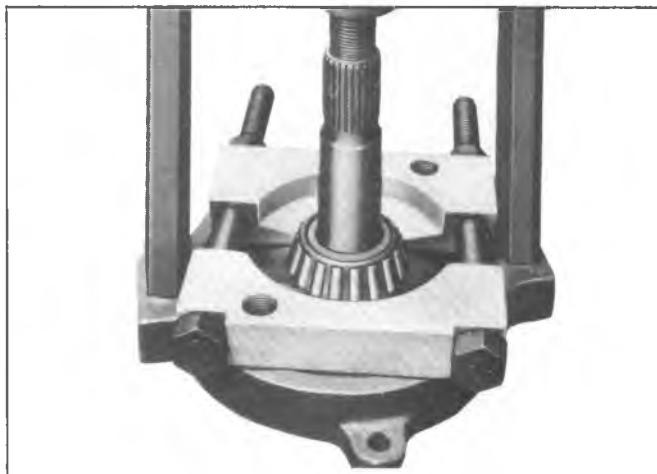


Fig. 4C-6--Removing Inner Pinion Bearing Cone and Roller

not indicate a defective bearing.

2. Inspect pinion splines and flange splines for evidence of excessive wear.

3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.

4. Inspect differential case for cracks or scores on side gears, thrust washers, and pinion thrust faces.

5. Check fit of differential side gears in case.

6. Check fit of side gears and axle shaft splines.

7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

#### DIFFERENTIAL CASE

#### Reassembly

1. Position differential side gears and new thrust washers in differential case.

2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.

3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.

4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.

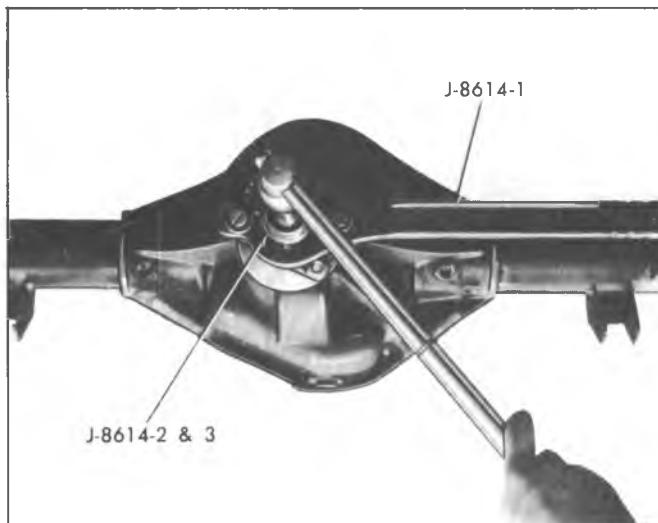


Fig. 4C-5--Removing Pinion Flange

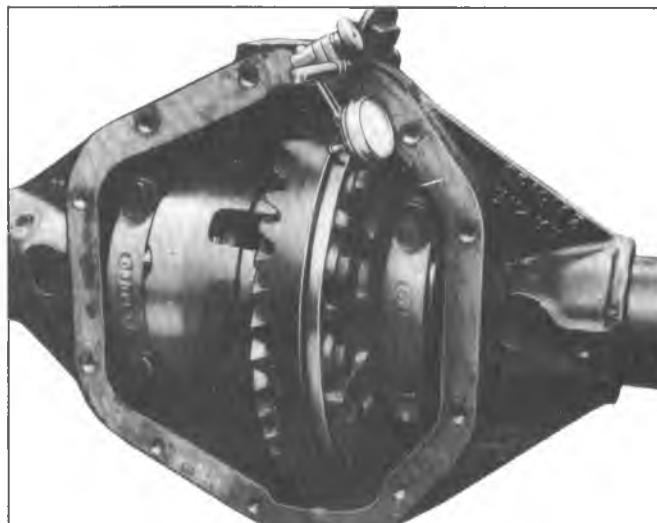


Fig. 4C-7--Checking Runout

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 4C-8--Drive Pinion Shim Chart

5. With an arbor press, press differential side bearings onto case using Tool J-22175. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.

7. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7). Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from case. Again install differential case and check runout at differential case flange.

8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.

9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "0".

10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Repeat several times until the same reading is obtained. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.

11. Remove differential from carrier.

## DRIVE PINION

### Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus + number, a minus - number, or a zero(0) number, which indicates the best running position for each particular gear

set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched + 3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a + 3 etching indicates. Or if a pinion is etched - 3, we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a - 3 etching indicated.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

**NOTE:** If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads + 2 and the new pinion is - 2, add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart (fig. 4C-8).

2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.

3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.

4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.

5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 4C-9.

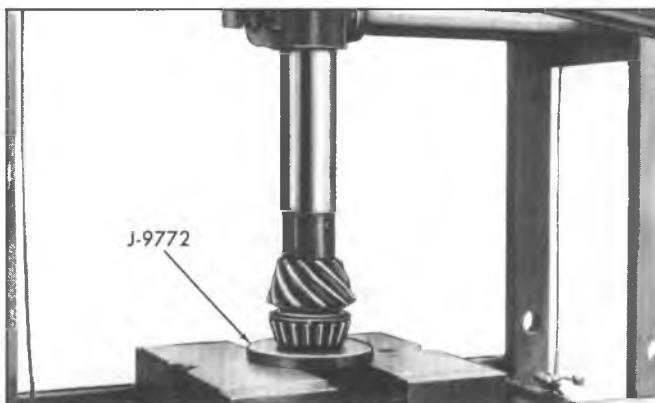


Fig. 4C-9--Installing Inner Pinion Core and Roller

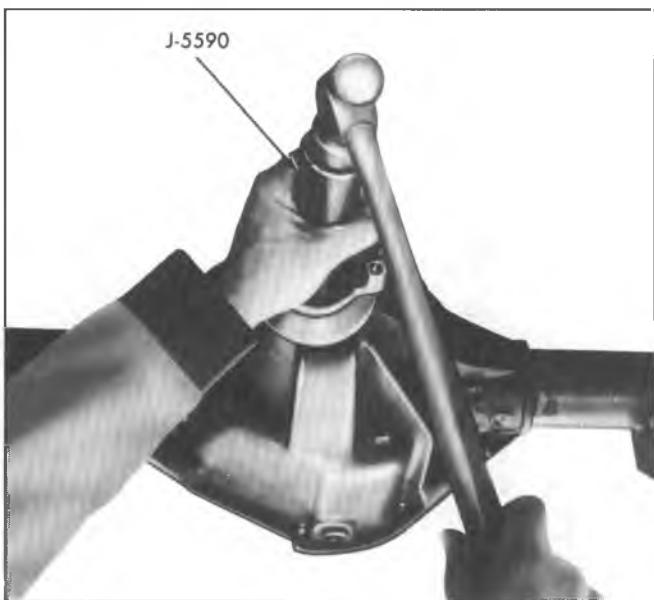


Fig. 4C-10--Installing Pinion Flange

6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.

7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion (Fig. 4C-10).

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.

9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

**NOTE:** Torque reading to start shaft turning must be disregarded.

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.

11. Remove nut, washer and flange from pinion shaft.

12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

13. Install flange, washer and nut. Torque nut to specifications.

## DIFFERENTIAL CASE

### Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.

2. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7).

3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".

4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.

5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.

a. Subtract the size of shim pack just installed on ring

gear side of case from the reading obtained and recorded in step 10 of Differential Case Reassembly.

b. To this figure, add an additional .015" shims to compensate for preload and backlash.

Example: If reading in step 10 of Differential Case-Reassembly was .085" and the shims installed on ring gear side of case was .055", the correct amount of shim will be  $.085" - .055" + .015" = .045"$ .

6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

### Installation

1. Spread differential carrier, using spreader as shown in Figure 4C-1.

2. Install differential bearing cups in their correct locations then install differential case into carrier.

3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft-faced hammer to ensure proper seating of case in carrier.

4. Remove spreader and torque cap bolts to specifications.

5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.

6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.

7. Check gear tooth contact as described in "Gear Tooth Contact Pattern Check".

8. After a successful pattern check, install housing cover using a new gasket.

9. Install axle shafts and install axle assembly into vehicle (See Service Manual).

10. Fill with recommended lubricant, lower vehicle to floor and road test vehicle.

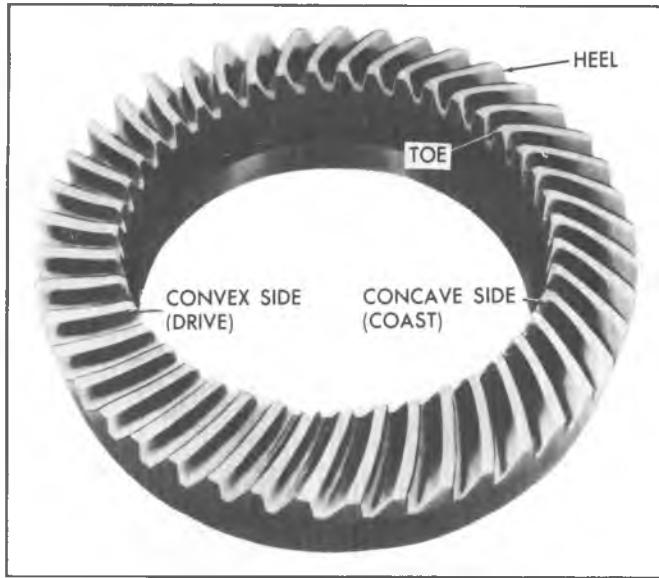


Fig. 4C-11--Gear Tooth Nomenclature

## GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

### Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4C-11.

### Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.
4. Apply a load until a torque of 40-50 lb. ft. is required to turn the pinion.

**NOTE:** A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 4C-12.

### Adjustments Affecting Tooth Contact

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

**NOTE:** It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

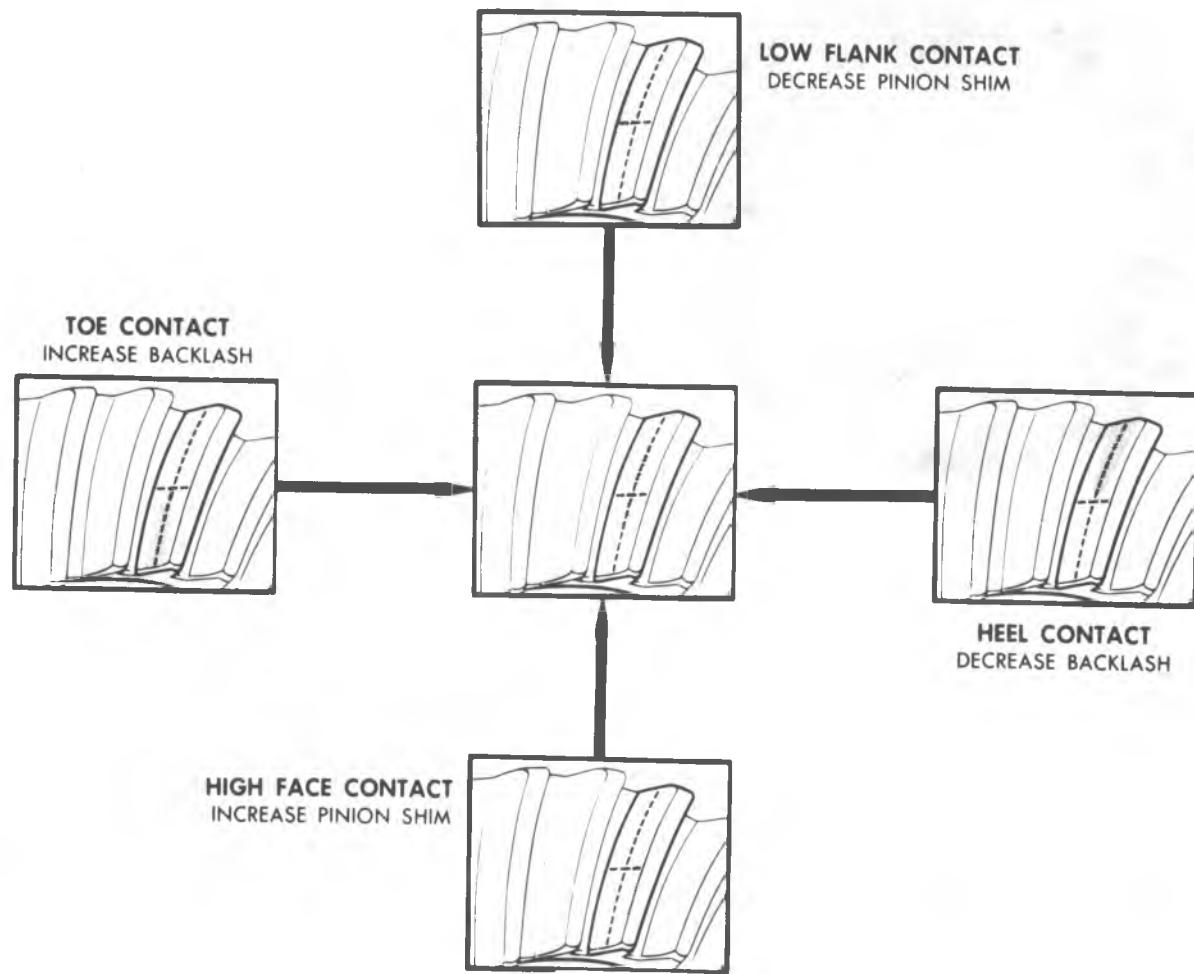
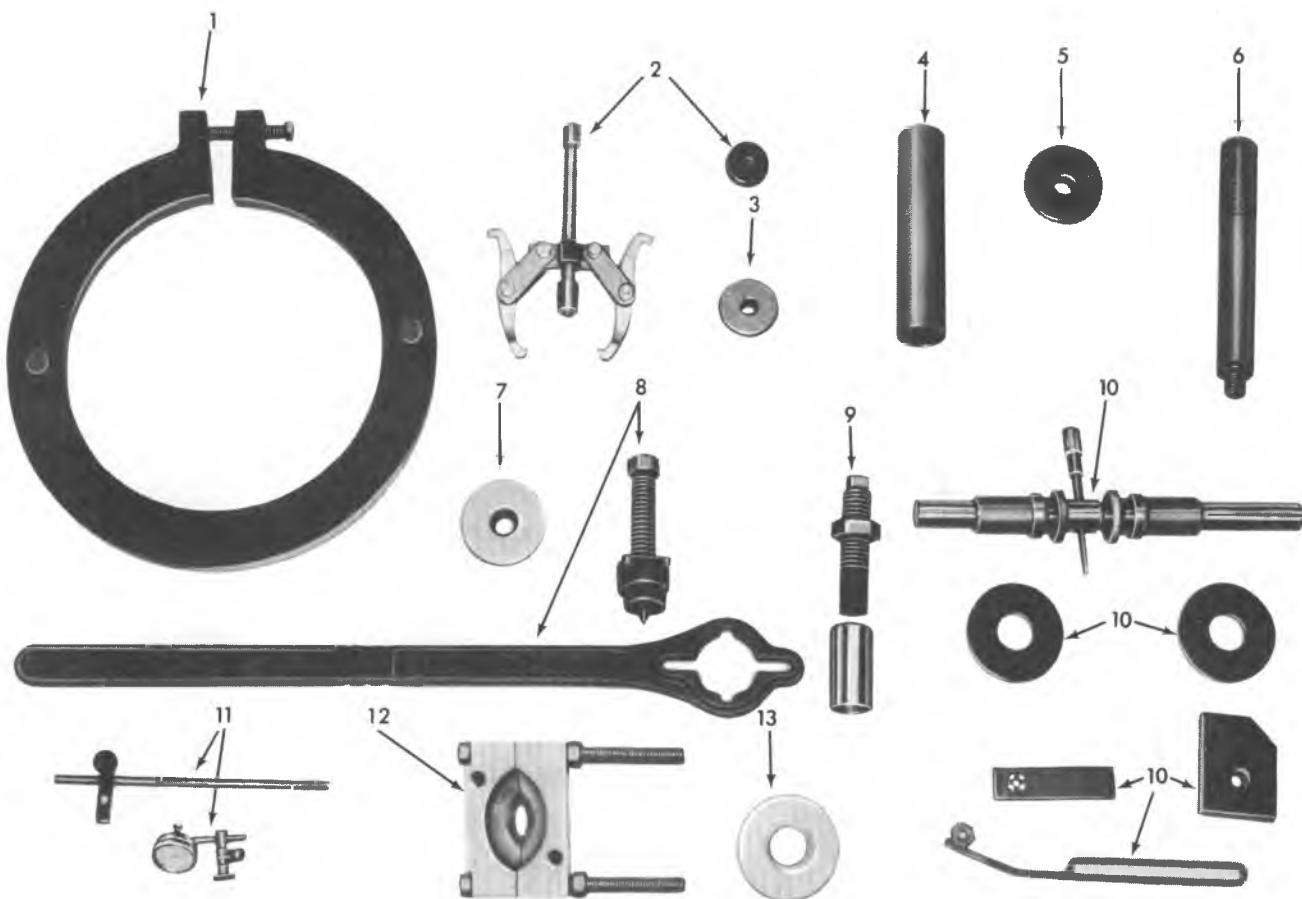
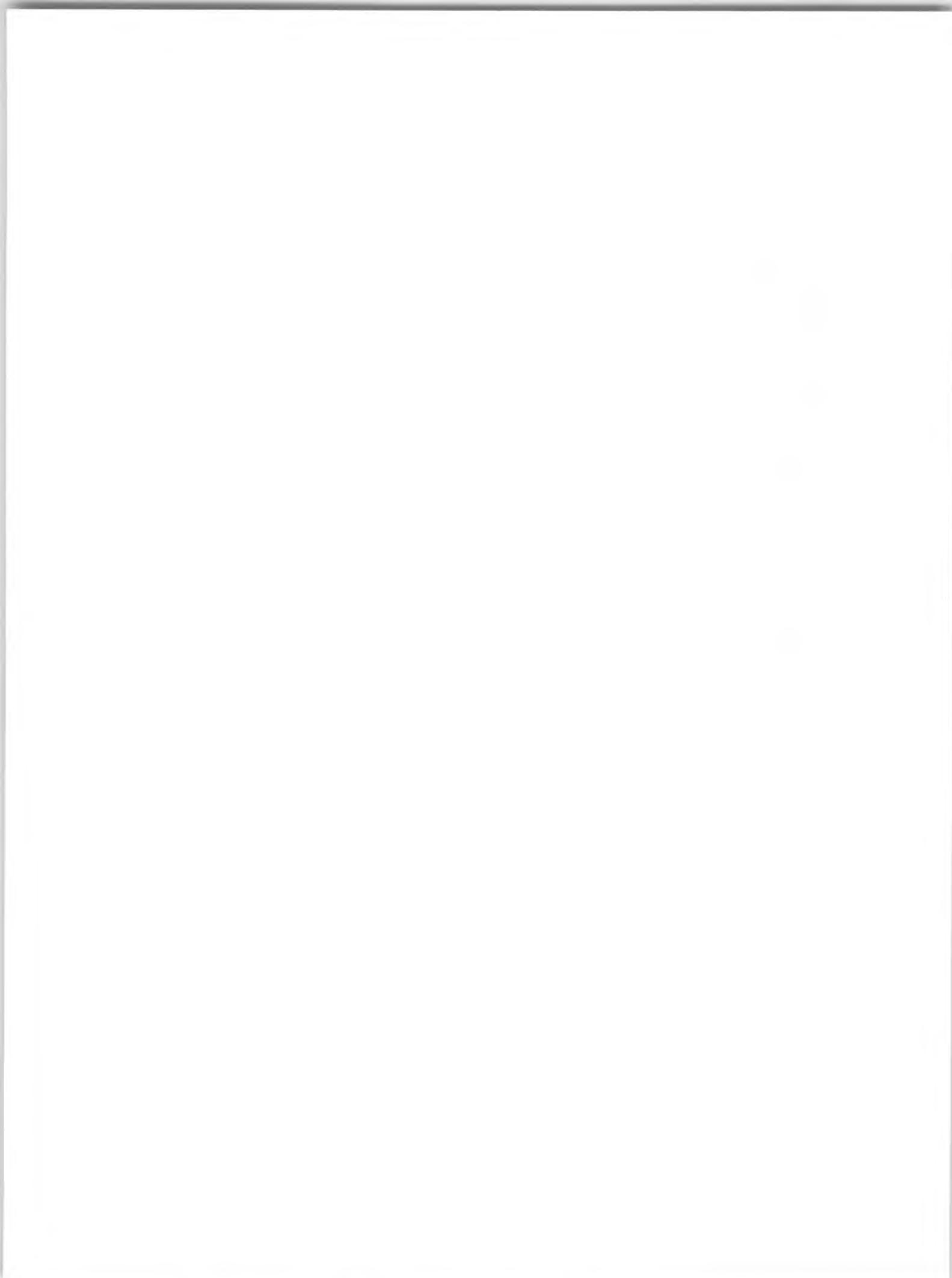


Fig. 4C-12--Gear Tooth Pattern Contact Pattern

## SPECIAL TOOLS



- |              |  |              |  |
|--------------|--|--------------|--|
| 1. J-5231-01 | Spreader - Axle Carrier                                | 8. J-8614-01 | Holder and Remover - Companion Flange        |
| 2. J-22888   | Puller - Side Bearing                                  | 9. J-23476   | Installer - Companion Flange                 |
| 3. J-22175   | Installer - Side Bearing                               | 10. J-5341   | Gauge - Pinion Depth Consists of Parts:      |
| 4. J-5590    | Installer - Pinion inner and outer bearing cone        |              | (1) SE 1065-1, (2)-5, (2)-6,                 |
| 5. J-6368    | Installer - Pinion outer bearing cup (use with J-8092) |              | (2)-9SS, (1)-10,                             |
| 6. J-8092    | Driver Handle (use with J-6368)                        |              | (1)-58 with 1" micrometer                    |
| 7. J-9276-2  | Installer - Pinion inner bearing                       | 11. J-8001   | Dial Indicator Set                           |
|              |  | 12. J-22912  | Press Plate Pinion bearing                   |
|              |  | 13. J-23494  | Installer - Pinion oil seal use with J-23476 |



## SECTION 5

# BRAKES

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this section".

**CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY. OR SUBSTITUTE DESIGN TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.**

## CONTENTS

Delco Tandem Power Brake Unit .....	5-1
Bendix Tandem Power Brake Unit .....	5-8
Delco Single Diaphragm Power Brake Unit.....	5-12
Bendix Single Diaphragm Power Brake Unit.....	5-19
Bendix Hydro-Boost Power Unit .....	5-23

## DELCO TANDEM POWER BRAKE UNIT UNIT REPAIR

### Disassembly (Fig. 5-1A)

**NOTE:** Scribe a line across front and rear housings to facilitate reassembly.

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate damage to studs. Clamp base in a bench vise with the power section up (fig. 5-2A).

2. Separate front and rear housings as follows:

a. **Straight Mounting Bracket (Fig. 5-2A)** - Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.

b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to bracket.

c. **Tilt Mounting Bracket Except Chevelle** - Place Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers, securing spanner wrench.

d. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to separate the two housings.

**CAUTION:** Care must be exercised not to damage or loosen studs in housing. Also, take care that no pressure is brought to bear on plastic power piston.

3. Remove Tools J-9504 and J-22893 from rear housing (tilted mounting bracket type), Tool J-9504 on regular type.

### Front Housing Group

1. Remove the power piston return spring. Remove and discard the vacuum check valve and grommet from the front housing.

2. Remove the front housing seal.

### Rear Housing Group

1. Remove the boot retainer and boot from the rear housing. Remove the felt silencer from inside the boot.

3. Remove the power piston group from the rear housing and remove the primary power piston bearing from the center opening of the rear housing.

### Power Piston Group

1. Remove the piston rod retainer and piston rod from the secondary piston.

**NOTE:** Due to an optional construction design on the primary and secondary power pistons, Tool J-23101 will have to be reworked as shown in Figure 5-3A.

2. Mount double-ended Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (fig. 5-4A).

3. Fold back primary diaphragm from the O.D. of the primary support plate. Grip the edge of the support plate and rotate counterclockwise to unscrew the primary power piston from the secondary power piston.

**NOTE:** It is possible that the primary support plate will unlock from the primary piston before the primary piston unscrews from the secondary piston. If this happens, continue to turn the primary support plate counterclockwise. Tabs (stops) on the primary support

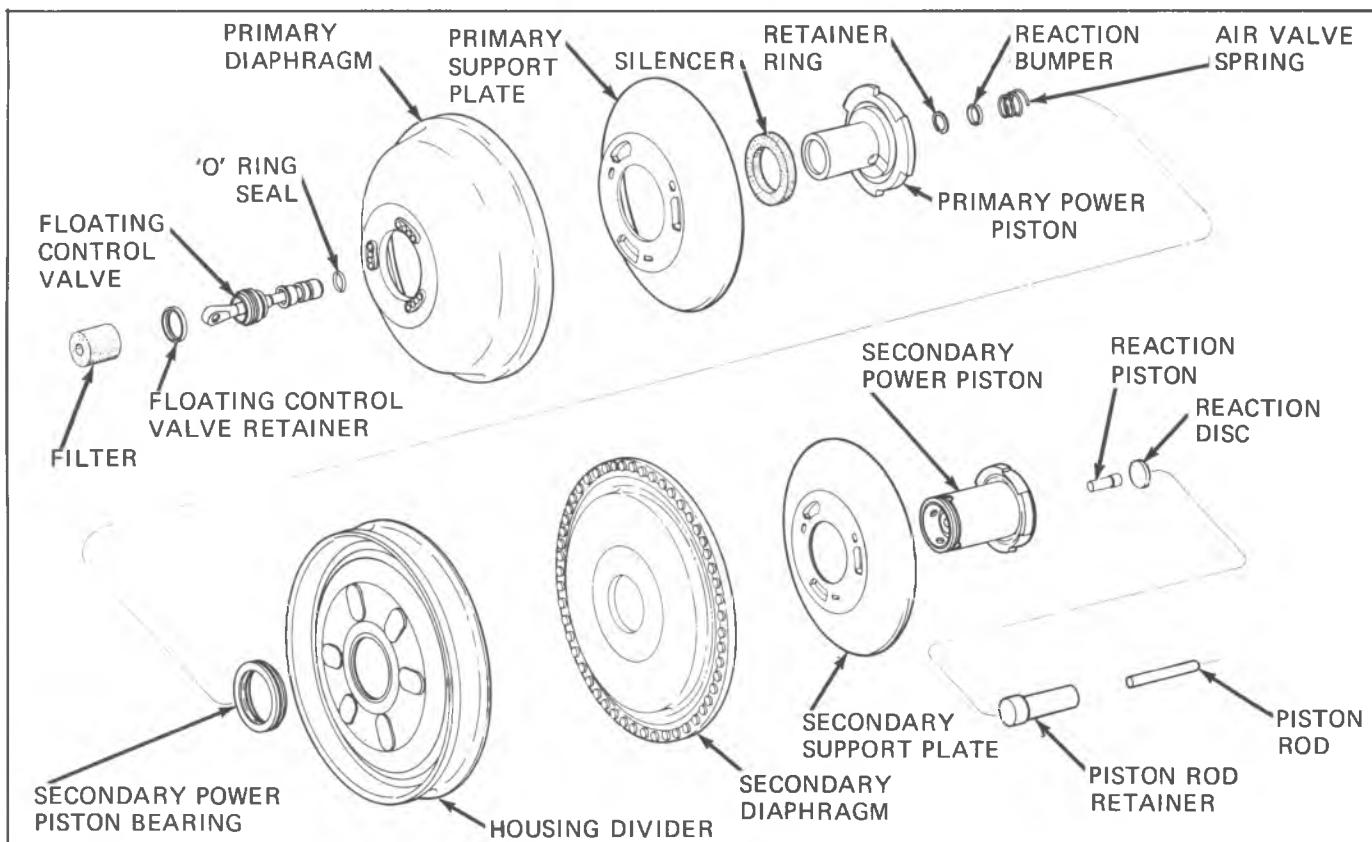


Fig. 5-1A--Power Piston Group

will temporarily lock the primary support plate to the primary power piston and permit continued counter-clockwise rotation to unscrew the primary power piston from the secondary power piston (fig. 5-5A).

4. Remove the housing divider from the secondary power piston. Remove the secondary power piston bearing from the housing divider.

5. The secondary power piston should still be positioned on Tool J-23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip the edges of the support plate and rotate clockwise to unlock the secondary support

plate from the secondary power piston (fig. 5-6A).

6. Remove the secondary diaphragm from the secondary support plate.

7. Remove the reaction piston and reaction disc from the center of the secondary power piston by pushing down on the end of the reaction piston with a small object, such as a pencil, wooden dowel or metal rod (fig. 5-7A).

8. Remove the air valve spring from the end of the air valve (if it didn't come off during disassembly of the power piston).

9. Mount Tool J-23101 in a vise (with small diameter end up). Position the primary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (fig. 5-8A).

10. Fold back primary diaphragm from the support plate. Grip the edge of the support plate and rotate in a counterclockwise direction to unlock the primary support plate from the primary power piston (fig. 5-9A).

11. Remove the primary diaphragm from the primary support plate.

12. Remove the air filter from the tubular section of the primary power piston.

13. Remove the power head silencer from the neck of the power piston tube.

14. Remove the rubber reaction bumper from the end of the air valve.

15. Using Snap Ring Pliers J-4880, remove the retaining ring from the air valve (fig. 5-10A).

16. Remove the air valve-push rod assembly from the tube end of the primary power piston. The following removal method is recommended:

a. Place the primary power piston in an arbor press, and

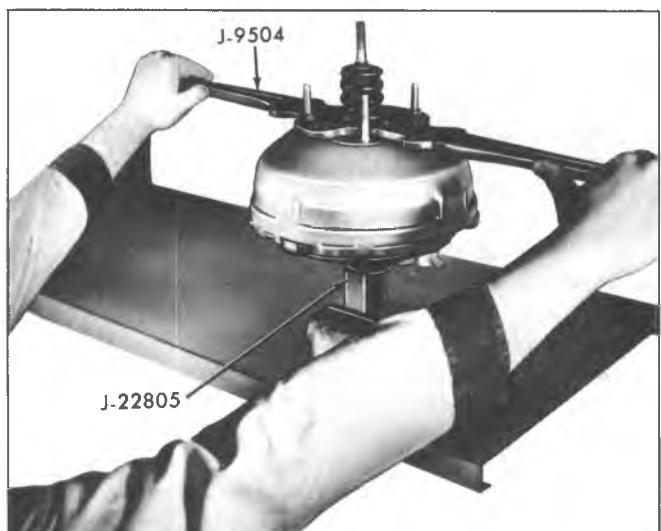


Fig. 5-2A--Unlocking Front and Rear Housings

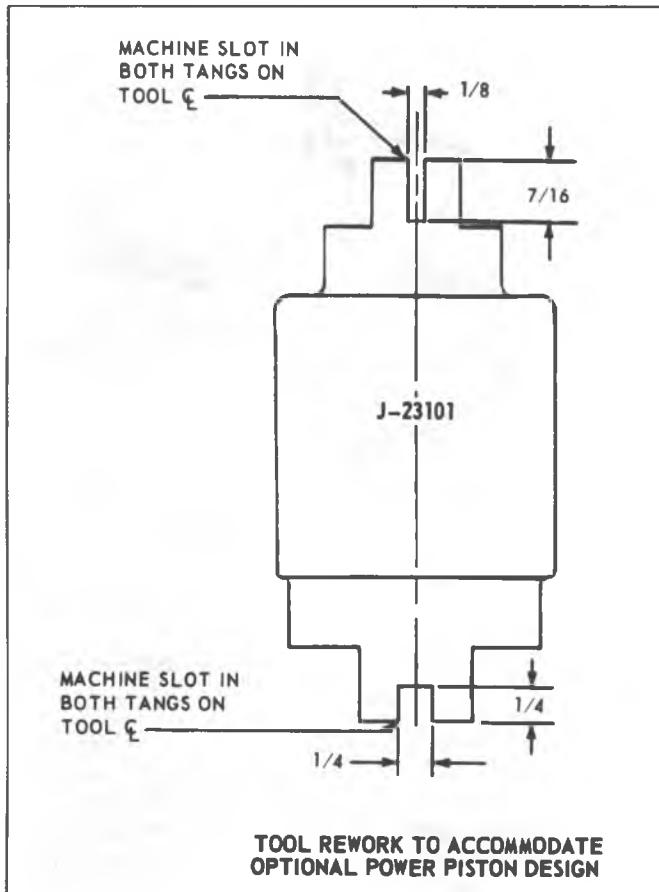


Fig. 5-3A--Rework of Tool J-23101

press the air valve-push rod assembly out the bottom of the power piston tube with a rod not exceeding 1/2" in diameter.

b. An alternate method would be the use of a heavy,

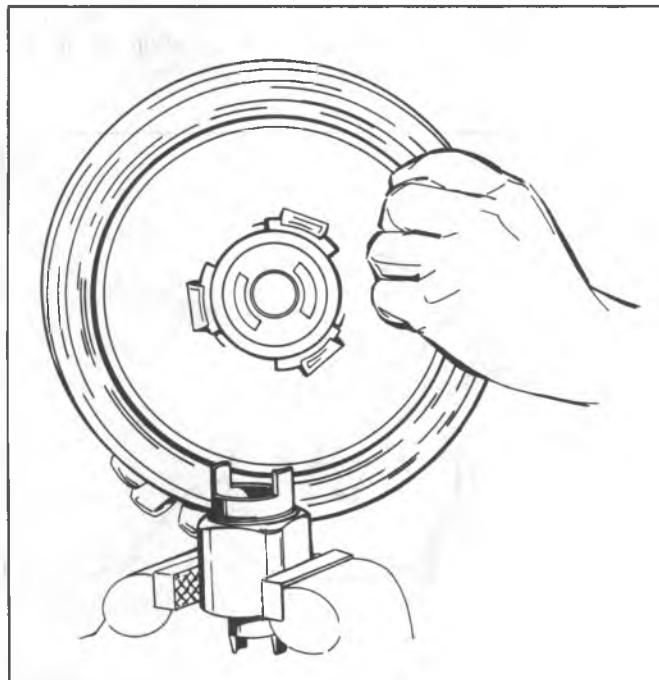


Fig. 5-4A--Positioning Secondary Power Piston in Tool J-23101  
(Large Dia. End Up)

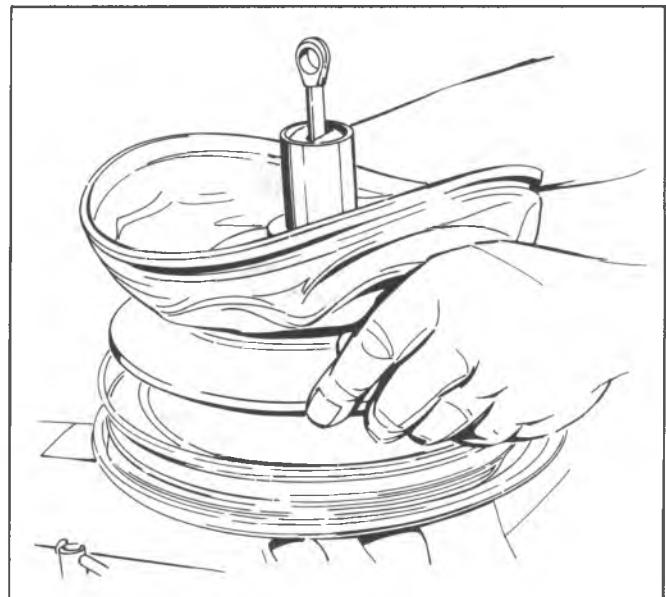


Fig. 5-5A--Locking or Unlocking Primary and Secondary Power Pistons

round shanked screwdriver. Insert screwdriver on both sides of the push rod and pull the air valve-push-rod assembly straight out. A considerable force will be required.

c. Another method requires the use of snap ring pliers. Approximately 5/8" from the pointed ends of the pliers, file or saw a small slot (approximately 1/32" - 1/16" wide and 1/10" deep) on each half of the pliers. Round off the pointed ends of the pliers. Slip the slots in the pliers into tangs on the control valve spring retainer. Grip the pliers and pull the air valve-push rod assembly straight out.

17. Removal of the air valve-push rod assembly will disassemble the control valve retainer.

18. Remove the "O" ring seal from the air valve.

19. Models using air valve-push rod assemblies with a formed eye on the end of the push rod will be serviced using a complete assembly, since the floating control valve cannot be removed over the eye end of the push rod.

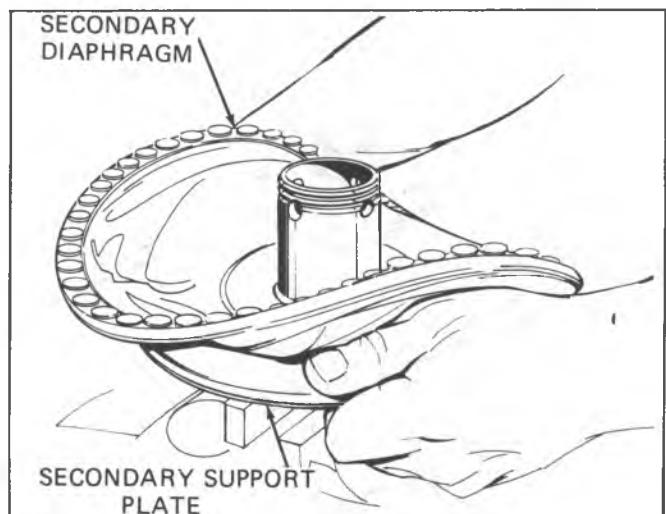


Fig. 5-6A--Locking or Unlocking Secondary Support Plate and Secondary Power Piston

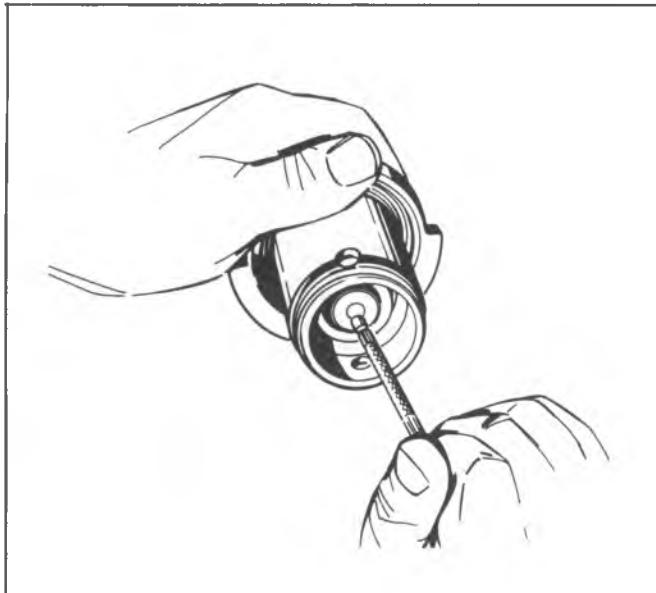


Fig. 5-7A--Removing Reaction Piston and Reaction Disc From Secondary Power Piston

### Cleaning

Use clean brake fluid to thoroughly clean all reusable brake parts. Immerse in the cleaning fluid and brush metal parts with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards. Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until re-assembly. Re-wash at re-assembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

**CAUTION:** If there is any suspicion of

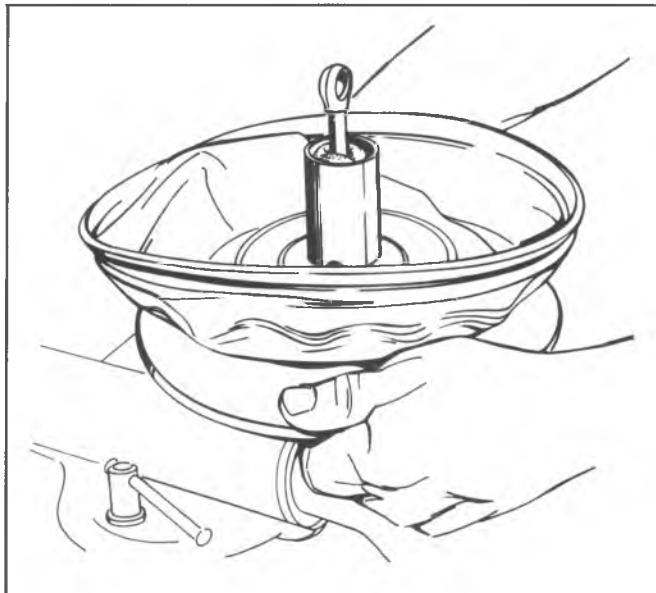


Fig. 5-9A--Locking or Unlocking Primary Support Plate From Primary Power Piston

*contamination or any evidence of corrosion, completely flush the vehicle hydraulic brake system. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.*

### Inspecting Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts, nicks, or other damage. These parts are the key to the control of fluid or air flow. If the unit is in for overhaul or if there is any question as to the serviceability of rubber parts, REPLACE them.

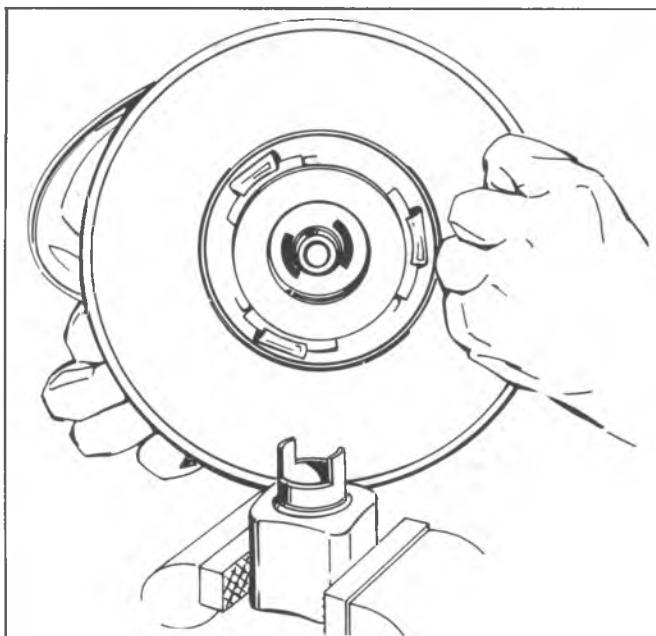


Fig. 5-8A--Positioning Primary Power Piston in Tool J-23101  
(Small Dia. End Up)



Fig. 5-10A--Removing Retaining Ring From Air Valve

## Inspecting Metal Parts

BADLY DAMAGED ITEMS, OR THOSE WHICH WOULD TAKE EXTENSIVE WORK OR TIME TO REPAIR, SHOULD BE REPLACED. In case of doubt, install new parts. Do not rely on the brake unit being overhauled at an early or proper interval. New parts will provide more satisfactory service, even if the brake unit is allowed to go beyond the desired overhaul period.

## Assembly

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.

2. Lubricate power head parts, as outlined below, with power brake silicone lubricant. This lubricant is provided in the service repair kit.

### Front Housing Group

1. Install a **new** vacuum check valve and a **new** grommet in front housing.

2. Place **new** front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

### Power Piston Group

1. Lubricate the I.D. and O.D. of the "O" ring seal with silicone lubricant and place on the air valve.

2. Wipe a thin film of silicone lubricant on the large and small O.D. of the floating control valve.

3. If the floating control valve needs replacement, it will be necessary to replace the complete air valve-push rod assembly, since the floating control valve is a component part of this assembly and cannot be disassembled from the push rod.

4. Place the air valve end of the air valve-push rod assembly into the tube of the primary power piston. Manually press the air valve-push rod assembly so that the floating control valve bottoms on the tube section of the primary power piston. Installer Tool J-23175 can be used to manually press the floating control valve to its seat.

5. Place the I.D. of the floating control valve retainer on the O.D. of floating control valve Retainer Installer J-23175 (fig. 5-11A). Place over the push rod so that the closed side of the retainer seats on the floating control valve. With Installer J-23175, manually press the retainer and floating control valve assembly to seat in the primary power piston tube (fig. 5-12A).

6. The filter element can now be stretched over the push rod and pressed into the primary power piston tube.

7. Using Snap Ring Pliers J-4880, place the retaining ring into the groove in the air valve (fig. 5-10A).

8. Position the rubber reaction bumper on the end of the air valve.

9. *Tolerances of those component parts affecting output of the tandem power brake are very critical.* Always use the factory gaged power piston kit, containing both the primary and secondary power pistons with factory gaged reaction piston, when replacement of any of these parts is required.

10. After determination of the correct reaction piston, apply a light film of silicone lubricant to the O.D. of the rubber reaction disc.

11. Place the rubber reaction disc in the large cavity of the secondary power piston and push the disc down to seat on the reaction piston.

12. Unlock the secondary power piston from the primary power piston.

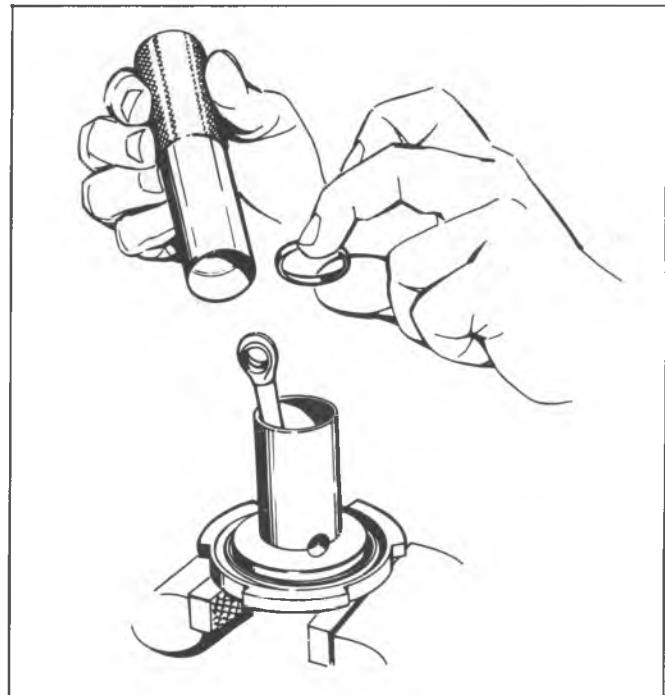


Fig. 5-11A--Installing Floating Control Valve Retainer with Installer J-23175

13. Assemble the primary diaphragm to the primary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Lubricate the diaphragm I.D. and the raised surface of the flange (that fits into a groove in the primary power piston) with a light coat of silicone lubricant.

14. Mount Tool J-23101 (small diameter end up) in a

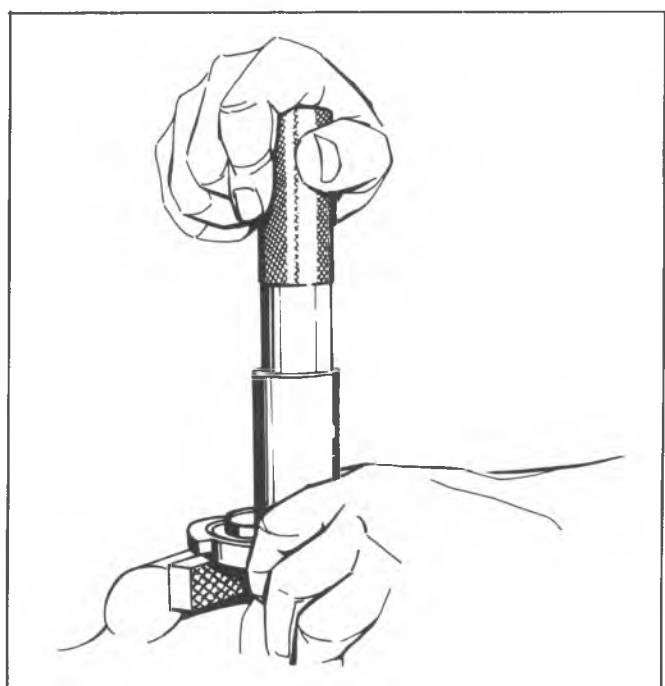


Fig. 5-12A--Seating Floating Control Valve Assembly with Installer J-23175

vise. Position the primary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (fig. 5-8A).

15. Fold the primary diaphragm away from the O.D. of the primary support plate.

16. Holding the edges of the support plate, with the locking tangs down, place the primary support plate and diaphragm assembly over the tube of the primary power piston. The flange on the I.D. of the primary diaphragm will fit into a groove in the primary power piston.

17. Grip the edges of the primary support plate, press down, and rotate clockwise until the tabs on the primary power piston contact the stops on the support plate (fig. 5-9A).

18. Place the power head silencer on the tube of the primary power piston so that the holes at the base of the tube are covered.

19. Apply silicone lubricant to the O.D. of the primary power piston tube.

20. Remove the primary piston assembly from Tool J-23101 and lay it aside.

21. Assemble the secondary diaphragm to the secondary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Apply a thin coat of silicone lubricant to the I.D. of the secondary diaphragm and the raised surface of the flange (that fits into a groove in the secondary power piston).

22. Mount Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the radial slots in the piston fit over the ears (tangs) of the tool. Apply a light coat of silicone lubricant to the tube of the secondary power piston (fig. 5-4A).

23. Fold the secondary diaphragm away from the O.D. of the secondary plate.

24. Holding the edges of the support plate with the locking tangs down, place the secondary diaphragm and support plate assembly over the tube of the secondary power piston. The flange on the I.D. of the secondary diaphragm will fit into the groove in the secondary piston.

25. Grip the edges of the secondary support plate, press down, and rotate counterclockwise until the tabs on the secondary power piston contact the stops on the support plate. Fold the secondary diaphragm back into position on the secondary support plate. Leave the secondary power piston assembly on Tool J-23101 in the vise (fig. 5-6A).

26. Apply a light coat of talcum powder or silicone lubricant to the bead on the O.D. of the secondary diaphragm. This will facilitate reassembly of front and rear housings.

27. Hold the housing divider so that the formed over flange (that holds the primary diaphragm) of the divider faces down. Place the secondary bearing in the I.D. of the divider so that the extended lip of the bearing faces up.

28. Lubricate the I.D. of the secondary bearing with silicone lubricant.

29. Position Secondary Bearing Protector Tool J-23188 on the threaded end of the secondary power piston (fig. 5-13A).

30. Hold the housing divider so that the six oblong protrusions on the middle of the divider are facing up. Press the divider down over the tool and onto the secondary power

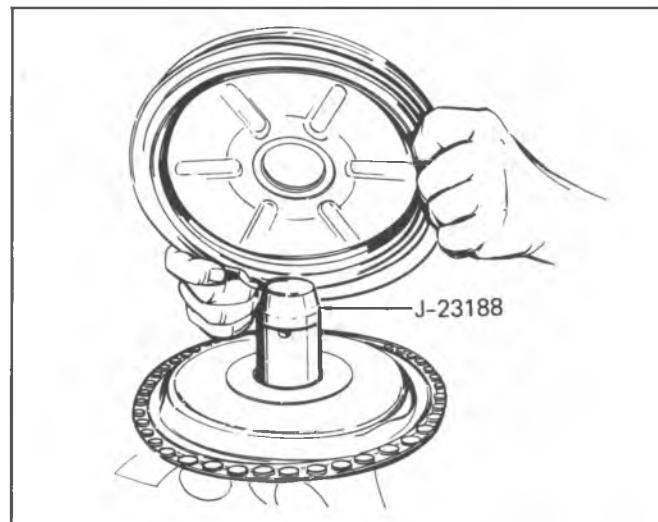


Fig. 5-13A--Positioning Housing Divider Over Secondary Bearing Protector Tool J-23188

piston tube where it will rest against the diaphragm support ring. Remove Tool J-23188 from secondary power piston; however, do not remove the secondary power piston sub-assembly from Tool J-23101.

31. Pick up the primary power piston assembly and fold the primary diaphragm away from the O.D. of the primary support plate.

32. Position the small end of the air valve return spring on the air valve so that it contacts the air valve retaining ring.

33. Position the primary power piston on the tubular portion of the secondary power piston, making sure that the air valve return spring seats down over the raised center section of the secondary piston.

34. Grip the edge of the primary support plate, press down, and start the threads on the secondary power piston into the threaded portion of the primary power piston by rotating in clockwise direction (fig. 5-5A).

35. Continue to tighten the primary power piston until it is securely attached (approximately 5-15 ft. lbs.) to the secondary power piston.

36. Fold the primary diaphragm back into position on the primary support plate and pull the diaphragm O.D. over the formed flange of the housing divider. Check that the bead on the diaphragm is seated evenly around the complete circumference.

37. Wipe a thin film of silicone lubricant on the O.D. of the piston rod retainer. Insert the master cylinder piston rod retainer into the cavity in the secondary power piston so that the flat end bottoms against the rubber reaction disc in the bottom of the cavity.

#### Rear Housing Group

- Place the NEW primary power piston bearing in the rear housing center hole so that the formed flange of the housing center hole fits into the groove of the seal. The thin lip of the bearing will protrude to the outside of the housing.

- Coat the I.D. of the primary power piston bearing with silicone lubricant.

#### Final Assembly

- Mount Holding Fixture J-22805 in a vise and position the front housing on the tool so that the housing studs fit in the holes provided in the tool.

- Position the power piston return spring over the inset

in the front housing.

3. Assemble the power piston group to the rear housing by pressing the tube of the primary piston through the rear housing bearing. Press down until the housing divider seats in the rear housing and the primary power piston bottoms against the housing.

4. Hold the rear housing assembly (with mounting studs up) over the front housing (make sure that the piston rod retainer does not dislodge from the secondary power piston during this operation). Position the rear housing so that when the tangs on the edge of the front housing are locked in the slots on the edge of the rear housing, the scribe marks on the top of the housings will be in line.

5. Lower the rear housing assembly onto the front housing. The power piston spring must seat in the depression in the face of the secondary power piston. Check that the bead on the O.D. of the secondary diaphragm is positioned between the edges of the housings.

6. Assemble front and rear housings as follows:

a. **Straight Mounting Bracket** - Place Spanner Wrench J-9504 over studs on rear housing, and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs.

b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to bracket.

c. **Tilt Mounting Bracket Except Chevelle** - Position Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts provided, securing Spanner Wrench.

d. Press down on spanner wrench and twist rear housing clockwise in relation to front housing until fully locked.

**NOTE:** If unit is not easily locked, hold housings together and apply vacuum to check valve in front housing. Do not put pressure on power piston extension.

7. Remove Tool J-9504 and, if used, Tool J-22893 from the rear housing.

8. Place the silencer in the closed end of the power head boot. Push the boot retainer over the boot. Stretch the boot over the push rod and over the flange in the center of the rear housing.

9. Remove the power head assembly from Holding Fixture J-22805 and remove Fixture J-22805 from the vise.

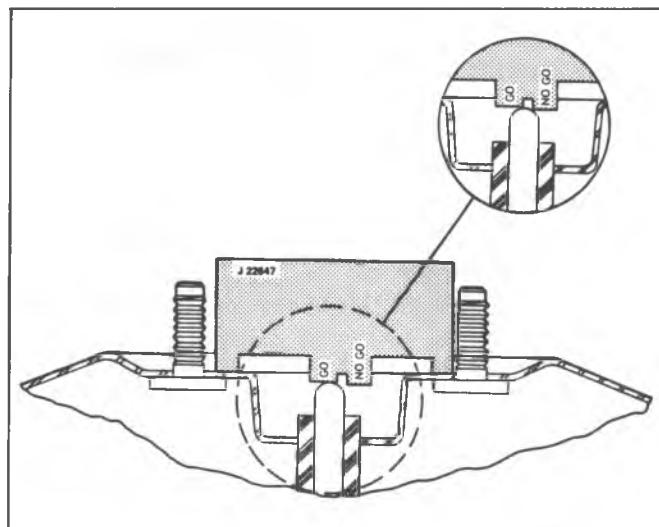


Fig. 5-14A--Gaging Piston Rod

### Gaging

1. Place the power head assembly in a padded vise (front housing up). *Do not clamp tight.*

2. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

3. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

4. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

5. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 5-14A).

6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should *never* contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self locking screw to meet gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

## BENDIX TANDEM POWER BRAKE UNIT UNIT REPAIR

### Disassembly

1. Scribe a line across the front and rear housings to facilitate reassembly.
2. Carefully remove hydraulic push rod and seal and slide seal from rod.
3. Remove vacuum check valve and grommet.
4. Remove dust boot and silencer from operating valve rod.
5. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then, reinstall steel retainer on hub.
6. Squirt denatured alcohol down the operating valve rod to lubricate rubber grommet in the valve plunger.
7. Position two small blocks of wood on either side of air valve rod and install end of air valve rod in vise, leaving just enough clearance to position two (2) open end wrenches between the vise and retainer on hub of rear plate.
8. Using the wrench nearest the vise as a pry, force the air valve off the ball end of the rod. DO NOT damage the plastic hub or allow vacuum cylinder to fall to the floor (fig. 5-1B and 5-2B).
9. The edge of the rear housing contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances break during straightening, the housing must be replaced (fig. 5-3B).
10. Remove the hydraulic push rod and vacuum seal from the front housing.
11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.
12. Place power unit with Holding Fixture J-22805 in

an arbor press with rear housing up and secure to plate of press by a suitable means of holding Tool J-22805 (fig. 5-4B). By using a 1-1/2" open end wrench on Tool J-22805 and allowing unit to turn against back of arbor press, press will hold unit from turning.

13. Place Spanner Wrench J-9504 over studs on rear shell (fig. 5-4B). Use three washers and nuts to attach wrench to housing. Use a suitable piece of pipe of approximately two inches I.D. and approximately three inches in length. Place over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe and press rear housing down far enough to relieve tension of diaphragm rubber lip and spring.
14. Rotate spanner bar counterclockwise until the lances in the edge of the rear housing are aligned with the cut-outs in the front housing. Considerable effort may be required to rotate the front housing.

**WARNING:** The diaphragm return spring is compressed in the power section and expands as the pressure on the housings is removed. If the housings do not separate when the screw has been turned slightly to reduce the pressure, tap the housings with a rubber hammer to break the bond.

15. Slowly release press to permit the two housings to separate.
16. Continue to release press until diaphragm spring tension has been removed.
17. Remove the front housing and return spring.
18. Remove three nuts and washers from Spanner Wrench and separate wrench and rear housing.
19. Remove Holding Fixture J-22805 from front housing.
20. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from

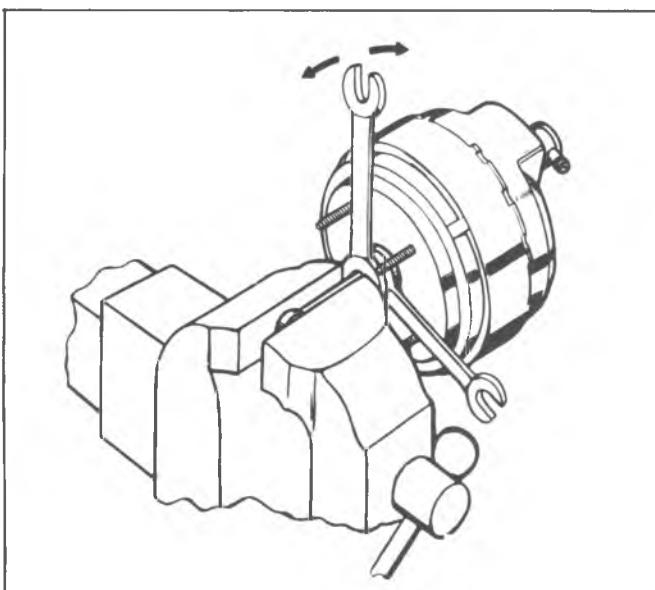


Fig. 5-1B--Removing Air Valve Rod

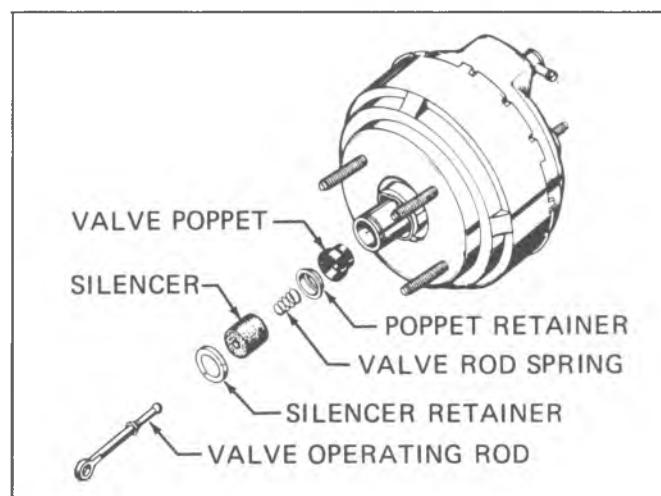


Fig. 5-2B--Air Valve Rod Assembly

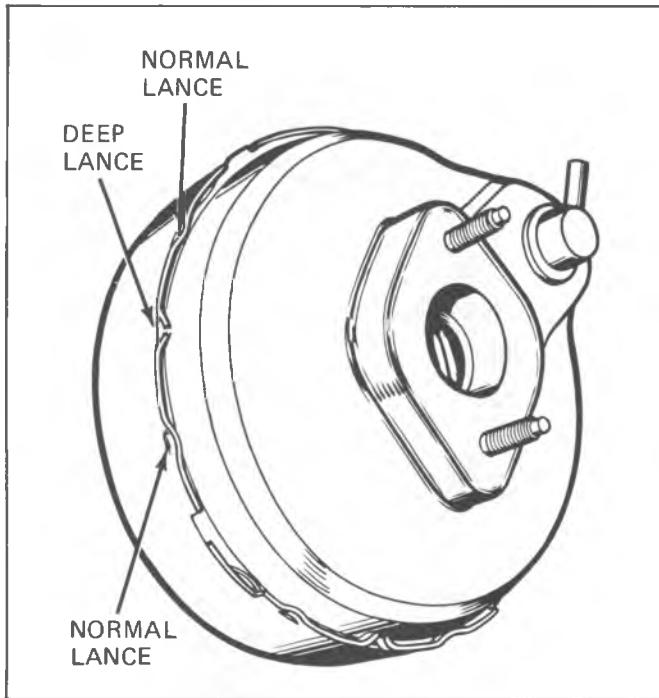


Fig. 5-3B--Lances in Rear Housing

rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.

21. Wet the rear diaphragm retainer with denatured alcohol and remove the retainer using fingers only.

22. Clamp Tool J-22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.

23. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate. It may be necessary to use a 1" x 1-3/16" x 8" wood strip as a lever in cover slot on outside circumference of rear plate.

24. After the two (2) plates have been loosened, remove the plates from Tool J-22839 and place on a bench with the front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the air valve

plunger and valve return spring as the parts are separated (fig. 5-5B).

25. Remove the square ring seal from the shoulder of the front diaphragm plate hub.

26. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate.

27. Remove the diaphragms from the plates.

28. Use a blunt punch or 1-1/4" socket to drive seal from rear housing (figs. 5-6B and 5-7B).

### Cleaning

All parts to be reused should be washed in denatured alcohol or brake fluid. Dry the parts with compressed air and place them on clean paper or lint free cloth.

Small rust spots inside the shells may be removed with crocus cloth or fine emery cloth. Be sure to clean thoroughly after using any abrasive.

Inspect all parts and replace any that are damaged or show excessive wear.

### Assembly

1. Press the new bearing and seal into the cavity in the rear housing using Tool J-22677 (fig. 5-8B). The flat rubber surface of the seal should be 5/16" below the flat, inside surface of the rear housing.

2. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

3. Mount Tool J-22839 in vise.

4. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.

5. Install Tool J-22733 over threads on front plate hub (fig. 5-9B).

6. Apply a light film of silicone lubricant to front plate hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub, being careful not to damage center plate seal. Remove Seal Protector J-22733.

7. Apply a light coat of silicone lubricant to bearing surfaces of air valve plunger, being careful not to apply lubricant to rubber grommet inside plunger. Install square ring seal on shoulder of front plate hub and install valve plunger return spring and plunger in base of front plate hub (fig. 5-10B).

8. Set rear plate over hub of front plate, and using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in. lbs. Check travel of valve plunger with index finger.

9. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate (fig. 5-11B).

10. Apply talcum powder to inside wall of rear housing and silicone lubricant to the scalloped cutouts of front housing and to seal in rear housing. Assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.

11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.

12. Secure front housing and Holding Fixture J-22805

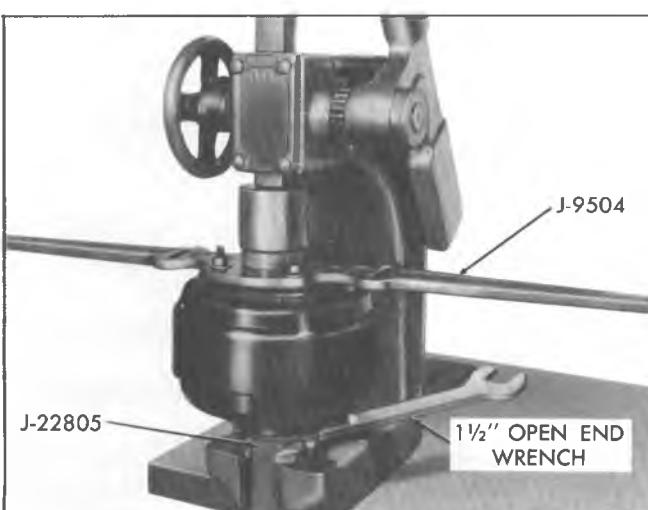


Fig. 5-4B--Holding and Separating Housings Using J-22805 and J-9504 in Arbor Press

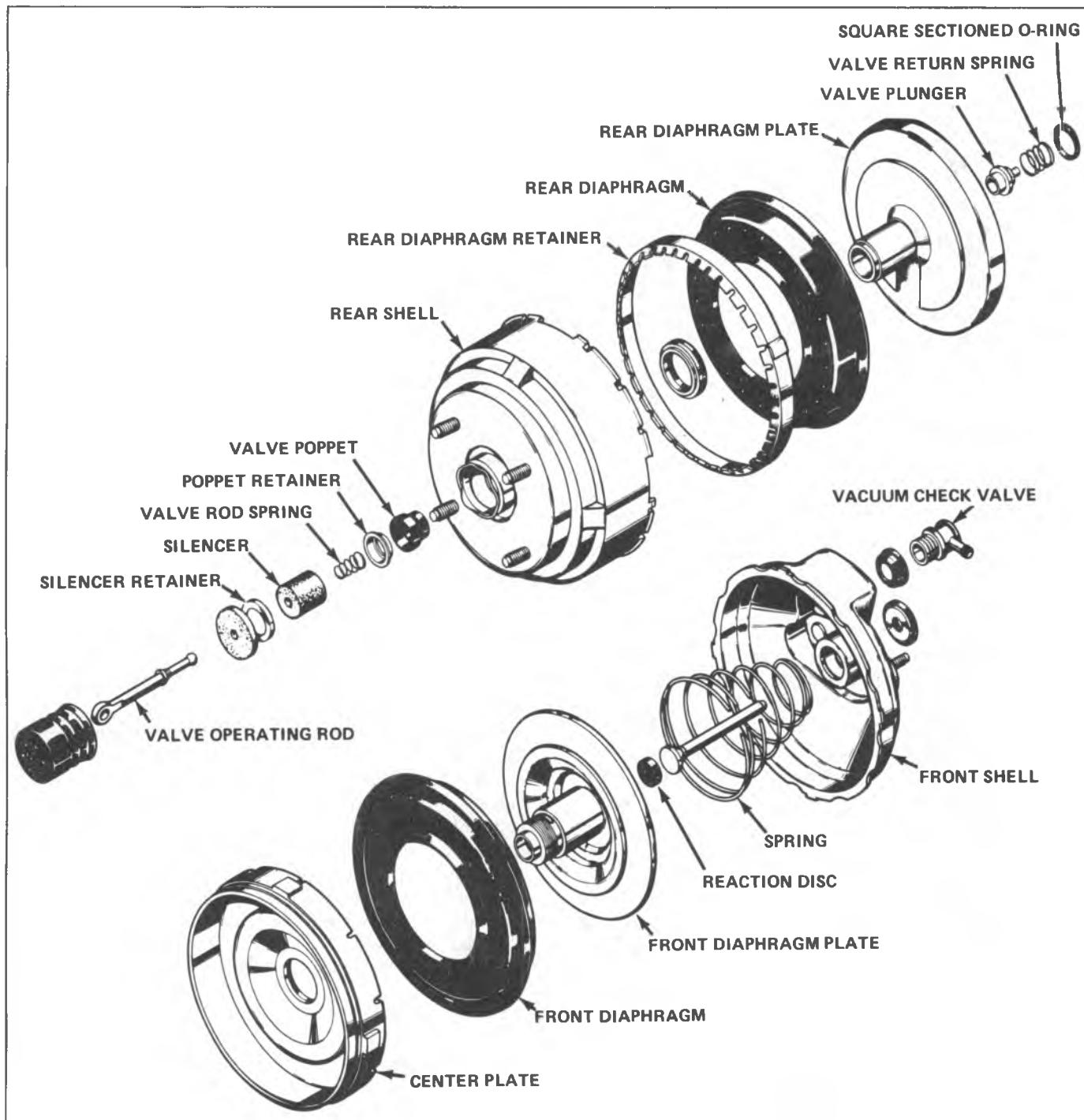


Fig. 5-5B--Diaphragm and Plates

on arbor press plate by a suitable means (fig. 5-4B).

13. Place Spanner Wrench J-9504 over studs on rear housing. Use three washers and nuts to attach wrench to housing. Place a suitable piece of pipe (approximately two inch I.D. and approximately three inches in length) over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe.

14. Install diaphragm return spring so that small end of spring is against front housing.

15. Place rear housing over front housing, and align scribe marks.

16. Rotate spanner wrench clockwise until housings are

locked together. Bend tabs of the four deep lances back to their original position.

17. Remove three nuts and lock washers securing rear housing to spanner wrench.

18. Remove Holding Fixture J-22805 from front housing by removing two nuts and washers.

19. Wet poppet valve with denatured alcohol and assemble in rear plate hub, small end first. Wet poppet retainer with denatured alcohol and assemble with shoulder inside poppet. Assemble retainer, filters and silencer over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with denatured



Fig. 5-6B--Removing Rear Seal

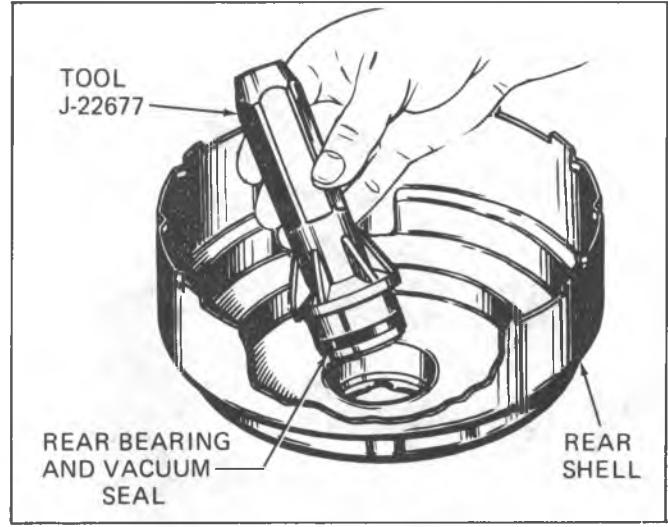


Fig. 5-8B--Installing Rear Bearing and Vacuum Seal

alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

20. Assemble silencer in dust boot, wet dust boot opening with denatured alcohol and assemble over operating valve rod and over flange of rear housing.

21. Install new check valve and grommet.

22. Apply silicone lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

#### Piston Rod Gauging

1. Place the power head assembly in a padded vise (front housing up); *Do not clamp tight*.

2. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

5. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 5-12B).

6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should never contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

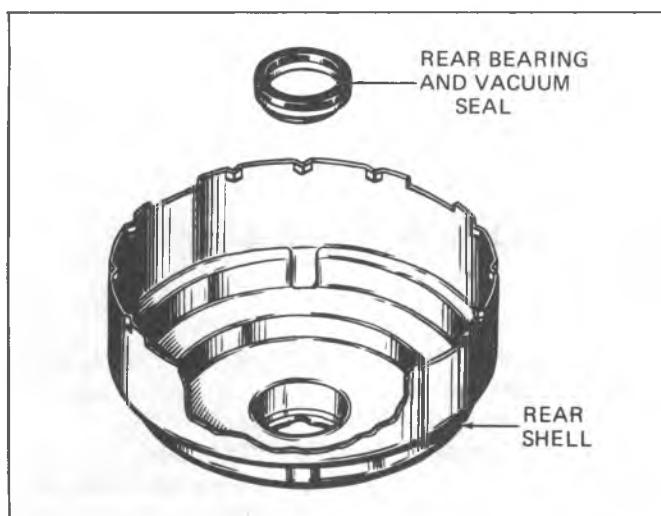


Fig. 5-7B--Rear Bearing and Rear Shell

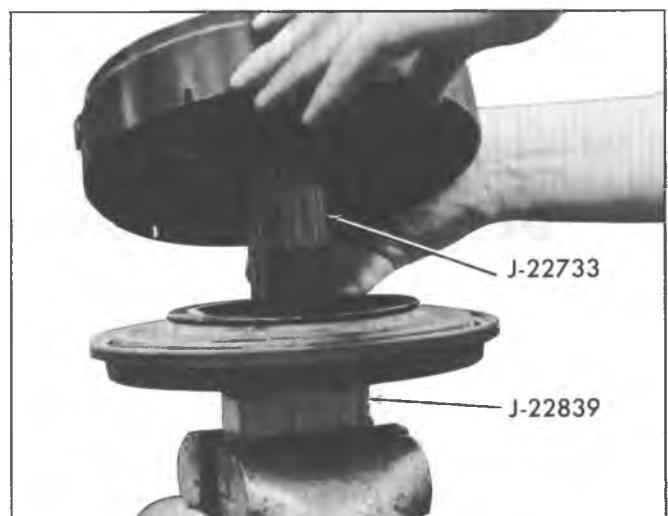


Fig. 5-9B--Seal Protector J-22733 Installed



Fig. 5-10B-Installing Air Valve Plunger

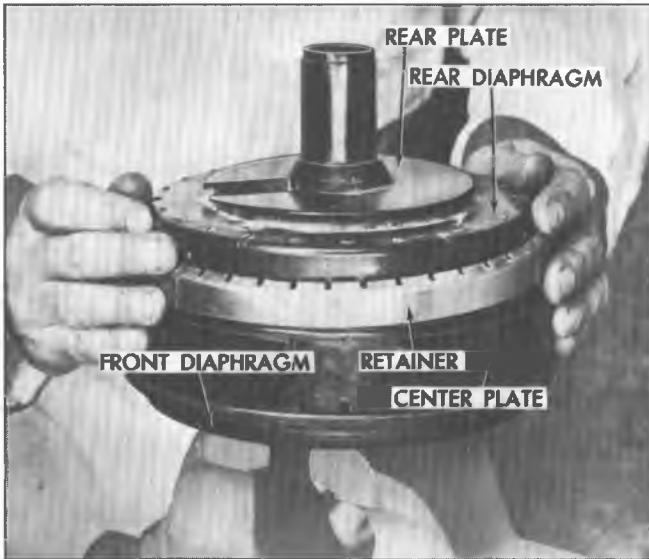


Fig. 5-11B--Installing Rear Diaphragm Retainer

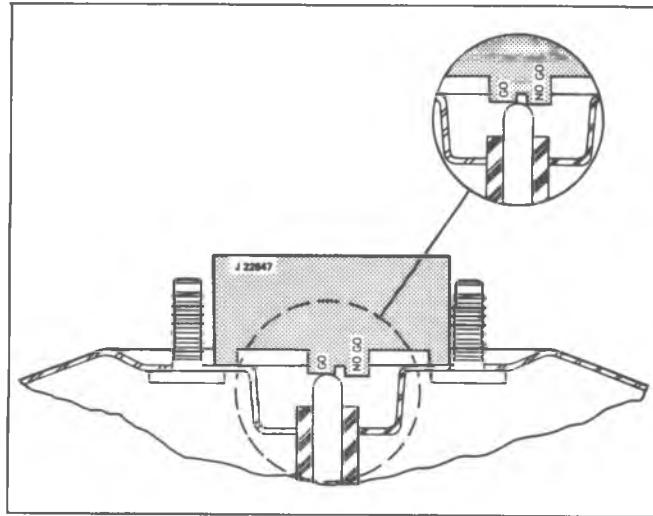


Fig. 5-12B Gaging Piston Rod

## DELCO SINGLE DIAPHRAGM POWER BRAKE UNIT UNIT REPAIR

### Disassembly

1. Scribe a mark on bottom center of front and rear housings to facilitate reassembly.
  2. Attach base of Tool J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2C).
  3. Separate front and rear housings as follows:
- a. **Straight Mounting Bracket (Fig. 5-3C)** - Place

Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.

- b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to bracket.
- c. **Tilt Mounting Bracket Except Chevelle (Fig. 5-4C)** - Place Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers securing spanner wrench.

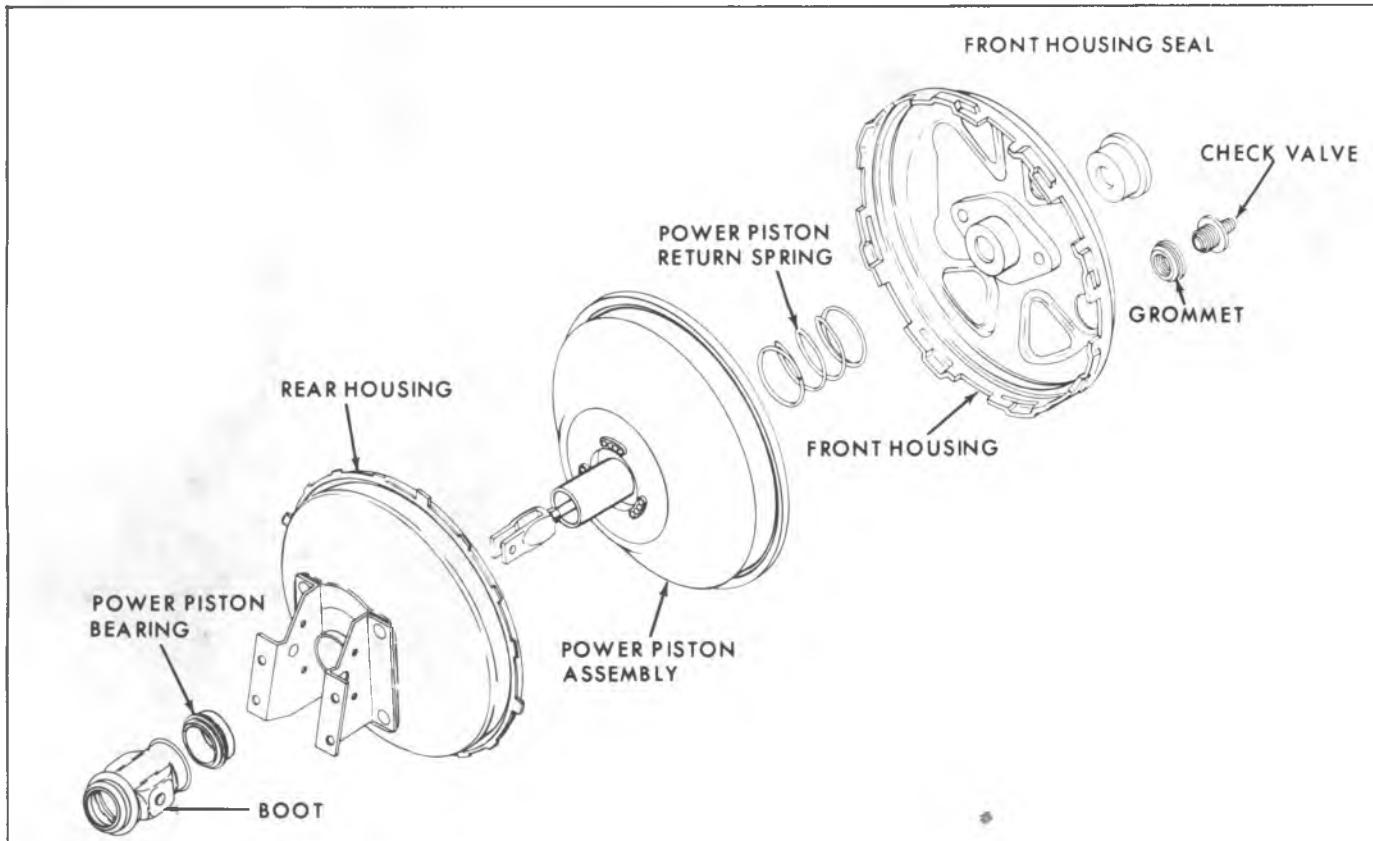


Fig. 5-1C-- Typical Power Brake Unit - Exploded View

- d. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to unlocked position. Loosen housing carefully as it is spring loaded.
- e. Remove Tools J-9504 and J-22893 from rear housing (tilted mounting bracket type); Tool J-9504 on regular type.
- 4. Lift rear housing and power piston assembly from unit. Then remove return spring.
- 5. Remove retaining ring on push rod that holds silencer in place on push rod; remove silencer.
- 6. Remove seal and vacuum check valve and grommet from front housing.

#### Power Piston Assembly Group (Fig. 5-5C)

**CAUTION:** Care must be used in handling the diaphragm of power piston assembly. Guard diaphragm against grease, oil, foreign matter and nicks or cuts.

1. Remove power piston assembly from rear housing.
2. Remove silencer from neck of power piston tube.
3. Remove lock ring from power piston by prying one end out from under large divided locking lug and then proceed to pull ring from under other two locking lugs on

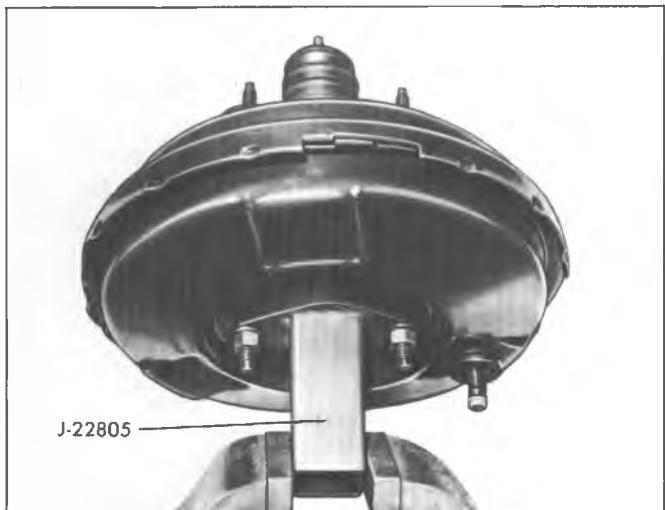


Fig. 5-2C--Holding Power Cylinder Using Tool J-22805

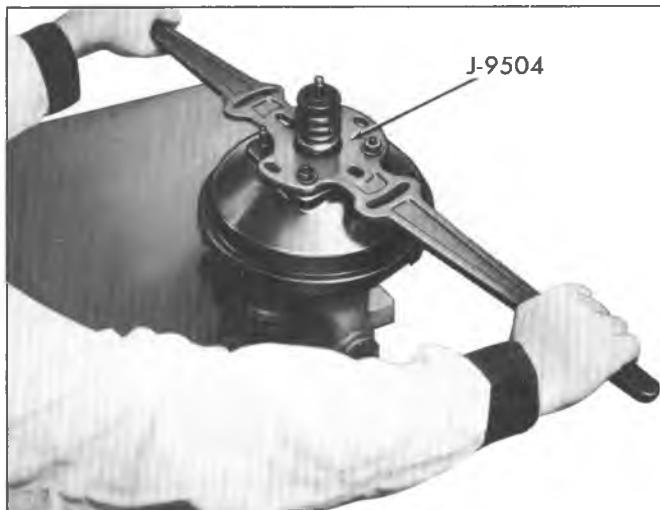


Fig. 5-3C-- Separating Housings With Tool J-9504

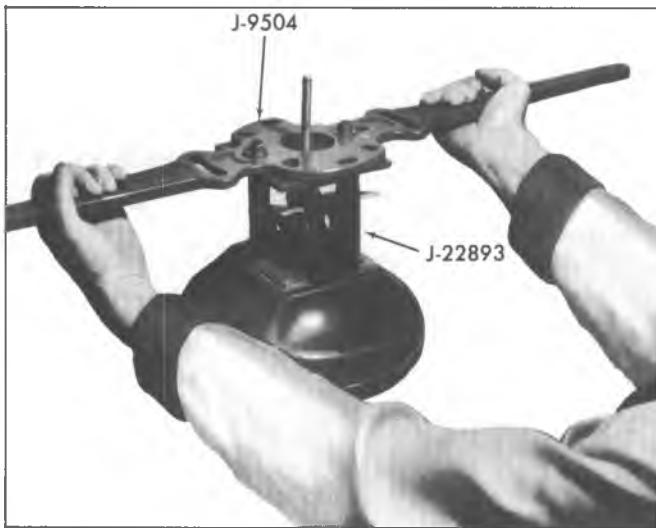


Fig. 5-4C--Separating Tilt Bracket Type Housings

power piston (fig. 5-6C).

4. Remove reaction retainer, piston, reaction plate, three (3) reaction levers and air valve spring. Also remove reaction bumper and air valve spring retainer from air valve (fig. 5-7C).

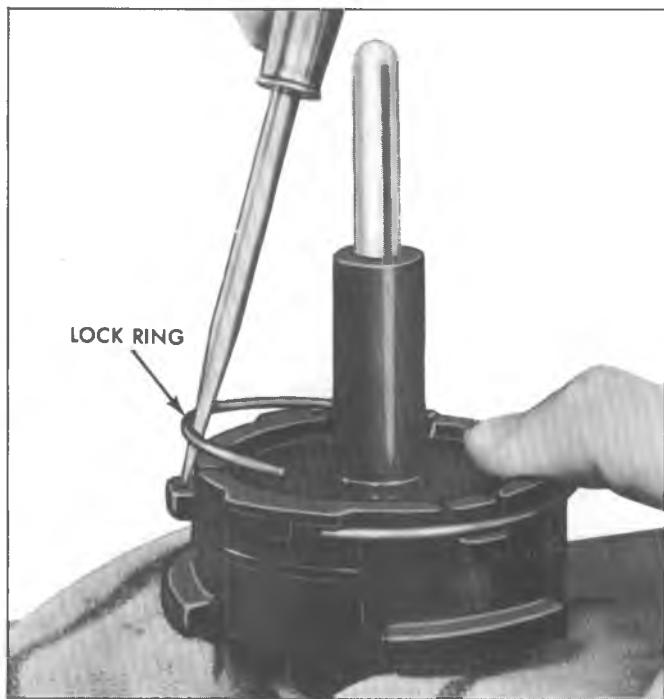


Fig. 5-6C--Removing Lock Ring From Power Piston

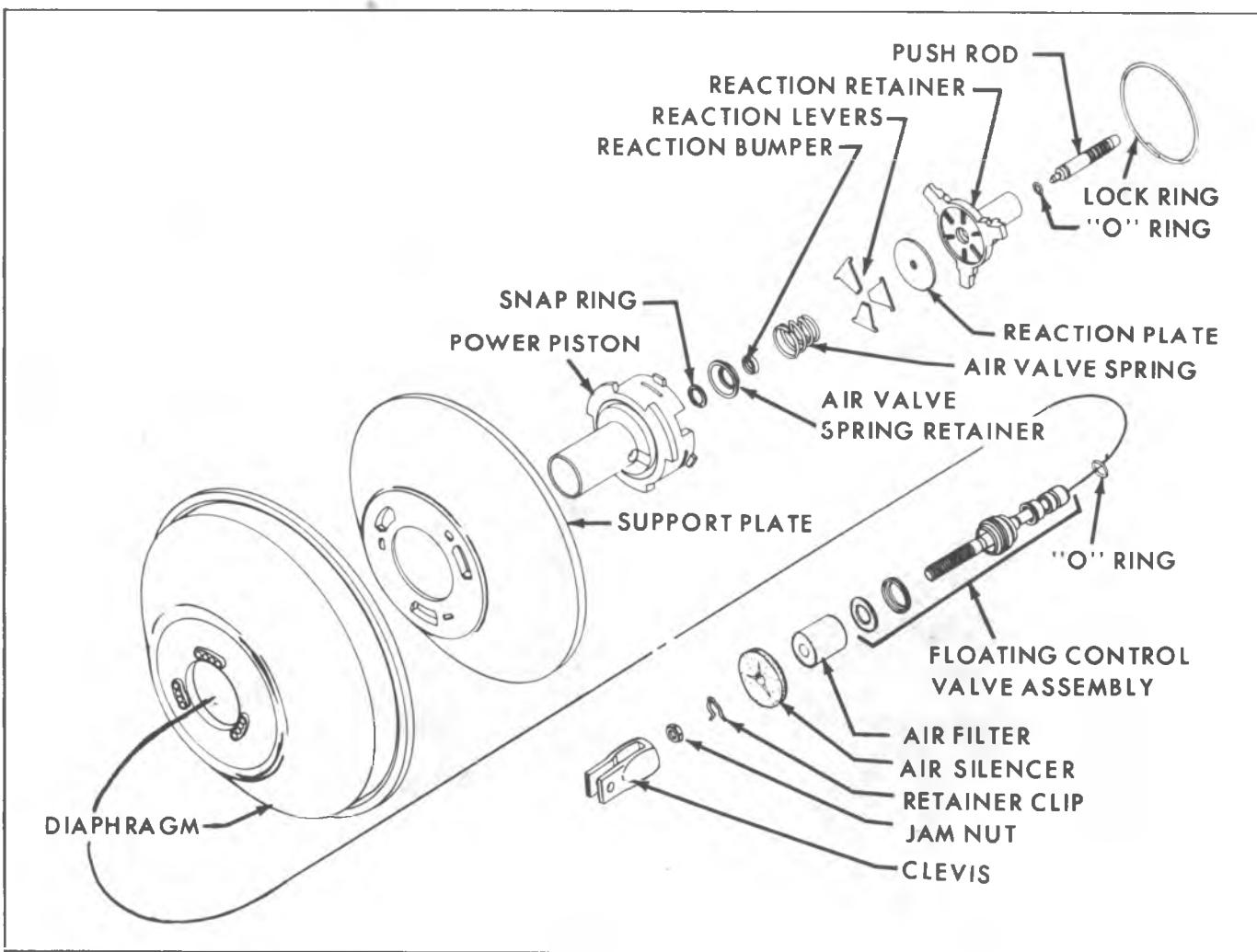


Fig. 5-5C--Power Piston Assembly - Exploded View

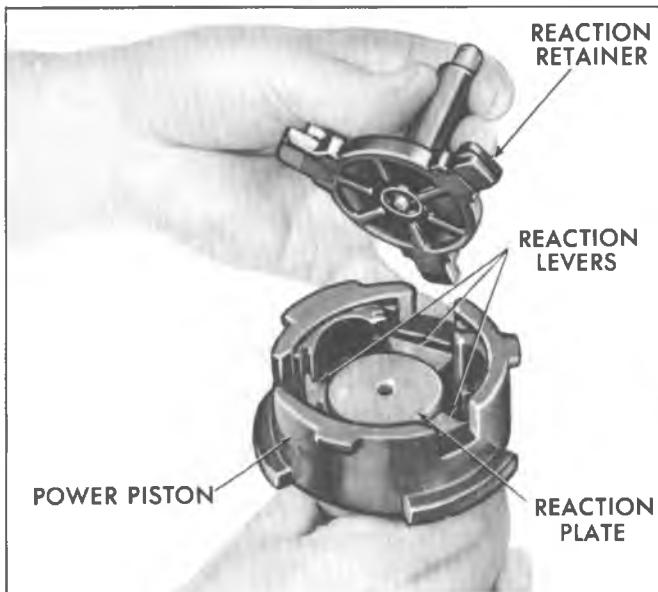


Fig. 5-7C--Removing Reaction Retainer

5. Place power piston Wrench J-21524 with square shank in vise. Hold support plate and power piston with tube of power piston up (fig. 5-8C).

6. Pull diaphragm edges away from support plate so hands can grip steel support plate. Position assembly on power piston Wrench J-21524 so three lugs on tool fit into three notches in power piston (fig. 5-9C).

7. Press down on support plate and rotate counterclockwise until support plate separates from power piston (fig. 5-10C).

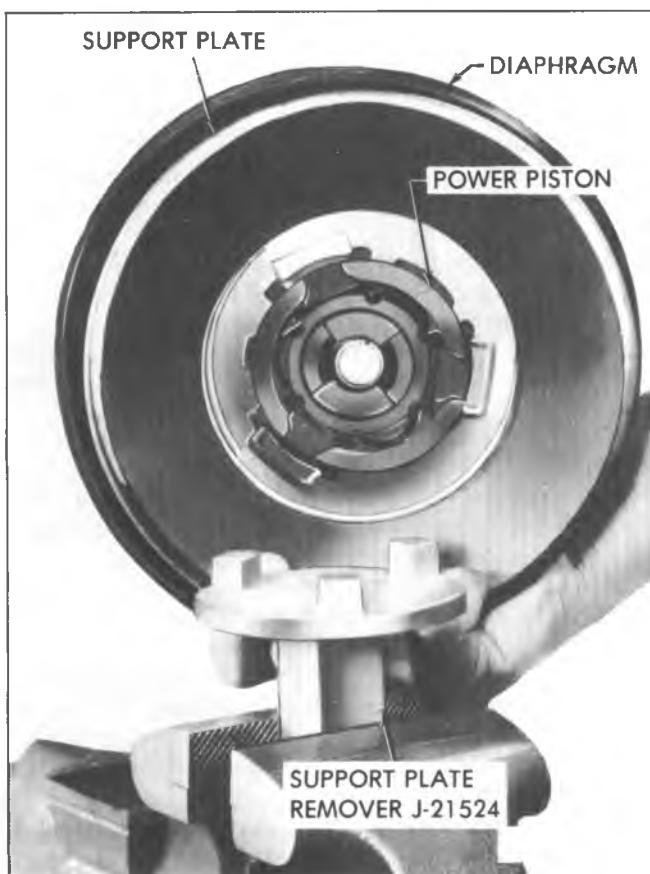


Fig. 5-8C--Positioning Support Plate Retainer in Vise



Fig. 5-9C--Positioning Power Piston on Support Plate Remover

8. Remove diaphragm from support plate and lay both parts aside.

9. Position power piston, tube down, in a tool, fabricated from a piece of wood 2" x 4" x 8" long with a 1-3/8" hole in center, clamped in a vise. Do not clamp tube in vise.

10. Use Snap Ring Pliers J-4880 to remove snap ring on air valve (fig. 5-11C).

11. Set up Power Ram and Hydraulic Pump with J-9746 Press Plate. Insert power piston, tube down, in press plate and remove air valve assembly using a 3/8" drive extension as a remover (fig. 5-12C).

12. Removal of air valve-push rod assembly disassembles the following parts from power piston: floating control valve assembly, floating valve retainer, push rod limiter washer and air filter.

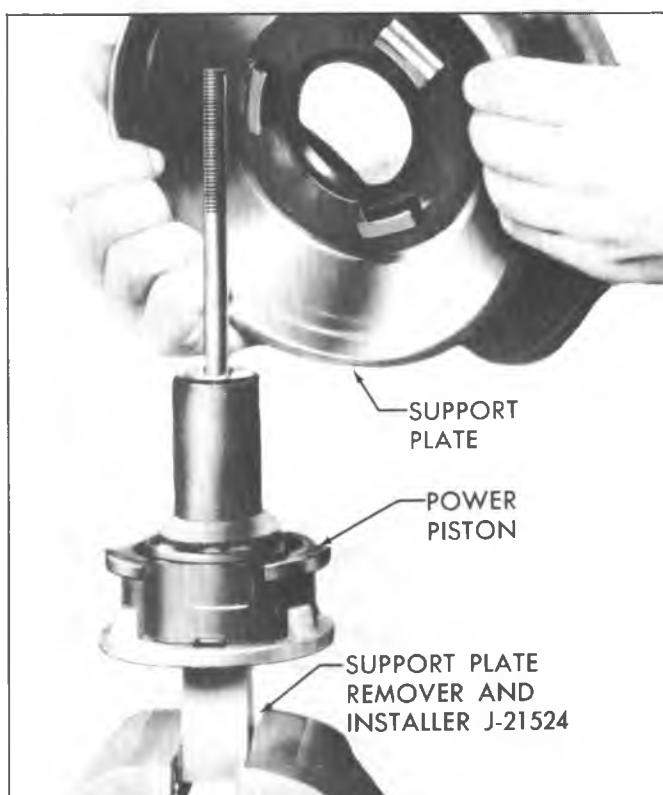


Fig. 5-10C--Removing Support Plate

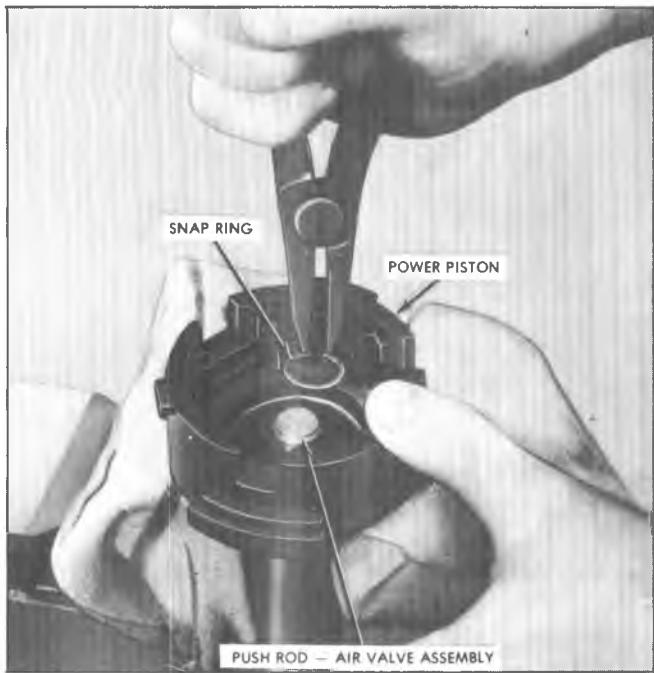


Fig. 5-11C--Removing Power Piston Snap Ring

13. Remove floating control valve assembly from push rod as it must be replaced by a new floating control valve assembly at rebuild.

14. The master cylinder push rod can now be pushed from center of reaction retainer. Remove "O" ring from groove in master cylinder piston rod.

#### Cleaning of Parts

1. Use denatured alcohol to clean thoroughly all metal brake parts. Immerse in cleaning fluid and brush with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth.

2. If slight rust is found inside either front or rear housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards with specified cleaning fluid.

**CAUTION:** If there is any suspicion of contamination or any evidence of corrosion, completely flush hydraulic brake system. Failure to clean hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts.

Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean. Rewash at reassembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

#### Inspection and Replacement of Parts

1. Inspect all rubber parts. Wipe free of fluid and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to control of fluid or air flow and should account for the majority of troubles traceable to leakage. Re-use rubber parts only if a fairly new unit is disassembled for some particular trouble and only then if there is no doubt that the parts are in equal-to-new condition. Badly damaged items or those which would take extensive work or time to repair should be replaced. In case of doubt, install new parts for safety.

2. Inspect in accordance with Inspection Table: (The table is organized by power brake unit groups.)

#### Assembly

Be certain that all rubber parts are clean at reassembly. Rewash in specified cleaning fluid if there is any doubt of cleanliness. Be careful during rebuild process that no grease or mineral oil comes in contact with rubber parts of power brake unit. Lubricate rubber parts with Delco approved lubricant or equivalent.

#### Front Housing Group

1. Install a new vacuum check valve using a new grommet.

2. Place new front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

#### Power Piston Group

1. Place new "O" ring in groove on the master cylinder piston rod. Wipe a thin film of Power Brake Lube or equivalent on "O" ring.

2. Master cylinder piston rod is now inserted through the reaction retainer so round end of piston rod protrudes from end of the tube on reaction retainer.

3. Place J-21524 power piston wrench in a vise. Position power piston on wrench with three lugs fitting into notches in power piston.

4. Position new "O" ring on air valve in second groove from push rod end.

5. On reassembly of power piston, floating control valve assembly must be replaced with a new one since the force required to remove it distorts component parts.

6. Place floating control valve on push rod-air valve assembly so flat face of valve will seat against valve seat on air valve.

7. Wipe a thin film of Power Brake Lube (or equivalent) on large O.D. of floating control valve and on "O" ring on air valve.

8. Press air valve-push rod assembly, air valve first, onto its seat in tube of power piston.

9. Place floating control valve retainer over push rod so flat side seats on floating control valve.

10. Start floating control valve and its retainer into power piston tube. Press the floating control valve to seat in

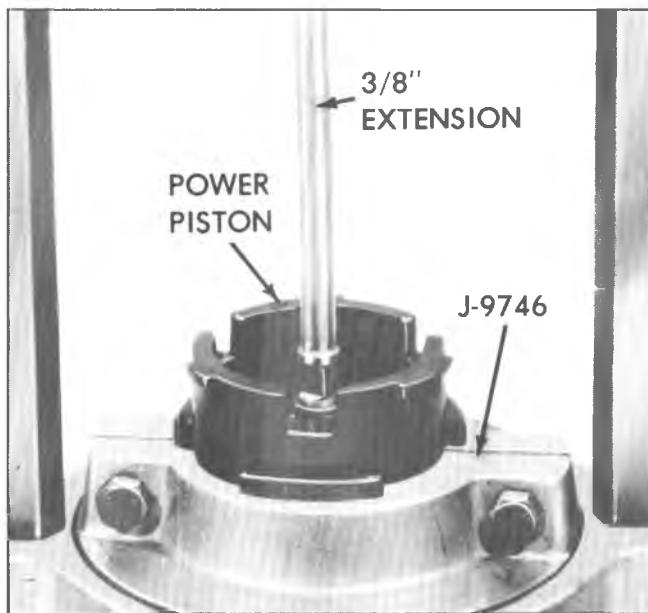


Fig. 5-12C--Removing Air Valve Assembly

## INSPECTION CHART

Part	Inspect For	Corrective Action
Power Piston and Support Plate and Reaction Retainer	<p>1. Cracks, distortion, chipping, damaged lever seats, pitted or rough holes.</p> <p>2. Worn seal surfaces (tubes).</p> <p>3. Rough or uneven floating valve seat.</p> <p>4. Open passages and flow holes.</p>	<p>1. Clean up or replace.</p> <p>2. Replace</p> <p>3. Replace</p> <p>4. Clean</p>
Reaction Levers or Plates	1. Cracks, distortion, tears and heavy wear.	1. Replace
Floating Control Valve	1. Deterioration of rubber or warped valve face.	1. Replace
Air Valve - Push Rod Assembly	<p>1. Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.</p> <p>2. Push rod must move freely in air valve, but must not pull out.</p>	<p>1. Do not repair - Replace.</p> <p>2. If worn, replace air valve - push rod assembly.</p>
Front and Rear Housings	<p>1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.</p> <p>2. Cracks, damage at ears, damaged threads on studs.</p> <p>3. Bent or nicked locking lugs.</p> <p>4. Loose studs.</p>	<p>1. Replace, unless easily repaired</p> <p>2. Replace, unless easily repaired</p> <p>3. Replace, unless easily repaired</p> <p>4. Replace or repair.</p>
Air Filters	1. Dirty	1. Replace



Fig. 5-13C--Installing Floating Control Valve Assembly

the tube, by placing J-21601-01 Floating Control Valve Retainer Installer on top of retainer and pushing down by hand (fig. 5-13C).

11. After floating control valve is seated, position push rod limiter washer over push rod and down onto floating control valve. Air filter element can now be stretched over end of push rod and pressed into power piston tube.

12. Assemble power piston diaphragm to diaphragm support plate from side of support plate opposite locking tangs. The raised flange of diaphragm is pressed through hole in center of support plate. Be sure that edge of center hole fits into groove in flange of diaphragm.

13. Pull diaphragm away from O.D. of support plate so that support plate can be gripped with hands.

14. With power piston still positioned on holding tool in vise, coat bead of diaphragm that contacts power piston with Power Brake Lube (or equivalent).

15. Holding support plate by metal, with locking tangs down, place support plate and diaphragm assembly over tube of power piston. The flange of diaphragm will fit into groove on power piston (fig. 5-10C).

16. Press down and rotate support plate clockwise, until lugs on power piston come against stops on support plate (fig. 5-10C).

17. This assembly can now be turned over and placed, tube down, in a tool, fabricated from a piece of wood, 2" x 4" x 8" long with a 1-3/8" hole in the center, clamped in a vise.

18. With Snap Ring Pliers J-4880, assemble snap ring into groove in air valve.

19. Place air valve spring retainer on snap ring. Assemble reaction bumper into groove in end of air valve.

20. Position air valve return spring, large end down, on spring retainer.

21. The three reaction levers are now placed into position with ears on wide end in slots in power piston. The

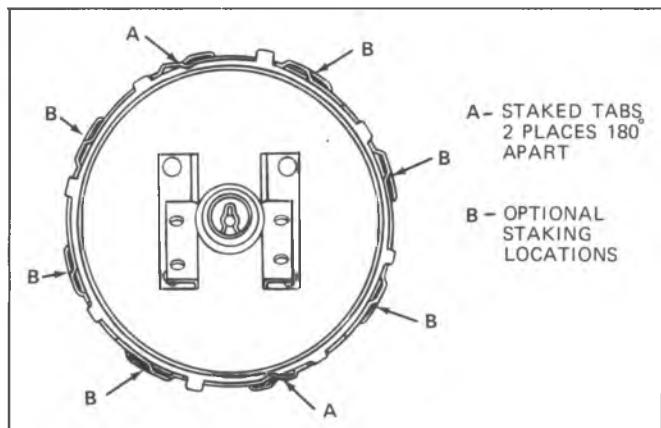


Fig. 5-14C--Housing Locking Tabs

narrow ends will rest on top of air valve return spring.

22. Position reaction plate (with numbered side up) on top of reaction levers. Press down on plate until large ends of reaction levers pop up so plate rests flat on levers. Be sure reaction plate is centered.

23. Master cylinder piston rod and reaction retainer assembly is now assembled to the power piston.

24. With round end of piston rod up, and with reaction retainer held toward top of piston rod, place small end of piston rod in hole in center of reaction plate. Line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches.

25. Maintain pressure on reaction retainer and position large lock ring down over master cylinder push rod.

26. There is a lug on the power piston which has a raised divider in the center. One end of lock ring goes under lug and on one side of divider.

27. As you work your way around power piston (either way), the lock ring goes over ear of reaction retainer, under a lug on power piston, and so forth, until other end of lock ring is seated under lug with raised divider.

Be sure both ends of lock ring are securely under large lug.

#### Rear Housing Group

1. Place a new power piston bearing in center of rear housing so flange on center hole of housing fits into groove of power piston bearing. The large flange on power piston bearing will be on stud side of housing.

2. Coat inside of power piston bearing with Delco Power Brake Lube (or equivalent).

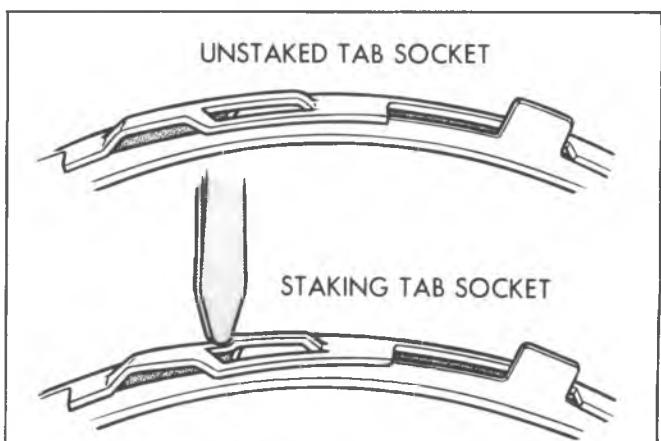


Fig. 5-15C--Staking Housing Tabs

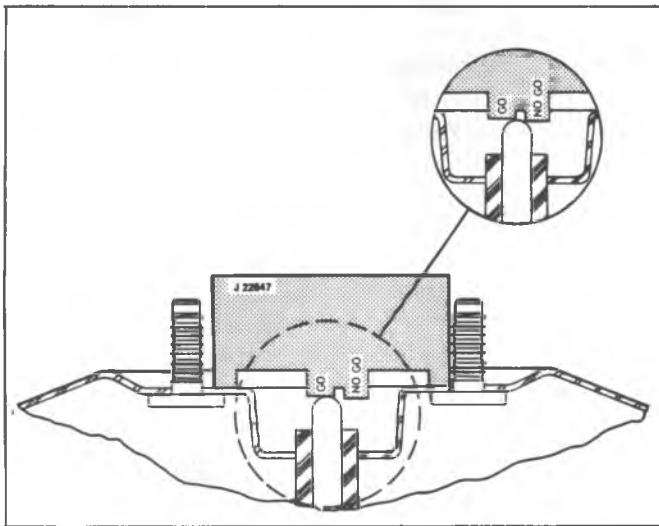


Fig. 5-16C--Gaging Master Cylinder Push Rod

## Final Assembly

1. Place air silencer over holes on tube of power piston. Wipe tube of power piston with Delco Power Brake Lube (or equivalent).
2. Assemble power piston to rear housing.
3. Wipe tube of reaction retainer with Delco Power Brake Lube (or equivalent) and lay assembly aside.
4. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damaging of studs. Clamp base in a vise. Place power piston return spring over the insert in the front housing.
5. Lubricate the I.D. of the support plate seal, the reaction retainer tube and the beaded edge of the diaphragm with Power Brake Lube (or equivalent).
6. Place the rear housing assembly over the front housing assembly and align the scribe marks of the two housings so they will match when in locked position.
7. Assemble front and rear housings as follows:
  - a. **Straight Mounting Bracket** - Place Spanner Wrench J-9504 over studs on rear housing, and attach with nuts and washers--draw nuts down tight to eliminate bending or damaging of studs.
  - b. **Tilt Mounting Bracket (Chevelle)** - Secure Spanner Wrench J-9504 to bracket with three bolts and nuts. Draw nuts down tight to eliminate damage to the bracket.

## BENDIX SINGLE DIAPHRAGM POWER BRAKE UNIT UNIT REPAIR

### Disassembly (Figs. 5-1D and 5-2D)

1. Scribe a line across front and rear housings to facilitate reassembly.
2. Remove the front housing seal (fig. 5-2D); pulling the piston rod from the front housing will also remove the seal assembly. Remove the piston rod.
3. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2A).

c. **Tilt Mounting Bracket (Except Chevelle)** - Position Tool J-22893 inside tilted mounting bracket. Place Spanner Wrench J-9504 on top of J-22893 and tighten nuts and washers to bolts provided, securing Spanner Wrench.

d. Press down on spanner wrench and twist rear housing clockwise in relation to front housing until fully locked. Do not break studs loose in rear housing or put pressure on power piston tube when locking housings.

8. Remove Spanner Wrench J-9504. Remove unit from vise and remove Holding Fixture J-22805 from the front housing.

9. Push felt silencer over push rod to seat against end of power piston tube. Snap ring retainer is now placed on push rod so it can hold silencer against power piston tube. Plastic boot is now pushed to seat against rear housing. Raised tabs on side of boot will locate in holes in center of brackets.

10. Using a 1/8" diameter rod (or similar tool), stake the front and rear housing in two places 180° apart (figs. 5-14C and 5-15C).

**CAUTION:** *The interlock tabs should not be used for staking a second time. Stake two of the remaining tabs. When all tabs have been staked once, the housing must be replaced.*

### Gaging of Power Brake Unit

The following gaging operation is necessary only when a major structural part such as front or rear housing, power piston assembly, master cylinder piston or master cylinder assembly is replaced with a new part. The gage measures how far the master cylinder push-rod projects from front housing. This dimension must be correct to insure proper clearance in master cylinder between primary cup and compensating port.

Make check as follows:

1. Place gage over piston rod in a position which will allow gage to be slipped to left or right without contacting studs.

The center section of gage has two levels. The piston rod end should always touch the longer section of gage which extends into front housing. The piston rod end should **never** touch the shorter section of gage (fig. 5-16C).

2. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod, and adjusting the screw in end to match height of gage.

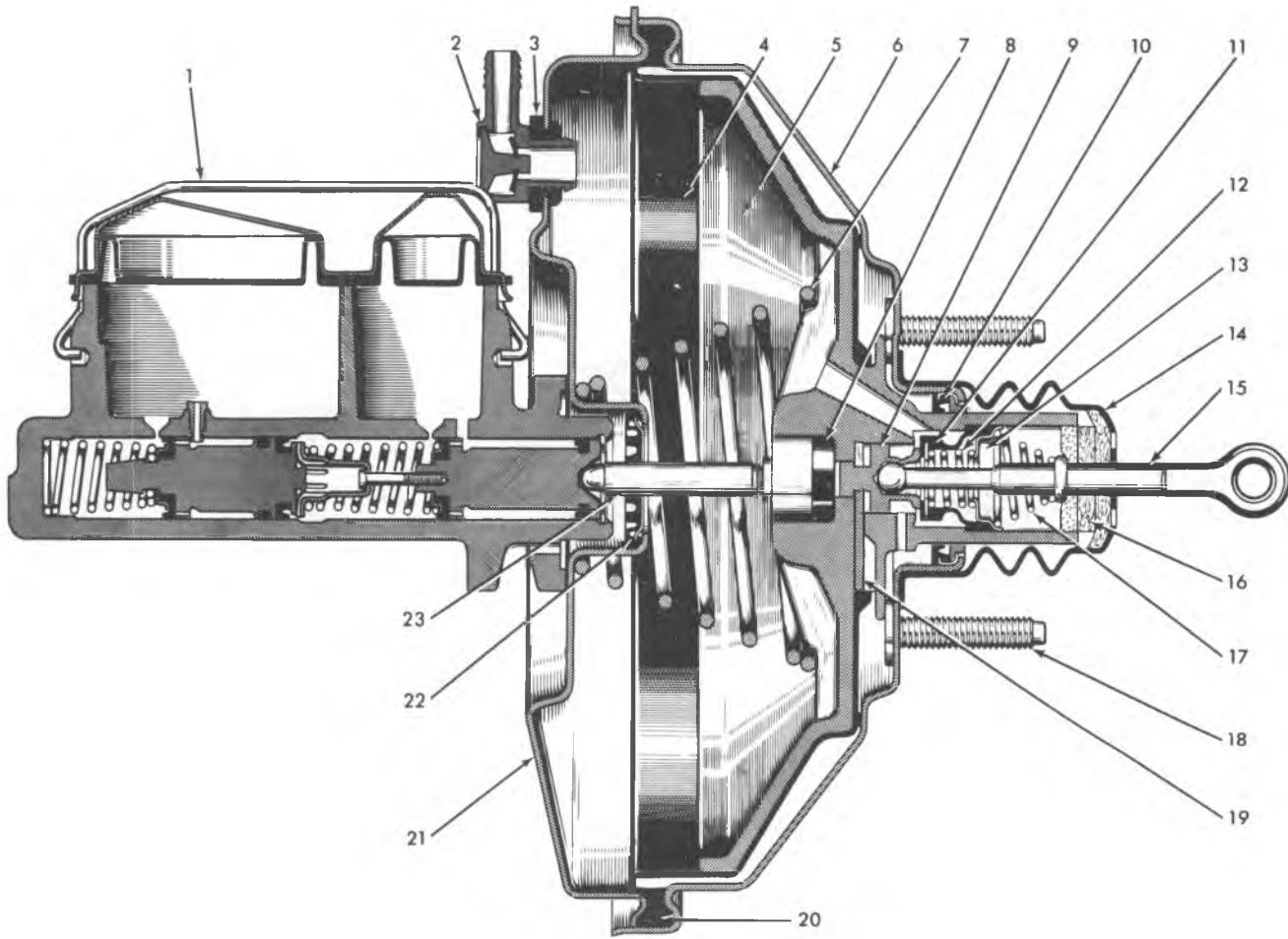
**CAUTION:** *Be sure to align tool so that the check valve in the front housing is not damaged.*

4. Loosen locknut and remove push rod clevis and locknut, if so equipped.
5. Remove the mounting bracket from the rear housing, if so equipped.
6. Remove the dust boot retainer, dust boot and silencer from the diaphragm plate extension.
7. The edge of the rear housing contains twelve lances. Four of these lances (one in each quadrant) are deeper than

the other lances (fig. 5-3D). The metal that forms the four deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances crack or break during straightening, the housing must be replaced.

8. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs (fig. 5-2A).

9. Press down on Spanner Wrench J-9504 and rotate the rear housing clockwise to separate the two housings. If the



- 1. Master Cylinder
- 2. Vacuum Check Valve
- 3. Grommet
- 4. Diaphragm
- 5. Diaphragm Plate
- 6. Rear Housing
- 7. Diaphragm Spring
- 8. Reaction Disc

- 9. Air Valve
- 10. Front Housing Seal
- 11. Poppet Valve
- 12. Poppet Valve Spring
- 13. Poppet Retainer
- 14. Dust Boot
- 15. Valve Push Rod
- 16. Filter and Silencers

- 17. Valve Return Spring
- 18. Mounting Stud
- 19. Air Valve Lock Plate
- 20. Diaphragm Lip
- 21. Front Housing
- 22. Front Housing Seal
- 23. Piston Rod

Fig. 5-1D--Bendix Single Diaphragm Unit (Typical)

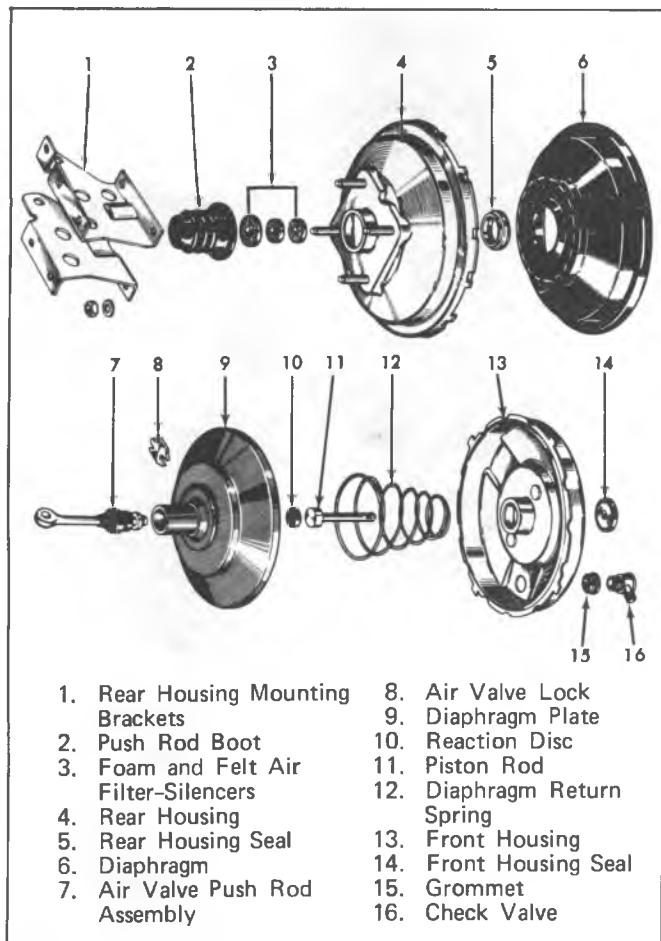


Fig. 5-2D--Bendix Power Booster Components (Typical)

rear housing cannot be readily loosened, tap the rear housing lightly with plastic hammer.

10. Remove Tool J-9504 from the rear housing.

**CAUTION:** Care must be exercised not to damage or loosen studs in the rear housing. Also, take care that no pressure is brought to bear on plastic

diaphragm plate tension.

11. Lift the rear housing assembly from the unit.

#### Rear Housing Group

1. Remove the air filter element from location within the diaphragm plate extension.

**CAUTION:** To prevent chipping of the plastic diaphragm plate, exercise extreme caution when removing the air filter retainer. Use a small screwdriver or other suitable tool, and pry at several peripheral locations until the retainer is freed.

2. Separate the diaphragm plate assembly from the rear housing and lay the rear housing aside.

3. Disassemble diaphragm plate assembly (fig. 5-2D).

a. Remove rolling diaphragm from the groove in the diaphragm plate hub.

**CAUTION:** Care should be used in handling the diaphragm of the diaphragm plate assembly. The diaphragm should be protected from grease, oil, foreign matter and from nicks, scratches and gouges.

b. Hold the diaphragm plate so that the push rod is in its normal (horizontal) installed position, depress the push rod slightly (approximately 1/16 inch), and rotate piston so the air valve lock will fall from its location in the diaphragm plate hub. Remove the air valve-push rod assembly from the diaphragm plate. Remove the reaction disc from its location in the diaphragm plate bore (insert the piston rod or other suitable tool through diaphragm plate extension and push disc from its seat). Exercise care so as not to chip surface of passages in the diaphragm plate.

**NOTE:** Perform Step 4 only if seal is defective and a new seal is available. Do not reuse seal once it has been removed from the unit.

4. Support outer surface of rear housing on blocks of wood or other suitable material (stud side up) and drive out seal with a punch or a thin blade screwdriver. Discard seal.

#### Front Housing Group

1. Remove check valve from grommet and then remove grommet from front housing; discard valve and grommet.

2. Remove front housing and holding fixture from vise; then remove holding fixture from front housing.

#### Cleaning

Use clean brake fluid to thoroughly clean all reusable brake parts. Immerse in the cleaning fluid and brush metal parts with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards. Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until re-assembly. Re-wash at re-assembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

**CAUTION:** If there is any suspicion of contamination or any evidence of corrosion, completely flush the vehicle hydraulic brake system. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.

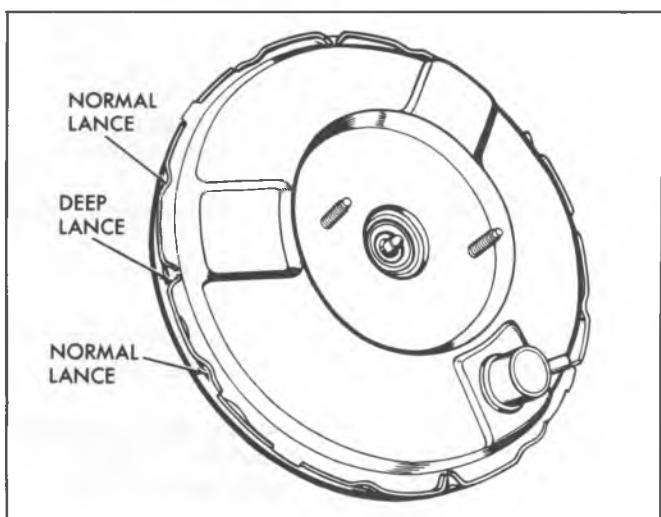


Fig. 5-3D--Lances in Rear Housing

## Inspecting Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to the control of fluid or air flow, if the unit is in for overhaul, or if there is any question as to the serviceability of rubber parts, **REPLACE** them.

## Inspecting Metal Parts

**BADLY DAMAGED ITEMS, OR THOSE WHICH WOULD TAKE EXTENSIVE WORK OR TIME TO REPAIR, SHOULD BE REPLACED.** In case of doubt, install new parts. Do not rely on the brake unit being overhauled at an early or proper interval. New parts will provide more satisfactory service, even if the brake unit is allowed to go beyond the desired overhaul period.

## Assembly (Figs. 5-1D and 5-2D)

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.

2. Lubricate power head parts, as outlined below, with silicone lubricant provided in the service repair kit.

### Front Housing Group

1. Install new check valve grommet in front housing with beveled edge of grommet inside of housing. Dip new check valve in clean denatured alcohol and install in grommet--check valve stem is to be outside of housing.

2. Position and secure Holding Fixture J-22805 to mounting studs, and place tool and front housing in a vise. Be sure to align tool so that check valve is not damaged.

**NOTE:** If either or both of the housings are replaced, make sure alignment marks are transferred to the new housing.

### Rear Housing Group

1. Place rear housing on a block of wood, stud side down, and position housing seal in center hole. Use Tool J-22677 (fig. 5-4D) to seat seal in recess of rear housing. Tool bottoms against housing when seal is in place.

2. Assemble diaphragm plate assembly (see fig. 5-2D).

- a. Apply silicone lubricant to outside diameter of diaphragm plate and extension, to bearing surfaces of air valve and to outer edge of valve poppet. Insert air valve and push rod assembly in extension of diaphragm plate.

**NOTE:** The air valve, poppet valve and push rod are serviced as an assembly; a complete unit must be installed if there is damage to any of the component parts.

- b. Depress the push rod slightly and install the air valve lock. Make sure the lock indexes and retains the air valve.

- c. Install the rolling diaphragm in the groove of diaphragm plate.

- d. Apply silicone lubricant to surface of reaction disc and position disc in center bore of diaphragm plate. Use piston rod to seat disc in bore. Make sure disc is fully seated before removing piston rod.

**NOTE:** If reaction disc is not fully seated, it will result in an erroneous push rod height adjustment.

3. Apply silicone lubricant to I.D. of rear housing seal and diaphragm bead contact surface of rear housing. Install diaphragm plate assembly in rear housing.

4. Place air filter element over push rod and into diaphragm plate extension. Install filter retainer.



Fig. 5-4D--Installing Rear Housing Seal

## Final Assembly

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-2A).

**CAUTION:** Be sure to align tool so that the check valve in the front housing is not damaged.

2. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.

3. Place diaphragm plate return spring in front housing and position rear housing assembly on front housing (small end of spring downward). Position rear housing so that when housings are locked, scribe marks on front and rear housings will be in alignment.

4. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to assemble the two housings.

**CAUTION:** Bend lances in on the rear housing. If the tangs crack or break during this operation it will be necessary to replace that half of the housing.

5. Remove Tool J-9504 from the rear shell.

6. Install air silencers over push rod end and then install push rod boot. Install boot retainer.

**Clevis Type Push Rod** - Install locknut and push rod clevis.

8. Install mounting bracket to the rear shell, if so equipped.

**CAUTION:** See "Caution" on Page 1 of this section.

9. Remove power cylinder from vise and remove Holding Fixture J-22805.

10. Apply silicone lubricant sparingly to the piston rod, keeping lubricant away from rounded end of rod. Guide piston rod into center bore of the diaphragm plate until it is fully seated against reaction disc.

11. Install front housing seal. Press seal into front housing until seal is bottomed in recess of housing.

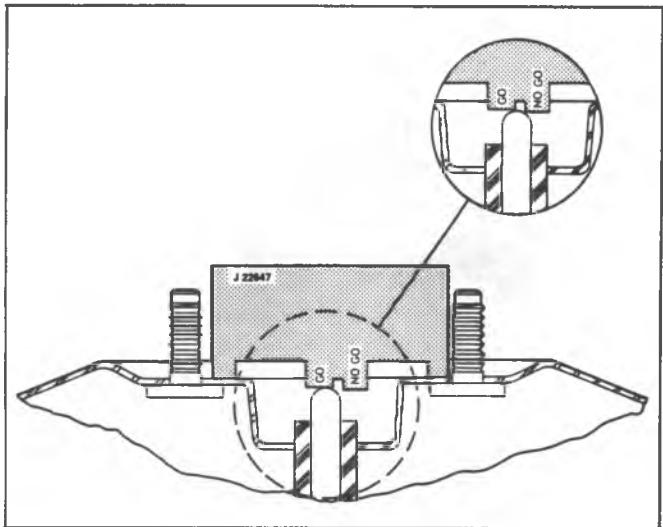


Fig. 5-5D--Gauging Piston Rod

### Gaging

1. Place the power head assembly in a padded vise (front housing up). *Do not clamp tight!*

2. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

5. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 5-5D).

6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should never contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

## BENDIX HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST) UNIT REPAIR

The Bendix Hydraulic Brake Booster utilizes the hydraulic pressure supplied by the power steering pump to provide power assist for brake applications (fig. 5-1E). The dual master cylinder is mounted to the output push rod end of the booster.

The procedures below include removal of the mounting bracket even though it is not necessary to remove the bracket for overhaul of the internal assembly.

### Disassembly (Fig. 5-2E)

1. Secure the booster in a vise (bracket end up) and use a hammer and chisel to cut the bracket nut that secures the

mounting bracket to the power section (cut the nut at the open slot in the threaded portion of the housing). Be careful to avoid damage to the threads on the booster hub. Spread the nut and remove it from the power section. Then remove the mounting bracket.

2. Remove the pedal rod boot (if equipped) by pulling it off over the pedal rod eyelet.

3. Place Tool J-24569 around the pedal rod and resting on the input rod end as shown in Figure 5-3E.

4. Place a punch (or similar tool) through the pedal rod from the lower side of Tool J-24569. Push the punch on through to rest on the higher side of the tool. Lift up on the punch to shear the pedal rod retainer; remove the pedal rod.

5. Remove the remnants of the rubber grommet from the groove near the end of the pedal rod and from the groove inside the input rod end.

6. With a small screwdriver, pry the plastic guide out of the output push rod retainer. Disengage the tabs of the spring retainer from the ledge inside the opening near the master cylinder mounting flange of the booster. Remove the retainer and the piston return spring from the opening.

7. Pull straight out on the output push rod to remove the push rod and push rod retainer from inside the booster piston.

8. Press in on spool plug, and using a small screwdriver, remove the snap ring from the housing bore.

9. Use pliers to remove the spool plug from the bore. Remove the "O" ring seal from the plug; discard the "O" ring. Remove the spool spring from the bore.

10. Place the booster cover in a vise equipped with soft jawed devices. Using special socket J-25085, remove the five screws that secure the booster housing to the cover.

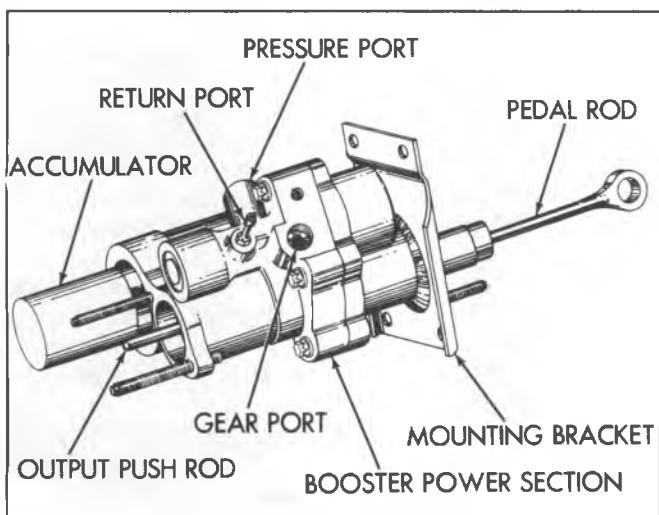
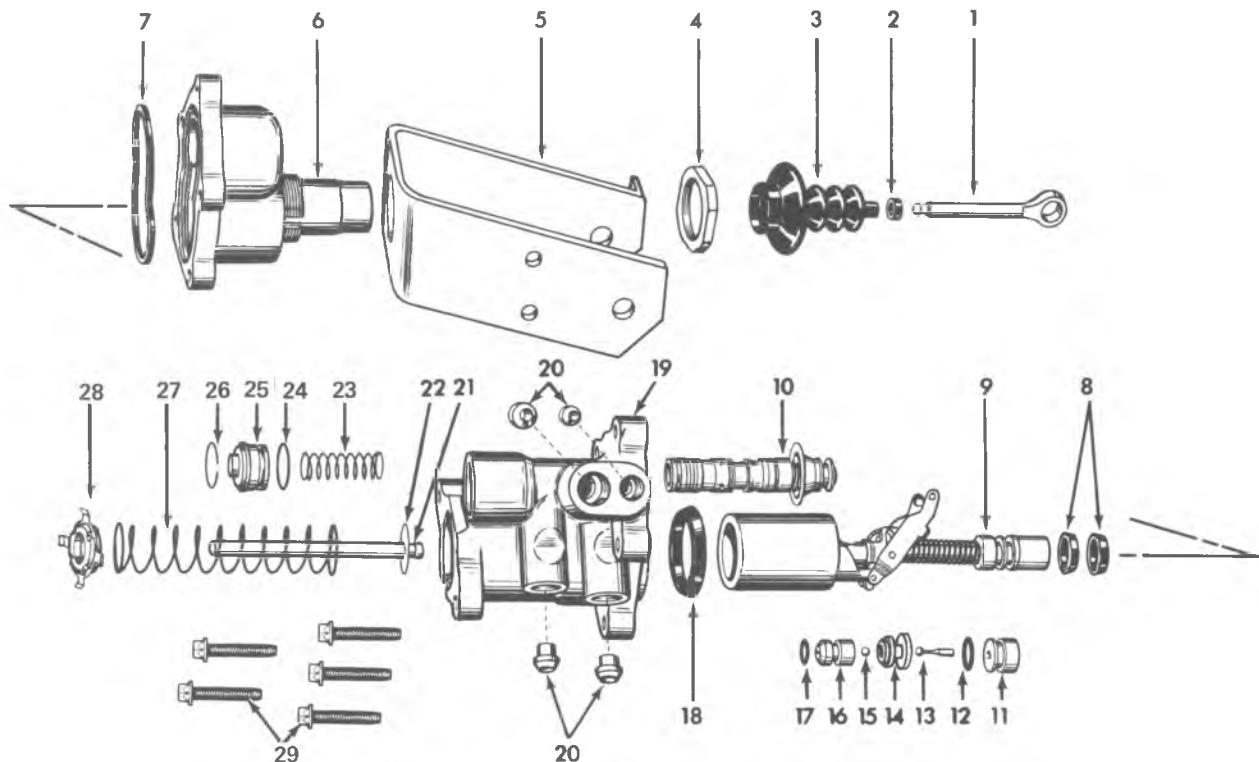


Fig. 5-1E-Bendix Hydro-Boost Brake Booster



- |                               |                             |                            |
|-------------------------------|-----------------------------|----------------------------|
| 1. Pedal Push Rod             | 11. Plunger Seat            | 21. Output Push Rod        |
| 2. Pedal Rod Retainer         | 12. "O" Ring Seal           | 22. Push Rod Retainer      |
| 3. Boot                       | 13. Plunger                 | 23. Spool Spring           |
| 4. Bracket Nut                | 14. Spacer                  | 24. Plug "O" Ring          |
| 5. Linkage Bracket            | 15. Check Valve Ball        | 25. Spool Plug             |
| 6. Booster Cover              | 16. Accumulator Check Valve | 26. Snap Ring              |
| 7. Cover to Housing Seal      | 17. "O" Ring Seal           | 27. Piston Return Spring   |
| 8. Input Rod Seals            | 18. Piston Seal             | 28. Spring Retainer        |
| 9. Input Rod and Piston Assy. | 19. Booster Housing         | 29. Housing to Cover Bolts |
| 10. Spool Assembly            | 20. Tube Seat Inserts       |                            |

Fig. 5-2E--Power Booster Components (Typical)

11. Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from the housing. Remove the large seal ring from the groove in the cover; discard the seal.

12. Remove the input rod and piston assembly, and the spool assembly from the booster housing.

13. Remove the input rod seals from the input rod end, and the piston seal from the piston bore in the housing; discard the seals.

14. Remove the plunger, seat, spacer and ball from the accumulator valve bore in the flange of the booster housing. Remove the "O" ring from the seat; discard the "O" ring.

15. Thread a screw extractor into the opening in the check valve in the bottom of the accumulator valve bore, and remove the check valve from the bottom of the bore. Discard the check valve and "O" ring.

**NOTE:** Using a screw extractor damages the seat in the check valve. A new charging valve kit must be installed whenever the check valve is removed from the accumulator valve bore.

16. Use a 1/4" or a 5/16" spiral flute type screw extractor to remove the tube seats from the booster ports.

### Cleaning and Inspection

1. Clean all metal parts in a suitable solvent. Be careful to avoid losing small parts.

2. Inspect the valve spool and the valve spool bore in the booster housing for corrosion, nicks, scoring or other damage. Discoloration of the spool or bore, particularly in the grooves, is not harmful and is no cause for concern.

3. If the valve spool or the valve spool bore has nicks or scoring that can be felt with a fingernail, particularly on the lands, the entire booster should be replaced as an assembly.

**NOTE:** The clearance between the valve spool and the spool bore of the housing assembly is important. Because of this, the valve spool and the housing assembly make up a selective assembly (the valve spool is selected to match the spool bore).

4. Inspect the input rod and piston assembly for corrosion, nicks, scoring or excessive wear. If the piston is damaged, the input rod and piston assembly should be replaced.

5. Inspect the piston bore in the booster housing for corrosion, nicks, scoring or other damage. If the bore is

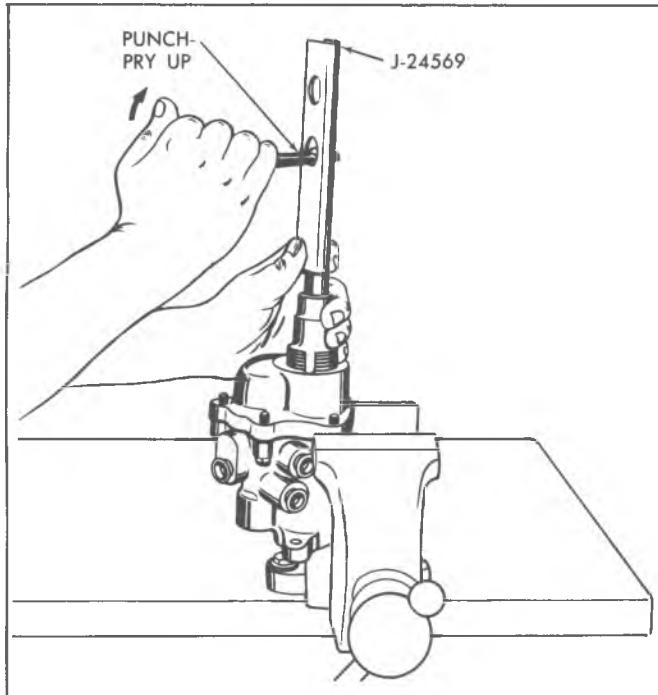


Fig. 5-3E-Removing Booster Pedal Rod (Typical)

damaged, the entire booster must be replaced as an assembly.

### Assembly

**CAUTION:** Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.

Lubricate all seals and metal friction points with power steering fluid.

Whenever the booster is disassembled, all seals, tube inserts and bracket nut should be replaced. All of these parts are included in a seal kit. If any of the accumulator valve components are damaged or lost, replace all valve components (all are included in charging valve kit).

1. Position a **NEW** tube seat in each booster port and screw a spare tube nut in each port to press the seat down into the port. Do not tighten the tube nuts in the port as this may deface the seats.

2. Remove the spare tube nuts and check for aluminum chips in the ports. Be sure that any foreign matter is removed.

3. Coat the piston bore and the piston seal with clean power steering fluid, and assemble the **NEW** seal in the bore. The lip of the seal must be toward the rear (away from the master cylinder mounting flange). Be sure the seal is fully seated in the housing.

4. Lubricate the input rod end, **NEW** input rod seals and Seal Installer Tool J-24553 with clean power steering fluid. Slide the seals on the tool with the lip of the cups toward the open end of the tool (fig. 5-4E).

5. Slide the tool over the input rod end and down to the second groove; then slide the forward seal off the tool and into the groove. Assemble the other seal in the first groove. Be sure that both seals are fully seated.

6. Lubricate the piston and Piston Installing Tool J-24551 with clean power steering fluid. Insert the large end of the tool into the piston (fig. 5-5E), and slide the tool and piston into the piston bore and through the piston seal.

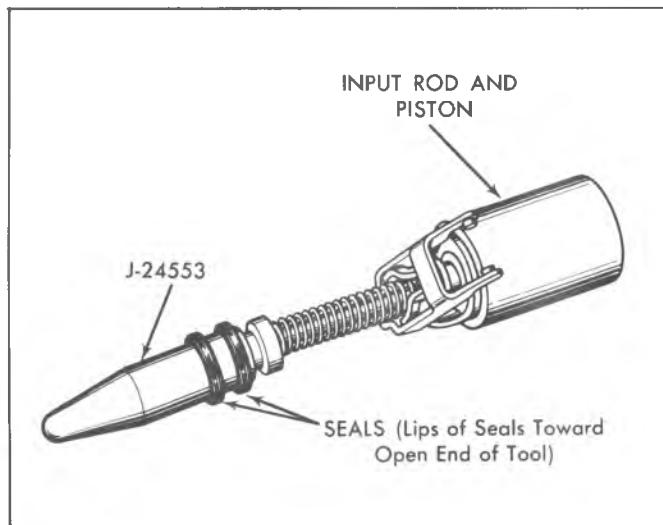


Fig. 5-4E--Installing Input Rod Seals

7. Assemble the **NEW** "O" ring onto the **NEW** accumulator check valve, and dip the assembly in clean power steering fluid. Insert the check valve into the accumulator valve recess in the housing flange.

8. Assemble the new ball and spacer in the same recess.

9. Assemble the **NEW** "O" ring onto the charging valve plunger seat and insert the plunger into the seat. Dip the assembly in clean power steering fluid, and insert it into the charging valve recess.

10. Dip the spool assembly in clean power steering fluid, and insert the assembly into the spool bore in the housing. Be sure that the pivot pins on the upper end of the input rod lever assembly are engaged in the groove in the sleeve. Remove Tool J-24551 from the piston assembly.

11. Position a **NEW** housing seal in the groove in the housing cover. Then join the booster housing and cover and secure with five screws. Tighten the screws to 18-26 ft. lbs. using Special Socket J-25085.

**CAUTION:** See "Caution" on Page 1 of this section.

12. Assemble a **NEW** "O" ring seal on the spool plug. Insert the spool spring and the spool plug in the forward end

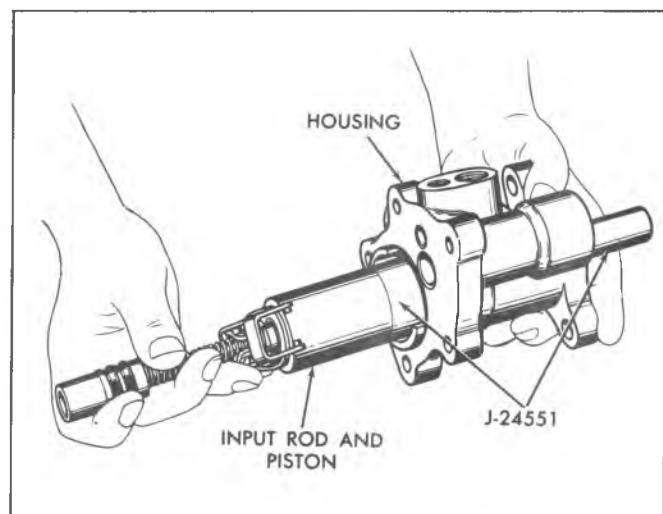


Fig. 5-5E--Installing Input Rod and Piston Assembly into Booster (Typical)

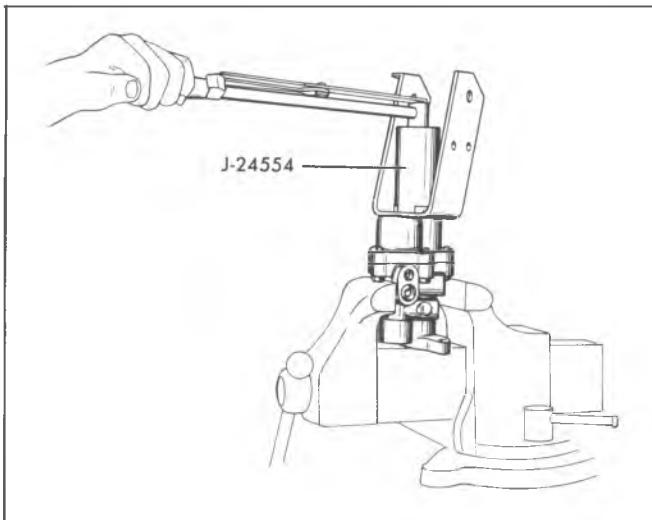


Fig. 5-6E--Installing Mounting Bracket Nut

of the spool bore. Press in on plug and assemble the plug snap ring in the groove in the bore.

13. Position the mounting bracket on the booster. The tab on the inside diameter of the large hole in the bracket should fit into a slot in the threaded portion of the booster hub.

14. Install the **NEW** bracket nut with the staking groove outward on the threaded hub of the booster. Using Tool J-24554 and a torque wrench (fig. 5-6E), tighten the nut to 95-120 ft. lbs.

**CAUTION:** See "Caution" on Page 1 of this section.

15. Use a hammer and a small punch inserted into the staking groove of the nut, at the slot in the booster hub (fig. 5-7E), to stake the nut in place. Be sure that the outer thread of the nut is upset.

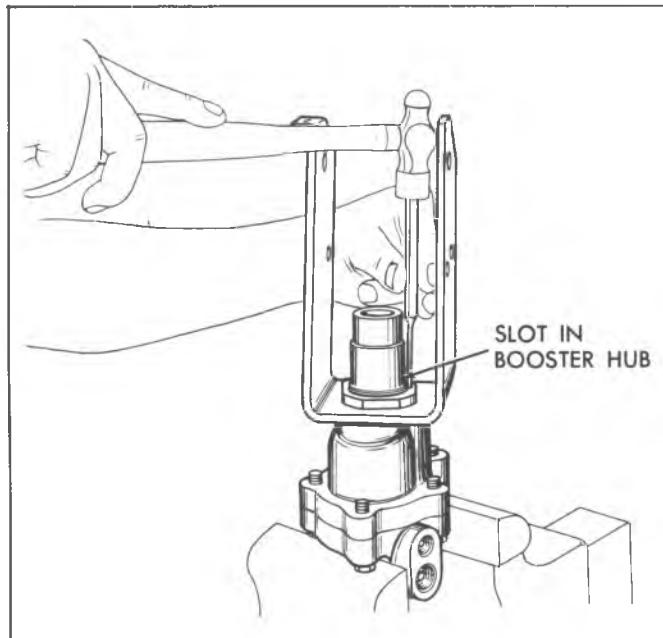


Fig. 5-7E--Staking Mounting Bracket Nut

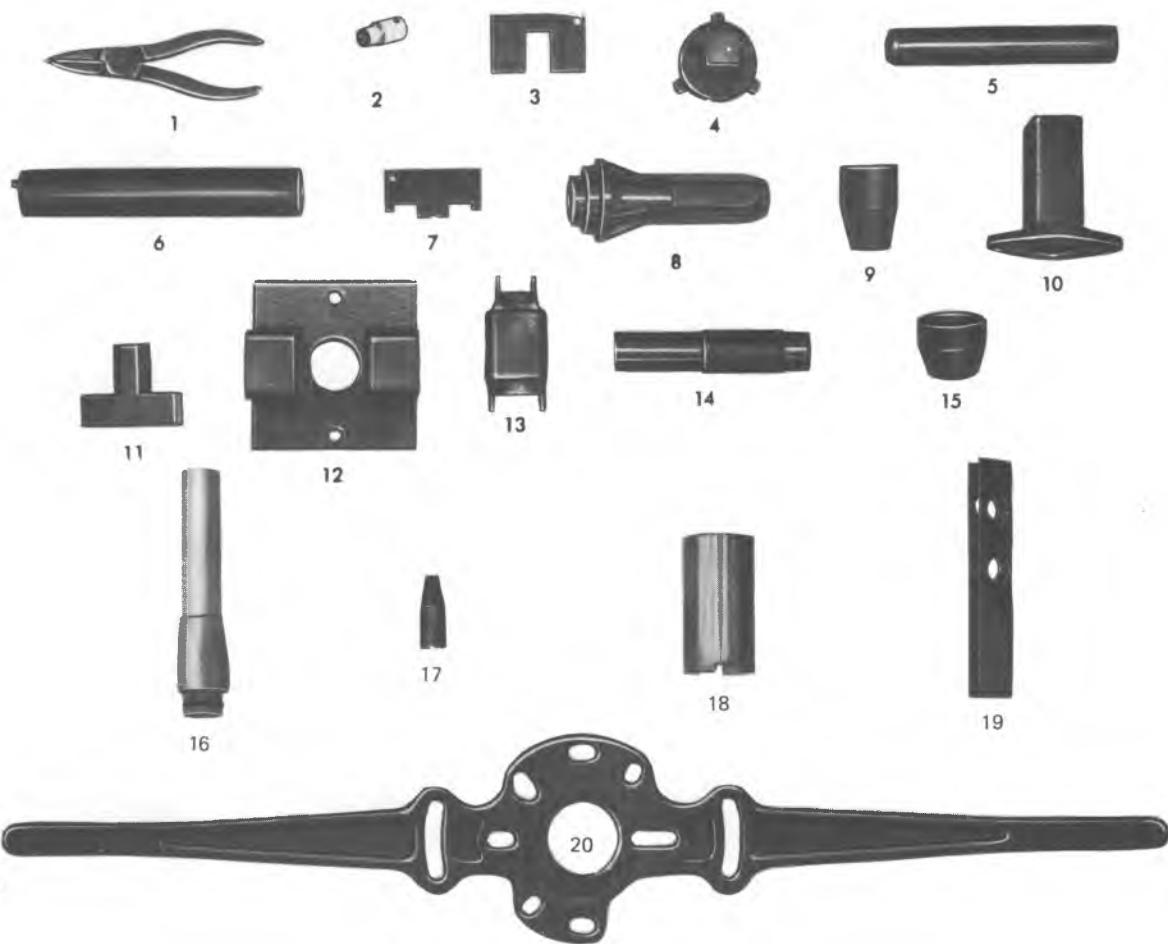
16. Assemble a **NEW** boot (if used) on the pedal rod. Then assemble a **NEW** grommet in the groove near the end of the pedal rod.

17. Moisten the grommet with water (to ease assembly), and insert the grommet end of the pedal rod into the input rod end of the booster housing. Push on the end of the pedal rod to seat the grommet in the groove inside the housing.

**NOTE:** When the grommet is fully seated, the pedal rod will rotate freely with no binding.

18. Slide the boot on the pedal rod and assemble the large end of the boot onto the hub of the power section.

## SPECIAL TOOLS



- |             |                                    |             |                               |
|-------------|------------------------------------|-------------|-------------------------------|
| 1. J-4880   | Snap Ring Pliers                   | 11. J-22839 | Front Plate Holding Fixture   |
| 2. J-25085  | Special Socket                     | 12. J-22893 | Booster Separating Adapter    |
| 3. J-21183  | Height Gauge                       | 13. J-23101 | Power Piston Holding Tool     |
| 4. J-21524  | Power Piston Remover and Installer | 14. J-23175 | Control Valve Installer       |
| 5. J-21601  | Power Brake Retainer and Installer | 15. J-23188 | Secondary Bearing Protector   |
| 6. J-22657  | Bushing Retainer Socket            | 16. J-24551 | Piston Installer              |
| 7. J-22647  | Height Gauge                       | 17. J-24553 | Input Rod Seal Installer      |
| 8. J-22677  | Power Cylinder Seal Installer      | 18. J-24554 | Socket                        |
| 9. J-22733  | Seal Installer and Protector       | 19. J-24569 | Pedal Push Rod Remover        |
| 10. J-22805 | Power Cylinder Holding Fixture     | 20. J-9504  | Power Cylinder Spanner Wrench |

Fig. 5-8E--Special Tools



## SECTION 6C

# CARBURETOR

ALL NEW 1977 CHEVROLET'S ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

### CONTENTS OF THIS SECTION

Introduction .....	6C-1
Model 1ME Carburetor .....	6C-1
Model 2GC/2GV Carburetor .....	6C-7
Model M4MC/M4ME Carburetor .....	6C-13
Model 4MV Carburetor .....	6C-22
Special Tools.....	6C-28

### INTRODUCTION

A carburetor is designed to meet the particular requirements of the engine, transmission and vehicle and although they may look alike, they are not always interchangeable. Refer to carburetor part number and/or specifications.

This section, divided into sub-sections by carburetor model, covers the repair procedures for the various carburetors, assembly and disassembly procedures and internal carburetor adjustment. Although illustrations showing bench operations are used, most single operations,

when not part of a general overhaul, should be performed (if practical) with the carburetor on the engine. Typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

Refer to Passenger Car or Light Duty Truck Service Manual Section 6C for external carburetor adjustment procedures.

### MODEL 1ME CARBURETOR

#### **DISASSEMBLY**

Place carburetor on a holding fixture to prevent damage to throttle valve (Fig. 6C-1 and 2).

#### **Air Horn**

##### **Removal**

1. Remove choke vacuum break diaphragm hose.
2. Remove vacuum break diaphragm assembly from air horn by removing two attaching screws. These screws have a tapered head and do not use lockwashers. Remove diaphragm plunger stem from diaphragm to choke lever link. (Fig. 6C-3).

**CAUTION:** Screw that retains vacuum break lever to choke shaft is installed with thread torque retaining compound. It is not necessary to remove this screw and lever unless choke shaft replacement is required.

3. Remove fast idle cam attaching screw; then remove fast idle cam (Fig. 6C-4).

Remove choke rod from choke coil lever on end of choke shaft.

4. Remove electric thermostatic coil assembly from

choke housing by removing (3) screws and retainers.

5. Choke coil housing need not be removed from float bowl unless replacement is necessary. To remove choke housing, remove three attaching screws from float bowl. Two screws have lockwashers and the one facing the choke housing has a tapered head for locating choke housing.

6. Remove four remaining air horn to bowl attaching screws and lockwashers (three long and one short screw).

7. Remove air horn by lifting and twisting back towards choke housing so that the choke coil lever link will disengage from the choke coil lever at the choke housing, invert and place on clean bench. Air horn to float bowl gasket can remain on bowl for removal later (Fig. 6C-5).

#### **Disassembly**

1. If required, the choke valve and choke shaft can be removed from air horn by removing the screw that retains the vacuum break lever to the choke shaft. Care should be exercised when removing this screw because it is retained in place by thread torque retaining compound. Remove the two attaching screws from the choke valve, then, remove the choke valve and choke shaft from air horn.

**NOTE:** The choke valve screws are staked in place so

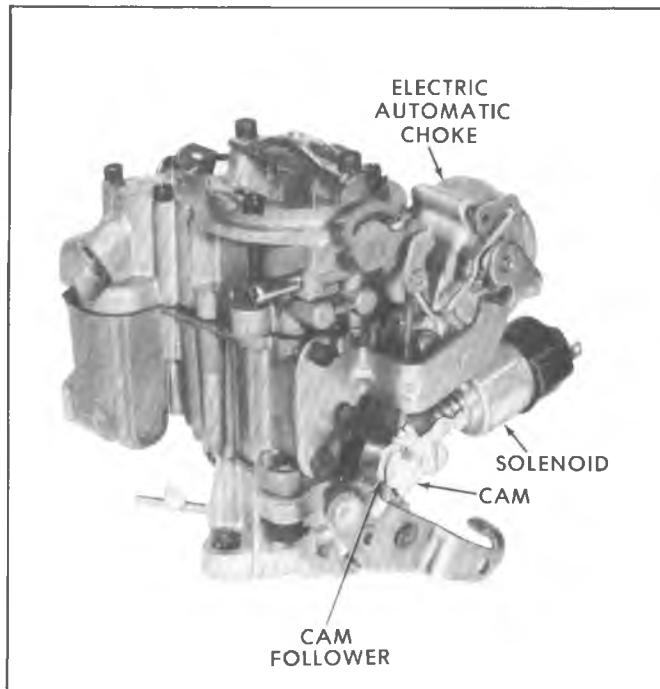


Fig. 6C-1—Model 1ME Carburetor-Rear View

it will be necessary to file off staking and re-stake during assembly.

**CAUTION:** *Do not bend choke shaft when restaking.*

2. No further disassembly of the air horn is necessary.

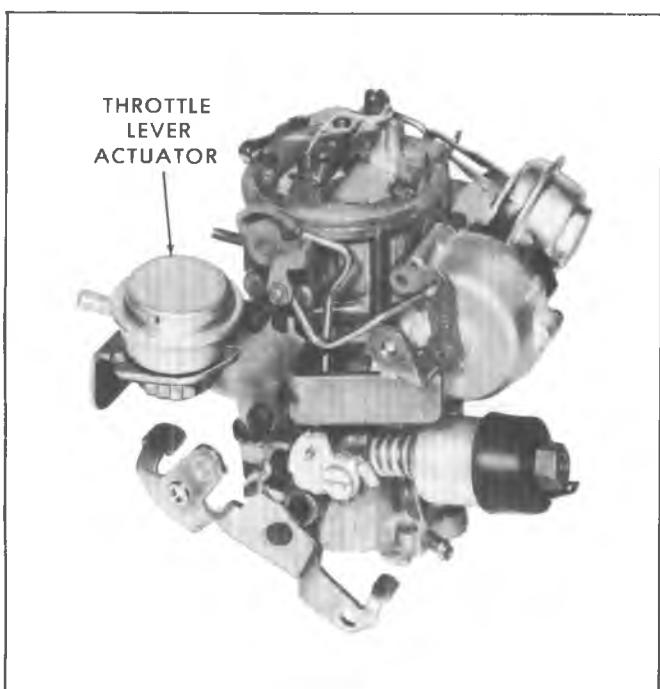


Fig. 6C-2—Model 1ME Carburetor-H.D. Emissions, Cal.

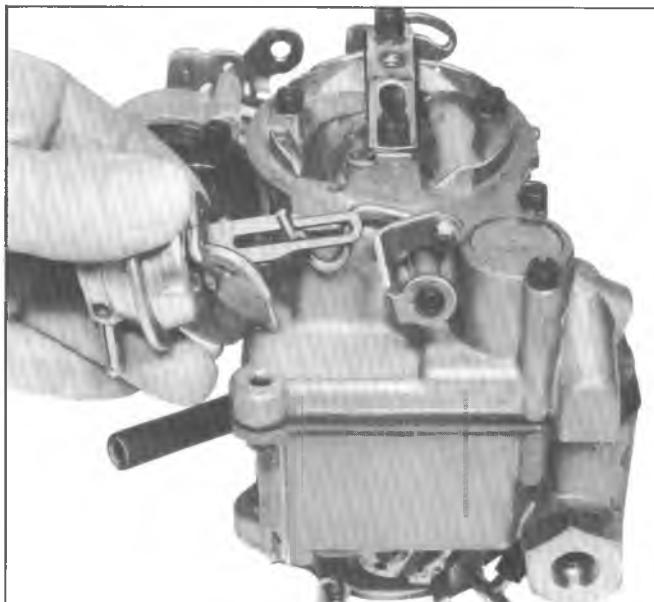


Fig. 6C-3--Vacuum Break Diaphragm

### Float Bowl Disassembly

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal. (Fig. 6C-6).
2. Remove float assembly from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.
3. Remove float needle from seat.
4. Disconnect accelerator pump and power piston actuator lever from end of throttle shaft by removing lever attaching screw (Fig. 6C-7).
5. Hold down on power piston while removing lever. Power piston spring and metering rod assembly may now be removed from float bowl (Fig. 6C-8).
6. Remove lower end of power piston link from actuator lever by rotating until tang on rod slides out of notch in lever.
7. Remove actuator lever from lower end of accelerator

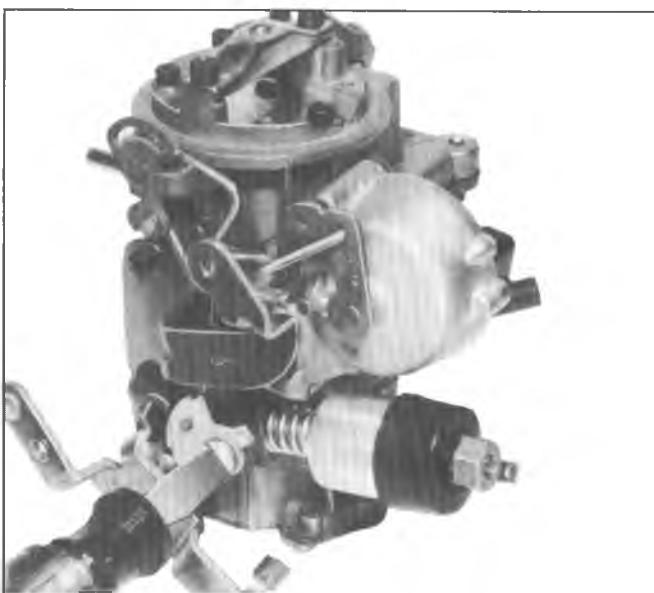


Fig. 6C-4--Fast Idle Cam



Fig. 6C-5--Air Horn Removal

pump link in same manner.

8. Push down on accelerator pump and remove actuator link by rotating until tang on rod aligned with slot on pump plunger lever. Remove the link.

9. Remove pump assembly from float bowl (Fig. 6C-9).

10. Remove pump return spring and power piston spring from float bowl (Fig. 6C-9).

11. Remove "T" guide and pump discharge spring using needle nose pliers (Fig. 6C-10).

12. Pump discharge ball and idle tube can be removed

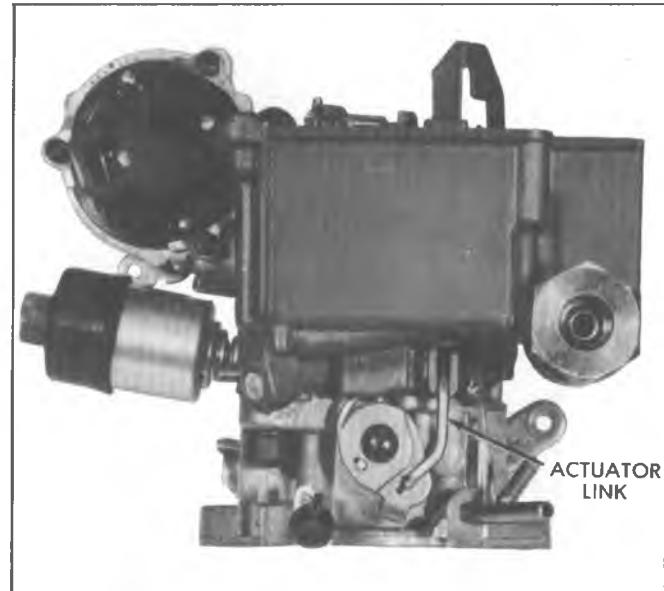


Fig. 6C-7--Pump and Power Piston Actuator Lever

at the same time by inverting the bowl.

13. Remove main metering jets from bottom of fuel bowl.

14. Remove float needle seat and gasket using Tool J-22769.

15. The idle stop solenoid can be removed at this time if desired.

16. Remove the fuel inlet nut, filter and spring (Fig. 6C-11).

No further disassembly of the float bowl is required.

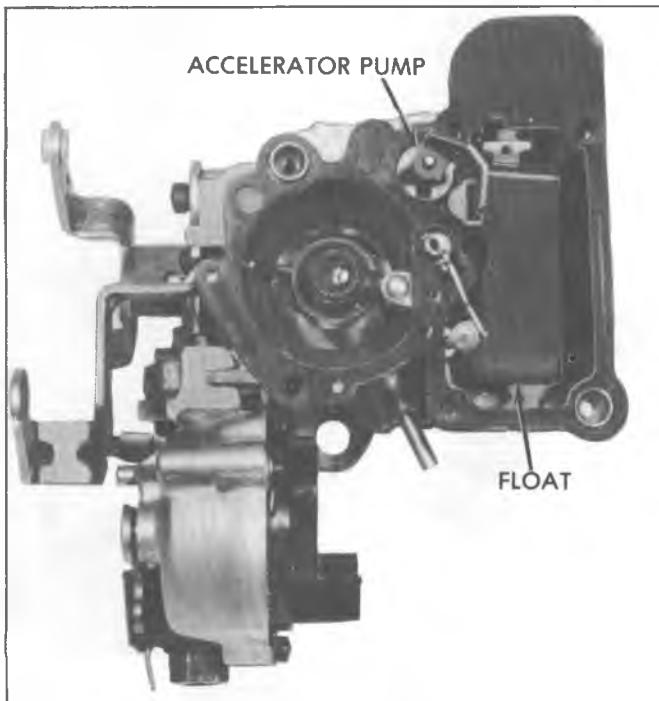


Fig. 6C-6--Float Bowl Disassembly

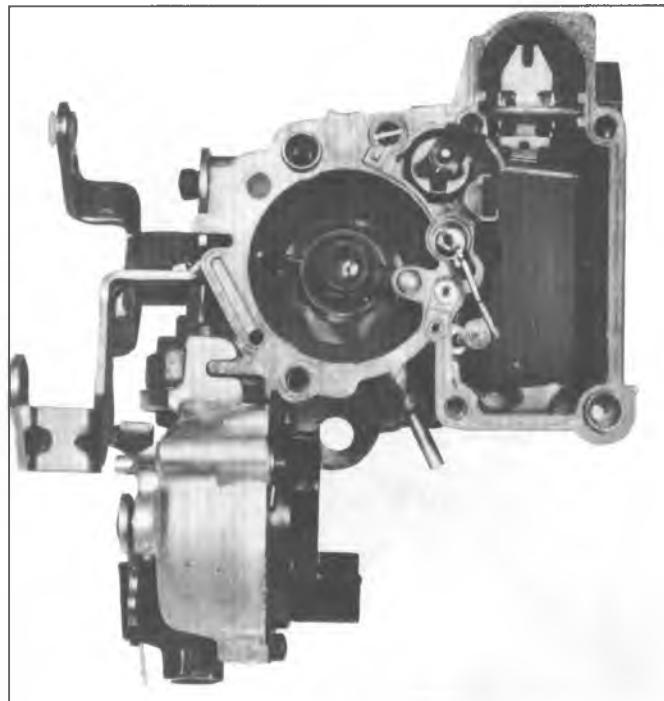


Fig. 6C-8--Float Bowl Assembly

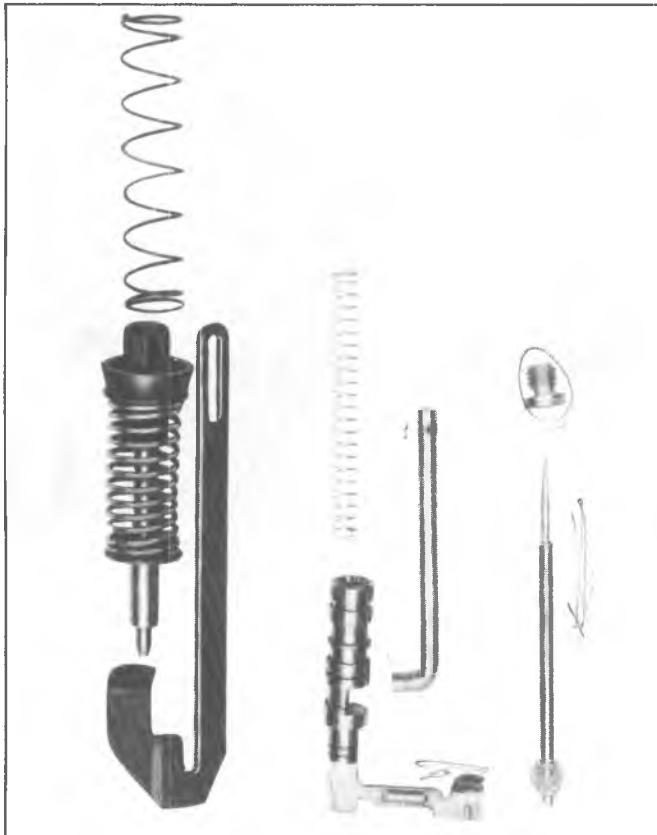


Fig. 6C-9--Metering Rod and Accelerator Pump

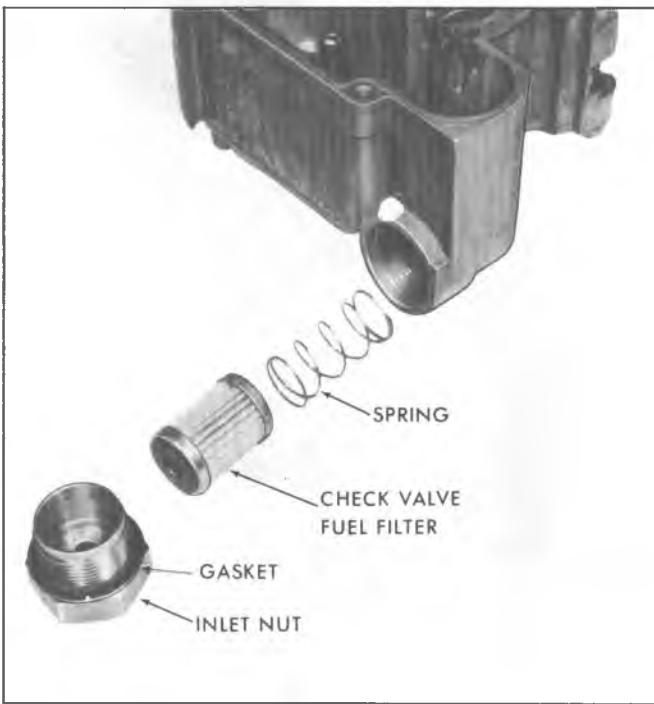


Fig. 6C-11--Fuel Filter and Check Valve

### Throttle Body (Fig. 6C-12)

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed.
2. No further disassembly of the throttle body is necessary unless the idle mixture needle is damaged or the idle channels need cleaning. If necessary to remove the idle mixture needle, cut the tang from the plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

**NOTE:** Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the throttle valve or shaft.

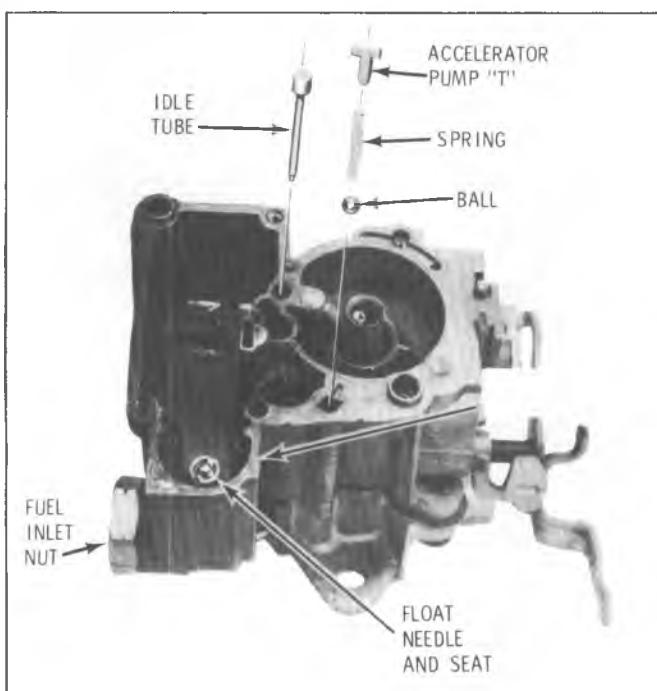


Fig. 6C-10--Pump Discharge "T" Retainer

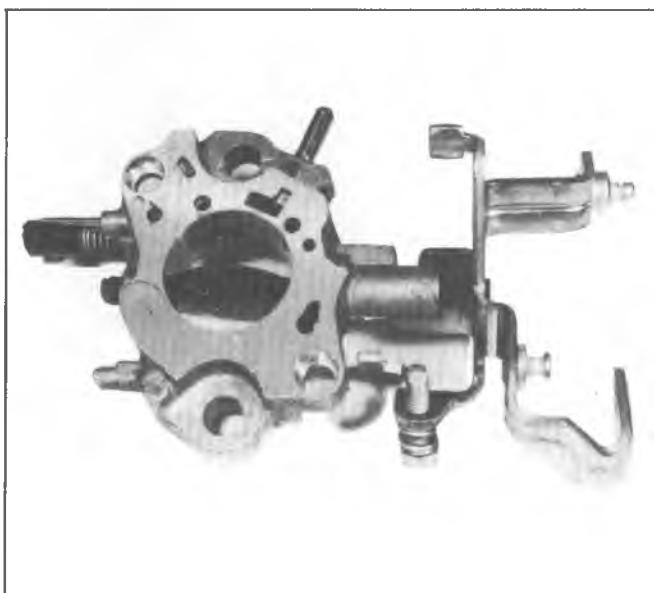


Fig. 6C-12--Throttle Body

## CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon X (X-55) or equivalent.

**NOTE:** Rubber and plastic parts should not be immersed in carburetor cleaner. However, the air horn which has the plastic relief valve will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.

4. Inspect upper and lower casting sealing surfaces for damage.

5. Inspect holes in levers for excessive wear or out of round condition. If levers are worn they should be replaced.

6. Examine fast idle cam for excessive wear or damage.

7. Check throttle and choke levers and valve for binds and other damage.

8. Check all springs for distortion or loss in tension; replace as necessary.

**NOTE:** When carburetor has been disassembled, new gaskets and filter must be used.

## CARBURETOR ASSEMBLY

### Throttle Body (Fig. 6C-12)

1. If removed, install idle mixture needle and spring into throttle body until lightly seated. Back out two turns as a preliminary adjustment. Final idle mixture adjustment will be made on vehicle.

2. Invert float bowl and install new throttle body to bowl insulator gasket.

3. Install throttle body on bowl gasket so all holes in throttle body are aligned with holes in gasket.

4. Install two throttle body to bowl attaching screws and lockwashers. Tighten even and securely to 20 N.m (15 ft. lbs.).

### Float Bowl

1. Install fuel filter spring, filter, and check valve assembly, (if used), inlet nut and gasket rubber seal on check valve faces fuel inlet nut.

**CAUTION:** The fuel inlet check valve must be installed (where required) in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter include the check valve, where required.

2. Install idle stop solenoid and spring, if removed. Adjust later for correct idle speed.

3. Install main metering jet into bottom of fuel bowl. Tighten securely.

4. Using wide blade screwdriver install needle seat and gasket.

5. Install idle tube flush with bowl casting.

6. Install pump ball, spring and "T" into pump discharge hole (Fig. 6C-10).

7. Drive pump discharge "T" in until flush with bowl casting.

8. Install accelerator pump return spring.

9. Install power piston return spring into piston cavity in the bowl.

10. Install lower end of pump link into actuator lever

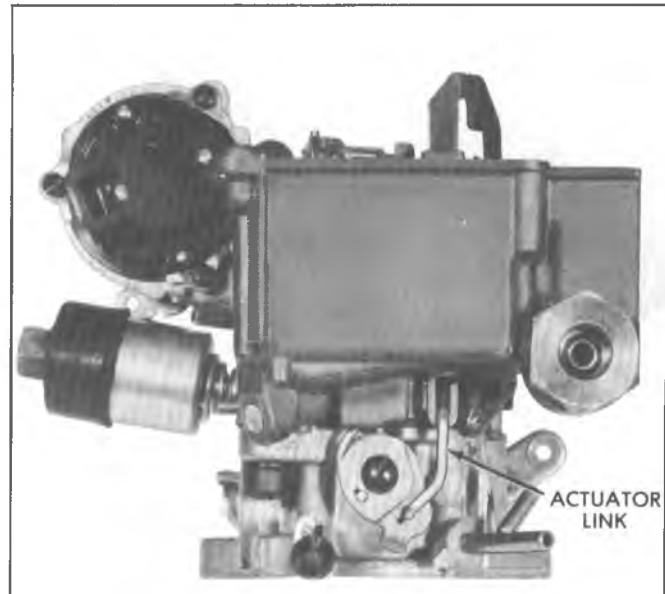


Fig. 6C-13--Pump Drive Link

which fits on throttle shaft. Ends of link point toward carburetor. Bend in link faces fuel inlet nut.

11. Install curved power piston actuator link into throttle actuator lever. End protrudes outward away from throttle bore and has tang which retains link to lever.

12. Install pump plunger assembly into pump well with actuating lever protruding through bottom of bowl casting. Push downward on pump lever and install pump assembly drive link into slot in lower end of shaft. Tang on upper end of link retains link to pump shaft (Fig. 6C-13).

13. Assembly metering rod to holder on power piston. Spring must be on top of arm when assembled correctly. Then install power piston actuating rod (right angle end) into slot in the power piston.

14. Install power piston, metering rod and drive rod assembly into the float bowl. End of drive rod must enter hole in bowl and end of metering rod into jet.

15. Before fastening power piston and pump actuator lever to end of throttle shaft, hold power piston assembly down and slide upper end of curved power piston actuator link into lower end of power piston actuating rod.

16. Install actuating lever on end of throttle shaft by aligning flats or lever with flats on shaft. Install lever retaining screw and tighten securely.

17. Install float needle valve on to float arm hooking pull clip over edge of float arm.

18. Install float hinge pin into float arm. Install float needle into seat and float with hinge pin into float bowl. Hinge pin should in locating channels in float bowl.

### Float Level Adjustment (Fig. 6C-14)

1. Hold float retaining pin firmly in place push down on float arm at outer end against top of float needle, as shown.

2. Use adjustable "T" scale and measure distance from top of float at index point on toe to float bowl gasket surface (gasket removed).

3. To adjust, bend float pontoon up or down at float arm junction.

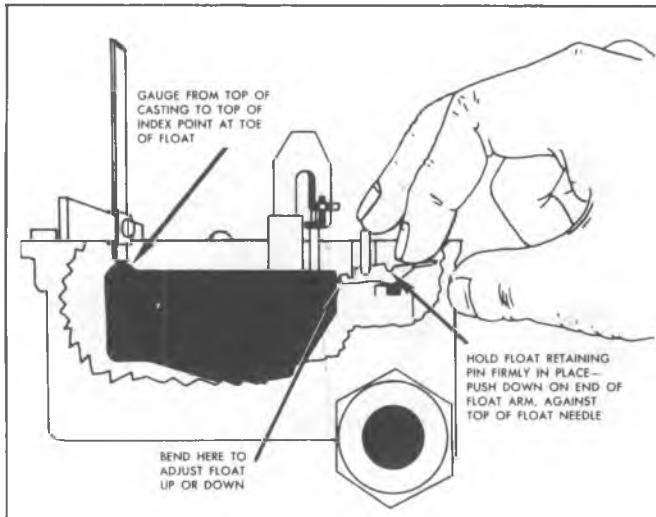


Fig. 6C-14--Float Level Adjustment

**Metering Rod Adjustment (Fig. 6C-15)**

1. Open throttle valve, slide metering rod out of holder and remove from main metering jet.
2. To check adjustment, back out 1/8" hex screw on idle stop solenoid and rotate fast idle cam so that cam follower is not contacting steps on cam.
3. With throttle valve completely closed, apply pressure to top of power piston and hold piston down against stop.
4. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting next to carburetor bore.
5. Insert gauge between bowl casting and lower surface of metering rod holder. Gauge should have a slide fit between both surfaces, as shown.
6. To adjust, carefully bend metering rod holder up or down.
7. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and

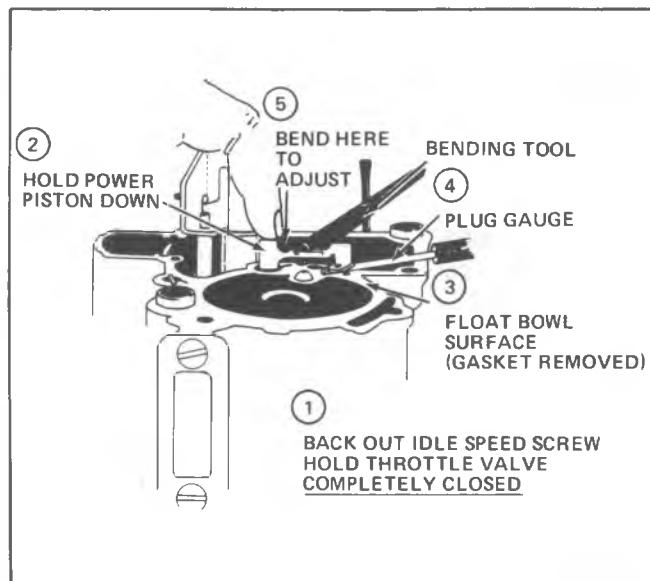


Fig. 6C-15--Metering Rod Adjustment

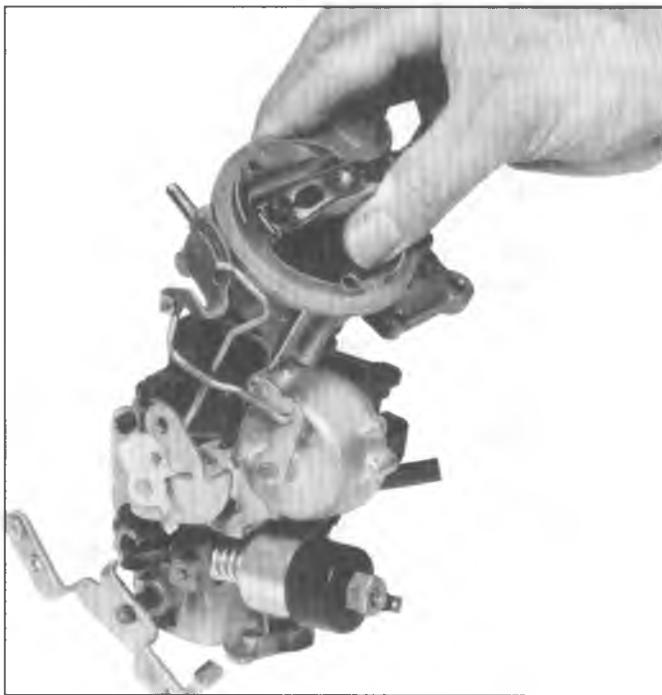


Fig. 6C-16--Installing Air Horn

press gasket firmly in place.

**Air Horn**

1. Install choke shaft assembly and choke valve into air horn, if removed. Align choke valve, tighten two retaining screws and stake securely in place.

**CAUTION:** Apply a torque retaining compound to the vacuum break lever retaining screw and install lever to choke shaft.

2. Install air horn to float bowl by engaging choke coil

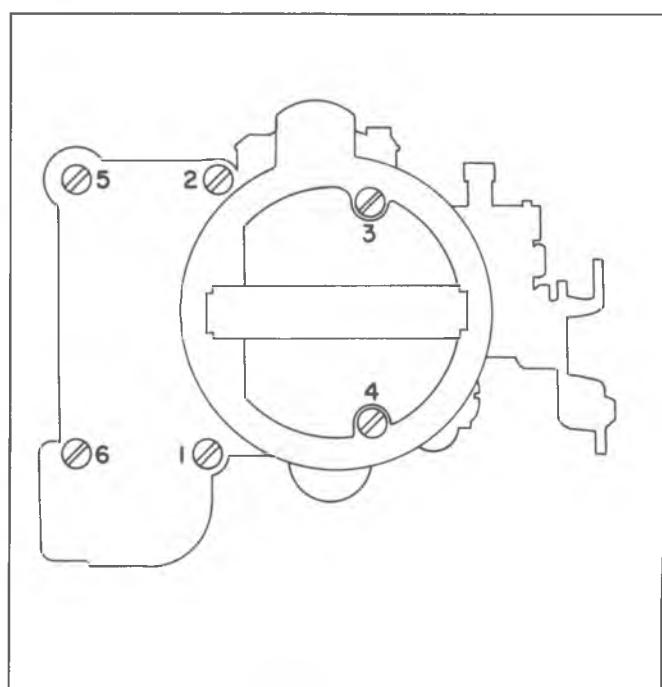


Fig. 6C-17--Tightening Sequence

lever link into notched hole in choke coil lever on choke housing. Then carefully twist and lower air horn onto float bowl. Install three long and one short air horn to float bowl attaching screws and lockwashers (Fig. 6C-16).

3. Install the choke vacuum break diaphragm assembly using two short air horn screws opposite the choke housing, connecting the choke vacuum break diaphragm link to slotted diaphragm plunger stem. The two attaching screws for the choke vacuum break assembly have tapered heads for locating choke diaphragm bracket. Make sure to use these in this location. Tighten all air horn screws evenly and securely using proper tightening sequence (Fig. 6C-17).

4. If removed, install choke housing to float bowl using three attaching screws. Two screws have lockwashers and the other one which face the choke housing has a tapered head

for locating choke housing.

5. Install fast idle cam, and fast idle cam link to upper choke lever assembly. Numbers on fast idle cam face outward.

6. Install electric choke coil assembly on choke housing. Install three retainers and attaching screws. Adjust using choke coil adjustment procedure.

**CAUTION:** *Do not use a gasket between electric coil and housing, as the coil is electrically grounded through housing.*

7. Install choke vacuum diaphragm hose to tube on diaphragm and connect to vacuum tube on bowl.

**NOTE:** Refer to Service Manual for the remaining adjustments.

## MODEL 2GC/2GV CARBURETOR

### DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates (Figs. 6C-18 and 19).

### Solenoid Assembly (If Used)

**CAUTION:** *The electrically operated solenoid should be removed from the float bowl for complete carburetor disassembly and should not be immersed in any type of carburetor cleaner.*

To remove the solenoid assembly, bend back the retaining tabs on lockwasher; then remove large nut which retains the stop solenoid to the carburetor bracket. It is not necessary to remove the bracket from the float bowl assembly unless replacement of the bracket is necessary.

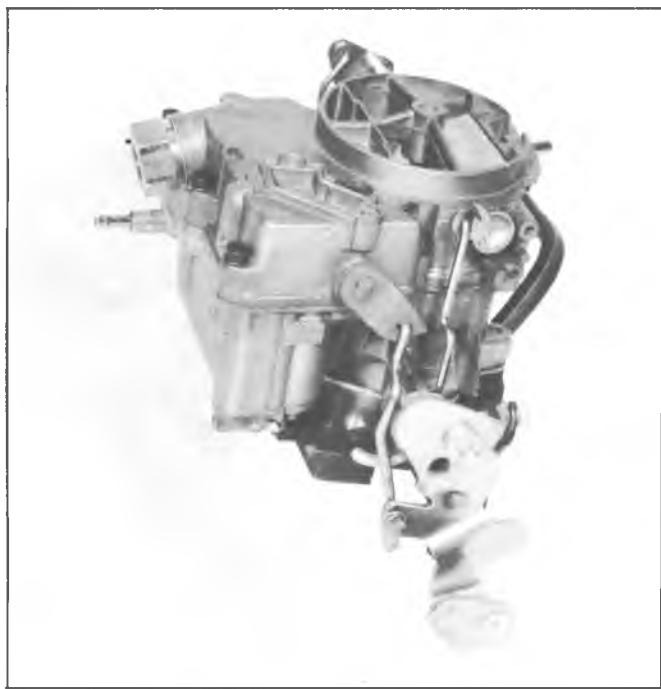


Fig. 6C-18—Model 2GC Carburetor

### Air Horn

1. Remove fuel inlet filter nut and gasket, and remove filter and spring.

2. Disconnect lower end of pump rod from throttle lever by removing spring clip (Fig. 6C-20).

3. Remove upper end of pump rod from pump lever by rotating rod out of hole in lever (Fig. 6C-21).

4. Remove the vacuum break diaphragm hose from tube on throttle body and tube on vacuum break diaphragm unit. Then remove the vacuum break diaphragm assembly from air horn by removing two attaching screws. Remove diaphragm and link assembly from lever on end of choke shaft.

5. Remove vacuum break lever from end of choke shaft by removing retaining screw in end of shaft (Fig. 6C-22). Then, remove the intermediate choke rod from the vacuum break lever and from the lever on the thermostatic coil housing (Fig. 6C-23).

6. Remove fast idle cam attaching screw from side of float bowl (Fig. 6C-23).

Remove fast idle cam from end of choke rod by rotating

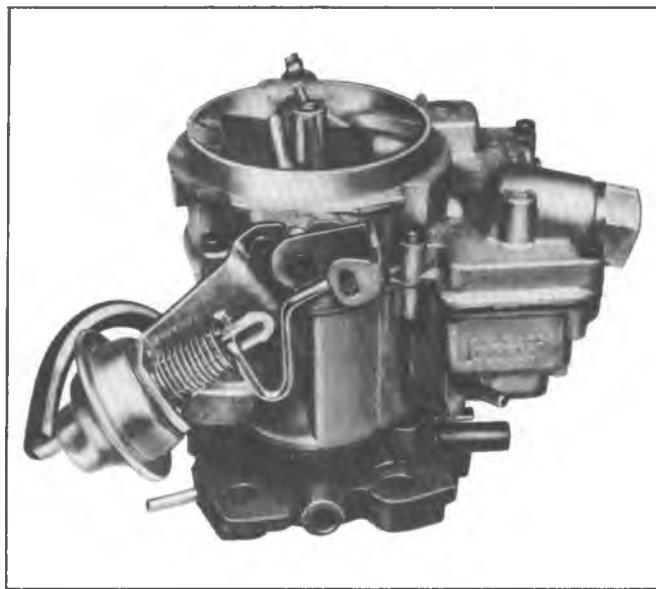


Fig. 6C-19—Model 2GV Carburetor

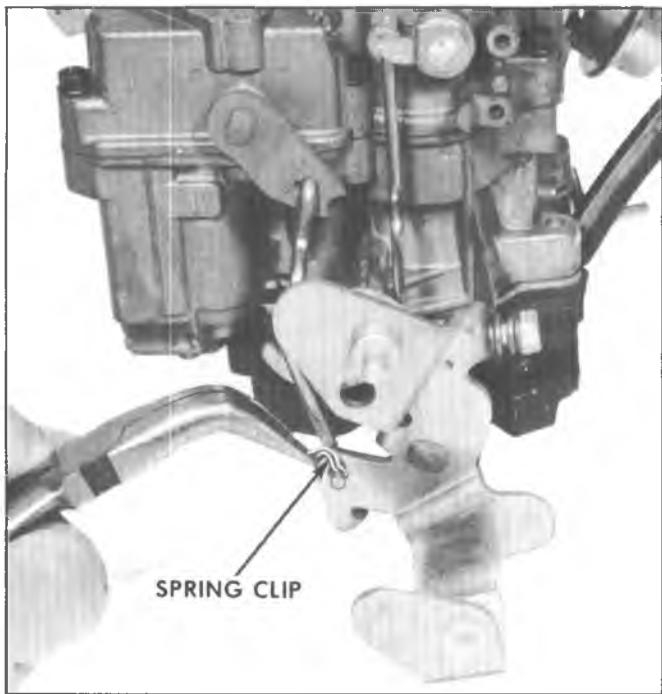


Fig. 6C-20--Removing Pump Rod Spring Clip

rod out of hole in fast idle cam. The upper end of the choke rod cannot be removed from the choke lever until after the air horn has been removed from the float bowl.

7. Remove eight air horn attaching screws and lockwashers, then lift air horn from float bowl. Rotate choke rod to remove upper end of rod from the choke shaft lever.

8. Place air horn on flat surface. Remove float hinge pin and lift float from air horn. Float needle may now be removed from needle seat or from float assembly (if pull-clip is used).

9. Remove float needle seat and gasket with a wide blade



Fig. 6C-22--Removing Vacuum Break Lever

screwdriver.

10. Remove power piston by depressing stem and allowing it to snap free (Fig. 6C-25). Use care not to bend the power piston stem.

11. Remove the pump plunger assembly and inner pump lever from pump shaft by loosening set screw on inner lever. To remove the pump plunger stem from the inner pump lever it will be necessary to break off the swedged or flattened end of the pump plunger stem. This should not be done unless pump assembly replacement is necessary, such as during

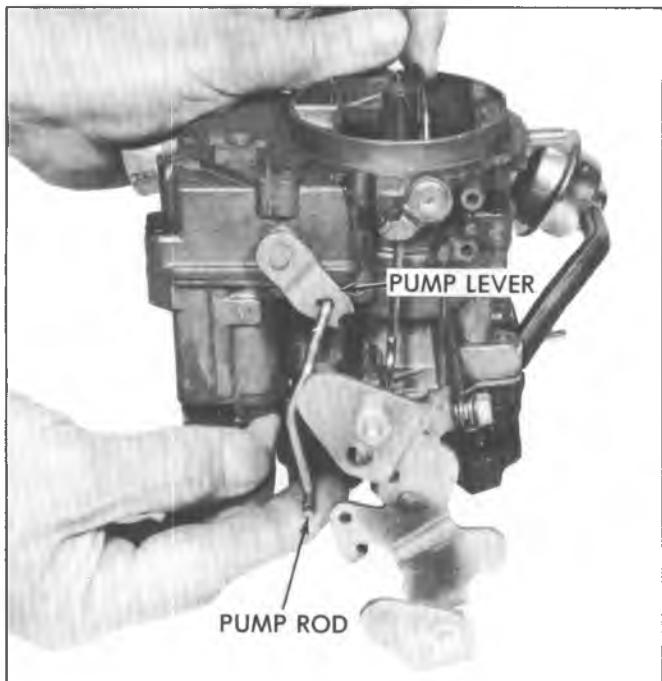


Fig. 6C-21--Removing Pump Rod

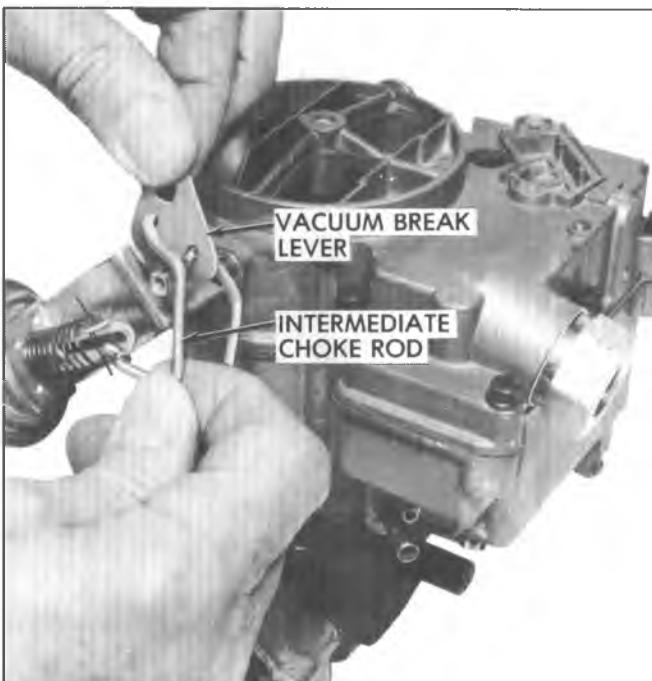


Fig. 6C-23--Removing Intermediate Choke Rod

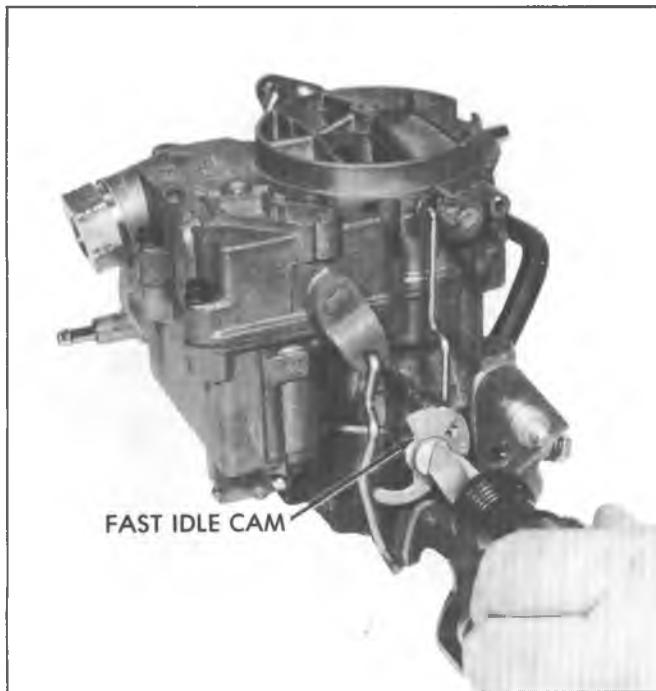


Fig. 6C-24--Removing Fast Idle Cam

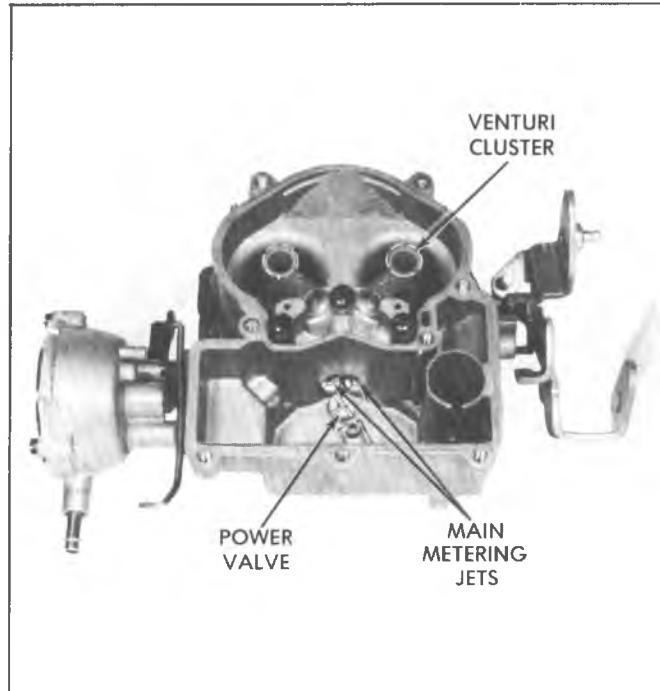


Fig. 6C-26--Float Bowl

overhaul. The service pump assembly uses a grooved pump plunger stem and retaining clip. After removing the inner pump lever and pump assembly, remove the outer pump lever and shaft assembly from air horn. Remove the plastic washer on pump plunger shaft.

12. Remove air horn gasket from air horn.
13. Remove fuel inlet baffle next to needle seat.
14. Remove two choke valve attaching screws, then remove choke valve. Care should be taken when removing attaching screws so that the choke shaft will not be bent. It

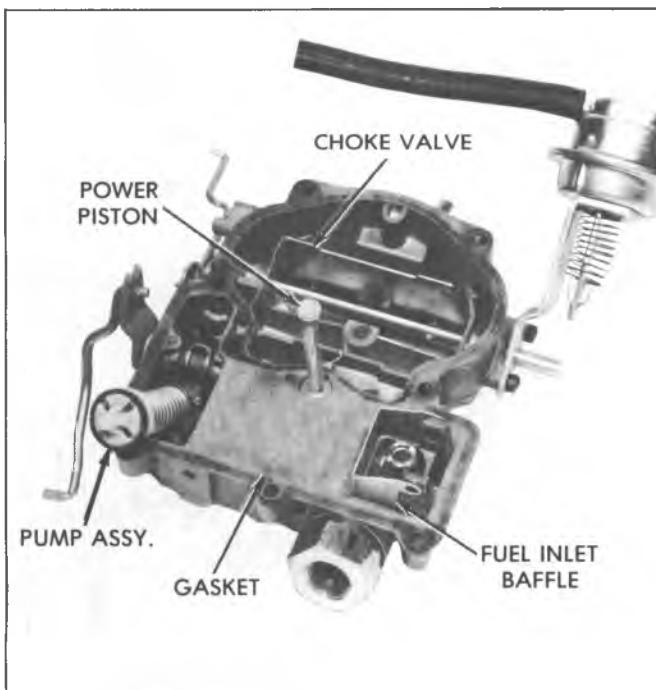


Fig. 6C-25--Power Piston

may be necessary to file off staked ends on choke valve screws before removing.

15. Remove choke valve shaft from air horn.

16. Remove the fast idle cam rod and lever from the choke shaft.

#### Float Bowl (Fig. 6C-26)

1. Remove pump plunger return spring from inside pump well (Fig. 6C-27). Then remove aluminum check ball from bottom of pump well by inverting bowl.

2. Remove main metering jets, power valve and gasket from inside float bowl.

3. Remove three screws holding venturi cluster to float bowl and remove cluster and gasket. Then remove the plastic main well inserts in the main well cavity (Fig. 6C-28).

4. Using a pair of long nosed pliers, remove pump discharge spring retainer (Fig. 6C-29). Then, spring and check ball may also be removed from discharge passage.

5. Invert carburetor and remove three large throttle body to bowl attaching screws and lockwashers (Fig. 6C-30). Throttle body and gasket may now be removed.

#### Throttle Body

1. Remove the three choke cover attaching screws and retainers, then remove thermostatic coil and cover assembly and gasket from choke housing (Fig. 6C-31).

**CAUTION:** Do not remove cup baffle from beneath thermostatic coil cover because coil distortion may result.

2. Remove baffle plate from inside choke housing (Fig. 6C-31).

3. Remove the two choke housing attaching screws from inside choke housing, then remove choke housing and gasket from throttle body casting (Fig. 6C-31).

4. Remove screw from end of intermediate choke shaft and remove intermediate choke lever from shaft. Remove inner choke coil lever and shaft assembly from choke housing. Remove rubber dust seal from inside choke housing.

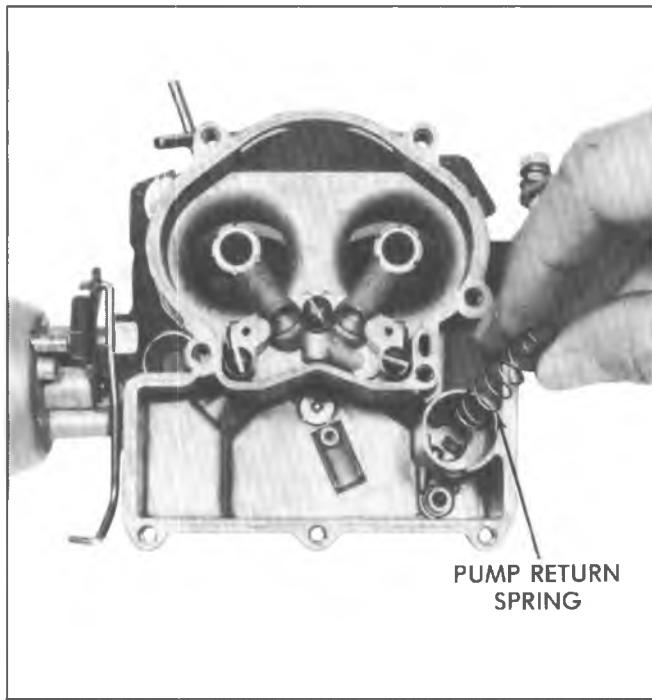


Fig. 6C-27--Removing Pump Return Spring

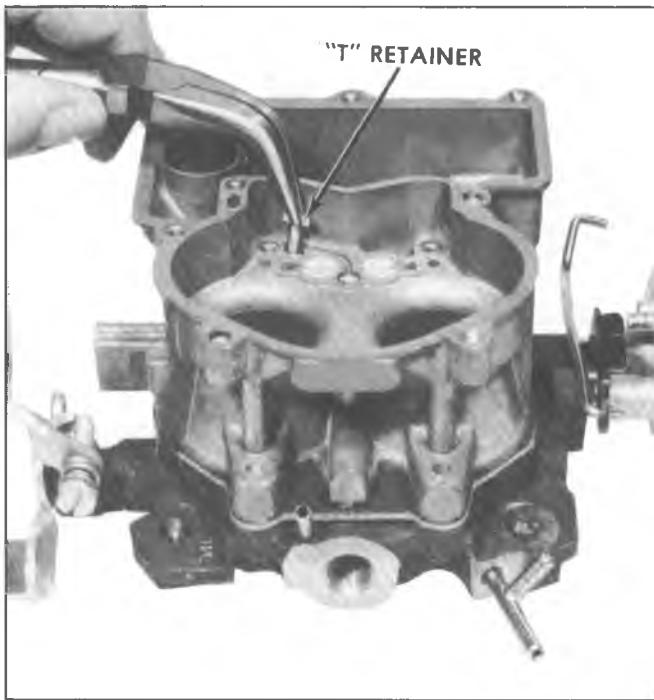


Fig. 6C-29--Pump Discharge "T" Retainer

5. The idle mixture needles have been adjusted and set at the factory and capped, to prevent excessive adjustment in the field. However, the carburetor has limited idle mixture adjustment. If it is necessary to remove the idle mixture needles for cleaning purposes or if they are defective, the following procedure should be used:

Using a pair of side cutter pliers, clip off the limit tang on the limiter cap, and unscrew the idle mixture screw and spring from throttle body. If new idle mixture needles are installed, no plastic limiter caps are required. If the original

idle mixture needles had to be removed, install the idle mixture needle and springs into throttle body as described under Assembly. No further disassembly of the throttle body is necessary.

**CAUTION:** *No attempt should be made to remove the throttle valves or shaft as it may be impossible to reassemble the throttle valves correctly in relation to the idle discharge orifices.*

#### CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

**CAUTION:** *The electric solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.*



Fig. 6C-28--Venturi Cluster Assembly

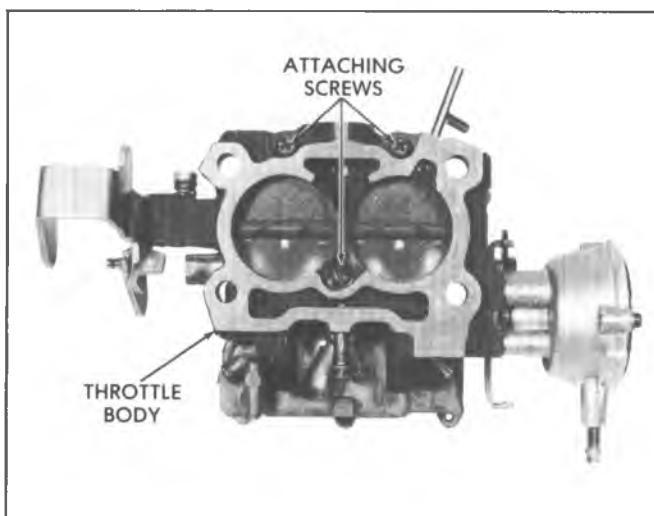


Fig. 6C-30--Throttle Body Attaching Screws

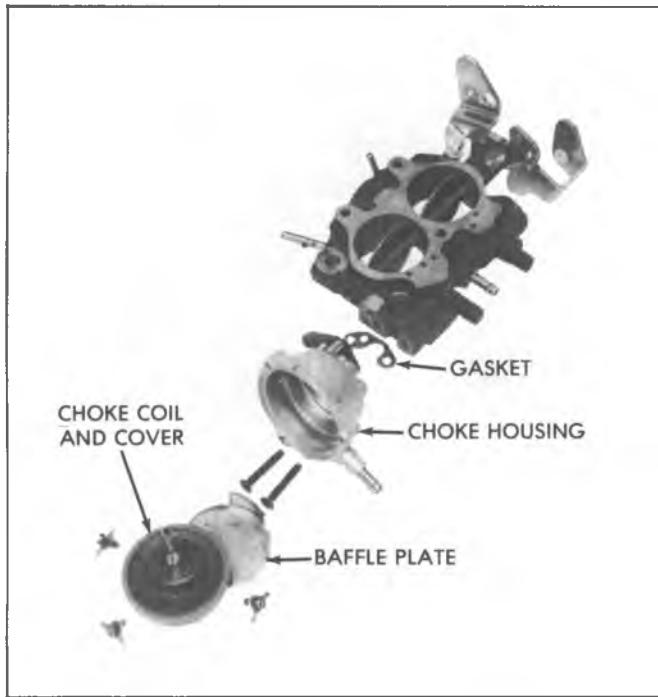


Fig. 6C-31--Choke Housing Assembly

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.
2. Check, repair or replace the following parts if the following problems were encountered.
  - a. Flooding
    1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.
    2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).
  - b. Hesitation
    1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.
    2. Inspect pump duration and return spring for being weak or distorted.
    3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.
    4. Check linkage for excessive wear, repair or replace as necessary.
  - c. Hard Starting - Poor Cold Operation
    1. Check choke valve and linkage for excessive wear, binds or distortion.
    2. Inspect choke vacuum diaphragm for leaks.
    3. Clean or replace carburetor filter.
    4. Inspect needle for sticking, dirt, etc.
    5. Examine fast idle cam for wear or damage.
    6. Also check items under "flooding".
  - d. Poor Performance - Poor Gas Mileage
    1. Power Piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.
    2. Clean all fuel and vacuum passages in castings.
  - e. Rough Idle
    1. Inspect idle needle for ridges, burrs or being bent.
    2. Inspect gasket mating surfaces on castings for damage to sealing bends, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

## ASSEMBLY

### Throttle Body

1. Install idle speed screw and spring assembly in throttle body if removed.

2. If it was necessary to remove the idle mixture needles, install the idle mixture needles and springs into the throttle body until finger tight and seated. Back out screws four turns as a preliminary idle adjustment.

3. Install new rubber dust seal into cavity inside choke housing. Lip on seal faces towards carburetor after the housing is installed.

4. Install inner choke coil lever and shaft assembly into choke housing.

5. With the choke coil lever and shaft assembly installed into housing, install the intermediate choke lever on flats of intermediate choke shaft and retain with screw. Tighten securely.

6. Install new choke housing to carburetor gasket.

7. Position choke housing on throttle body and retain with two attaching screws. Tighten securely.

8. Before installing the choke cover coil and baffle plate assembly, refer to intermediate choke rod adjustment (Service) to adjust intermediate choke rod so that with the choke valve closed, the lever inside the choke housing lines up with gauge.

9. Install choke thermostatic coil and cover assembly with new gaskets and end of coil below plastic tang on the inner choke housing lever. Refer to automatic choke coil adjustment (Service) to index cover. Install three choke thermostatic coil retainers and screws. Tighten securely.

10. Place a new gasket on the bottom of the float bowl with holes in gasket aligned with holes in casting, then position the throttle body on gasket and install the three attaching screws. Tighten screws evenly and securely.

### Float Bowl (Fig. 6C-32)

1. Install two main metering jets and vacuum operated power valve into bottom of float bowl. Tighten securely.

2. Drop small aluminum inlet check ball into hole in pump well.

3. Install pump return spring, pressing with finger to center in pump well.

4. Drop steel pump discharge ball into pump discharge hole located beneath the venturi cluster. Ball is 3/16" diameter (do not confuse with aluminum inlet ball). Install pump discharge ball spring and "T" retainer.

5. Install plastic main well inserts into the main fuel wells located beneath the venturi cluster and make sure they are seated in recesses provided. Then install venturi cluster and gasket, tighten three screws evenly and securely. Make certain center screw is fitted with a gasket to prevent pump discharge leakage.

### Air Horn

1. Install the upper choke rod lever and collar assembly on to choke shaft. Then install the choke shaft assembly into the air horn from the throttle lever side. Then install the choke valve onto the choke shaft with part number facing upward.

Install the choke valve attaching screws. Center the choke valve before tightening choke valve screws. Tighten

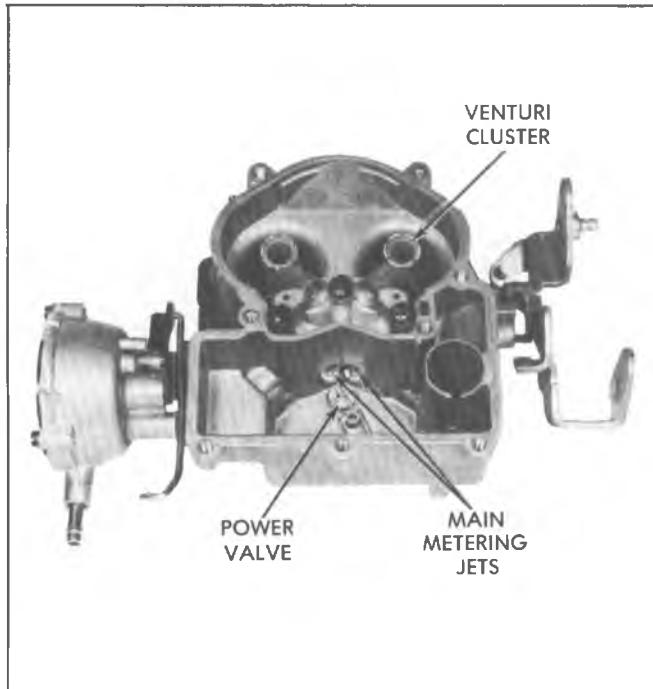


Fig. 6C-32--Float Bowl Assembly

choke valve screws and stake lightly in place. Check choke and shaft for freedom of movement.

2. If removed, install the outer pump shaft and lever assembly into air horn casting. Make sure the plastic washer is in place before installing the outer pump shaft and lever assembly.

3. Install the pump plunger to the inner lever and retain with clip provided in the repair kit. End of pump plunger shaft should point inward towards center of carburetor when installed correctly. Then install inner pump lever onto the pump shaft and tighten set screws securely.

4. Position the float needle seat gasket on the needle seat and install seat in the air horn. Tighten securely.

5. Install the power piston assembly into the air horn casting and lightly stake the retaining washer to casting. Make sure the piston travels up and down freely and is not bent.

6. Install fuel inlet baffle next to needle seat. Make sure baffle is seated in grooves in air horn casting.

7. Install air horn gasket onto air horn casting.

8. Install float needle into needle seat. On models with pull clip, install pull clip and needle in slot in float arm. Then install float assembly on air horn and insert hinge pin. Check float action and for free movement of needle in the seat.

9. Check float level and drop adjustments.

10. Install choke rod in upper choke lever and collar assembly rotating rod until tang on end of rod aligns with slot in lever.

### Air Horn to Float Bowl

1. Place the air horn assembly on bowl, making certain that the accelerator pump plunger is correctly positioned into pump well and will move freely.

2. Install lockwashers and tighten eight air horn attaching screws evenly and securely according to sequence

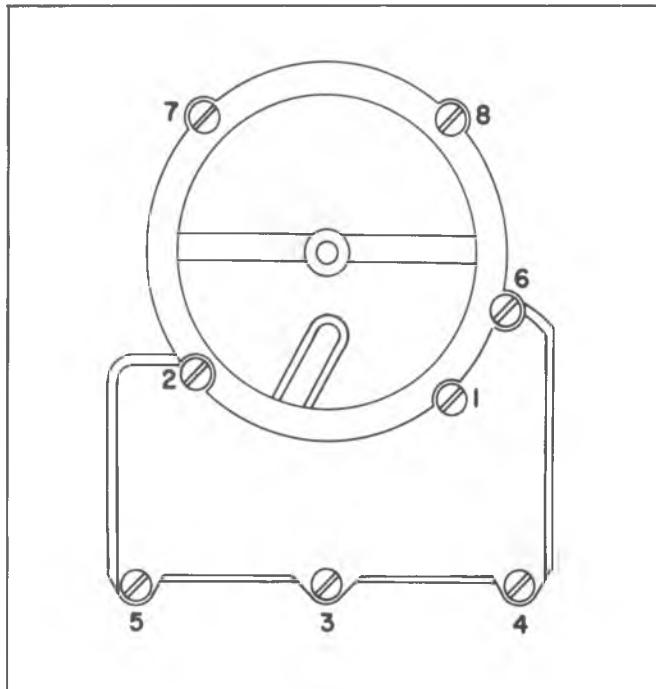


Fig. 6C-33--Air Horn Tightening Sequence

in Figure 6C-33.

3. Install filter spring into air horn casting, then install fuel inlet filter and fuel inlet nut and gasket. Tighten nut to 25 pound feet.

**CAUTION:** *The fuel inlet filter contains a check valve for a vehicle with light duty emission requirements to meet Motor Vehicle Safety Standards. Service replacement filter must contain check valve on these vehicles.*

4. Install fast idle cam to lower end of choke rod (part number or identification faces outward on fast idle cam assembly). Then install the fast idle cam to float bowl retaining with the fast idle cam attaching screw. Tighten securely.

Move linkage up and down to make sure that the cam will fall freely.

5. Install pump rod into upper pump lever by rotating offset end into hole in lever and install lower end of pump rod to throttle lever and retain with a spring clip.

6. Install vacuum break diaphragm assembly onto air horn with two attaching screws and tighten securely.

7. Install lower end of intermediate choke rod into intermediate choke lever on choke housing and connect upper end of rod to vacuum break lever. Install vacuum break diaphragm rod into stem of vacuum break diaphragm and vacuum break lever.

8. Install the vacuum break lever onto end of choke shaft making sure that the lever fits over flats on shaft. Install attaching screw and tighten securely.

9. Connect vacuum break hose to diaphragm unit and vacuum tube on throttle body.

After complete carburetor assembly, check and re-set (if necessary) all choke adjustments and pump rod adjustments.

## MODEL M4MC/M4ME CARBURETOR

### DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates (Figs. 6C-34 and 35).

#### Solenoid (If Equipped)

Remove screws securing the solenoid and bracket to float bowl and remove solenoid and bracket assembly.

**CAUTION:** The solenoid should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.

#### Air Horn

1. Remove upper choke lever from the end of choke shaft by removing retaining screw (Fig. 6C-36). Then rotate upper choke lever to remove choke rod from slot in lever.

2. Remove choke rod from lower lever inside the float bowl casting by holding lower lever outward with small screwdriver and twisting rod counterclockwise.

3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger. (Fig. 6C-37).

4. Using special tool J-25322, drive small roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever from pump rod (Fig. 6C-38).

**CAUTION:** Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.

5. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws). (Fig. 6C-39).

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later (Fig. 6C-40).

**CAUTION:** When removing air horn from float bowl, use care to prevent bending the small tubes



Fig. 6C-34--Model M4MC Carburetor

protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.

#### Air Horn Disassembly

Remove front vacuum break bracket attaching screws. The diaphragm assembly may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever (Fig. 6C-41).

**CAUTION:** Do not place vacuum break assembly in carburetor cleaner.

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:

1. Remove staking on two choke valve attaching screws, then remove choke valve and shaft from air horn.
2. Air valves and air valve shaft should not be removed.
3. If it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

#### Float Bowl

1. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the main metering rods (Fig. 6C-42).

2. Remove pump plunger from pump well.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free (Fig. 6C-43).

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

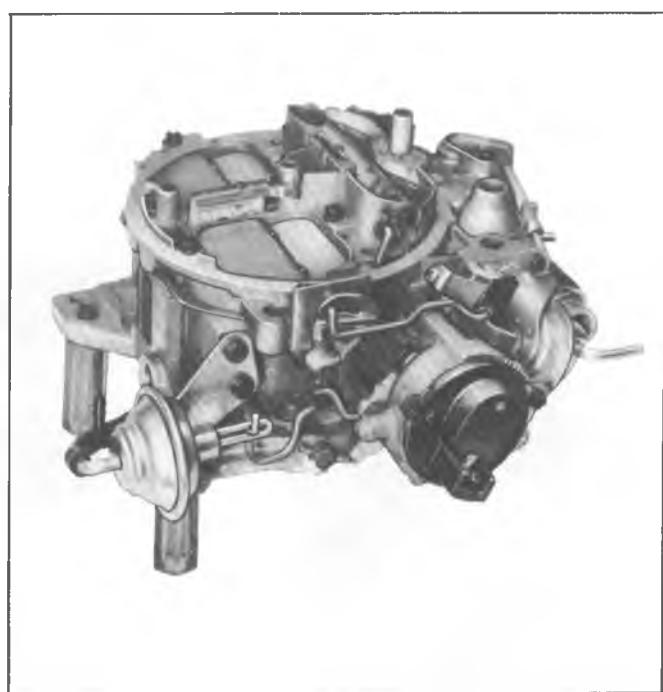


Fig. 6C-35--Model M4ME Carburetor

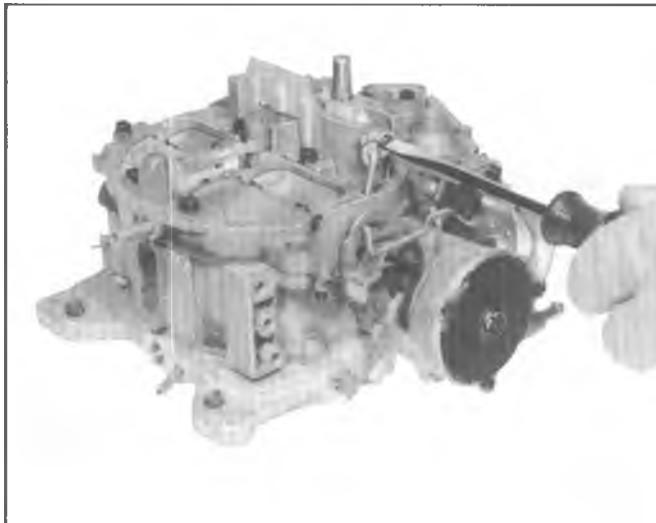


Fig. 6C-36--Removing Upper Choke Lever

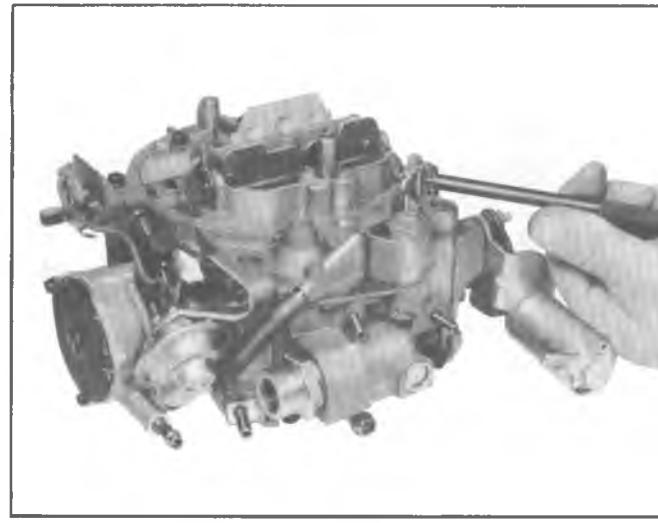


Fig. 6C-38--Removing Pump Lever

**CAUTION:** Do not remove power piston by using pliers on metering rod hanger.

Remove the power piston spring from the well.

**CAUTION:** The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in the field. If float bowl replacement is required during service, the new bowl assembly will be supplied with an A.P.T. metering rod screw which will be pre-set as required.

5. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C-44).

**CAUTION:** Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.

6. Remove plastic filler block over float valve.

7. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket. (Fig. 6C-45).

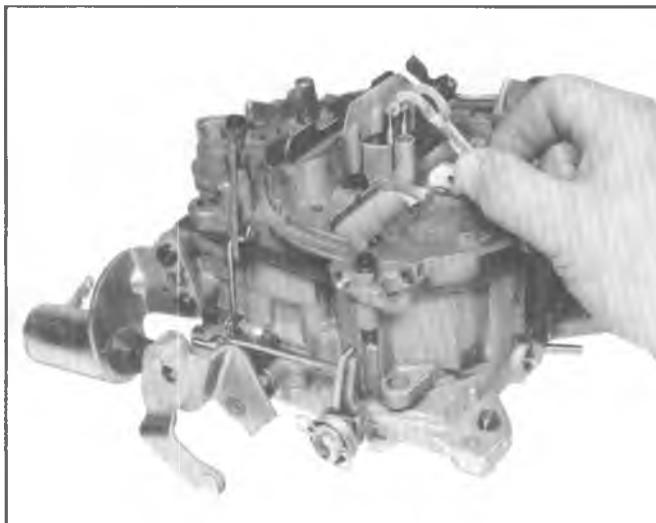


Fig. 6C-37--Removing Secondary Metering Rods

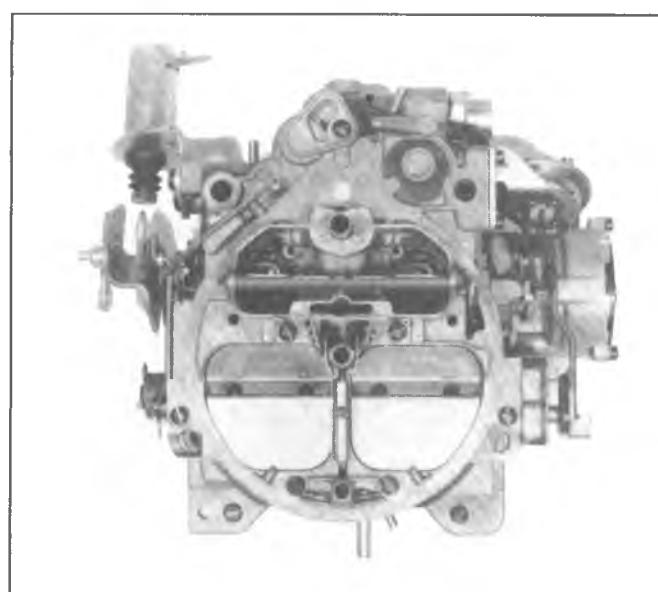


Fig. 6C-39--Removing Air Horn Screws

8. Remove aneroid cavity insert from float bowl. (Fig. 6C-46).

9. Remove primary main metering jets (only if necessary) (Fig. 6C-47).

**NOTE:** No attempt should be made to remove the secondary metering jet (metering orifice plates). These jets are fixed and, if damaged, bowl replacement is required.

10. Remove pump discharge check ball retainer and check ball.

11. Remove secondary air baffle, if replacement is required.

12. Remove pump well fill slot baffle.

#### M4ME Model With Rear Vacuum Break

11. Remove hose from rear vacuum break control assembly. Remove two screws from rear vacuum break bracket and rotate the assembly to remove vacuum break rod from slot in plunger head (Fig. 6C-48).

**CAUTION:** Do not place vacuum break assembly in carburetor cleaner.

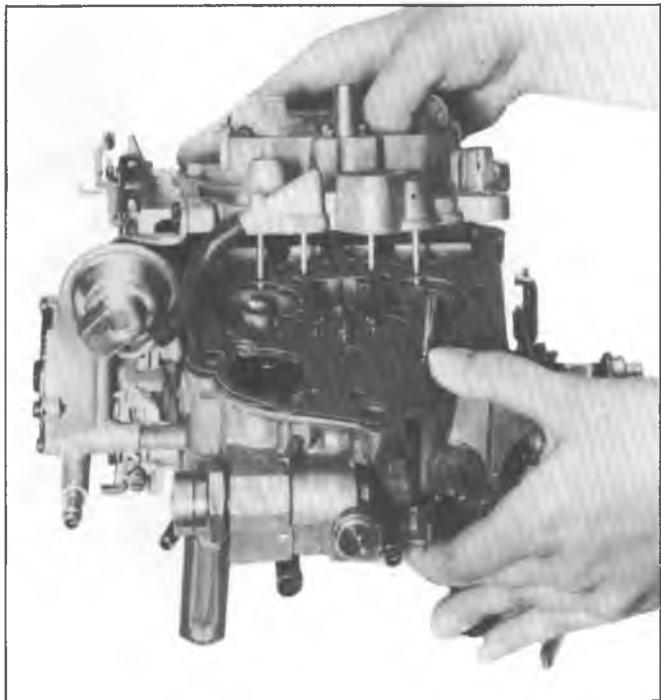


Fig. 6C-40--Removing Air Horn

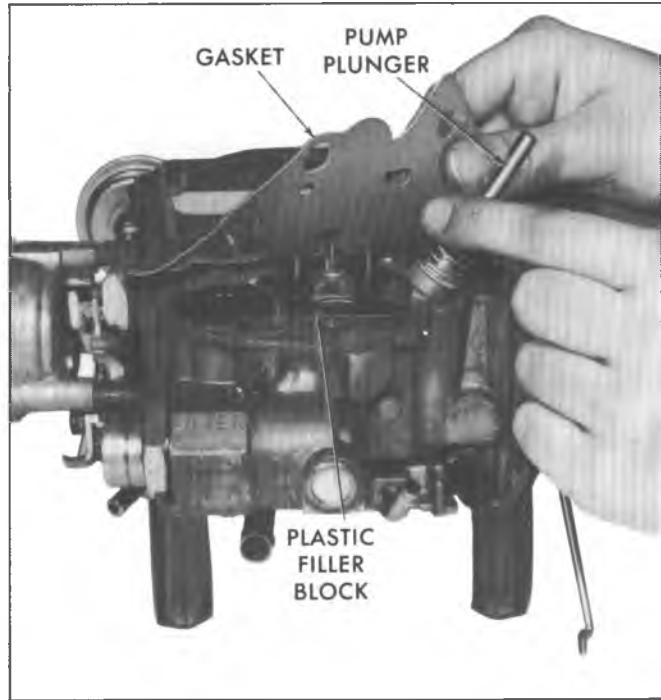


Fig. 6C-42--Removing Air Horn Gasket and Pump Plunger

12. Remove vacuum break rod by holding down on fast idle cam (hot idle position); move end of vacuum break rod away from float bowl; then disengage rod from hole in intermediate choke lever.

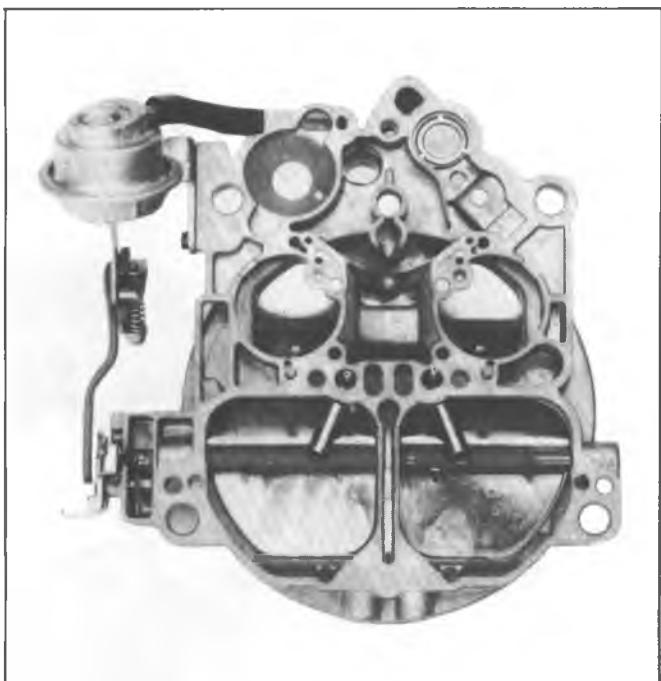


Fig. 6C-41--Removing Front Vacuum Break

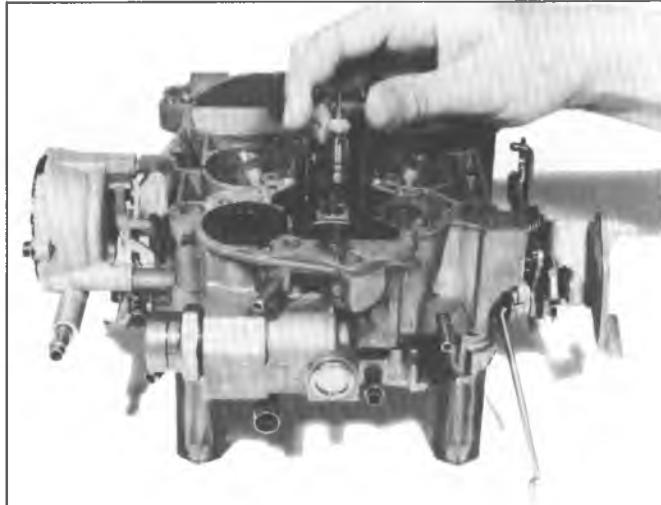


Fig. 6C-43--Removing Power Piston and Metering Rods

### Choke

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove cover and coil assembly from choke housing. Remove choke cover gasket, if used.

On M4MC hot air choke model, it is not necessary to remove baffle plate from beneath the thermostatic coil. Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (Fig. 6C-49). The complete choke assembly can be removed from the float bowl by sliding outward.

3. Remove secondary throttle valve lock-out lever from float bowl. (Fig. 6C-50).

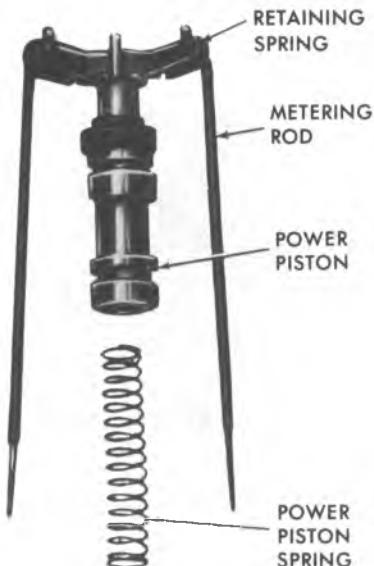


Fig. 6C-44--Power Piston and Metering Rods

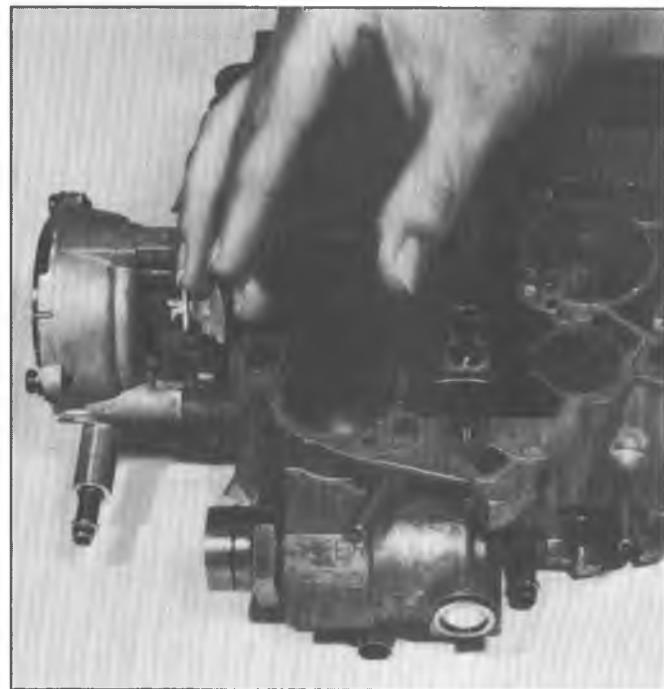


Fig. 6C-46--Removing Aneroid Cavity Insert

4. Remove lower choke lever from inside float bowl cavity by inverting bowl.

5. Remove plastic tube seal from choke housing (Fig. 6C-50).

**CAUTION:** Plastic tube seal should not be immersed in carburetor cleaner.

6. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing (Fig. 6C-49). Then remove thermostatic coil lever from flats on intermediate choke shaft.

Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft (Fig. 6C-50).

**CAUTION:** Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT

RETAINING PIN

FLOAT ASSEMBLY

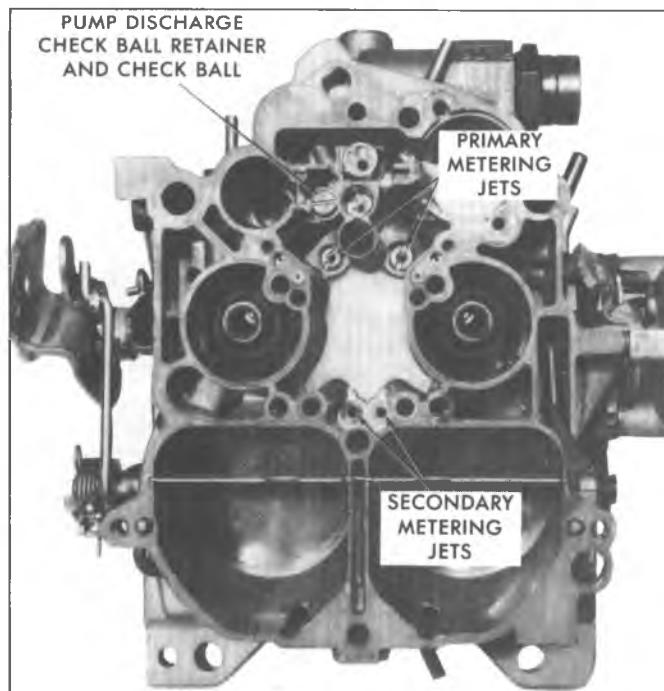
PUMP DISCHARGE  
CHECK BALL RETAINER  
AND CHECK BALLPRIMARY  
METERING  
JETSSECONDARY  
METERING  
JETS

Fig. 6C-45--Float Assembly

Fig. 6C-47--Float Bowl Jets



Fig. 6C-48--Rear Vacuum Break - M4ME

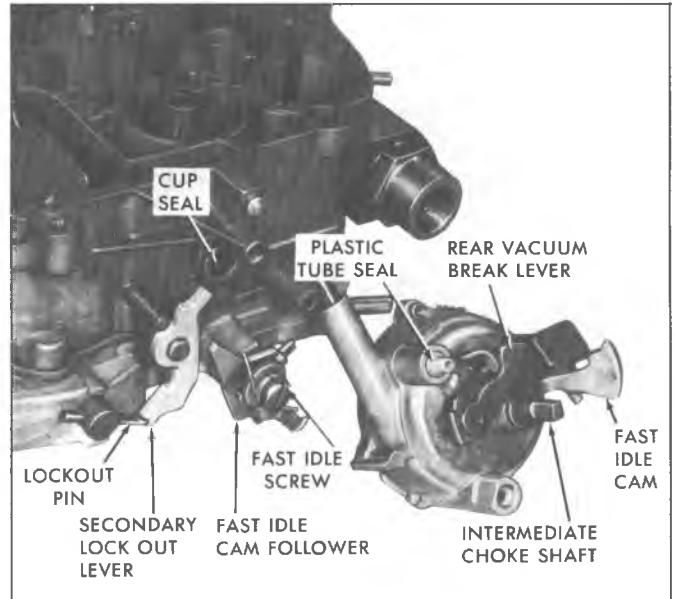


Fig. 6C-50--Choke Housing Assembly

### Float Bowl Disassembly

1. Remove fuel inlet nut, gasket and filter (Fig. 6C-51).
2. Remove throttle body by removing throttle body to bowl attaching screws (Fig. 6C-52).
3. Remove throttle body to bowl insulator gasket (Fig. 6C-53).

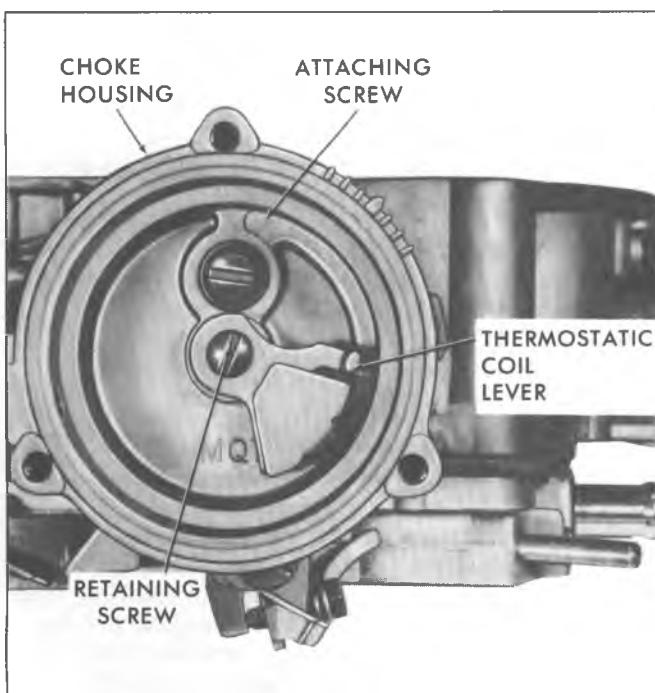


Fig. 6C-49--Removing Choke Housing

### Throttle Body Disassembly

1. Remove pump rod from throttle lever.
2. DO NOT REMOVE idle mixture limiter caps, unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, refer to Service Manual for adjustment procedure. If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been re-adjusted.

### CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

**CAUTION:** The electric solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.
2. Check, repair or replace the following parts if the

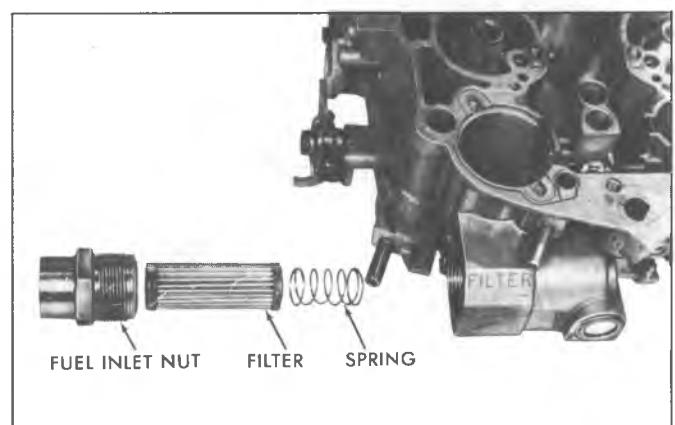


Fig. 6C-51--Fuel Filter

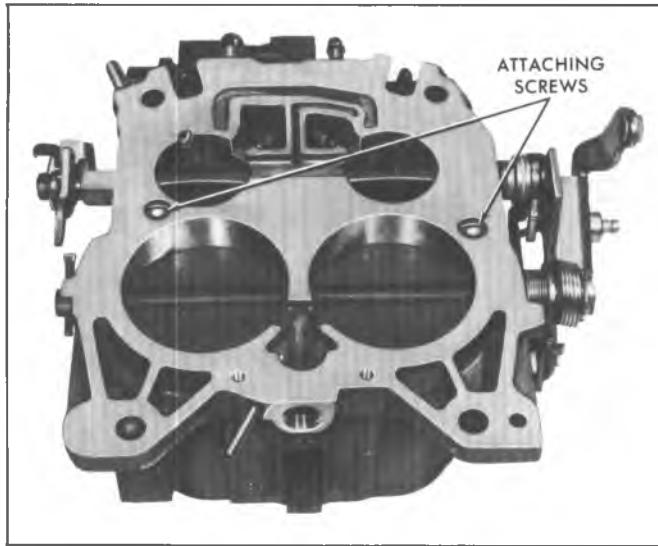


Fig. 6C-52--Removing Throttle Body

following problems were encountered.

a. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

c. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragm for leaks.

3. Clean or replace carburetor filter.

4. Inspect needle for sticking, dirt etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

d. Poor Performance - Poor Gas Mileage

1. Power Piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

e. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing bends, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

## ASSEMBLY

### Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles 4 turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under slow idle adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards towards throttle lever.

### Float Bowl Assembly

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely (Fig. 6C-52).

3. Place carburetor on proper holding fixture J-8328.

4. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut to 18 pounds feet (Fig. 6C-51).

**CAUTION:** The fuel inlet check valve on a vehicle with light duty emissions must be installed in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter includes the check valve.

**NOTE:** Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.

**CAUTION:** Tightening beyond specified torque can damage nylon gasket.

### Choke

1. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.

2. Install secondary throttle valve lock-out lever on boss on float bowl with recess in hole in lever facing inward.

3. Install new cup seal into inside choke housing shaft hole. Lips on seal face inward, towards inside of housing.

4. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward) (Fig. 6C-50).

5. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing; then install

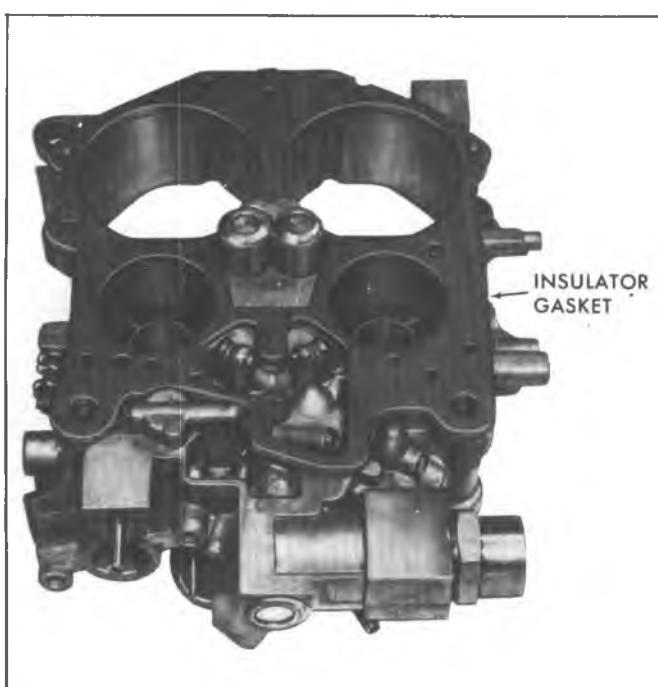


Fig. 6C-53--Removing Insulator Gasket

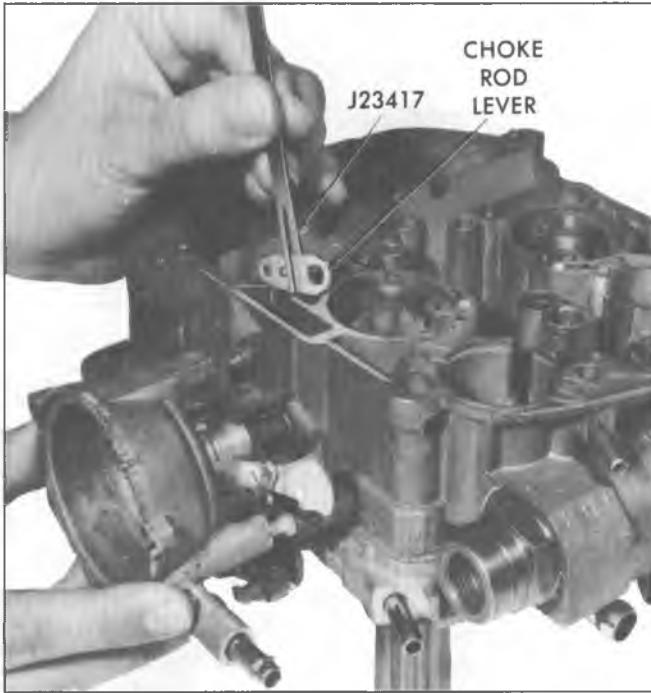


Fig. 6C-54--Installing Choke Rod Lever

thermostatic coil lever onto flats on intermediate choke shaft. Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face towards fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

6. Using Tool J-23417, install lower choke rod lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl sliding intermediate choke shaft into lower choke lever (Fig. 6C-54).

**NOTE:** The intermediate choke shaft lever and fast idle cam are in correct relation when the tang on lever is beneath the fast idle cam. Do not install choke cover and coil assembly until inside coil lever is adjusted. Refer to Service Section for adjustment procedures.

### Float Bowl

#### M4ME Model With Rear Vacuum Break

1. Holding down on fast idle cam (hot idle position), install end of vacuum break rod in hole in intermediate choke lever.

2. Install end of vacuum break rod in slot in rear vacuum break plunger head. Then install rear vacuum break control and bracket assembly to float bowl using two attaching screws (Fig. 6C-48). Tighten securely.

**NOTE:** Do not attach vacuum break hose until after the vacuum break adjustment is complete. Refer to Service Section for adjustment procedure.

#### All Models

3. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

4. If removed, install baffle in pump well fill slot.

5. Install pump discharge check ball and retainer in passage next to pump well. Tighten retainer securely.

6. Install primary main metering jets (if removed) (Fig. 6C-47).

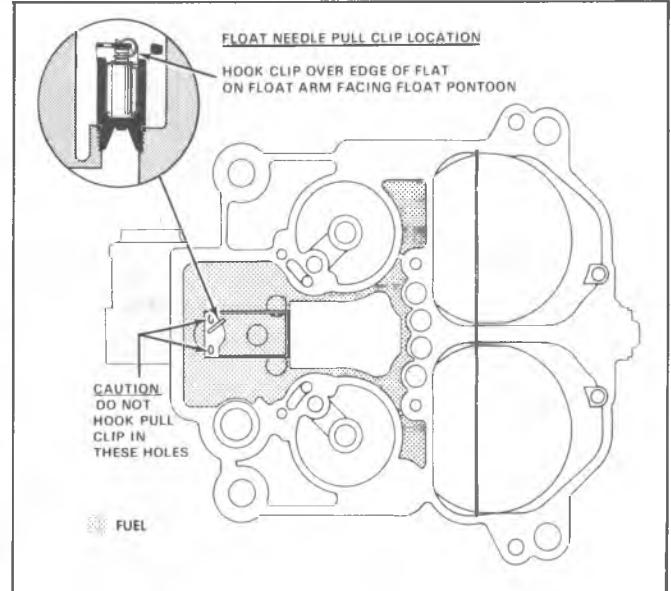


Fig. 6C-55--Pull Clip Location

7. Install aneroid cavity insert into float bowl.
8. Install new needle seat assembly, with gasket.
9. To make adjustment easier, bend float arm upward at notch in arm before assembly.

Install needle by sliding float lever under needle pull clip--correct installation of the needle pull clip is to hook the clip over the edge of the flat on the float arm facing the float pontoon (Fig. 6C-55). With float lever in pull clip, hold float assembly at toe and install retaining pin from aneroid cavity side (ends of retaining pin face the accelerating pump well).

**CAUTION:** Do not install float needle pull clip into holes in float arm.

10. Adjust float level.

#### Float Level Adjustment (Fig. 6C-56)

- a. Hold float retainer firmly in place.
- b. Push float down lightly against needle.
- c. With adjustable T-scale, gauge from top of float bowl casting (air horn gasket removed) to top of float gauging point  $3/16$ " back from end of float at toe.
- d. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to adjustment chart for specification.
- e. Visually check float alignment after adjustment.
11. Install plastic filler block over float needle, pressing downward until properly seated.
12. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (Fig. 6C-43). Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.
13. Install pump return spring in pump well.
14. Install air horn gasket by carefully sliding tab of gasket around main metering rods and beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.

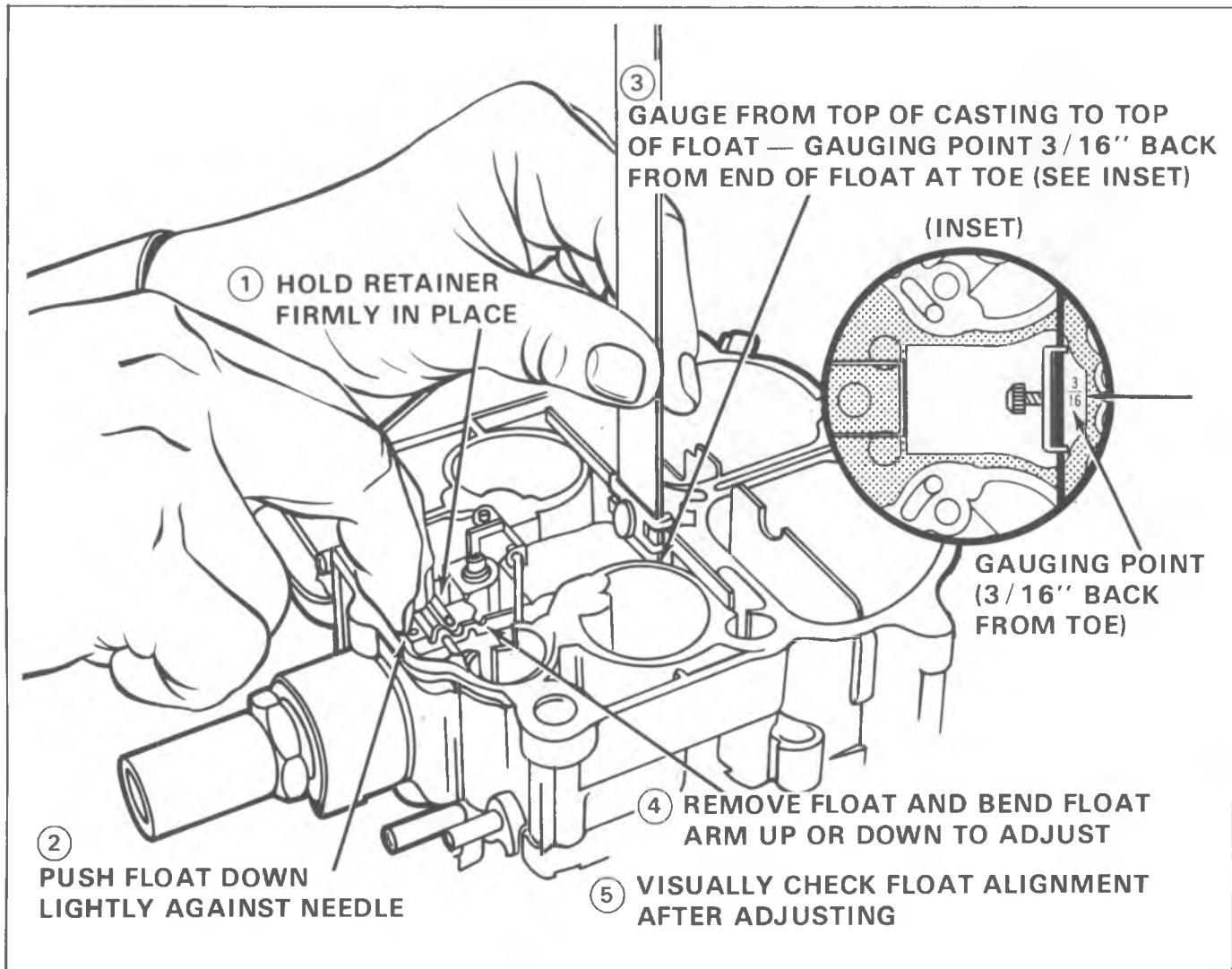


Fig. 6C-56—Float Level Adjustment

15. Carefully lift one corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket and press gasket in place.

#### Air Horn

1. If removed, install choke shaft, choke valve, and two attaching screws. Tighten screws securely and stake lightly in place.

2. Check choke valve for freedom of movement and proper alignment before staking screws in place.

#### Air Horn to Bowl Installation

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pull-over enrichment tubes (if used), and pump plunger stem are positioned properly through the holes in the air horn gasket.

**CAUTION:** Do not force the air horn assembly onto the bowl but rather lightly lower in place.

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area.

Install secondary air baffle beneath screw number 3 and 4.

All air horn screws must be tightened evenly and securely. See Figure 6C-57 for proper tightening sequence.

3. Install vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the front vacuum break diaphragm plunger. Install front vacuum break control and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely.

**NOTE:** Do not attach vacuum break hose until vacuum break adjustment is completed. Refer to Service Section for adjustment procedure.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn (Fig. 6C-58).

**CAUTION:** Use care installing the small roll pin to prevent damage to pump lever casting bosses.

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw

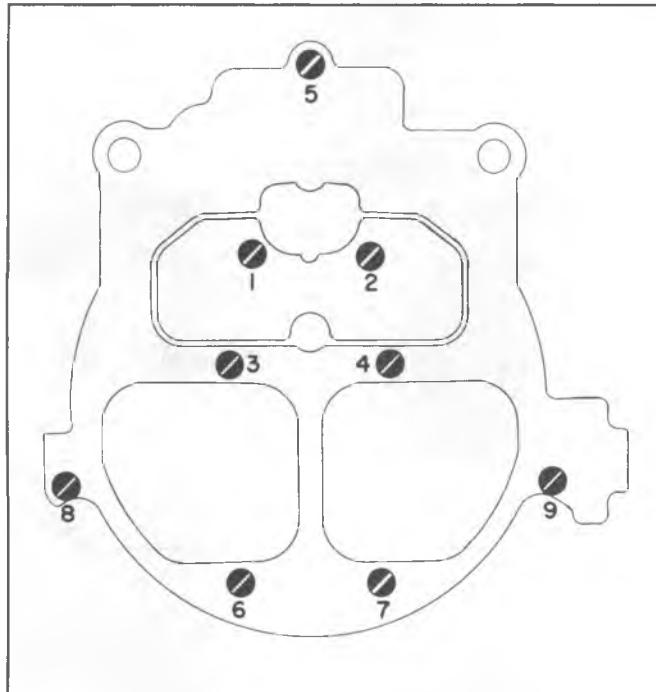


Fig. 6C-57--Air Horn Screw Tightening Sequence

end tighten securely. Work air valves up and down several times to make sure they are free in all positions.

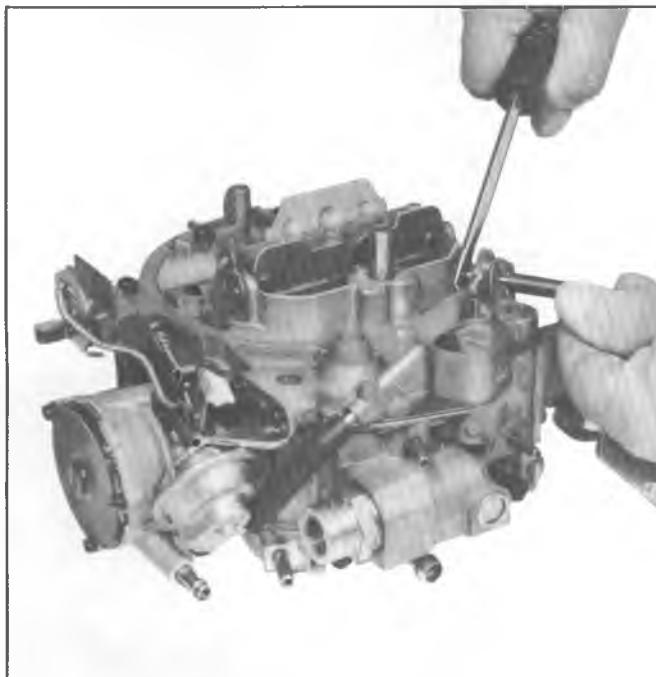


Fig. 6C-58--Installing Pump Lever Pivot Pin

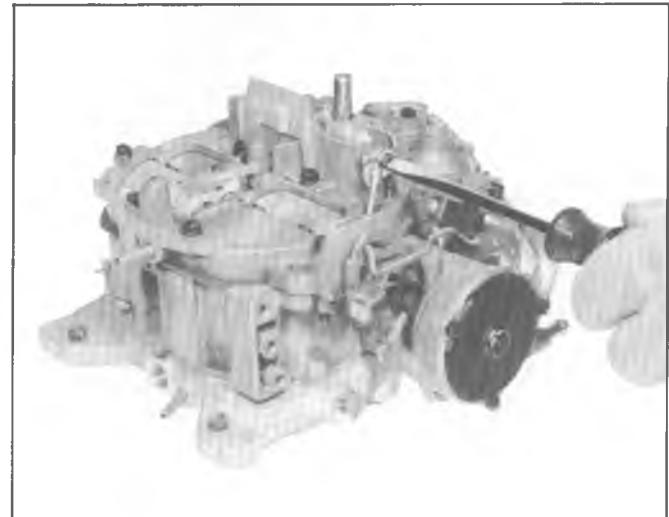


Fig. 6C-59--Choke Lever and Housing

6. Connect check rod into lower choke lever inside bowl cavity; they install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw. Tighten securely. When properly installed, the lever will point to the rear of the carburetor and the number on the lever will face outward (Fig. 6C-59).

Make sure that the flats on the end of the choke shaft align with flats in the choke lever.

The front and rear vacuum break units, fast idle cam (choke rod), and inside thermostatic choke coil lever must be adjusted properly before installing the choke thermostatic coil and cover assembly and gasket. Refer to the Adjustment Procedures, in Service Section.

7. After the vacuum break, fast idle cam (choke rod), and inside thermostatic coil lever are adjusted, the thermostatic coil and cover, and gasket on hot air choke model, should be installed and the cover assembly rotated until the choke valve just closes.

On all models (except 454 V8), tang on thermostatic coil must be installed in slot in inside choke coil lever pick-up arm. On M4ME electric choke model, coil tang contacts bottom side of inside choke coil lever pick-up arm.

**CAUTION:** *On M4ME electric choke model, do not install a choke cover gasket between the electric choke assembly and the choke housing.*

Align index point on cover with specified mark on housing as shown on adjustment chart.

Install three choke cover retainers and screws and tighten securely.

8. After making vacuum break adjustment, install vacuum break hose.

9. If used, position and retain solenoid and bracket assembly.

## MODEL 4MV CARBURETOR

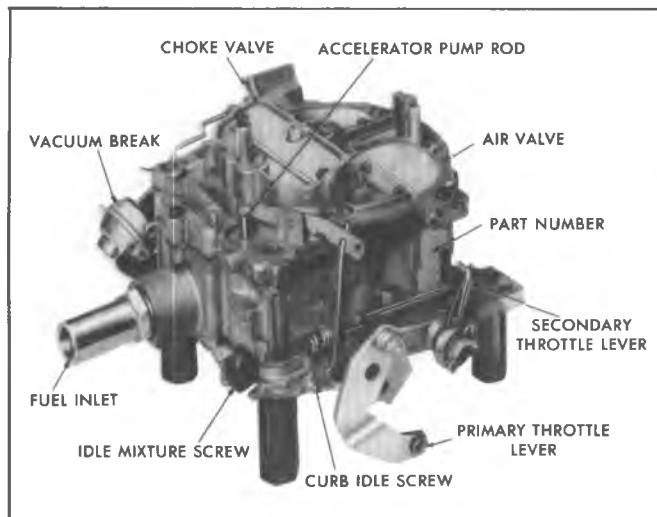


Fig. 6C-60--Model 4MV Carburetor

### DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle plates (Fig. 6C-60).

#### Throttle Return Control Valve (If Equipped)

Remove screws securing the throttle return control valve and bracket assembly to float bowl and remove control valve and bracket.

**CAUTION:** *The control valve should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.*

#### Air Horn

1. Remove horseshoe clip from upper end of choke rod. Disconnect choke rod from upper choke shaft lever.

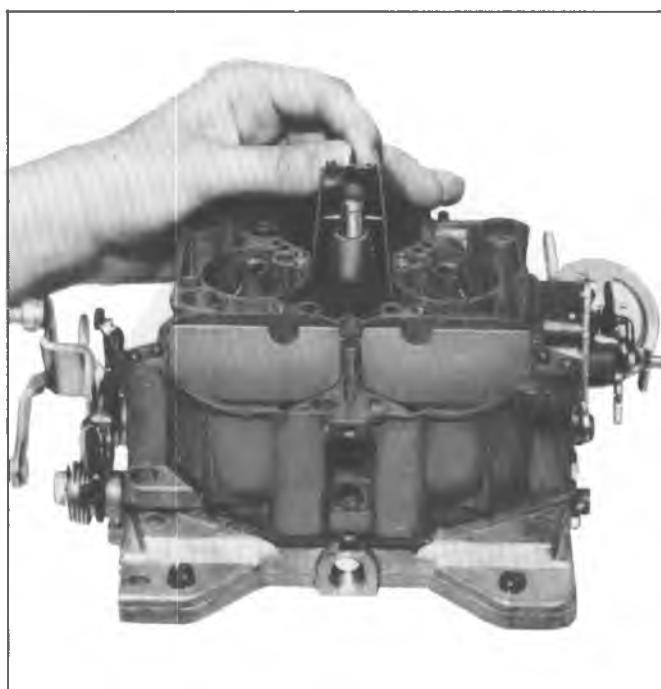


Fig. 6C-61--Removing Secondary Metering Rods

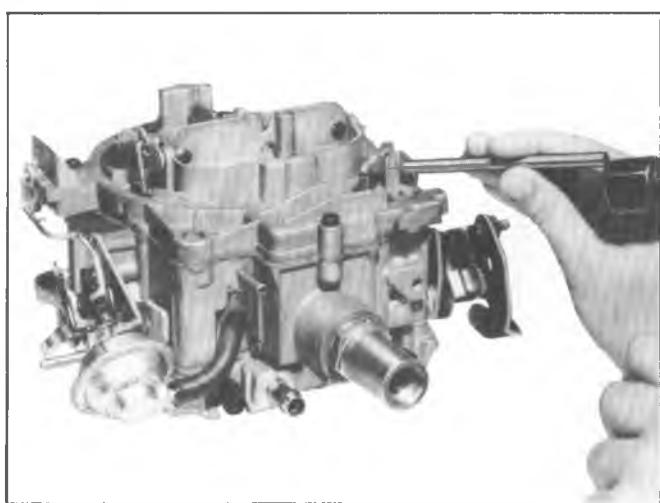


Fig. 6C-62--Removing Pump Lever

2. Remove choke rod from lower lever inside the float bowl casting by holding lower lever outward with small screwdriver and twisting rod counterclockwise.

3. Remove vacuum hose from vacuum break unit.

4. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger (Fig. 6C-61).

5. Using special tool J-25322, drive small roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever from pump rod (Fig. 6C-62).

**CAUTION:** *Use care in removing small roll pin to prevent damage to pump lever casting bores in air horn.*

6. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws) (Fig. 6C-63).

7. Lift air horn off bowl and twist to disengage vacuum break rod from air valve shaft lever. Air horn gasket should remain on bowl for removal later. (Fig. 6C-64).

8. Remove vacuum break rod from vacuum break diaphragm plunger.

**CAUTION:** *Care must be taken not to bend the small tubes protruding from air horn. These are permanently pressed into the casting. Do not remove.*

#### Air Horn Disassembly

**NOTE:** Further disassembly of the air horn is not required for cleaning purposes and is not recommended. If part replacement is required, proceed as follows:

1. Remove staking on two choke valve attaching screws and then remove choke valve and shaft.

2. Remove pump lever roll pin.

**CAUTION:** *Air valves and air valve shaft are calibrated and should not be removed. However, should it be necessary to replace the plastic air valve cam on the air valve shaft, a repair kit is available, which includes the plastic cam, closing spring, pin, screw and instructions.*

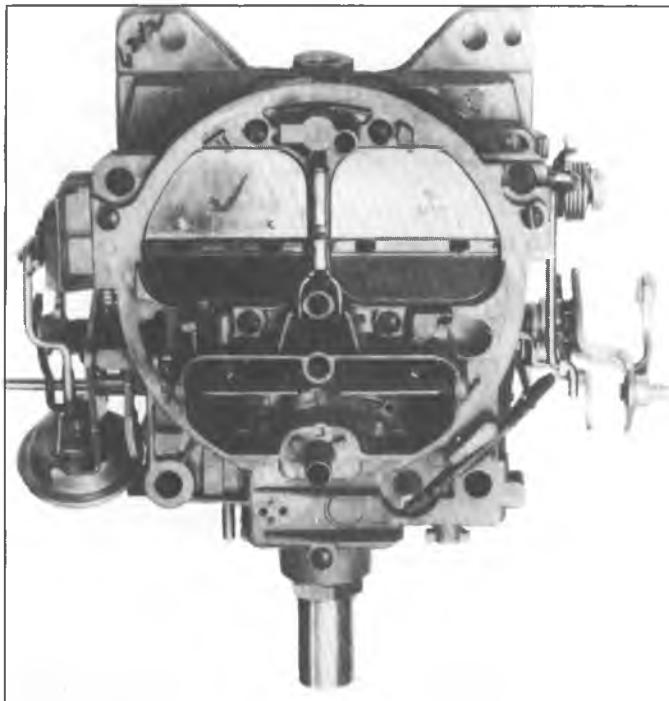


Fig. 6C-63--Removing Air Horn Screws

### Float Bowl

1. Remove accelerator pump plunger from pump well.
2. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the main metering rods.
3. Remove pump return spring from pump well.
4. Remove plastic filler block over float valve.
5. Remove power piston and metering rods by

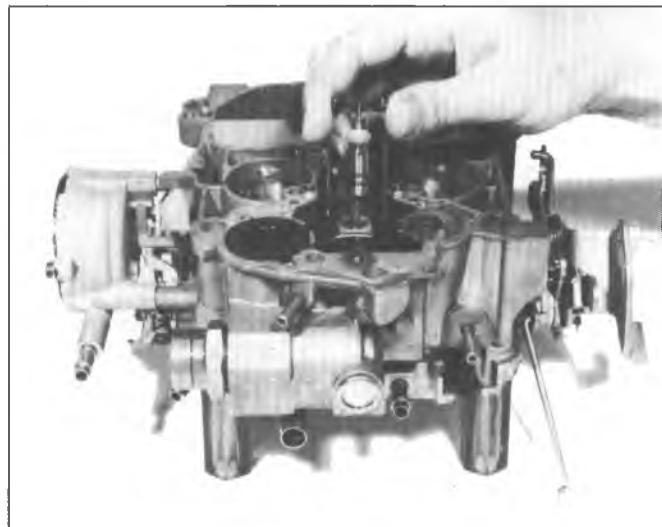


Fig. 6C-65--Removing Power Piston and Metering Rods

depressing piston stem and allowing it to snap free (Fig. 6C-65).

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

**CAUTION:** *Do not remove power piston by using pliers on metering rod hanger.*

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C-66).

**CAUTION:** *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.*

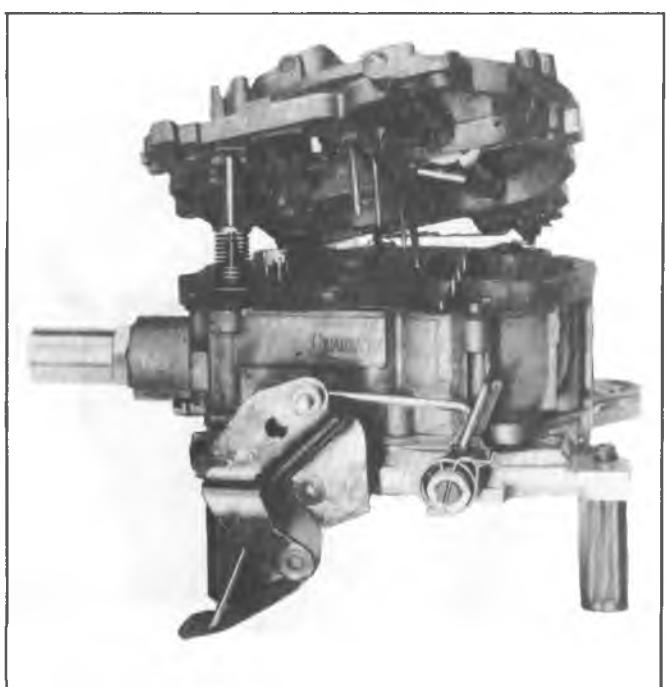


Fig. 6C-64--Removing Air Horn

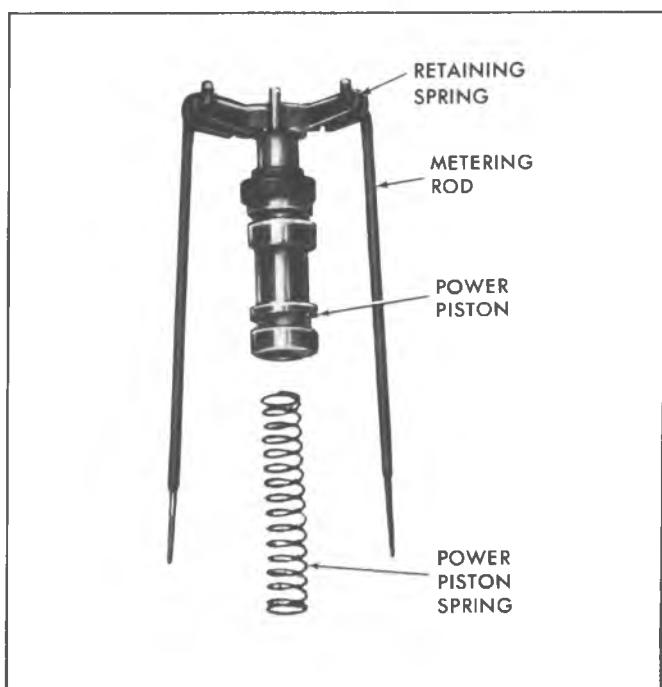


Fig. 6C-66--Power Piston and Metering Rods

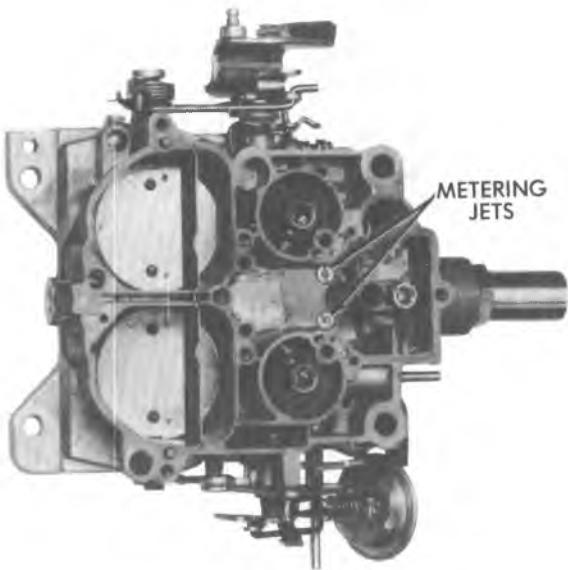


Fig. 6C-67—Metering Jets

7. Remove float assembly and inlet needle by pulling up on retaining hinge pin. Do not remove inlet needle seat unless it is damaged, in which case it and fuel needle must be replaced as an assembly. If needle seat is to be removed, use fuel inlet needle seat remover, J-22769.

8. Do not remove primary metering jets, Figure 6C-67 unless damaged or worn. No attempt should be made to remove secondary metering plates. If jets are removed but not replaced, they should be installed in the same hole from which they were removed.

9. Remove pump discharge check ball retainer screw and check ball.

10. Remove vacuum hose from vacuum break assembly and from tube connection on bowl if not previously removed.

11. Remove retaining screw from vacuum break assembly and remove assembly from float bowl.

**NOTE:** If further disassembly of vacuum break mechanism is necessary, spread the retaining ears on bracket next to vacuum break assembly, then remove vacuum break assembly from bracket.

12. Remove secondary throttle valve lock-out lever from float bowl.

13. Remove choke rod actuating lever from inside of float bowl well.

### Float Bowl Disassembly

1. Remove fuel inlet nut, gasket, filter and spring (Fig. 6C-68).

2. Remove secondary air baffle, if replacement is required.

3. Remove primary main metering jets, if necessary.

**NOTE:** No attempt should be made to remove the A.P.T. metering screws, or secondary metering orifice plates. These items are fixed and, if damaged, float bowl replacement is required.

4. Turn bowl over and remove throttle body assembly by removing two throttle body to bowl attaching screws (Fig.



Fig. 6C-68—Fuel Filter

6C-69).

**NOTE:** Be careful when inverting bowl assembly as smallest venturi protrudes beyond the gasket surface.

5. Remove throttle body to bowl insulator gasket.

### Throttle Body Disassembly

1. Remove pump rod from throttle lever by rotating rod out of lever.

2. DO NOT REMOVE idle mixture limiter caps unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, refer to Service Manual for adjustment procedure. If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

**CAUTION:** Extreme care must be taken to avoid damaging throttle valves.

No further disassembly of the throttle body is required.

### CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

**CAUTION:** The electric choke, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.

The plastic cam on the air valve shaft (where used) and

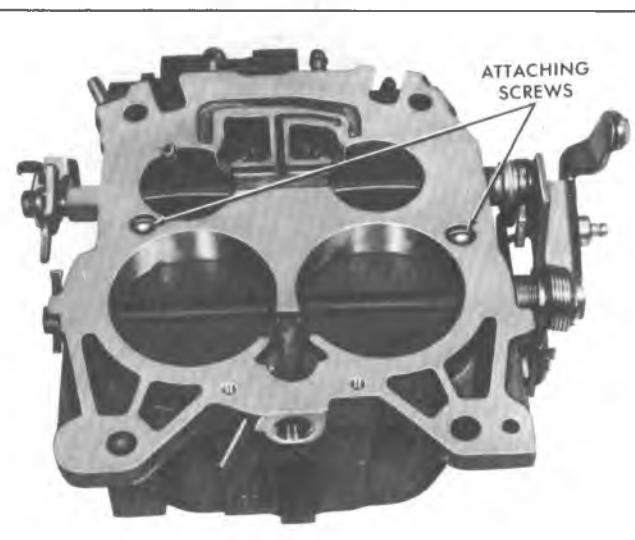


Fig. 6C-69—Removing Throttle Body

bushing in bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

a. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup, excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check all pump passages and jets for dirt, improper seating inlet or discharge balls, scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

c. Hard Starting - Poor cold operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filters.

4. Inspect needle for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

d. Poor Performance - Poor Gas Mileage

1. Power piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. (If used) Check air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in kit.

3. Clean all fuel and vacuum passages in castings.

e. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle levers and valves for binds, nicks and other damage.

## ASSEMBLY

### Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles 4 turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards toward throttle lever.

### Float Bowl

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely

(Fig. 6C-69).

3. Place carburetor on proper holding fixture J-8328.

4. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut securely (18 ft. lbs.).

**CAUTION:** Tightening beyond specified torque can damage nylon gasket.

5. If vacuum break diaphragm was removed from bracket, slide vacuum break diaphragm between retaining ears and bend ears down slightly to hold securely.

6. Install secondary lock-out lever.

7. Install fast idle cam on vacuum break assembly. Be sure arm of vacuum break lever is located beneath the tail of the fast idle cam.

8. Install vacuum hose to connection on bowl and vacuum break assembly.

**NOTE:** Do not attach vacuum hose to inlet on vacuum break diaphragm until after vacuum break adjustment is complete. (Refer to Service Manual for adjustment procedure).

9. Connect choke rod (plain end) to choke rod actuating lever, then holding choke rod with grooved end pointing inward - position choke rod actuating lever in well of float bowl and install choke assembly, engaging shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.

10. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

11. Install pump discharge check ball and retainer screw in passage next to pump well. Tighten retainer securely.

12. Install main metering jets. If removed, the jets should be installed in the same hole from which they were removed.

13. If fuel inlet needle seat was removed, use new needle seat gasket and position new seat on Fuel Inlet Needle Seat Remover and Installer, J-22769. Carefully thread needle seat into float bowl. Tighten securely.

14. To make adjustment easier, bend float arm upward at notch in arm before assembly.

15. Install needle by sliding float lever under needle pull clip----correct installation of the needle pull clip is to hook the clip over the edge of the flat on the float arm facing the float pontoon (Fig. 6C-70).

With float lever in pull clip, hold float assembly at toe and install retaining hinge pin from A.P.T. metering side (ends of retaining pin face the accelerating pump well).

**CAUTION:** Do not install float needle pull clip into holes in float arm. Severe flooding will result.

16. Adjust Float Level:

### FLOAT LEVEL (Fig. 6C-71)

a. Hold float retainer firmly in place.

b. Push float down lightly against needle.

c. With adjustable T-scale, gauge from top of float bowl casting (air horn gasket removed) to top of float - gauging point is 3/16" back from end of float at toe (See inset - Fig. 6C-71).

d. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to Service Manual for specification.

c. Visually check float alignment after adjustment.

17. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod. Install power piston assembly in well with metering rods

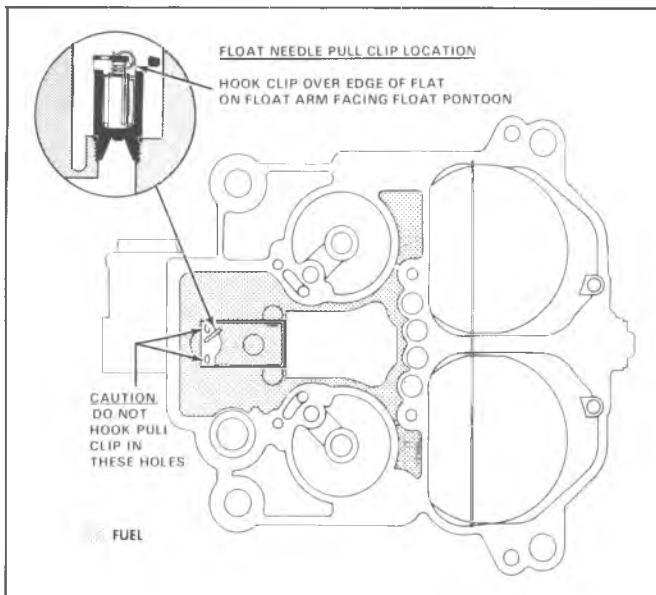


Fig. 6C-70--Pull Clip Location

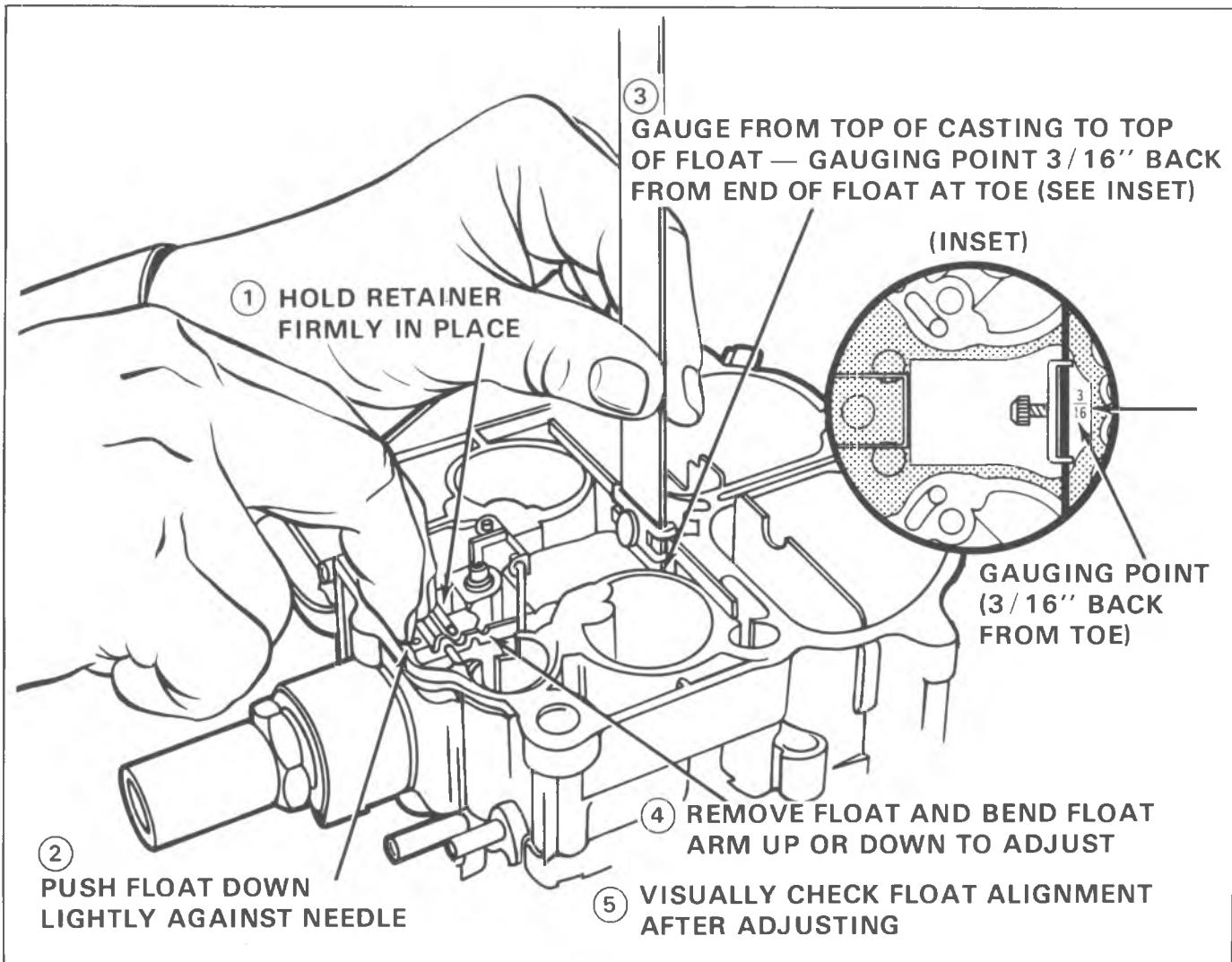


Fig. 6C-71--Float Level Adjustment

properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

18. Install plastic filler block over fuel inlet needle, pressing downward until seated properly.

19. Install pump return spring in pump well.

20. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

21. Install pump plunger in pump well to complete float bowl assembly.

### Air Horn

1. Install the following, if removed: choke shaft, choke valve and two attaching screws. Check for free operation.

The choke valve screws have a special sealing compound to hold them in place. If removed, they should be lightly staked after tightening.

**Air Horn to Bowl Assembly**

1. Install vacuum break rod into vacuum break diaphragm plunger.

2. Insert vacuum break rod in slot of air valve shaft and twist air horn into position.

3. Lower air horn assembly to bowl carefully, positioning vent tubes and accelerating well tubes through air horn gasket.

**CAUTION:** *Do not force the air horn assembly onto the bowl but rather lightly lower in place.*

4. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area.

All air horn screws must be tightened evenly and securely. See Figure 6C-57 for proper tightening sequence.

5. Connect choke rod in lower choke lever and retain in upper lever with horseshoe clip.

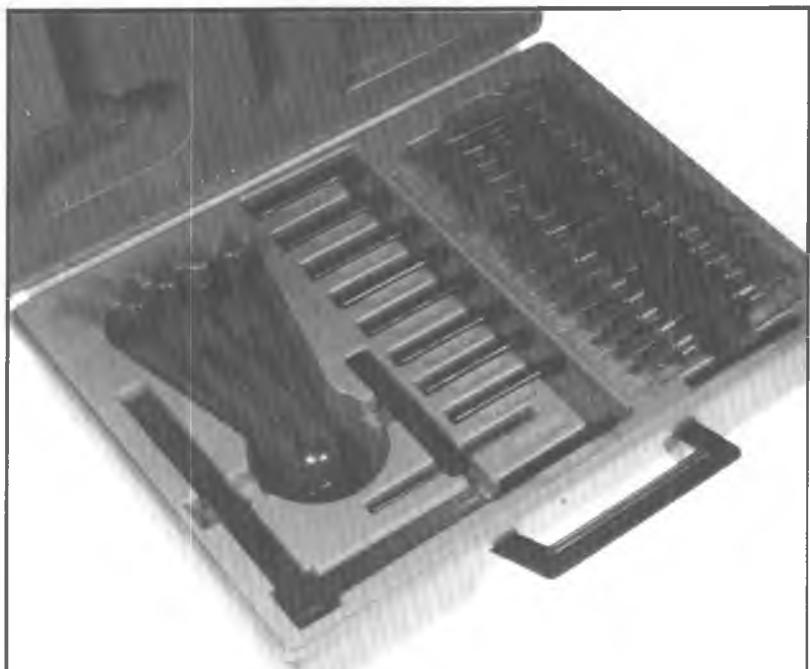
6. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn.

**CAUTION:** *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

7. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they are free in all positions.

8. If used, position and retain throttle stop vacuum assembly.

## SPECIAL TOOLS



J9789-02 UNIVERSAL CARBURETOR GAUGE SET



J9789-118 CARBURETOR HOLDING STAND



J9789-111 BENDING TOOL



J25322 PUMP LEVER PIN DRIVE PUNCH



J23417 CHOKE LEVER INSTALLING TOOL



J26701 CHOKE VALVE ANGLE GAUGE

Fig. 6C-72-Special Tools

## SECTION 6D

# ENGINE ELECTRICAL

### CONTENTS

Starting Motor .....	6D-1	Installation.....	6D-6
Disassembly .....	6D-1	10 SI Series Generator.....	6D-7
Cleaning and Inspection .....	6D-2	Disassembly .....	6D-7
Testing and Repairs .....	6D-3	Cleaning and Inspection .....	6D-8
Assembly .....	6D-4	Testing .....	6D-8
Pinion Clearance .....	6D-5	Reassembly .....	6D-11
Starting Solenoid .....	6D-6	Special Tools .....	6D-11
Removal.....	6D-6	Specifications .....	6D-12
Replacement of Contacts.....	6D-6		

## STARTING MOTOR

### **DISASSEMBLY (Figs. 6D-1S and 6D-2S)**

1. Disconnect the field coil connector(s) from the motor solenoid terminal.
2. Remove through bolts.
3. Remove Commutator end frame, field frame assembly and armature assembly from drive housing.
4. Remove overrunning clutch from armature shaft as follows:

a. Slide two piece thrust collar off end of armature shaft.

b. Slide a standard half-inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (fig. 6D-3S). Tap end of coupling with hammer, driving retainer towards armature end of snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If the snap ring is too badly distorted during removal, it may be necessary to use a new one when reassembling clutch.

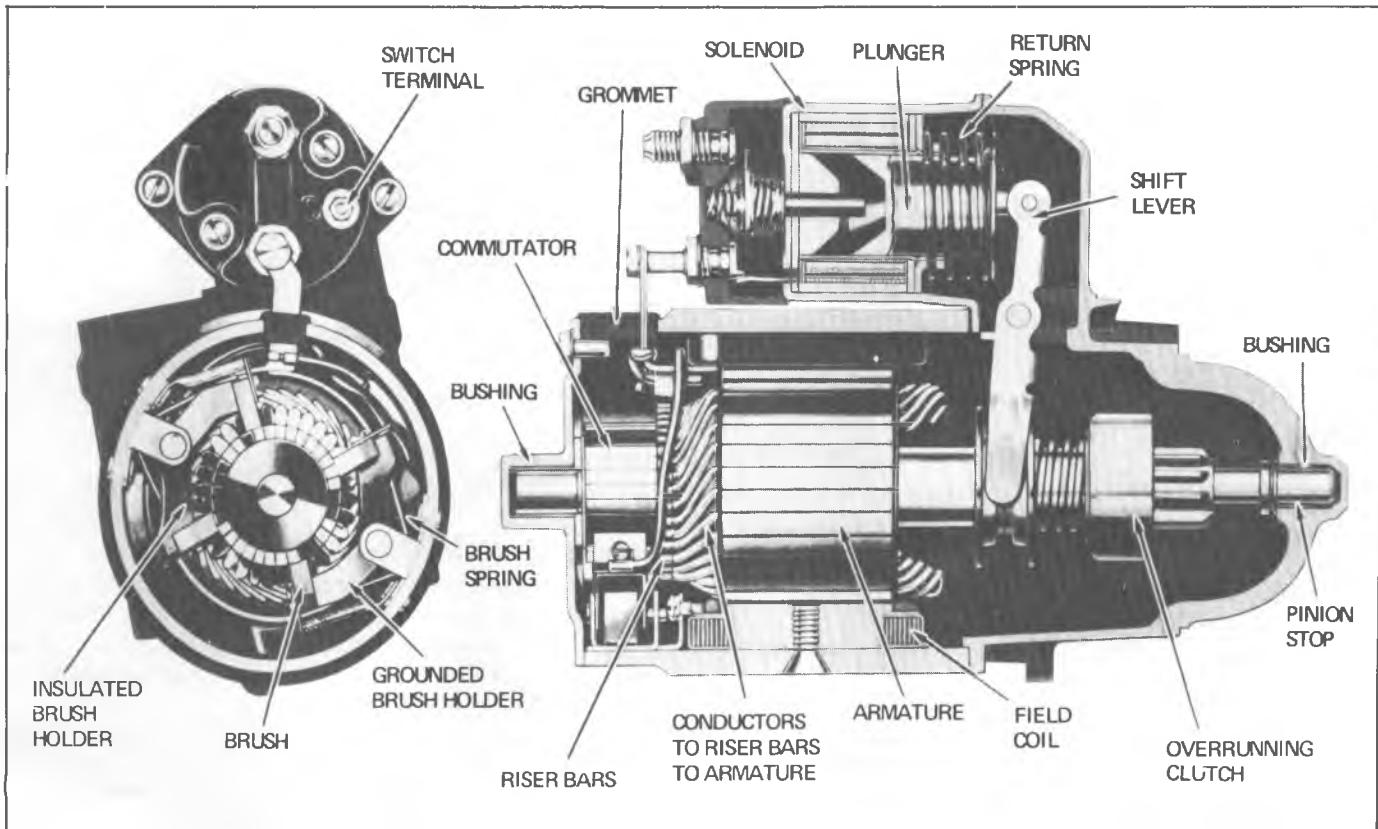


Fig. 6D-1S-Starting Motor Cross Section

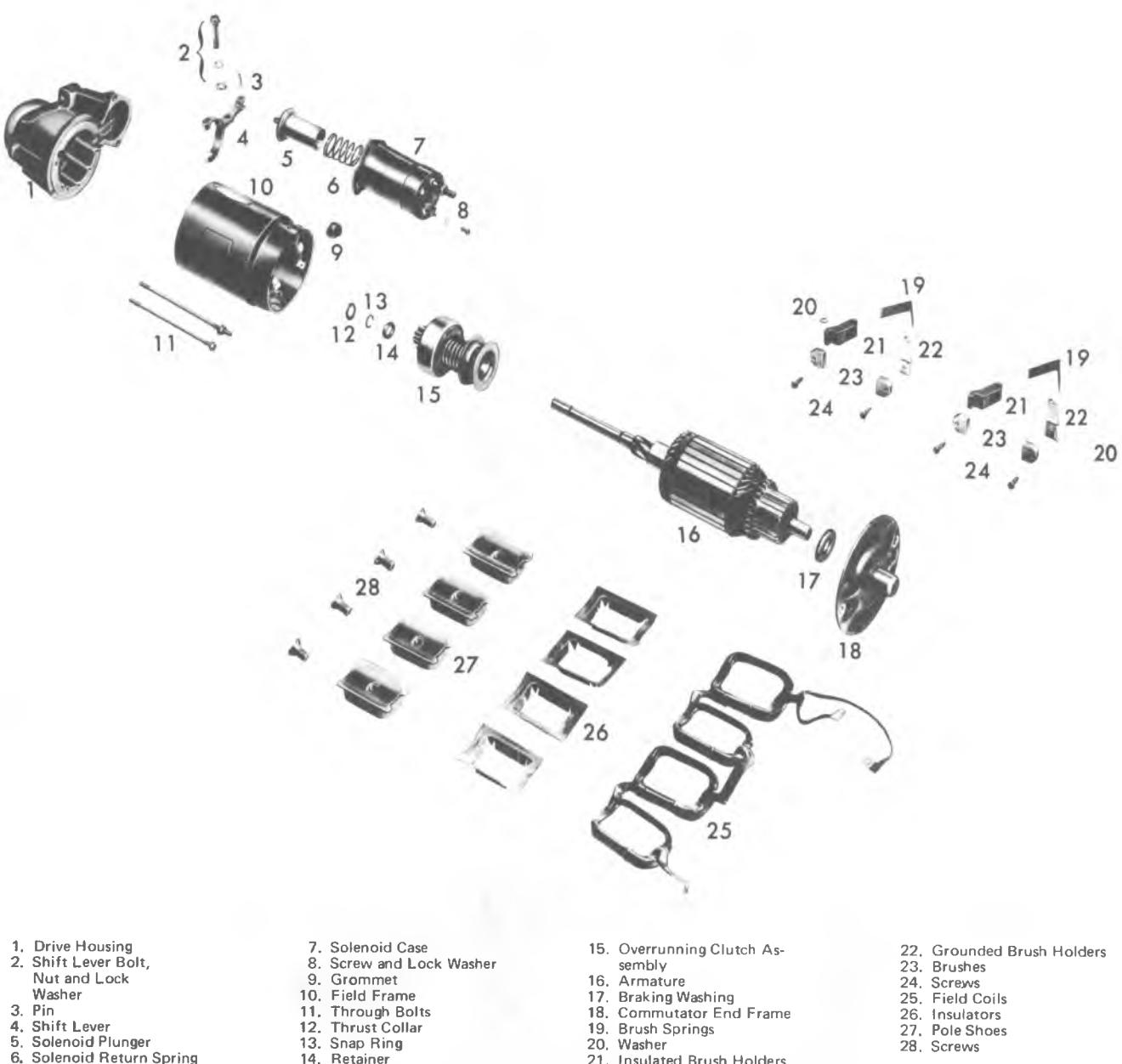


Fig. 6D-2S-Starting Motor Parts Layout

- d. Slide retainer and clutch from armature shaft.
- 5. Disassemble brush rigging from field frame.
  - a. Release "V" spring from slot in brush holder support.
  - b. Remove support pin.
  - c. Lift brush holders, brushes and spring upward as a unit.
  - d. Disconnect leads from each brush.
  - e. Repeat operation for other set of brushes.

### CLEANING AND INSPECTION

With the starting motor completely disassembled except for removal of field coils, the component parts should be cleaned and inspected as described below. Field coils need be removed only where defects in the coils are indicated by the tests described in this section.

1. Clean all starting motor parts, but do not use grease dissolving solvent for cleaning the overrunning clutch, armature, and field coils since such a solvent would dissolve the grease packed in the clutch mechanism and would damage armature and field coil insulation.

2. Test overrunning clutch action. The pinion should



Fig. 6D-3S--Driving Retainer Off Snap Ring

turn freely in the overrunning direction and must not slip in the cranking direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Check the spring for normal tension and drive collar for wear. If necessary the spring or collar can be replaced by forcing the collar toward the clutch and removing lock ring from end of tube.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

4. Check the condition of the brushes and if pitted or worn to one-half their original length, they should be replaced.

**CAUTION:** Some starter motor models use a molded armature commutator design and no attempt to undercut the insulation should be made or serious damage may result to the commutator. Undercutting reduces the bonding of the molding material which holds the commutator bars and since the molding material is softer than the copper bars, it is not necessary to undercut the material between the bars of the molded commutator.

5. 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. Apply a silicone lubricant to this bushing before reassembly. Avoid excessive lubrication.

6. Check fit of bushing in commutator end frame. If this bushing is damaged or worn excessively, the end frame assembly must be replaced. Apply a silicone lubricant to this bushing before reassembly. Avoid excessive lubrication. Lubricant forced onto the commutator would gum and cause poor commutation with a resulting decrease in cranking motor performance.



Fig. 6D-4S--Armature Short Circuit Test

**CAUTION:** Some starter motor models use a molded armature commutator design and no attempt to undercut the insulation should be made or serious damage may result to the commutator. Undercutting reduces the bonding of the molding material which holds the commutator bars and since the molding material is softer than the copper bars, it is not necessary to undercut the material between the bars of the molded commutator.

7. Inspect armature commutator. If commutator is rough or out of round, it should be turned down and undercut. Inspect the points where the armature conductors join the commutator bars to make sure that it is a good firm connection. A burned commutator bar is usually evidence of a poor connection. See "Turning the Commutator," described under Testing and Repairs.

## TESTING AND REPAIRS

### Armature Test For Shorts

Check the armature for short circuit by placing on growler and holding hack saw blade over armature core while armature is rotated (fig. 6D-4S). If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.

### Armature Test For Ground

Place one lead on the armature core or shaft and the other on the commutator (fig. 6D-5S). If the lamp lights, the armature is grounded and must be replaced.

### Field Coil Test For Open Circuit

Place one lead on the insulated brush and the other to the field connector bar (fig. 6D-6S). If the lamp does not light, the field coils are open and will require replacement.

### Field Coil Test For Ground

**NOTE:** Be sure to disconnect the shunt coil before performing this test (when applicable).

Place one lead on the connector bar and the other on the grounded brush (fig. 6D-7S). If the lamp lights, the field coils are grounded.

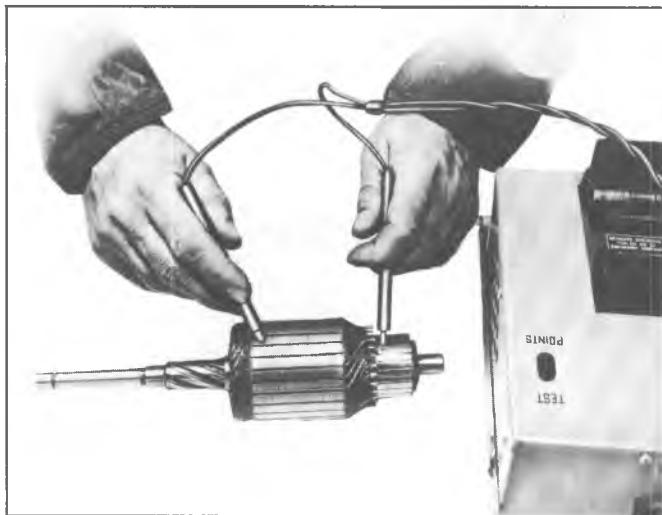


Fig. 6D-5S--Armature Ground Test

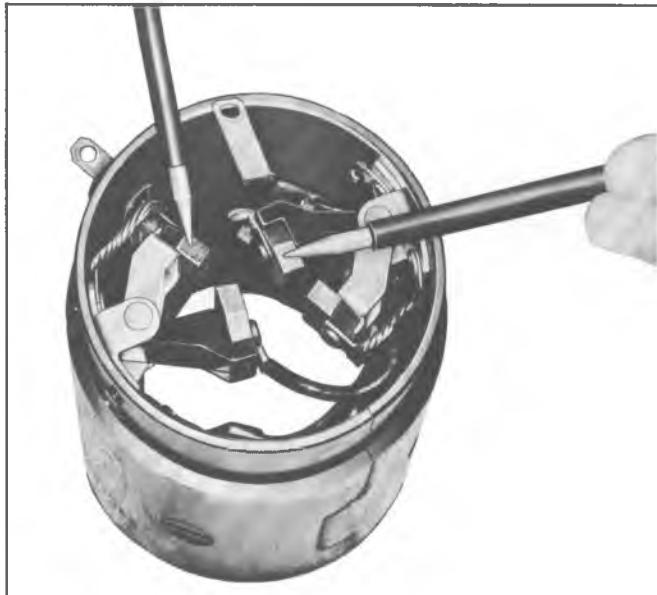


Fig. 6D-7S--Field Coil Ground Test

## Field Coil Replacement

Field coils may be removed from the field frame using a pole shoe screwdriver and a pole shoe spreader. The spreader prevents distortion of the field frame. Careful installation of field coils is necessary to prevent shorting or grounding of the field coils as the pole shoe screws are tightened in place. Formed insulators are used to protect the field leads from grounding to the frame and must be replaced with assembly.

## Loose Electrical Connections

When an open soldered connection of the armature to commutator leads is found during inspection, it may be resoldered provided resin flux is used for soldering. Acid flux should never be used on electrical connections.

When inspection shows commutator roughness, it should be cleaned as follows:



Fig. 6D-6S--Field Coil Open Circuit Test

## Turning The Commutator

1. Turn down commutator in a lathe until it is thoroughly cleaned.

**CAUTION:** Some starter motor models use a molded armature commutator design and no attempt to undercut the insulation should be made or serious damage may result to the commutator. Undercutting reduces the bonding of the molding material which holds the commutator bars and since the molding material is softer than the copper bars, it is not necessary to undercut the material between the bars of the molded commutator.

2. Undercut insulation between commutator bars  $1/32"$ . This undercut must be the full width of insulation and flat at the bottom; a triangular groove will not be satisfactory. After undercutting, the slots should be cleaned out carefully to remove any dirt and copper dust.

3. Sand and the commutator lightly with No. 00 sandpaper to remove and slight burrs left from undercutting.

4. Recheck armature on growler for short circuits.

## Brush Holder Replacement

If brush holders are damaged, they can be replaced by special service units.

## OVERRUNNING CLUTCH

The overrunning clutch (roll clutch design) used in the various starting motors is (fig. 6D-8S) designed to be serviced as a complete unit.

## ASSEMBLY

After all parts have been thoroughly tested and inspected and worn or damaged parts replaced, the starter should be reassembled.

1. Assemble brush rigging to field frame.

a. Assemble brushes to brush holders.

b. Assemble insulated and grounded brush holder together with the "V" spring and position as unit on the support pin. Push holders and spring to bottom of support and rotate spring to engage the "V" in slot in support.

c. Attach ground wire to grounded brush and field lead

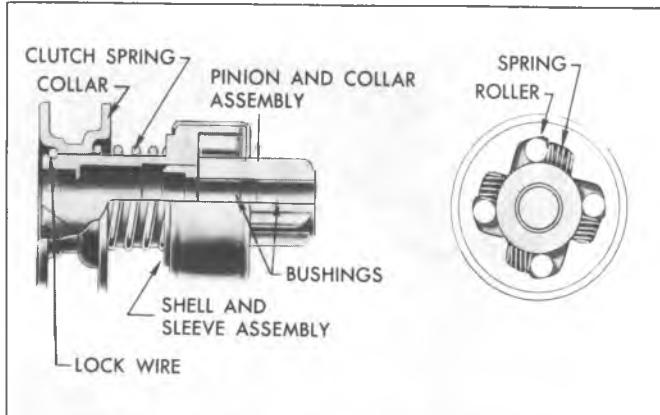


Fig. 6D-8S--Roll Type Clutch Cross-Section

wire to insulated brush.

- d. Repeat for other set of brushes.
2. Assemble overrunning clutch assembly to armature shaft.
  - a. Lubricate drive end of armature shaft with silicone lubricant.
  - b. Slide clutch assembly onto armature shaft with pinion outward.
  - c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).
  - d. Stand armature on end of wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with block of wood. Tap wood block with hammer forcing snap ring over end of shaft (fig. 6D-9S). Slide snap ring down into groove.
  - e. Assemble thrust collar on shaft with shoulder next to snap ring.

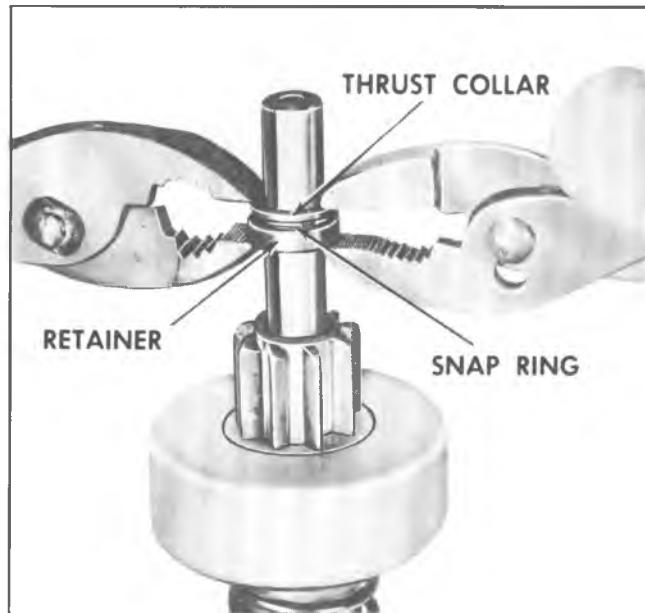


Fig. 6D-10S--Forcing Snap Ring Into Retainer

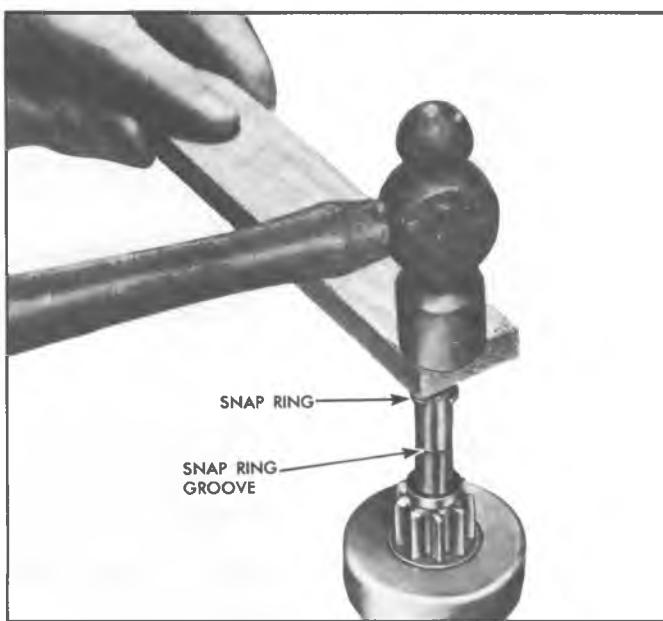


Fig. 6D-9S--Forcing Snap Ring Over Shaft

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then using two pair of pliers at the same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until snap ring is forced into retainer (fig. 6D-10S).

3. Lubricate the drive housing bushing with a silicone lubricant. Make sure thrust collar is in place against snap ring and retainer and slide armature and clutch assembly into place in drive housing engaging shift lever with clutch.

4. Position field frame over armature and apply special sealing compound between frame and solenoid case. Position frame against drive housing using care to prevent damage to the brushes.

5. Lubricate the bushing in the commutator end frame with a silicone lubricant. Place leather brake washer on armature shaft and slide commutator end frame onto shaft.

6. Reconnect the field coil connectors to the "motor" solenoid terminal.

7. After overhaul is completed, perform "Pinion Clearance Check".

#### PINION CLEARANCE CHECK

1. Connect a battery, of the same voltage as the solenoid, from the solenoid switch terminal to the solenoid frame or ground terminal (fig. 6D-11S).

**NOTE:** Disconnect the motor field coil connector for this test.

2. Momentarily flash a jumper lead from the solenoid motor terminal to the solenoid frame or ground terminal. The pinion will now shift into cranking position and will remain there until the battery is disconnected.

3. Push the pinion back towards the commutator end to eliminate slack movement.

4. Measure the distance between the pinion and pinion stop (fig. 6D-12S). If clearance is not within specified limits (.010-.140) it may indicate excessive wear of solenoid linkage shift lever yoke buttons or improper assembly of the shift lever mechanism. Worn or defective parts should be replaced.

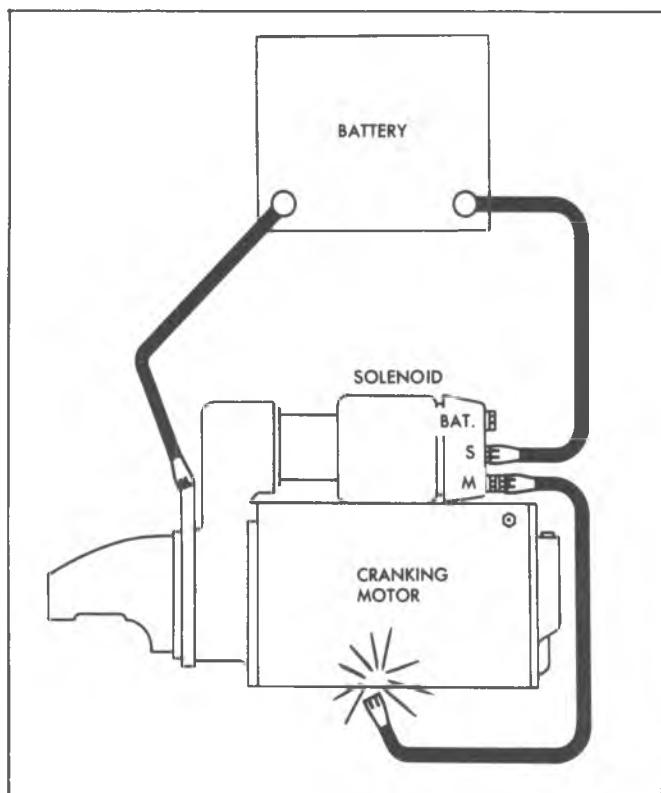


Fig. 6D-11S--Circuit for Checking Pinion Clearance

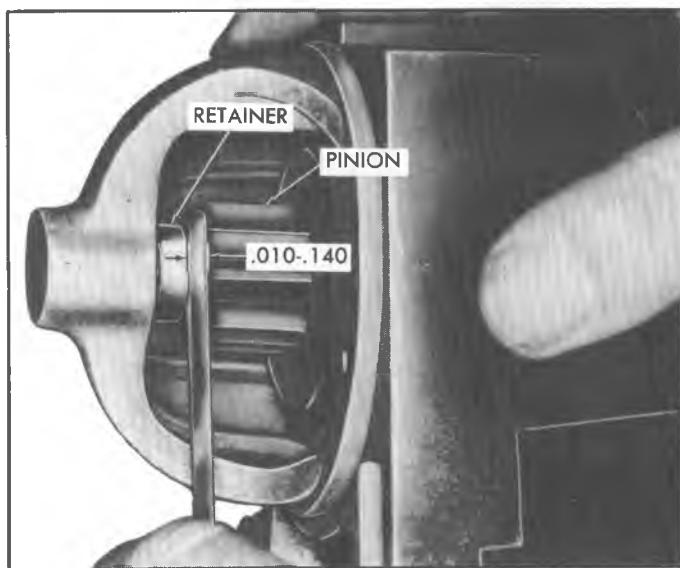


Fig. 6D-12S--Checking Pinion Clearance

## STARTING SOLENOID

### Removal

1. Remove the outer screw and washer from the motor connector strap terminal.
2. Remove the two screws retaining solenoid housing to end frame assembly.
3. Twist solenoid clockwise to remove flange key from keyway slot in housing; then remove solenoid assembly.

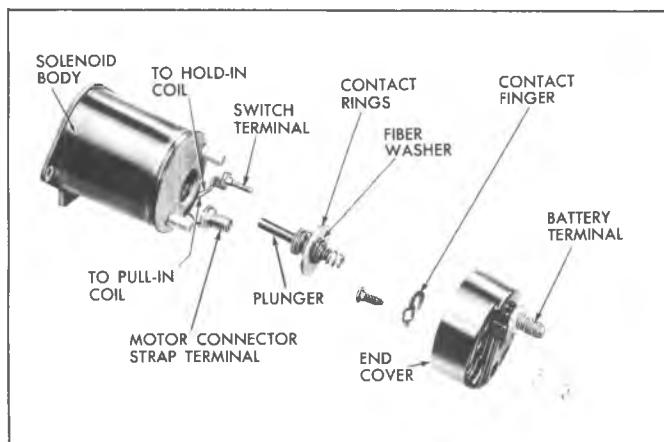


Fig. 6D-13S--Exploded View of Solenoid

### Replacement of Contacts (fig. 6D-13S)

1. With solenoid removed from motor, remove nuts and washers from switch and motor connector strap terminals.
2. Remove the two solenoid end cover retaining screws and washers and remove end cover from solenoid body.
3. Remove nut and washer from battery terminal on end cover and remove battery terminal. Remove resistor by-pass terminal and contactor.
4. Remove motor connector strap terminal and solder new terminal in position.
5. Using a new battery terminal, install terminal washer and retaining nut to end cover. Install by-pass terminal and contactor.
6. Position end cover over switch and motor terminals and install end cover retaining screws. Also install washers and nuts on the solenoid switch and starting motor terminals.
7. Bench test solenoid for proper operation.

### Installation

1. With solenoid return spring installed on plunger, position solenoid body to drive housing and turn counterclockwise to engage the flange key in the keyway slot.
2. Install two screws retaining solenoid housing to end frame.
3. Install outer screw and washer securing motor connector strap terminal.
4. Install starter motor as previously described.

## 10-SI SERIES GENERATOR

### DISASSEMBLY (fig. 6D-1C)

1. Hold generator in a vise, clamping the mounting flange lengthwise.

2. Remove the four thru-bolts and separate the slip ring end frame and stator assembly from the drive end and rotor assembly by prying apart with a screwdriver at the stator slot.

**NOTE:** A scribe mark will help locate the parts in the same position during assembly.

3. Place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material, and also a piece of tape over the shaft at the slip ring end.

**CAUTION:** Brushes may drop onto the rotor shaft and become contaminated with bearing lubricant. Clean brushes prior to installing with a non-toxic cleaner such as trichlorethylene or a soft dry cloth.

4. Remove the stator lead attaching nuts and separate stator from end frame.

**NOTE:** At this point, with the two end frames separated the stator disconnected and the rotor removed electrical checks of the rotor, rectifier bridge, stator and diode trio brush lead clip may be made without further disassembly. Refer to the specific checks as outlined in this section.

5. Remove screw attaching diode trio to brush holder assembly and remove diode trio from end frame (fig. 6D-7C).

**NOTE:** Diode trio may be checked for a grounded brush lead clip at this point. Refer to diode trio checks.

6. Remove the rectifier bridge attaching screw and the

"BAT" terminal screw, and disconnect the capacitor lead. Remove rectifier bridge from the end frame.

7. Remove two attaching screws, and remove brush holder and regulator assemblies.

**NOTE:** Two insulators are assembled over the top of the brush retaining clips and the two screws have special insulating sleeves over the screw body.

8. Remove retaining screw and capacitor from end of frame (fig. 6D-6C).

9. Remove slip ring end frame bearing (if necessary). Refer to bearing replacement covered in this section.

10. Remove pulley retaining nut and slide washer, pulley, fan and spacer from shaft.

a. Single groove pulley--place 15/16" box wrench on the shaft nut and insert a 5/16" allen wrench into the shaft end hole to hold the shaft while removing the nut (fig. 2C).

b. Double groove pulley--place a 15/16" socket (with wrench flats on the drive end or use adapter J-21501 and a box wrench on the pulley retaining nut, insert a 5/16" allen wrench through the socket and adapter into hex hole in the shaft to hold the shaft while removing the nut.

11. Remove rotor and spacers from the drive end frame assembly.

12. Remove drive end frame bearing retainer plate screws, plate, gasket, bearing, and slinger from end frame (if necessary).

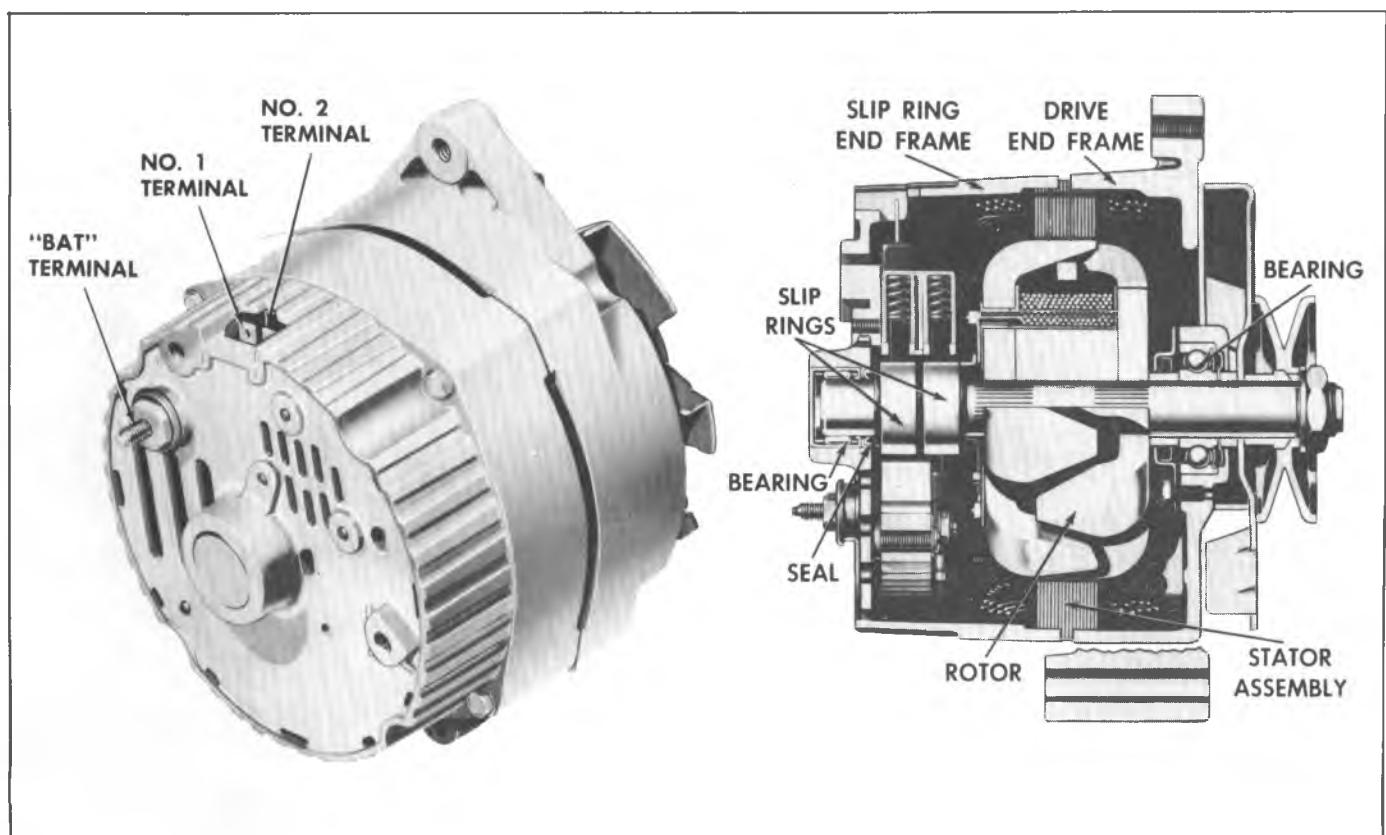


Fig. 6D-1C--10-SI Series Generator

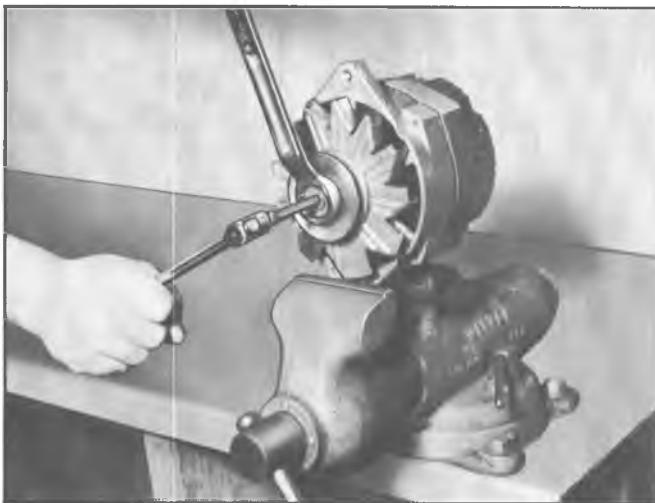


Fig. 6D-2C-Removing Pulley

### CLEANING AND INSPECTION

With generator completely disassembled the components should be cleaned and inspected. Be sure testing equipment is in good working order before attempting to check the generator.

1. Wash all metal parts except stator and rotor assemblies.
2. Clean bearings and inspect for sealing, pitting or roughness.
3. Inspect rotor slip rings, they may be cleaned with 400 grain polishing cloth. Rotate rotor for this operation to prevent creating flat spots on slip rings.
4. Slip rings which are out of round may be trued in a lathe to .002" maximum indicator reading. Remove only enough material to make the rings smooth and concentric. Finish with 400 grain polishing cloth and blow dry.
5. Slip rings are not replaceable--excessive damage will require rotor assembly replacement.
6. Inspect brushes for wear. If they are worn halfway, replace. Inspect brush springs for distortion or weakening. If brushes appear satisfactory and move freely in brush holder, springs may be reused.

### TESTING

Where specified, conduct the following tests using an ohmmeter with a 1-1/2 volt cell and use the lowest range scale for the readings.

#### Rotor Field Winding Checks (fig. 6D-3C)

The rotor may be checked electrically with a 110-volt test lamp or an ohmmeter.

##### Open Circuit

Connect one test lamp or ohmmeter lead to each slip ring. If the lamp fails to light or if the ohmmeter reading is high, the windings are open.

##### Short Circuit

The windings are checked for shorts by connecting a 12 volt battery and an ammeter in series with the two slip rings. Note the ammeter reading. An ammeter reading above the

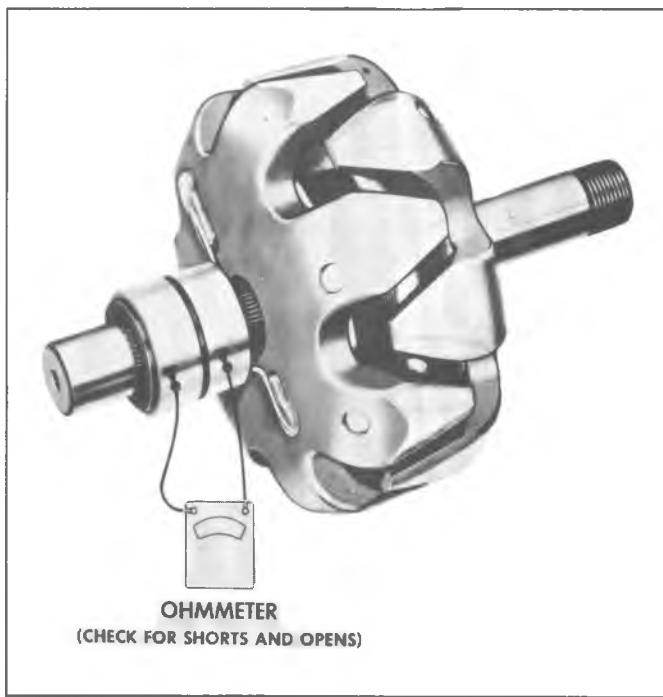


Fig. 6D-3C--Checking Rotor

specified field amperage draw indicates shorted windings. Refer to Specifications at the end of this manual.

#### Stator Checks (fig. 6D-4C)

##### Grounds

Connect a 110-volt test lamp or an ohmmeter from any stator lead to the stator frame. If test lamp lights or if ohmmeter reads low, the windings are grounded.

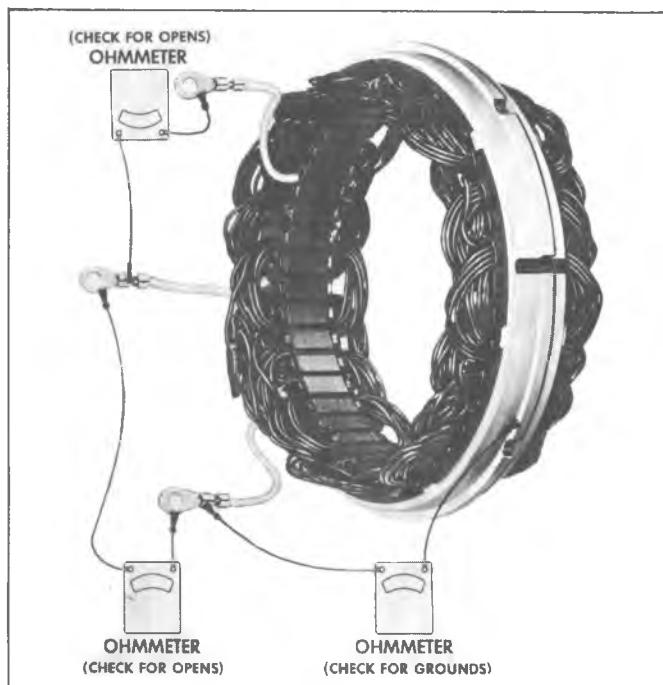


Fig. 6D-4C--Checking Stator

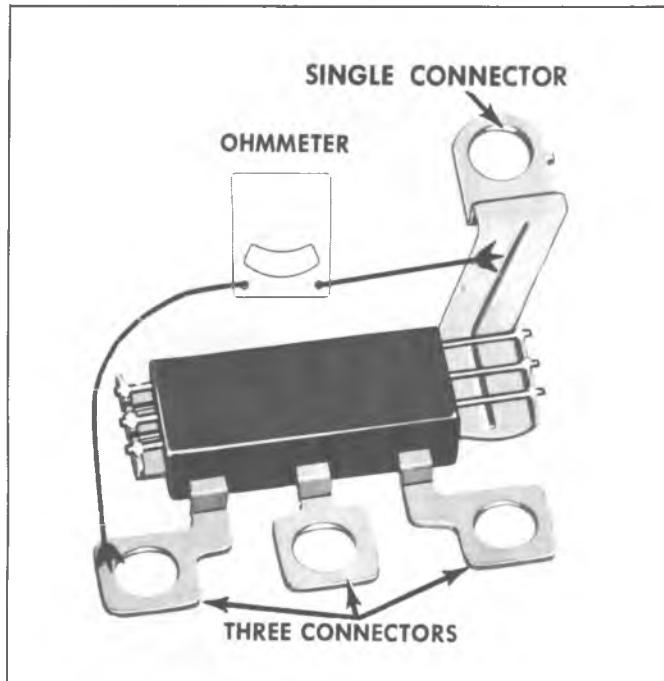


Fig. 6D-5C-Diode Trio Checks

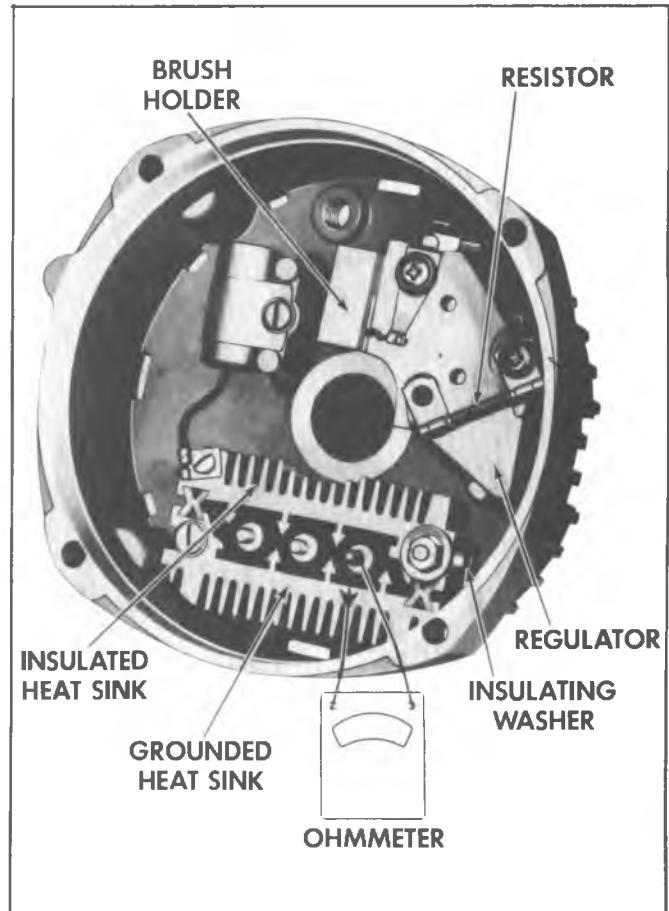


Fig. 6D-6C--Rectifier Bridge Checks

### Open Circuit

If lamp fails to light or if ohmmeter reads high when successively connected between each pair of stator leads, the windings are open.

### Short Circuit

A short in the stator windings is difficult to locate without special test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated. Also, look for heat discoloration on the windings.

### Diode Trio (fig. 6D-5C)

With the diode trio unit removed from the end frame, connect an ohmmeter to the single connector and to one of the three connectors. Observe the reading, then reverse the ohmmeter leads to the same connectors. A good diode trio will give one high and one low reading. If both readings are the same, replace the diode trio. Repeat this test between the single connector and each of the other two connectors.

**NOTE:** There are two diode trio units differing in appearance used in the generator but they are completely interchangeable.

The diode trio may also be checked for a grounded brush lead while still installed in the end frame. Connect an ohmmeter from the brush lead clip to the end frame as shown in Step 2, Figure 6D-7C, then reverse the lead connection. If both readings are zero, check for a grounded brush lead clip caused by omission of the insulating washer, of the insulating sleeve over the screw, or damaged insulating sleeve. Remove the screw to inspect the sleeve. If sleeve or screw are not grounded, replace regulator.

**CAUTION:** Do not use high voltage such as 110 volt test lamp to check the diode trio.

### Rectifier Bridge Check (fig. 6D-6C)

Connect an ohmmeter to the grounded heat sink and one of the three terminals. Then reverse the lead connections to the grounded heat sink and same terminal. If both readings are the same, replace the bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. When this is done all six diodes are checked with two readings taken for each diode.

**NOTE:** The diodes are not replaced individually. The entire rectifier bridge is replaced if one or more diodes are defective.

**CAUTION:** Do not use high voltage to check the rectifier bridge, such as a 110 volt test lamp.

### Voltage Reg./Brush Lead Clip Check (fig. 6D-7C)

Connect an ohmmeter from the brush lead clip to the end frame as shown in Step 1, Figure 6D-7C. Then reverse lead connections. If both readings are zero, either the brush lead clip is grounded or the regulator is defective.

A grounded brush lead clip can result from omission of the insulating washer, omission of the insulating sleeve on the screw, or a damaged insulating sleeve. Remove the screw and inspect the sleeve. If it is satisfactory, replace the regulator unit.

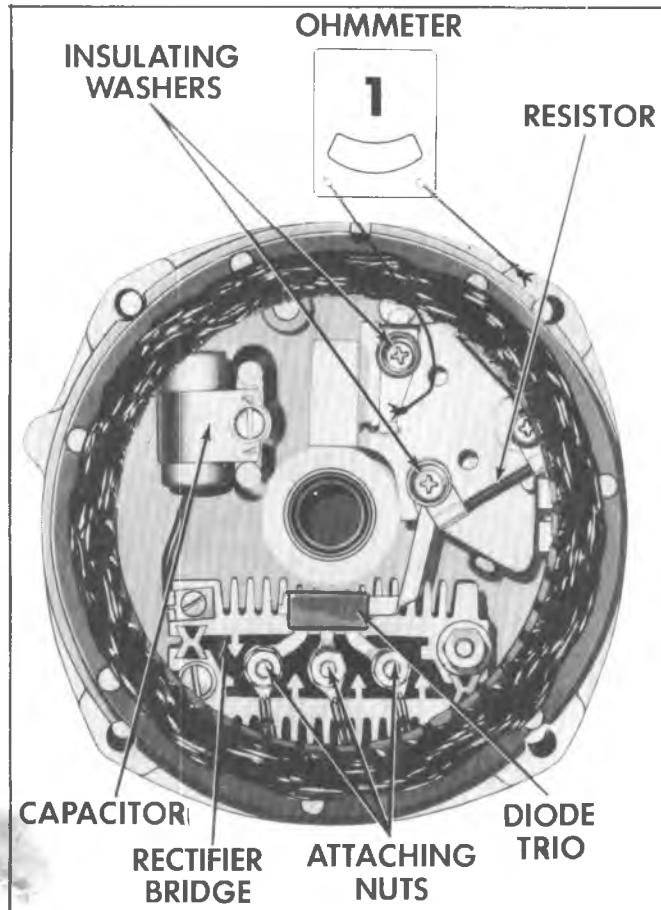


Fig. 6D-7C--Brush Lead Clip Checks

## REPAIRS

### Brush Holder and Regulator Replacement (fig. 6D-7C)

1. If not previously removed, remove the three stator lead attaching nuts, the stator, diode trio brush lead screw and diode trio from the end frame.

2. Remove the remaining two screws from the brush holder and regulator and remove these units from the end frame.

**NOTE:** The two screws retaining the brush clips have insulating washers over the tops of the brush clips and special insulating sleeves over the screw body above the threads. If they are damaged or missing a ground will result causing uncontrolled or no output.

3. Replace defective unit and reassemble using reverse of removal procedures.

**NOTE:** The screw nearest regulator terminals does not have an insulating washer, but may or may not have an insulating sleeve.

### Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. 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.

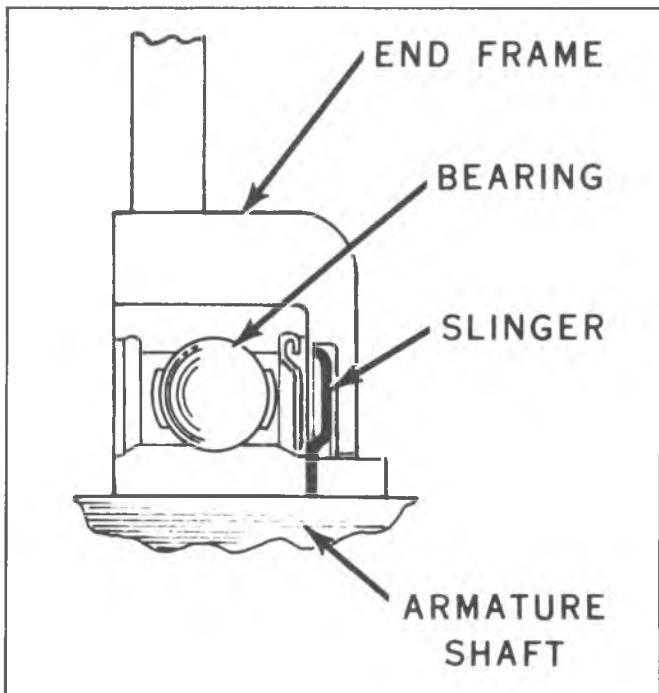


Fig. 6D-8C--Drive End Bearing Cross Section

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

### Drive End Frame--Bearing Replacement/Lubrication

1. The drive end frame bearing can be removed by detaching the retainer plate bolts and separating retainer plate and seal assembly from end frame, and then pressing bearing out using suitable tube or pipe on outer race.

2. Refill bearing one-quarter full with Delco-Remy No. 1948791 grease or equivalent. Do not overfill.

3. Press bearing into end frame using tube or pipe as in Step 1 with bearing and slinger assembled as shown in Figure 6D-8C.

4. Install retainer plate. Use new retainer plate if felt seal is hardened or excessively worn.

**NOTE:** Stake retainer plate bolts to plate.

### Slip Ring End Frame--Bearing Replacement

1. Replace the bearing if the grease supply is exhausted. Make no attempt to re-lubricate and reuse the bearing.

2. Press out from outside of housing, using suitable tool over outer race of bearing.

3. To install, place a flat plate over the bearing and press in from outside of housing until bearing is flush with the outside of the end frame. Support inside of end frame around bearing bore with a suitable tool to prevent distortion. Use extreme care to avoid misalignment.

4. Install new seal whenever bearing is replaced. Lightly coat the seal lip with oil and press seal into the end frame with the seal lip toward the inside of the end frame.

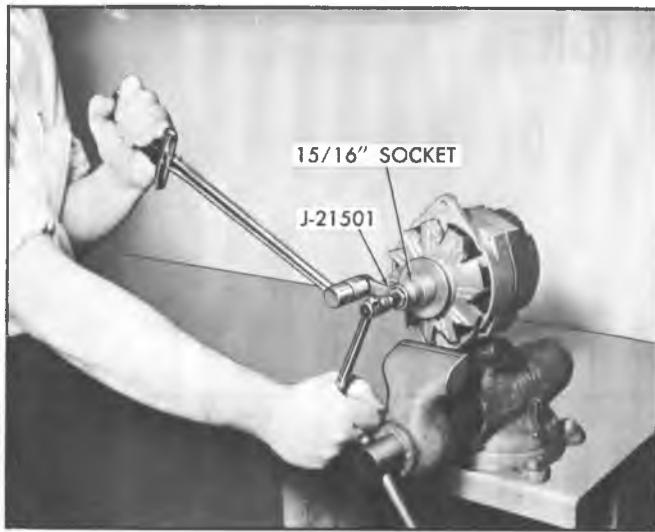


Fig. 6D-9C-Installing Pulley Nut

#### REASSEMBLY

1. Install rotor in drive end frame and attach spacer, fan, pulley, washer, and nut.
2. Using adapter J-21501, insert an allen wrench into hex .

shaped hole at end of shaft and torque the shaft nut to 40-50 ft. lbs. (fig. 6D-9C).

3. Install capacitor and retaining screw in slip ring end frame.

4. Position brush holder and regulator assemblies in end frame and install two retaining screws.

**NOTE:** The two screws retaining the brush clips have insulating washers over the top of the brush clips and special insulating sleeves over the screw body above the threads. If the third screw does not have an insulating sleeve, it must not be interchanged with either of the other two screws.

5. Position rectifier bridge to end frame. Install attaching screw and the "BAT" terminal screw. Connect capacitor lead to bridge.

6. Position diode trio on rectifier bridge terminal and install screw attaching brush lead clip to brush holder.

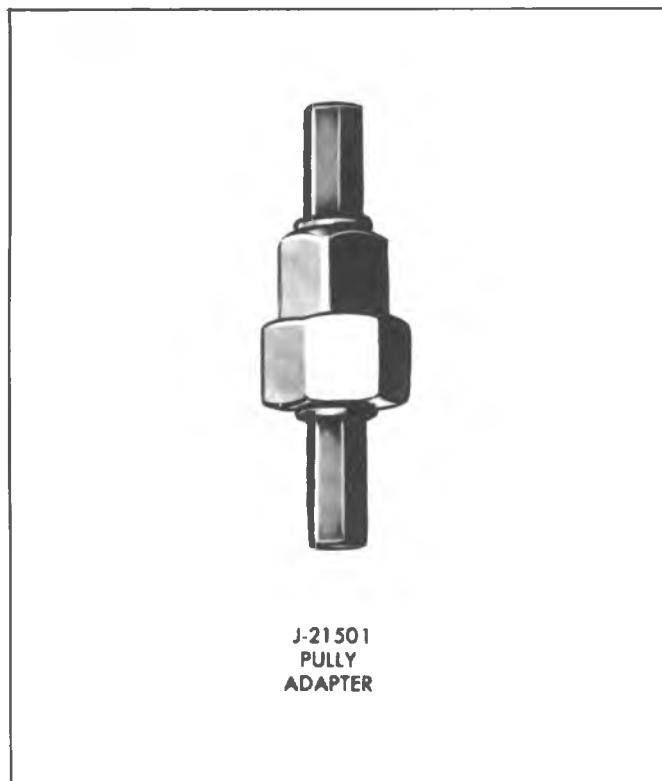
**CAUTION:** *Insulating washer on the screw must be assembled over top of the connector.*

7. Position stator in end frame. Connect stator leads to rectifier bridge terminals and install attaching nuts.

8. Position slip ring end frame to drive end frame and install four thru bolts.

**NOTE:** Remove tooth pick from brush holder at opening in slip ring end frame before operating machine on vehicle.

#### SPECIAL TOOLS



J-21501  
PULLY  
ADAPTER

Fig. 6D-10C-Special Tool

## SPECIFICATIONS

### TRUCK BATTERY

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
85-4	250 L-6 (LD4)	275 Amps	130	60
85-5	292 L-6 (L25) 305 V-8 (LG9) 350 V-8 (LS9) 400 V-8 (LF4)	350 Amps	170	80
89-5	454 V-8 (LF8) RPO UA1	465 Amps	230	125
87-5	RPO TP2	430 Amps	210	100

### PASSENGER BATTERY

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
Y87P	250 L-6 (L22) (Except Chevrolet)	275 Amps		60
85-4*	250 L-6 (L22) (Chevrolet)	275 Amps	130	60
R87P	305 V-8 (LG3) 350 V-8 (LM1) (Except Chevrolet)	350 Amps		80
85-5*	305 V-8 (LG3) 350 V-8 (LM1) (Chevrolet)	350 Amps	170	80
87-5*	350 V-8 (L48) 350 V-8 (L82) (Corvette)	430 Amps	210	100
89-5*	RPO UA1	465 Amps	230	125

\*Freedom Type

# TRUCK GENERATOR

MODEL NO.	APPLICATION	DELCO REMY SPEC. NO.	FIELD CURRENT AMPS 27°C (80°F) @ 12 VOLTS	COLD OUTPUT* AMPS @ 5000 RPM	RATED HOT OUTPUT** AMPS
1102394 1102491 1102889	All L-6 (Base) (Except G-20, 30 & P-Truck) All C-K-G Truck Base V-8 (Except K31303 & G30003)	4519	4-4.5	33	37
1102485 1102841 1102887	292 L-6 (L25) (Base) (G-20, 30 & P-Truck) All P-Truck Base V-8 (Except P31832)	4521	4-4.5	38	42
1102480 1102486 1102886 1102888	P31832 Truck (Base) All L-6 or V-8 with RPO K76 454 V-8 (FL8) (Base) K31303 & G30003 Truck Base V-8	4522	4-4.5	57	61
1101016 1101028	Optional (COPO)	4525	4-4.5	76	80

\*Generator temperature approximately 27°C. (80°F.).

\*\*Ambient temperature 27°C. (80°F.).

Note: The only difference between generators within each group above is the position end frame is rotated.

# PASSENGER GENERATOR

MODEL NO.	APPLICATION	DELCO REMY SPEC. NO.	FIELD CURRENT AMPS 27°C (80°F) @ 12 VOLTS	COLD OUTPUT* AMPS @ 5000 RPM	RATED HOT OUTPUT** AMPS
1102491	All L-6 (Base)	4519	4-4.5	33	37
1102474	Corvette — with C60	4522	4-4.5	57	61
1102478	Nova L-6 — with C60	4520	4-4.5	51	55
1102479	Nova V-8 — with C60	4520	4-4.5	51	55
1102480	All (Except Corvette & Nova) V-8 — with C60	4522	4-4.5	57	61
1102484	Corvette (Base)	4521	4-4.5	38	42
1102486	All (Except Nova) L-6 — with C60	4522	4-4.5	57	61
1102394	All (Except Corvette) V-8 (Base)	4519	4-4.5	33	37

\*Generator temperature approximately 27°C. (80°F.).

\*\*Ambient temperature 27°C. (80°F.).

# TRUCK STARTING MOTOR

MODEL NO.	APPLICATION	SPEC. NO.	VOLTS	FREE SPEED AMPERES	RPM
1108778	250 L-6 (LD4) (C & K-10)	3573	9	50-80*	5500-10500
1108779	250 L-6 (LD4) (G-Van)	3573	9	50-80*	5500-10500
1108780	292 L-6 (L25)	2438	9	50-80*	3500-6000
1109056	305 V-8 (LG9) (C & K)	3573	9	50-80*	5500-10500
1109798	305 V-8 (LG9) (G-Van)	3573	9	50-80*	5500-10500
1109052	350 V-8 (LS9)	3563	9	65-95*	7500-10500
1108776	400 V-8 (LF4) 454 V-8 (LF8)	3563	9	65-95*	7500-10500

\*Includes Solenoid

# PASSENGER STARTING MOTOR

MODEL NO.	APPLICATION	SPEC. NO.	FREE SPEED		
			VOLTS	AMPERES	RPM
1108774	250 CID L-6 Engine	3573	9	50-80*	5500-10500
1109056	305 CID V-8 Engine w/Auto Trans.	3573	9	50-80*	5500-10500
1108799	305 CID V-8 Engine w/Manual Trans.	3573	9	50-80*	5500-10500
1109059	350 CID V-8 Engine w/Manual Trans.	3563	9	65-95*	7500-10500
1109052	350 CID V-8 Engine w/Auto. Trans.	3563	9	65-95*	7500-10500

\*Includes Solenoid

# SECTION 7A

## AUTOMATIC TRANSMISSION

### THM 200 TRANSMISSION

#### INDEX

Disassembly .....	7A-1
Removal of Converter .....	7A-1
Teflon Seals .....	7A-1
External Parts .....	7A-2
Front Unit Parts .....	7A-5
Front Gear Parts .....	7A-6
Rear Gear Parts .....	7A-8
Manual Shaft and Parking Pawl .....	7A-9
Inspection and Reassembly .....	7A-9
Case .....	7A-9
Manual Shaft and Parking Pawl .....	7A-10
Rear Gear Parts .....	7A-13
Low and Reverse Clutch .....	7A-17
Front Gear Parts .....	7A-20
Front Unit Parts .....	7A-23
Forward and Direct Clutch .....	7A-29
Pump Assembly .....	7A-30
External Parts .....	7A-34
Control Valve Assembly .....	7A-37
Bushing Replacement .....	7A-42
Specifications .....	7A-47
Special Tools .....	7A-47

#### DISASSEMBLY

##### **Removal of Converter**

1. With transmission in cradle of portable jack, remove J-21366 and then converter assembly by pulling straight out.
2. Install Holding Fixture, J-8763-02 on transmission and place into Holding Fixture, J-3289-20, with manual shaft facing bench and oil pan side up (Fig. 7A-1A).

**CAUTION:** *Do not over-torque fixture holding screw.*

**NOTE:** Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and reassembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

**CAUTION:** *Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers.*

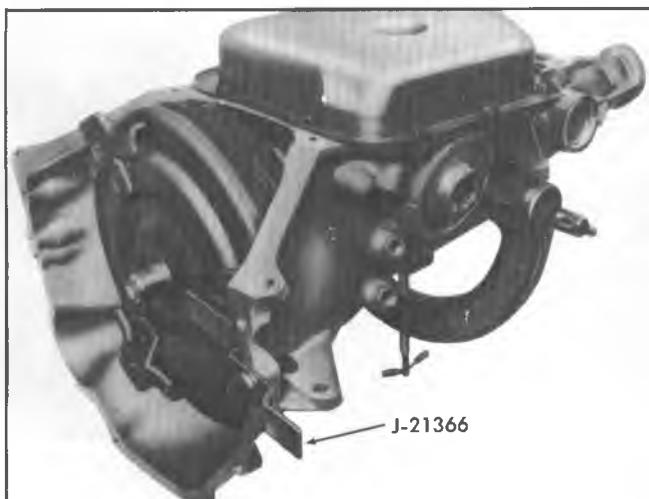


Fig. 7A-1A--Transmission Holding Fixture

##### **Teflon Seals**

If any teflon seal rings are damaged (distorted, cut, scored, etc.), or do not rotate freely in their groove, and replacement is necessary, do the following:

1. Remove and discard old angle cut seal rings; full circle rings must be cut off.
2. Inspect seal ring groove for burrs or damage.
3. When installing angle cut seal rings, do not overstretch. Make sure cut ends are in same relation as cut (Fig. 7A-2A). Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings. Retain with petrolatum.
4. New angle cut or full circle teflon seal rings may appear to be distorted after being installed. Once exposed to normal transmission oil temperatures, the new seal rings will return to their normal shape and fit freely in their bores.
5. The teflon seal rings allow for a free fit in their bores after operation. The free fit of the rings in their bores does not indicate leakage during operation.

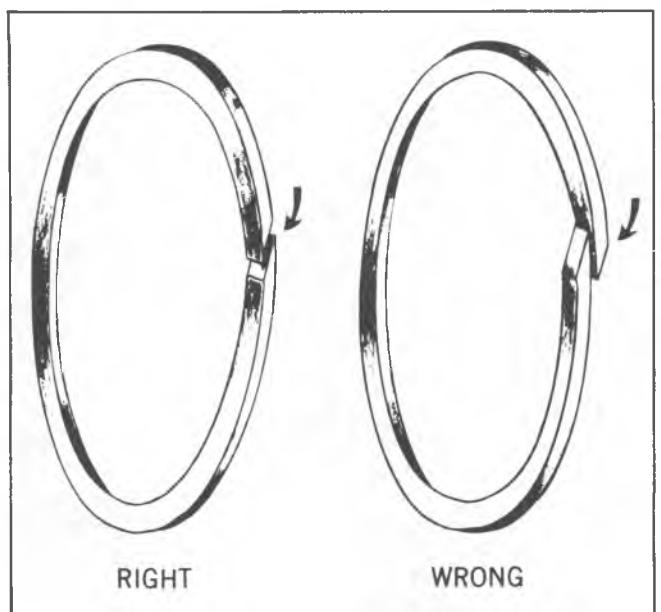


Fig. 7A-2A--Teflon Oil Seal Rings

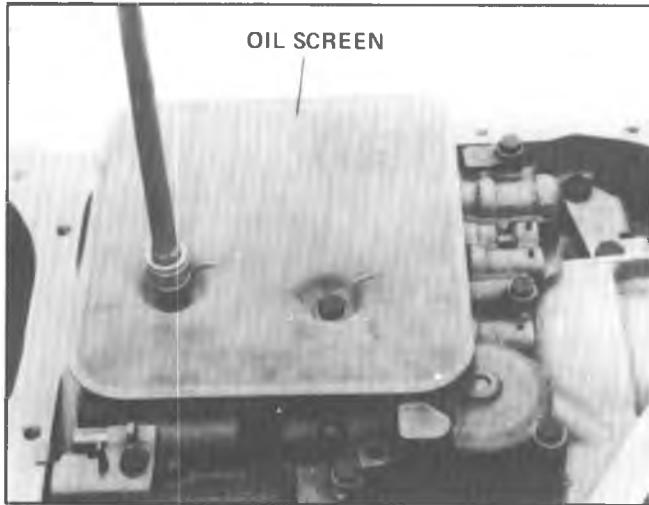


Fig. 7A-3A--Removing Oil Screen

**Snap Rings**

Do not over expand snap rings when removing or installing.

**Thrust Washer Surfaces**

The thrust washers and thrust bearings will polish the surfaces they protect. This is not to be considered a damaged part because of this condition.

**EXTERNAL PARTS - REMOVAL**

1. Remove oil pan and discard gasket.
2. Remove oil screen and discard gasket (Fig. 7A-3A).
- CAUTION:** The two oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.
3. Control Valve Assembly:
  - a. Remove throttle lever and bracket assembly (Fig. 7A-4A). Do not bend throttle lever link.
  - NOTE:** T.V. exhaust valve lifter and spring may separate from throttle lever and bracket assembly.
  - b. Remove manual detent roller and spring assembly (Fig. 7A-5A).
  - c. Remove remaining control valve assembly attaching bolts.



Fig. 7A-4A--Removing Throttle Valve and Bracket Assembly

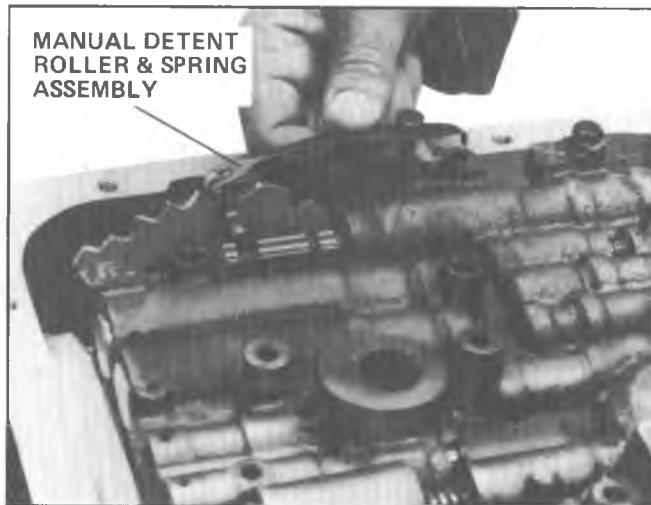


Fig. 7A-5A--Removing Manual Detent Roller and Spring Assembly

**CAUTION:** Do not drop manual valve.

d. Holding manual valve with finger, remove control valve assembly, spacer plate, and gaskets together, to prevent the dropping of 4 check balls, located in the control valve assembly (Fig. 7A-6A).

e. Lay control valve assembly down with spacer plate side up and discard gaskets.

4. Remove 1-2 accumulator spring (Fig. 7A-7A).

5. Remove 5th check ball located in case (Fig. 7A-8A).

6. Governor Assembly:

a. Using small screwdriver, remove governor cover retaining ring (Fig. 7A-9A).

b. Using pliers, remove governor cover and discard 2 seal rings; seal rings may be located in case (Fig. 7A-10A).

**NOTE:** Governor assembly may come out with cover.

**CAUTION:** Do not use any type of pliers to remove governor assembly.

c. Remove governor assembly from case. It may be necessary to rotate output shaft counterclockwise while removing the governor.

7. Intermediate Servo Assembly:

a. Using small screwdriver, remove intermediate servo cover retaining ring (Fig. 7A-11A).

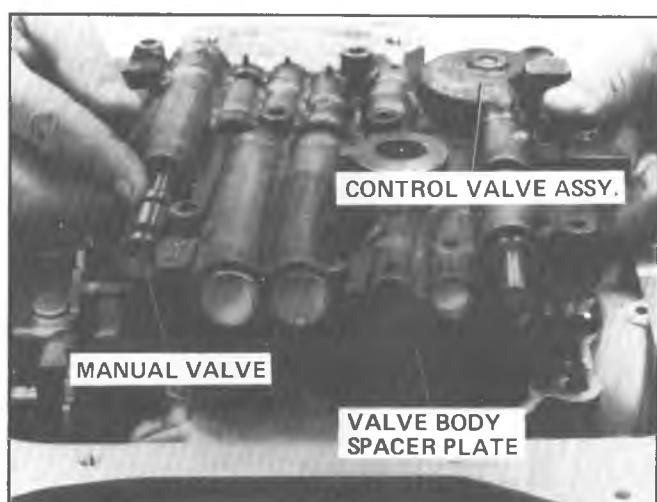


Fig. 7A-6A--Removing Control Valve Assembly from Case

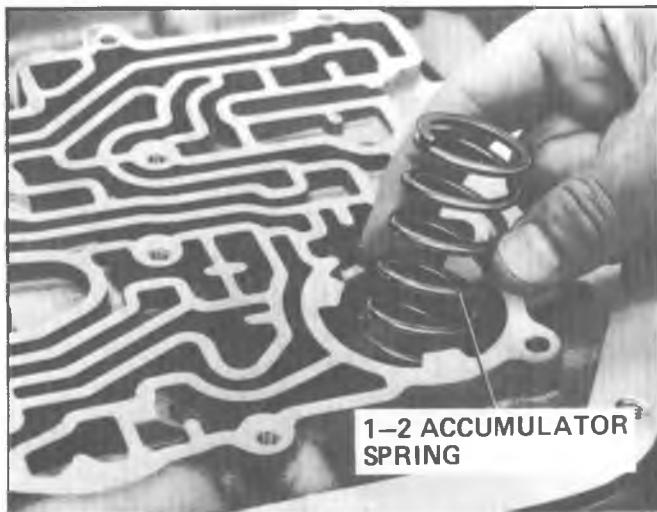


Fig. 7A-7A--Removing 1-2 Accumulator Spring



Fig. 7A-10A--Removing Governor Cover

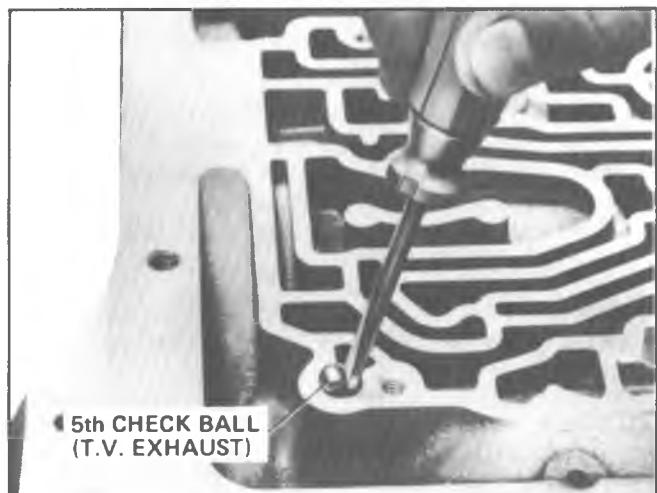


Fig. 7A-8A--Removing 5th Check Ball



Fig. 7A-11A--Removing Intermediate Servo Retaining Ring

b. Using pliers, remove intermediate servo cover and discard seal rings; cover seal ring may be located in case (Fig. 7A-12A).

c. Remove intermediate servo piston and band apply pin assembly (Fig. 7A-13A).

**NOTE:** If intermediate servo cover and seal assembly can not be removed easily, place shop towels and hand over cover and case. Apply air pressure into the direct clutch accumulator port (Figs. 7A-14A and 7A-15A).



Fig. 7A-9A--Removing Govenor Cover Retaining Ring

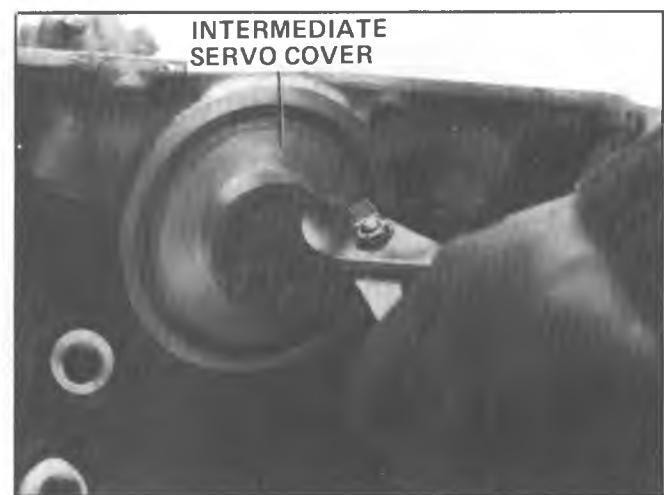


Fig. 7A-12A--Removing Servo Cover and Seal



Fig. 7A-13A--Removing Intermediate Servo



Fig. 7A-16A--Checking for Proper Intermediate Band Apply Pin



Fig. 7A-14A--Direct Clutch Accumulator Port

8. Check for proper intermediate band apply pin as follows:

- Install J-25014-2 in intermediate servo bore and retain with intermediate servo cover retaining ring, aligning ring with gap at case slot (Fig. 7A-16A).
- Install pin J-25014-1 into J-25014-2 (Fig. 7A-16A).



Fig. 7A-15A--Apply Air Pressure to Remove Intermediate Servo

INTERMEDIATE BAND APPLY PIN CHART		
DIAL INDICATOR TRAVEL	APPLY PIN IDENTIFICATION	APPLY PIN IDENTIFICATION +
.0	.72mm (.0 - .029")	1 Ring
.72mm-	1.44mm (.029" - .057")	2 Rings
1.44mm-	2.16mm (.057" - .086")	3 Rings
2.16mm-	2.88mm (.086" - .114")	Wide Band

Fig. 7A-17A--Intermediate Band Apply Pin Selector Chart

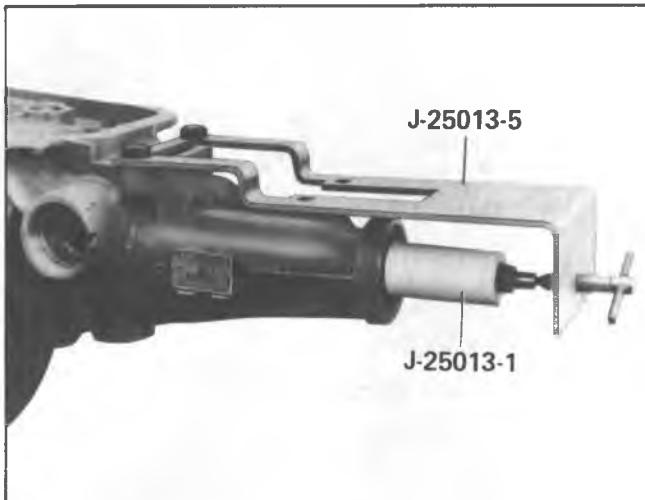


Fig. 7A-18A--Installing Tools on Rear End of Case

The identification ring is located on the band end of the pin.

f. Remove tools J-25014-2 and J-25014-1.

## FRONT UNIT PARTS

### Removal

1. Check front unit end play as follows:
  - a. Install J-25013-1 sleeve on output shaft first; then bolt J-25013-5 on end of case (Fig. 7A-18A).
  - b. Turn transmission to vertical position, pump side up.
  - c. Remove pump to case bolt and washer and install 278mm (11") long bolt and locking nut as shown (Fig. 7A-19A).
  - d. Push turbine shaft downward.
  - e. Install J-25022 on J-24773 tool and secure on end of turbine shaft (Fig. 7A-19A).
  - f. Mount dial indicator and clamp assembly on bolt, positioning indicator point against cap nut of J-24773.
  - g. Move output shaft upward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear (Fig. 7A-18A), then set dial indicator to zero.
  - h. Pull J-24773 on turbine shaft upward and read end play. Front unit end play should be 0.56mm-1.30mm (.022"-.051").



Fig. 7A-19A--Checking Front Unit End Play

FRONT UNIT END PLAY CHART	
THICKNESS	IDENTIFICATION
Number and/or Color	
1.66-1.77mm (0.065"-0.070")	1
1.79-1.90mm (0.070"-0.075")	2
1.92-2.03mm (0.076"-0.080")	3 - Black
2.05-2.16mm (0.081"-0.085")	4 - Light Green
2.18-2.29mm (0.086"-0.090")	5 - Scarlet
2.31-2.42mm (0.091"-0.095")	6 - Purple
2.44-2.55mm (0.096"-0.100")	7 - Cocoa Brown
2.57-2.68mm (0.101"-0.106")	8 - Orange
2.70-2.81mm (0.106"-0.111")	9 - Yellow
2.83-2.94mm (0.111"-0.116")	10 - Light Blue
2.96-3.07mm (0.117"-0.121")	11
3.09-3.20mm (0.122"-0.126")	12

Fig. 7A-20A--Front Unit End Play Washer Chart

**NOTE:** Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart shown in figure 7A-20A.

- i. Remove dial indicator clamp assembly, J-24773 and J-25022 (Fig. 7A-19A).
- j. Do not remove J-25013-5 or J-25013-1.
2. Pump:
  - a. If necessary, remove pump oil seal and discard (Fig. 7A-21A).
  - b. Remove remaining pump to case bolts and washers; discard washers.
  - c. Using J-24773 tool, remove pump assembly, pump to case gasket and discard gasket (Fig. 7A-22A).
3. Forward and Direct Clutch:
  - a. Grasp turbine shaft and remove direct and forward clutch assemblies (Fig. 7A-23A).
  - b. Lift direct clutch assembly off forward clutch assembly.
- NOTE:** The direct-to-forward clutch thrust washer may stick to the end of the direct clutch housing when it is removed from the forward clutch housing.
4. Remove intermediate band assembly (Fig. 7A-24A).
5. Remove band anchor pin (Fig. 7A-25A).



Fig. 7A-21A--Removing Oil Pump Seal



Fig. 7A-22A--Removing Pump Assembly

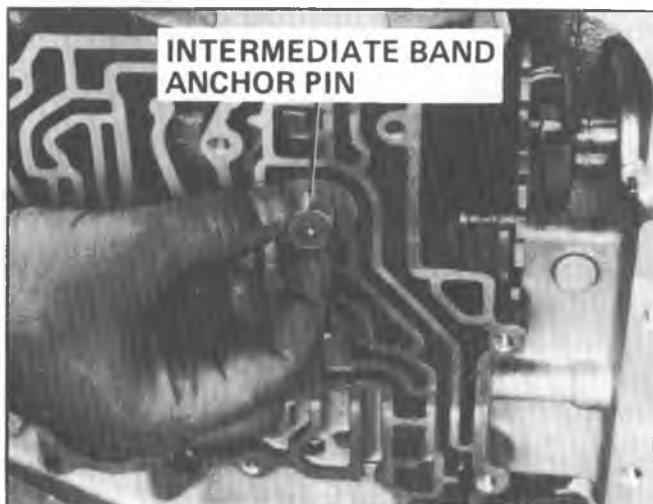


Fig. 7A-25A--Removing Intermediate Band Anchor Pin

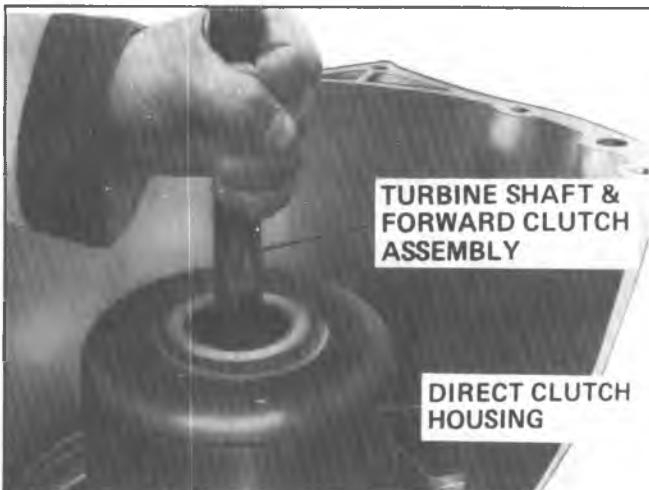


Fig. 7A-23A--Removing Forward and Direct Clutch Assemblies

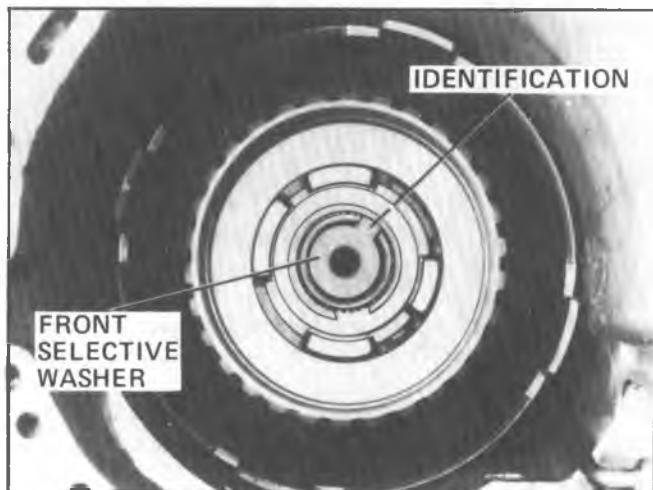


Fig. 7A-26A--Location of Front Selective Washer

## FRONT GEAR PARTS

### Removal

1. Remove output shaft to turbine shaft front selective washer (Fig. 7A-26A).

**NOTE:** This washer may be stuck to the end of the turbine shaft.

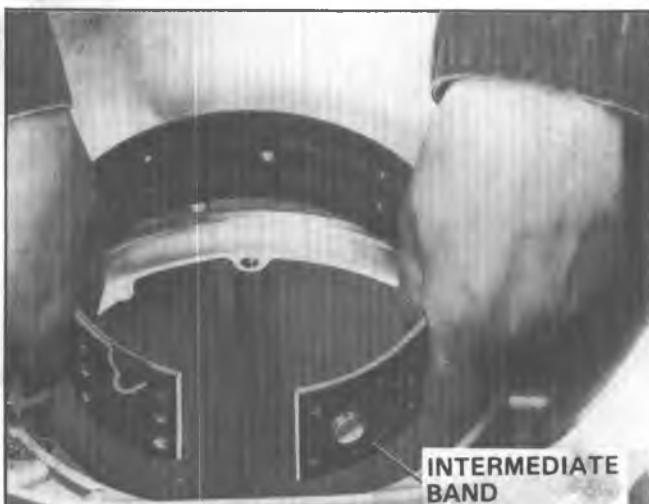


Fig. 7A-24A--Removing Intermediate Band Assembly

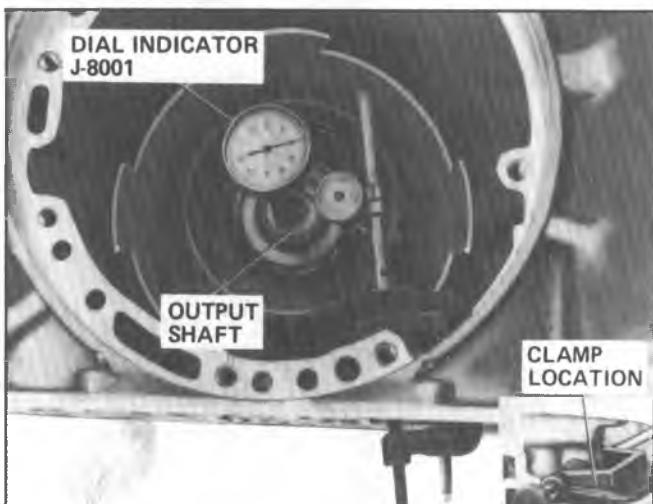


Fig. 7A-27A--Checking Rear Unit End Play

2. Check Rear Unit end play as follows:
  - a. Loosen J-25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A-18A).
  - b. Install gauge clamp on case as shown (Fig. 7A-27A).
  - c. Install dial indicator J-8001 and plunger extension

J-7057. Position extension against end of output shaft and set dial indicator to zero (Fig. 7A-27A).

d. Move output shaft upward by turning adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013 begins to disappear; then read end play. (Rear unit end play should be 0.10-0.63mm.) (.004"-.025").

**NOTE:** Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart shown in Fig. 7A-28A.

e. Remove dial indicator and clamp assembly (Fig. 7A-27A). Do not remove J-25013 tools.

**NOTE:** It may be necessary to tighten J-25013 adjusting screw on output shaft to remove snap ring.

3. Using snap ring pliers, remove output shaft to selective washer snap ring (Fig. 7A-29A).

#### 4. Front Internal Gear:

a. Remove front internal gear, rear selective washer and thrust washer.

b. Remove rear selective washer and thrust washer from front internal gear.

5. Remove front carrier assembly and the front internal gear to front carrier roller bearing assembly (Fig. 7A-30A).

**NOTE:** Models CN, CU and CZ use a front carrier with 2 pinions. All other models use 4 pinions.

REAR UNIT END PLAY CHART		
<u>THICKNESS</u>	<u>IDENTIFICATION</u>	
	<u>Number and/or Color</u>	
2.90 - 3.01mm	(0.114"-0.119")	1 Orange
3.08 - 3.19mm	(0.121"-0.126")	2 White
3.26 - 3.37mm	(0.128"-0.133")	3 Yellow
3.44 - 3.55mm	(0.135"-0.140")	4 Blue
3.62 - 3.73mm	(0.143"-0.147")	5 Red
3.80 - 3.91mm	(0.150"-0.154")	6 Brown
3.98 - 4.09mm	(0.157"-0.161")	7 Green
4.16 - 4.27mm	(0.164"-0.168")	8 Black
4.34 - 4.45mm	(0.171"-0.175")	9 Purple

Fig. 7A-28A--Rear Unit End Play Washer Chart

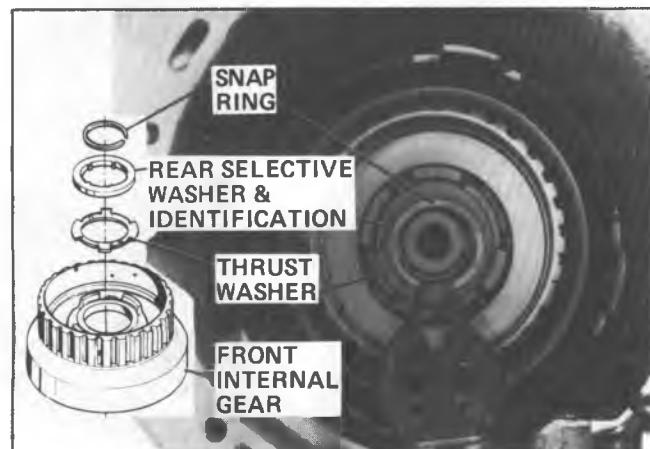


Fig. 7A-29A--Removing Output Shaft to Selective Washer Snap Ring

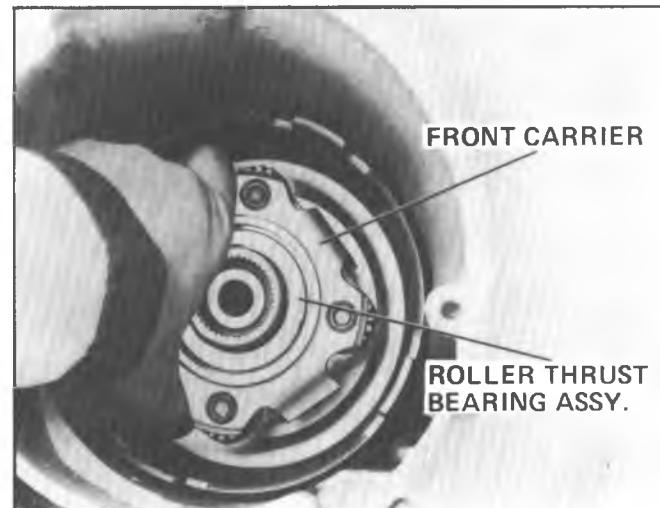


Fig. 7A-30A--Removing Front Carrier and Roller Thrust Bearing

**NOTE:** The front sun gear to front carrier thrust bearing assembly may come out as the front carrier is removed.

6. Remove front sun gear and front sun gear to front carrier thrust bearing assembly (Fig. 7A-31A).

**NOTE:** This thrust bearing requires only one thrust race.

7. Input drum and rear sun gear assembly:

a. Remove input drum and rear sun gear (Fig. 7A-32A).

b. Remove the 4 tanged input drum to reverse clutch housing thrust washer from rear of input drum or from reverse clutch housing.

8. Low and Reverse clutch housing assembly:

**CAUTION:** If low and reverse clutch housing assembly has to be removed, the low and reverse clutch piston travel must be checked.

a. Using a No. 14 sheet metal screw, remove housing to case cup plug and seal by turning screw 2 or 3 turns and pulling straight out. Discard cup plug and seal (Fig. 7A-33A).

**NOTE:** If cup plug will not remove, grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug. Then use No. 14 sheet metal screw to remove seal.

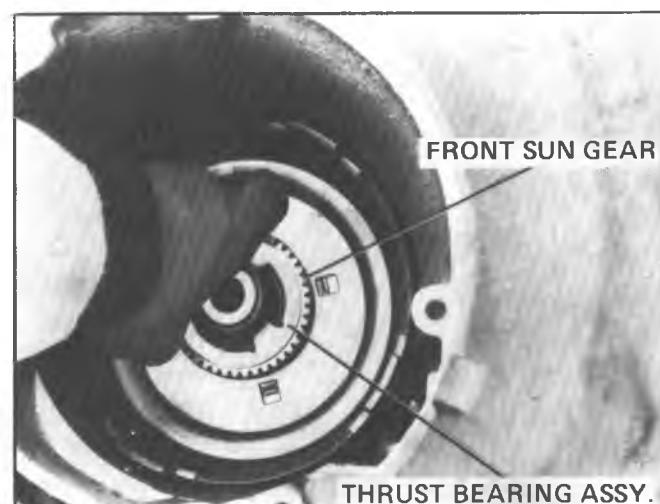


Fig. 7A-31A--Removing Thrust Bearing Assembly and Front Sun Gear



Fig. 7A-32A--Removing Input Drum and Rear Sun Gear

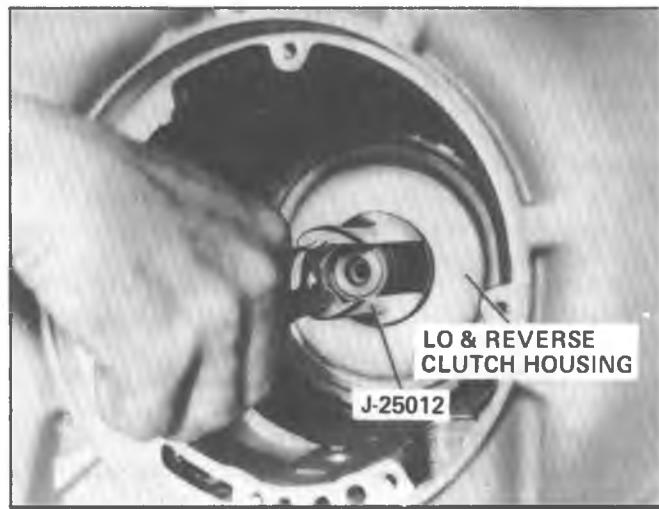


Fig. 7A-35A--Removing Low and Reverse Clutch Housing



Fig. 7A-33A--Removing Cup Plug and Seal

b. Remove low and reverse clutch housing to case beveled snap ring (Fig. 7A-34A).

**NOTE:** The flat side of the ring should have been against the low and reverse clutch housing with beveled side up.



Fig. 7A-34A--Removing Low and Reverse Housing to Case Snap Ring

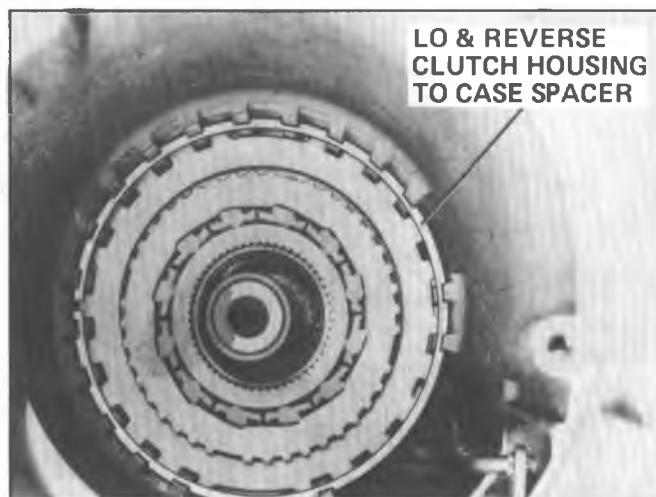


Fig. 7A-36A--Proper Location of Low and Reverse Housing to Case Spacer

c. Using J-25012, remove low and reverse clutch housing assembly by moving J-25012 back and forth (Fig. 7A-35A).

d. Remove low and reverse clutch housing to case spacer ring (Fig. 7A-36A).

## REAR GEAR PARTS

### Removal

**NOTE:** Make sure governor has been removed at this time.

1. Grasp output shaft and lift out remainder of rear unit parts and lay down in a horizontal position (Fig. 7A-37A).

2. Remove low and reverse clutch selective spacer.

3. Roller clutch and rear carrier assembly.

a. Remove roller clutch and rear carrier assembly off output shaft.

**NOTE:** Models CN, CU and CZ use a rear carrier with 2 pinions. All other models use 4 pinions.

b. Remove the 4 tanged rear carrier to rear internal gear thrust washer off the end of the rear carrier, or inside the rear internal gear (Fig. 7A-38A).

4. Remove low and reverse clutch plates off output shaft.

5. Rear internal gear:

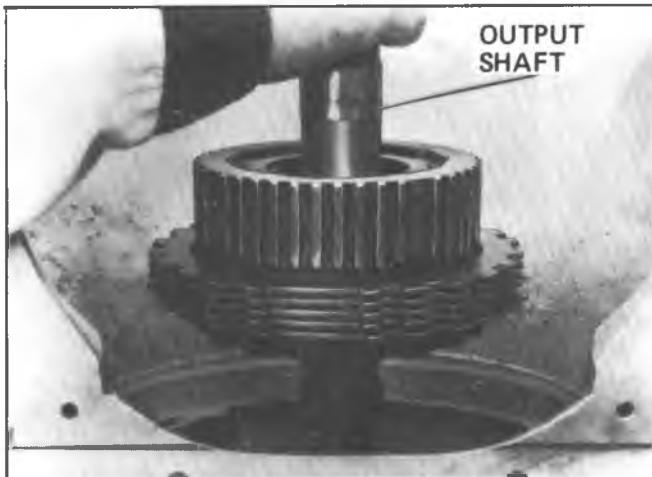


Fig. 7A-37A--Removing Rear Unit Parts



Fig. 7A-40A--Removing Rear Oil Seal



Fig. 7A-38A--Removing Thrust Washers

- a. Remove rear internal gear to rear sun gear roller thrust bearing assembly off rear internal gear.
- b. Remove gear internal gear off output shaft (Fig. 7A-39A).
- c. Turn transmission to horizontal position and remove J-25013-5 and J-25013-1 tools from case. Turn transmission to vertical position with rear end up.

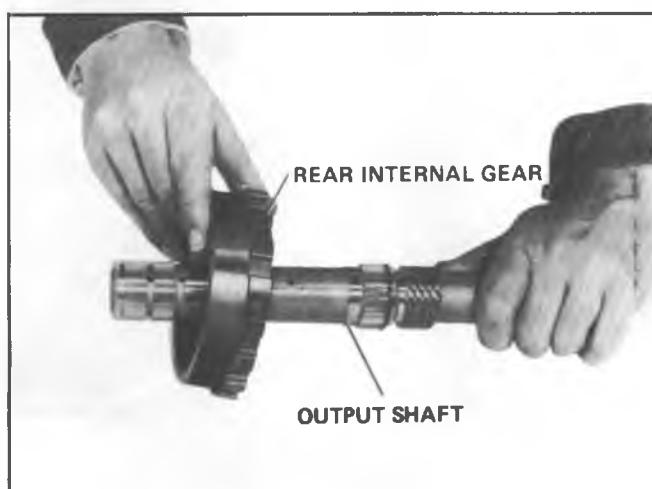


Fig. 7A-39A--Removing Rear Internal Gear

7. If necessary, remove real oil seal (Fig. 7A-40A).

#### **MANUAL SHAFT AND PARKING PAWL PARTS**

##### **Removal**

1. Turn transmission to horizontal position, oil pan side up.
2. If necessary, remove manual shaft and parking linkage as follows:
  - a. Remove hex nut which holds inside detent lever to manual shaft (Fig. 7A-42A).
  - b. Remove parking brake actuator rod and inside detent lever assembly.
  - c. Remove manual shaft retaining pin from case and slide manual shaft out (Fig. 7A-43A).
  - d. Inspect manual shaft to case seal for damage. If necessary, pry out manual shaft seal using screwdriver (Fig. 7A-44A).
  - e. Remove parking brake bracket (Fig. 7A-45A).
  - f. Remove parking brake pawl shaft retaining pin (Fig. 7A-46A).
  - g. Using 6.3mm (No. 4) easy out, remove parking brake pawl cup plug and discard (Fig. 7A-47A).
- NOTE: Grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug.
- h. Using sheet metal screw or 4mm (No. 3) easy out, remove parking brake pawl shaft (Fig. 7A-48A).
- i. Remove parking pawl and return spring.

#### **INSPECTION AND REASSEMBLY**

##### **Inspection of Case Assembly**

**NOTE:** Model CN, CU and CZ cases have a tapped hole with a hex head plug or a pressure switch near the intermediate servo bore. Do not remove the switch or plug unless replacement is required.

1. Inspect case assembly for damage, cracks, porosity or interconnected oil passages. If case is porous, refer to porosity repair.
2. Inspect orifice plug in the intermediate servo bore. If the plug requires replacement, place the new plug, orifice end first, into plug hole in case. Drive plug flush to slightly below top of plug hole.
3. Inspect the exhaust vents for being opened.
4. Inspect reverse clutch lugs, governor bore, intermediate servo bore, speedometer bore and snap ring grooves for damage.

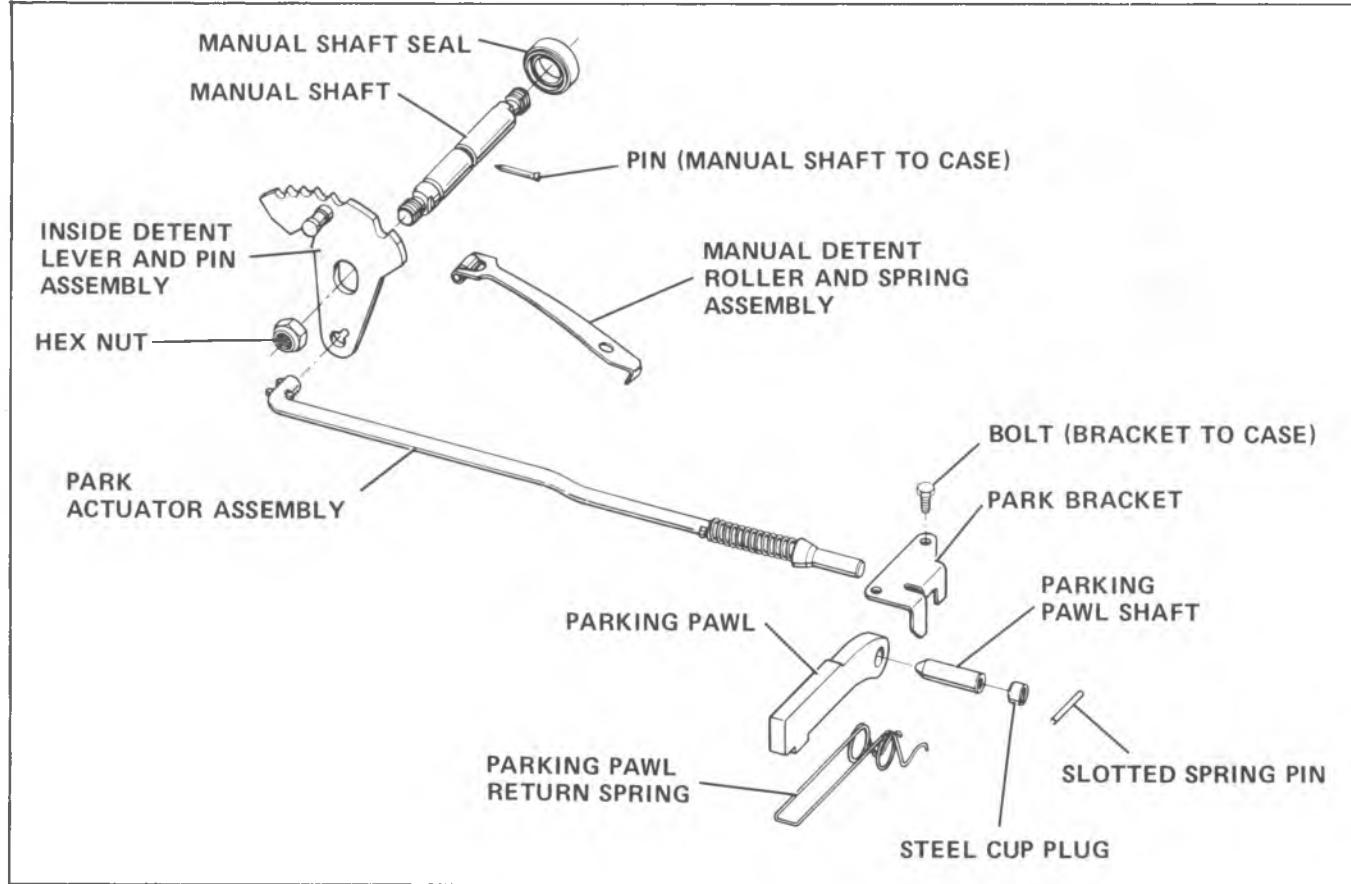


Fig. 7A-41A--Manual Shaft and Parking Shaft Parts

5. Inspect reverse clutch seal and intermediate band anchor pin bores for damage.
6. Inspect vent assembly in case for damage. Do not remove unless replacement is required.
7. Inspect for damaged or stripped bolt holes. If any threaded holes require heli-coils or equivalent, install these to renew the threads.
8. Turn transmission to vertical position, rear end up.
9. Inspect cooler line connectors for damage. Do not remove unless replacing.
10. Inspect case bushing for damage or scoring.
11. If removed, install a new oil seal, using J-21426 (Fig. 7A-51A).

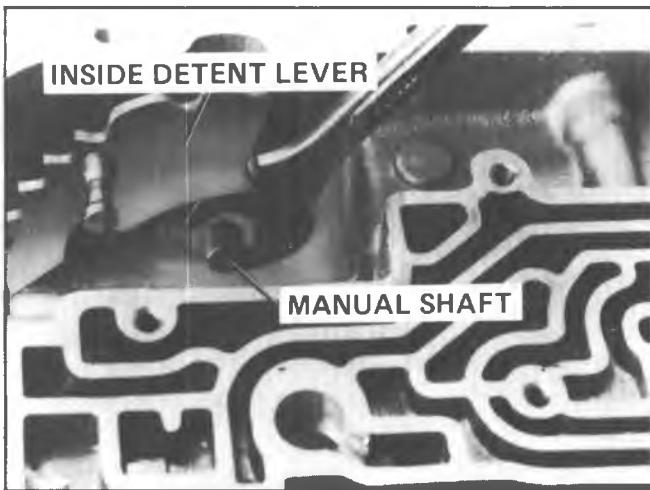


Fig. 7A-42A--Removing Manual Shaft Nut

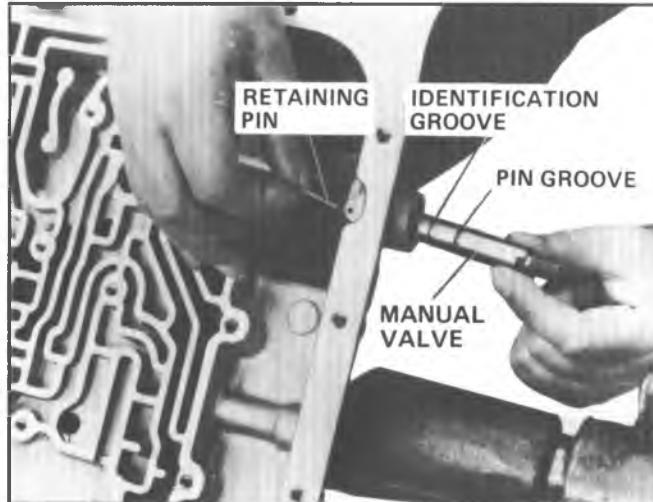


Fig. 7A-43A--Removing Manual Shaft from Case

12. If vent was removed, apply Loctite Primer "T", or equivalent, to the outside diameter of the vent that locates in the case and Loctite 35, or equivalent, to the vent hole in the case. Install vent, using a rubber or plastic hammer.

13. If removed, install new cooler line washer(s) and connector(s); torque connector(s) to 20.0-27.0 N·m (15-20 ft. lbs.).

#### MANUAL SHAFT AND PARKING PAWL PARTS (Fig. 7A-52A)

##### Inspection

1. Align actuator rod tangs with hole in inside detent lever and separate.



Fig. 7A-44A--Removing Manual Shaft Seal From Case



Fig. 7A-47A--Removing Parking Pawl Shaft Cup Plug from Case

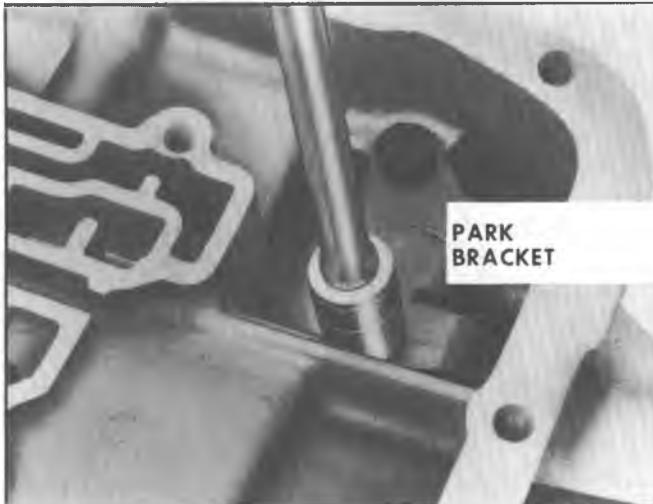


Fig. 7A-45A--Removing Parking Pawl Bracket Bolt

2. Inspect parking actuator rod for damage, or broken retainer lugs.
3. Inspect parking actuator spring for damage.
4. Inspect actuator for free fit on actuator rod.
5. Inspect parking pawl for cracks or damage.



Fig. 7A-46A--Removing Parking Pawl Shaft Pin

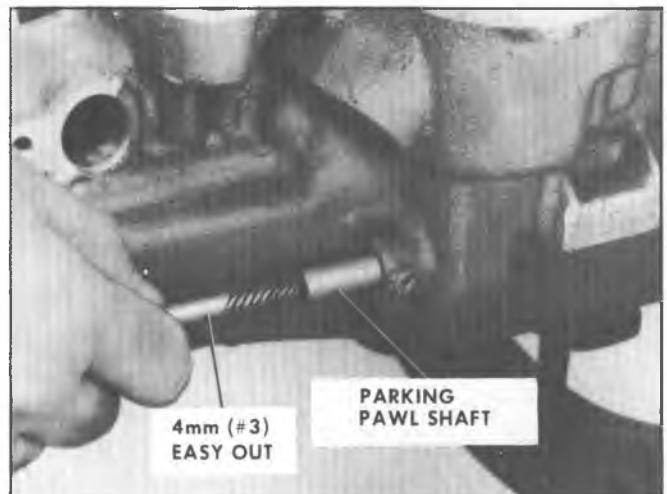


Fig. 7A-48A--Removing Parking Pawl Shaft from Case

6. Inspect parking pawl return spring for deformed end or coils.

7. Inspect parking pawl shaft for damage.
8. Inspect parking bracket for cracks or wear.
9. Inspect inside detent lever for cracks or loose pin.
10. Inspect manual shaft for damaged threads and the flats for raised edges. File down any raised edges.

#### Reassembly

1. Turn transmission to horizontal position, oil pan side up.
2. If removed, install new manual shaft seal with lip facing inward into transmission case using a 13mm or 9/16" socket to seat seal (Fig. 7A-53A).
3. Install parking pawl and return spring with tooth toward inside of case and parking pawl return spring under pawl tooth with spring ends toward inside of case (Fig. 7A-54A). Make sure spring ends locate against case pad.
4. Align parking pawl and return spring with case shaft bore.
5. Install parking pawl shaft, tapered end first.
6. Using 10mm (3/8") rod, install new parking pawl shaft cup plug, open end out, past retaining pin hole (Fig. 7A-55A).

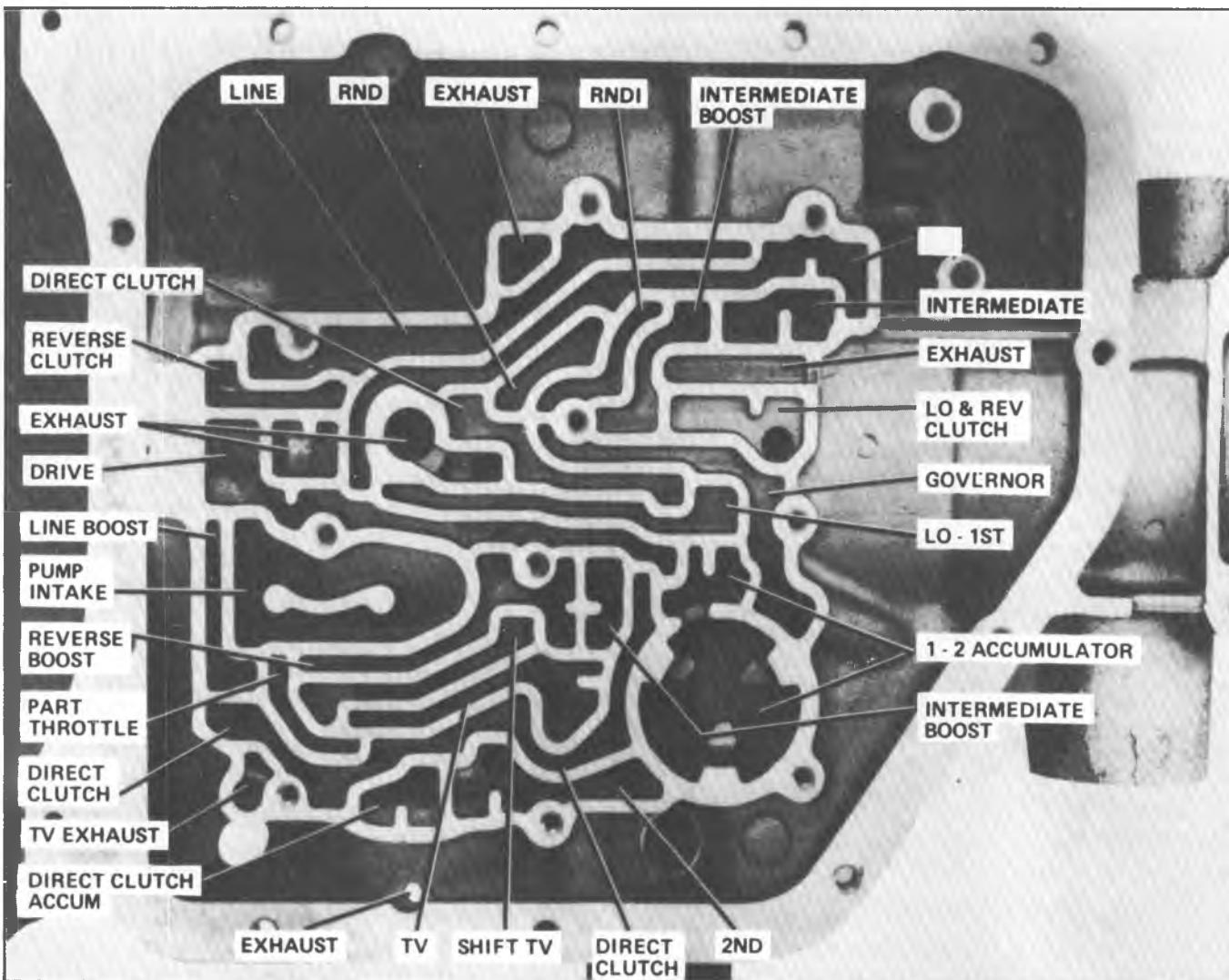


Fig. 7A-49A--Oil Passages - Bottom of Case

7. Install parking pawl shaft retaining pin.

8. While holding the parking pawl toward center of transmission, install parking bracket. Torque bolts to 20.0-27.0 N·m (15-20 ft. lbs.).

9. Install parking actuator rod into inside detent lever on pin side, locating lever between actuator rod tangs.

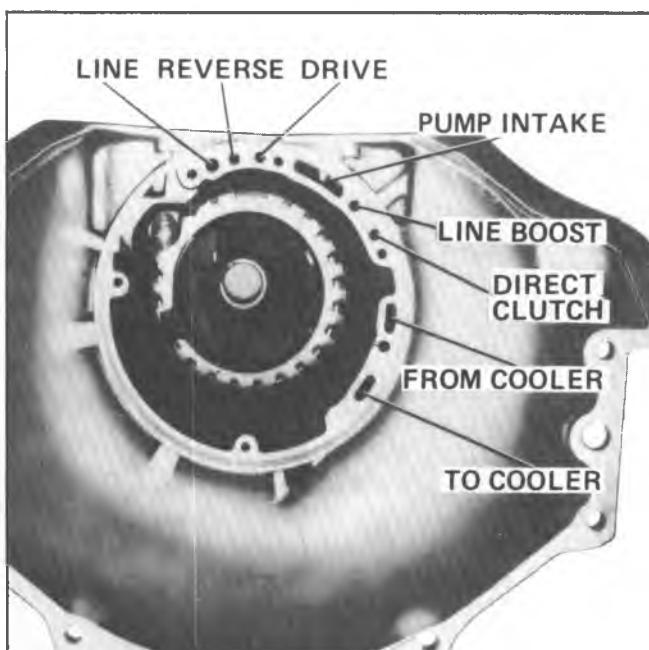


Fig. 7A-50A--Oil Passages, Front of Case

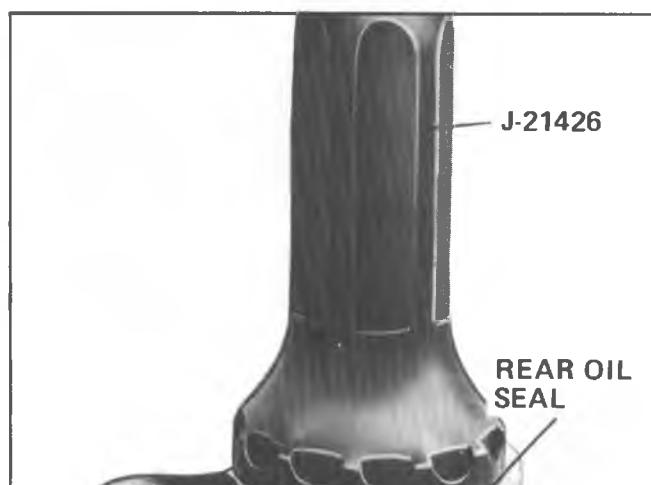


Fig. 7A-51A--Installing Rear Oil Seal

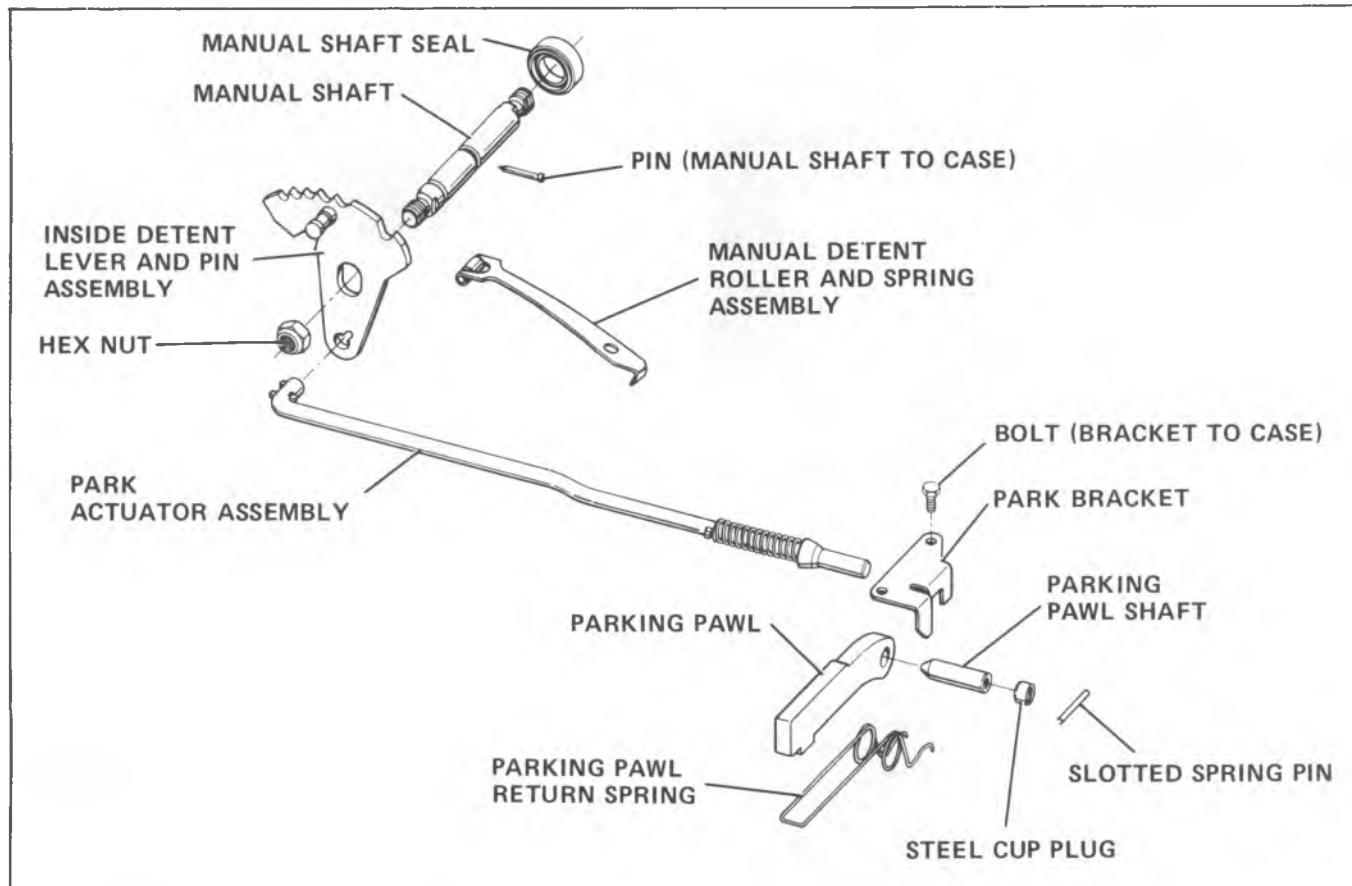


Fig. 7A-52A--Manual Shaft and Parking Shaft Parts

10. Install parking actuator rod and inside detent lever with detent lever pin toward center of transmission and actuator plunger between parking pawl and parking bracket (Fig. 7A-56A).

**CAUTION:** File any burrs or raised edges off the manual shaft that could damage the seal during installation of the shaft.

11. Install manual shaft, small identification ring groove first, through case. Install manual shaft to case retaining pin, indexing with larger groove on manual shaft (Fig. 7A-57A).

12. Aligning inside detent lever with flats on manual shaft, install inside detent lever on shaft.

13. Install hex nut on manual shaft and torque to 27.0-34.0 N·m (20-25 ft. lbs.).

## REAR GEAR PARTS

### Output Shaft (Fig. 7A-58A)

**NOTE:** The service output shaft has one speedometer drive gear clip hole at the front speedometer gear location which is about 6.3mm (1/4") diameter and opposite this hole is another clip hole which is about



Fig. 7A-53A--Installing Manual Shaft Seal Into Case



Fig. 7A-54A--Installing Parking Pawl

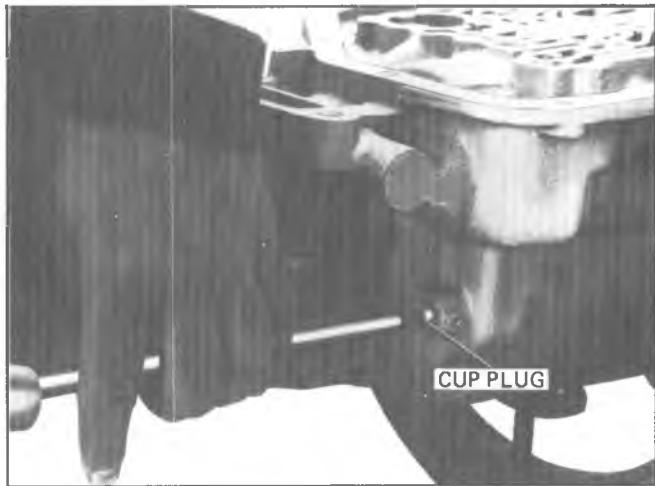


Fig. 7A-55A--Installing Parking Pawl Cup Plug

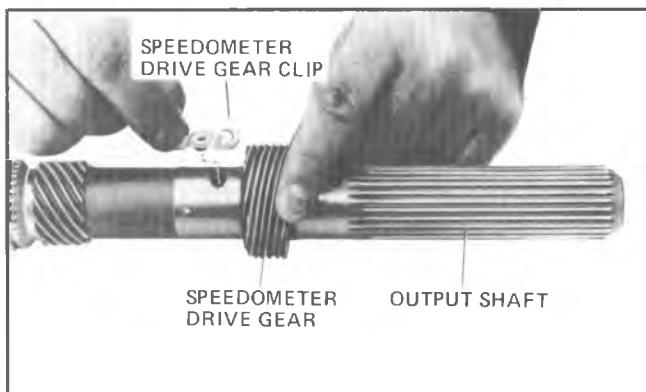


Fig. 7A-58A--Output Shaft

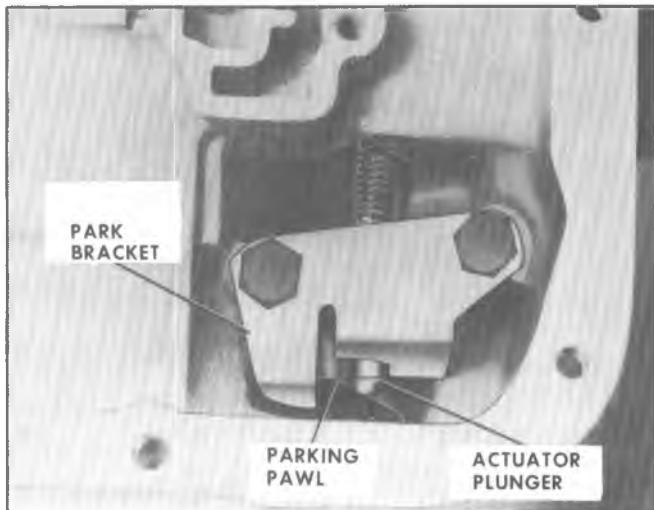


Fig. 7A-56A--Installing Parking Pawl Rod

4.0mm (5/32"). The shaft also has the same size holes at the rear speedometer gear location.

1. Inspect journals and snap ring grooves for wear or damage.
2. Inspect lubrication passages for being plugged or damaged.

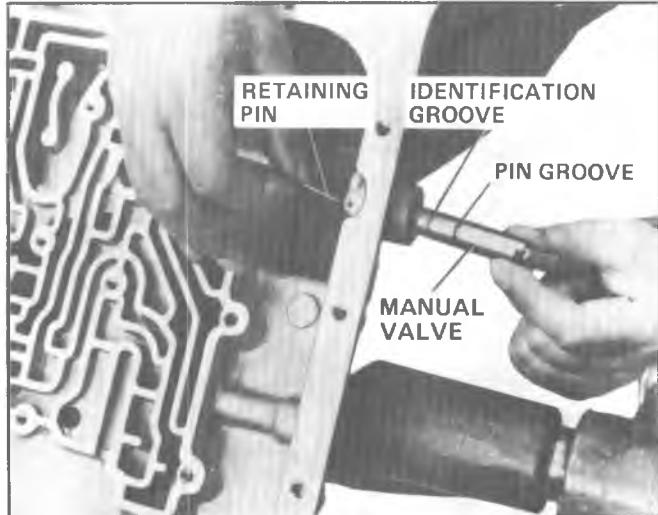


Fig. 7A-57A--Installing Manual Shaft Into Case

### Rear Internal Gear

1. Inspect rear internal gear, splines, teeth and bearing surface for wear, cracks or damage.

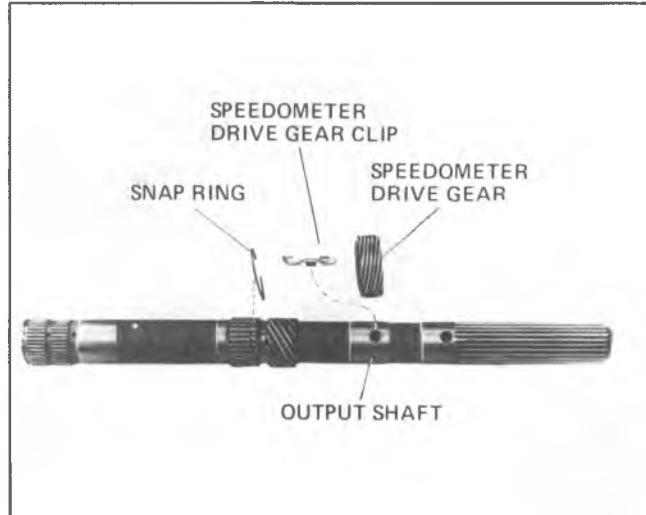


Fig. 7A-59A--Installing Speedometer Drive Gear and Clip

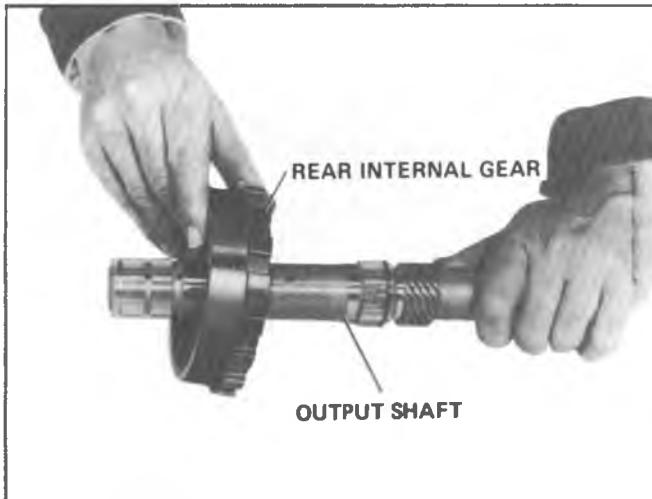


Fig. 7A-60A--Installing Rear Internal Gear on Output Shaft

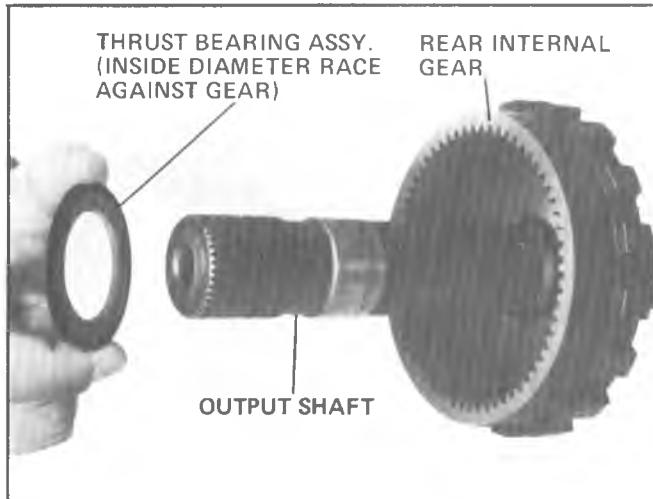


Fig. 7A-61A--Installing Thrust Bearing Assembly

2. Inspect parking pawl lugs for cracks or damage.
3. Install rear internal gear, hub end first, on output shaft, as shown in Fig. 7A-60A.
4. Thoroughly clean, air dry and inspect closely, the rear internal gear to rear sun gear roller thrust bearing assembly for pitted or rough conditions.
5. Install rear internal gear to rear sun gear roller thrust bearing assembly by placing the small diameter race over the output shaft (Fig. 7A-61A).

### Roller Clutch and Rear Carrier Assembly

**NOTE:** Models CN, CU and CZ use a rear carrier with 2 pinions. All other models use 4 pinions.

### Inspection

1. Remove roller clutch race. Inspect race and spline for scoring or wear (Fig. 7A-62A).
2. Remove roller clutch assembly and inspect roller bearings cage and springs for damage or wear (Fig. 7A-62A).
3. Remove and inspect rear carrier to roller clutch thrust washer for signs of scoring or excessive wear.
4. Inspect 4 tanged rear carrier to rear internal gear thrust washer for being scored or distorted tangs (Fig. 7A-62A).
5. Inspect rear carrier for damage.
6. Inspect roller clutch cam ramps for damage.
7. Inspect bushing for damage or scoring.

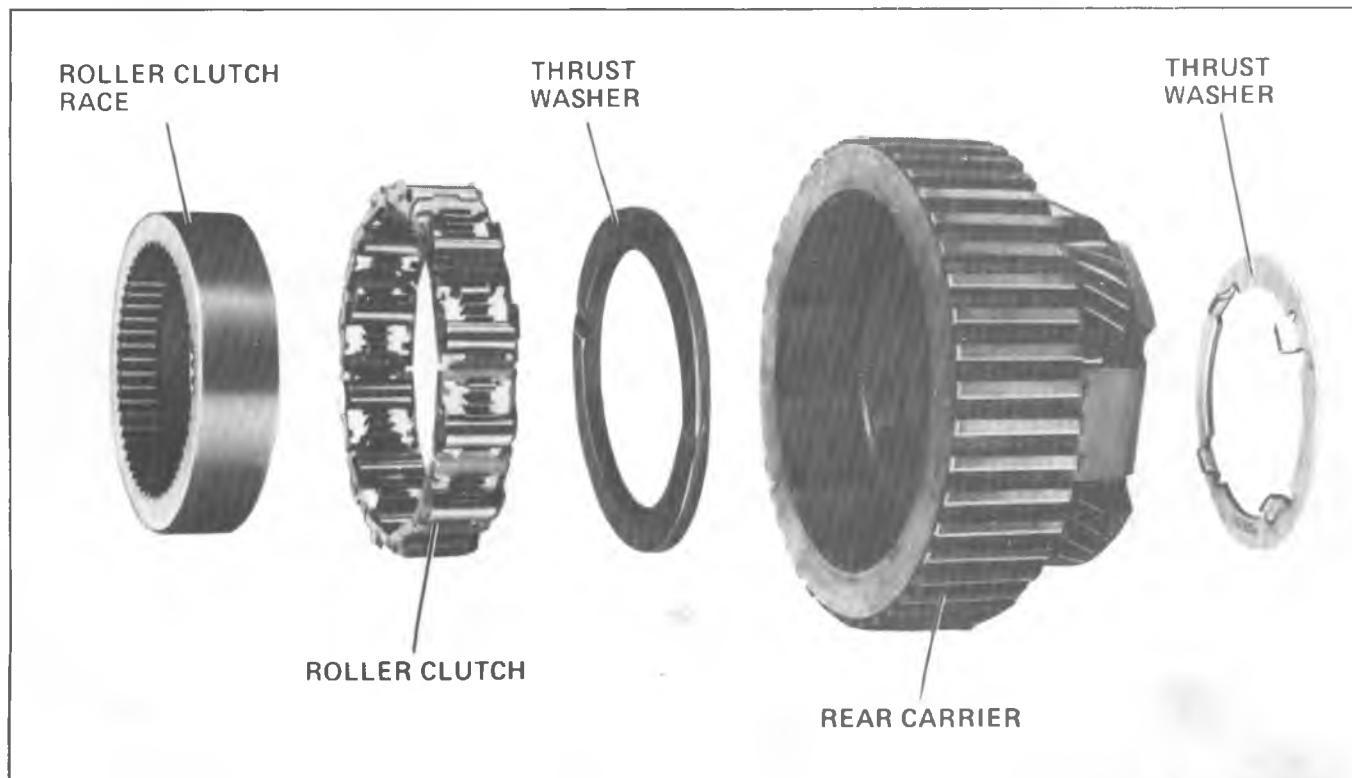


Fig. 7A-62A--Roller Clutch and Rear Carrier-Exploded

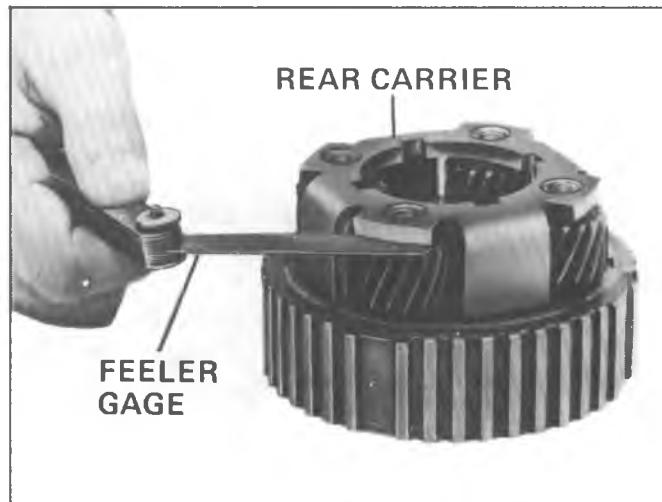


Fig. 7A-63A--Checking Rear Carrier Pinion End Play

8. Inspect planet pinions for damage, rough bearings or tilt.
9. Check pinion end play. Pinion end play should be 0.24-0.69mm (0.009"-0.027") (Fig. 7A-63A).



Fig. 7A-64A--Installing Thrust Washer Into Rear Carrier

### Reassembly

1. Install roller clutch to rear carrier thrust washer (Fig. 7A-64A).
2. Install rollers that may have come out of roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from outer edge (Fig. 7A-65A).
3. Install roller clutch assembly into roller clutch cam (Fig. 7A-66A).
4. Install roller clutch race, spline side out and rotate clutch race counterclockwise into position (Fig. 7A-67A).
5. Install 4 tanged rear carrier to rear internal gear thrust washer. Align tangs into slots of rear carrier and retain with petrolatum (Fig. 7A-68A).
6. Install roller clutch and rear carrier assembly into rear internal gear (Fig. 7A-69A).
7. Install J-25013-1, open end first, into rear end of case. Bolt J-25013-5 on end of case (Fig. 7A-70A).
8. Turn case to vertical position, pump end up.
9. Install rear unit parts into case and into J-25013-1 sleeve (Fig. 7A-71A) indexing rear internal gear parking pawl lugs to pass by parking pawl tooth.
10. Using J-25013-5 adjusting screw (Fig. 7A-70A) and looking through parking pawl case slot, adjust the height of the rear internal gear parking pawl lugs to align flush with the parking pawl tooth.

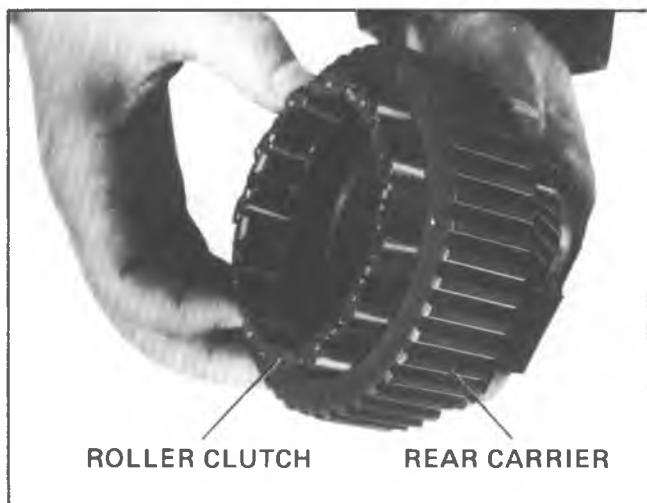


Fig. 7A-66A--Installing Roller Clutch Into Rear Carrier

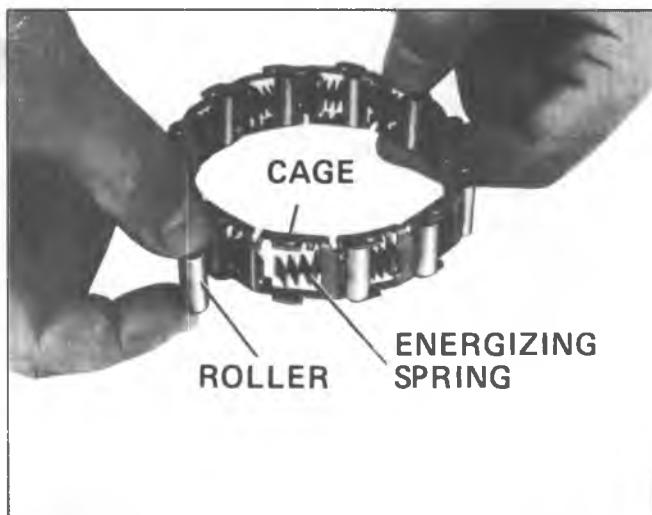


Fig. 7A-65A--Installing Roller Into Cage

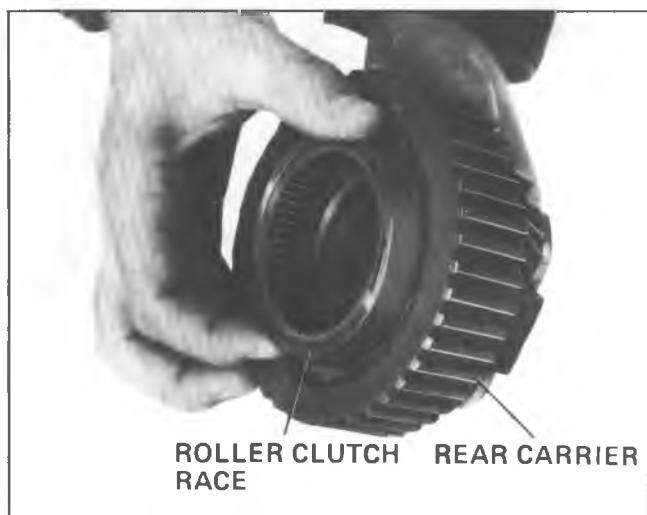


Fig. 7A-67A--Installing Roller Clutch Race

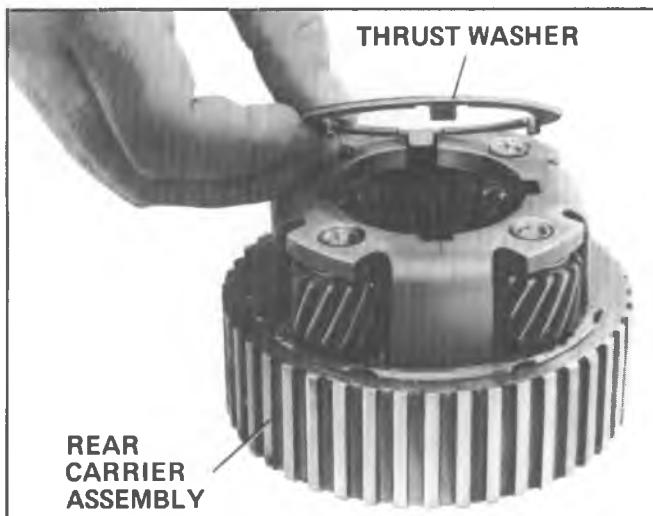


Fig. 7A-68A--Installing Thrust Washer

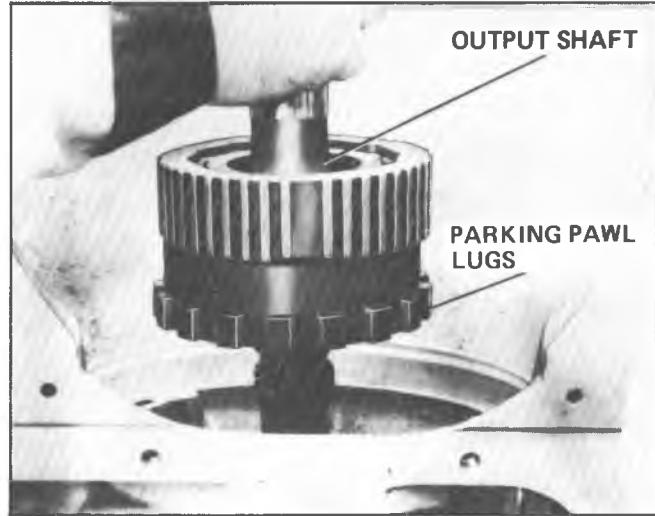


Fig. 7A-71A--Installing Rear Unit Parts

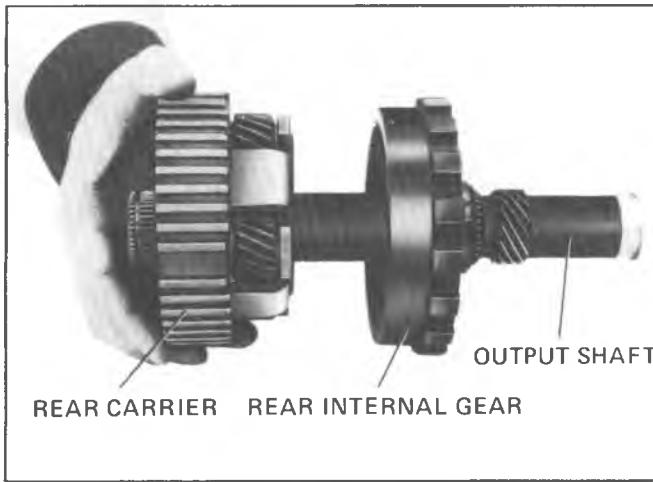


Fig. 7A-69A--Installing Rear Carrier Into Rear Internal Gear

**NOTE:** Make sure speedometer drive gear is visible through speedometer gear bore. If drive gear is not visible, it may be located on wrong journal of shaft.

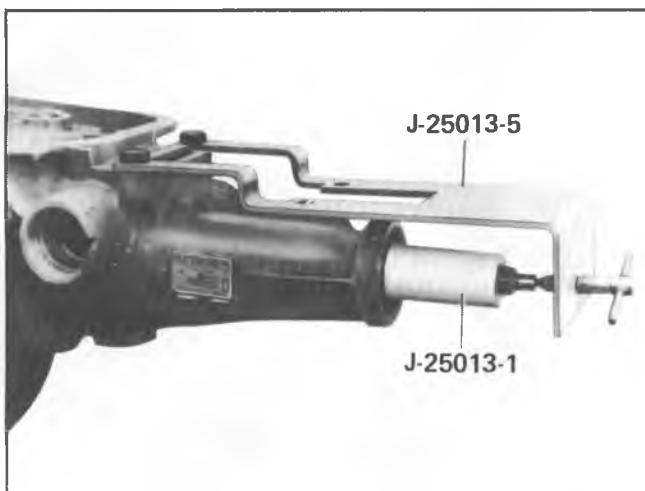


Fig. 7A-70A--Installing Tools on Rear End of Case

## LOW AND REVERSE CLUTCH

### Inspection

**CAUTION:** If low and reverse clutch housing has been removed, the low and reverse clutch piston travel must be checked.

Inspect low and reverse clutch composition-faced and steel clutch plates for signs of wear or burning.

### Low and Reverse Clutch Housing Assembly (Fig. 7A-72A)

#### Disassembly

1. Compress low and reverse clutch spring retainer, remove snap ring and retainer and inspect for damage or distortion (Fig. 7A-73A).
2. Remove waved spring (Fig. 7A-74A).
3. Remove low and reverse clutch piston.
4. Remove outer and inner piston seals (Figs. 7A-75A and 7A-76A).
5. Remove clutch apply ring.

#### Inspection

1. Inspect low and reverse clutch housing for damage, plugged feed hole.
2. Inspect low and reverse clutch housing bushing for damage or scoring.
3. Inspect low and reverse clutch splines and snap ring groove for damage or burrs. Remove any burrs on splines or snap ring groove.
4. Inspect low and reverse clutch piston and clutch apply ring assembly for distortion, cracks or damage.

**NOTE:** The apply ring is identified by a number located on the ring. The ring usage and identification are as follows:

- Models CE, CD, CR and CY are identified by No. 7.
- Models CN, CU, CX and CZ are identified by No. 9.
- 5. Inspect low and reverse clutch spring retainer for damage.
- 6. Inspect waved spring for damage.
- 7. Inspect low and reverse clutch housing to case spacer ring for damage.

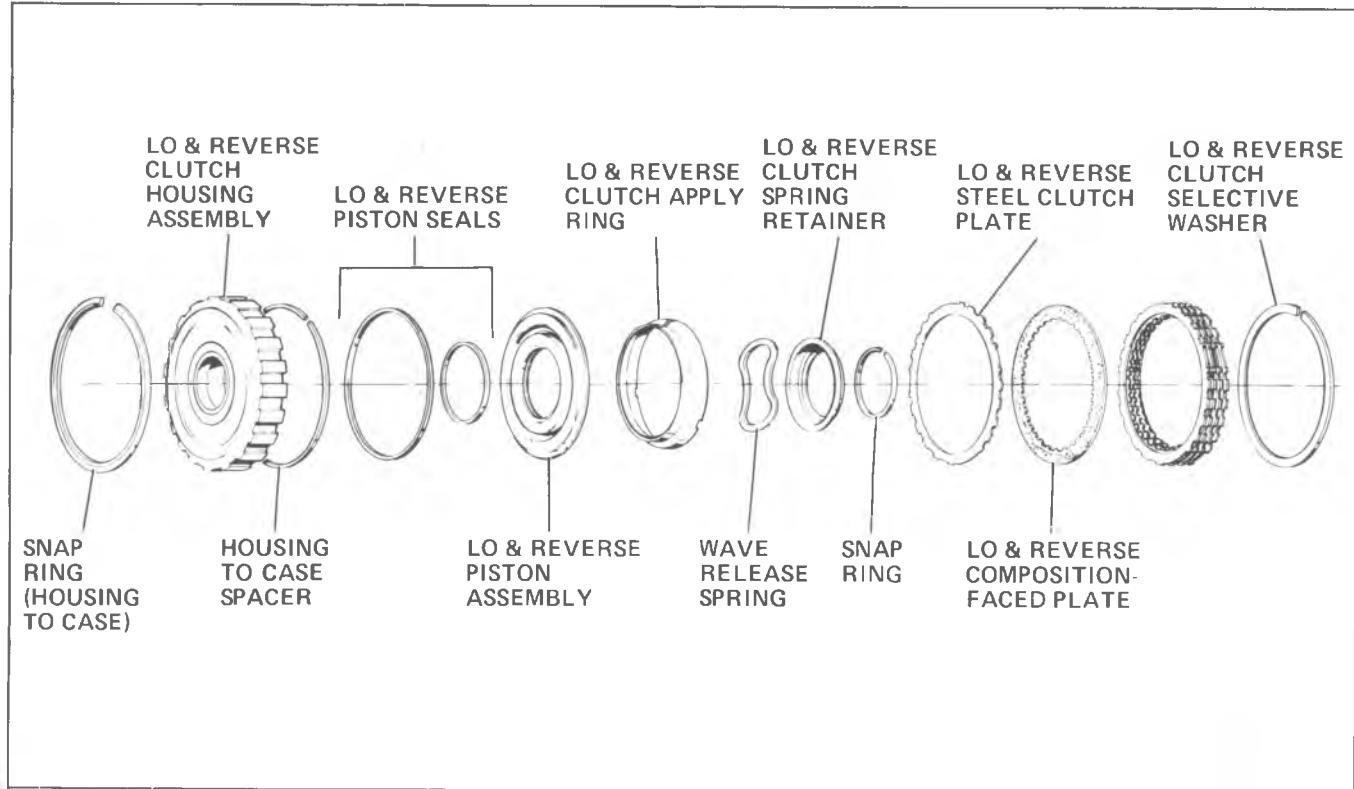


Fig. 7A-72A--Low and Reverse Clutch Housing-Exploded View

**Reassembly**

1. Install clutch apply ring on low and reverse clutch piston.
2. Install new outer and inner seals on piston with lips facing away from clutch apply ring side.
3. Install seal protector J-25011.
- NOTE:** Apply transmission fluid to all clutch seals before reassembly.
- CAUTION:** Flat screwdriver surface area must be smooth to prevent damaging outer seal.
4. Using flat edged small screwdriver, install low and reverse clutch piston, while rotating and pushing down into place (Fig. 7A-77A).
5. Remove seal protector J-25011.

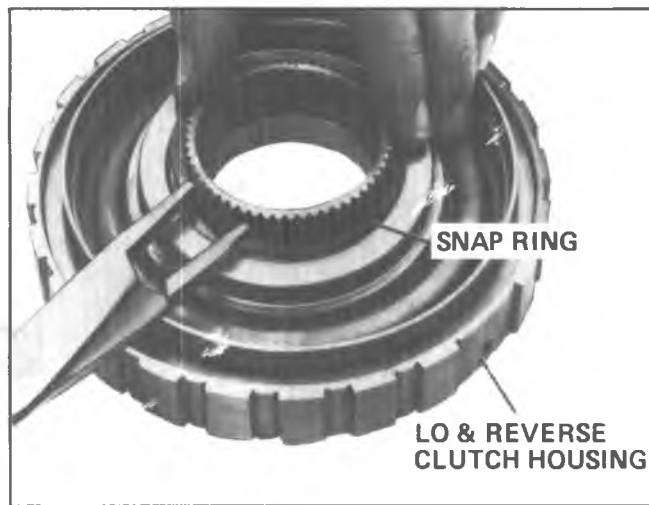


Fig. 7A-73A--Removing or Installing Low and Reverse Clutch Spring Retaining Snap Ring

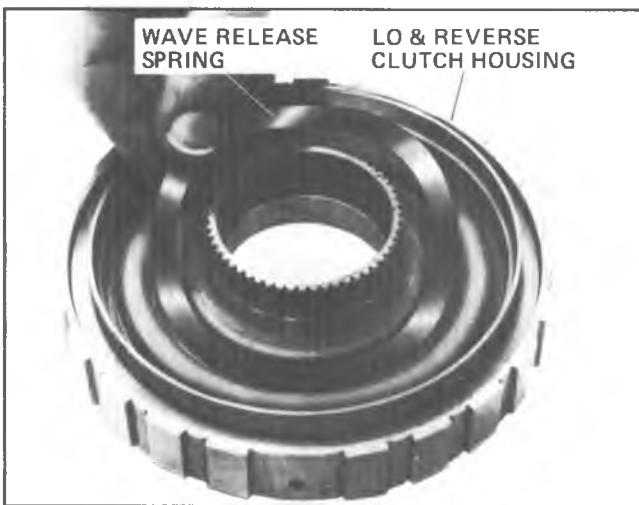


Fig. 7A-74A--Removing or Installing Low and Reverse Clutch Wave Release Springs

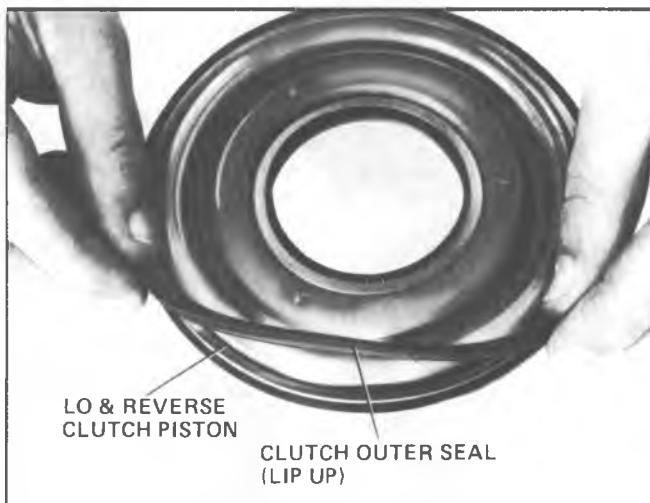


Fig. 7A-75A--Removing or Installing Low and Reverse Clutch Outer Seal

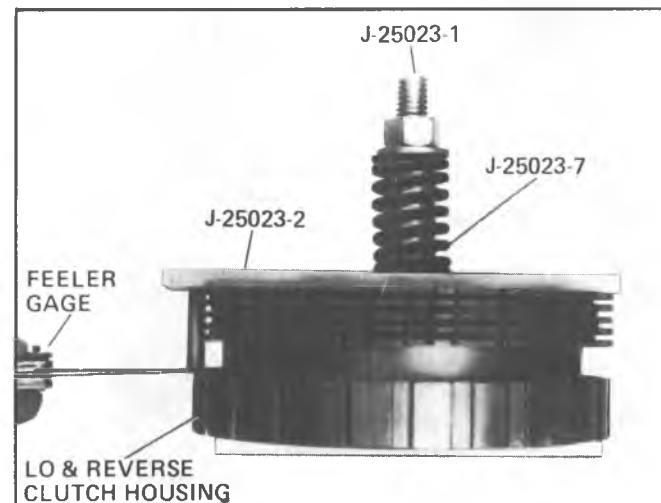


Fig. 7A-78A--Checking for Correct Low and Reverse Selective Spacer

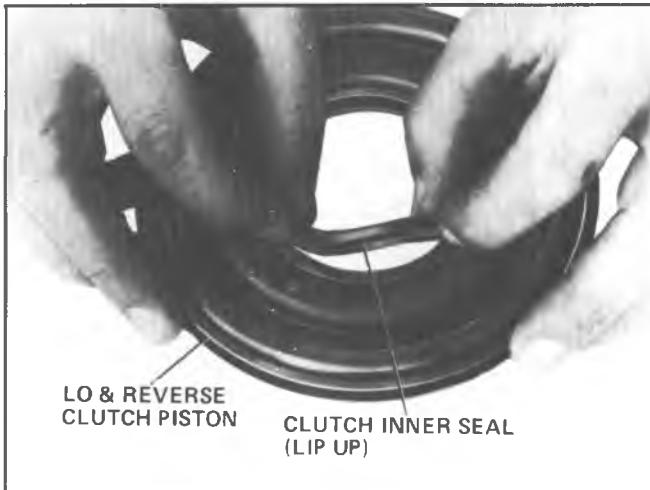


Fig. 7A-76A--Removing or Installing Low and Reverse Clutch Inner Seal

e. Using feeler gauge, determine distance between gauge pin on J-25023-2 and top edge of housing (Fig. 7A-78A). See Selective Spacer chart (Fig. 7A-79A) to determine proper selective spacer.

LO AND REVERSE CLUTCH SELECTIVE SPACER THICKNESS			
FEELER STOCK THICKNESS		SPACER I.D. NUMBER	
0.04mm	0.4mm	(.001"-.016")	6
0.4mm	0.8mm	(.016"-.032")	5
0.8mm	1.20mm	(.032"-.048")	4
1.20mm	1.60mm	(.048"-.064")	3
1.60mm	2.0 mm	(.064"-.080")	2
2.0 mm	2.40mm	(.080"-.096")	1

Fig. 7A-79A--Lo and Reverse Clutch Selective Spacer Chart

**NOTE:** The low and reverse clutch selective spacer identification number is also the last number of the part number. It may be necessary to measure the thickness of the selective spacer for positive identification.

f. Remove J-25023.

g. Install proper low and reverse clutch selective spacer in the case (Fig. 7A-80A).

1. Oil and install the lo and reverse clutch plates into the case, starting with a flat steel and alternating

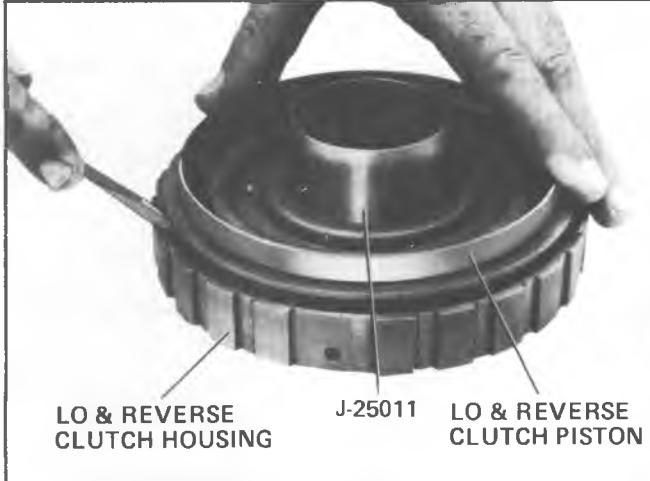


Fig. 7A-77A--Installing Low and Reverse Clutch Piston



Fig. 7A-80A--Correct Location of Low and Reverse Clutch Selective Spacer

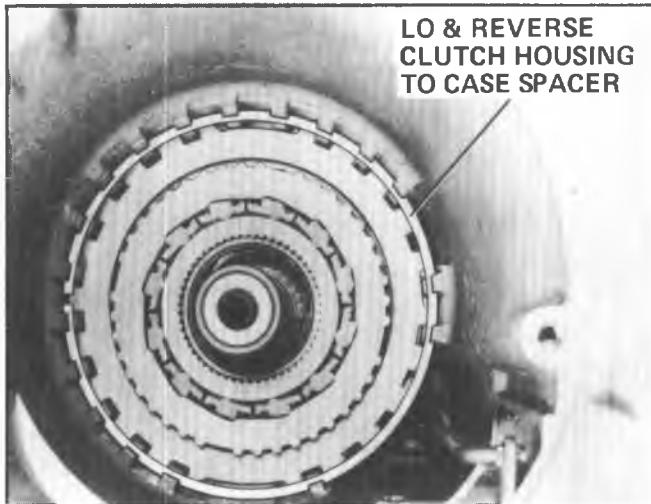


Fig. 7A-81A—Proper Location of Low and Reverse Housing to Case Spacer

composition-faced and flat steel clutch plates. (See Clutch Plate Usage Chart, Fig. 7A-82A).

2. Install low and reverse clutch housing to case spacer ring in case (Fig. 7A-81A).

3. Install low and reverse clutch housing assembly aligning reverse clutch housing feed hole to reverse clutch case feed passage, using J-25012 (Fig. 7A-83A).

If the low and reverse clutch housing does not seat past the case snap ring groove, proceed as follows:

a. Remove tool J-25012.

b. Using rear sun gear and input drum as a tool, install input drum and rear sun gear in case.

c. Rotate rear sun gear back and forth, tapping lightly with input drum, to align roller clutch race and low and reverse clutch hub splines (Fig. 7A-84A).

d. Remove tool (input drum and rear sun gear).

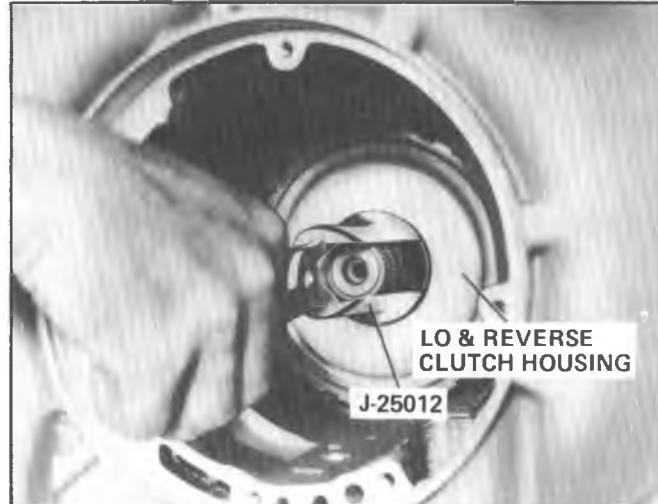


Fig. 7A-83A—Installing Low and Reverse Clutch Housing

**NOTE:** It may be necessary to loosen adjusting screw on J-25013-5 on output shaft to install snap ring.

e. Repeat the above steps if low and reverse clutch housing is not fully seated past case snap ring groove.

4. Install low and reverse clutch housing to case snap ring, flat side against housing (beveled side up). Position snap ring gap on opposite side of parking actuator rod.

#### FRONT GEAR PARTS

#### Rear Sun Gear and Input Drum (Fig. 7A-85A)

##### Inspection

1. Inspect rear sun gear for cracks, splits, damage spline, worn gear or journals and plugged lubrication holes (Fig. 7A-85A).

2. Inspect rear sun gear bushing for damage or scoring.

3. If necessary, remove input drum to rear sun gear snap ring and remove sun gear from input drum.

MODEL	DIRECT CLUTCH				FORWARD CLUTCH				LO & REV. CLUTCH		
	Flat Steel		Composition Plates		Waved Plates		Flat Steel		Composition Plates		
	No.	Thickness	No.	No.	Thickness	No.	Thickness	No.	No.	No.	
CU, CN, CZ	4	2,324mm (.091")		4	1	1,585mm (.062")	2	1,969mm (.077")	3	5	4-Grooved
CX	3	2,324mm (.091")		3	1	1,585mm (.062")	2	1,969mm (.077")	3	5	4-Grooved
CD, CE, CR, CY	5	2,324mm (.091")		5	1	1,585mm (.062")	3	1,969mm (.077")	4	7	6-Non-Grooved

- NOTE:**
- The direct and forward clutch flat steel clutch plates should be identified by their thickness.
  - The waved plate has (3) teeth, equally spaced, omitted, for identification.
  - The direct and forward production installed composition-faced clutch plates must not be interchanged. For service, direct and forward clutch use the same composition-faced plates.
  - All lo and reverse clutch composition-faced plates are serviced with the grooved composition-faced plates.

Fig. 7A-82A—Clutch Plate Usage

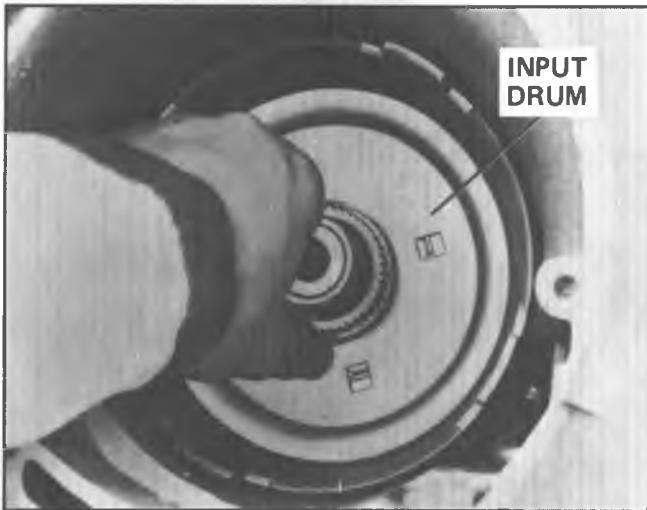


Fig. 7A-84A--Installing Input Drum and Rear Sun Gear

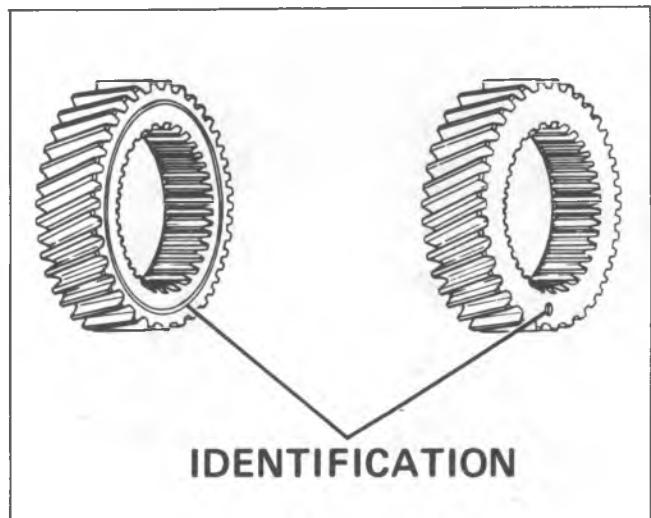


Fig. 7A-87A--Front Sun Gear Identification

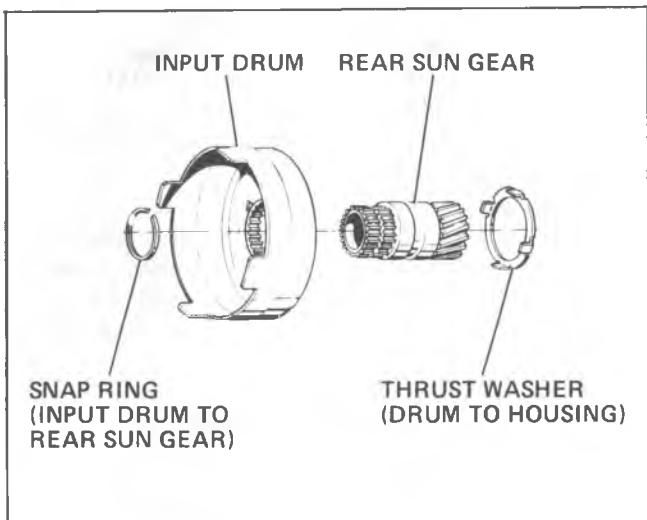


Fig. 7A-85A--Rear Sun Gear and Input Drum

4. Inspect input drum for damage.
5. Inspect 4 tanged input drum to low and reverse clutch housing thrust washer for scoring or distorted tangs.
6. If damaged, replace rear sun gear to input drum snap ring.



Fig. 7A-86A--Installing Thrust Washer



Fig. 7A-88A--Installing Front Sun Gear

### Reassembly

1. Install rear sun gear into input drum, spline side first, and retain with snap ring.
  2. Install 4 tanged thrust washer on input drum over sun gear end; align tangs into input drum and retain with petrodatum (Fig. 7A-86A).
  3. Install rear sun gear and input drum assembly (Fig. 7A-84A).
- Front Sun Gear**
1. Inspect front sun gear splines and teeth for damage or wear.
  2. Inspect machined face for pitting, scoring or damage.
  3. Install front sun gear face with the identification mark (a drill spot or groove) against input drum to rear sun gear snap ring (Fig. 7A-87A and 7A-88A).
  4. Thoroughly clean, air dry and inspect front sun gear to front carrier thrust race and thrust bearing for pitted or rough conditions.
  5. Install front sun gear to front carrier thrust bearing and race assembly with roller thrust bearing against the front sun gear (Fig. 7A-89A).

**NOTE:** This thrust bearing requires only 1 thrust race.

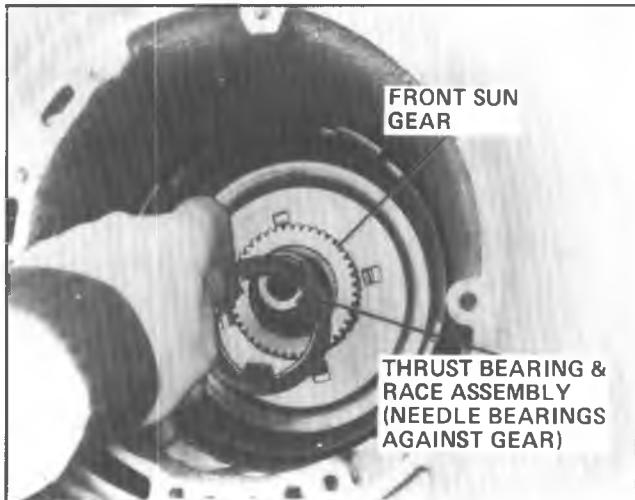


Fig. 7A-89A-Installing Thrust Bearing Assembly Against Front Sun Gear

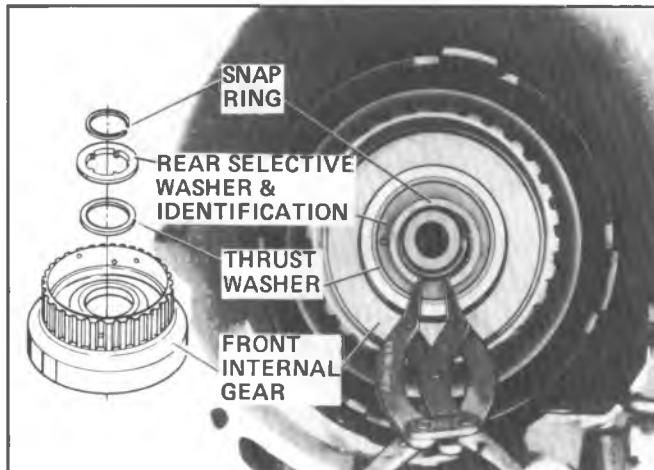


Fig. 7A-92A--Installing Output Shaft to Selective Washer Snap Ring

2. Inspect pinions for damage, rough bearings or tilt.
3. Check pinion end play. Pinion end play should be 0.24mm-0.69mm (0.009" to 0.027") (Fig. 7A-90A).
4. Thoroughly clean, air dry and inspect closely, front carrier to front internal gear roller thrust bearing assembly for pitted or rough conditions.

#### Reassembly

1. Install front carrier to front internal gear roller thrust bearing assembly by placing the smaller diameter race against carrier. Retain with petrolatum (Fig. 7A-91A).
2. Install front carrier and thrust bearing assembly (Fig. 7A-93A).

#### Front Internal Gear and Thrust Washer

1. Inspect forward clutch hub for worn splines and for lubrication holes.
2. Inspect internal gear for cracks or damage.
3. Inspect gear teeth for excessive wear or damage.
4. Inspect bushing for damage or scoring.
5. Inspect thrust washer, front internal gear to selective washer for scoring or damage.
6. Install thrust washer on front internal gear and retain with petrolatum (Fig. 7A-92A).
7. Install front internal gear and thrust washer.

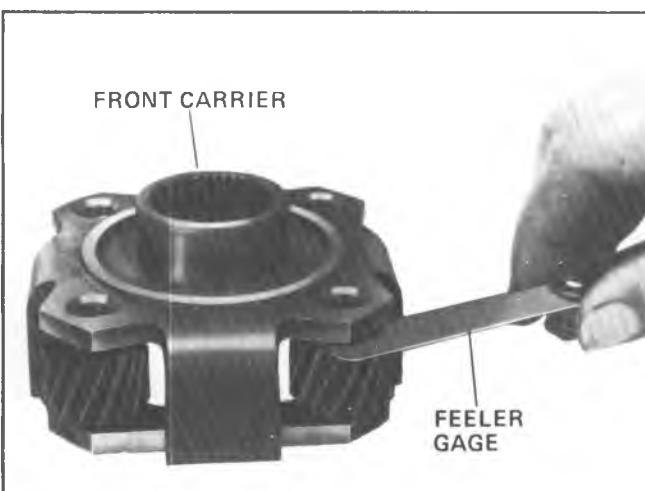
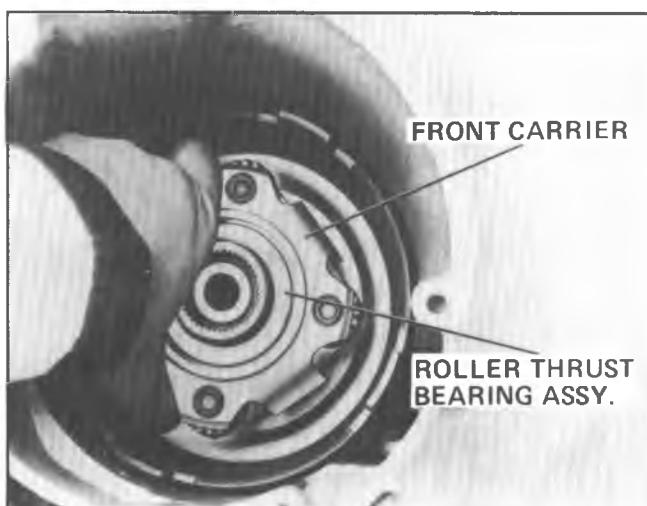


Fig. 7A-90A--Checking Front Carrier Pinion End Play

#### Front Carrier Assembly

**NOTE:** Models CN, CU and CZ use a front carrier with 2 pinions. All other models use 4 pinions.

#### Inspection

1. Inspect front carrier for damage (Fig. 7A-90A).

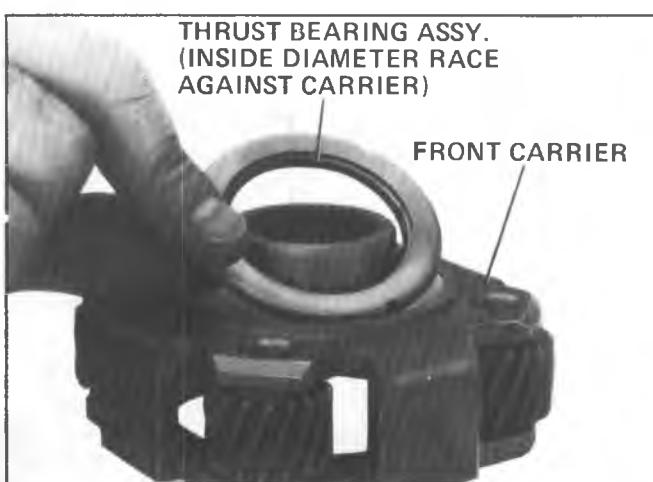


Fig. 7A-91A-Installing Thrust Bearing Assembly Onto Front Carrier

Fig. 7A-93A--Installing Front Carrier and Roller Thrust Bearing

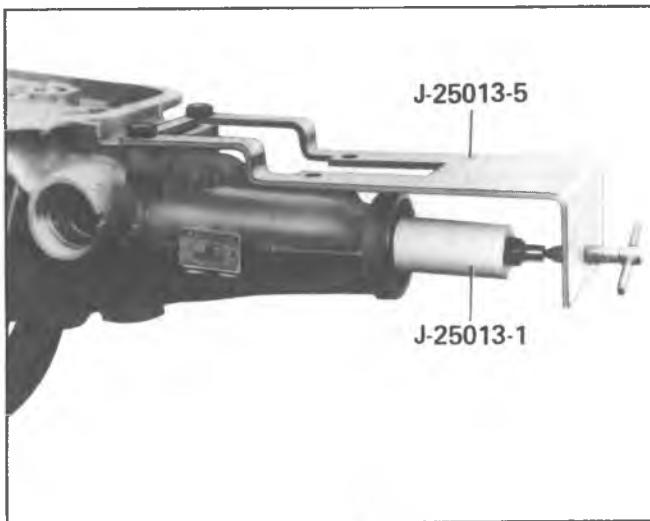


Fig. 7A-94A--Installing Tools on Rear End of Case

### Rear Selective Thrust Washer

1. Inspect selective washer for scoring or damage (Fig. 7A-92A).

**CAUTION:** The rear selective thrust washer must be installed with the identification number toward the front of the transmission.

2. Install rear selective washer.
3. Inspect output shaft to selective thrust washer snap ring for damage or distortion.

**NOTE:** It may be necessary to move output shaft upward by turning the adjusting screw on J-25013-5 to install output shaft to selective washer snap ring.

4. Install snap ring on output shaft (Fig. 7A-92A).

**CAUTION:** Make sure snap ring is fully seated in output shaft groove.

### Check Rear Unit End Play

1. Loosen J-25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A-94A).

**CAUTION:** Do not install clamp assembly on any machined case surfaces.

2. Install gauge clamp on case as shown in Fig. 7A-95A.

3. Install dial indicator J-8001 and plunger extension J-7057. Position extension against end of output shaft. Set dial indicator to zero (Fig. 7A-95A).

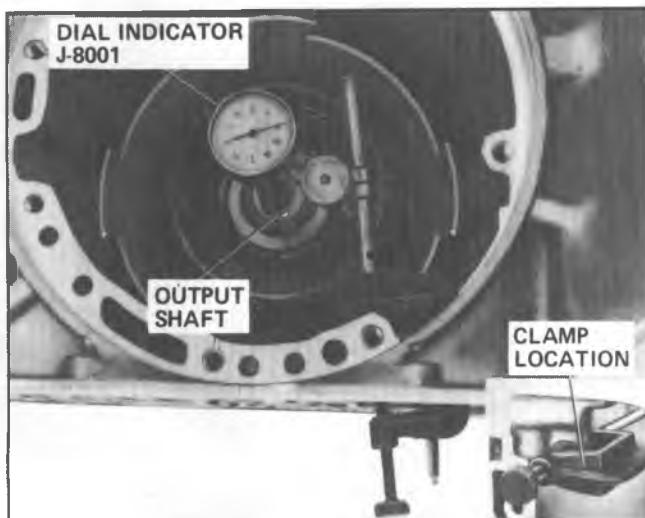


Fig. 7A-95A--Checking Rear Unit End Play

REAR UNIT END PLAY CHART			
<u>THICKNESS</u>		<u>IDENTIFICATION</u>	
Number and/or Color			
2.90	3.01mm	(0.114"-0.119")	1 Orange
3.08	3.19mm	(0.121"-0.126")	2 White
3.26	3.37mm	(0.128"-0.133")	3 Yellow
3.44	3.55mm	(0.135"-0.140")	4 Blue
3.62	3.73mm	(0.143"-0.147")	5 Red
3.80	3.91mm	(0.150"-0.154")	6 Brown
3.98	4.09mm	(0.157"-0.161")	7 Green
4.16	4.27mm	(0.164"-0.168")	8 Black
4.34	4.45mm	(0.171"-0.175")	9 Purple

Fig. 7A-96A--Rear Unit End Play Washer Thickness Chart

4. Move output shaft upward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear (Fig. 7A-94A) and read end play. Rear unit end play should be 0.10-0.64mm (.004"-.025").

**NOTE:** Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart shown in Figure 7A-96A.

5. Remove dial indicator and clamp assembly (Fig. 7A-95A).

6. Loosen J-25013-5 adjusting screw on output shaft.

7. Inspect output shaft to turbine shaft front selective thrust washer for damage or scoring.

8. Install output shaft to turbine shaft, front selective thrust washer, locating in output shaft and retain with petrolatum (Fig. 7A-97A).

### FRONT UNIT PARTS

#### Direct Clutch Housing Assembly (Fig. 7A-98A)

1. Remove snap ring (Fig. 7A-99A).
2. Remove the clutch backing plate from the direct clutch housing.

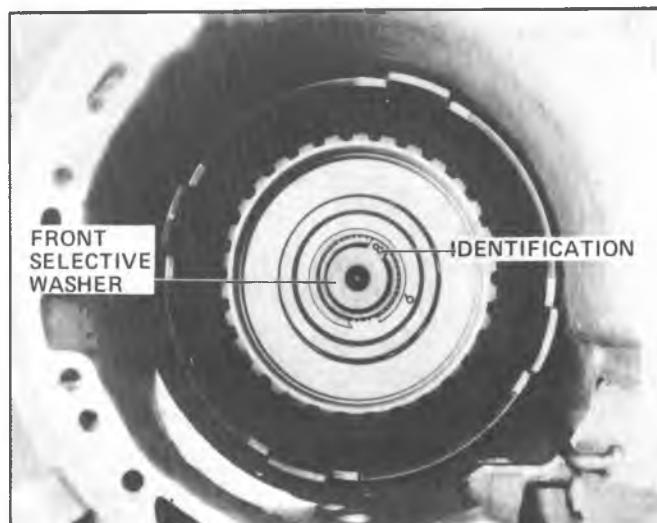


Fig. 7A-97A--Location of Front Selective Washer

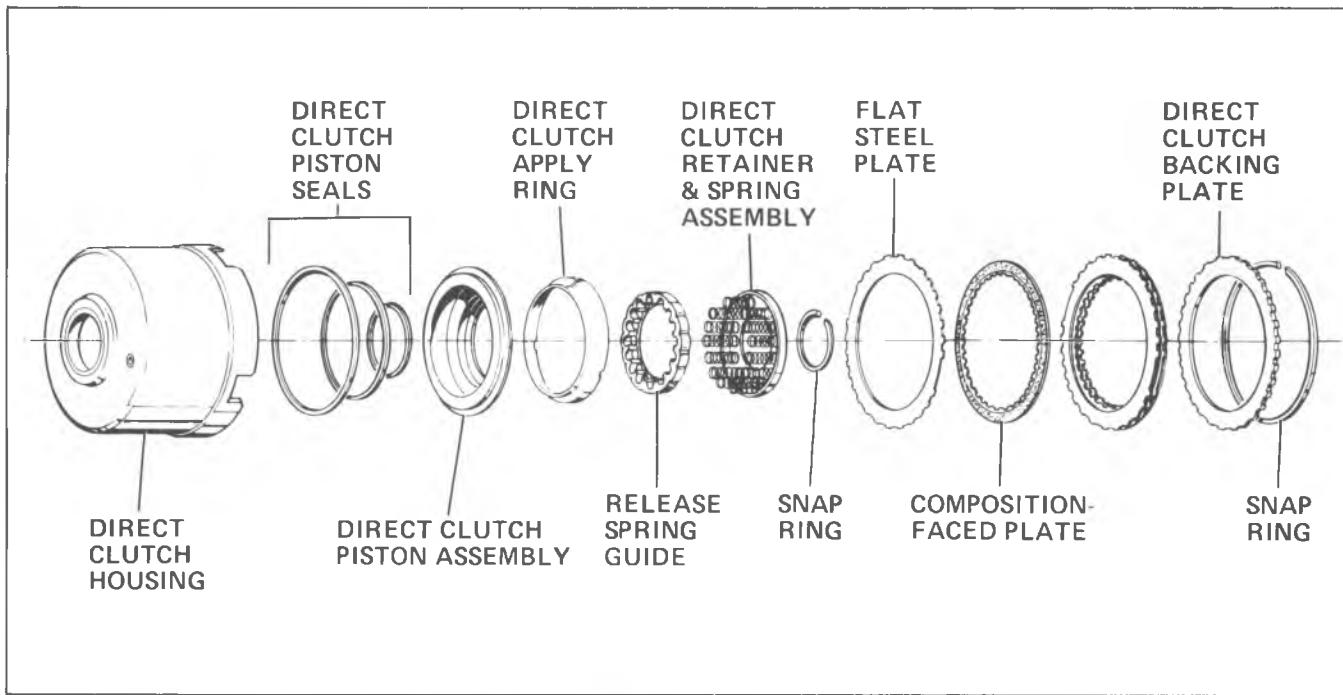


Fig. 7A-98A--Direct Clutch Assembly - Exploded

3. Remove the clutch plates from the direct clutch housing and keep them separated from the forward clutch plates. (See Clutch Plate Usage Chart, Fig. 7A-82A).
4. Inspect composition-faced plates and steel clutch plates for wear or burning.
5. Inspect clutch backing plate for scoring or other damage.
6. Using J-23327, compress retainer and spring assembly (Fig. 7A-100A), remove snap ring and inspect for damage distortion.
7. Remove J-23327.
8. Remove retainer and spring assembly from housing.
9. Inspect release spring retainer for being collapsed.
10. Inspect release springs for being collapsed.
11. Remove release spring guide and inspect for damage.
12. Remove direct clutch piston.
13. Remove outer and inner seals from direct clutch piston and discard (Figs. 7A-101A and 7A-102A).

14. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

**NOTE:** The apply ring is identified by a number on the ring. The ring usage and identification are as follows:

- Models CN, CU and CZ are identified by No. 1
- Model CX is identified by No. 2
- Models CD, CE, CR and CY are identified by No. 9.

15. Inspect direct clutch piston assembly for distortion, cracks, damage and check ball for free operation.

16. Remove center seal from direct clutch housing and discard (Fig. 7A-103A).

17. Inspect direct clutch housing for cracks, wear and open oil passages.

18. Check for free operation of check ball.

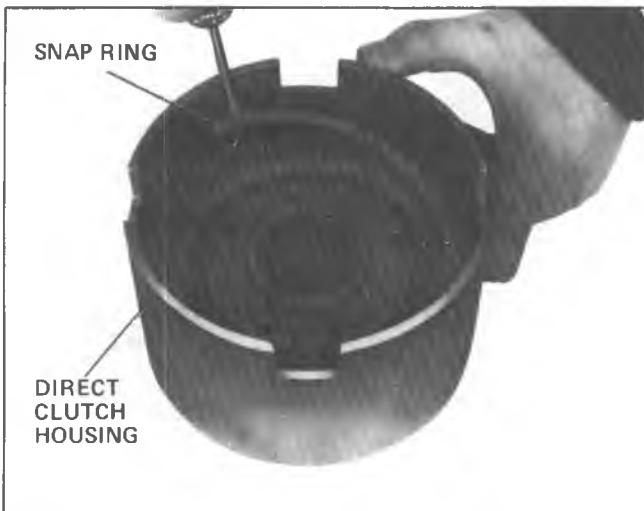


Fig. 7A-99A--Removing or Installing Direct Clutch Snap Ring

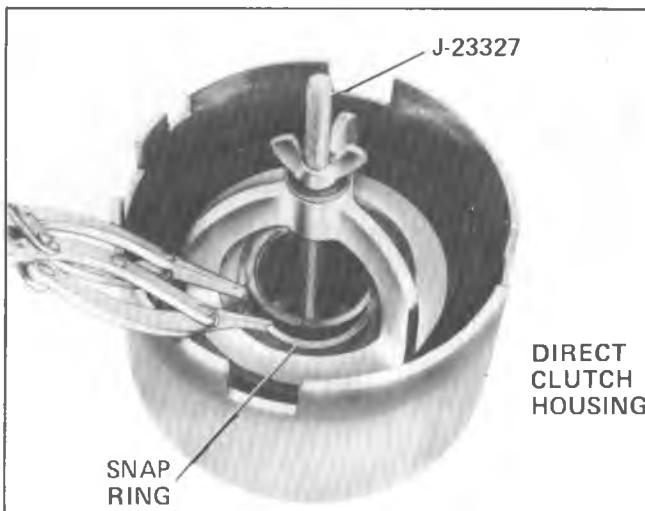


Fig. 7A-100A--Removing or Installing Direct Clutch Inner Snap Ring

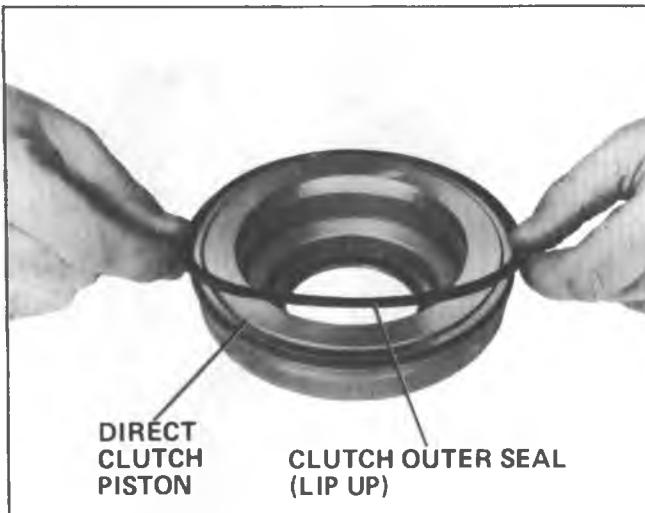


Fig. 7A-101A--Removing Direct Clutch Piston Outer Seal

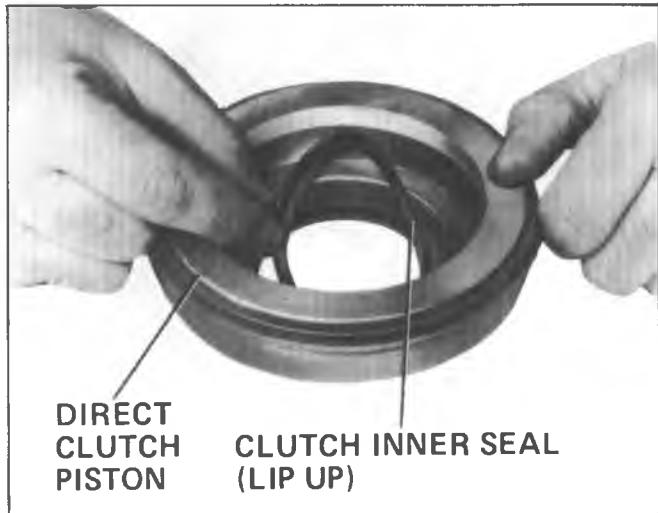


Fig. 7A-104A--Installing Direct Clutch Piston Inner Seal

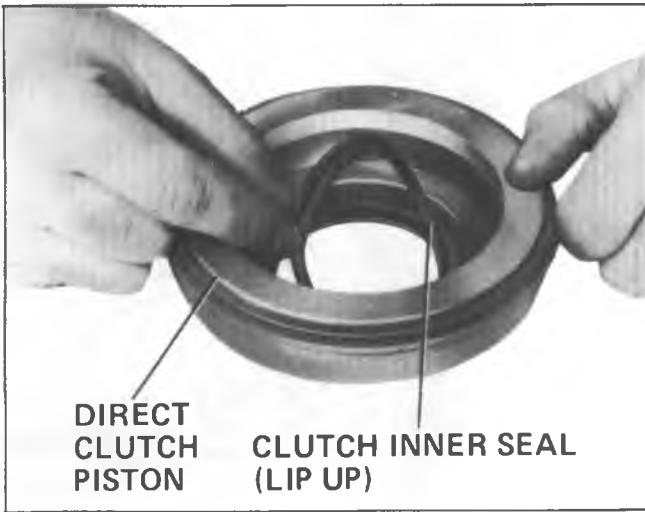


Fig. 7A-102A--Removing Direct Clutch Piston Inner Seal

19. Inspect direct clutch housing snap ring grooves for damage.
20. Inspect direct clutch bushings for damage or scoring.

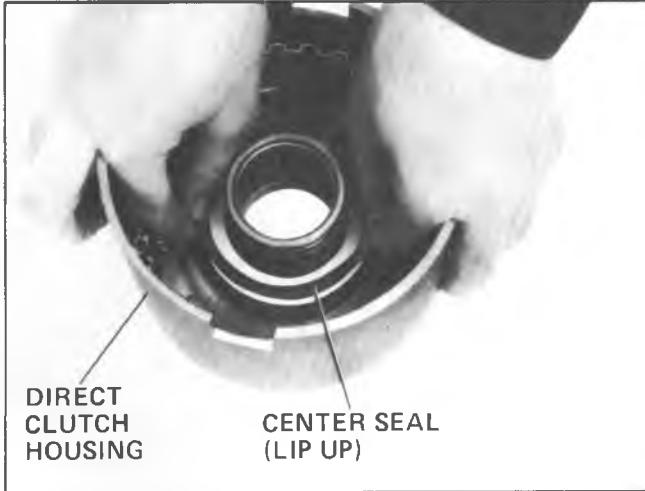


Fig. 7A-103A--Removing or Installing Center Seal of Direct Clutch Housing

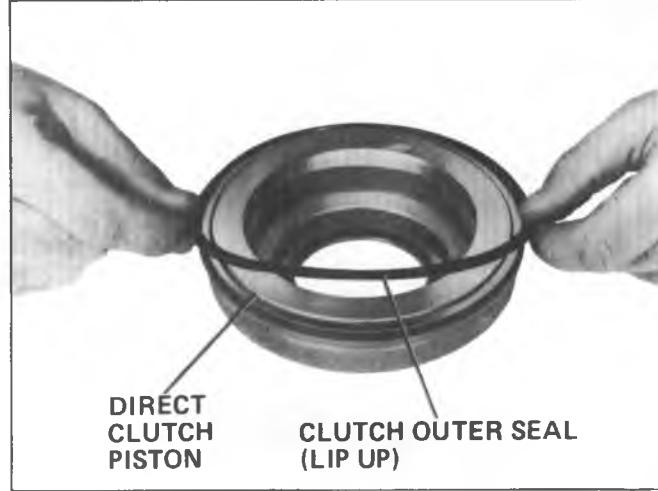


Fig. 7A-105A--Installing Direct Clutch Piston Outer Seal

### Reassembly

1. Install clutch apply ring on piston.
2. Install new inner and outer seals on piston with lips facing away from clutch apply ring side (Figs. 7A-104A and 7A-105A).
3. Install new center seal on direct clutch housing with lip facing up.
4. Install seal protector J-25010 (Fig. 7A-105A).

**CAUTION:** Use extreme care when installing direct clutch piston past larger direct clutch snap ring groove. Groove could cut outer seal on piston.

5. Oil seals and install direct clutch piston (Fig. 7A-106A).

**NOTE:** To make the piston easier to install, insert tool between seal and housing; rotate tool around the housing to compress the lip of the seal, while pushing down slightly on the piston. See Fig. 7A-107A.

6. Remove seal protector J-25010.
7. Install release spring guide with the omitted rib over the check ball in the piston, as shown in Fig. 7A-108A.
8. Install retainer and spring assembly.

**NOTE:** Models CN, CU, CX and CZ use a direct clutch retainer and spring assembly which contains (16) release springs. All other models use a retainer and spring assembly with (10) release springs.

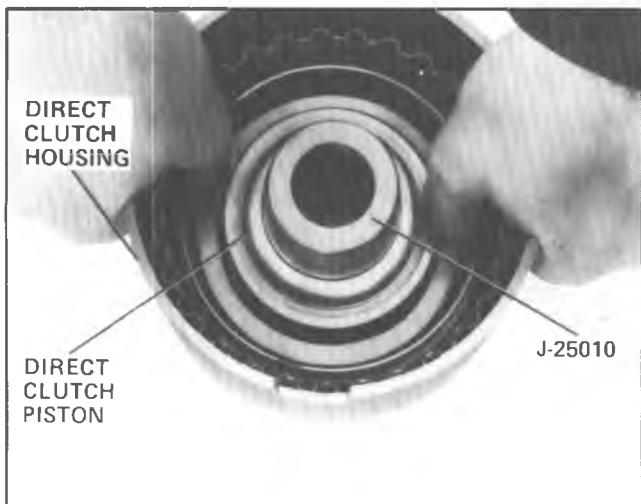


Fig. 7A-106A--Installing Direct Clutch Piston

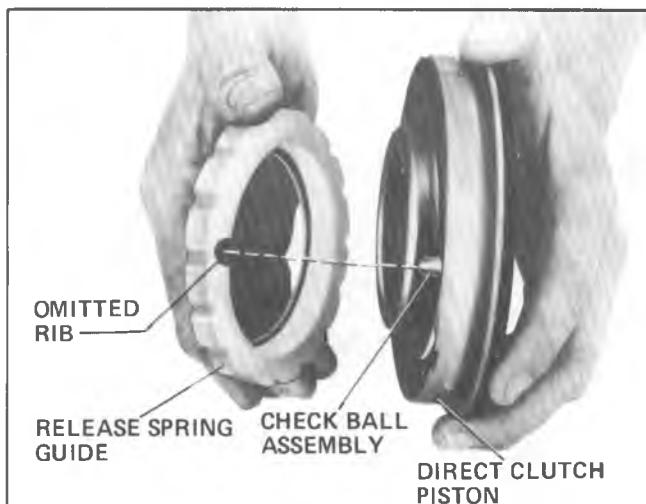


Fig. 7A-108A--Installing Release Spring Guide

**CAUTION:** Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate when installing.

9. Using J-23327 tool, compress retainer and spring assembly past the snap ring groove. Install the snap ring (Fig. 7A-100A). An arbor press and J-23327-1 can be used to compress the retainer and spring assembly.

10. Remove J-23327-1 and/or J-6129.

11. Oil and install the direct clutch plates into the direct clutch housing, starting with a flat steel and alternating composition-faced and flat steel clutch plates. (See Figs. 7A-109A and Fig. 7A-82A).

12. Install backing plate, chamfered side up.

13. Install snap ring (Fig. 7A-99A).

**NOTE:** Make sure composition clutch plates turn freely.

14. Set direct clutch assembly aside.

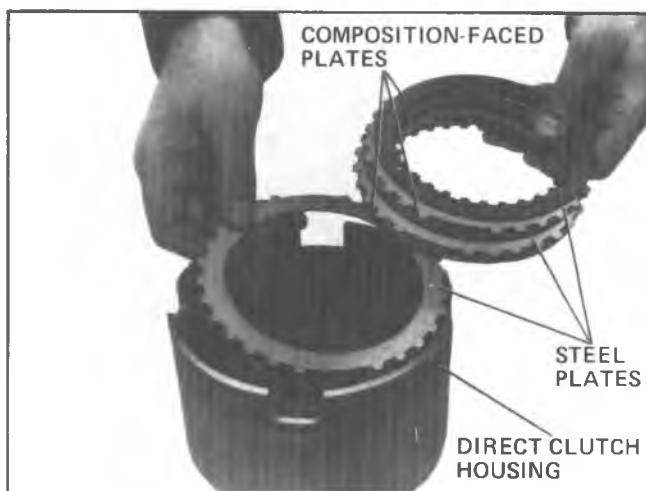


Fig. 7A-109A--Installing Clutch Plates into Direct Clutch Housing

## Forward Clutch Housing Assembly (Fig. 7A-110A)

### Inspection

1. Inspect teflon oil seals on turbine shaft for damage and free fit in grooves. Do not remove unless replacing.

2. Remove and inspect forward clutch to direct clutch thrust washer for damage (Fig. 7A-111A).

3. Place forward clutch down with turbine shaft through hole in work bench.

4. Remove snap ring and inspect for damage (Fig. 7A-112A).

5. Remove backing plate from the forward clutch housing.

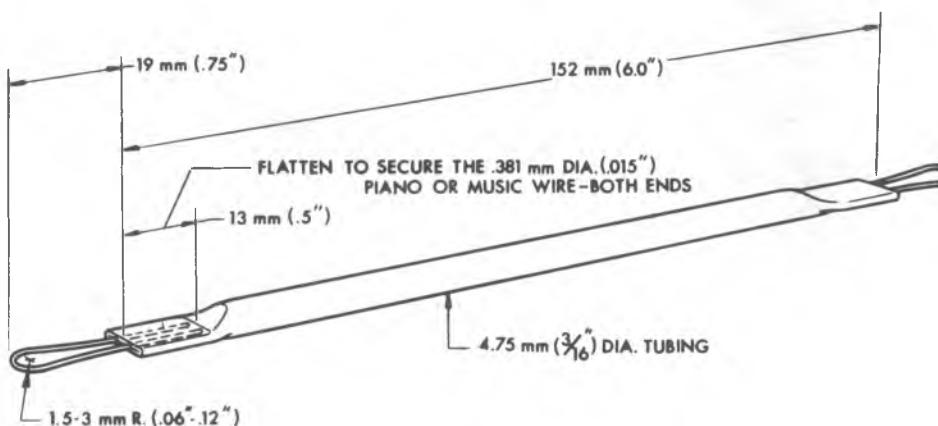


Fig. 7A-107A--Piston Installing Tool

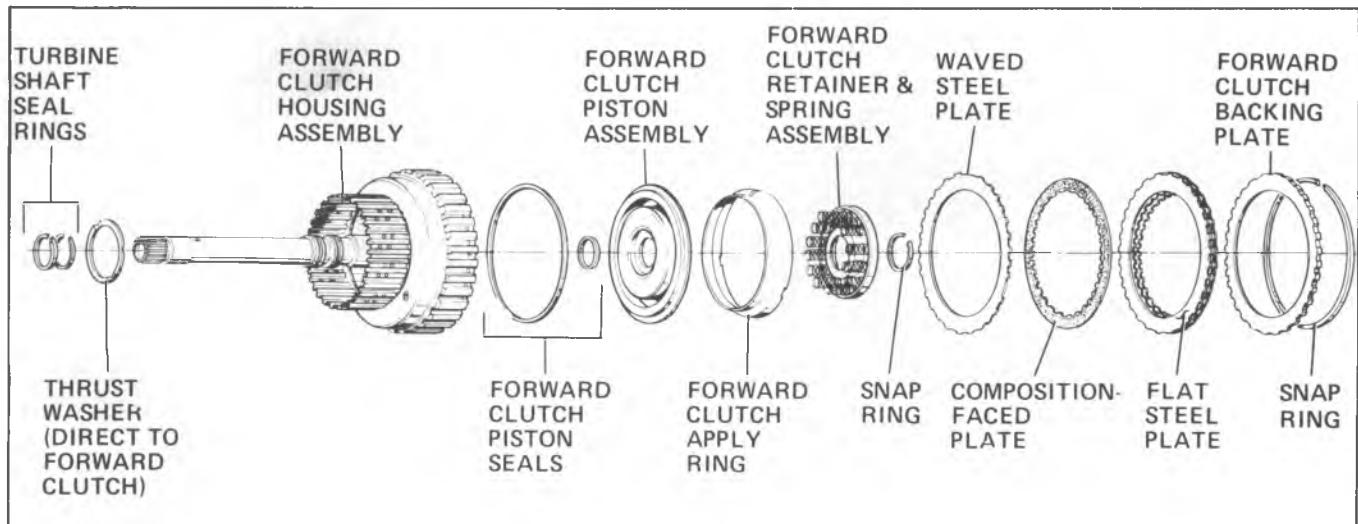


Fig. 7A-110A-Forward Clutch Assembly - Exploded View

6. Remove the clutch plates from the forward clutch housing and keep them separated from the direct clutch plates. (See Clutch Plate Usage Chart Fig. 7A-82A).

7. Inspect composition-faced and steel clutch plates for signs of wear or burning.

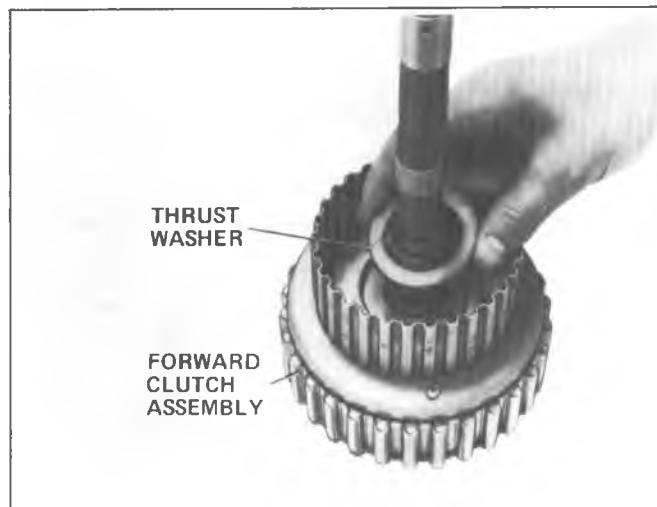


Fig. 7A-111A--Removing or Installing Forward Clutch to Direct Clutch Thrust Washer

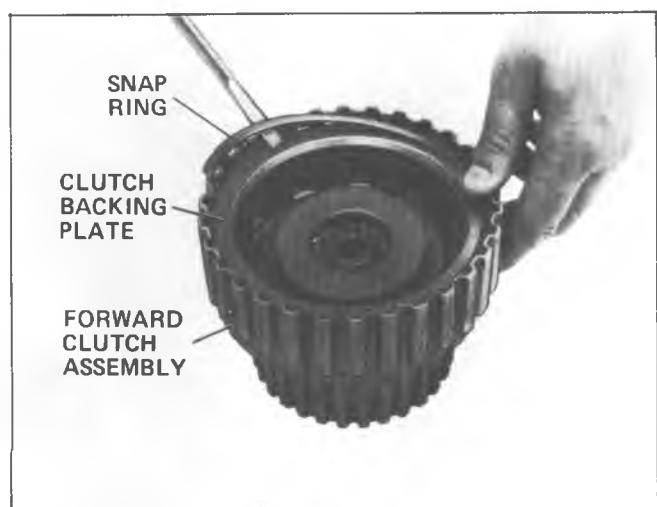


Fig. 7A-112A-Removing or Installing Snap Ring from Forward Clutch Housing

8. Inspect backing plate for scratches or damage.

9. Using tools J-25018, -25024 and J-23327, compress retainer and spring assembly and remove snap ring (Fig. 7A-113A). An arbor press and tools J-25018 and J-23327-1 can be used to compress the retainer and spring assembly.

10. Remove J-23327-1, J-25024 and J-25018.

11. Remove retainer and spring assembly from housing.

12. Inspect release spring retainer for distortion.

13. Inspect release springs for being collapsed.

14. Remove forward clutch piston.

15. Remove forward clutch outer and inner piston seals and discard (Figs. 7A-114A and 7A-115A).

16. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

17. Inspect the forward clutch piston and clutch apply ring assembly for cracks or damage.

**NOTE:** The apply ring is identified by a number located on the apply ring, as follows:

Models CN, CU, CX and CZ are identified by No. 0.

Models CD, CE, CR and CY are identified by No. 8.

18. Inspect forward clutch housing for cracks, opened oil passages or other damage (Fig. 7A-116A).

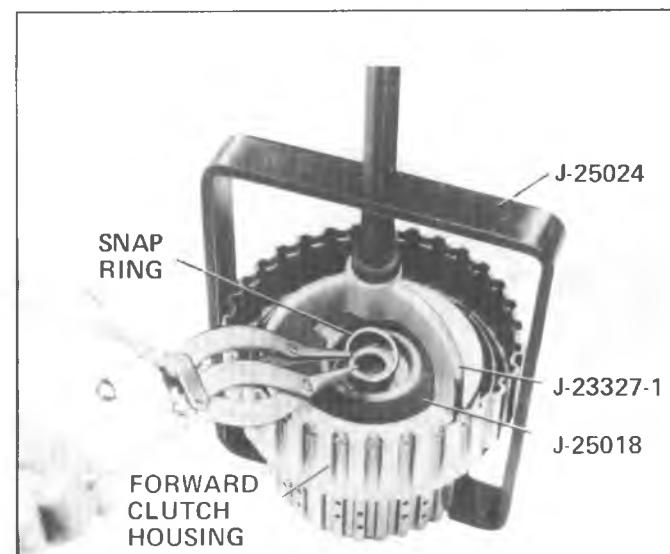


Fig. 7A-113A-Removing or Installing Forward Clutch Release Spring Snap Ring



Fig. 7A-114A--Removing or Installing Outer Piston Seal



Fig. 7A-115A--Removing or Installing Inner Piston Seal

19. Check for free operation of check ball.
20. Inspect forward clutch housing snap ring groove for damage or burrs.
21. Inspect turbine shaft for open oil passages on both ends of shaft and journals for damage.

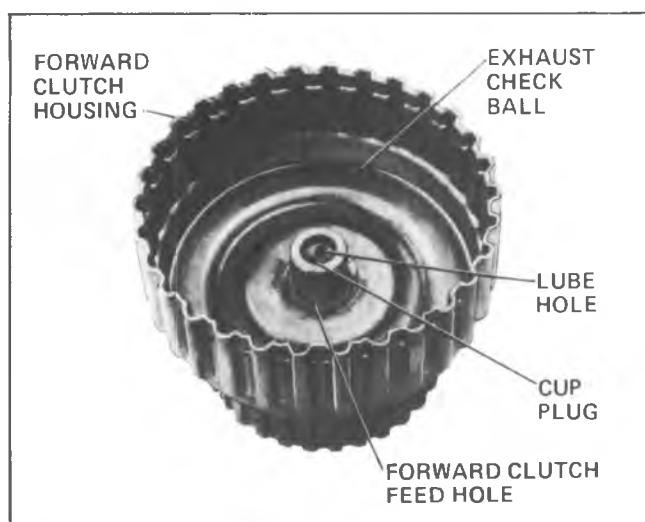


Fig. 7A-116A--Forward Clutch Housing

22. Inspect cup plug for damage. If cup plug is damaged or missing, proceed as follows:

- a. Use 4mm (No. 3) easy out (grind to fit) and remove cup plug.
- b. Install new cup plug to 1.0mm (.039") below surface.

#### Reassembly

1. Install clutch apply ring on piston.
2. Install new outer and inner seals on piston with lips facing away from clutch apply ring side (Figs. 7A-114A and 7A-115A).

**CAUTION:** Use extreme care when installing forward clutch piston past large forward clutch snap ring groove. Groove could cut outer seal on piston.

3. Lubricate seals and install forward clutch piston (Fig. 7A-117A).

**NOTE:** To make the piston easier to install, insert tool between the inner seal and shaft; rotate tool around the shaft to compress the lip of the seal, while pushing down slightly on the piston. Use the same procedure between the outer seal and the housing. Refer to Figs. 7A-117A and 7A-118A.

4. Install retainer and spring assembly.

**CAUTION:** Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate.

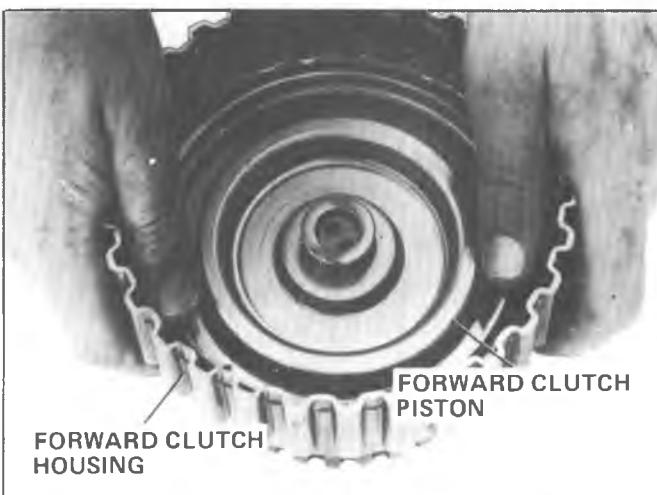


Fig. 7A-117A--Installing Forward Clutch Piston

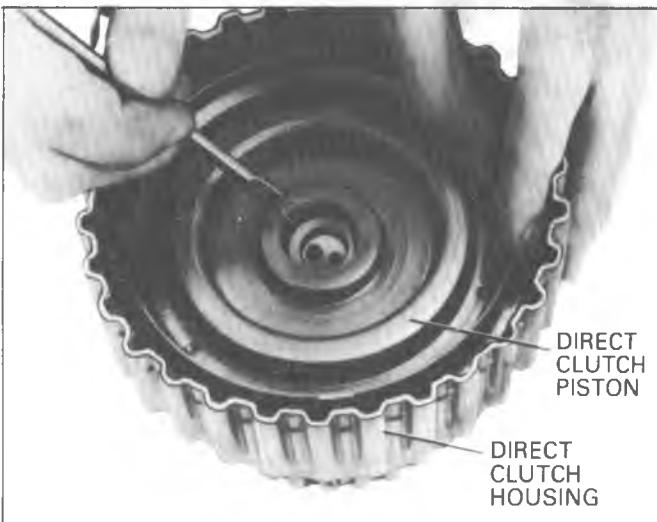


Fig. 7A-118A--Installing Forward Clutch Piston



Fig. 7A-119A--Installing Clutch Plates Into Forward Clutch HOusing

5. Using J-23327-1, J-25024 and J-25018 adaptor, compress retainer past the snap ring groove, and install snap ring (Fig. 7A-113A).

**NOTE:** An arbor press and J-23327-1 and J-25018 can be used to compress the retainer and spring assembly.

6. Remove J-23327-1 and J-25018.

7. Oil and install the forward clutch plates into the forward clutch housing, starting with the waved steel plate and alternating composition-faced and flat steel clutch plates. (See Fig. 7A-119A, and Clutch Plate Usage Chart Fig. 7A-82A).

8. Install backing plate, chamfered side up.

9. Install snap ring (Fig. 7A-112A).

**NOTE:** Make sure composition clutch plates turn freely.

10. Install forward to direct clutch thrust washer and retain with petrolatum (Fig. 7A-111A).

11. If removed, install new turbine shaft seal rings, making sure cut ends are assembled in the same relationship as cut and rings are seated in their groove. Retain with petrolatum. (See Fig. 7A-120A for correct way to position cut ends.)

### Intermediate Band Assembly

1. Inspect band for burning, flaking or damage.
2. Install intermediate band, locating band apply lug and anchor pin lug in case slots (Fig. 7A-125A).

### Forward and Direct Clutch Installation

1. Position direct clutch assembly, clutch plate end up, over hole in bench.

**NOTE:** Align direct clutch composition-faced clutch plate teeth one above the other to make the forward clutch assembly easier to install.

2. Install forward clutch assembly into direct clutch. Hold direct clutch housing and rotate forward clutch back and forth until the forward clutch is seated (Fig. 7A-121A).

**NOTE:** When the forward clutch is seated, it will be approximately 19.05mm (3/4") from the tang end of the direct clutch housing to the end of the forward clutch drum, Fig. 7A-122A.

3. Grasp direct and forward clutch assemblies to prevent their separation and position on bench, with the turbine shaft up.

4. Install J-25021 as shown in Fig. 7A-123A.

5. Install direct and forward clutch assemblies, using J-25021, and rotate into position (Fig. 7A-123A).

**NOTE:** The direct clutch housing will be approximately 33.34mm (1-5/16") from the pump face in case when correctly seated. See Fig. 7A-124A.

6. Remove J-25021.

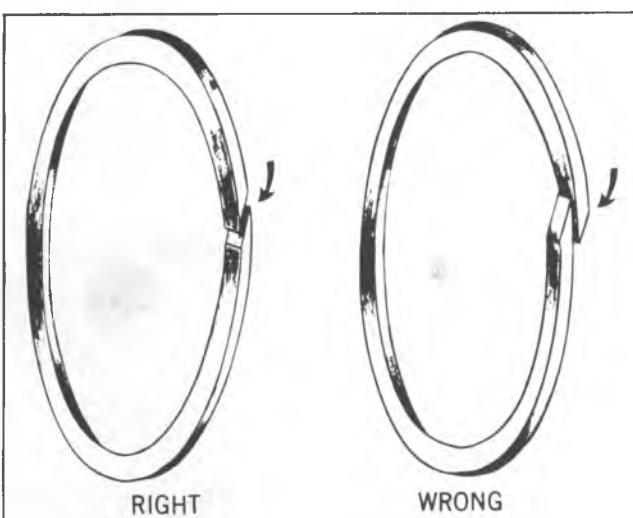


Fig. 7A-120A--Teflon Oil Seal Rings

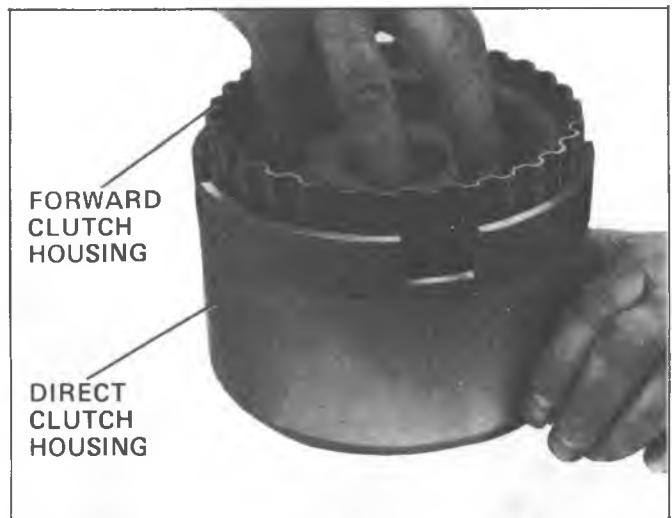


Fig. 7A-121A--Installing Forward Clutch Assembly

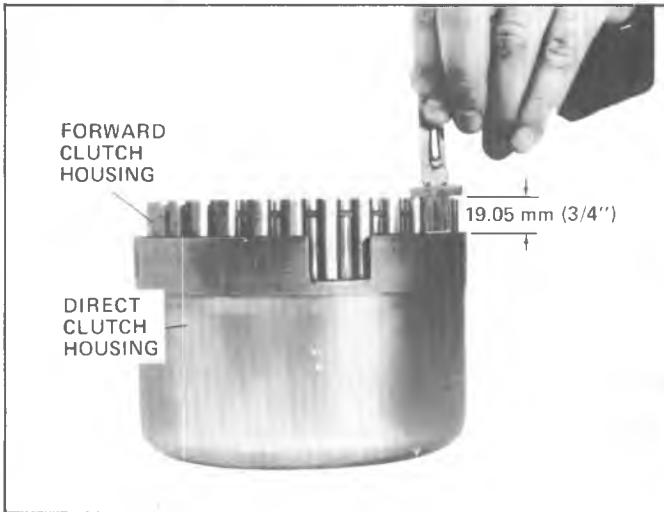


Fig. 7A-122A--Forward Clutch Properly Seated in Direct Clutch

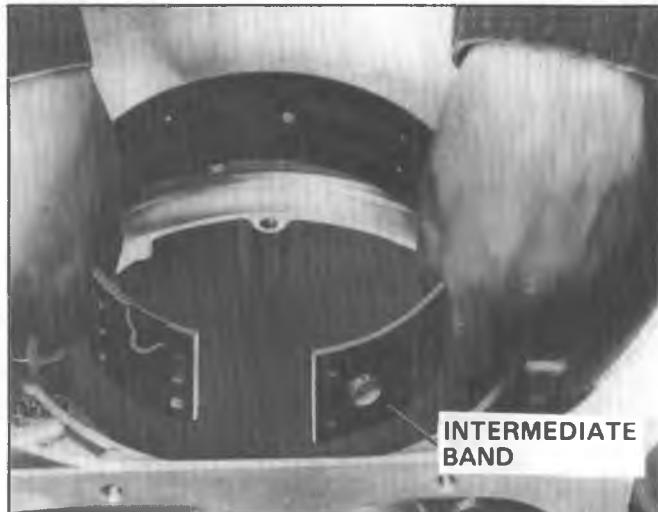


Fig. 7A-125A--Installing Intermediate Band Assembly

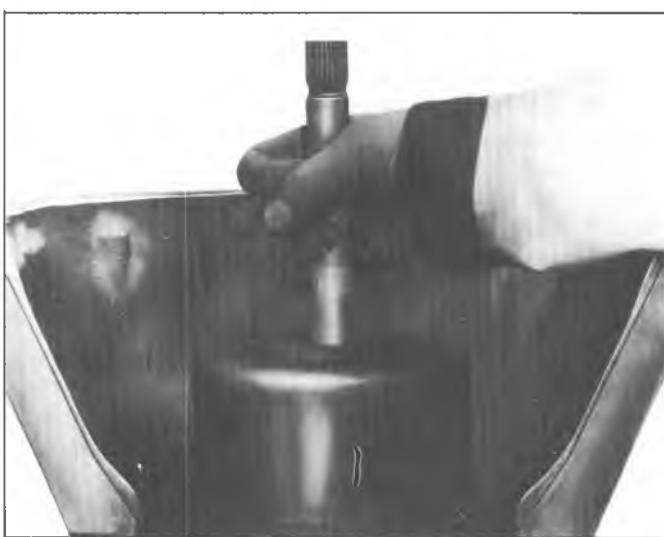


Fig. 7A-123A--Installing Direct and Forward Clutch Assemblies

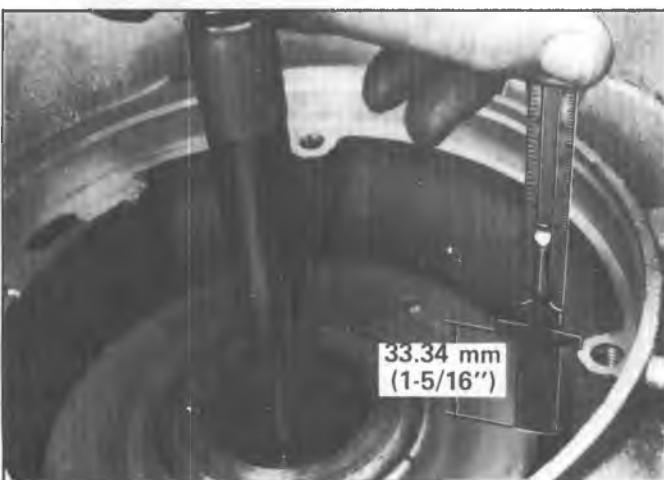


Fig. 7A-124A--Direct and Forward Clutch Assemblies Properly Installed

## Pump Assembly (Fig. 7A-126A)

### Inspection

1. Remove pump to case seal ring and inspect groove for damage.
2. Place pump over hole in bench with pump cover side up.
3. Remove pump to direct clutch thrust washer and inspect for damage or wear (Fig. 7A-127A).
4. Inspect 3 teflon oil ring seals for damage and free fit in grooves. Do not remove unless replacing.

### Pressure Regulator

#### Inspection

1. To prevent the pump from turning while removing the pressure regulator valve, place a bolt or screwdriver through a hole in the pump and bench (Fig. 7A-128A).
2. Using small screwdriver, push on bore plug, compressing pressure regulator spring; and using snap ring pliers, remove retaining ring (Fig. 7A-128A).
3. Release valve spring tension slowly and remove valve train.
4. Inspect pressure regulator valve for nicks or damage.

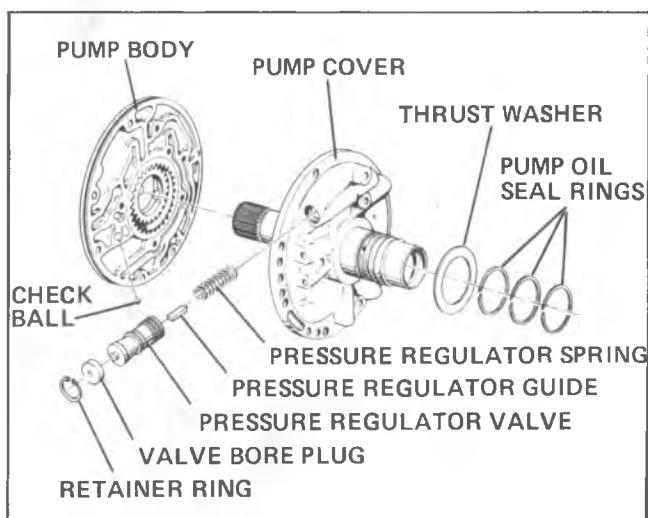


Fig. 7A-126A--Pump Assembly - Exploded View

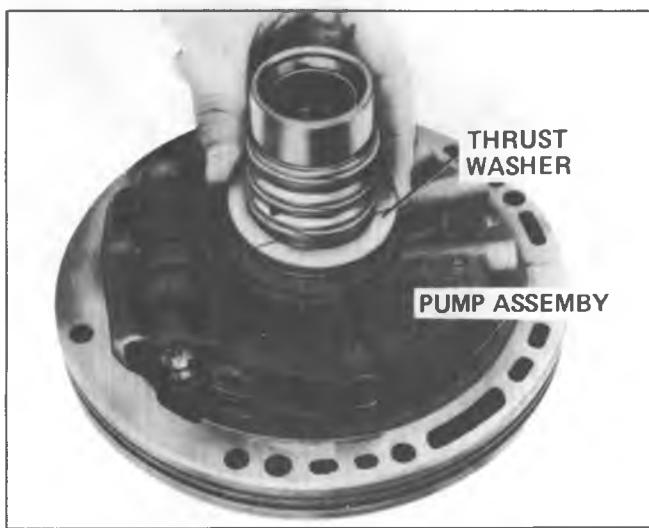


Fig. 7A-127A--Removing or Installing Thrust Washer from Pump

5. Inspect spring and guide for damage or distortion.
6. Inspect pressure regulator valve for free operation in bore.

**CAUTION:** Do not drop the check ball that is in the pump, as the pump body and pump cover are separated.

7. Remove pump cover to pump body attaching bolts and separate pump cover from pump body.

## Pump Body

### Inspection

1. Remove the 7.14mm (.281") check ball from the pump body or pump cover and keep it separated from the five 6.35mm (.250") check balls used in the case and control valve assembly.

2. Remove drive gear and driven gear from pump body (Fig. 7A-129A).

3. Inspect drive and driven gears for scoring, galling or damage.

**NOTE:** Driven gear identification marks should have been against the pump body gear pocket. (See Fig. 7A-133A for identification.) The drive gear has 1 identification mark on each drive tang (Fig. 7A-129A).

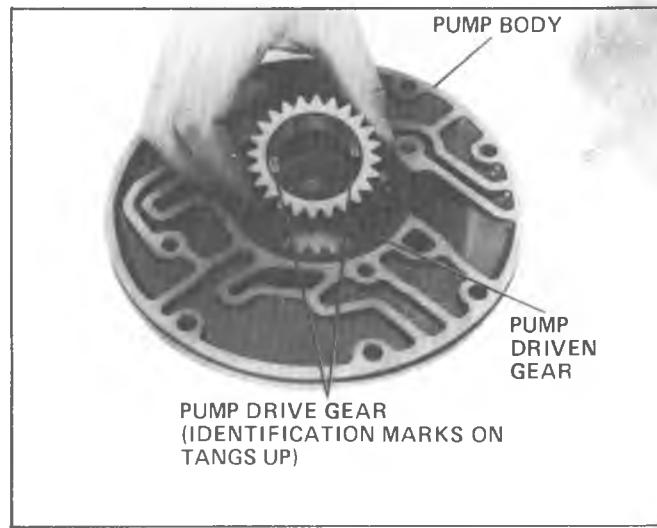


Fig. 7A-129A--Removing Pump Drive Gear

This side should be facing away from the pump body gear pocket.

4. Inspect drive and driven gear pocket and crescent for scoring or damage.
5. Inspect pump body face for nicks and overall flatness.
6. Inspect for open oil passages (Fig. 7A-130A).
7. Inspect for damaged bolt hole threads.
8. Inspect for open drainback hole.
9. Inspect bushing for scores or nicks.
10. If removed, coat outside of seal body with non-hardening sealing compound; support pump body, oil seal side up, and using J-25016, install new pump body oil seal (Fig. 7A-131A).
11. Install driven pump gear with identification mark down against gear pocket of pump body (Figs. 7A-132A and 7A-133A).
12. Install drive gear with identification marks on drive tangs up (Fig. 7A-129A).
13. Pump body face to gear face clearance should be 0.020-0.055mm (.0007"-.0021") (Fig. 7A-134A).
14. Place the check ball into the check ball pocket in the pump body and retain it with petrodatum. (See Fig. 7A-130A for ball location).

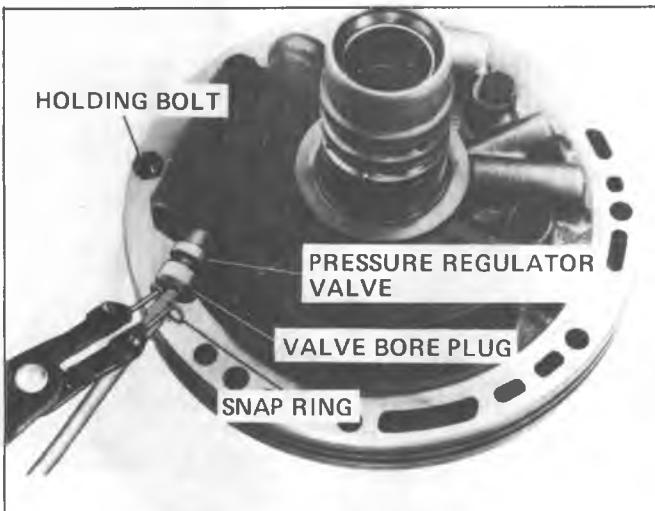


Fig. 7A-128A Removing or Installing Pressure Regulator Valve

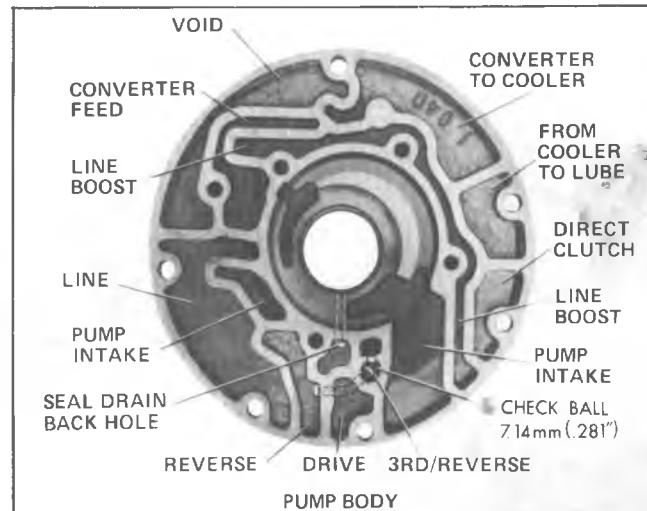


Fig. 7A-130A--Pump Body Assembly

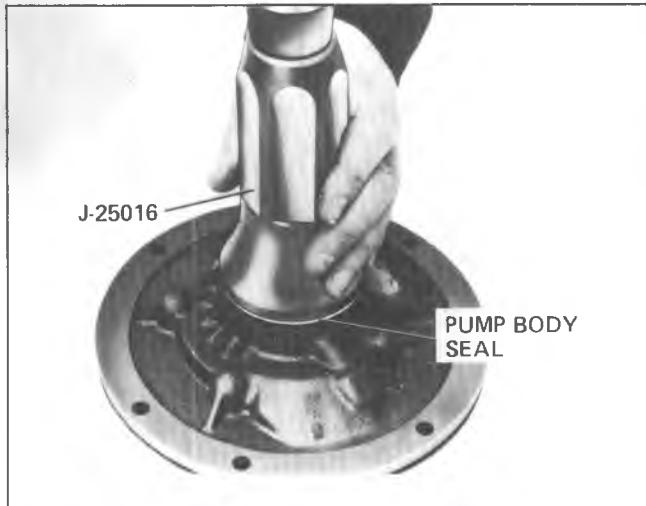


Fig. 7A-131A--Installing Seal Into Pump Body



Fig. 7A-134A--Checking Pump Body-to-Gear End Clearance

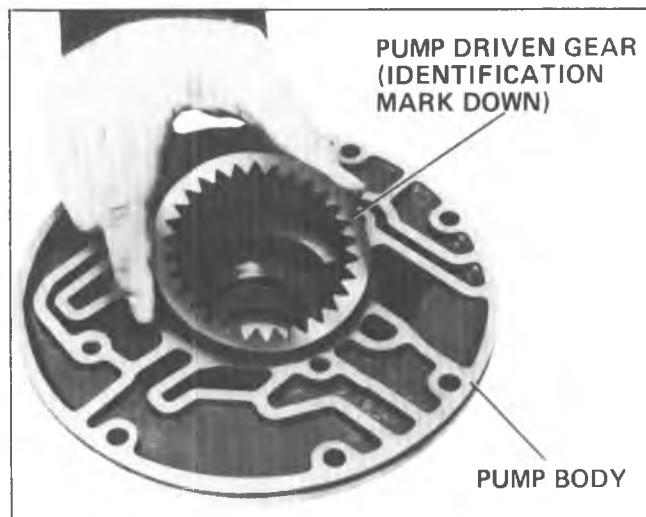


Fig. 7A-132A--Installing Pump Driven Gear

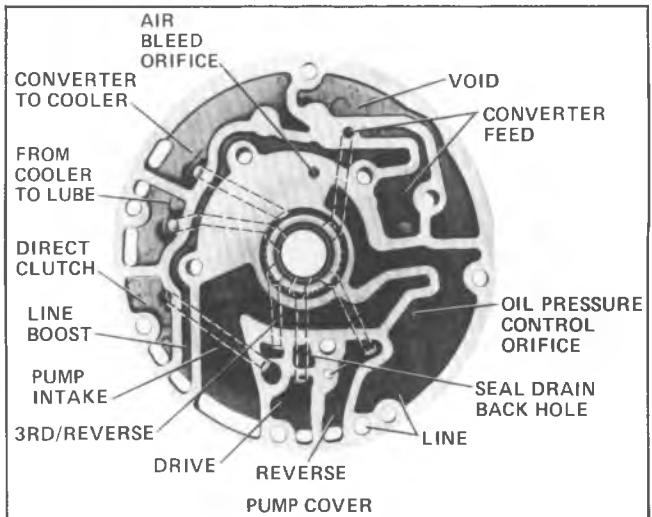


Fig. 7A-135A--Pump Cover Assembly

## Pump Cover

### Inspection

1. Inspect for open oil passages (Figs. 7A-135A and 7A-136A).
2. Inspect seven (7) cup plugs. If a plug is missing, drive a new cup plug to .79mm (1/32") below top of hole, using a 7.14mm (9/32") diameter rod on the smaller plugs and

a 7.92mm (5/16") diameter rod on the larger plugs. Stake top of hole two places, directly opposite each other, to retain plug.

3. Inspect pump cover face for nicks and overall flatness.
4. Inspect for chips in pressure regulator bore.

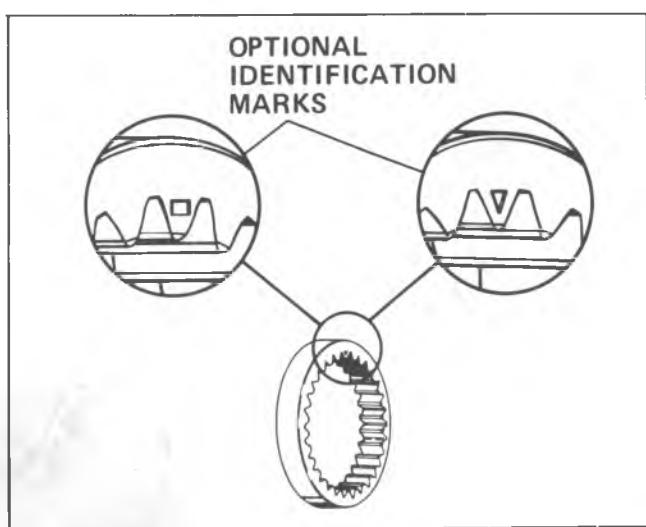


Fig. 7A-133A--Pump Driven Gear Identification

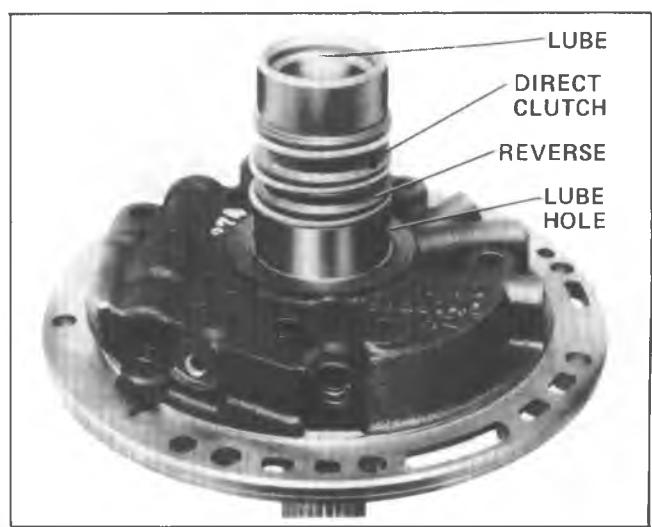


Fig. 7A-136A--Pump Cover Oil Passages

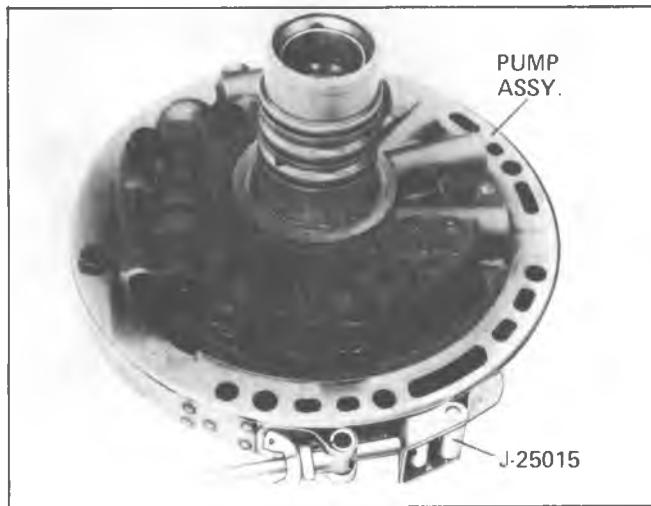


Fig. 7A-137A--Aligning Pump Cover and Pump Body

5. Inspect stator shaft for damaged splines or damaged bushings.
6. Inspect orifice plug (see Fig. 7A-135A). If the plug requires replacement, place new plug, orifice end first, into plug hole from the rough casting side. Drive the plug flush to .25mm (.010") below top of hole, rough casting side. Stake the top of hole two places to retain the plug.

#### Reassembly

1. Place pump body over hole in bench.
2. Assemble pump cover to pump body with attaching bolts, finger tight.
3. Align pump cover and pump body using J-25015 (Fig. 7A-137A) and place bolt or screwdriver through pump to case bolt hole and bench.
4. Torque pump cover attaching bolts to 20.0-27.0 N·m (15-20 ft. lbs.).
5. Remove J-25015.
6. Install pressure regulator spring, guide, valve with stem end out, and bore plug, hole side out (Fig. 7A-126A).
7. Compress pressure regulator valve spring by pushing on bore plug with small screwdriver and install retaining ring (Fig. 7A-128A).
8. If removed, install 3 new oil seal rings, making sure cut ends are assembled in the same relationship as cut (Fig.



Fig. 7A-138A--Installing Pump Assembly

7A-120A). Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings. Retain with petrolatum.

9. Install pump to case seal ring, chamfered side out, making sure the ring is not twisted.
10. Install pump to direct clutch thrust washer and retain with petrolatum (Fig. 7A-127A).
11. Remove holding bolt or screwdriver.
12. Install new pump to case gasket on pump and retain with petrolatum.
13. Install 2 pump to case alignment pins in case as shown in Fig. 7A-138A.

**NOTE:** Before installing pump, make sure intermediate band anchor pin lug is aligned with band anchor pin hole in case.

14. Install pump assembly and finger start pump to case bolts and new washers, except one bolt hole (Fig. 7A-139A), which will be used to make the front unit end play check.

**NOTE:** If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.

15. Replace 2 alignment pins with 2 bolts and new washers.
16. Torque pump to case bolts to 20.0-27.0 N·m (15-20 ft. lbs.).

**NOTE:** Make sure turbine shaft rotates freely.

#### Check Front Unit End Play (Fig. 7A-139A)

1. Install 278mm (11") bolt and locking nut as shown in Fig. 7A-139A.

2. Push turbine shaft downward.
3. Install J-25022 on J-24773 tool and locate on end of turbine shaft (Fig. 7A-139A).

4. Mount dial indicator on bolt and position indicator point against cap nut of J-24773.

5. Move output shaft forward by turning the adjusting screw on J-25013-5 until the white or scribed line on sleeve J-25013-1 begins to disappear, then set dial indicator to zero.

6. Pull turbine shaft upward, and read end play. Front unit end play should be 0.56mm-1.30mm (.022"-.051").

**NOTE:** Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end



Fig. 7A-139A--Checking Front Unit End Play

FRONT UNIT END PLAY CHART	
<u>THICKNESS</u>	<u>IDENTIFICATION</u>
<u>Number and/or Color</u>	
1.66-1.77mm (0.065"-0.070")	1
1.79-1.90mm (0.070"-0.075")	2
1.92-2.03mm (0.076"-0.080")	3 - Black
2.05-2.16mm (0.081"-0.085")	4 - Light Green
2.18-2.29mm (0.086"-0.090")	5 - Scarlet
2.31-2.42mm (0.091"-0.095")	6 - Purple
2.44-2.55mm (0.096"-0.100")	7 - Cocoa Brown
2.57-2.68mm (0.101"-0.106")	8 - Orange
2.70-2.81mm (0.106"-0.111")	9 - Yellow
2.83-2.94mm (0.111"-0.116")	10 - Light Blue
2.96-3.07mm (0.117"-0.121")	11
3.09-3.20mm (0.122"-0.126")	12

Fig. 7A-140A-Front Unit End Play Washer Thickness Chart

play within specifications, select proper washer from Fig. 7A-140A.

7. Remove front unit end play checking tools.

8. Install remaining pump to case bolt and new washer, torquing bolt to 20.0-27.0 N·m (15-20 ft. lbs.).

9. Remove J-25013-5 and J-25013-1 from rear end of transmission (Fig. 7A-141A).

10. Turn transmission to horizontal position, oil pan side up.

## EXTERNAL PARTS

### Governor Assembly

#### Inspection

1. Inspect governor cover for damage, scored or worn bore, or plugged oil passage.

2. Wash in cleaning solvent and blow out oil passage.

3. Inspect governor driven gear for nicks or damage.

4. Inspect governor shaft seal ring for cuts, damage and free fit in groove.

5. Inspect for free operation of governor weights.

6. Inspect for damaged, mispositioned, or tilted springs. (Some governors use one spring, and some governors use two springs.)

7. Inspect for presence of 2 check balls.

8. Inspect shaft for damage.

9. Inspect governor washer for damage.

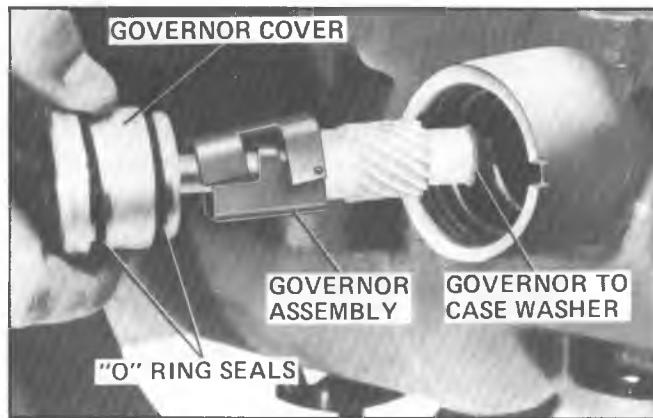


Fig. 7A-142A--Installing Governor and Cover Assembly

10. If damaged, cut seal ring off governor shaft.

**CAUTION:** Do not damage seal ring when removing seal.

#### Installation

1. If removed, install new seal ring on shaft and place seal ring end into governor cover to size seal; lubricate with petrolatum.

2. Lubricate with petrolatum and install 2 new seal rings on governor cover.

**CAUTION:** The governor cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of the rings. Also, make sure 2 check balls are in the governor before installation.

3. Install governor assembly, seal ring end first, into cover.

**CAUTION:** Do not use any type of hammer to install governor assembly and cover into case. Damage to case, governor or cover could result.

4. Install governor and cover assembly, aligning governor shaft with shaft hole in case (Fig. 7A-142A). Rotate governor and cover assembly and output shaft slightly. The governor cover fits tight in the bore the last 1.5mm (1/16").

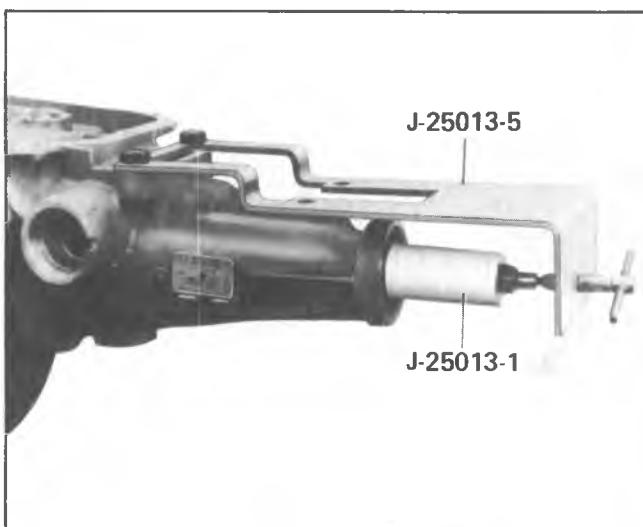


Fig. 7A-141A--Installing Tools on Rear End of Case



Fig. 7A-143A--Installing Intermediate Band Anchor Pin

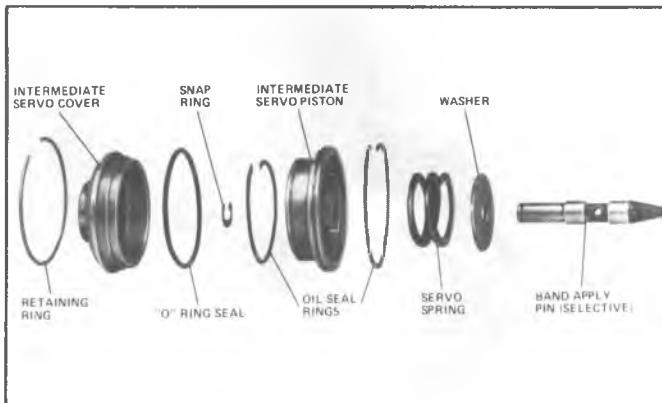


Fig. 7A-144A--Intermediate Servo-Exploded

- NOTE:** Governor shaft is not aligned with case hole, if retaining ring cannot be installed.
5. Install governor retaining ring. Align ring gap with an end showing in case slot.

### Intermediate Band Anchor Pin

1. Inspect anchor pin for damage.
2. Install anchor pin, stem end first, making sure stem locates in hole of intermediate band lug (Fig. 7A-143A).

### Intermediate Servo Piston Assembly (Fig. 7A-144A)

#### Inspection

- NOTE:** Production transmissions may be built with either two or zero oil seal rings on the band apply pin. All service band apply pins will have two oil seal rings.
1. Inspect pin for damage and fit in case bore.
  2. Inspect inner and outer piston seal rings for damage and free fit in ring grooves. Do not remove unless replacing.



Fig. 7A-146A--Intermediate Band Apply Gages

3. Inspect spring.
  4. Inspect intermediate servo cover and piston assembly for proper combination and usage. (See Fig. 7A-145A).
  5. Check for proper intermediate band apply pin as follows:
    - a. Install J-25014-2 in intermediate servo bore and retain with intermediate servo cover retaining ring, aligning ring with gap at case slot (Fig. 7A-146A).
    - b. Install pin J-25014-1 into J-25014-2.
- CAUTION:** Make sure the tapered pin end is properly located against the band apply lug. Also, make sure the band anchor pin is properly located in the case and band anchor lug.

T. H. M. "200" INTERMEDIATE SERVO COVER & PISTON USAGE - 1977			
MODEL	COVER		PISTON
	Identified by Cast Part No. On Cover	Identified by Cast Part No. On Piston	
CU			
CN	8628696	8630131	
CZ			
CX	*8630085	**8630083	
CE			
CR	8628134	8628112	
CD			
CY	8628133	8628111	

**NOTE:** \*Intermediate servo cover, 8630085, at start of production will be identified by the part no. 8628696 cast on the cover with the letter "A" stamped on it.

\*\*Intermediate servo piston, 8630083, at start of production will be identified by the part no. 8628111 cast on the cover with the letter "A" stamped on it.

Fig. 7A-145A--Intermediate Servo Cover and Piston Usage Chart

## INTERMEDIATE BAND APPLY PIN CHART

DIAL INDICATOR TRAVEL	APPLY PIN IDENTIFICATION
APPLY PIN IDENTIFICATION +	
.0 .72mm (.0 -.029")	1 Ring
.72mm- 1.44mm (.029" - .057")	2 Rings
1.44mm- 2.16mm (.057" - .086")	3 Rings
2.16mm- 2.88mm (.086" - .114")	Wide Band

Fig. 7A-147A--Intermediate Band Apply Pin Chart

c. Install dial J-8001 and position dial indicator point on top of J-25014-2 zero post, and set dial indicator to zero.

d. Align stepped side of pin J-25014-1 with torquing arm of J-25014-2. Arm must stop against step of pin J-25014-1.

**NOTE:** If band selection pin does not register between the high and low limits, look for possible problem with the intermediate band, direct clutch or case.

Make sure J-25014-2 gauge plate is pulled backwards and seated squarely against the retaining ring.

e. Apply 12 N·m (100 in. lbs.) of torque to hex nut on side of gauge. Slide dial indicator over gauge pin J-25014-1 (Fig. 7A-146A). Read dial indicator and see Fig. 7A-147A for proper size.

**NOTE:** Dial indicator travel is reversed, making the indicator readings backwards. On an indicator that ranges from 0-100, a 5mm (.020") travel will read 2mm (.080"), a 1.5mm (.060") travel will read 1mm (.040").

The identification ring is located on the band end of the pin.

f. Remove retaining ring and band apply pin gauges. If new apply pin or replacement of piston is required, proceed as follows:

**Disassembly**

1. Using J-22269-01, compress intermediate servo piston spring (Fig. 7A-148A).

2. Using small flat edge screwdriver, remove intermediate pin to piston snap ring.

3. Remove J-22269-01 and separate band apply pin, spring and washer from intermediate servo piston.

**Reassembly**

1. Install washer on snap ring end of band apply pin (Fig. 7A-144A).

2. Install spring on washer.

3. Install band apply pin, spring end first through intermediate servo piston.

4. Using J-22269-01, compress intermediate servo piston spring (Fig. 7A-148A).

5. Using small pliers, install intermediate servo pin to piston snap ring. Remove J-22269-01.

6. If removed, install new intermediate servo piston, inner and outer seal rings. Make sure cut ends are assembled in the same relationship as cut (Fig. 7A-120A). Make sure rings are seated in the grooves to prevent damage to the rings. Retain with petrolatum.

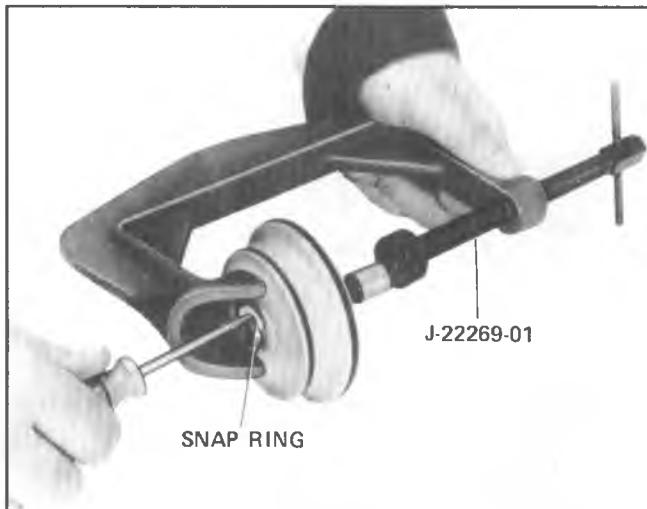


Fig. 7A-148A--Removing Intermediate Servo Piston from Apply Pin

7. Lubricate with petrolatum and install new seal ring on intermediate servo cover.

**CAUTION:** The intermediate servo cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of ring.

8. Install intermediate servo piston assembly into intermediate servo cover (Fig. 7A-149A).

9. Install intermediate servo assembly into case, tapping lightly with non-metal or plastic hammer if necessary (Fig. 7A-150A).

**CAUTION:** Make sure the tapered end of the band apply pin is properly located against the band apply lug.

10. Install servo retaining ring. Align ring gap with an end showing in case slot.

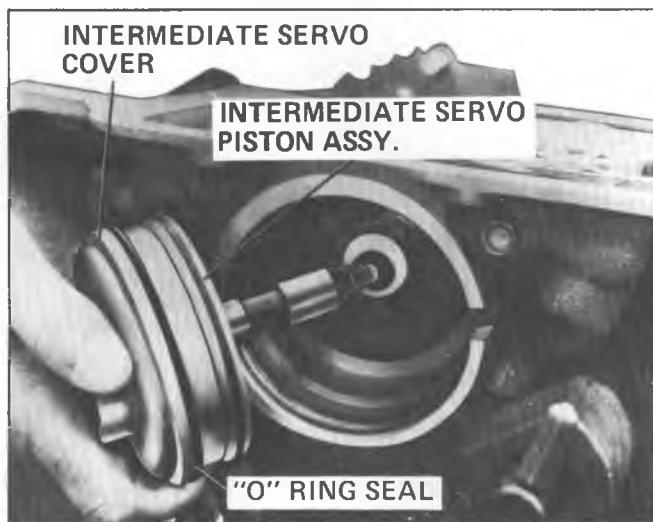
**Low and Reverse Clutch Housing to Case Cup Plug and Seal (Fig. 7A-151A)**

1. Install new seal.

2. Place cup plug, with smaller hole end first, into hole in case. Using a 10mm (3/8") diameter by 150mm (6") metal rod and hammer, drive plug until flush with top of plug hole in case.



Fig. 7A-149A--Installing Intermediate Servo Piston into Cover



7A-150A--Installing Intermediate Servo Piston and Cover Assembly

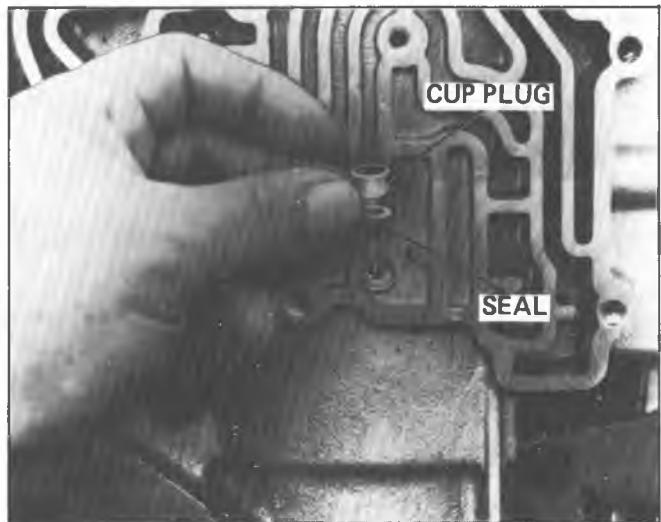


Fig. 7A-151A--Installing Low and Reverse Clutch Housing to Case Cup Plug and Seal

## Control Valve Assembly

### Disassembly

**NOTE:** As each valve train is removed, place the individual valve train in the order that it is removed and in a separate location relative to its position in the valve body. None of the valves, bushings or springs are interchangeable; some coiled pins are interchangeable.

Remove all coiled pins by pushing through from the rough cast surface side of the control valve assembly, except the 2 pins which retain the throttle valve and throttle valve plunger.

1. Remove the 4 check balls.
2. Position control valve assembly as shown in Fig. 7A-152A.

3. Remove 1-2 accumulator piston.
4. Remove manual valve from upper bore.

**CAUTION:** Some of the coiled pins in the control valve assembly have pressure against them. Therefore, hold a shop towel over the bore while removing the pin, to prevent possibly losing a bore plug, spring, etc.

5. Remove coiled pin from upper right bore. Remove 2-3 throttle valve bushing 2-3 throttle valve spring, 2-3 throttle valve and 2-3 shift valve.

**NOTE:** The 2-3 throttle valve spring and 2-3 throttle valve may be inside the 2-3 throttle valve bushing.

6. From next bore down, remove coiled pin. Remove 1-2 throttle valve bushing, 1-2 throttle valve spring, 1-2 throttle valve and 1-2 shift valve.

**NOTE:** The 1-2 throttle valve spring and the 1-2 throttle valve may be inside the 1-2 throttle valve bushing.

7. From next bore down, remove coiled pin and bore plug. Remove reverse boost spring and reverse boost valve.

8. Check the operation of the shift T.V. valve in the next bore down, by moving the valve against the spring. If it is necessary to remove the valve, proceed as follows: (Figs. 7A-153A and 7A-154A).

- a. Remove coiled pin and place valve body on shop towel with rough casting surface up.
- b. Using needle nose pliers, compress the shift T.V. spring by pushing on the shift T.V. valve; hold valve with small screwdriver.

c. Place 6.3mm (1/4") rod, 9.5mm (3/8") long, against the end of the shift T.V. valve.

d. Prying on end of the rod with a large screwdriver, remove small screwdriver and remove shift T.V. plug, shift T.V. spring and shift T.V. valve.

e. Discard shift T.V. plug and remove 6.3mm (1/4") rod from shift T.V. bore.

9. From next bore down, remove outer coiled pin. Remove the throttle valve plunger, bushing, throttle valve spring and detent pin. Using a 1.5mm (1/16") allen wrench with ground sides to fit inside the pin, remove the inner coiled pin (Fig. 7A-155A). Remove the throttle valve.

10. From upper left bore, remove coiled pin, intermediate boost spring and intermediate boost valve.

11. From next bore down, remove coiled pin, low overrun clutch spring and low overrun clutch valve.

12. From next bore down, remove coiled pin, direct clutch exhaust spring and direct clutch exhaust valve.

13. From next bore down, remove coiled pin, valve bore plug, 1-2 accumulator valve and 1-2 accumulator valve and 1-2 accumulator valve spring.

### Inspection

1. Wash control valve body, valves, springs, and other parts in clean solvent and air dry.

2. Inspect 1-2 accumulator piston for damage.

3. Inspect 1-2 accumulator piston seal for damage and free fitting groove. Do not remove seal unless replacing.

4. Inspect valve for scoring, cracks and free movement in their bores.

5. Inspect bushings for cracks or scored bores.

6. Inspect valve body for cracks damage or scored bores.

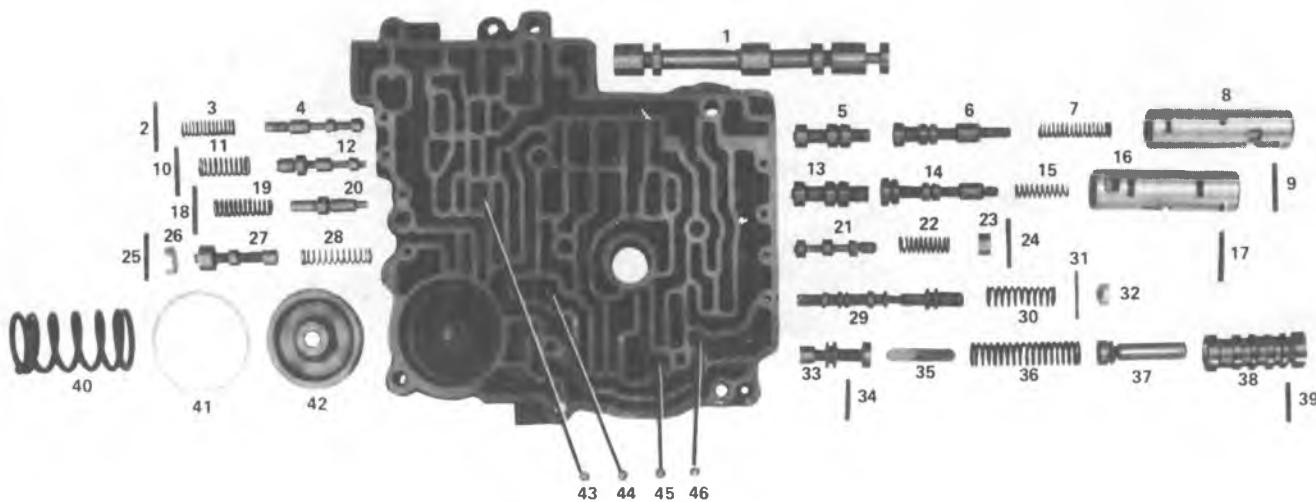
7. Inspect springs for distortion or collapsed coils.

8. Inspect bore plugs for damage.

### Reassembly

**NOTE:** Install all coiled pins from machined face side except the coiled pin retaining the throttle valve bushing, plunger, spring and detent pin. Install this coiled pin from rough casting side. Coiled pins do not fit flush on rough casting face.

1. Position control valve body as shown in Fig. 7A-152A.



- |                                |                                  |  |
|--------------------------------|----------------------------------|--|
| 1. MANUAL VALVE                | 17. RETAINING COILED PIN         | 33. THROTTLE VALVE   |
| 2. RETAINING COILED PIN        | 18. RETAINING COILED PIN         | 34. RETAINING COILED PIN                                   |
| 3. INTERMEDIATE BOOST SPRING   | 19. DIRECT CLUTCH EXHAUST SPRING | 35. DETENT PIN   |
| 4. INTERMEDIATE BOOST VALVE    | 20. DIRECT CLUTCH EXHAUST VALVE  | 36. THROTTLE VALVE SPRING                                  |
| 5. 2-3 SHIFT VALVE             | 21. REVERSE BOOST VALVE          | 37. THROTTLE VALVE PLUNGER                                 |
| 6. 2-3 THROTTLE VALVE          | 22. REVERSE BOOST SPRING         | 38. THROTTLE VALVE PLUNGER BUSHING                         |
| 7. 2-3 THROTTLE VALVE SPRING   | 23. REVERSE BOOST BORE PLUG      | 39. RETAINING COILED PIN                                   |
| 8. 2-3 THROTTLE VALVE BUSHING  | 24. RETAINING COILED PIN         | 40. 1-2 ACCUMULATOR SPRING                                 |
| 9. RETAINING COILED PIN        | 25. RETAINING COILED PIN         | 41. 1-2 ACCUMULATOR PISTON SEAL                            |
| 10. RETAINING COILED PIN       | 26. 1-2 ACCUMULATOR BORE PLUG    | 42. 1-2 ACCUMULATOR PISTON                                 |
| 11. LO OVERRUN CLUTCH SPRING   | 27. 1-2 ACCUMULATOR VALVE        | 43. CHECK BALL #4  |
| 12. LO OVERRUN CLUTCH VALVE    | 28. 1-2 ACCUMULATOR VALVE SPRING | 44. CHECK BALL #3  |
| 13. 1-2 SHIFT VALVE            | 29. SHIFT T.V. VALVE             | 45. CHECK BALL #2  |
| 14. 1-2 THROTTLE VALVE         | 30. SHIFT T.V. SPRING            | 46. CHECK BALL #1 (Note: 5th Check<br>Ball Is In The Case) |
| 15. 1-2 THROTTLE VALVE SPRING  | 31. RETAINING COILED PIN         |  |
| 16. 1-2 THROTTLE VALVE BUSHING | 32. SHIFT T.V. BORE PLUG         |  |

Fig. 7A-152A-Control Valve Assembly - Exploded View

2. Install into lower left bore, 1-2 accumulator spring, 1-2 accumulator valve, smaller stem end out. Install bore plug, hole out, and coiled pin.

3. In next bore up, install direct clutch exhaust valve, longer stem end out, direct clutch exhaust spring and coiled pin.

4. In next bore up, install low overrun clutch valve, longer stem end out, low overrun clutch spring and coiled pin.

5. In next bore up, install intermediate boost valve, longer stem end out, intermediate boost spring and coiled pin.

6. In lower right bore, install throttle valve, smaller outside diameter land first, making sure valve is seated at the bottom of the bore. Install inner coiled pin between the lands of this valve (Fig. 7A-155A). Install the detent pin into

the shift T.V. spring and install these 2 parts into the bore. Install the throttle valve plunger, stem end first, into the throttle valve plunger bushing and install these 2 parts into the bore, valve end first. Install outer coiled pin from rough cast surface side, aligning pin with slot in bushing.

7. In next bore up, if removed, install shift T.V. valve, larger outside diameter stem end out, shift T.V. spring and coiled pin. Then, using plastic hammer, install new shift T.V. plug flush with rough casting surface.

8. In next bore up, install reverse boost valve, stem end out, reverse boost spring. Install bore plug, hole side out and coiled pin.

9. In next bore up, install 1-2 shift valve, longer stem end out, making sure valve is seated at the bottom of the bore. Install 1-2 throttle valve spring into the 1-2 throttle valve bushing and 1-2 throttle valve, stem end first, into the

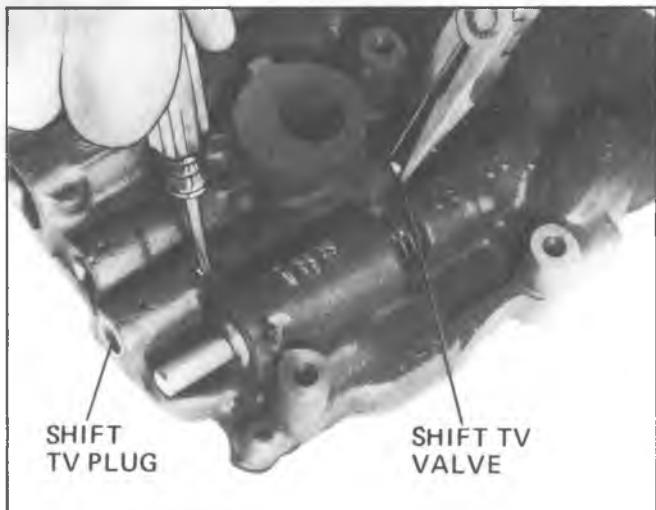


Fig. 7A-153A--Removing Shift T. V. Plug

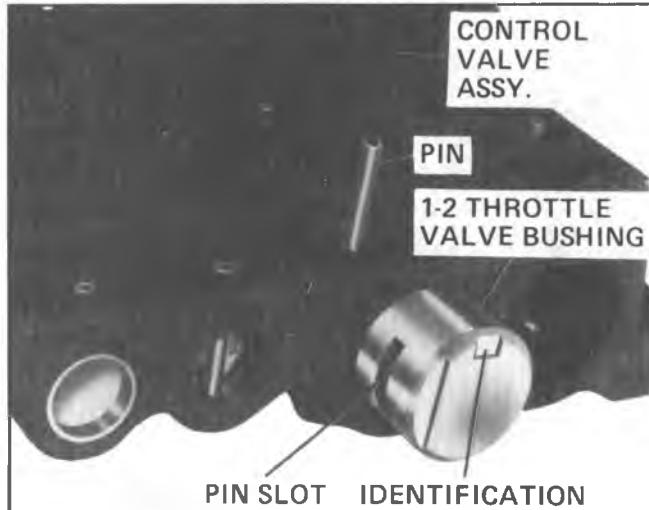


Fig. 7A-156A--Install 1-2 Throttle Valve Bushing

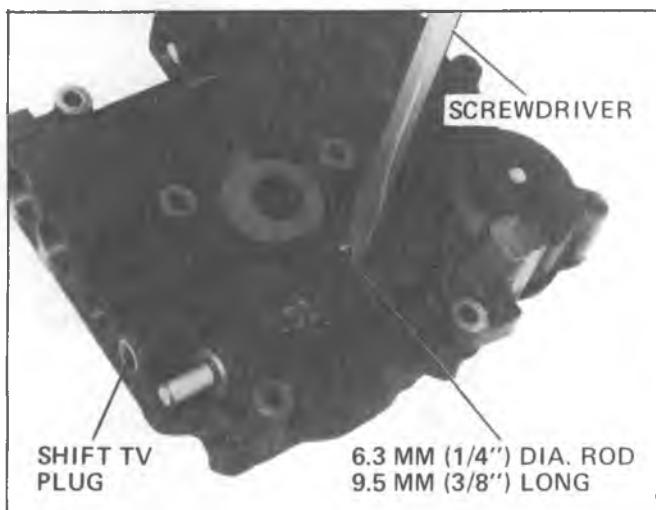


Fig. 7A-154A--Removing Shift T.V. Plug

bushing. Install these 3 parts, valve end first, into the bore, aligning bushing so the pin can be installed in the pin slot. (See Fig. 7A-156A for pin slot and identification of 1-2 throttle valve bushing.)

10. In next bore up, install 2-3 shift valve, longer stem end out, making sure valve is seated at the bottom of the

bore. Install 2-3 throttle valve spring into the 2-3 throttle valve bushing and 2-3 throttle valve, stem end first, into the bushing. Install these 3 parts, valve end first, into the bore, aligning bushing so pin can be installed in the pin slot (Fig. 7A-157A).

11. Install manual valve with the inside detent lever pin groove to the right.
12. If removed, install new seal ring on 1-2 accumulator piston.
13. Oil and install 1-2 accumulator piston, spring pocket side out, into 1-2 accumulator piston bore of valve body.

## Control Valve Assembly

### Installation

1. Inspect 1-2 accumulator spring for damage.
2. Install 1-2 accumulator spring into case (Fig. 7A-158A).
3. Inspect control valve assembly and spacer plate for damage (Fig. 7A-159A).

**NOTE:** The size of the 5 check balls used in the case and control valve assembly is 6.35mm (.250"). The size of the check ball used in the pump is 7.14mm (.281"). Do not interchange.

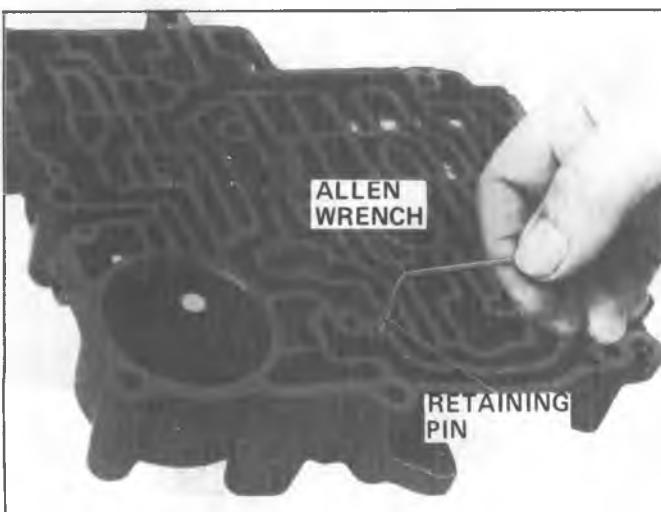


Fig. 7A-155A--Removing Inner Coiled Retaining Pin



Fig. 7A-157A--Installing 2-3 Throttle Valve Bushing



Fig. 7A-158A--Installing 1-2 Accumulator Spring

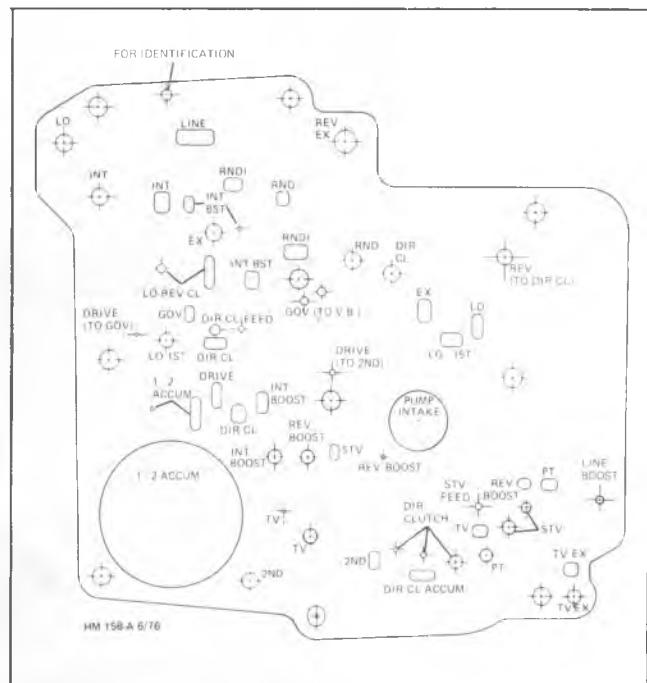


Fig. 7A-159A--Typical Valve Body Spacer Plate

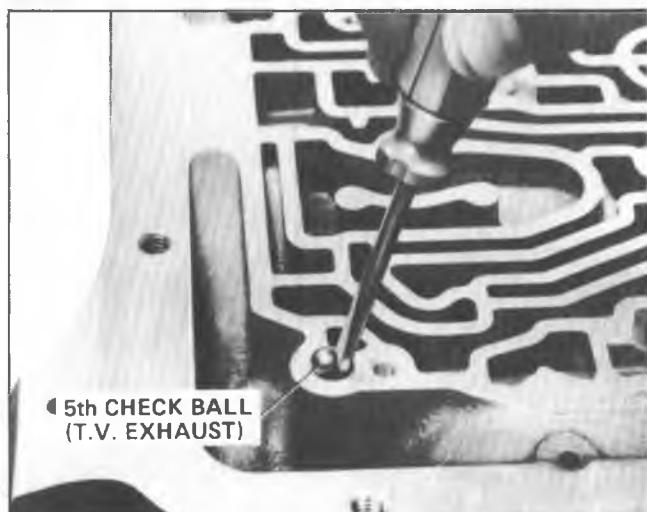


Fig. 7A-160A--Installing 5th Check Ball

4. Install 5th check ball in case as shown (Fig. 7A-160A).

5. Install 2 guide pins as shown in Fig. 7A-161A.

6. Install 4 check balls into ball seat pockets in control valve assembly and retain with petrolatum. (See Fig. 7A-162A for check ball location.)

7. Place the control valve assembly to spacer plate gasket marked "VB" on the control valve assembly.

8. Place the valve body spacer plate on the gasket marked "VB".

9. Place the spacer plate to case gasket marked "C" on the spacer plate.

10. Insert 2 control valve assembly to case attaching bolts through the control valve assembly, gaskets and spacer plate; and install these parts, aligning the manual valve with the detent lever pin (Fig. 7A-161A).

**NOTE:** Make sure check balls, 1-2 accumulator piston and manual valve do not fall out.

11. Start control valve assembly to case attaching bolts, except the throttle lever and bracket assembly and the oil screen attaching bolts.

**CAUTION:** The (2) oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.

12. Inspect inside manual detent roller and spring assembly for damage.

13. Remove guide pins and replace with bolts and inside manual detent roller and spring assembly, locating the tang in the control valve assembly, and the roller on the inside detent lever (Fig. 7A-163A).

14. Throttle lever and bracket assembly.

a. Inspect throttle lever and bracket assembly for damage (Fig. 7A-164A).

b. If removed, install spring on top of lifter, then lifter spring first into throttle bracket.

c. Install link on throttle lever making sure link is hooked as shown (Fig. 7A-165A).

d. Install throttle lever and bracket assembly, locating slot in bracket with coiled pin, aligning lifter through valve body hole and link through T.V. linkage case bore. Retain with bolt.

15. Torque all control valve assembly to case attaching bolts to 13.0-17.0 N·m (9-12 ft. lbs.).

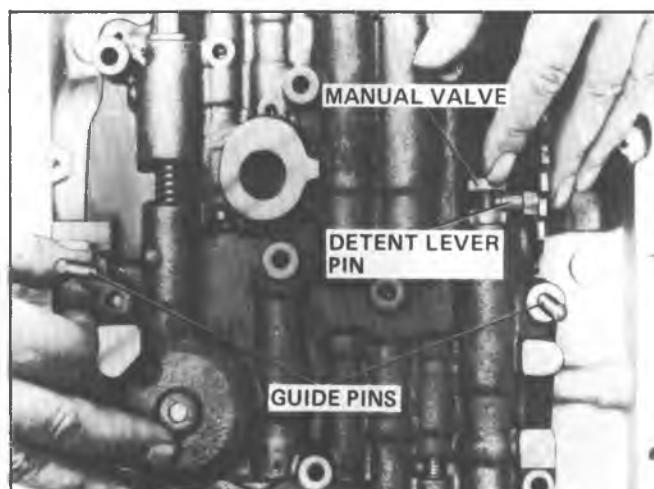


Fig. 7A-161A--Installing Control Valve Assembly Using Guide Pins

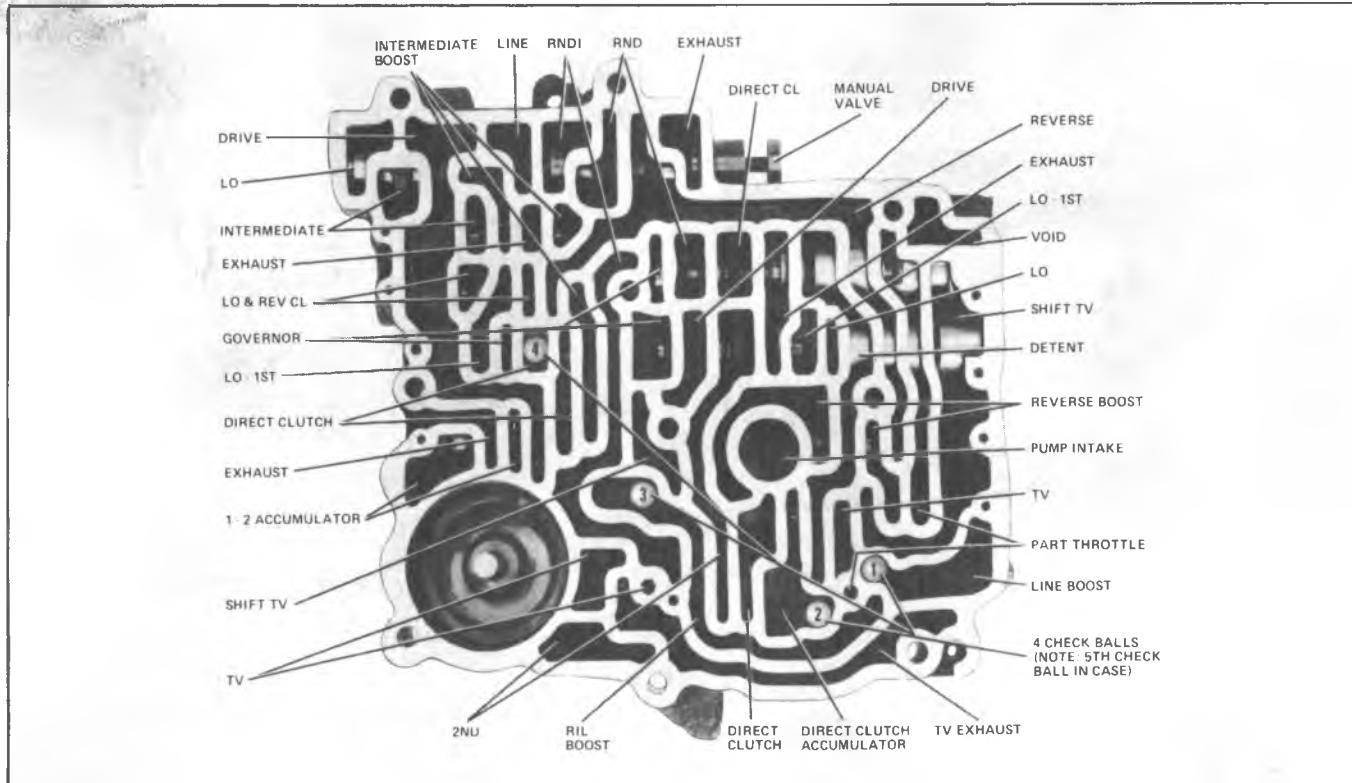


Fig. 7A-162A--Location of Four Check Balls

## Oil Screen

1. Thoroughly clean, air dry and inspect oil screen assembly.
2. Install new oil screen gasket on screen and retain with petrolatum.
3. Install oil screen assembly and attaching bolts (Fig. 7A-166A). Torque bolts to 13.0-17.0 N·m (9-12 ft. lbs.).

## Oil Pan

1. Clean and inspect oil pan for damage.
2. Install new oil pan to case gasket on case.
3. Install oil pan and retaining bolts. Torque bolts to 14.0-18.0 N·m (10-13 ft. lbs.).



Fig. 7A-163A--Installing Manual Detent Roller and Spring Assembly

## Speedometer Driven Gear (Fig. 7A-167A)

### Inspection

1. Remove speedometer driven gear from housing and inspect for damage.
2. Inspect housing for damage and "O" ring for damage or cuts.
3. If damaged, remove and discare "O" ring.

### Reassembly

1. If removed, install new "O" ring on housing.
2. Install speedometer driven gear into housing.
3. Install speedometer driven gear assembly into case (Fig. 7A-167A).

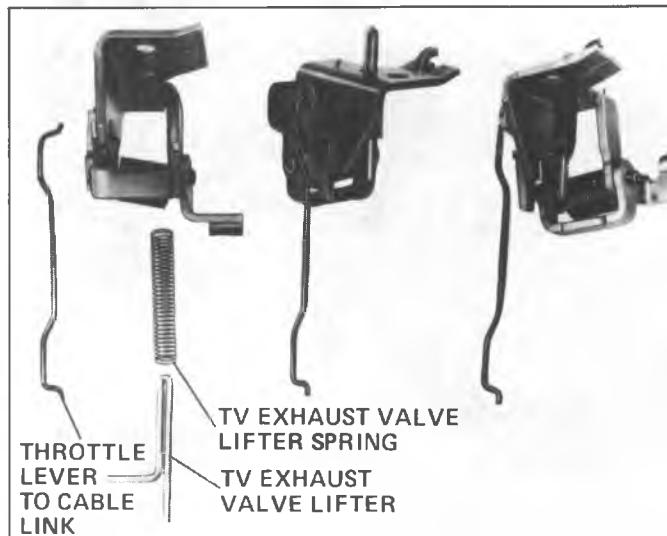


Fig. 7A-164A--Throttle Lever and Bracket Assembly

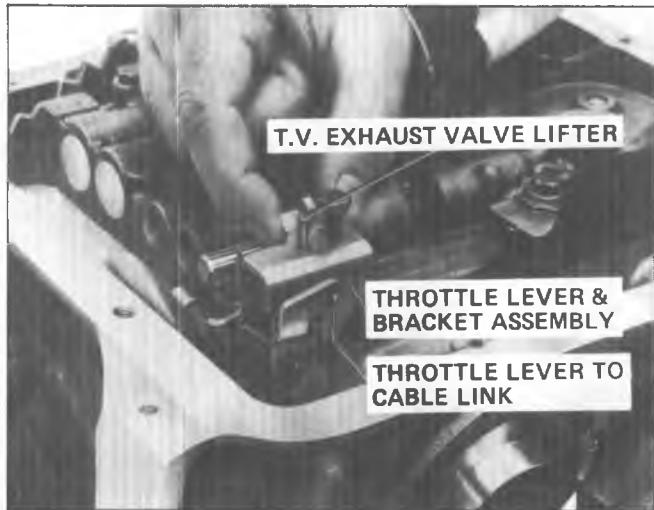


Fig. 7A-165A--Installing Throttle Valve and Bracket Assembly

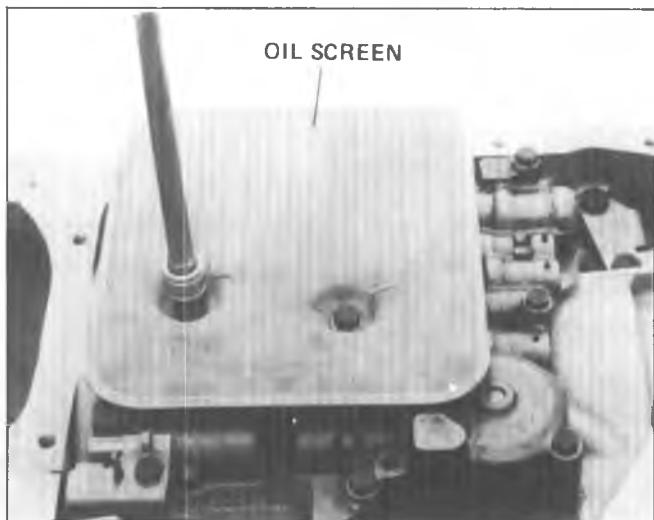


Fig. 7A-166A--Installing Oil Screen

4. Install speedometer retainer and attaching bolt, align slot in speedometer driven gear housing with retainer. Torque bolt to 8.0-14.0 N·m (6-10 ft. lbs.).

5. Place transmission in cradle or transmission jack. Remove holding fixture, J-8763-02 from transmission.

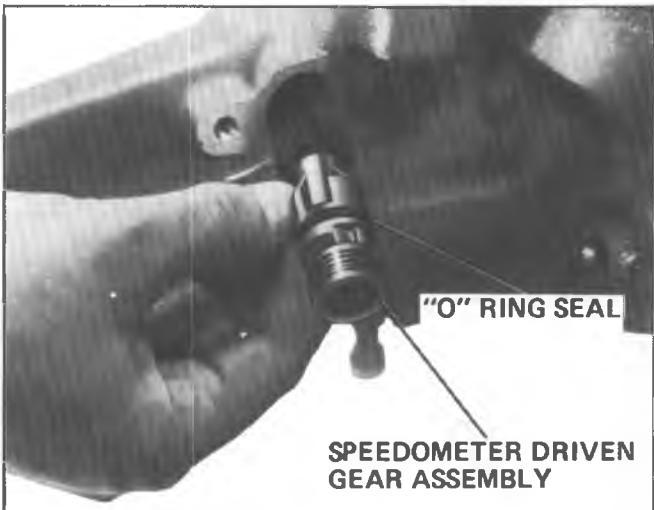


Fig. 7A-167A--Removing and Installing Sper Driven Gear - Typical

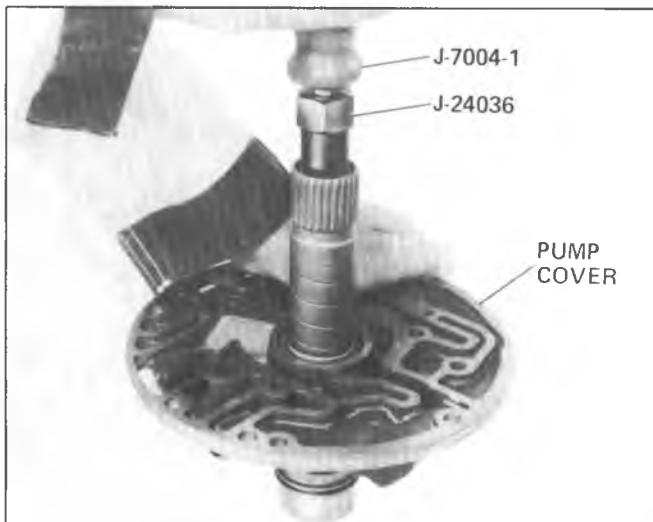


Fig. 7A-168A--Removing Pump Cover Bushing - Front

## BUSHING REPLACEMENT PUMP COVER BUSHINGS

### Front Bushing

1. Using tool J-24036 with Slide Hammer, J-7004-1, remove bushing (Fig. 7A-168A).
2. Using tool J-25019-2 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-169A).

### Rear Bushing

1. Using tool J-25019-14 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-170A).
2. Using tool J-25019-6 with Driver Handle J-8092, drive or press new bushing until tool bottoms (Fig. 7A-171A).

### PUMP BODY BUSHING

1. Place pump body with the machined face down, on two blocks of wood, to prevent damaging the machined surface.
2. Using tool J-25019-4 with Drive Handle J-8092, remove bushing (Fig. 7A-172A).
3. Using tool J-25019-12 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-173A).

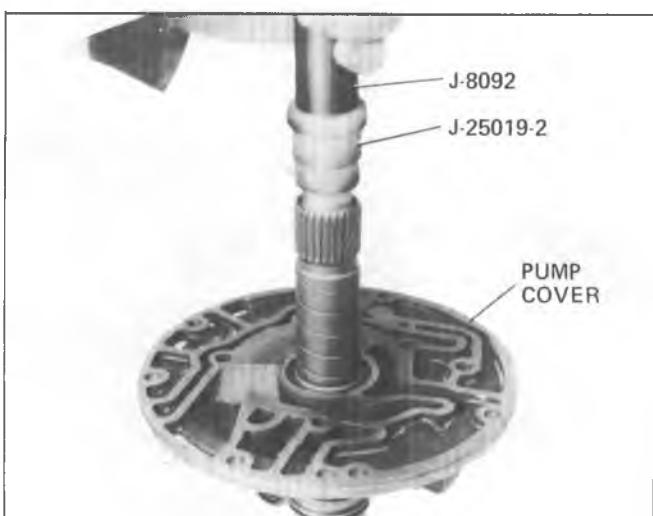


Fig. 7A-169A--Installing Pump Cover Bushing - Front

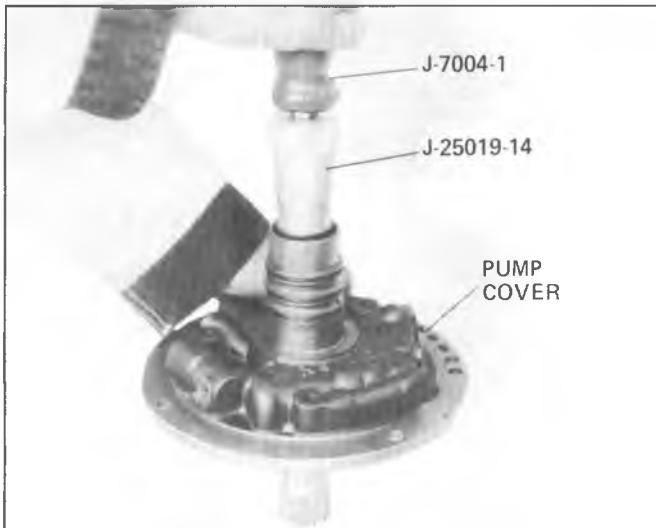


Fig. 7A-170A--Removing Pump Cover Bushing - Rear

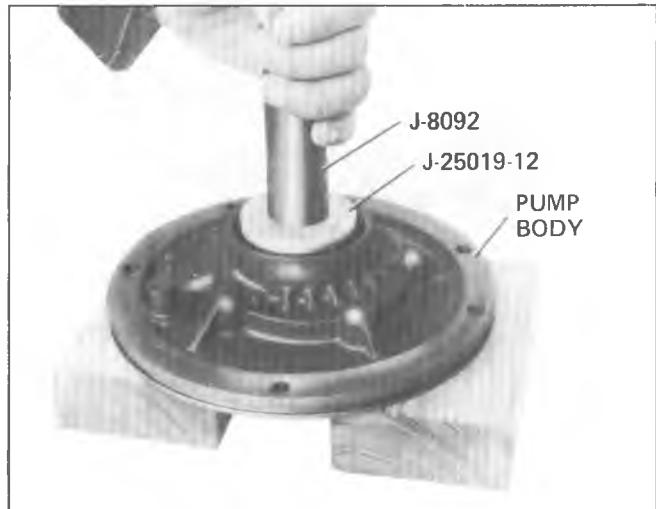


Fig. 7A-173A--Installing Pump Body Bushing

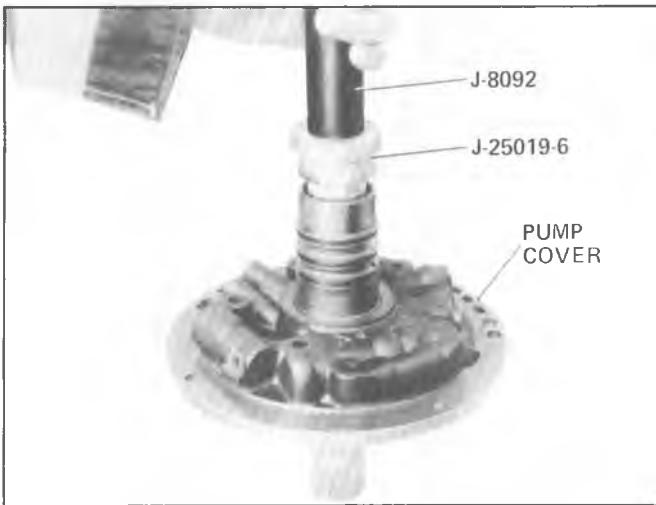


Fig. 7A-171A--Installing Pump Cover Bushing - Rear

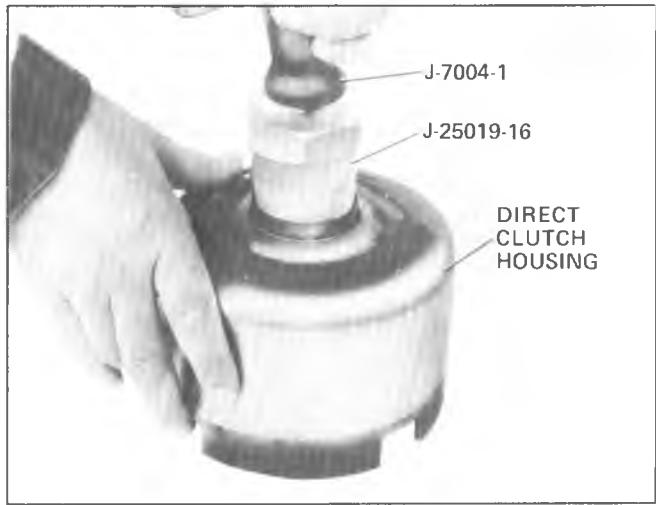


Fig. 7A-174A--Removing Direct Clutch Housing Bushing - Front

## DIRECT CLUTCH HOUSING

### Front Bushing

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-174A).
2. Place bushing, chamfered inside diameter end first, over tool J-25019-9. Using tool J-25019-9 with Driver

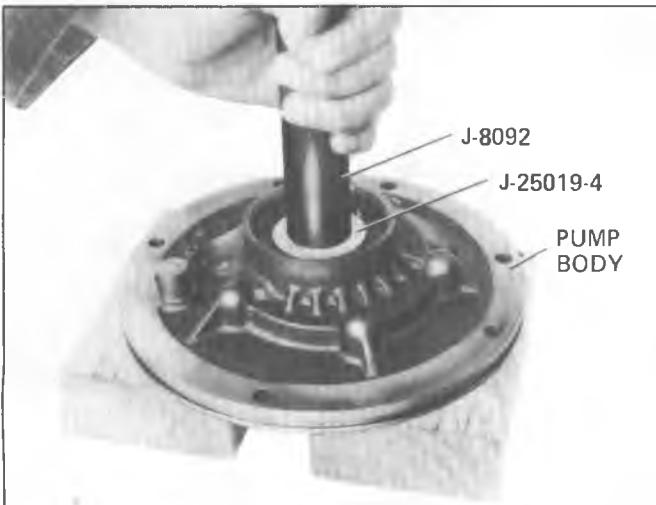


Fig. 7A-172A--Removing Pump Body Bushing



Fig. 7A-175A--Installing Direct Clutch Housing Bushing - Front

Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-175A).

### Rear Bushing

1. Place direct clutch housing with the thrust washer

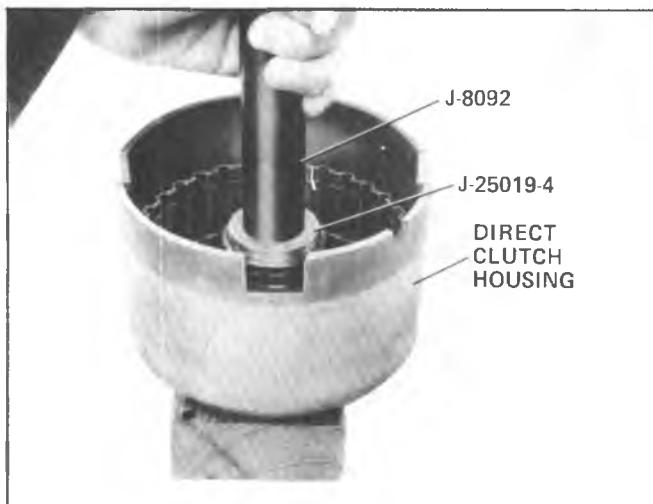


Fig. 7A-176A--Removing Direct Clutch Housing Bushing - Rear

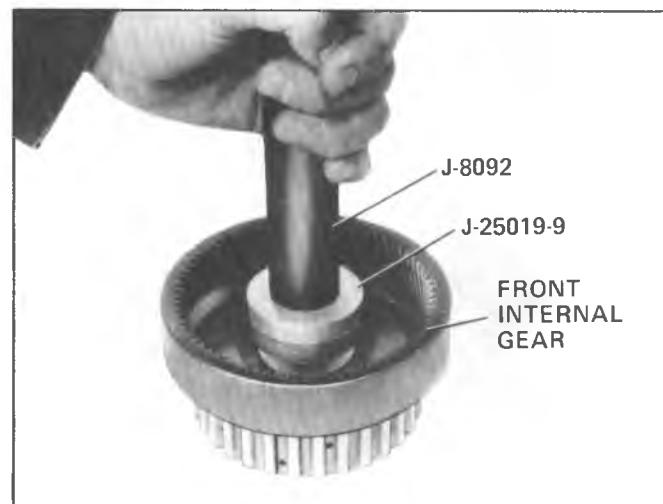


Fig. 7A-179A--Installing Front Internal Gear Bushing

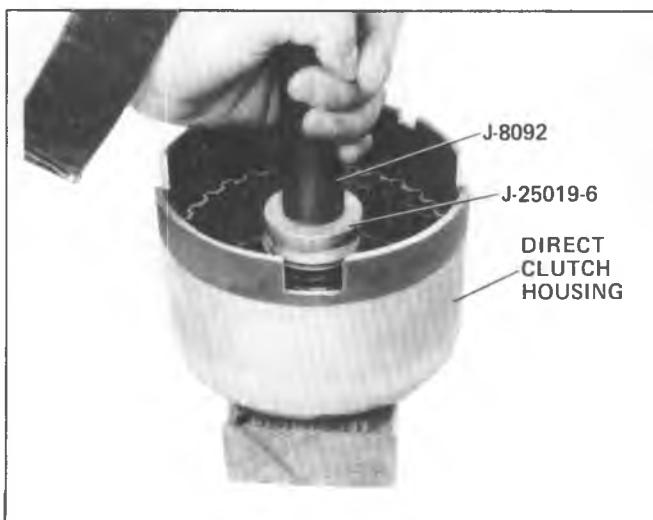


Fig. 7A-177A--Installing Direct Clutch Housing Bushing - Rear

face down on a block of wood to prevent damaging the thrust washer surface.

2. Using tool J-25019-4 with Driver Handle J-8092, remove bushing (Fig. 7A-176A).
3. Using tool J-25019-6 with Driver Handle J-8092,

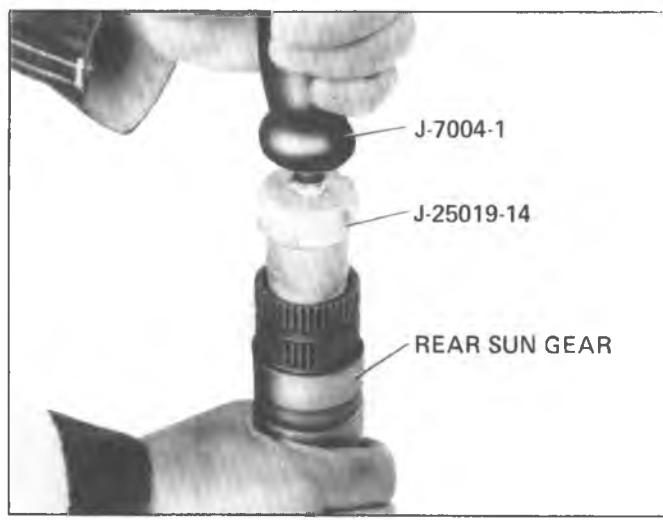


Fig. 7A-180A--Removing Rear Sun Gear Bushing

drive or press new bushing into place until tool bottoms (Fig. 7A-177A).

#### FRONT INTERNAL GEAR BUSHING

1. Using tool J-25019-3 with Driver Handle J-8092, remove bushing (Fig. 7A-178A).

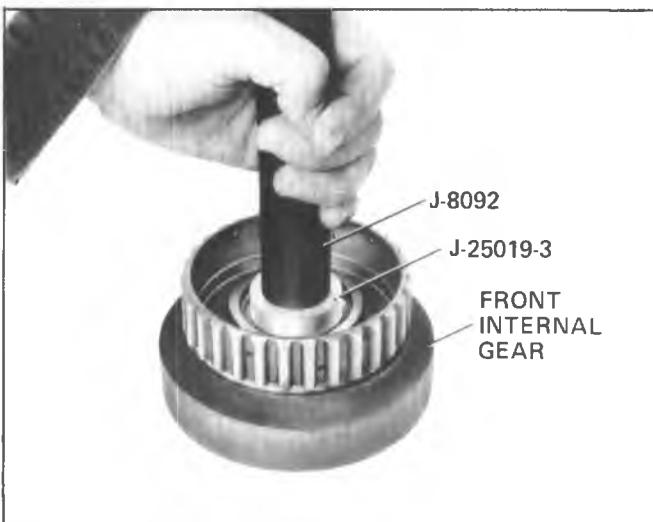


Fig. 7A-178A--Removing Front Internal Gear Bushing

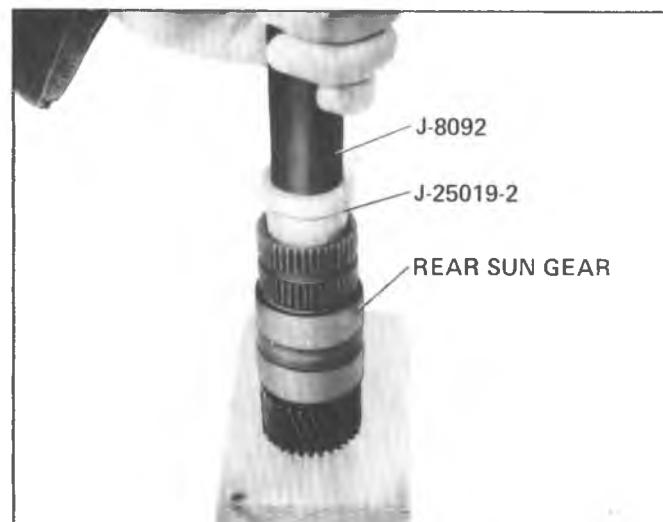


Fig. 7A-181A--Installing Rear Sun Gear Bushing

2. Using tool J-25019-9 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-179A).

### REAR SUN GEAR

1. Using tool J-25019-14 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-180A).
2. Place rear sun gear with gear side down on block of wood to prevent damaging the gear.

3. Using tool J-25019-2 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-181A).

### LO AND REVERSE CLUTCH HOUSING BUSHING

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-182A).
2. Place lo and reverse clutch housing with splined hub between two blocks of wood to prevent damaging the splines.
3. Using tool J-25019-8 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-183A).

### REAR CARRIER BUSHING

1. Using tool J-25019-16 with Slide Hammer J-7004-1, remove bushing (Fig. 7A-184A).
2. Using tool J-25019-7 with Driver Handle J-8092, drive or press new bushing into place until tool bottoms (Fig. 7A-185A).

### CASE BUSHING

1. Using tool J-21424-9 with Driver Handle J-8092, remove bushing (Fig. 7A-186A).
2. Using tool J-21424-9 with Driver Handle J-8092, drive or press new bushing to a distance of approximately 17.3mm (11/16") between rear end of the bushing and rear end of the case (Fig. 7A-186A).



Fig. 7A-182A--Removing Lo and Reverse Clutch Housing Bushing



Fig. 7A-183A--Installing Lo and Reverse Clutch Housing Bushing



Fig. 7A-184A--Removing Rear Carrier Bushing

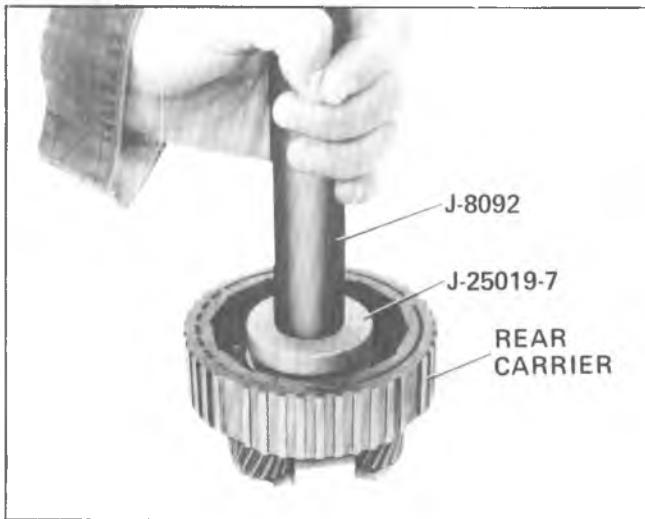


Fig. 7A-185A--Installing Rear Carrier Bushing

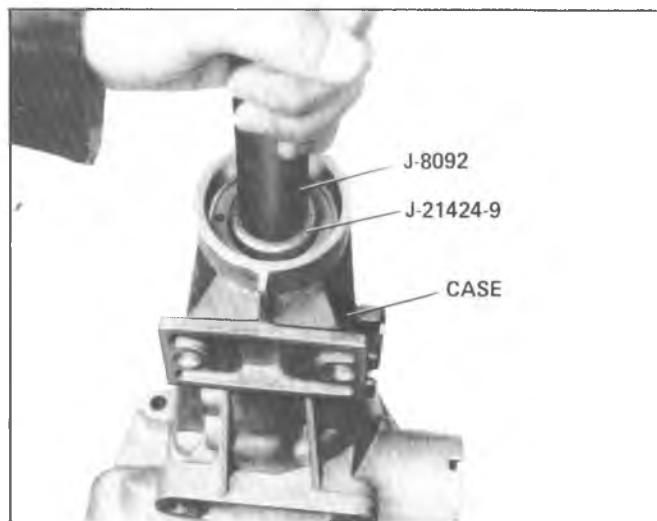


Fig. 7A-186A--Removing or Installing Case Bushing

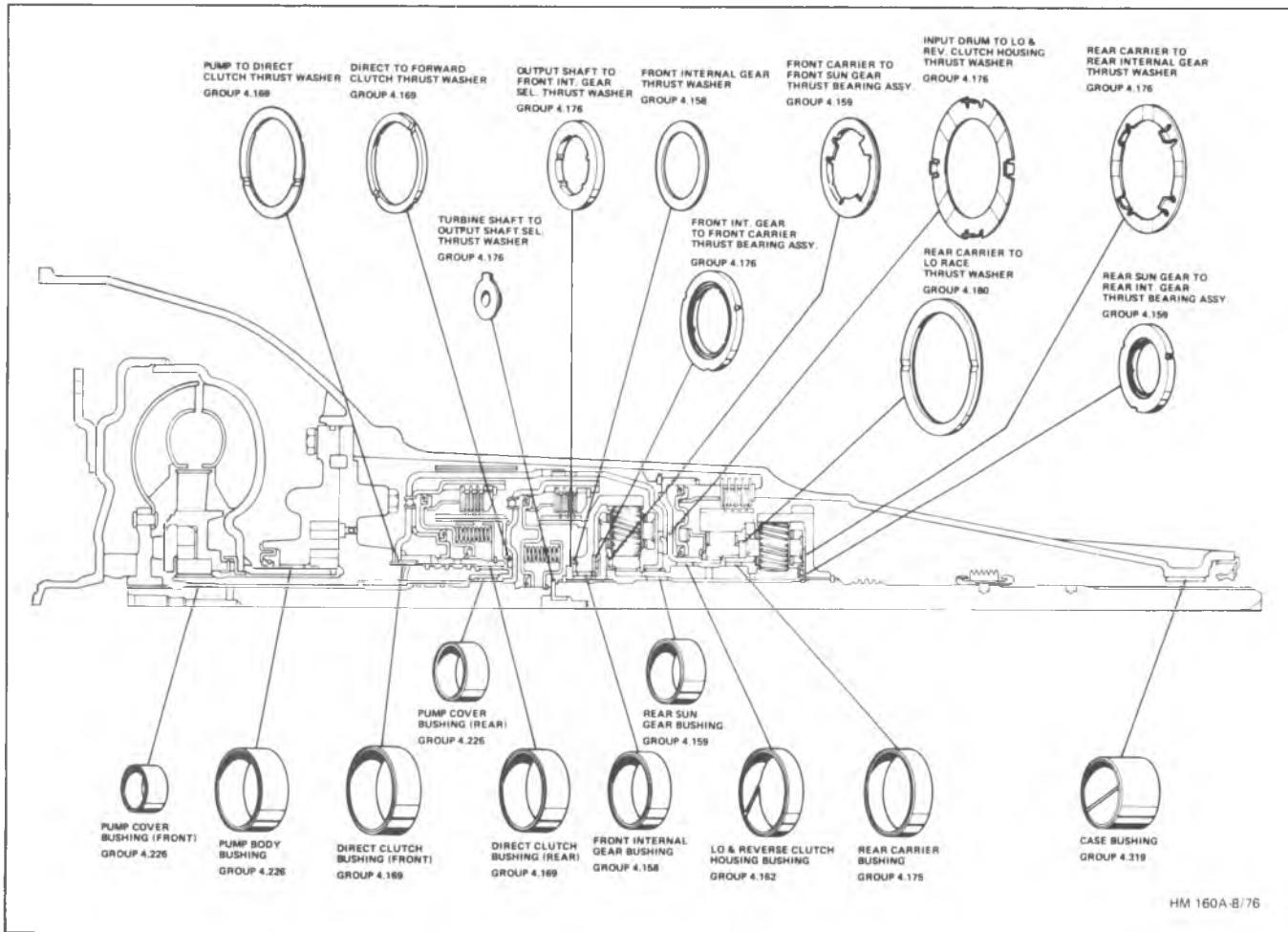


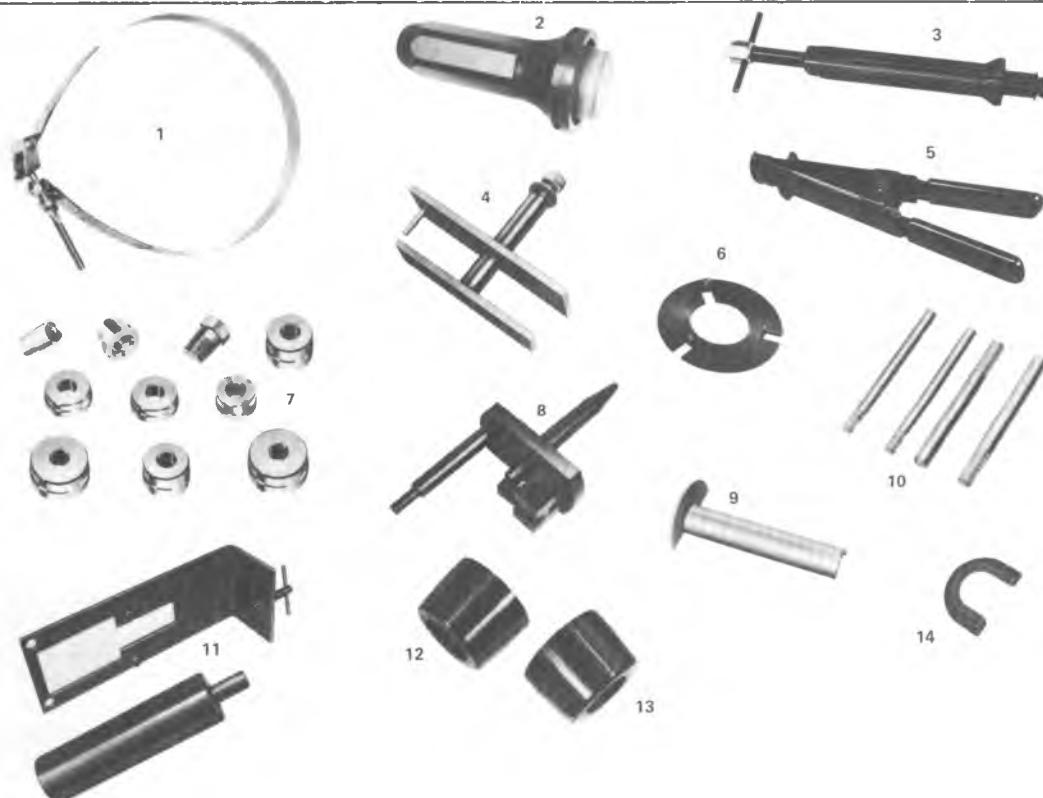
Fig. 7A-187A--Bushing Locations

# SPECIFICATIONS

## TURBO-HYDRAMATIC "200"

Pump Cover Bolts .....	24 N·m	(18 ft. lbs.)
Pump to Case Attaching Bolts .....	24 N·m	(18 ft. lbs.)
Parking Pawl Bracket Bolts .....	24 N·m	(18 ft. lbs.)
Control Valve Body Bolts .....	15 N·m	(11 ft. lbs.)
Oil Screen Retaining Bolts .....	15 N·m	(11 ft. lbs.)
Bottom Pan Attaching Bolts .....	16 N·m	(12 ft. lbs.)
Converter to Flywheel Bolts .....	48 N·m	(35 ft. lbs.)
Transmission to Engine Mounting Bolts .....	34 N·m	(25 ft. lbs.)
Converter Dust Shield Screws .....	11 N·m	(8 ft. lbs.)
Manual Shaft Nut .....	31 N·m	(23 ft. lbs.)
Speedometer Driven Gear Attaching Bolts .....	11 N·m	(8 ft. lbs.)
Detent Cable Attaching Screw .....	9 N·m	(6 ft. lbs.)
Oil Cooler Line to Transmission Connector .....	37 N·m	(25 ft. lbs.)
Oil Cooler Line to Radiator Connector .....	27 N·m	(20 ft. lbs.)
Linkage Swivel Clamp Nut .....	41 N·m	(30 ft. lbs.)
Shifter Assembly to Sheet Metal Screws .....	10 N·m	(8 ft. lbs.)
Converter Bracket to Adapter Nuts .....	17 N·m	(13 ft. lbs.)
Catalytic Converter to Rear Exhaust Pipe Nuts .....	23 N·m	(17 ft. lbs.)
Exhaust Pipe to Manifold Nuts .....	16 N·m	(12 ft. lbs.)
Rear Transmission Support Bolts .....	54 N·m	(40 ft. lbs.)
Mounting Assembly to Support Nuts .....	29 N·m	(21 ft. lbs.)
Mounting Assembly to Support Center Nut .....	44 N·m	(33 ft. lbs.)
Adapter to Transmission Bolts .....	44 N·m	(33 ft. lbs.)

## SPECIAL TOOLS



- 1. J25015 Oil Pump Body and Cover Alignment Band
- 2. J25016 Front Oil Pump Seal Installer
- 3. J25020-01 Converter Stator and Turbine End-Play Checking Fixture
- 4. J25023 Reverse Clutch Selective Shim Group
- 5. J25012 Reverse Clutch Housing Installer and Remover
- 6. J25018 Forward Clutch Spring Compressor
- 7. J25019 Bushing Service Set
- 8. J25014 Intermediate Band Apply Pin Gauge
- 9. J25021 Turbine Shaft and Direct Clutch Installer
- 10. J25025 Alignment Pin and Stud Set
- 11. J25013 Output Shaft and Rear Unit Support Fixture
- 12. J25010 Direct Clutch Seal Protector
- 13. J25011 Reverse Clutch Seal Protector
- 14. J25022 End-Play Checking Fixture Adapter

Fig. 7A-ST--THM 200, Special Tools



## SECTION 7A

## AUTOMATIC TRANSMISSION

## CBC 350 TRANSMISSION

## INDEX

Transmission Disassembly and Reassembly .....	7A-3
Disassembly (Transmission) .....	7A-3
Converter Inspection.....	7A-3
Converter End Clearance Check .....	7A-4
Removal of Extension, Speedometer Driven Gear	
Oil Pan and Screen .....	7A-4
Removal of Valve Body and Linkage.....	7A-6
Removal of Oil Pump and Internal Case	
Components.....	7A-10
Valve Body .....	7A-16
Disassembly .....	7A-16
Inspection .....	7A-16
Reassembly .....	7A-16
Oil Pump .....	7A-18
Disassembly .....	7A-18
Inspection .....	7A-19
Assembly.....	7A-19
Direct Clutch and Intermediate Overrun	
Roller Clutch.....	7A-21
Disassembly .....	7A-21
Inspection .....	7A-23
Reassembly .....	7A-23
Forward Clutch.....	7A-25
Disassembly .....	7A-25
Inspection .....	7A-26
Reassembly .....	7A-26
Sun Gear and Sun Gear Drive Shell .....	7A-26
Disassembly .....	7A-26
Inspection .....	7A-27
Assembly.....	7A-27
Low and Reverse Roller Clutch Support .....	7A-29
Disassembly .....	7A-29
Inspection .....	7A-29
Assembly.....	7A-29
Governor Assembly .....	7A-29
Disassembly .....	7A-30
Inspection .....	7A-30
Governor Driven Gear Replacement .....	7A-30
Reassembly .....	7A-30
Bushing Replacement.....	7A-31
Extension Housing Bushing.....	7A-31
Output Shaft Bushing .....	7A-31
Case Bushing .....	7A-31
Stator Shaft Front Bushing .....	7A-31
Stator Shaft Rear Bushing .....	7A-32
Input Ring Gear Bushing.....	7A-32
Sun Gear Bushing.....	7A-32
Reaction Carrier Bushing .....	7A-32
Direct Clutch Bushing.....	7A-32
Transmission Assembly .....	7A-32
Transmission Internal Components .....	7A-32
Speedometer Drive Gear and Extension.....	7A-34
Manual Linkage .....	7A-35
Intermediate Servo Piston	
Valve Body, Oil Pan and Gasket .....	7A-35
Governor and Vacuum Modulator .....	7A-35
Intermediate Clutch Accumulator .....	7A-35

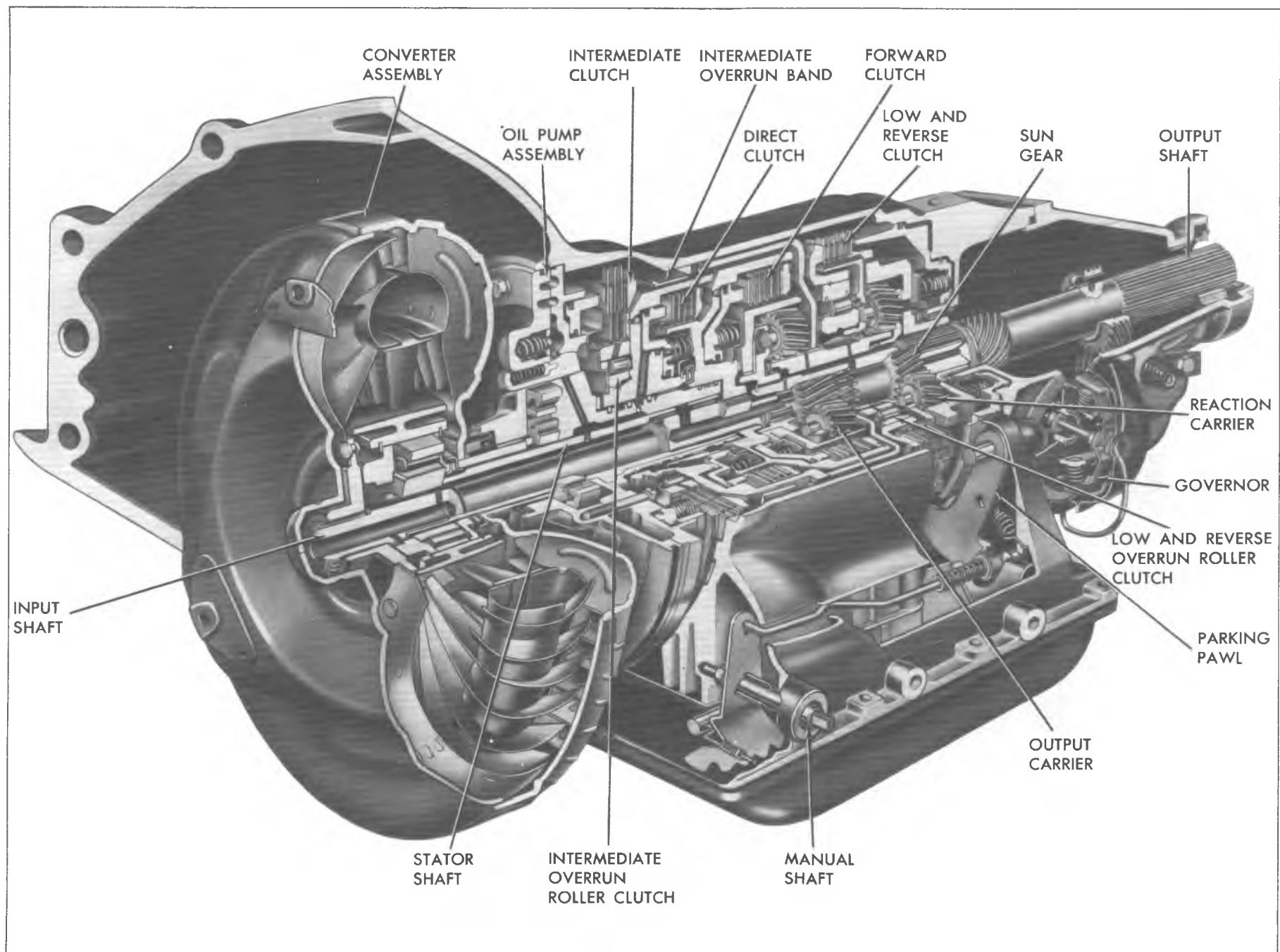


Fig. 7A-1B--CBC 350 Sectioned View

# TRANSMISSION DISASSEMBLY AND REASSEMBLY

## DISASSEMBLY

1. Install Holding Fixture J-8763-02 on transmission and place into Holding Tool base J-3289-20 with converter facing up (fig. 7A-2B).

**NOTE:** Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the case should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During disassembly, all parts should be thoroughly cleaned in cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

**CAUTION:** Do not use solvents which could damage rubber seals or clutch facings.

2. With transmission in holding fixture remove torque converter assembly.
3. Remove vacuum modulator assembly attaching bolt and retainer.
4. Remove vacuum modulator assembly, "O" ring seal, and modulator valve from case (fig. 7A-3B). Discard "O" ring.

## Inspection of Converter

1. Check converter for leaks as follows (fig. 7A-4B):
  - a. Install Tool J-21369 and tighten.
  - b. Apply 80 psi air pressure to tool.

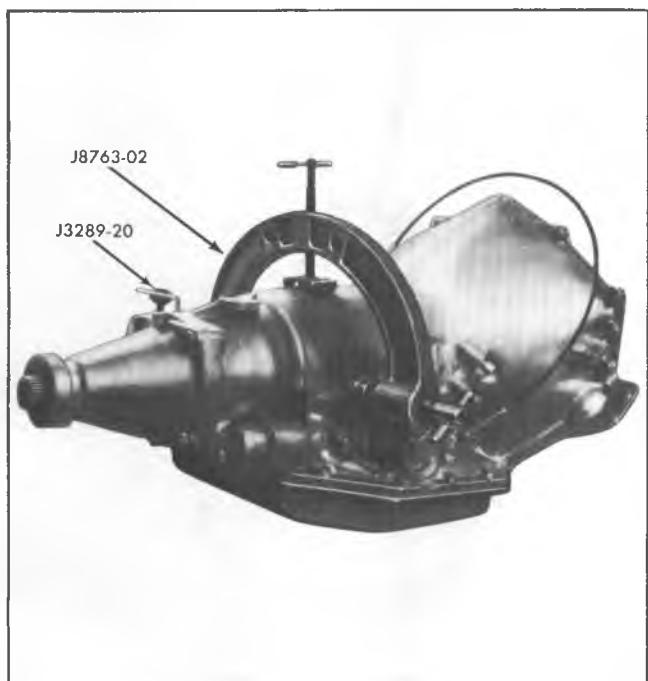


Fig. 7A-2B--Transmission in Holding Fixture



Fig. 7A-3B--Removing Vacuum Modulator Assembly

- c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear.

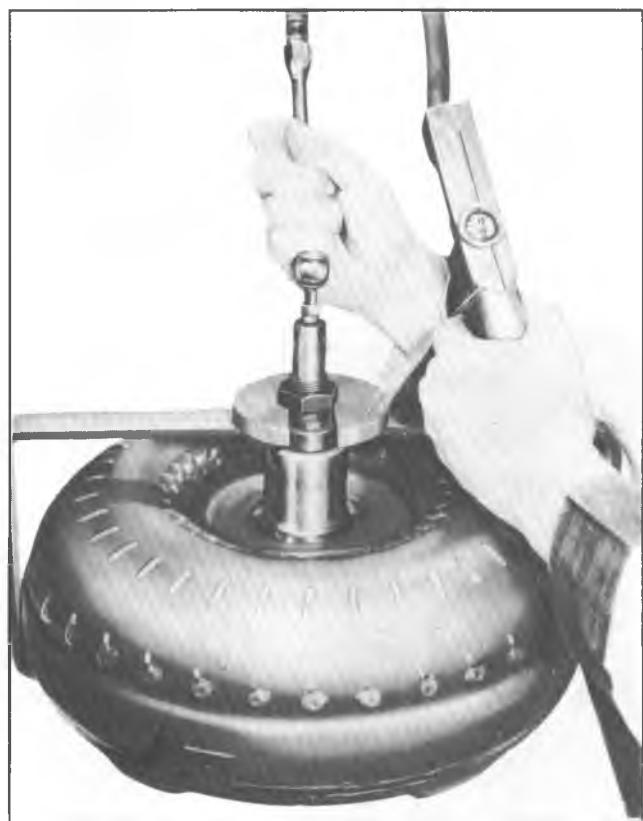


Fig. 7A-4B--Checking Converter for Leaks

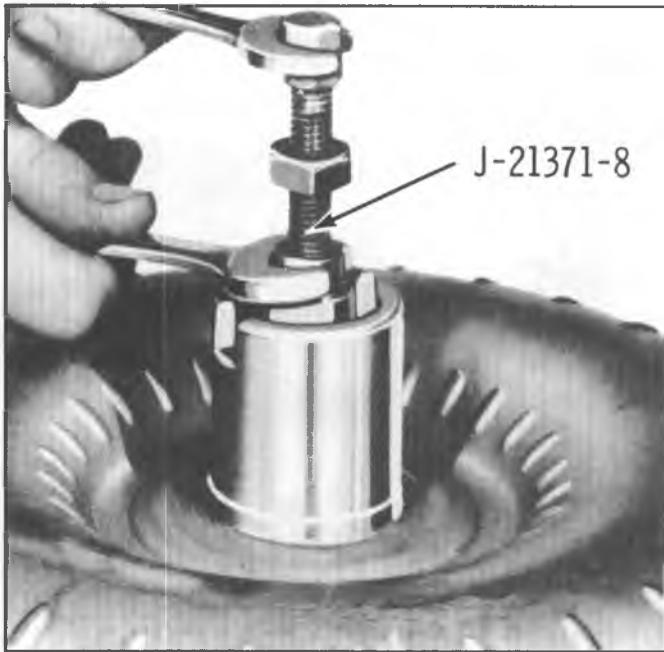


Fig. 7A-5B--Installing J-21371-8



Fig. 7A-7B--Removing Extension Housing Lip Seal

### Converter End Clearance Check

(Figs. 7A-5B, 7A-6B)

1. Fully release collet end of Tool J-21371-8.
2. Install collet end of Tool J-21371-8 into converter hub until it bottoms; then tighten cap nut to 5 ft. lbs. (fig. 7A-5B).
3. Install Tool J-21371-3 and tighten hex nut to 3 ft. lbs. (fig. 7A-6B).
4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.
5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.

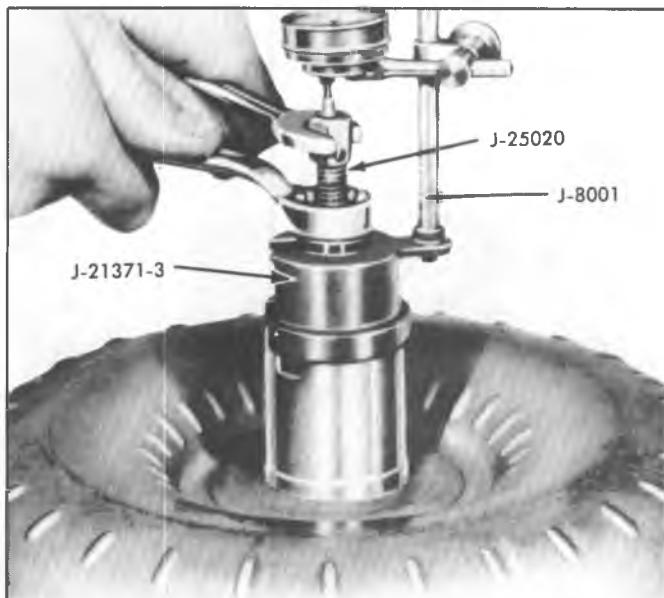


Fig. 7A-6B--Checking Converter End Clearance

### REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND SCREEN

1. Remove four housing to case attaching bolts.
2. Remove extension housing form case and remove square cut "O" ring seal from extension housing.
3. Remove extension housing lip seal using screw driver (fig. 7A-7B).
4. If extension housing bushing is to be replaced, collapse bushing (fig. 7A-8B) and refer to Figure 7A-98B for installation.



Fig. 7A-8B--Removing Extension Housing Bushing

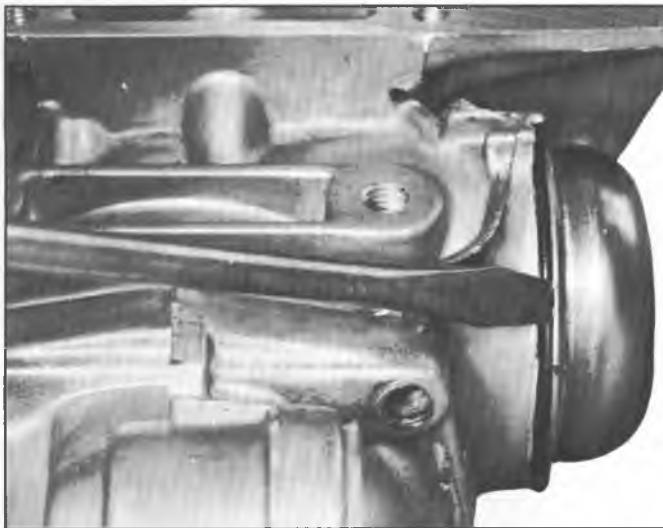


Fig. 7A-9B--Removing Governor Cover

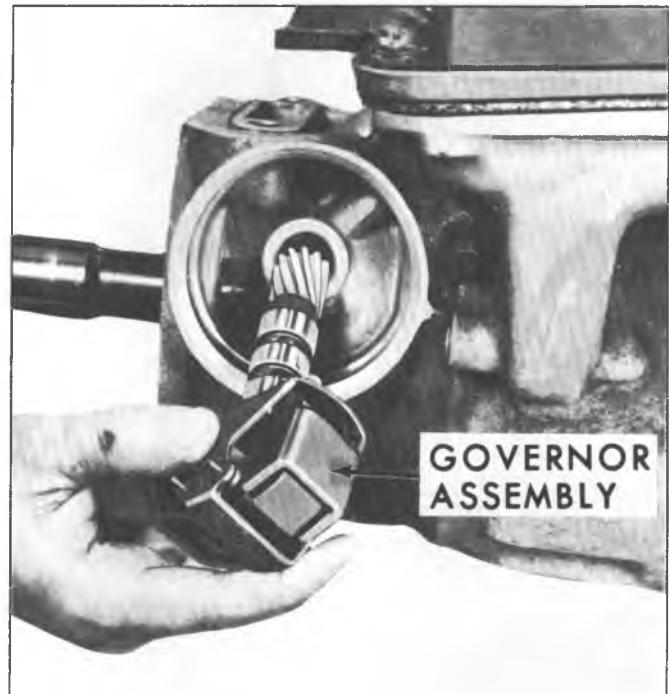


Fig. 7A-11B--Removing Governor from Case

5. Install speedometer drive gear remover tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on output shaft and remove speedometer drive gear. Remove retaining clip.

6. Remove governor cover retainer with a screwdriver.

7. Using a screwdriver and hammer, gently tap along governor cover lip (fig. 7A-9B), remove governor cover and "O" ring seal (fig. 7A-10B). Discard seal.

**CAUTION:** Do not attempt to pry the screwdriver between the case and governor cover as this could cause damage to the case.

8. Withdraw governor assembly from case (fig. 7A-11B)

and check governor bore and governor sleeve for scoring.

9. Remove oil pan attaching screws (fig. 7A-12B), oil pan, and gasket. Discard gasket.

10. Remove oil pump suction screen (strainer) to valve body attaching screws (fig. 7A-13B).

11. Remove oil pump screen (strainer) and gasket from valve body.



Fig. 7A-10B--Governor Cover and "O" Ring Seal



Fig. 7A-12B--Removing Transmission Oil Pan



Fig. 7A-13B--Removing Oil Pump Suction Screen (Strainer) from Valve Body

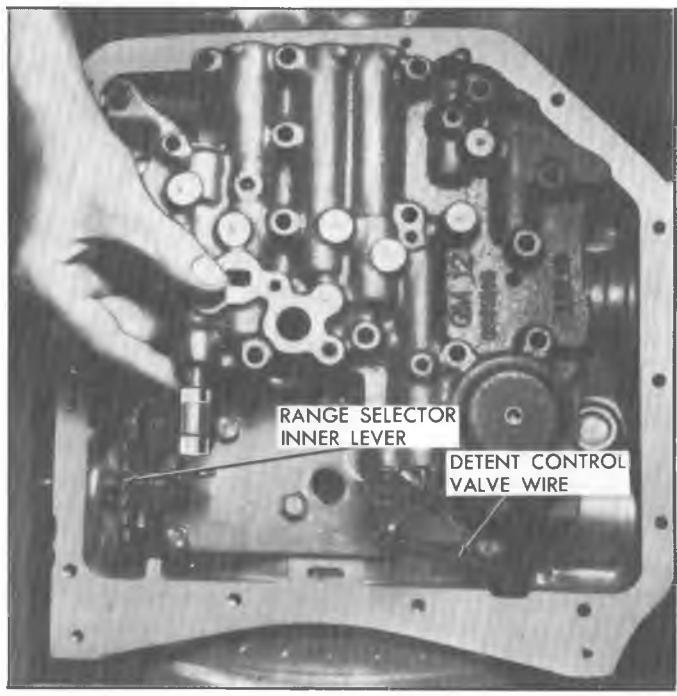


Fig. 7A-15B--Removing Manual Control Valve Link, Valve Body and Detent Actuating Lever

#### REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent spring and roller assembly from valve body. Remove valve body to case attaching bolts (fig. 7A-14B).
2. Remove manual control valve link from range selector inner lever. Remove detent control valve link from detent

actuating lever (fig. 7A-15B). Refer to valve body disassembly.

3. Remove transfer plate support bolts. Remove transfer support plate (fig. 7A-16B).
4. Remove upper gasket, valve body transfer (spacer) plate and valve body transfer (spacer plate to case gasket (fig. 7A-17B).

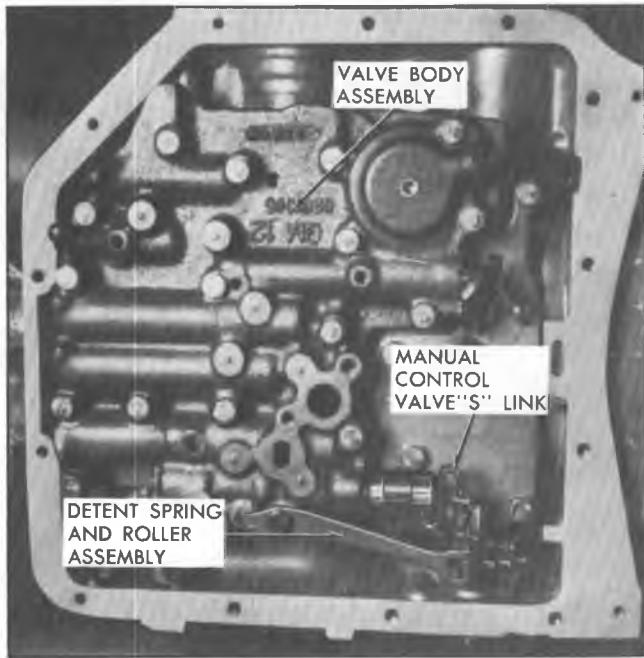


Fig. 7A-14B--Detent Spring and Roller Assembly

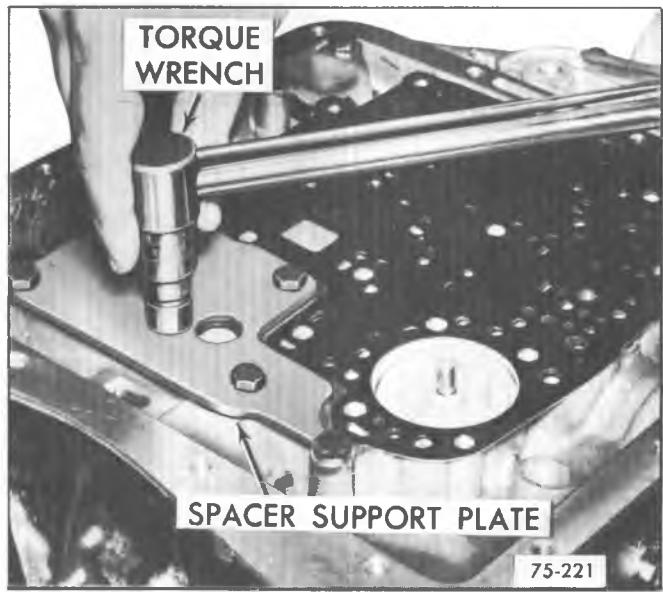


Fig. 7A-16B--Removing Transfer (Spacer) Support Plate

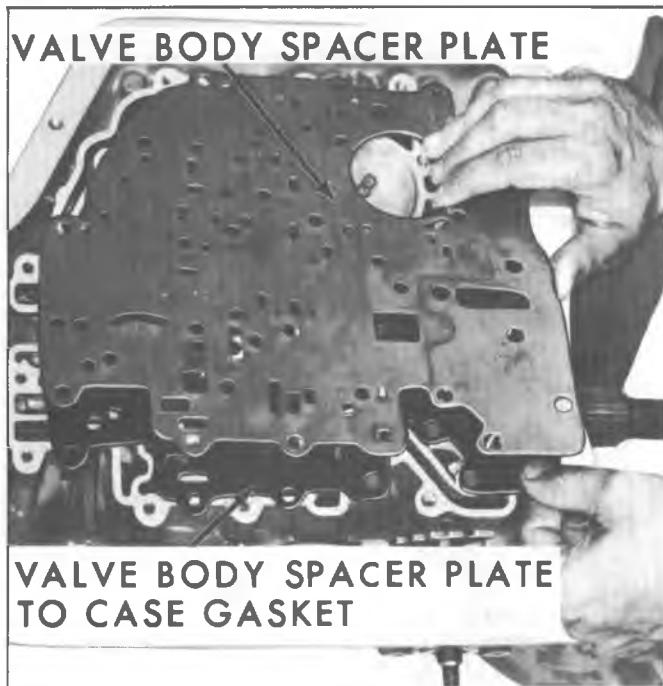


Fig. 7A-17B--Removing Valve Body Transfer (Spacer) Plate and Gasket

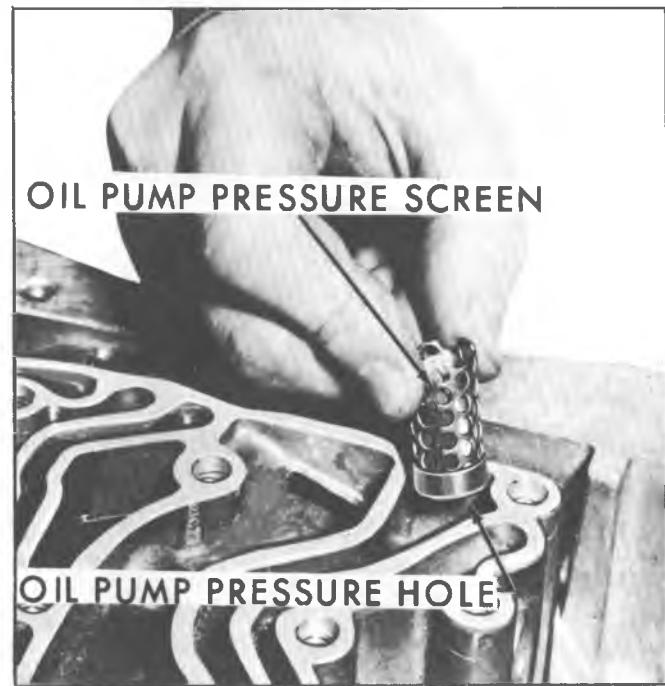


Fig. 7A-19B--Removing Oil Pump Pressure Screen

5. Remove four (4) check balls from correct passages in case face (fig. 7A-18B).

6. Remove oil pump pressure screen from oil pump pressure hole in case (fig. 7A-19B).

7. Remove governor feed screen from governor feed hole (drive oil) in case (fig. 7A-20B).

**NOTE:** on JA and JH models, there are two governor feed screens.

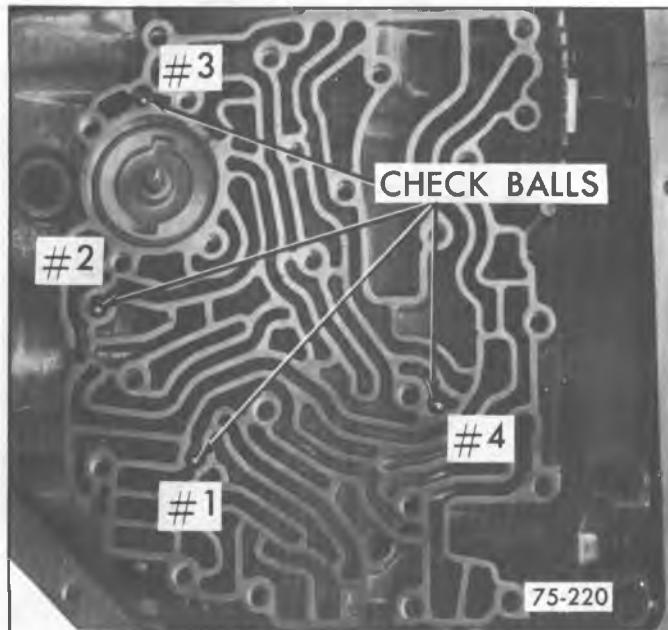


Fig. 7A-18B--Check Ball Four (4) Locations

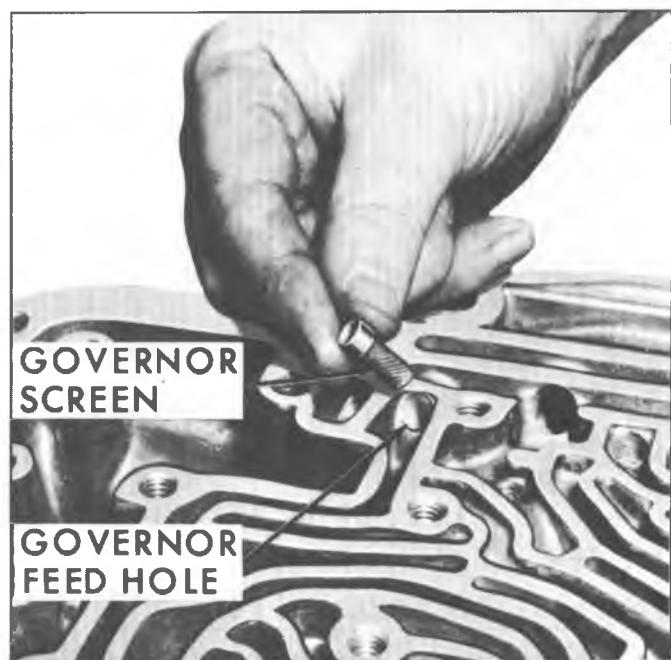


Fig. 7A-20B--Removing Governor Feed Screen

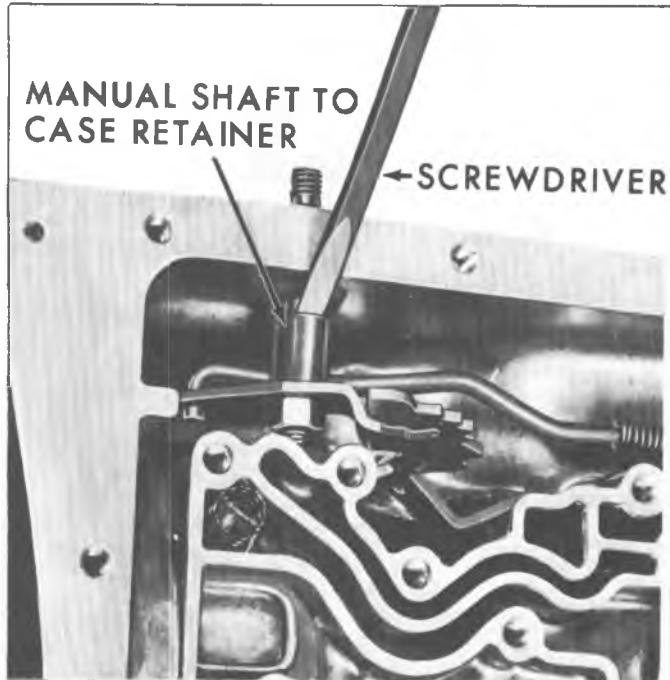


Fig. 7A-21B--Removing Manual Shaft to Case Retainer

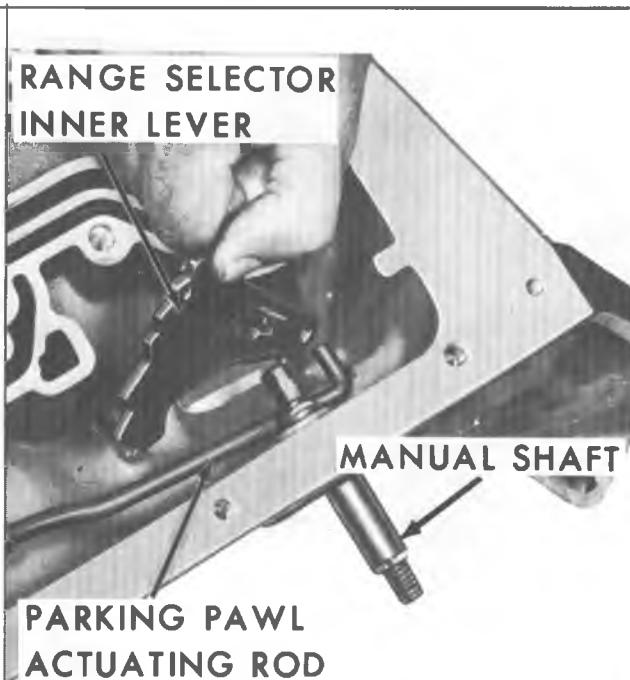


Fig. 7A-23B--Removing Manual Shaft and Inner Lever and Parking Pawl Actuator Rod from Case

8. Remove manual shaft to case retainer with screwdriver (fig. 7A-21B).
9. Loosen nut holding range selector inner lever to manual shaft (fig. 7A-22B).

10. Remove range selector inner lever from manual shaft. Remove manual shaft from case. Remove inner lever and parking pawl actuator rod from case. Disassembly inner lever from parking pawl actuator rod (fig. 7A-23B).
11. Remove manual shaft to case lip seal (fig. 7A-24B).



Fig. 7A-22B--Loosening Nut Holding Range Selector Inner Lever to Manual Shaft



Fig. 7A-24B--Removing Manual Shaft to Case Lip Seal

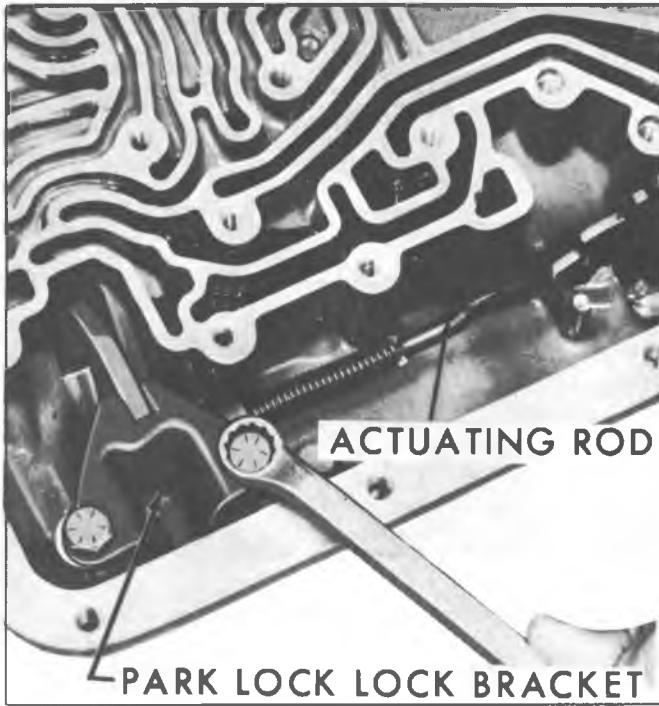


Fig. 7A-25B--Removing Park Lock, Lock Bracket

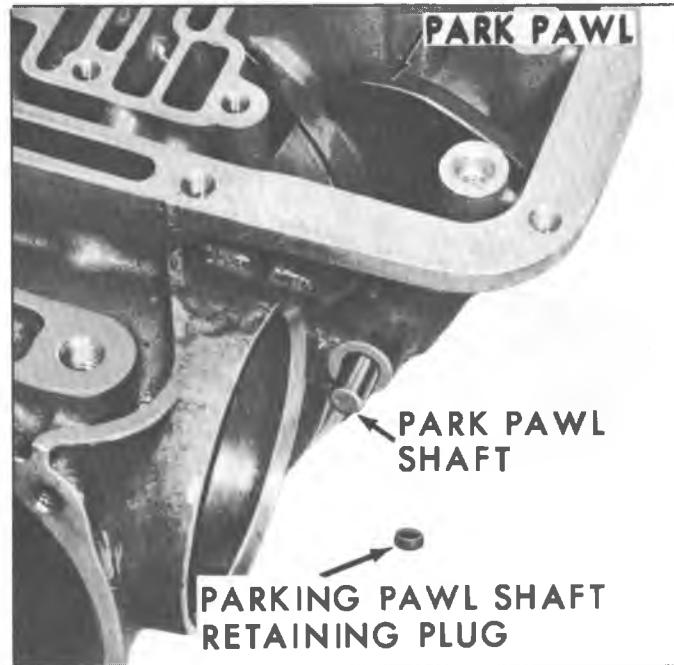


Fig. 7A-27B--Parking Pawl Shaft Retaining Plug, Parking Pawl Shaft and Parking Pawl

12. Remove parking lock; lock bracket (fig. 7A-25B). (Special Bolts).
13. Remove parking pawl disengaging spring (fig. 7A-26B).
14. Remove parking pawl shaft retaining plug, parking pawl shaft, and parking pawl (fig. 7A-27B) if replacement is required.

**NOTE:** The parking pawl shafts retaining plug may be removed by using a bolt extractor.

15. Remove intermediate servo piston and seal ring. Remove washer, spring seat and apply pin (fig. 7A-28B).

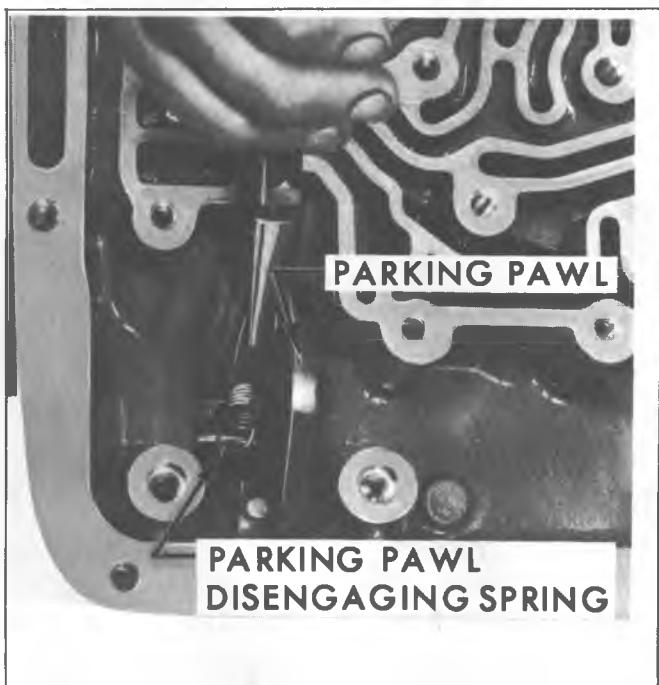


Fig. 7A-26B--Removing Parking Pawl Disengaging Spring

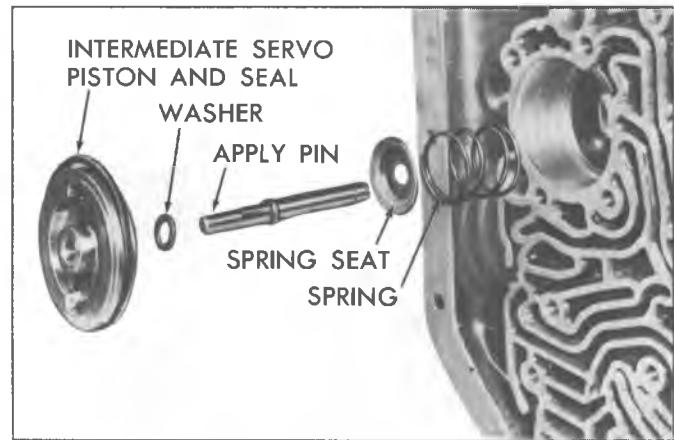


Fig. 7A-28B--Intermediate Servo Piston and Related Parts



Fig. 7A-29B--Removing Pump Attaching Bolts

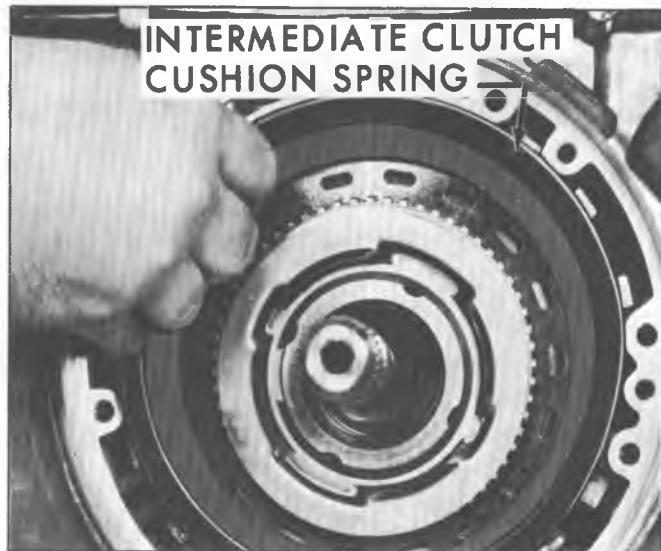


Fig. 7A-31B--Removing Intermediate Clutch Cushion Spring

### REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (fig. 7A-29B).
2. Install two (2) threaded slide hammers J-7004 into threaded holes in pump body and remove pump assembly from case (fig. 7A-30B). Discard pump gasket.

3. Remove intermediate clutch cushion spring (fig. 7A-31B).
4. Remove intermediate clutch drive plates and steel reaction plates (fig. 7A-32B).



Fig. 7A-30B--Removing Pump from Case

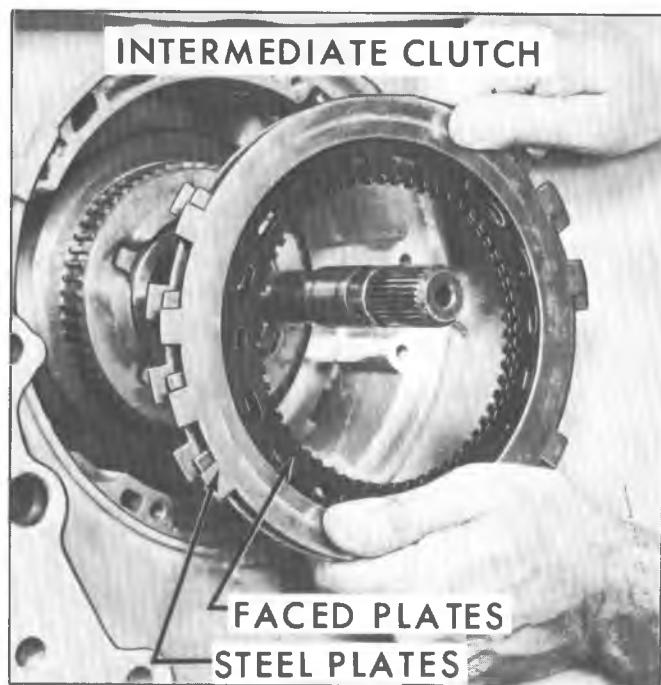
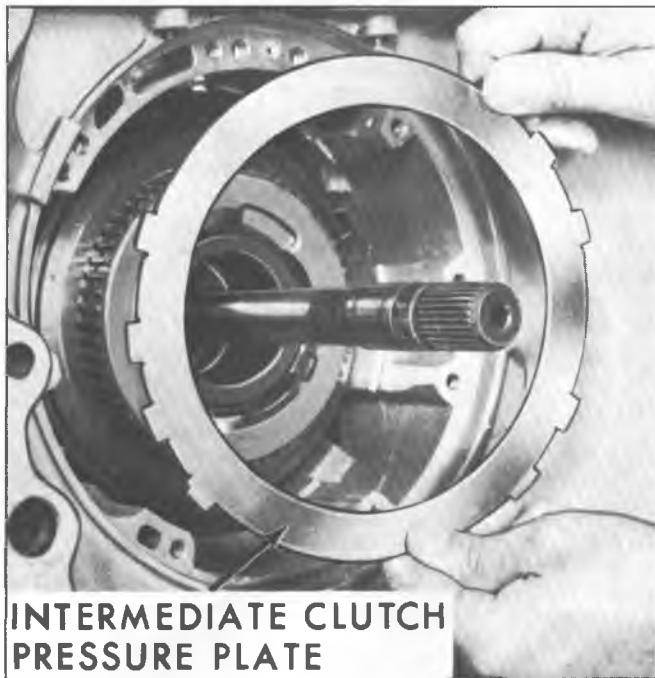


Fig. 7A-32B--Removing Intermediate Clutch Plates



**INTERMEDIATE CLUTCH  
PRESSURE PLATE**



**FORWARD AND DIRECT  
CLUTCH ASSEMBLIES**

Fig. 7A-33B--Removing Intermediate Clutch Pressure Plate

Fig. 7A-35B--Removing Direct and Forward Clutch Assemblies

5. Remove intermediate clutch pressure plate (fig. 7A-33B).
6. Remove intermediate overrun brake band (fig. 7A-34B).

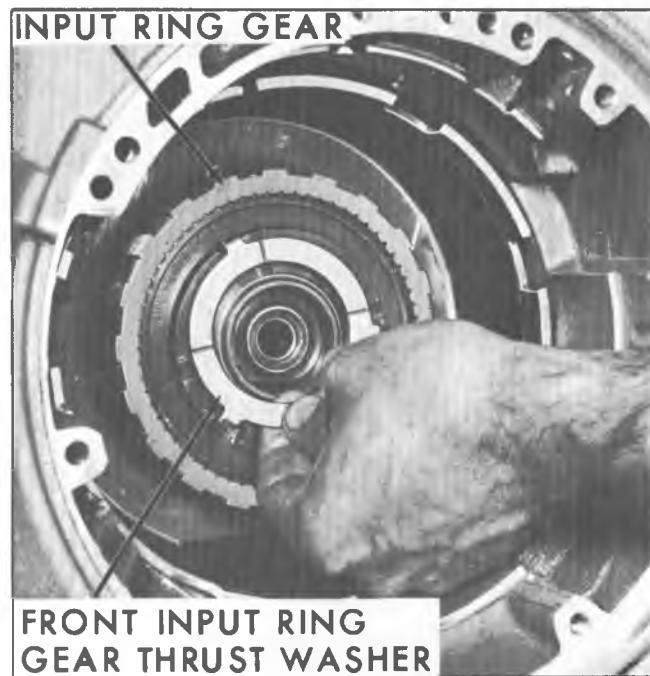
7. Remove direct and forward clutch assemblies from case (fig. 7A-35B).
8. Remove input ring gear front thrust washer (fig. 7A-36B).

**NOTE:** Washer has 3 tangs.



**INTERMEDIATE OVERRUN  
BRAKE BAND**

Fig. 7A-34B--Removing Intermediate Overrun Brake Band



**FRONT INPUT RING  
GEAR THRUST WASHER**

Fig. 7A-36B--Removing Input Ring Gear Front Thrust Washer

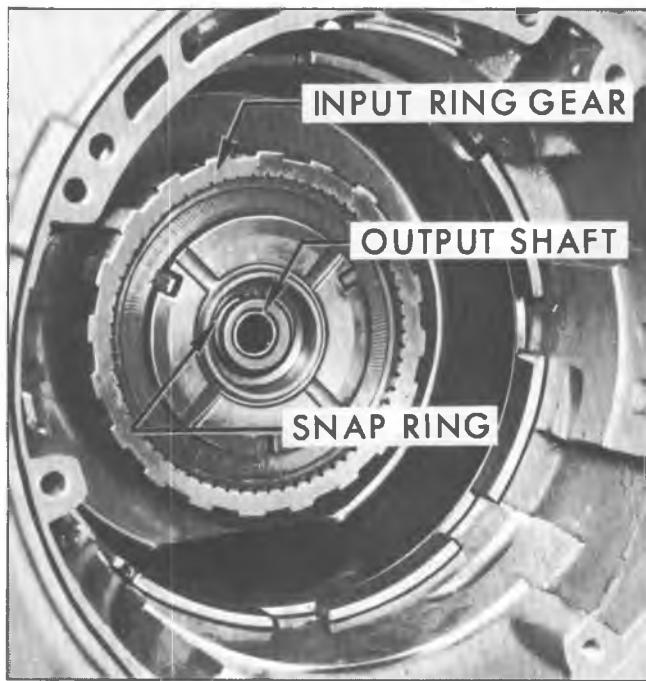


Fig. 7A-37B--Removing Input Ring Gear to Output Shaft Snap Ring

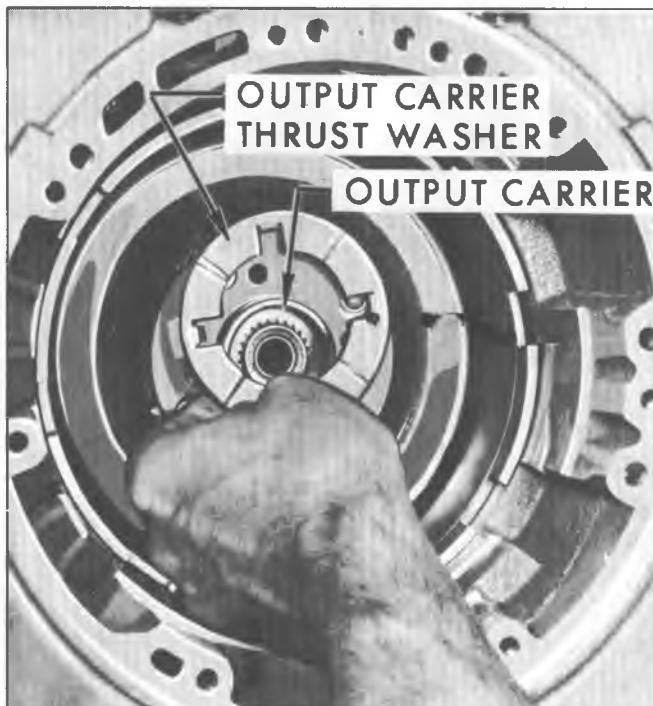


Fig. 7A-39B--Removing Input Ring Gear Rear Thrust Washer

9. Remove input ring gear to output shaft snap ring (fig. 7A-37B).

10. Remove input ring gear (fig. 7A-38B).

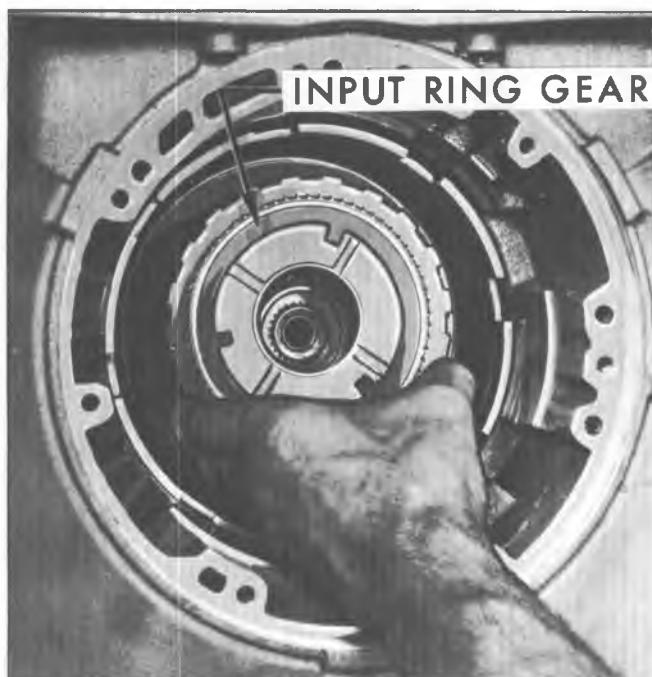


Fig. 7A-38B--Removing Input Ring Gear

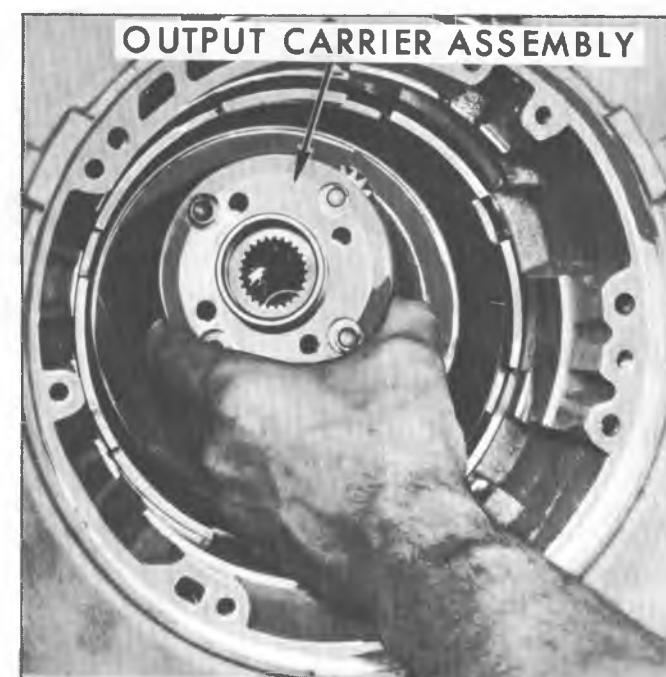


Fig. 7A-40B--Removing Output Carrier Assembly

11. Remove input ring gear rear (output carrier) thrust washer (fig. 7A-39B).

12. Remove output carrier assembly (fig. 7A-40B).



Fig. 7A-41B--Removing Sun Gear Drive Shell

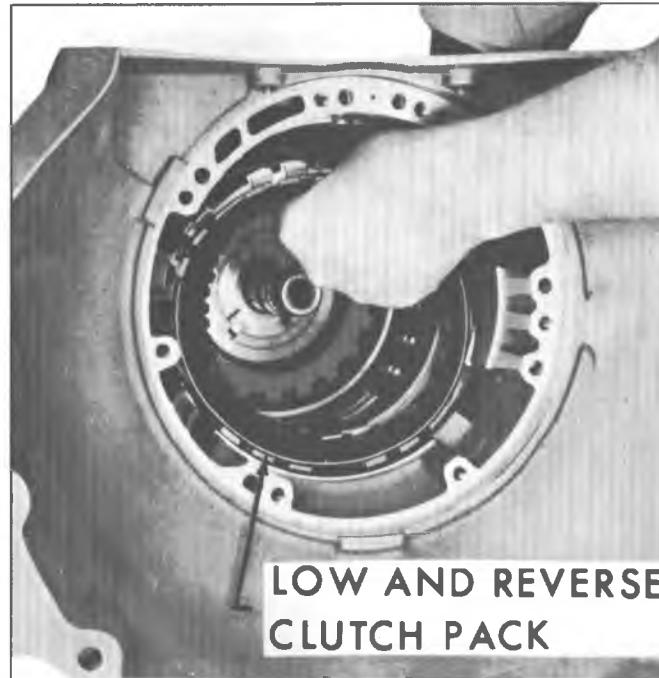


Fig. 7A-43B--Removing Low and Reverse Clutch Pack

13. Remove sun gear drive shell assembly (fig. 7A-41B).
14. Remove low and reverse roller clutch support to case retaining ring (fig. 7A-42B).
15. Remove low and reverse clutch support and race assembly and anti-clunk spring.

16. Remove low and reverse clutch plates and steel reaction plates (fig. 7A-43B).
17. Remove reaction carrier assembly from output ring gear and shaft assembly (fig. 7A-44B).

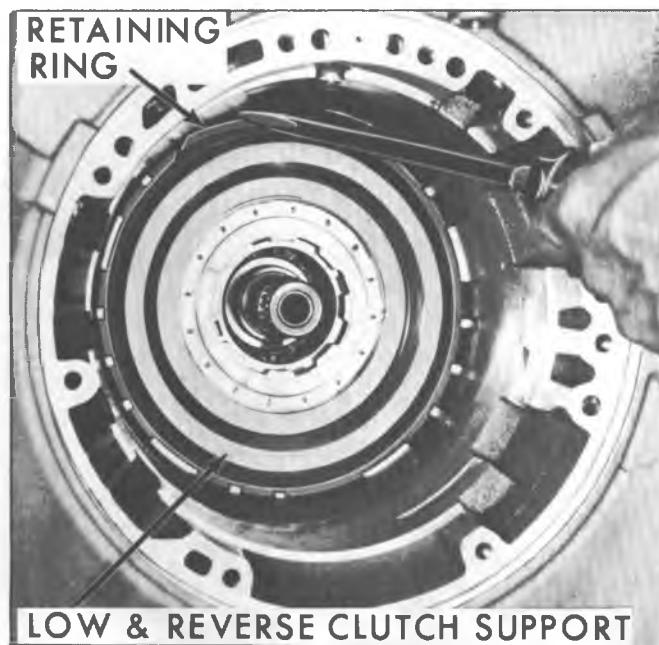


Fig. 7A-42B--Removing Low and Reverse Clutch Support  
Retaining Ring

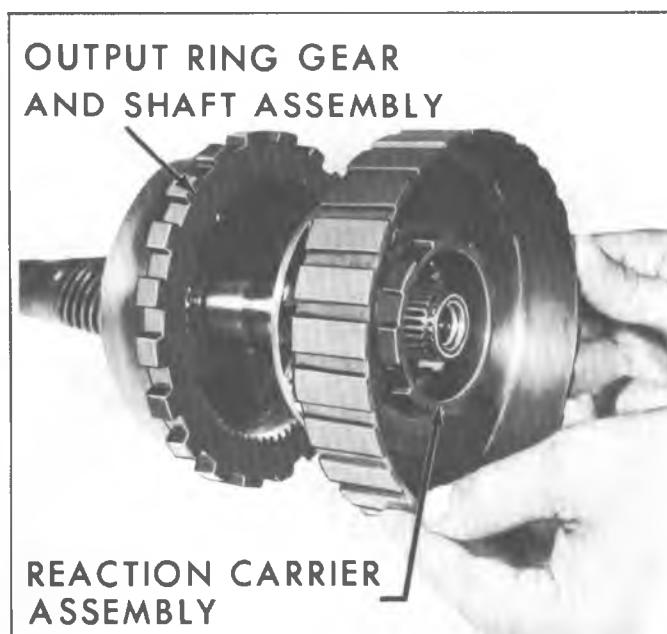


Fig. 7A-44B--Removing Reaction Carrier Assembly

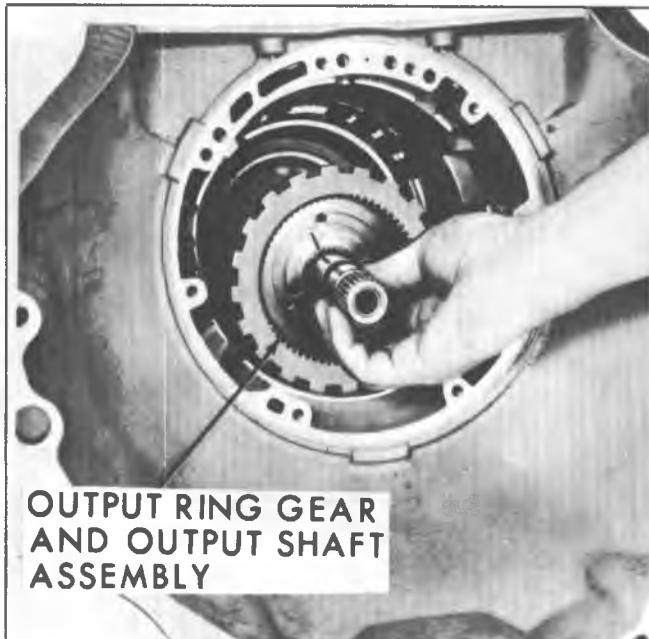


Fig. 7A-45B--Removing Output Ring Gear and Shaft Assembly

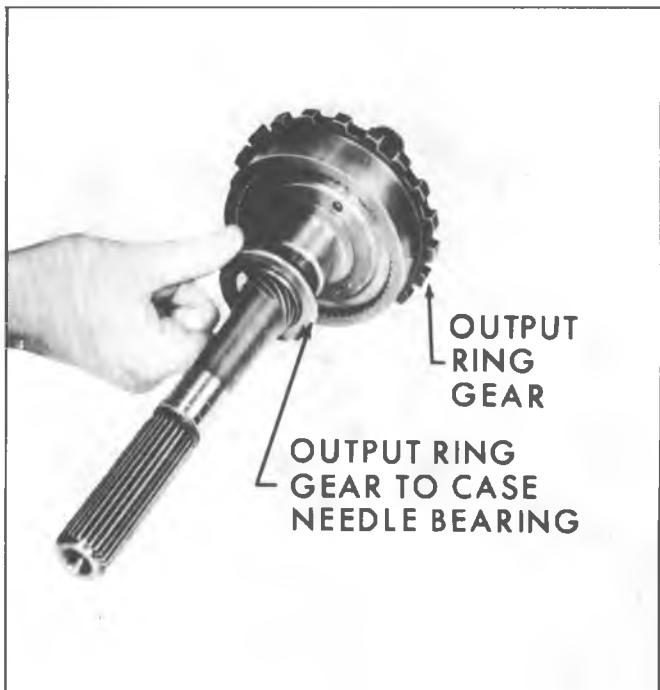


Fig. 7A-47B--Removing Output Ring Gear to Case Needle Bearing Assembly

18. Remove output ring gear and shaft assembly from case (fig. 7A-45B).

**NOTE:** On Trucks, also remove grease pack sleeves from output shaft before taking shaft from case.

19. Remove reaction carrier to output ring gear tanged (front) thrust washer (fig. 7A-46B).

20. Remove output ring gear to case needle bearing assembly (fig. 7A-47B).

21. Compress low and reverse clutch piston spring retainer using tool J-23327 (fig. 7A-48B) and remove piston retaining ring and spring retainer.



Fig. 7A-46B--Removing Output Ring Gear Tanged Thrust Washer

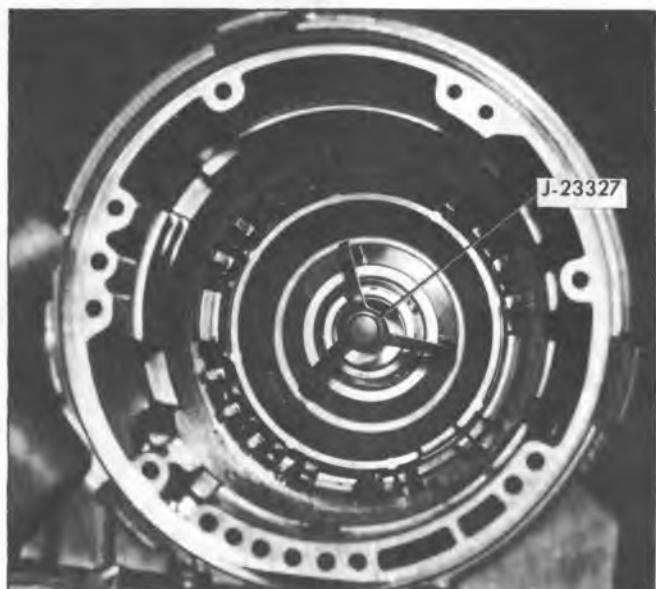


Fig. 7A-48B--Compressing Low and Reverse Clutch Piston Spring Retainer

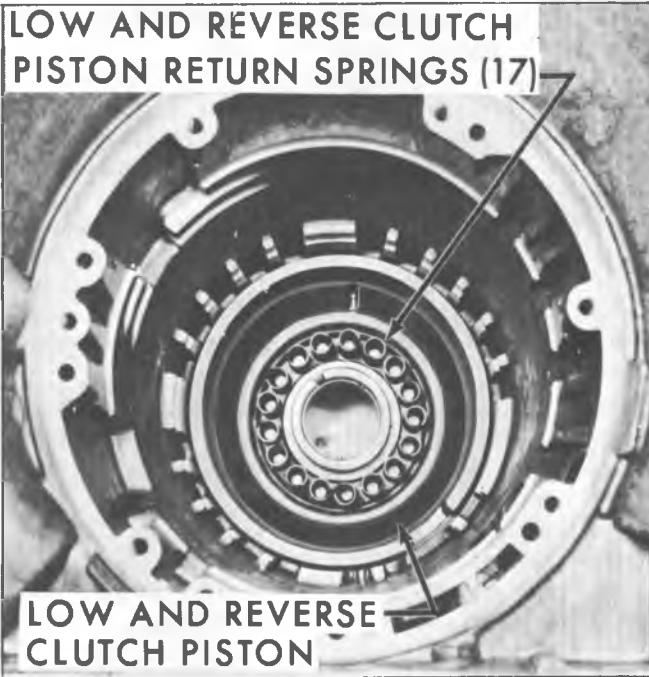


Fig. 7A-49B--Low and Reverse Clutch Piston Springs and Piston

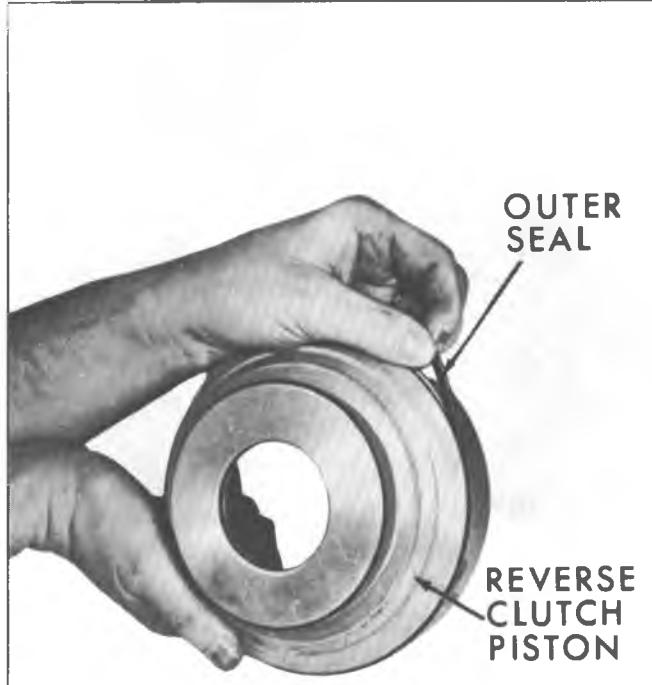


Fig. 7A-51B--Removing Low and Reverse Clutch Piston Outer Seal

22. Remove seventeen (17) piston springs from piston (fig. 7A-49B).
23. Remove low and reverse clutch piston assembly by applying compressed air in passage shown on Figure 7A-50B.
24. Remove low and reverse clutch piston outer seal (fig. 7A-51B).
25. Remove low and reverse clutch piston center and inner seal (fig. 7A-52B).
26. Install tool J-23069 to compress intermediate clutch accumulator piston cover and remove retaining ring (fig. 7A-53B).



Fig. 7A-50B--Removing Low and Reverse Clutch Piston

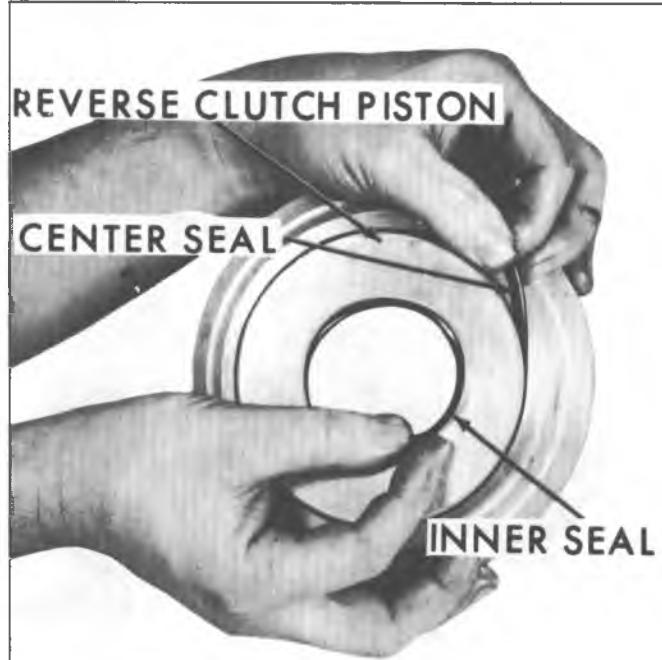


Fig. 7A-52B--Removing Low and Reverse Clutch Piston Center and Inner Seal

27. Remove intermediate clutch accumulator piston cover and remove "O" ring seal from case.
28. Remove intermediate clutch accumulator piston spring.
29. Remove intermediate clutch accumulator piston assembly (fig. 7A-54B).
30. Also, remove inner and outer hook type oil seal rings if required.

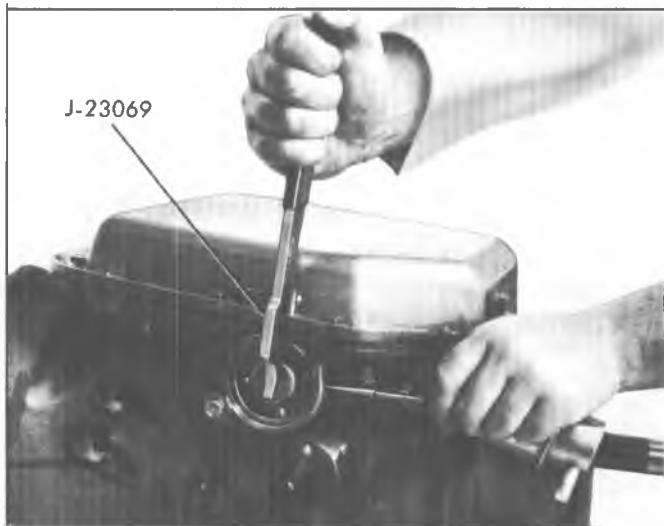


Fig. 7A-53B--Removing Accumulator Piston Cover Retaining Ring

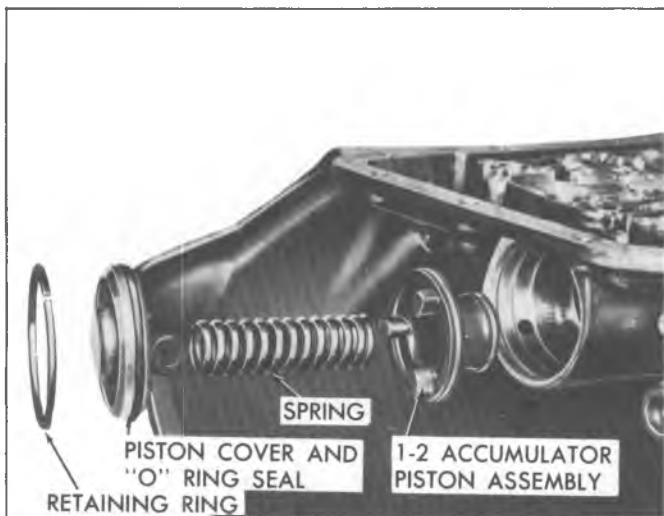


Fig. 7A-54B--Intermediate Clutch Accumulator Components



Fig. 7A-55B--Removing Direct Clutch Accumulator Piston Retaining "E" Ring

## VALVE BODY DISASSEMBLY, INSPECTION, AND REASSEMBLY (FIG. 7A-56B)

### Disassembly

1. Position valve body assembly with cored face up and direct clutch accumulator piston pocket positioned as shown in Figure 7A-56B.

2. Remove manual valve from lower left hand bore.

3. From lower right hand bore remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring, and the pressure regulator valve.

4. From the next bore, remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring, and the 2-3 shift valve.

5. From the next bore, remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve, and the 1-2 shift valve.

6. From the next bore, remove retaining pin, plug, manual low control valve spring, and the manual low control valve.

7. From the next bore, remove the retaining pin, spring, seat, and the detent regulator valve.

8. Install Tools J-22269 and J-24675 on direct clutch accumulator piston and compress piston only enough to remove retaining "E" ring (fig. 7A-55B).

**CAUTION:** Piston may be damaged if piston is over compressed.

9. Remove direct clutch accumulator piston, and metal oil seal ring, and spring.

10. From the next bore down from the direct clutch accumulator, remove the detent actuating lever bracket bolt, bracket, actuating lever and retaining pin, stop, spring retainer, seat, outer spring, inner spring, washer and detent valve.

### Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.

2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.

3. Check all springs for distortion or collapsed coils.

### Reassembly

1. Install direct clutch accumulator piston spring and piston into valve body.

2. Install special tools J-22269 and J-24675 and compress spring and piston only enough to install retaining ring.

**NOTE:** Align piston and oil seal ring when entering bore.

3. Install the detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 in. lbs. Assembly detent actuating lever with retaining pin.

4. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.

5. In the next bore up, install 2-3 shift valve, shift valve

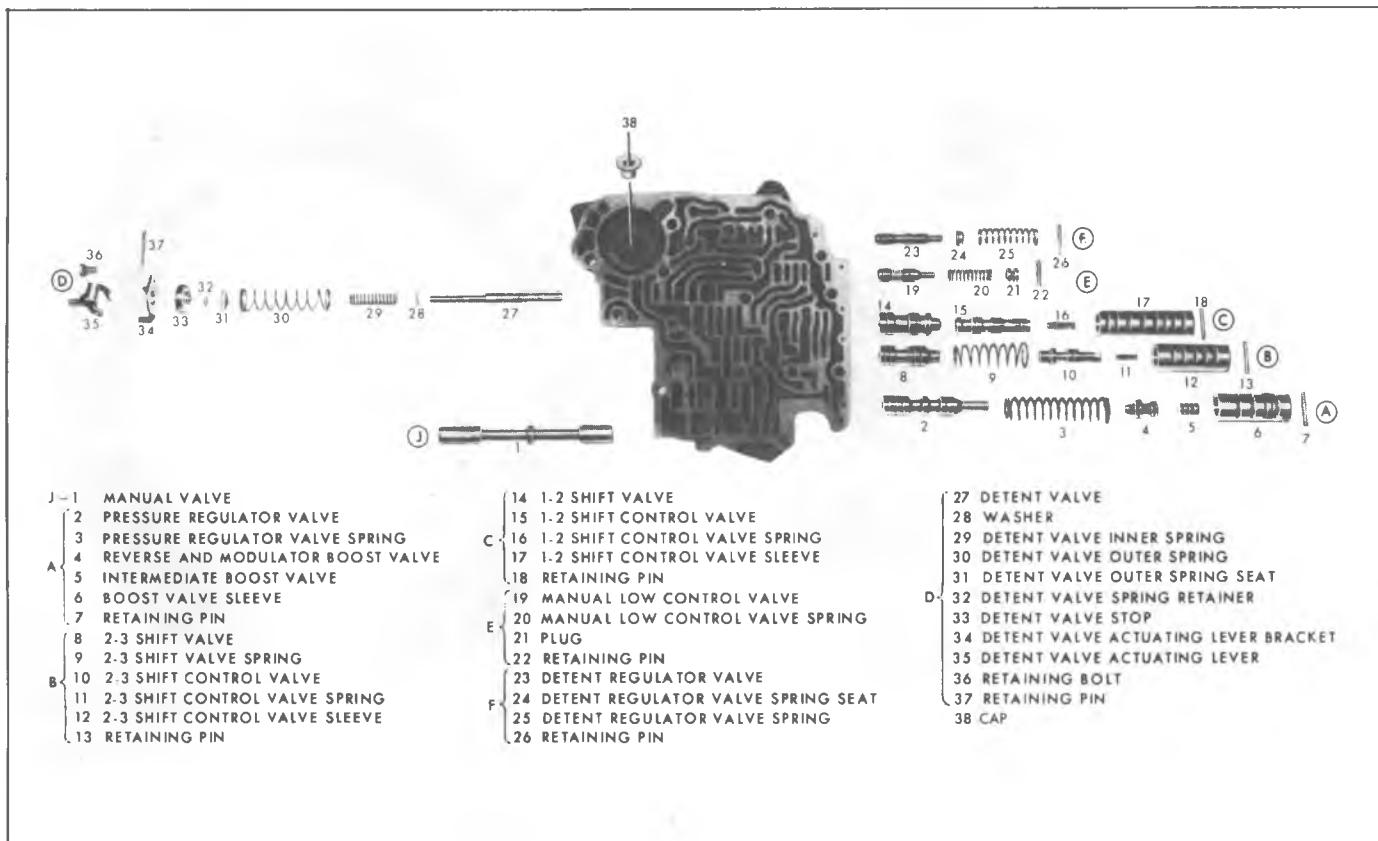


Fig. 7A-56B--Valve Body - Exploded View

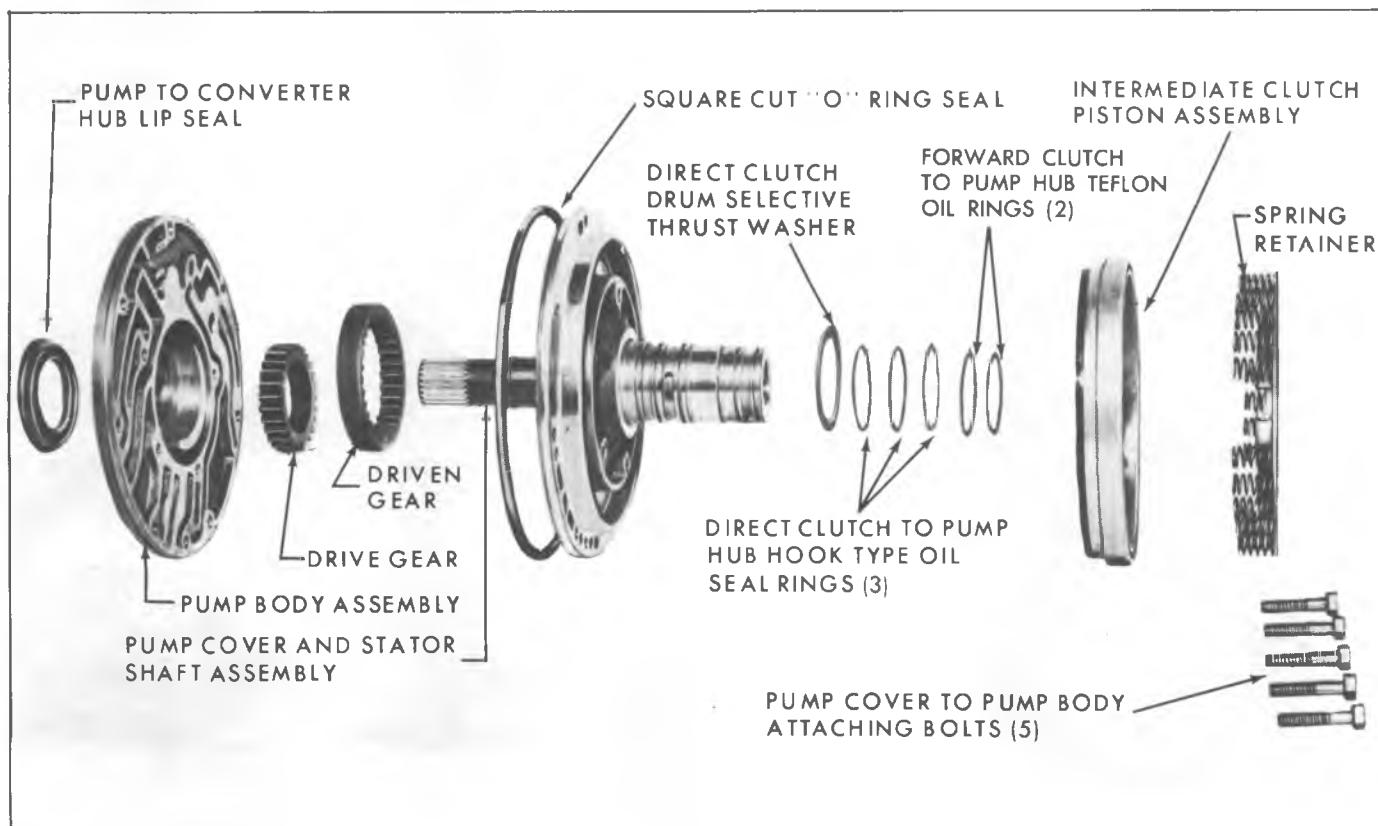


Fig. 7A-57B--Pump Assembly - Exploded View

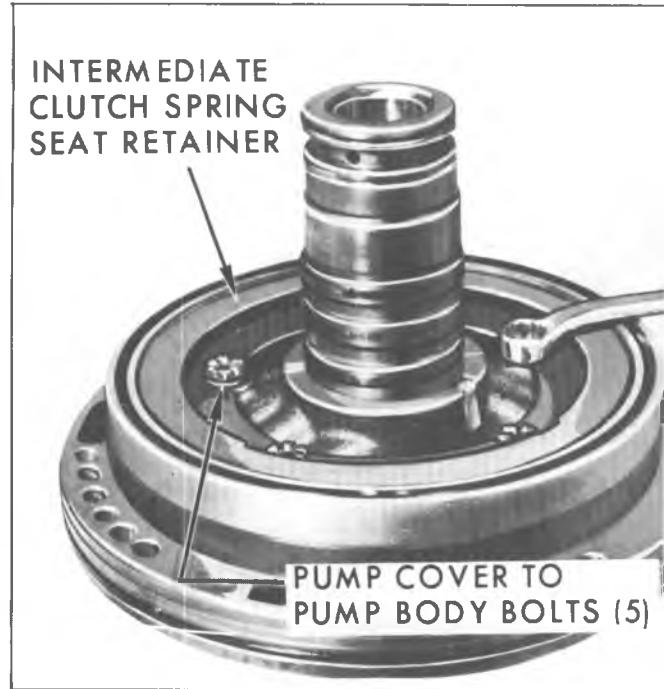


Fig. 7A-58B--Removing Pump Cover to Pump Body Bolts

spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.

6. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.

7. In the next bore up, install the manual low control valve, spring, plug and retaining pin.

8. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

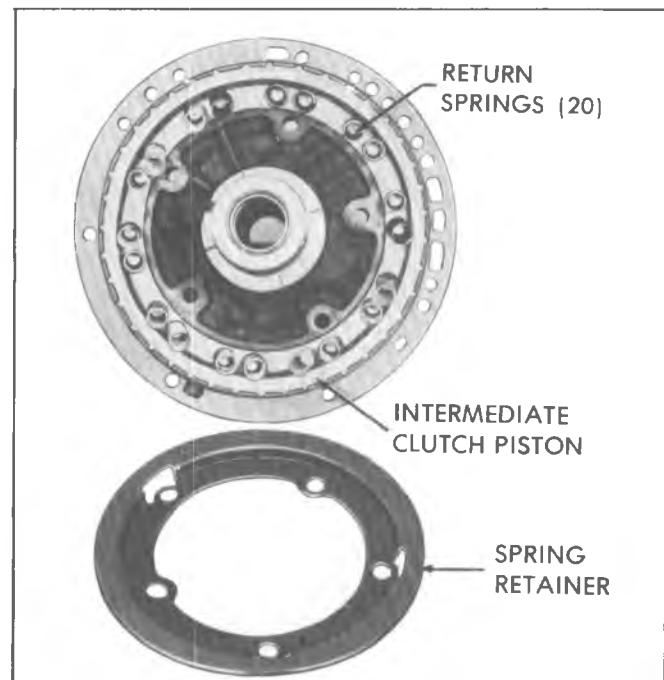


Fig. 7A-59B--Intermediate Clutch Spring Retainer, Return Springs and Piston

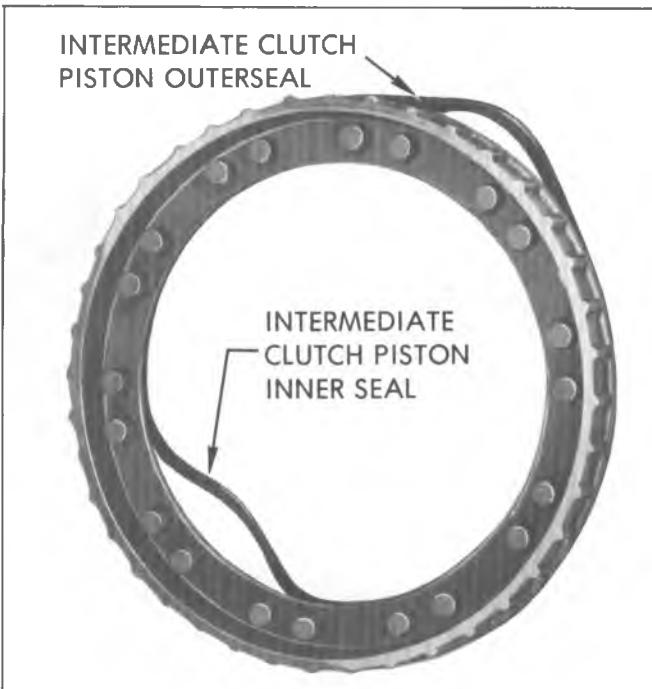


Fig. 7A-60B--Removing Intermediate Clutch Piston Inner and Outer Seal

### OIL PUMP (FIG. 7A-57B)

#### Disassembly

1. Place pump cover and stator shaft assembly through hole in bench.
2. Remove pump cover to body attaching bolts  $5/16 \times 18-1 \frac{1}{2}$  (fig. 7A-58B).
3. Remove intermediate clutch spring retainer, twenty (20) intermediate clutch return springs and the intermediate clutch piston assembly (fig. 7A-59B).
4. Remove intermediate clutch piston inner and outer seals (fig. 7A-60B).
5. Remove two (2) forward clutch housing to pump hub hook type oil seal rings and three (3) direct clutch drum to pump hub hook type oil rings (fig. 7A-61B).



Fig. 7A-61B--Pump Hub Oil Seal Rings

**NOTE:** Forward clutch oil seal rings are teflon on JA and JH models.

6. Remove pump cover to direct clutch drum housing selective thrust washer (fig. 7A-61B).

**NOTE:** A needle bearing is used on C series Truck instead of a thrust washer.

7. Remove pump cover and stator shaft assembly from pump body (fig. 7A-62B).

8. Remove pump drive gear and driven gear.

9. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.

### Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages. DO NOT USE RAGS TO DRY PARTS.

**CAUTION:** Some solvents may be harmful to rubber seals.

2. Inspect pump gears for nicks or damage.
3. Inspect body and cover faces for nicks or scoring. Inspect cover hub O.D. for nicks or burrs which might damage clutch drum bushing journal.
4. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub. Maximum clearance is .005". If the bushing is damaged, the oil pump body should be replaced.



Fig. 7A-63B--Checking Pump Body to Gear Face Clearance

5. Inspect converter housing hub O.D. for nicks or burrs which might damage pump seal or bushing. Repair or replace as necessary.

6. If hub lip seal is damaged or is leaking (and the pump body is otherwise suitable for reuse), replace seal.

7. With parts clean and dry, install pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0005"-.0015" (fig. 7A-63B).

### Reassembly

1. Replace hub lip seal if defective (figs. 7A-64B and 7A-65B).

2. Place pump body on wood blocks and pry out defective seal. Coat outer diameter of new seal with a non-hardening sealer and install seal using seal installer J-21359 to seat seal fully in counterbore.



Fig. 7A-62B--Separating Pump Cover From Pump Body

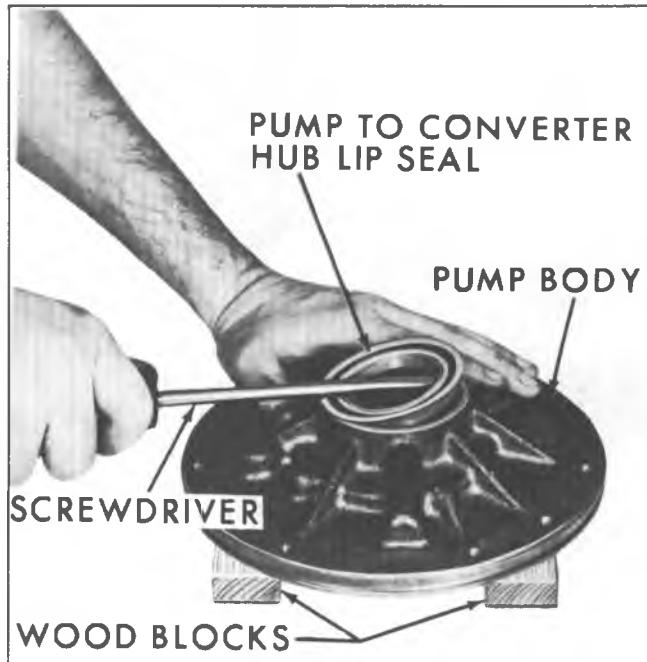


Fig. 7A-64B--Removing Pump to Converter Hub Lip Seal

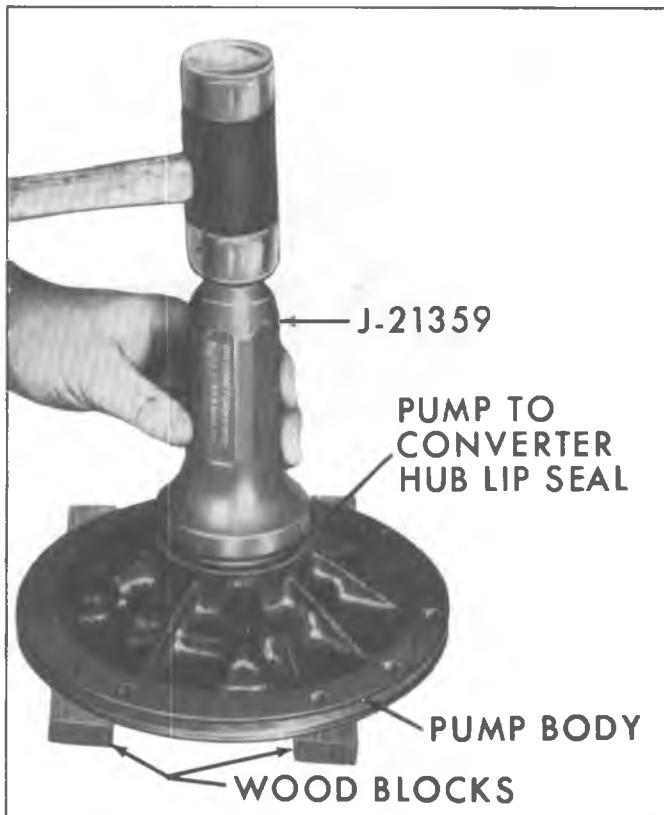


Fig. 7A-65B--Installing Hub Lip Seal

3. Install pump drive gear and driven gear (fig. 7A-66B).
4. Install direct clutch drum housing to pump cover selective thrust washer over pump cover delivery sleeve.
5. Install three (3) direct clutch to pump hub hook type oil seal rings. Install two (2) forward clutch to pump hub hook type oil seal rings.



Fig. 7A-66B--Installing Pump Drive and Driven Gears

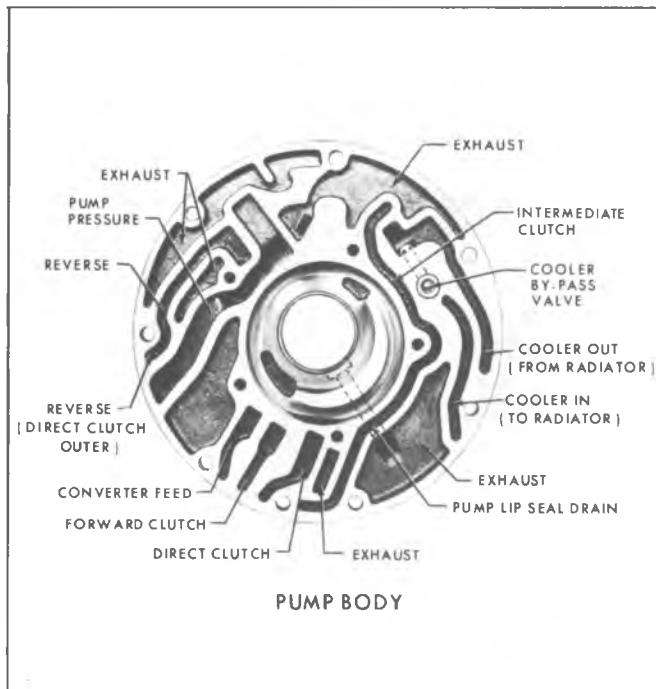


Fig. 7A-67B--Pump Body Oil Passages

**CAUTION:** Check pump cover and body oil passages to make sure they are not restricted (figs. 7A-67B and 7A-68B).

6. Install intermediate clutch piston inner seal and outer seal on piston.
7. Install pump outside diameter to case (square cut) "O" ring seal.
8. Install intermediate clutch piston assembly into pump cover being careful not to damage seals.
9. Install spring retainer with attached clutch return springs, align pump body to cover, and install five (5) attaching bolt. Tighten bolts to 18 pound-feet.
10. Align pump body to cover and start bolts.

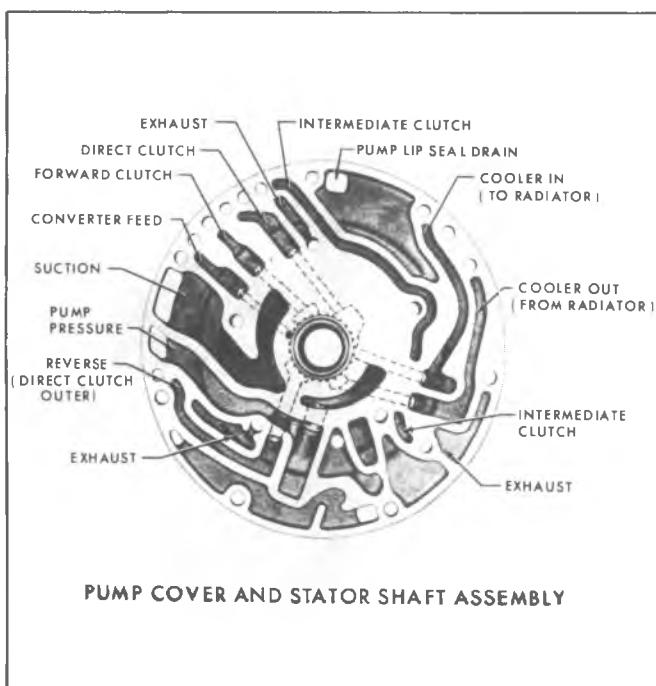


Fig. 7A-68B--Pump Cover Oil Passages

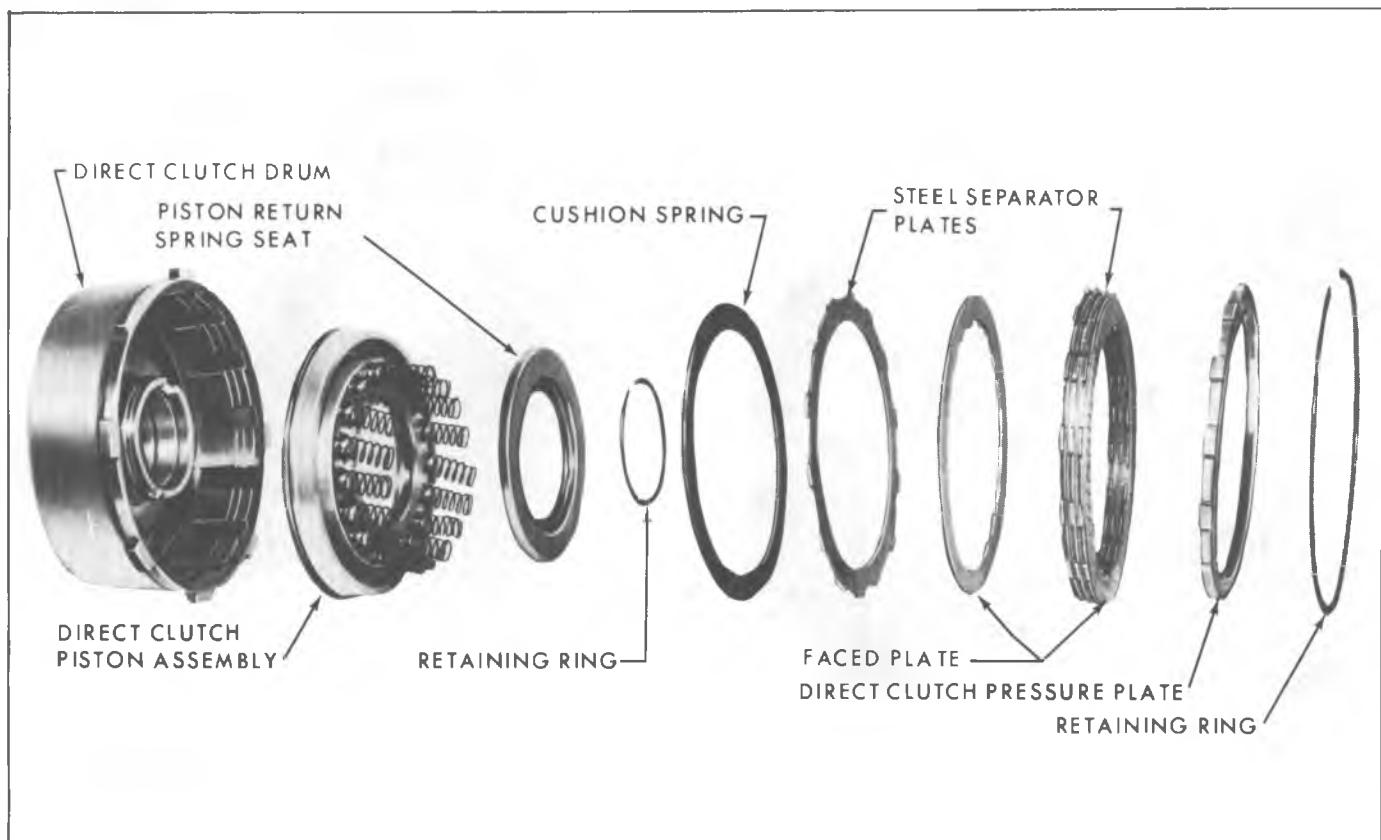


Fig. 7A-69B--Direct Clutch Assembly - Exploded View

### DIRECT CLUTCH AND INTERMEDIATE OVERRUN ROLLER CLUTCH (FIG. 7A-69B)

#### Disassembly

1. Remove intermediate overrun clutch drum front retaining ring and retainer (fig. 7A-70B).
2. Remove intermediate clutch overrun outer race (fig. 7A-70B).

3. Remove intermediate overrun roller clutch assembly (fig. 7A-71B).

**NOTE:** Intermediate overrun roller clutch inner race is a press fit. Do not remove unless replacement is necessary.

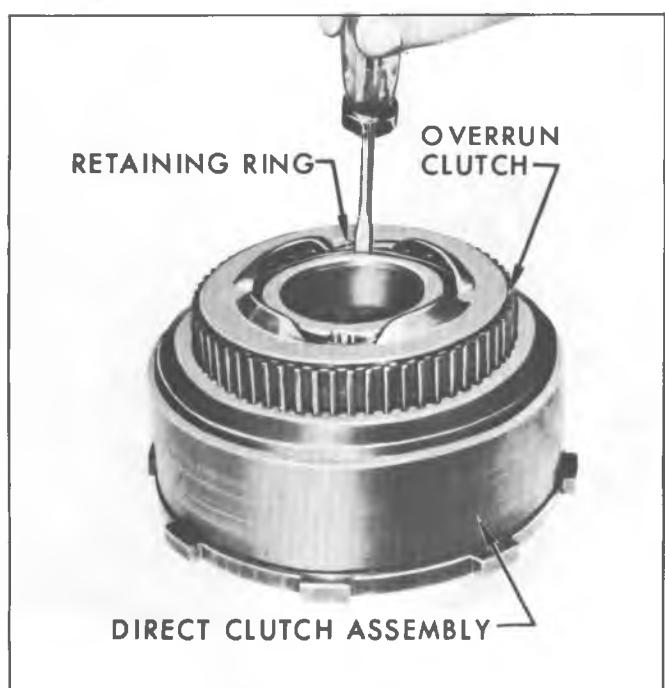


Fig. 7A-70B--Removing Overrun Clutch Retaining Ring and Retainer

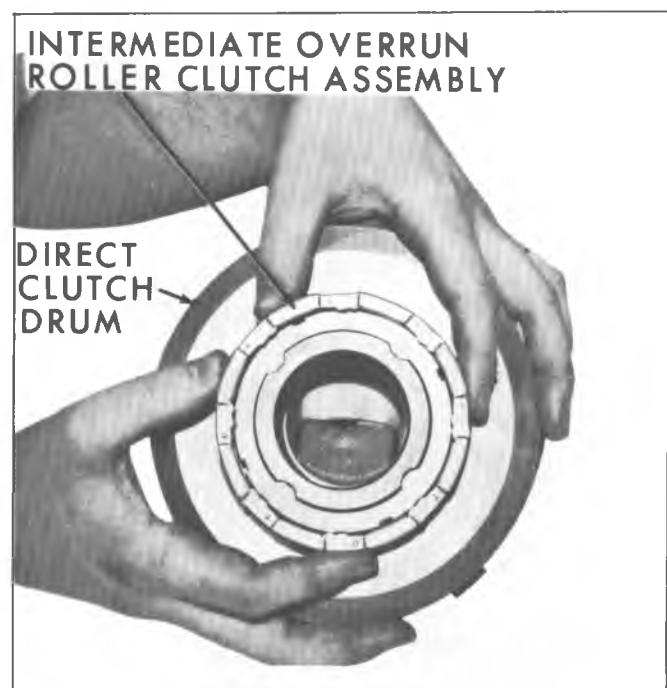


Fig. 7A-71B--Removing Intermediate Overrun Roller Clutch

**DIRECT CLUTCH DRUM TO FORWARD CLUTCH HOUSING NEEDLE ROLLER BEARING**

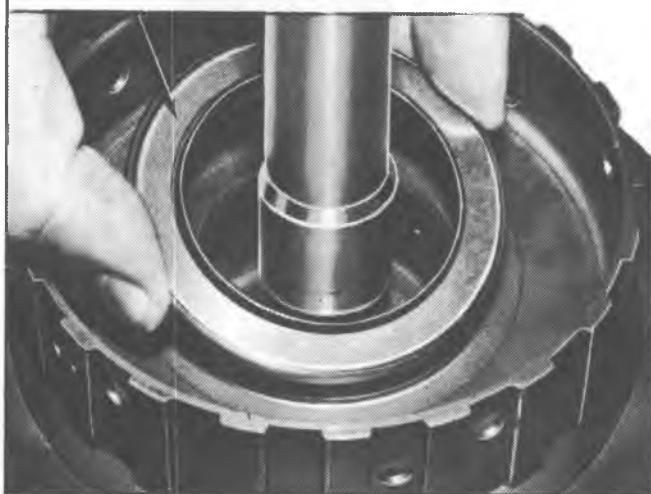


Fig. 7A-72B--Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

**RETAINING RING  
PRESSURE PLATE  
DIRECT CLUTCH DRUM**



Fig. 7A-73B--Removing Direct Clutch Pressure Plate

4. Remove direct clutch drum to forward clutch housing needle roller bearing (fig. 7A-72B).
5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (fig. 7A-73B).
6. Remove drive plates and steel driven plates (fig. 7A-74B).

7. Using compressor tool J-23327, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (fig. 7A-75B).

**NOTE:** On JA and JH models, return coil springs are attached to retaining ring.

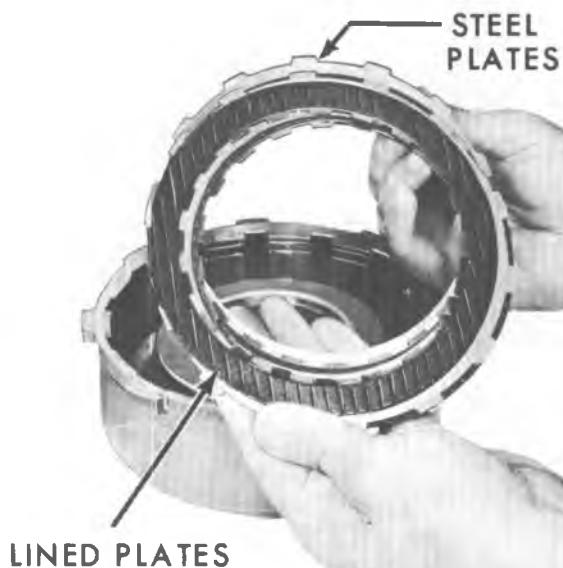


Fig. 7A-74B--Removing Face Plates and Steel Separator Plates

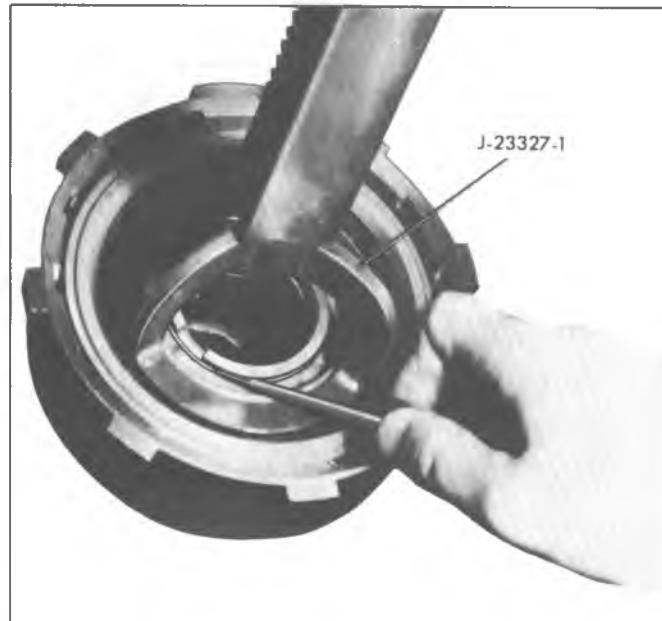


Fig. 7A-75B--Compressing Direct Clutch Spring Seat



Fig. 7A-76B--Removing Direct Clutch Outer and Inner Seals

8. Remove direct clutch piston.
9. Remove direct clutch piston outer seal and inner seal (fig. 7A-76B).
10. Remove direct clutch piston center seal from drum (fig. 7A-77B).

### Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.
2. Inspect seventeen (17) springs for collapsed coils or signs of distortion.

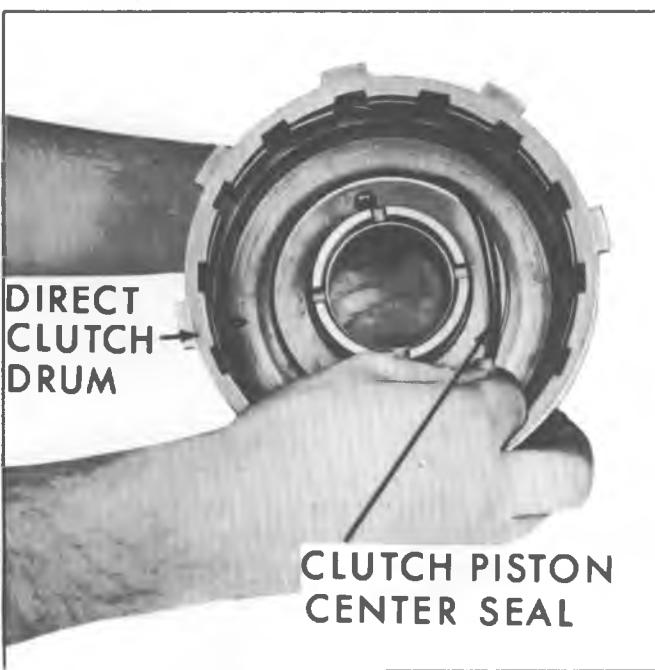


Fig. 7A-77B--Removing Direct Clutch Piston Center Seal



Fig. 7A-78B--Installing Direct Clutch Piston

3. Inspect piston for cracks.
4. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.
5. Inspect roller clutch inner and outer race for scratches or indentations.
6. Inspect roller cage for wear and roller springs for distortion.

### Reassembly

1. Install new direct clutch piston outer seal and inner seals.
2. Install new direct clutch piston center seal on drum with lip facing upward.
3. Install direct clutch piston into housing with aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 7A-78B).
4. Install seventeen (17) clutch return coil springs.
5. Install piston return spring seat. Compress spring seat with tool J-23327 and install retaining ring (fig. 7A-79B).
6. Lubricate with transmission fluid and install face plates and steel separator plates, alternating steel and faced plates.
7. Install direct clutch pressure plate and retaining ring.
8. Install intermediate overrun roller clutch assembly with four (4) holes toward front of transmission.

**CAUTION:** If roller falls out during assembly operation, reinstall roller from inside to outside cage direction to avoid bending spring.

9. Install intermediate clutch overrun outer race.

**NOTE:** When outer race is installed, it should free wheel in counterclockwise direction only.

10. Install intermediate overrun clutch retainer and retainer ring as shown on Figure 7A-70B.



Fig. 7A-79B--Installing Direct Clutch Springs, Spring Seat and Retaining Ring

CLUTCH	DRIVE PLATE	DRIVEN PLATES	CUSHION SPRING
FORWARD	4	4	1
250 L-6, 262-305 V-8			
350 V-8, 400 V-8	5	5	1
TAXI AND TRUCK			
INTERMEDIATE			
250 L-6, 262 V-8	2	2	1
305-350 V-8, 400 V-8	3	3	1
TAXI AND TRUCK			
DIRECT			
250 L-6, 262 V-8	3	3	NONE
305-350 V-8, 400 V-8	4	4	NONE
TAXI AND TRUCK			
REVERSE			
250 L-6, 262-305 V-8	4	4	NONE
350 V-8, 400 V-8	5	5	NONE
TAXI AND TRUCK			

Fig. 7A-80B--Automatic Clutch Chart

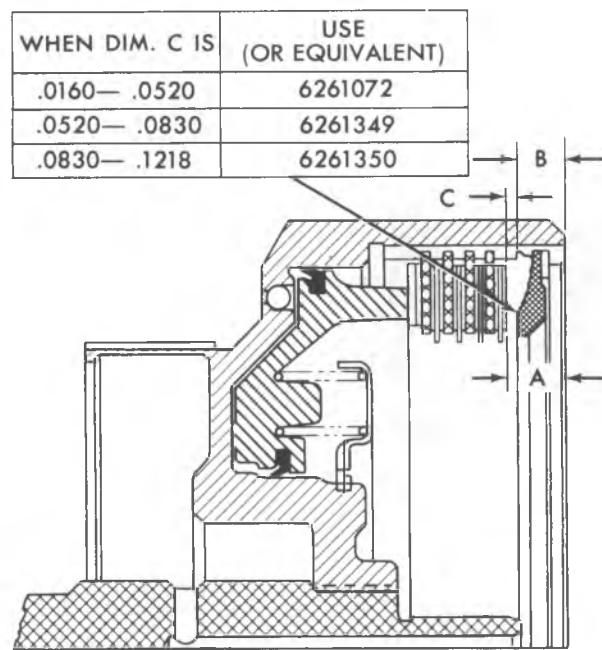


Fig. 7A-81B--Forward Clutch Assembly - Exploded View

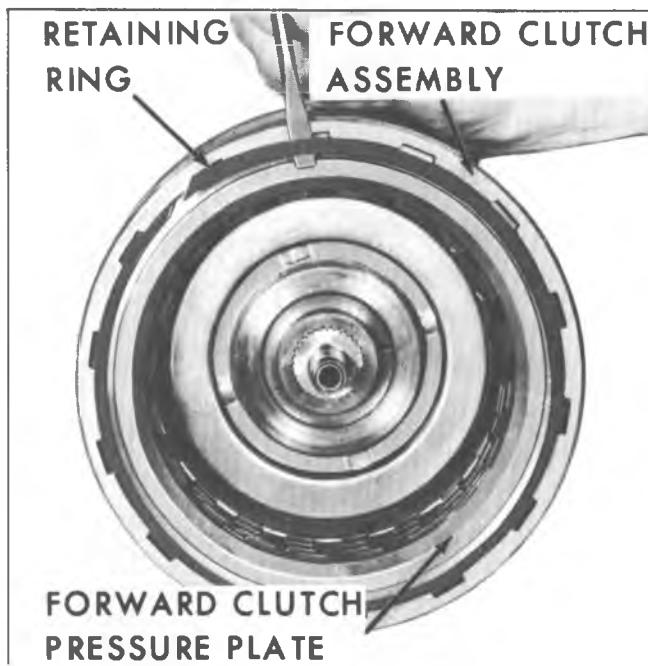


Fig. 7A-82B--Removing Forward Clutch Retaining Ring and Pressure Plate

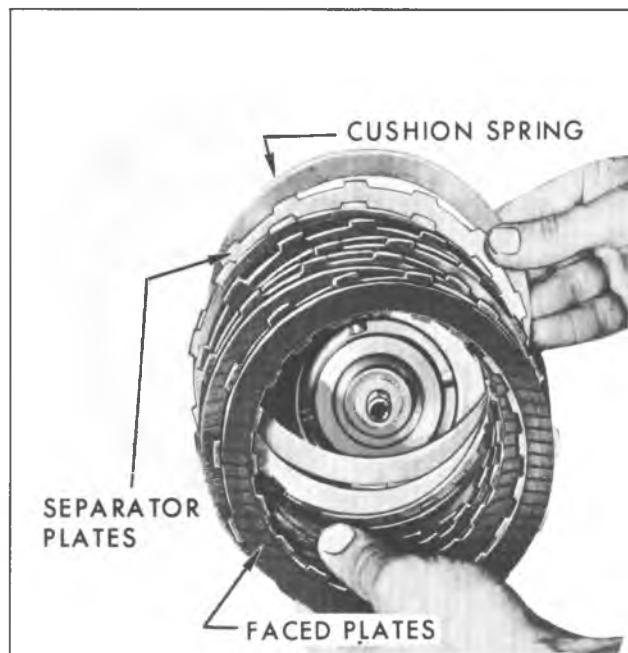


Fig. 7A-83B--Removing Forward Clutch, Clutch Pack

### FORWARD CLUTCH (FIG. 7A-81B)

#### Disassembly

1. Remove forward clutch retaining ring and pressure plate (fig. 7A-82B).
2. Remove face plates, steel separator plates and cushion spring (fig. 7A-83B).
3. Using tool J-23327, compress piston return seat and remove retaining ring (fig. 7A-84B).

4. Remove piston return seat and twenty-one (21) clutch return springs.

**NOTE:** On JA and JH models, return springs are attached to return seat.

5. Remove forward clutch piston assembly.
6. Remove the forward clutch inner and outer piston seals (fig. 7A-85B).

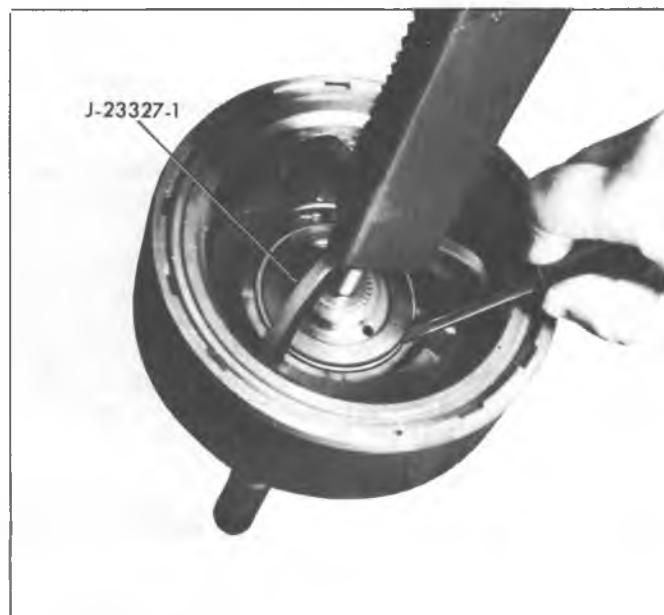


Fig. 7A-84B--Compressing Forward Clutch Piston Return Seat



Fig. 7A-85B--Removing Forward Clutch Piston Inner and Outer Seals

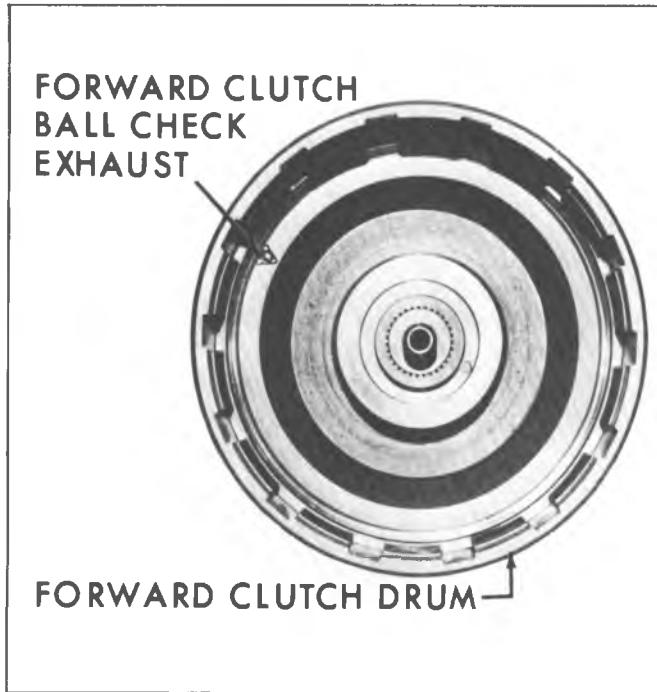


Fig. 7A-86B--Forward Clutch Exhaust Check Ball

### Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.
2. Inspect twenty one (21) springs for collapsed coils or signs of distortion.
3. Inspect piston for cracks.
4. Inspect clutch housing for wear, scoring, open oil passages and free operation of exhaust check ball (fig. 7A-86B).

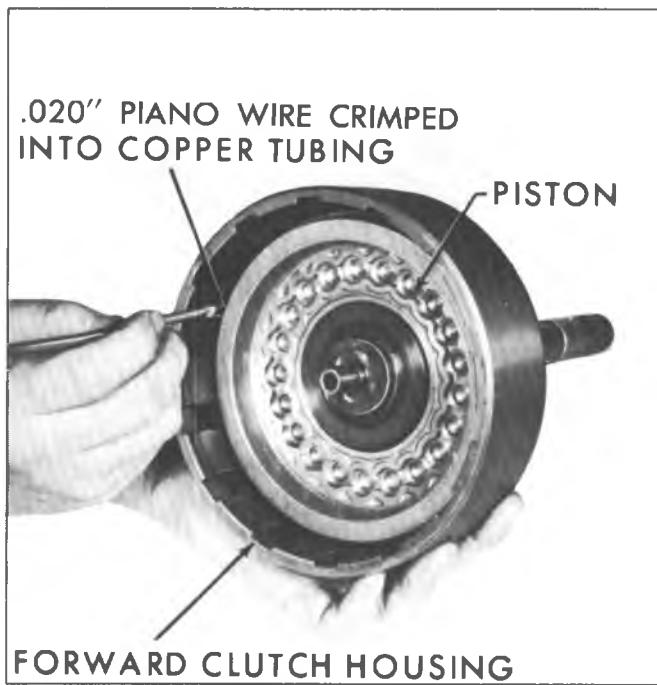


Fig. 7A-87B--Installing Forward Clutch Piston

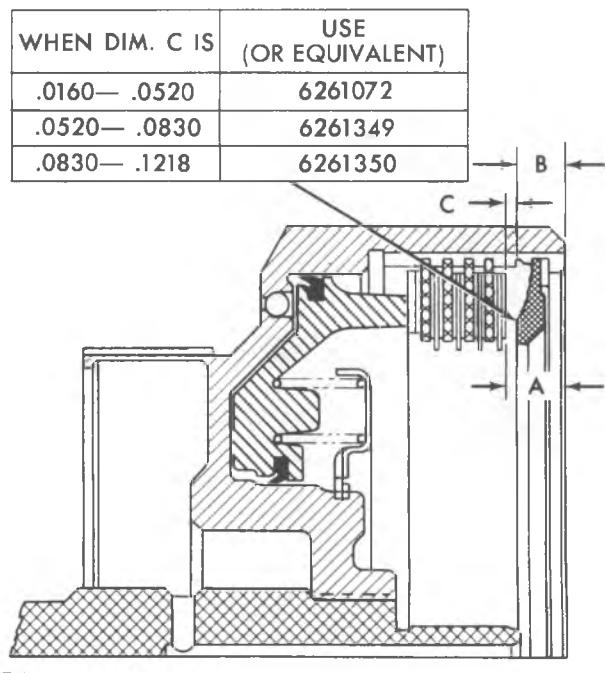


Fig. 7A-88B--Determining Selective Fit for Forward Clutch Pressure Plate

### 5. Inspect input shaft.

- a. Inspect for open lubrication passages at each end.
- b. Inspect splines for damage.
- c. Inspect ground bushing journals for damage.
- d. Inspect shaft for cracks or distortion.

**NOTE:** Input shaft and clutch housing are serviced separately.

### Reassembly

1. Install new forward clutch inner piston seal and outer piston seal.
2. Install the forward clutch pistons assembly with the aid of a feeler gauge or a piece of .020" piano wire crimped into copper tubing (fig. 7A-87B).
3. Install twenty-one (21) clutch return coil springs.
4. Install spring retainer. Compress spring retainer and install retaining ring using tool J-23327-1 as shown on Figure 7A-84B.
5. Lubricate with transmission fluid and install cushion spring face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.
6. Install forward clutch pressure plate (selective fit) and retaining ring. Using chart on Figure 7A-88B to select correct pressure plate (dimension C), measure distance from the top of clutch pack to the top of clutch drum (dimension A). Measure distance from the lower edge of the notch on the inner surface of the drum to the end of the drum (dimension B). Subtract B from A to get dimension C.

### SUN GEAR AND SUN GEAR DRIVE SHELL (FIG.7A-89B)

#### Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (fig. 7A-90B).

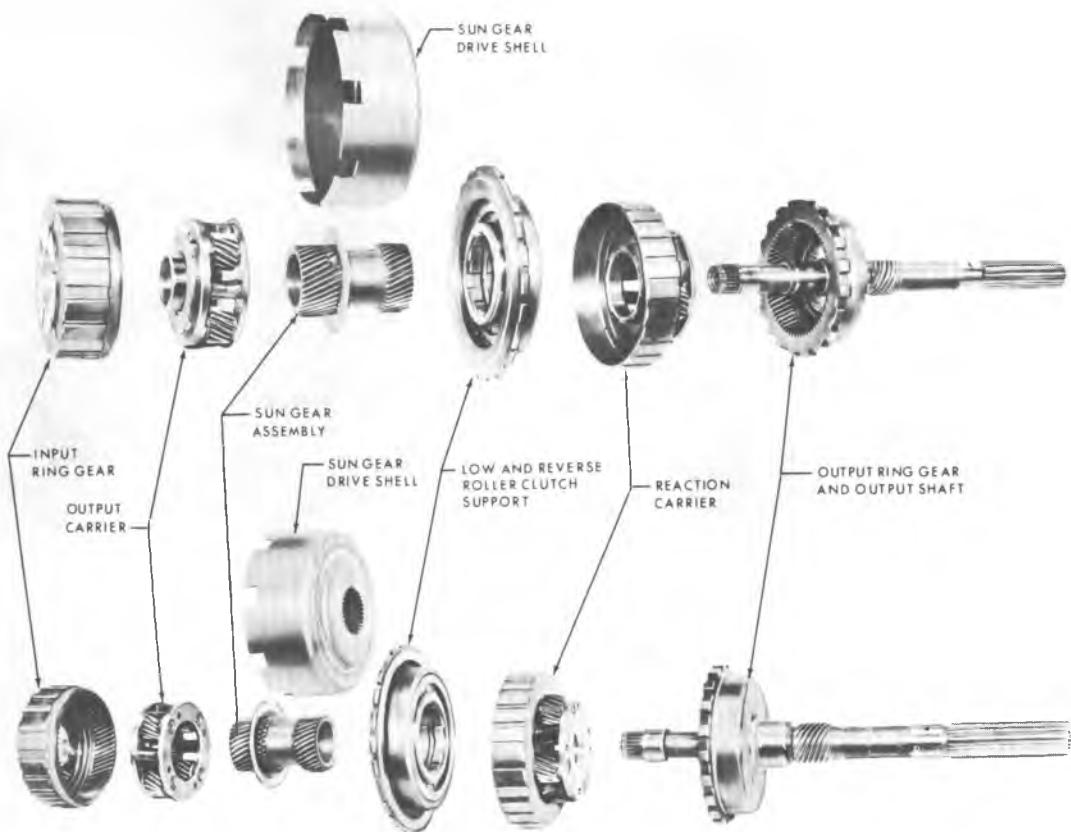


Fig. 7A-89B--Planetary Gear Train - Exploded View



Fig. 7A-90B--Removing Sun Gear Drive Shell Rear Retaining Ring

2. Remove sun gear to drive shell flat rear steel thrust washer (fig. 7A-91B).
3. Remove sun gear assembly from drive shell.
4. Remove sun gear to drive shell front retaining ring (fig. 7A-92B). Discard retaining ring.
5. If bushing is to be replaced, refer to Figure 7A-104B.

### Inspection

Check gear and sun gear shell for damage or wear.

### Assembly

1. Install new sun gear to drive shell front retaining ring.
2. Install sun gear assembly into drive shell.
3. Install sun gear to drive shell flat steel thrust washer.
4. Install new sun gear to sun gear drive shell retaining ring.

**NOTE:** Do not stress front and rear retaining rings at installation.

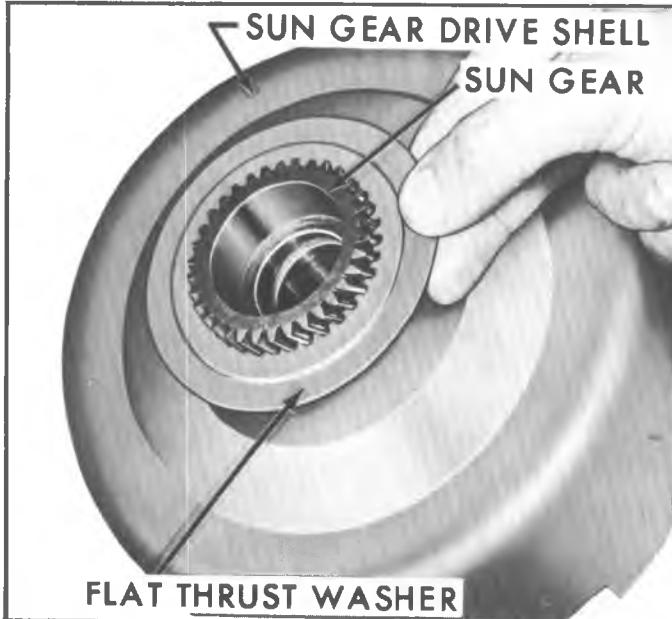


Fig. 7A-91B--Removing Sun Gear to Drive Shell Rear Steel Thrust Washer



Fig. 7A-92B--Removing Sun Gear to Drive Shell Front Steel Thrust Washer

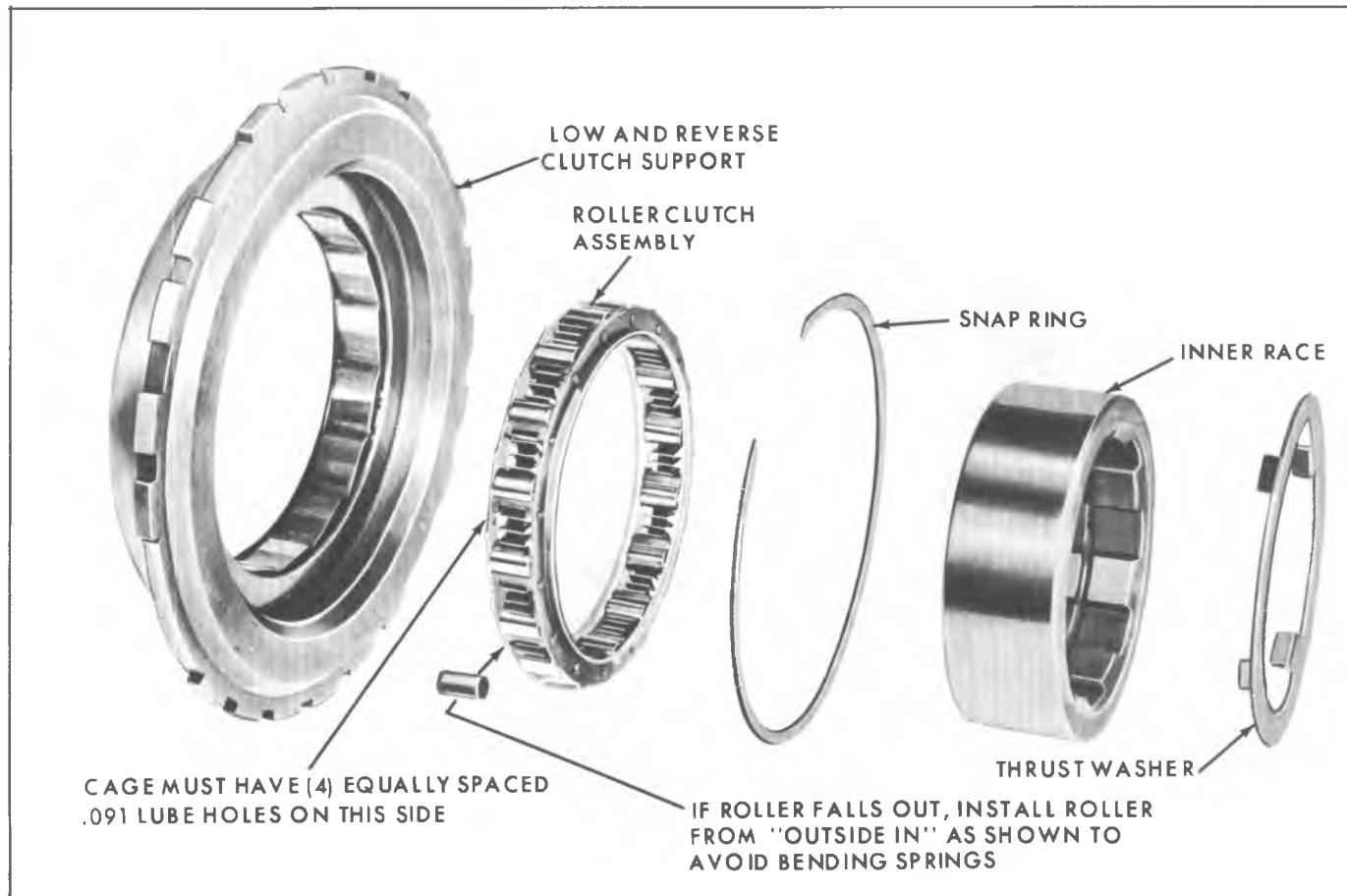


Fig. 7A-93B--Low and Reverse Clutch Assembly - Exploded View

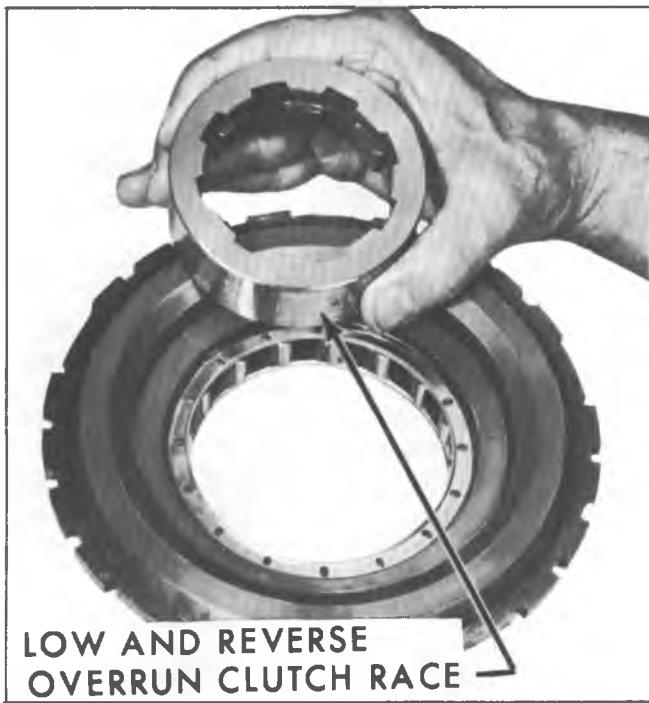


Fig. 7A-94B--Removing Overrun Clutch Inner Race



Fig. 7A-95B--Removing Overrun Roller Clutch Retaining Ring

### LOW AND REVERSE ROLLER CLUTCH SUPPORT (FIG. 7A-93B)

#### Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race from support (fig. 7A-94B).
3. Remove low and reverse clutch roller clutch retaining ring (fig. 7A-95B).
4. Remove low and reverse roller clutch assembly (fig. 7A-96B).

#### Inspection

1. Inspect follower clutch inner and outer race for scratches and indentations.
2. Inspect rollers for wear and roller springs for distortion.

#### Assembly

1. Install low and reverse roller clutch assembly to inner race with oil holes toward rear of transmission.
2. Install low and reverse overrun clutch outer race.
3. Install low and reverse clutch to cam retaining ring.

**NOTE:** Low and reverse overrun clutch inner race should free wheel in the clockwise direction only.

#### GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated.

The governor, including the driven gear, is serviced as a complete assembly. The driven gear can be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to improper operation. In such cases, proceed as follows:



Fig. 7A-96B--Removing Overrun Roller Clutch Assembly

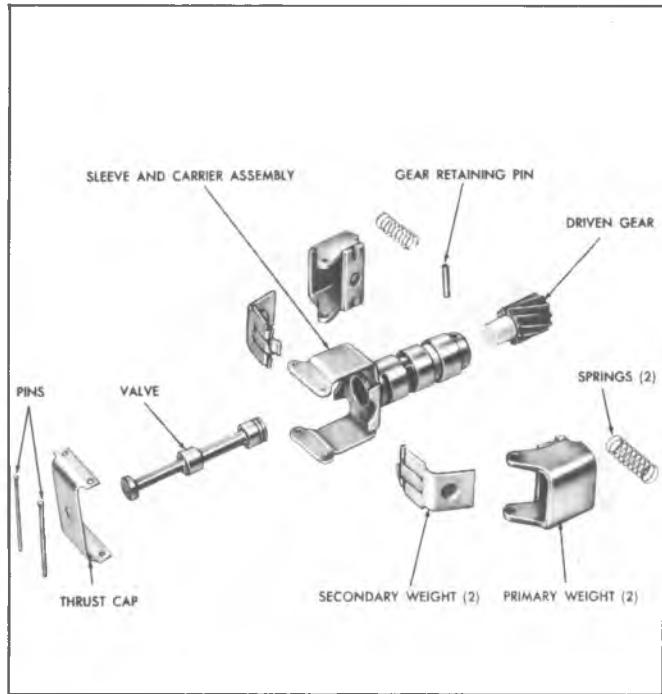


Fig. 7A-97B--Governor Assembly - Exploded View Typical

## Disassembly

- Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified (fig. 7A-97B).
- Remove governor valve from governor sleeve. Be careful not to damage valve.
- Perform following inspections and replace governor driven gear, if necessary.

## Inspection

- Wash all parts in cleaning solvent, air dry and blow out all passages.
- Inspect governor sleeve for nicks, burrs, scoring or galling.
- Check governor sleeve for free operation in bore of transmission case.
- Inspect governor valve for nicks, burrs, scoring or galling.
- Check governor valve for free operation in bore of governor sleeve.
- Inspect governor driven gear for nicks, burrs, or damage.
- Check governor driven gear for looseness on governor sleeve.
- Inspect governor weight springs for distortion or damage.
- Check governor weights for free operation in their retainers.
- Check valve opening at entry and exhaust (.020 inch minimum).

## Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two

governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

- Drive out governor gear retaining split pin using small punch.
- Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
- Carefully clean governor sleeve of chips that remain from original gear installation.
- Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
- A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.
- Install split retaining pin.
- Wash governor assembly thoroughly to remove any chips that may have collected.

## Assembly

- Install governor valve in bore of sleeve, large land end first.
- Install governor weights and springs, and thrust cap on governor sleeve.
- Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
- Check governor weight assemblies for free operation on pins.
- Check governor valve for free movement in governor sleeve.

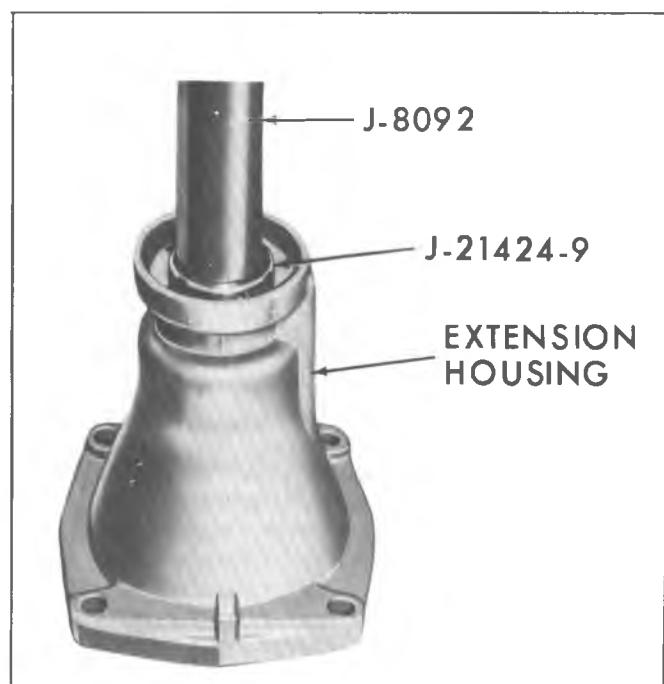


Fig. 7A-98B--Installing Extension Housing Bushing

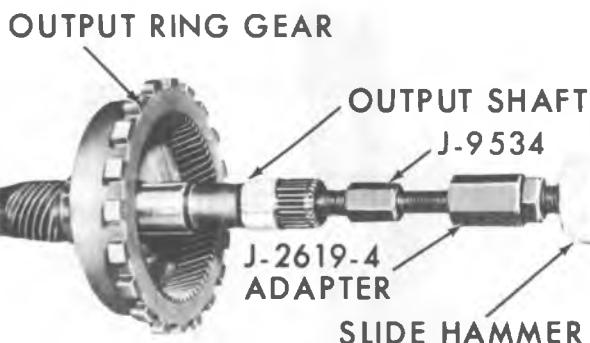


Fig. 7A-99B--Removing Output Shaft Bushing

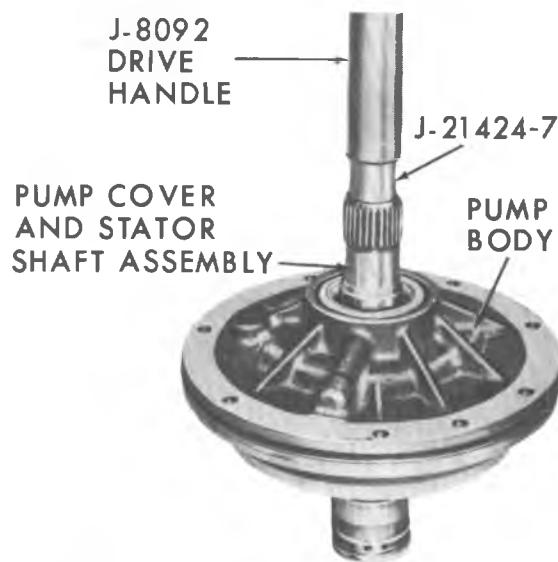


Fig. 7A-101B--Installing Stator Shaft Front Bushing

## BUSHING REPLACEMENT

### Extension Housing Bushing

Remove extension housing bushing from housing using tool J-21424-9 with drive handle J-8092. Install extension housing bushing in housing flush to .010 below seal counter bore surface using tool J-21424-9 with drive handle J-8092 (fig. 7A-98B).

### Output Shaft Bushing

With output shaft properly supported, remove bushing using remover J-9534-01 and slide hammer J-7004 (fig. 7A-99B). Using tool J-23062-7, install bushing until tool bottoms on output shaft.

### Case Bushing

With case properly supported, drive out bushing from rear of case using tool J-23062-1 and drive handle J-8092. Using tool J-23062-1 and drive handle J-8092 with extension J-21465-13, install bushing from interior of case to 3/16"

from front surface with split in bushing located at governor pilot upper bore wall area.

### Stator Shaft Front Bushing

With stator shaft properly supported, remove front bushing using tool J-21465-16 and slide hammer with adapter J-2619-01 (fig. 7A-100B). Using tool J-21424-7 and drive handle J-8092, install bushing to .250" from face (fig. 7A-101B).

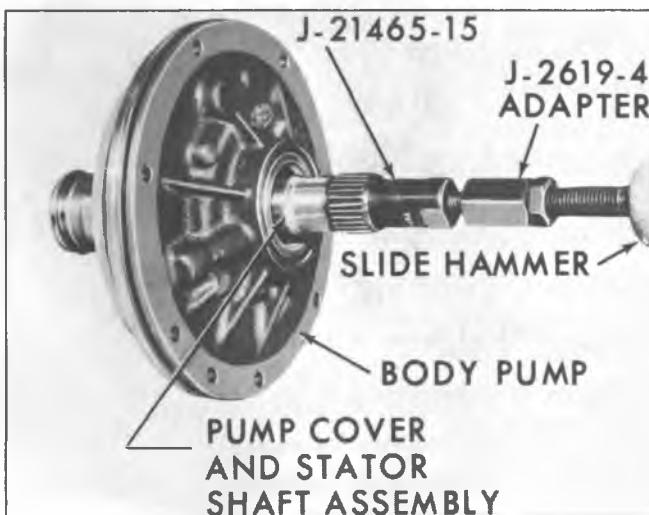


Fig. 7A-100B--Removing Stator Shaft Front Bushing

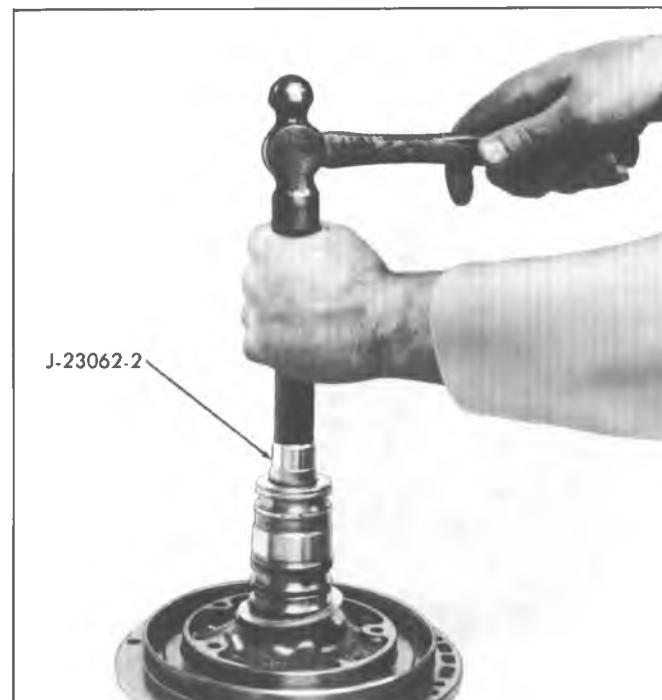


Fig. 7A-102B--Installing Inner and Outer Stator Shaft Bushing

### Stator Shaft Rear Bushing

With stator shaft properly supported, remove front bushing (fig. 7A-102B). Place tool J-21424-7 and drive handle J-8092 with extension J-21465-13 through front of stator shaft and drive out two (2) rear bushings. Using tool J-23062-2 and extension J-21465-13, install inner bushing to approximately 1-5/32" below front face and outer bushing 3/32" below front face (fig. 7A-102B). Install new front bushing (fig. 7A-101B).

### Input Ring Gear Bushing

With input ring gear properly supported, remove bushing using tool J-23062-5 and drive handle J-8092. Using tool J-23062-5 and drive handle J-8092, install bushing to approximately 1/16" below rear face inside gear end (fig. 7A-103B).

### Sun Gear Bushing

With sun gear properly supported, remove two (2) sun gear bushing using tool J-23062-3 and drive handle J-8092 with extension J-21465-13. Using tool J-23062-3 and drive handle J-8092, install sun gear bushing to .010" below surface at either end (fig. 7A-104B).

### Reaction Carrier Bushing

With reaction carrier properly supported, remove bushing using tool J-23062-3 and drive handle J-8092. Using tool J-23062-3 and drive handle J-8092, install bushing flush to or .010" below inside face.

### Direct Clutch Bushing

With direct clutch drum properly supported, remove bushing (fig. 7A-105B). Using tool J-23329 and drive handle J-8092, install direct clutch drum bushing (fig. 7A-106B).

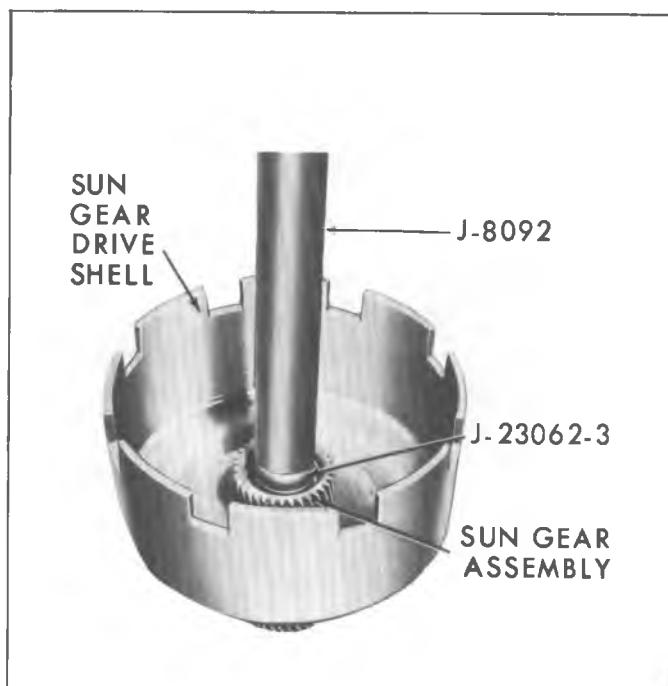


Fig. 7A-104B--Installing Sun Gear Bushings

## TRANSMISSION ASSEMBLY

When servicing transmission, use only transmission oil or petroleum jelly as lubricants to retain bearings or races during assembly. Lubricate all bearings, seal rings and clutch plates prior to assembly.

### Transmission Internal Components

1. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl.
2. Install seventeen (17) piston return (coil) springs.
3. Install spring retainer and retaining ring. Using tool

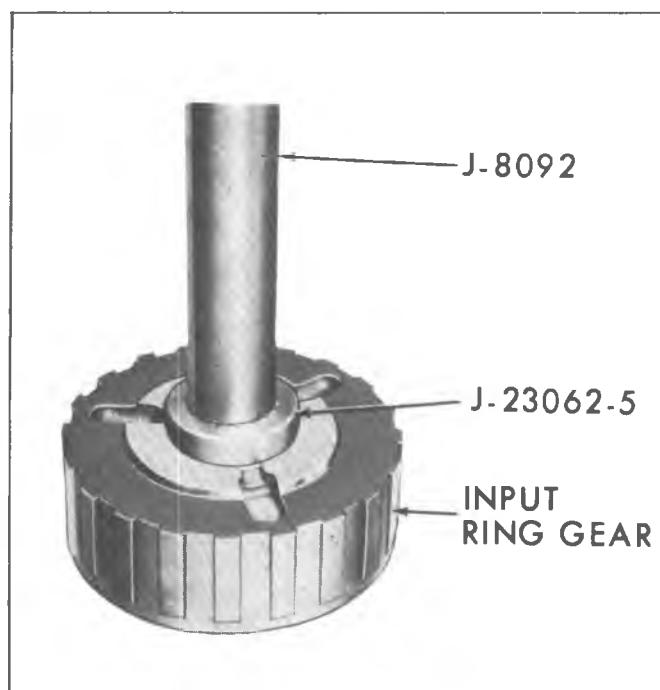


Fig. 7A-103B--Installing Input Ring Gear Support Bushing

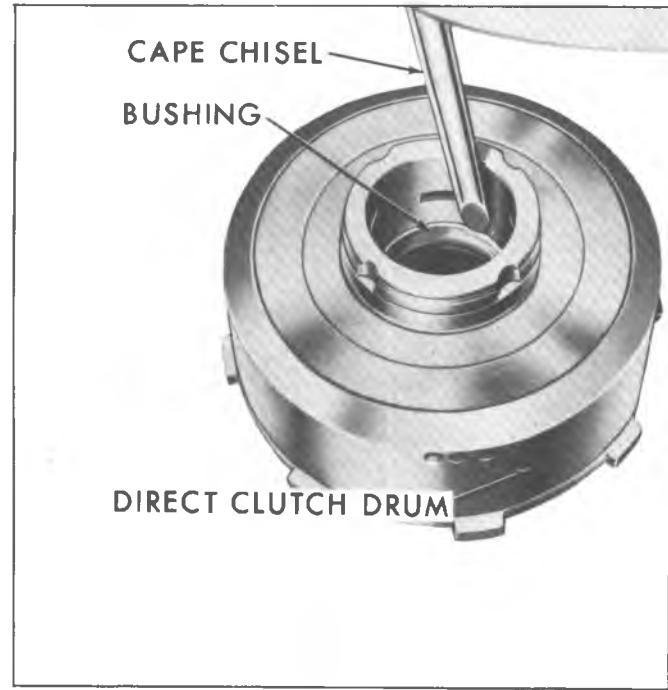


Fig. 7A-105B--Removing Direct Clutch Drum Bushing



Fig. 7A-106B--Installing Direct Clutch Drum Bushing

J-23327, compress return seat so spring retainer retaining ring may be installed. Install output ring gear rear thrust bearing in case.

4. Install output ring gear on output shaft.
5. Install reaction carrier to output ring gear front thrust washer (3 tangs) into output ring gear support.
6. Install output shaft assembly into case.
7. Install reaction carrier assembly into output ring gear and shaft assembly.
8. Oil and install low reverse clutch steel reaction plates

and face plates, starting with a steel plate and alternating with face plates. Install low and reverse clutch support retainer (anti-clunk) spring.

**NOTE:** Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly with position of notch with low and reverse clutch support retainer (anti-clunk) spring as shown on Figure 7A-107B.

10. Install low and reverse roller clutch inner race to sun gear shell thrust washer.

11. Install low and reverse clutch support to case snap ring with anti-clunk spring between gap.

12. Install rear thrust washer and sun gear drive shell assembly.

13. Install output carrier assembly.

14. Install input ring gear rear thrust washer.

15. Install input ring gear.

16. Install new input ring gear to output shaft snap ring.

**CAUTION:** Do not over stress snap ring.

17. Install input gear front thrust washer.

18. Install direct clutch assembly, and special thrust washer to forward clutch assembly.

19. Install clutch assemblies into case.

**CAUTION:** Make certain forward clutch face plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell.

20. Install intermediate clutch overrun brake band.

21. Install intermediate clutch pressure plate.

22. Oil and install face and steel intermediate clutch plates, starting with a face plate and alternating steel and face.

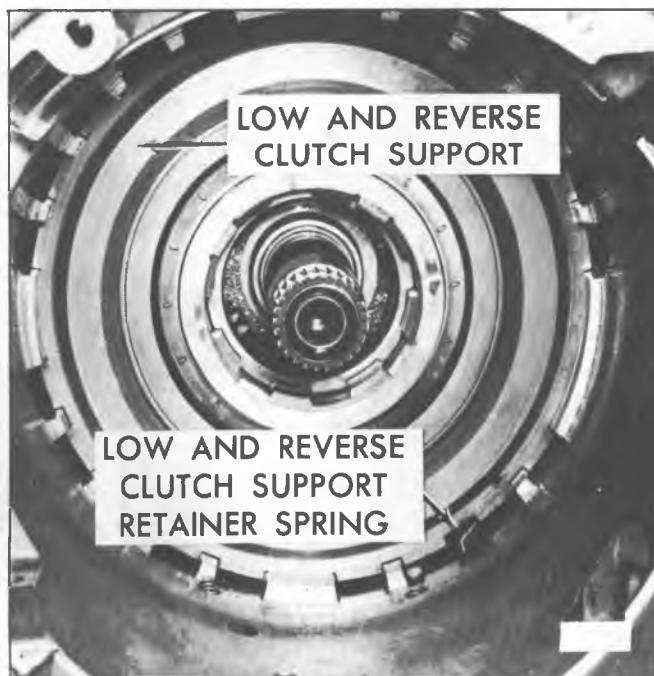


Fig. 7A-107B--Installing Low and Reverse Clutch Support Assembly



Fig. 7A-108B--Pump Cover to Direct Clutch Selective Thrust Washer

**NOTE:** Notch in steel reaction plates is installed toward selector lever inner bracket.

23. Install intermediate clutch cushion spring.

#### Pump to Direct Clutch Thrust Washer Selection Procedure

24. To check for proper thickness of selective fit thrust washer between the oil pump cover and direct clutch assembly, proceed as follows:

a. Install selective fit thrust washer, (fig. 7A-108B) oil pump gasket and using guide studs from J-3387 set install oil pump. Install two pump to case bolts.

b. Move transmission so that output shaft points down. Mount a dial indicator so that plunger of indicator is resting on end of the input shaft. J-5492 may be used to support the dial indicator as shown in Figure 7A-109B. Zero the indicator.

c. Push up on the transmission output shaft and observe the total indicator movement.

d. The indicator should read .010" to .044". If the reading is within limits, the proper selective fit washer is being used. If the reading is not within limits, it will be necessary to remove the pump and change to a thicker or thinner selective fit thrust washer, as required to obtain the specified clearance. Repeat the above checking procedure.

**NOTE:** Selective fit thrust washers are available in thicknesses of .066", .083" and .100".

25. Install new pump assembly in case gasket.
26. Install new pump assembly to case square cut oil seal ring.
27. Install guide pins into case.
28. Install pump assembly into case. Install attaching bolts with new washer type seals.

#### Speedometer Drive Gear and Extension

1. Place speedometer drive gear retaining clip into hole in output shaft.
2. Heat a new speedometer drive gear using a heat lamp or suitable heat method.
3. Align slot in speedometer drive gear with retaining clip and install.

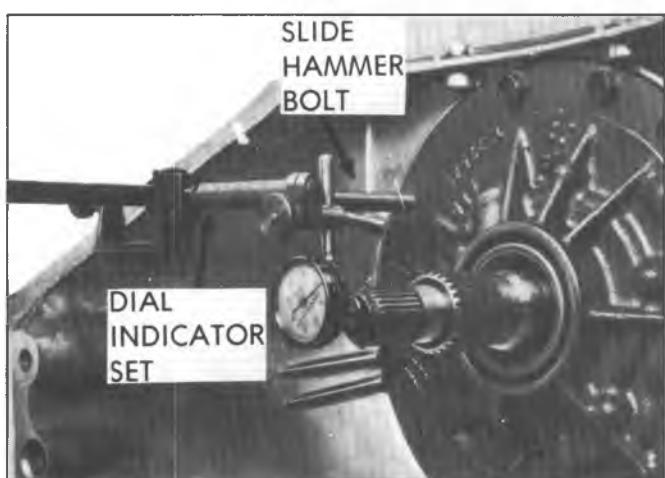


Fig. 7A-109B--Checking End Play for Proper Thrust Washer Selection

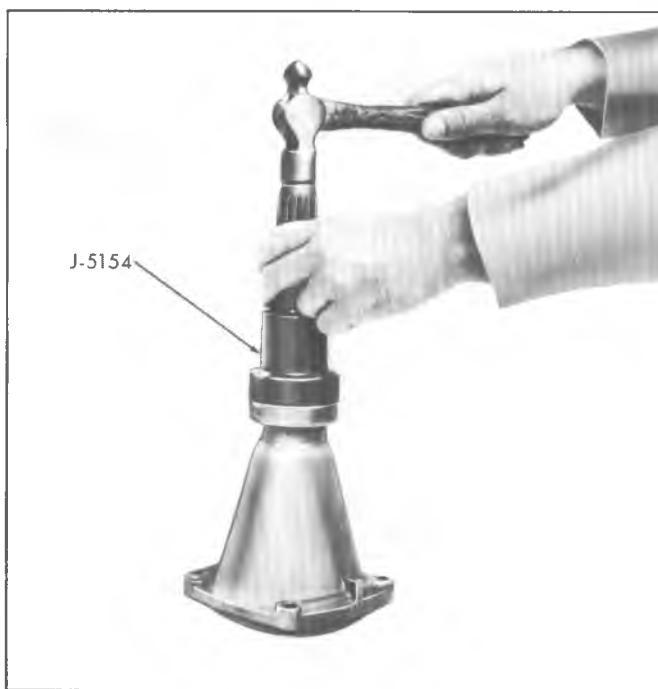


Fig. 7A-110B--Installing Extension Housing Seal

4. Install extension housing to case square cut "O" ring seal.
5. Attach extension housing to case using attaching bolts. Torque to 25 ft. lbs.
6. If necessary, install a new extension housing seal, using seal installer J-5154 or J-21426 (fig. 7A-110B).

#### Manual Linkage

1. If necessary, install a new manual shaft to case lip seal using 3/4" dia. rod, seat seal in case.

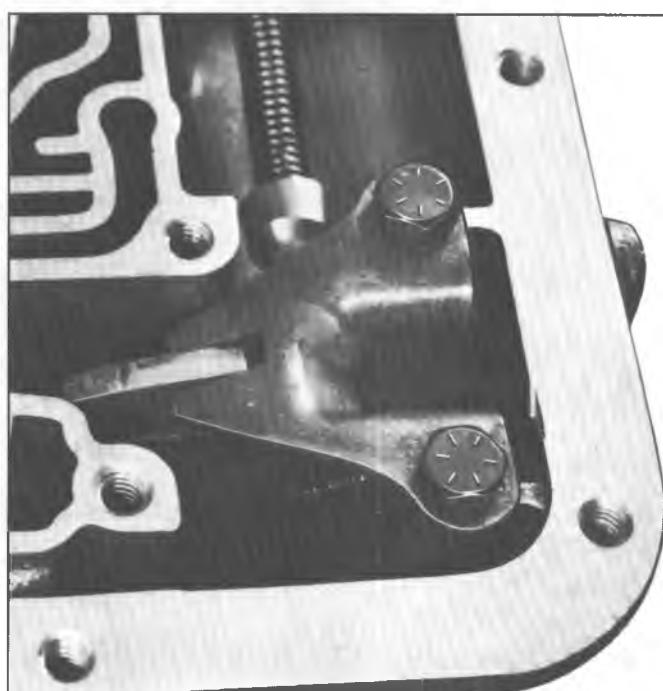


Fig. 7A-111B--Park Lock Bracket Special Bolt Identification

2. Install parking pawl, tooth toward the inside of case, into case.

3. Install parking pawl shaft into case and through parking pawl.

4. Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is .130" to .170" below face of case, then stake in three places.

5. Install parking pawl disengaging spring, square end hooked on pawl.

6. Install park lock bracket, torque bolts to 29 ft. lb. (fig. 7A-111B).

**CAUTION: 290 M Bolts - 6 marks on head.**

7. Install range selector inner lever to parking pawl actuator rod.

8. Install actuating rod under the park lock barcket and parking pawl.

9. Install manual shaft through case and range selector inner lever.

10. Install retaining nut on manual shaft. Torque to 30 ft. lbs.

11. Install manual shaft to case spacer clip.

### Intermediate Servo Piston, Valve Body, Oil Pan and Gasket

1. Install intermediate servo piston, apply pin, spring and spring seat.

2. Install intermediate servo piston and metal oil seal ring.

3. Install four (4) check balls into proper transmission case pockets (fig. 7A-18B).

4. Install oil pump pressure screen and governor feed screen.

5. Install valve body transfer plate and gasket assembly.

6. Install valve body to transfer plate gasket.

7. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 130 inch pounds.

8. Install spacer support plate, torque bolts to 130 in. lbs.

9. Connect detent control valve wire to detent valve actuating lever, then attach lever to valve body.

10. Install detent roller and spring assembly to valve body.

11. Align lube holes in strainer with those in valve body and install strainer assembly gasket and strainer.

12. Install oil pan using a new gasket. Tighten bolts to 130 inch pounds in succession until bolts maintain torque specification.

**NOTE:** If a new oil pan is being installed, transfer production code number is on right side of old pan to new pan. On JA and JH models, production code number is on governor cover.

### Governor and Vacuum Modulator

1. Install governor assembly, cover and seal and retainer wire.

2. Install vacuum modulator valve.

3. Install vacuum modulator and retainer clip. Torque bolt to 130 inch pounds.

**NOTE:** Position retainer with tangs pointing toward modulator.

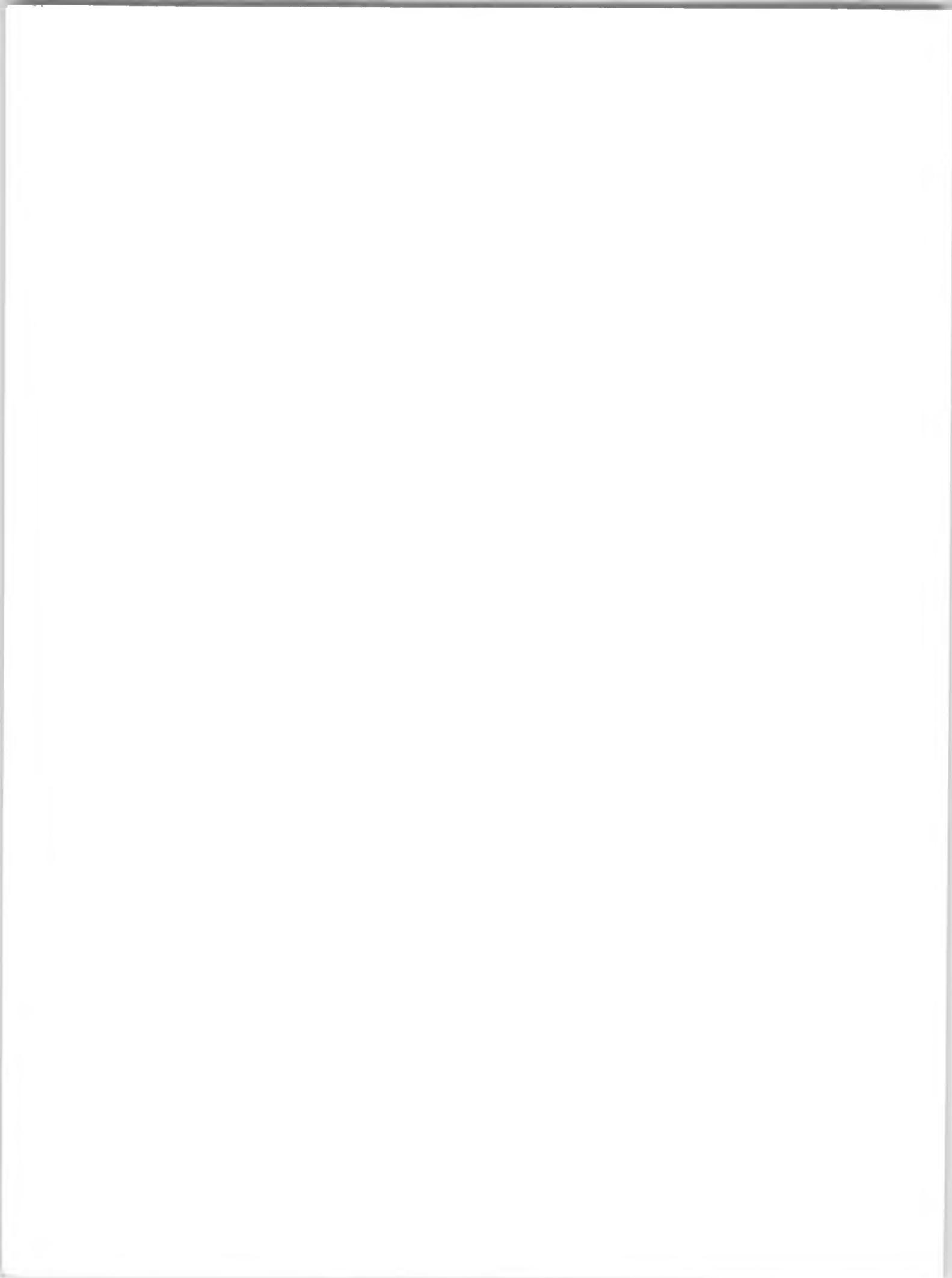
### Intermediate Clutch Accumulator (Refer to Figures 7A-54B and 7A-55B)

1. Install intermediate clutch accumulator piston assembly.

2. Install intermediate clutch accumulator spring.

3. Install new "O" ring seal in groove in case before installing cover.

4. Install intermediate slutch accumulator cover and retaining ring using tool J-23069.



## SECTION 7A

# AUTOMATIC TRANSMISSION

## TURBO HYDRA-MATIC 400 TRANSMISSION

## INDEX

Transmission Disassembly and Reassembly .....	7A- 1	Output Shaft, Rear Internal Gear, Sun Gear and Shaft.....	7A-40
Disassembly of Major Units.....	7A- 1	Sun Gear Shaft Bushing-Front.....	7A-40
Governor, Speedometer Driven Gear, Pan, Filter and Intake Pipe.....	7A- 1	Sun Gear Shaft Bushing-Rear .....	7A-40
Control Valve Assembly, Solenoid Connector, Governor Pipes and Detent Spring.....	7A- 3	Main Shaft Inspection.....	7A-40
Rear Servo, Valve Body Spacer, Gasket and Front Servo .....	7A- 4	Front and Rear Bands Inspection.....	7A-40
Rear Band Apply Pin Selection .....	7A- 5	Case Extension .....	7A-40
Manual Linkage .....	7A- 7	Modulator and Valve.....	7A-41
Rear Oil Seal and Case Extension .....	7A- 9	Manual and Parking Linkage Inspection .....	7A-41
Front Unit End Play Checking Procedure.....	7A- 9	Case Assembly Inspection .....	7A-42
Oil Pump and Internal Case Components.....	7A-10	Case Assembly Bushing .....	7A-42
Rear End Play Checking Procedure .....	7A-11	Converter Inspection.....	7A-42
Gear Unit Assembly .....	7A-13	Converter End Clearance Check .....	7A-44
Speedometer Drive Gear.....	7A-15	Assembly of Rear Unit .....	7A-44
Governor Assembly .....	7A-16	Case Modification-Corvette .....	7A-46
Driven Gear Replacement .....	7A-17	Assembly of Units to Transmission Case .....	7A-47
Front Servo Parts Inspection .....	7A-18	Install Manual Linkage.....	7A-49
Rear Servo Parts Service .....	7A-18	Rear Extension Assembly .....	7A-51
Control Valve Service .....	7A-19	Check Balls, Front Servo, Spacer and Solenoid.....	7A-51
Oil Pump Service .....	7A-22	Rear Servo Assembly.....	7A-53
Forward Clutch Service.....	7A-24	Control Valve Assembly and Governor Pipes.....	7A-54
Direct Clutch and Intermediate Roller Service.....	7A-29	Filter and Intake Pipe.....	7A-55
Center Support Service .....	7A-34	Modulator Valve and Valve and Vacuum Modulator .....	7A-55
Reaction Carrier, Roller Clutch and Output Carrier Assembly.....	7A-38	Governor.....	7A-55
Pinion Replacement .....	7A-39	Speedometer Driven Gear .....	7A-55
		Converter Assembly-Installation .....	7A-56
		Special Tools .....	7A-57

## DISASSEMBLY OF MAJOR UNITS

1. With transmission in cradle on portable jack, remove converter assembly by pulling straight out.

**NOTE:** Converter contains a large amount of oil.

2. Install holding Fixture J-8763-01 on transmission so that modulator assembly will be located on side of holding fixture nearest bench (Fig 7A-2C).

**NOTE:** Do not over-torque holding screw. This will bind center support.

3. Install fixture and transmission into holding Tool Base J-3289-14 with bottom pan facing up (Fig. 7A-2C).

4. Remove modulator assembly attaching screw and retainer (Fig. 7A-3C).

5. Remove vacuum modulator assembly and "O" ring seal from case (Fig. 7A-4C). Discard "O" ring.

6. Remove modulator valve from transmission case (Fig. 7A-4C).

### Removal of Governor, Speedometer Driven Gear, Pan, Filter and Intake Pipe

1. Remove attaching screws, governor cover and gasket (Fig. 7A-5C). Discard gasket.

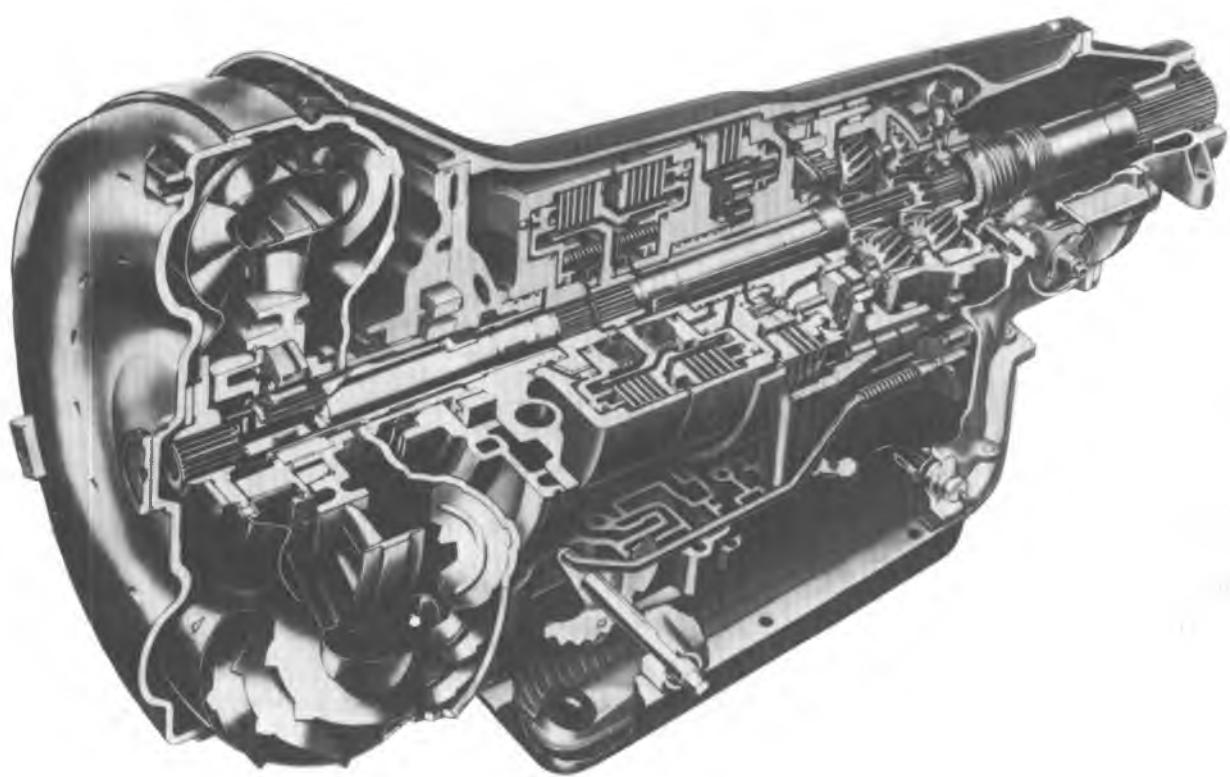


Fig. 7A-1C-Side Cross Section-Typical

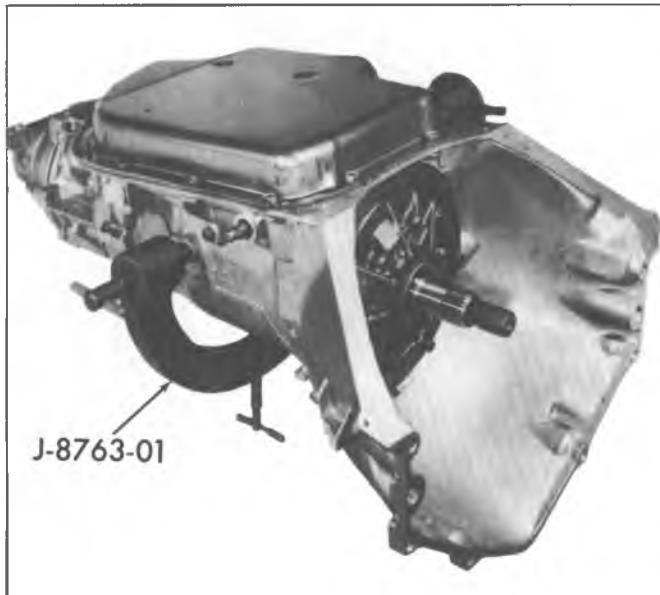


Fig. 7A-2C—Transmission in Holding Fixture

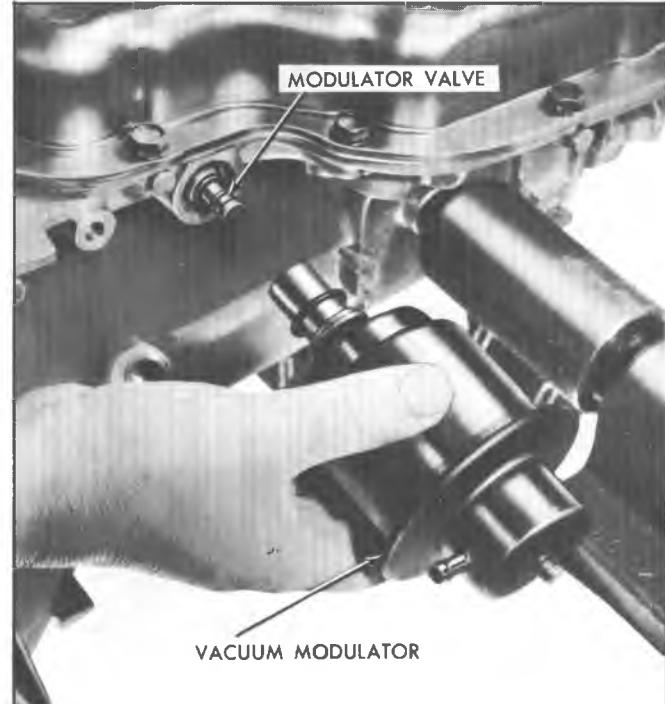


Fig. 7A-4C—Removing Vacuum Modulator and Valve

2. Withdraw governor assembly from case.
3. Remove speedometer driven gear attaching screw and retainer (Fig. 7A-6C).
4. Withdraw speedometer driven gear assembly from case.
5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket.

6. Remove the filter retainer bolt (Fig. 7A-7C).
7. Remove filter and intake pipe assembly from case (Fig. 7A-8C) and discard filter.
8. Remove intake pipe to case "O" ring seal from intake pipe or case and discard.

**Removal of Control Valve Assembly,  
Solenoid Connector, Governor Pipes, Governor  
Screen Assembly, and Detent Spring Assembly**

1. Remove control valve body attaching screws and detent roller and spring assembly (Fig. 7A-9C).



Fig. 7A-3C—Removing Modulator Retainer



Fig. 7A-5C—Removing Governor Cover Attaching Screws



Fig. 7A-6C--Removing Speedometer Driven Gear Retainer

**NOTE:** Do not remove solenoid attaching screws.

**CAUTION:** If transmission is in the vehicle, the front servo parts may drop out as the control valve assembly is removed.

2. Remove control valve assembly and governor pipes (Fig. 7A-10C).

**CAUTION:** Do not drop manual valve.

3. Remove governor screen assembly from governor feed pipe hole in the case or from end of governor feed pipe (Fig.

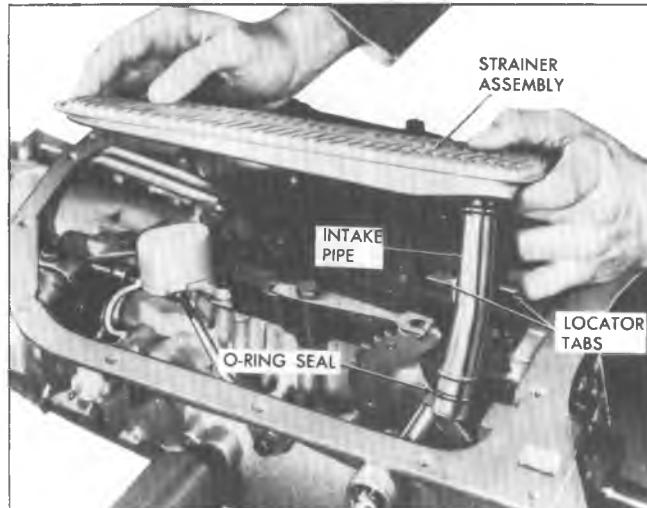


Fig. 7A-8C--Removing Filter Assembly and "O" Ring

7A-11C). Clean governor screen in clean solvent and air dry.

4. Remove governor pipes from control valve assembly.

5. Disconnect solenoid lead wire from connector terminal (Fig. 7A-12C).

### Removal of Rear Servo, Valve Body Spacer, Gasket and Front Servo

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (Fig. 7A-13C).

2. Remove rear servo assembly from case (Fig. 7A-14C).

3. Remove rear servo accumulator spring.

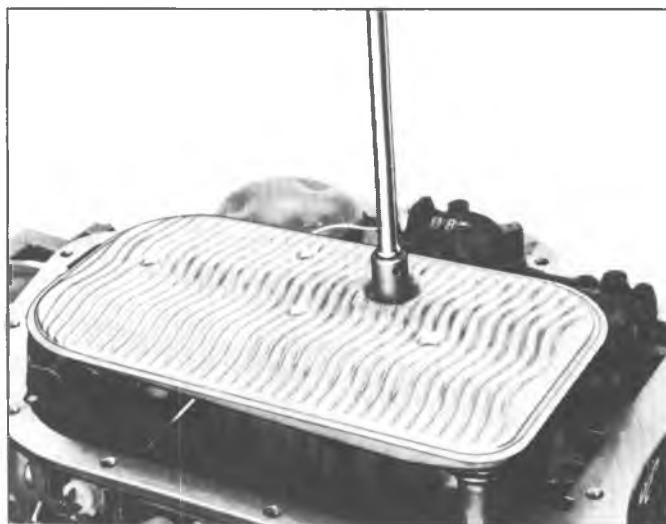


Fig. 7A-7C--Removing Filter Retainer Bolt

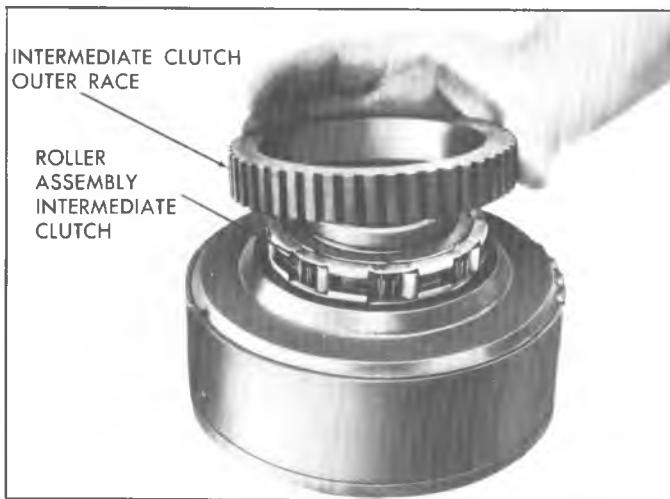


Fig. 7A-9C--Removing Detent Roller and Spring Assembly

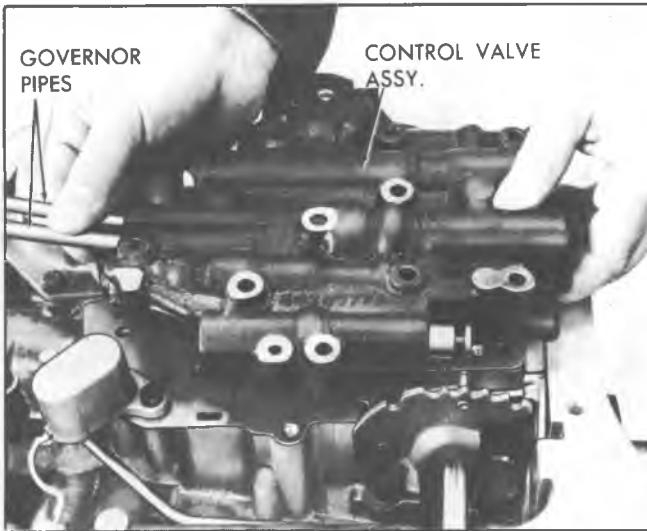


Fig. 7A-10C--Removing Control Valve Assembly and Governor Pipes from Case

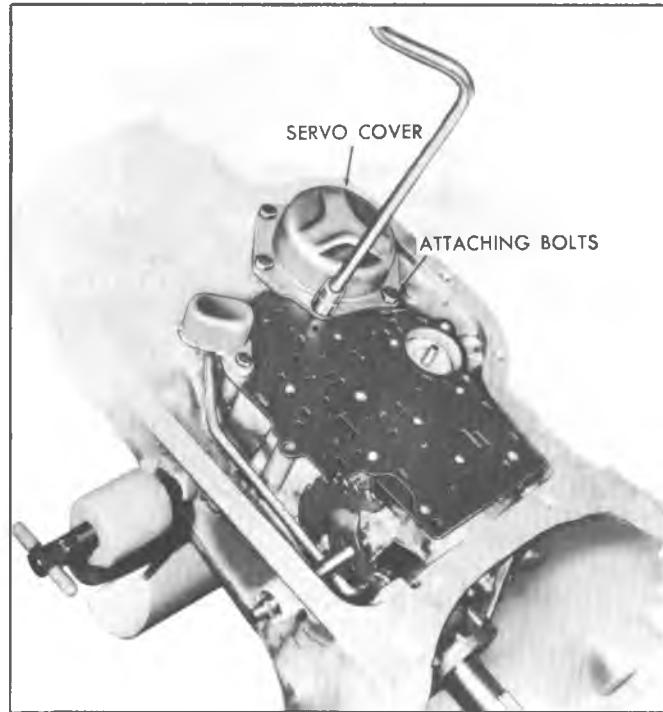


Fig. 7A-13C--Removing Rear Servo Cover Attaching Bolts

4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7A-15C).

#### Rear Band Apply Pin Selection (All Models Except CB and CL)

a. Attach band apply pin selection Gauge J-21370-5 and J-21370-6 to transmission case with attaching screws checking to make certain the gauge pin does not bind in servo pin hole (Fig. 7A-15C).

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

**NOTE:** Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two or three rings.

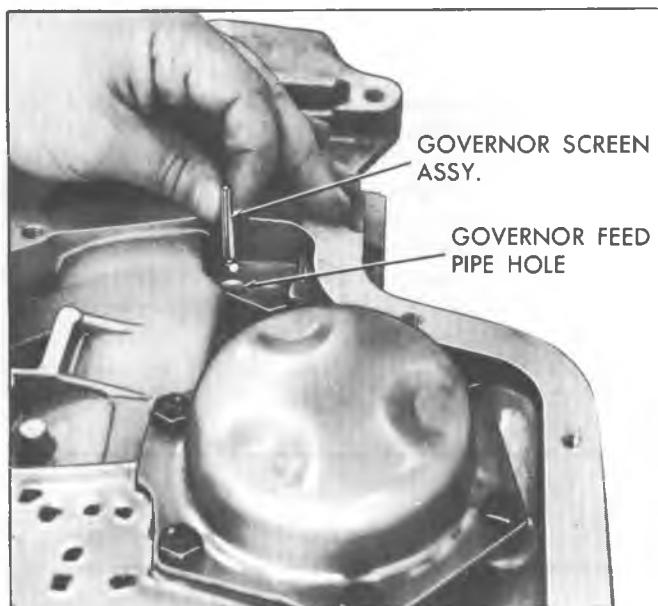


Fig. 7A-11C--Removing Governor Screen Assembly



Fig. 7A-12C--Disconnecting Detent Solenoid Wire



Fig. 7A-14C--Removing Rear Servo Assembly

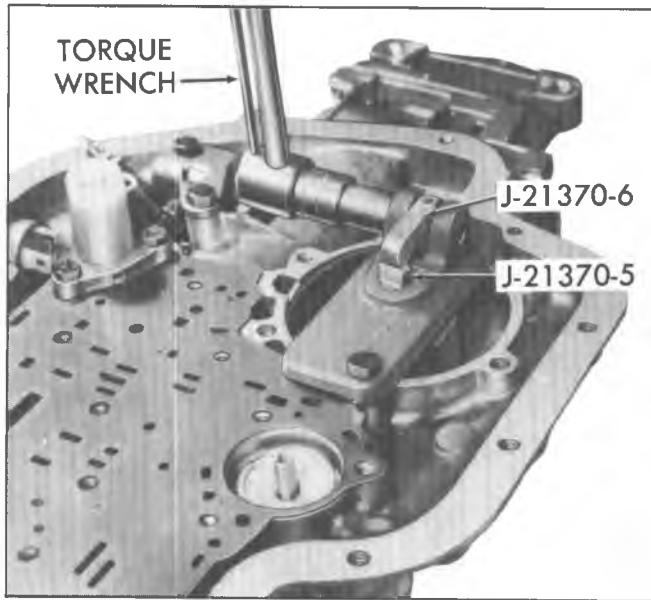


Fig. 7A-15C--Checking Rear Band Apply Pin, Except Models CB and CL

- c. If both steps of J-21370-5 are below the gauge surface, the long pin, identified by 3 rings, should be used.
- d. If the gauge surface is between the steps, the medium pin, identified by 2 rings, should be used.
- e. If both steps are above the gauge surface, the short pin, identified by 1 ring, should be used.

#### Rear Band Apply Pin Selection (Models CB and CL)

**NOTE:** There are six selective pins identified as shown in Figure 7A-17C. Selecting proper pin is equivalent to adjusting band.

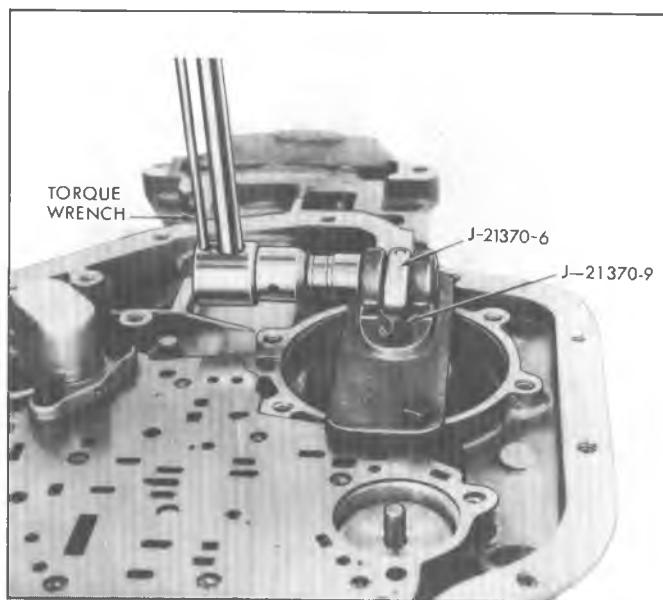


Fig. 7A-16C--Checking Rear Band Apply Pin, Models CB and CL

- a. Attach band apply pin selection gauge (J-21370-9 and J-21370-6), to transmission case (lever pivot pin to rear) with rear servo cover attaching screws.
- b. Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 foot-pounds and recheck pin to make certain it does not bind.
- c. Apply 25 foot-pounds torque to the lever on Tool J-21370-6 (Fig. 7A-16C). Selection of the proper rear band apply pin is determined by the relation of the flat on Tool J-21370-9 to the flat machined area around the hole on Tool J-21370-6.

GAGING STEPS LOCATED ON THREE SIDES OF TOOL J-21370-9	PART NO.	PIN IDENTIFICATION
C LONGEST PIN	THIS STEP: USE PIN NO. 8627195	
B	THIS STEP: SIDES B TO C USE PIN NO. 8627194	
A	THIS STEP: USE PIN NO. 8624141	
LOWER STEP SHORTEST PIN	THIS STEP: SIDES A TO B USE PIN NO. 8627193	
	THIS STEP: USE PIN NO. 8624140	
	LOWER STEP: USE PIN NO. 8627192	

Note: The Identification Rings are .030" and .100" wide.

Fig. 7A-17C--Rear Band Apply Pin Identification



Fig. 7A-18C--Removing Detent Solenoid and Gasket

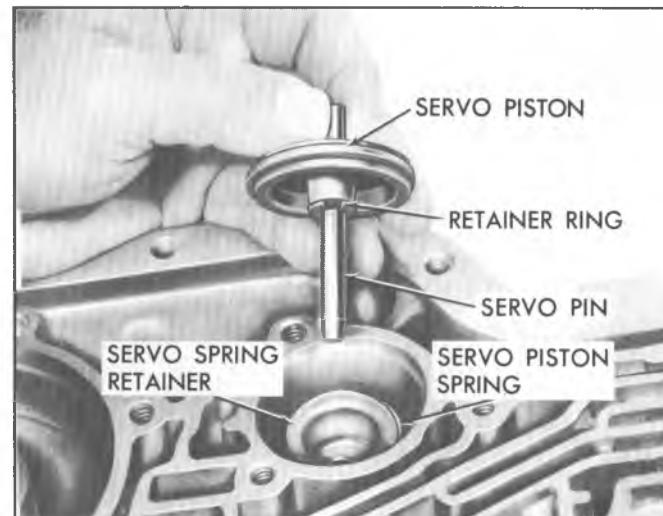


Fig. 7A-20C--Removing Front Servo Piston, Retainer Ring, and Pin

d. Before removing gauging tool make note of the proper band apply pin to be used during assembly of the transmission as determined by the six selective pins identified as shown in Fig. 7A-17C.

**NOTE:** If the transmission is in the vehicle, be careful when the detent solenoid is removed as it prevents the spacer plate and gasket and check balls from dropping down.

5. Remove detent solenoid attaching screws, detent solenoid and gasket (Fig. 7A-18C).
6. Withdraw electrical connector and "O" ring seal (Fig. 7A-19C).
7. Remove control valve assembly spacer plate and gasket.
8. Remove six (6) check balls from cored passages in transmission case.

**NOTE:** Mark location of balls for aid in reassembly.

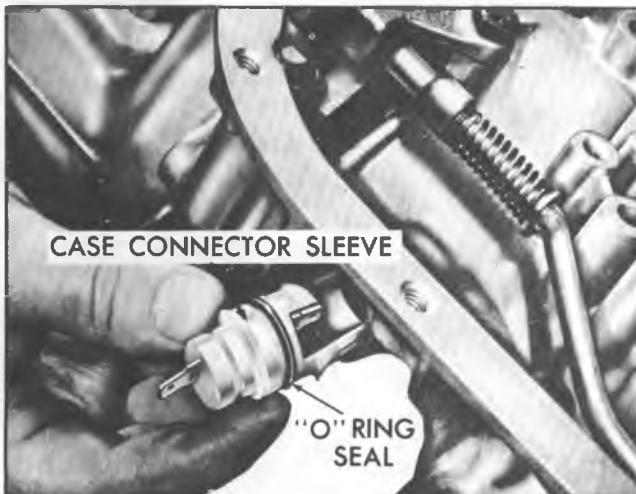


Fig. 7A-19C--Removing Electrical Connector and "O" Ring Seal

9. Remove front servo piston, retainer ring, washer, pin, spring retainer and spring from transmission case (Fig. 7A-20C).

### Remove Manual Linkage

**NOTE:** If necessary, remove manual linkage as follows:

1. Unthread jam nut holding detent lever to manual shaft.
2. Remove manual shaft retaining pin from case (Fig. 7A-21C).
3. Remove manual shaft and jam nut from case (Fig. 7A-22C). Do not lose jam nut as it becomes free from manual shaft.
4. Remove parking actuator rod and detent lever assembly.

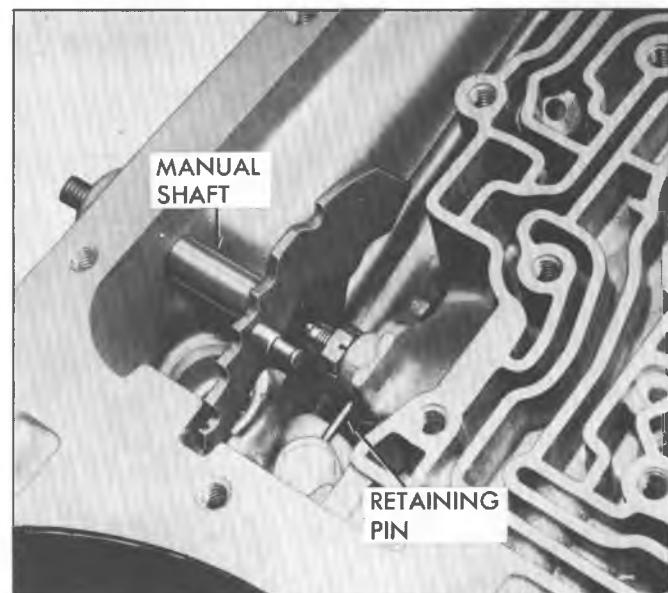


Fig. 7A-21C--Removing Manual Shaft Retaining Pin from Case

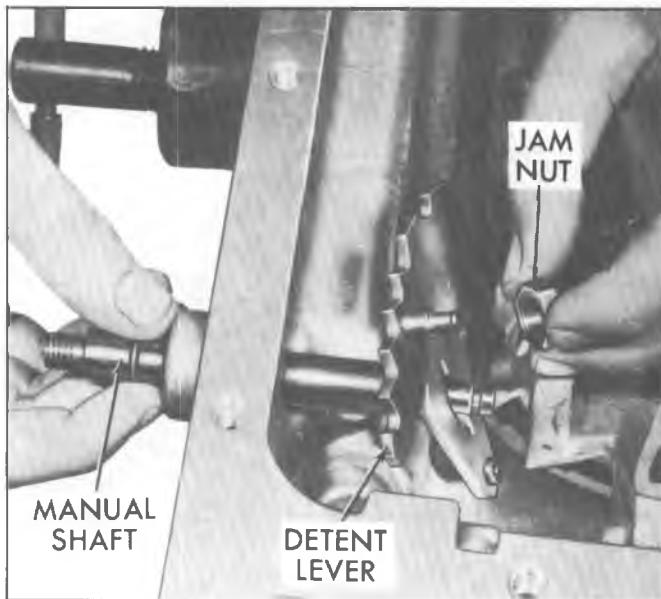


Fig. 7A-22C--Removing Detent Lever and Jam Nut from Manual Shaft

5. Remove attaching screws and parking bracket (Fig. 7A-23C).
6. Remove parking pawl return spring (Fig. 7A-24C).

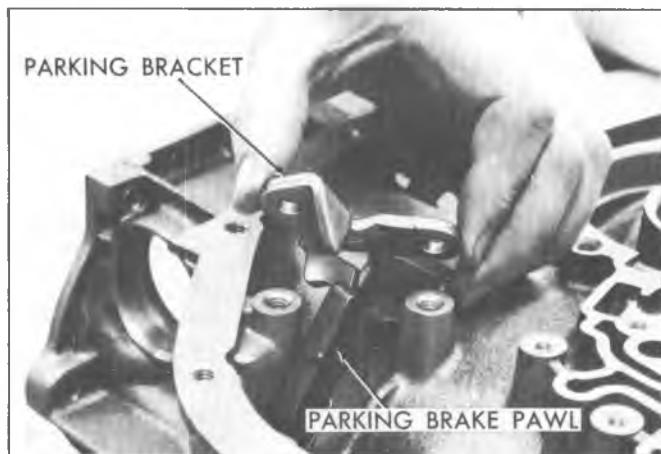


Fig. 7A-23C--Removing Parking Bracket



Fig. 7A-24C--Removing Parking Pawl Return Spring



Fig. 7A-25C--Removing Parking Shaft Retaining Spring

**NOTE:** The following steps are to be completed only if 1 or more of the parts involved require replacement.

7. Remove parking pawl shaft retainer (Fig. 7A-25C).
8. Remove parking pawl shaft cup plug by inserting a screwdriver, between the parking pawl shaft and the case rib, and prying outwards (Fig. 7A-26C).
9. Remove parking pawl shaft and parking pawl (Fig. 7A-26C).

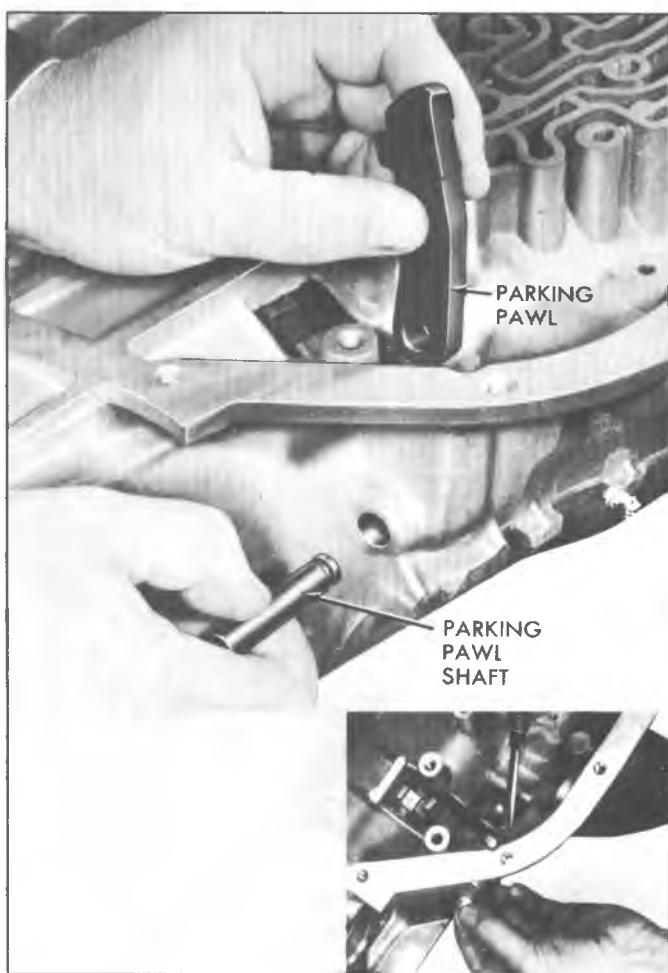


Fig. 7A-26C--Removing Parking Pawl, Shaft and Cup Plug

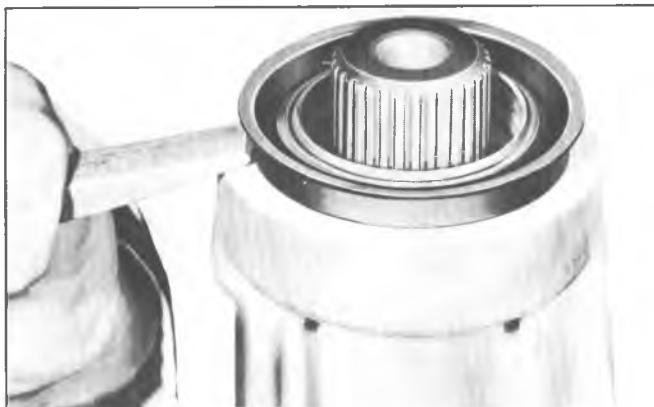


Fig. 7A-27C--Removing Rear Oil Seal from Case Extension

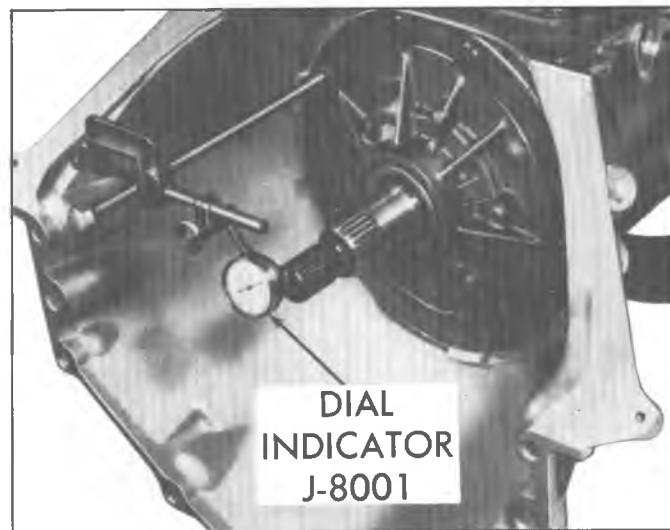


Fig. 7A-29C--Checking Front Unit End Play

### Removal of Rear Oil Seal and Case Extension

1. If necessary to replace, pry rear oil seal from case extension (Fig. 7A-27C).
2. Remove case extension to case attaching bolts.
3. Remove case extension to case gasket (Fig. 7A-28C).
4. Make front unit end play check as follows (Fig. 7A-29C):
  - a. Remove one front pump attaching bolt, and bolt washer. (See Fig. 7A-29C for location).
  - b. Install a 3/8"-16 threaded slide hammer bolt or J-9539, into bolt hole.

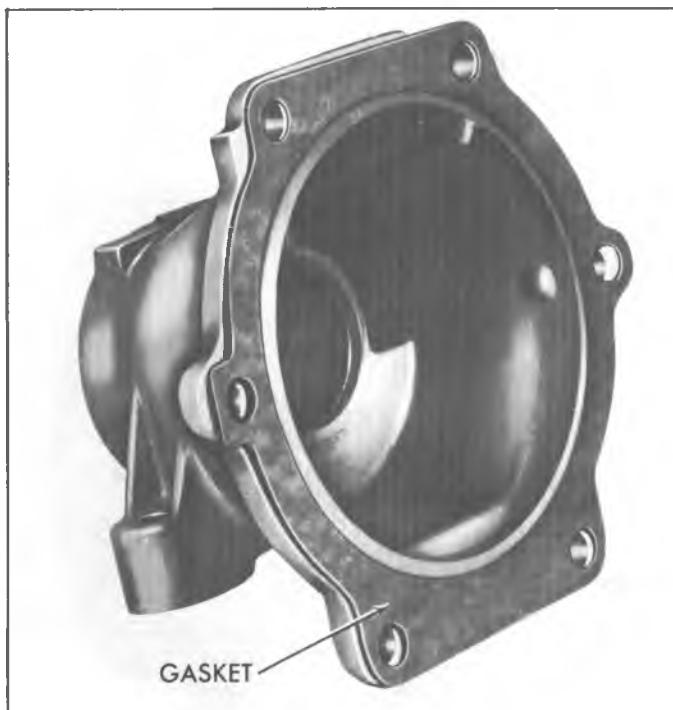


Fig. 7A-28C--Case Extension and Gasket

c. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

d. Push on turbine shaft rearward.

e. Push output shaft forward.

f. Set dial indicator to Zero.

g. Pull turbine shaft forward.

Read resulting travel or end play. Should be .003"-.024".

Selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart shown in Fig. 7A-30C.

**NOTE:** An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.

### FRONT END WASHER THICKNESS

Thickness	Color
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

Fig. 7A-30C--Front End Washer Selection Chart



Fig. 7A-31C--Removing Front Seal

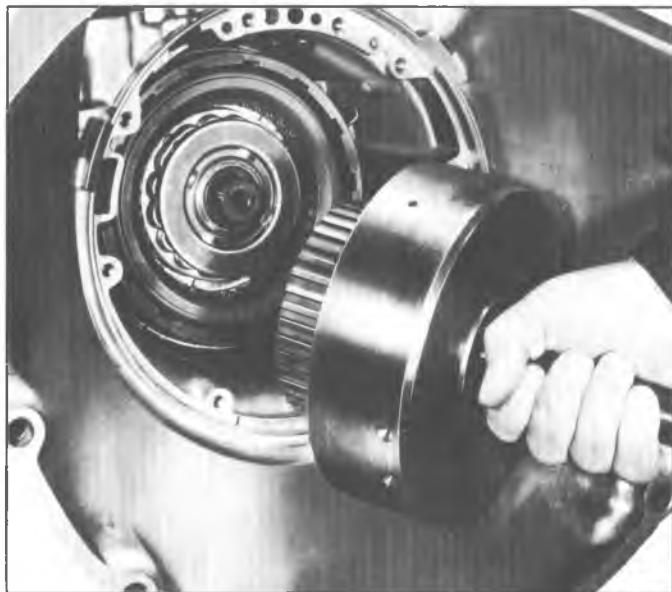


Fig. 7A-33C--Removing Forward Clutch Assembly and Turbine Shaft

## Oil Pump and Internal Case Components Removal

1. If necessary to replace, pry front seal from pump (Fig. 7A-31C).
2. Remove pump attaching bolts.
3. Install two 3/8"-16 threaded slide hammer bolts, J-9539 with weights J-6585-01, into bolt holes in pump body and remove pump assembly from case (Fig. 7A-32C). (See illustration for location of threaded holes.)



Fig. 7A-32C--Removing Pump Assembly

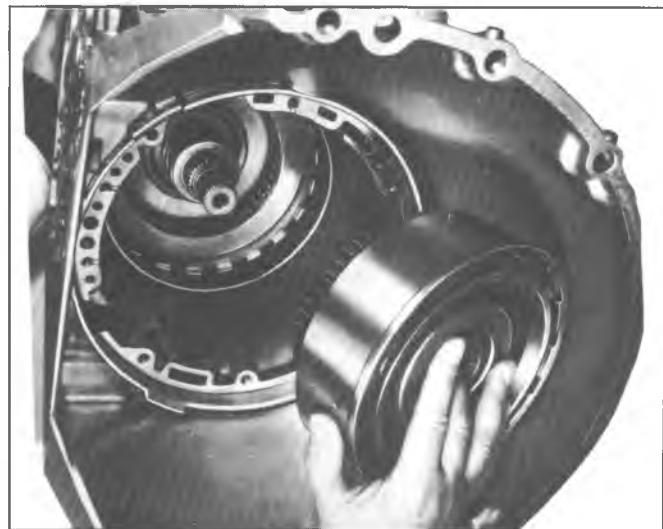


Fig. 7A-34C--Removing Direct Clutch Assembly

4. Remove and discard pump to case seal and gasket.
5. Remove forward clutch assembly and turbine shaft from transmission (Fig. 7A-33C).
6. Remove forward clutch hub to direct clutch housing thrust washer, if it did not come out with forward clutch housing assembly.
7. Remove direct clutch assembly (Fig. 7A-34C).
8. Remove front band assembly (Fig. 7A-35C).



Fig. 7A-35C--Removing Front Band

9. Remove sun gear shaft (Fig. 7A-36C).

#### Check Rear End Play as Follows (Fig. 7A-37C)

- Install J-9539 or a 3/8"-16 threaded bolt into an extension housing attaching bolt hole (Fig. 7A-37C).
- Mount a dial indicator on bolt and index with end of output shaft.
- Move output shaft in and out to read end play. End play should be from .007"-.019". Selective washer controlling this end play is a steel washer having 3 lugs that is located between output shaft thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specification, it can be selected from the chart

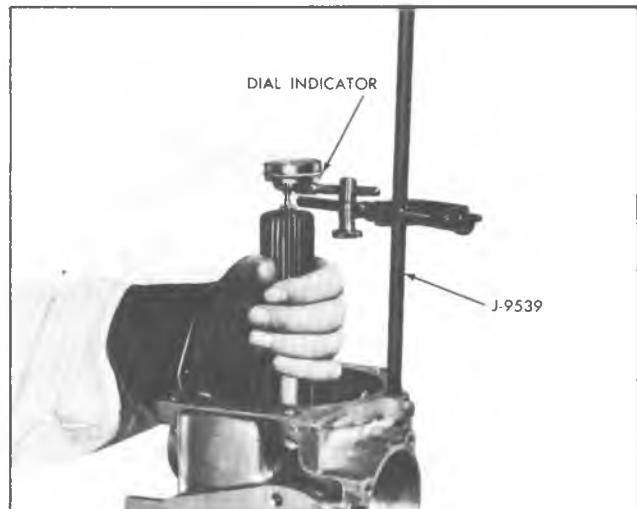


Fig. 7A-37C--Checking Rear Unit End Play

#### REAR END WASHER THICKNESS

Thickness	Identification	Notches and/or Numeral
.074 - .078	None	1
.082 - .086	1 Tab Side	2
.090 - .094	2 Tab Side	3
.098 - .102	1 Tab O.D.	4
.106 - .110	2 Tabs O.D..	5
.114 - .118	3 Tabs O.D.	6

Fig. 7A-38C--Rear End Washer Thickness Chart

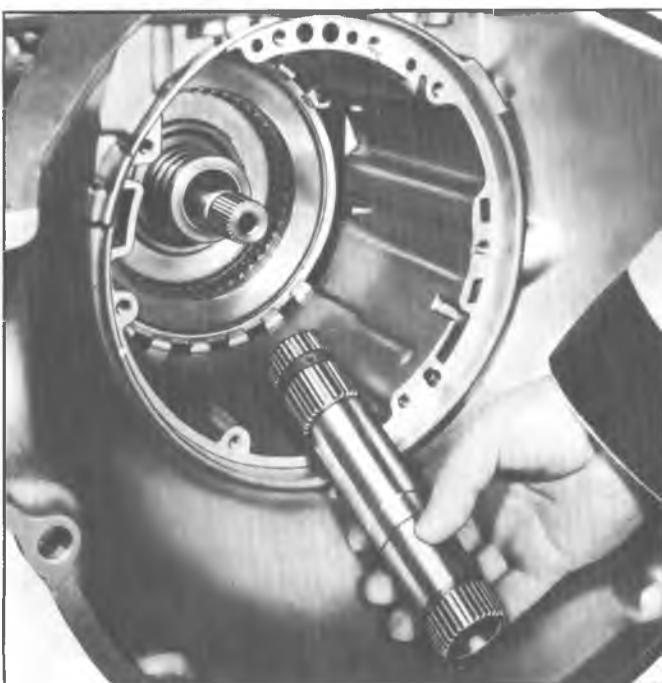


Fig. 7A-36C--Removing Sun Gear Shaft

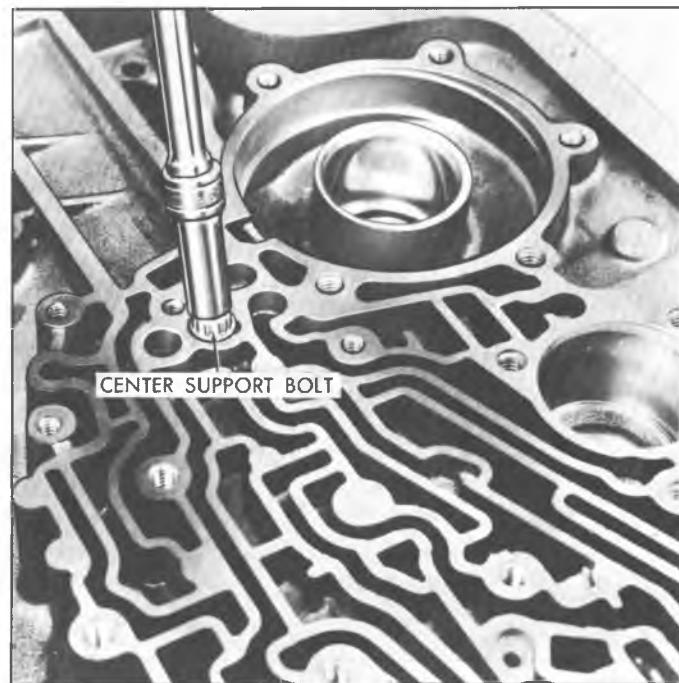


Fig. 7A-39C--Removing Center Support Bolt

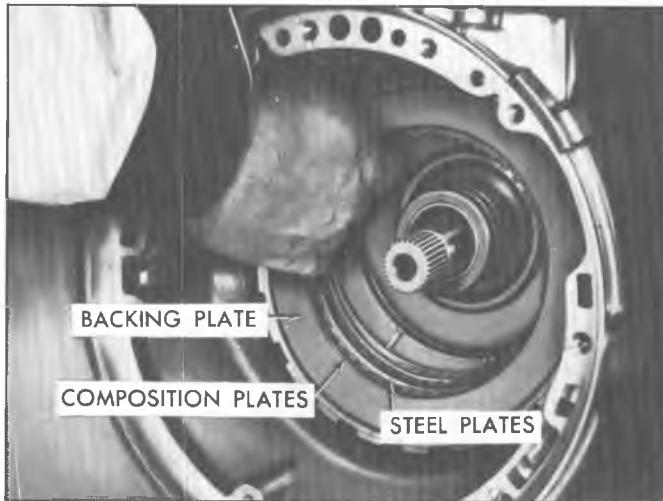


Fig. 7A-40C--Removing Intermediate Backing Plate and Clutch Plates

shown in Fig. 7A-38C.

10. Remove center support to case bolt (Fig. 7A-39C), using a 3/8" 12-point thin wall deep socket.

11. Remove intermediate clutch backing plate to case snap ring.

12. Remove intermediate clutch backing plate, as shown in Fig. 7A-40C.

13. Remove intermediate clutch plates.

a. (All except CB, CL and CS models) Remove three (3) composition, two (2) steel clutch plates and one waved steel plate.

b. (CB, CL and CS models) Remove three (3) composition, and three (3) steel clutch plates.

14. Remove center support to case retaining snap ring (Fig. 7A-41C).

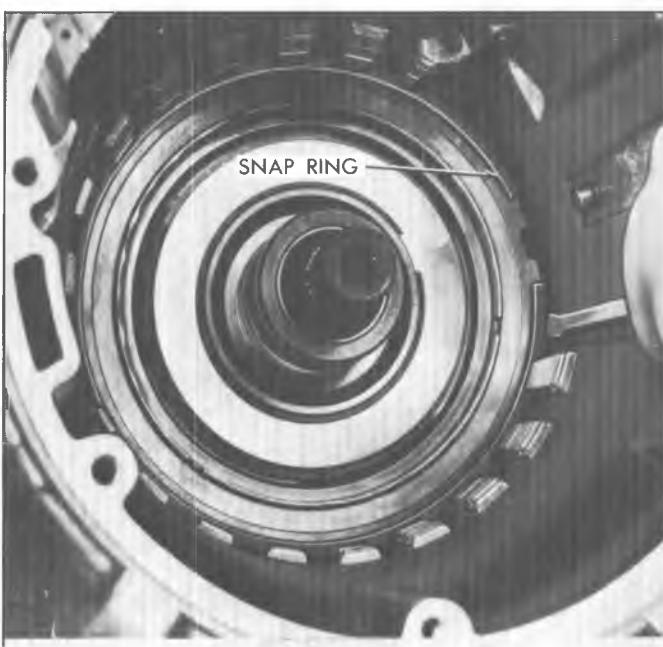


Fig. 7A-41C--Removing Center Support to Case Retaining Snap Ring

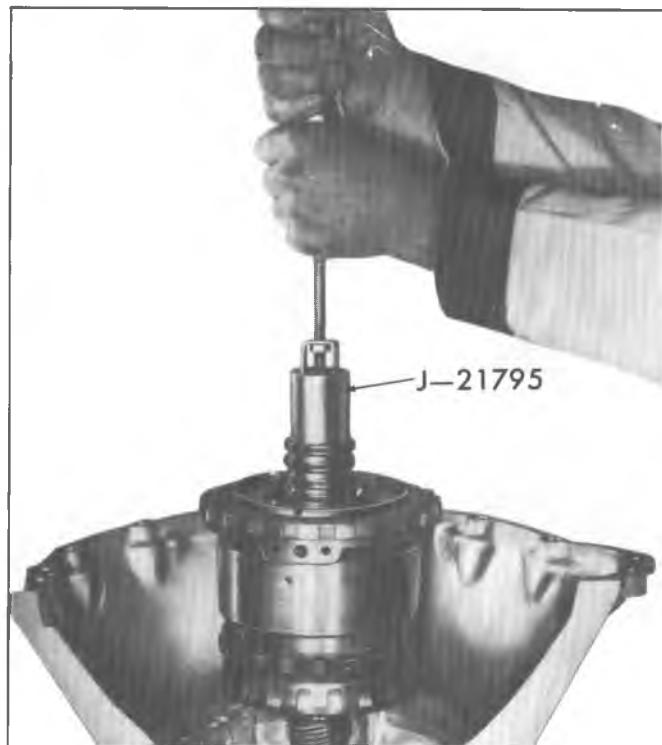


Fig. 7A-42C--Removing Center Support and Gear Unit from Case

15. Remove entire gear unit assembly by lifting with gear assembly installing and removing Holding Tool J-21795 with J-9539 slide hammer (Fig. 7A-42C).

16. Remove shaft to case thrust washer from rear of output shaft or inside case.

17. Place gear unit assembly, with output shaft facing down through hole in work bench.

18. Remove rear unit selective washer from transmission case (Fig. 7A-43C).



Fig. 7A-43C--Removing Selective Washer

Fig. 7A-43C--Removing Selective Washer



Fig. 7A-44C--Removing Center Support to Case Spacer



Fig. 7A-46C--Removing Center Support Assembly

19. Remove center support to case spacer (Fig. 7A-44C).
20. Remove rear band assembly (Fig. 7A-45C).

#### Disassembly of Gear Unit Assembly

**NOTE:** CL Model (spur gears) disassembly procedure is identical as illustrated.

1. Remove center support assembly (Fig. 7A-46C).

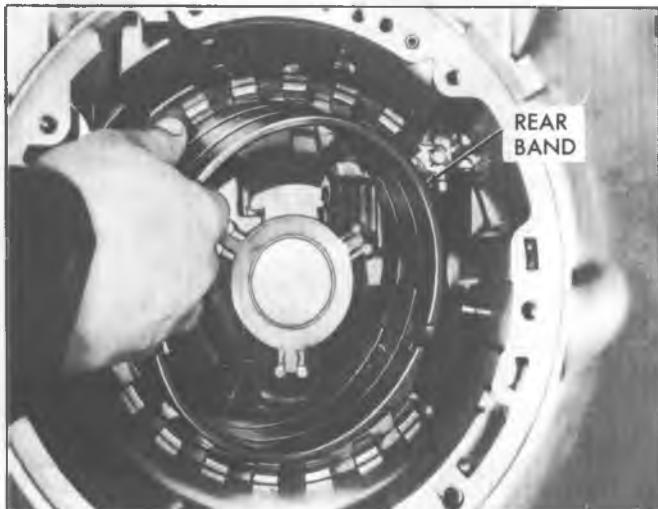


Fig. 7A-45C--Removing Rear Band

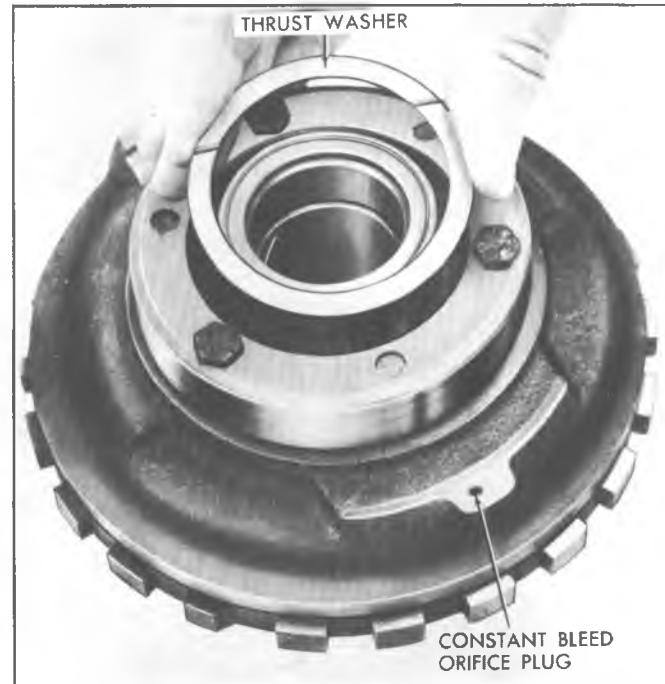


Fig. 7A-47C--Removing Center Support Thrust Washer

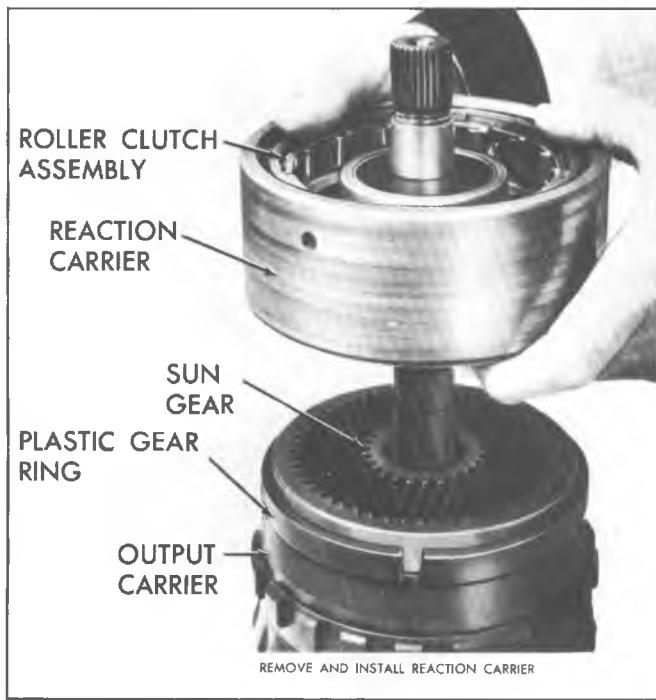


Fig. 7A-48C--Removing Reaction Carrier and Roller Clutch from Output Carrier

4. Remove reaction carrier and roller clutch assembly (Fig. 7A-48C). Lift roller clutch assembly out of carrier.
5. Remove front internal gear ring from output carrier assembly.
6. Remove sun gear (Fig. 7A-49C).
7. Remove reaction carrier to output carrier thrust washer.
8. Turn assembly over and place main shaft through hole in work bench.
9. Remove "O" ring from output shaft of models that use an "O" ring.



Fig. 7A-49C--Removing Sun Gear

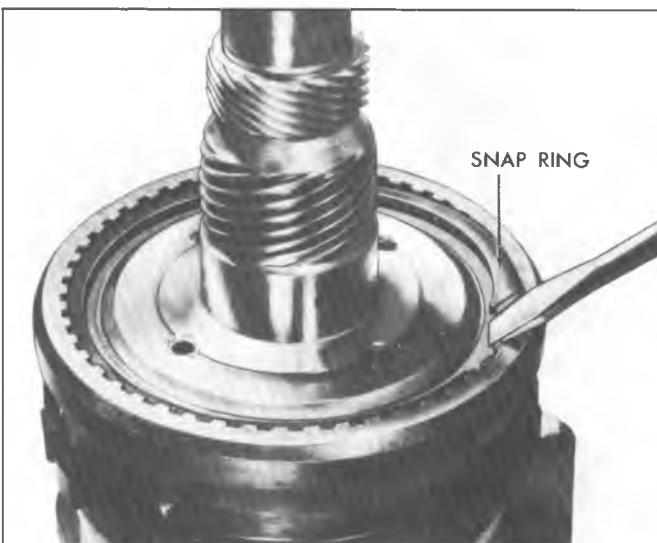


Fig. 7A-50C--Removing Output Shaft to Carrier Snap Ring

10. Remove output shaft to output carrier snap ring (Fig. 7A-50C).
  11. Remove output shaft.
  12. Remove output shaft to rear internal gear thrust bearing and two (2) races.
  13. Remove rear internal gear and mainshaft (Fig. 7A-51C).
- NOTE:** Do not drop bearings.
14. Remove rear internal gear to sun gear thrust bearing and two (2) races.
  15. If necessary, remove rear internal gear to mainshaft snap ring, to remove mainshaft (Fig. 7A-52C).



Fig. 7A-51C--Removing Rear Internal Gear and Mainshaft

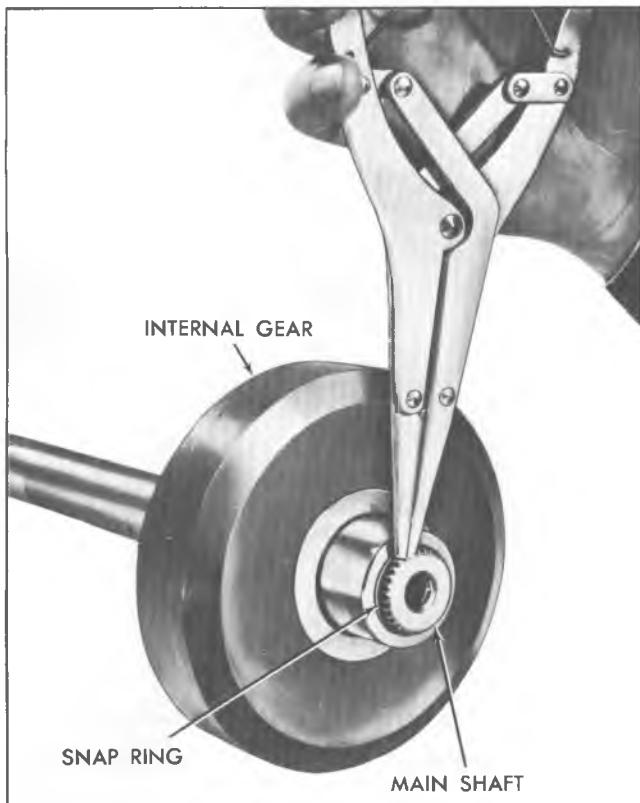


Fig. 7A-52C--Removing Rear Internal Gear to Main Shaft Snap Ring

### Speedometer Drive Gear Replacement

If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

#### Nylon Speedometer Drive Gear

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 7A-53C).
2. To install, place clip (square end toward flange of shaft) into hole in output shaft (Fig. 7A-54C). Align slot in

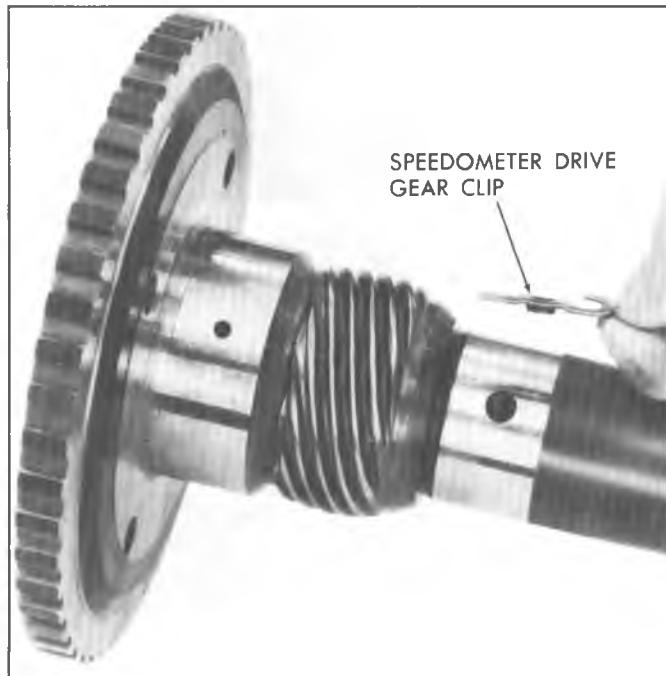


Fig. 7A-54C--Installing Speedometer Drive Gear Clip

speedometer drive gear with clip and install gear.

**NOTE:** The nylon speedometer drive gear is installed at the factory only. ALL SERVICE REPLACEMENT SPEEDOMETER DRIVE GEARS ARE STEEL.

When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and refer to step "2" of steel speedometer drive gear installation.

#### Steel Speedometer Drive Gear

1. Install speedometer drive gear remover Tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on output shaft, and remove speedometer drive gear (fig. 7A-55C).

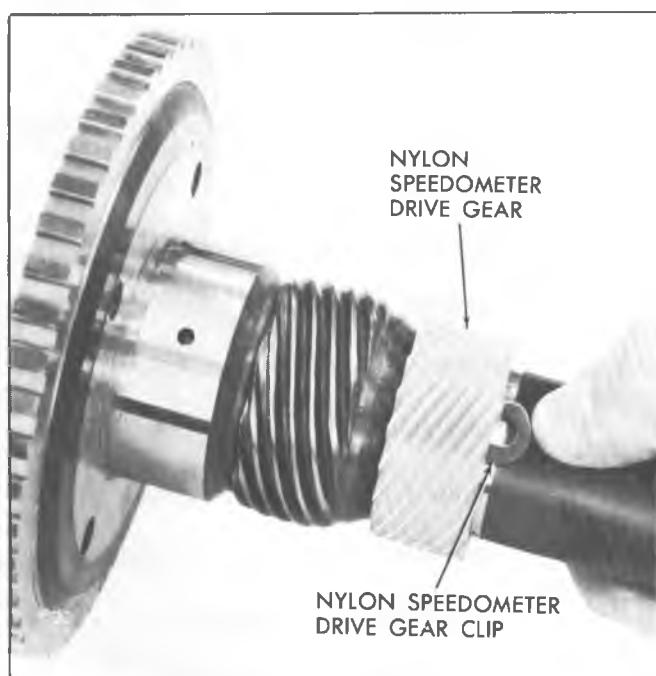


Fig. 7A-53C--Removing Nylon Speedometer Drive Gear

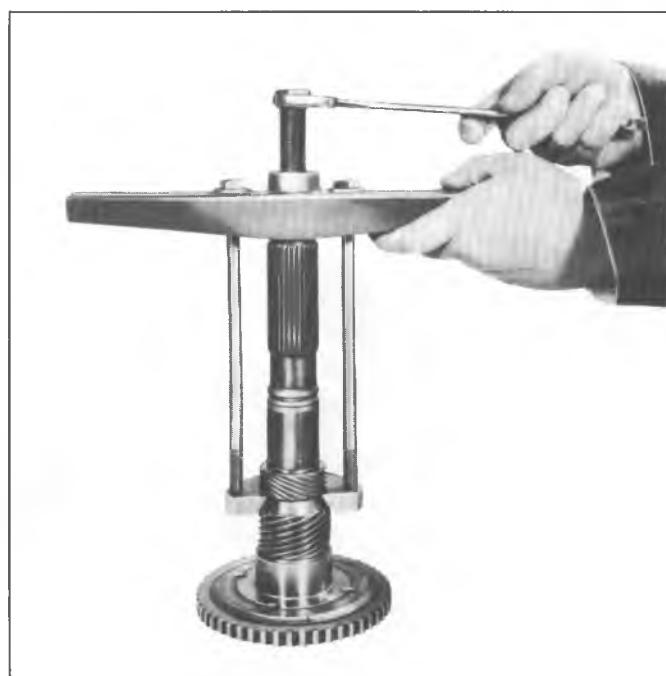


Fig. 7A-55C--Removing Steel Speedometer Drive Gear

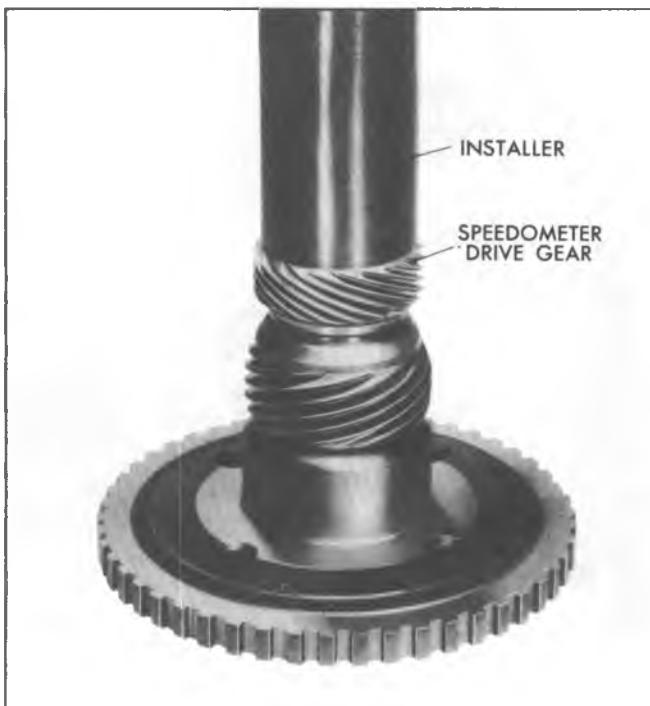


Fig. 7A-56C--Installing Steel Speedometer Drive Gear

2. Install new steel speedometer drive gear and drive to location (5-43/64") below end of output shaft for all models except CA, CG and CR) (11-15/64" below end of output shaft for model CA) (11-29/64 below end of output shaft for models CG and CR) using J-5590 (Fig. 7A-56C).

## GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary

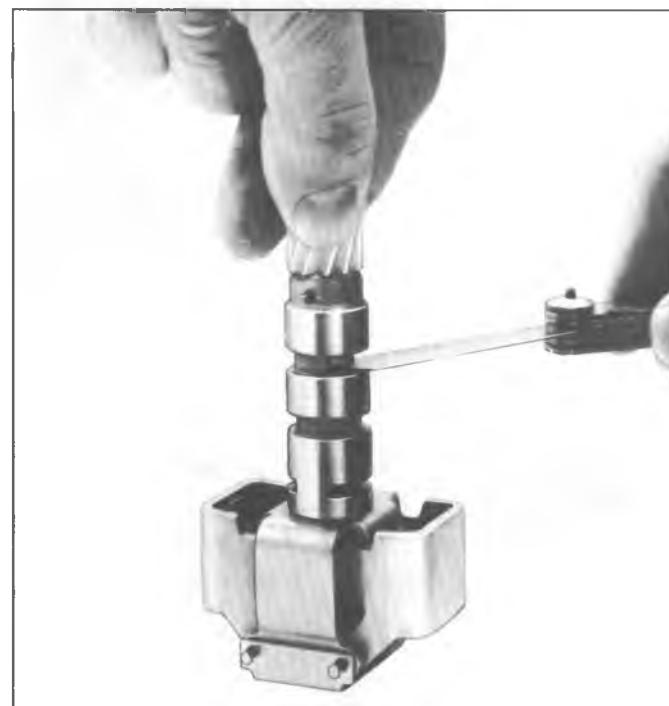


Fig. 7A-58C--Checking Valve Opening With Weights Outward

due to foreign material causing improper operation. In such cases, proceed as follows:

### Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified. (Fig. 7A-57C).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform following inspections and replace governor driven gear, if necessary.

### Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve operating at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward (Fig. 7A-58C).

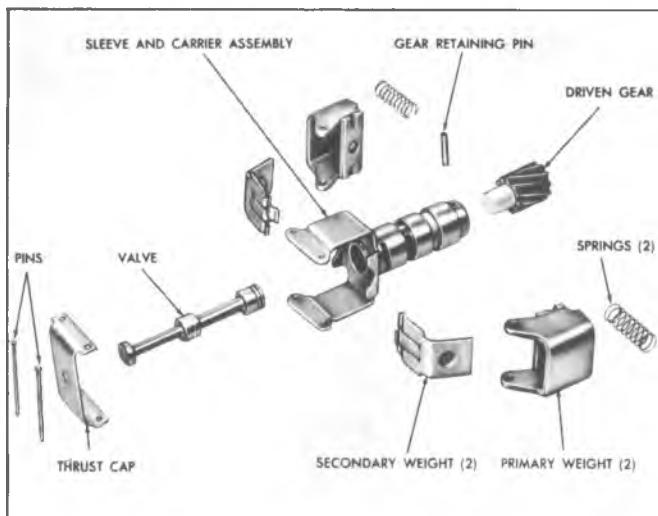


Fig. 7A-57C--Governor--Exploded



Fig. 7A-59C--Checking Valve Opening With Weight Inward

11. Check valve opening at exhaust (.020" minimum) with a feeler gauge, holding governor as shown with governor weights completely inward (Fig. 7A-59C).

#### Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

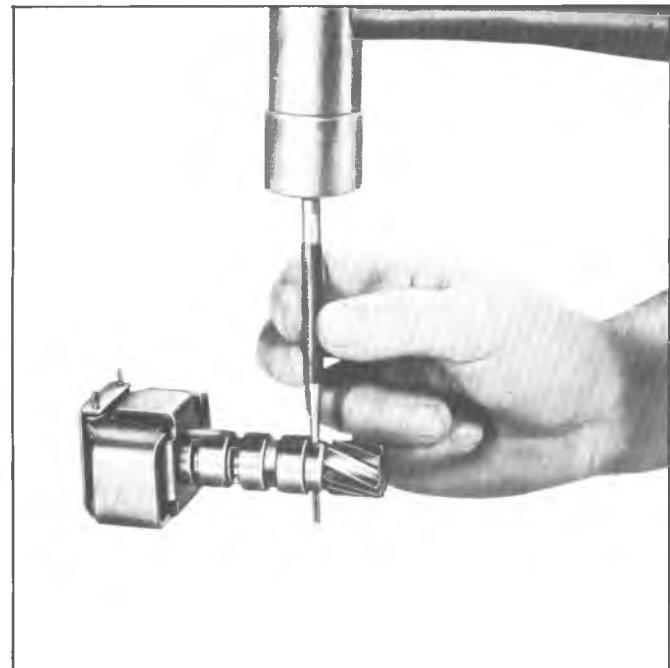


Fig. 7A-60C--Removing Governor Gear Retaining Pin

1. Drive out governor gear retaining split pin using small punch (Fig. 7A-60C).
2. Support governor on 7/64 inch plates installed in exhaust slots of governor sleeve, place in arbor press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 7/64 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated.

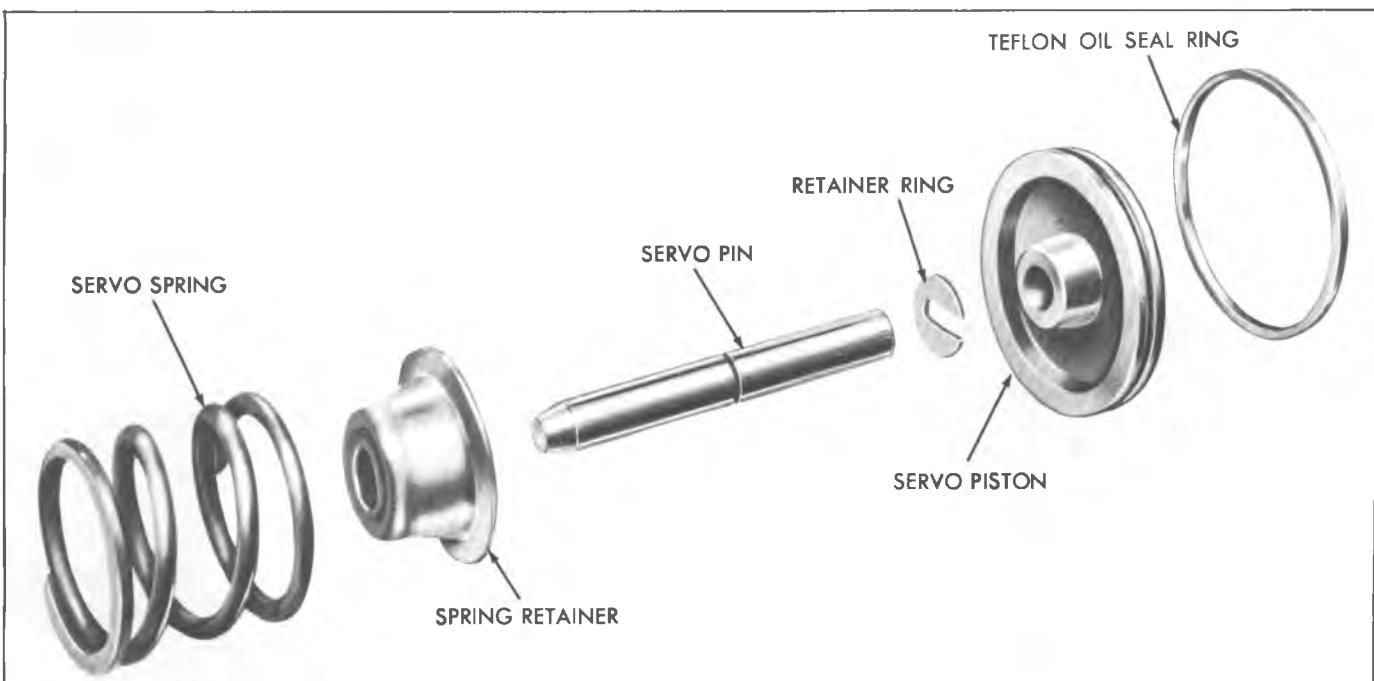


Fig. 7A-61C--Front Servo Assembly--Exploded View

Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.

6. Install split retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

### Assembly

1. Install governor valve in bore of governor sleeve, large end first.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.
4. Check governor weight assemblies for free operation on pins.
5. Check governor valve for free movement in governor sleeve.

### Front Servo Parts Inspection

**NOTE:** See Fig. 7A-61C. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. For service, the oil seal ring is aluminum.

1. Inspect servo pin for damage.
2. Inspect piston and oil ring for damage.
3. Check fit of servo pin in piston and case bore.

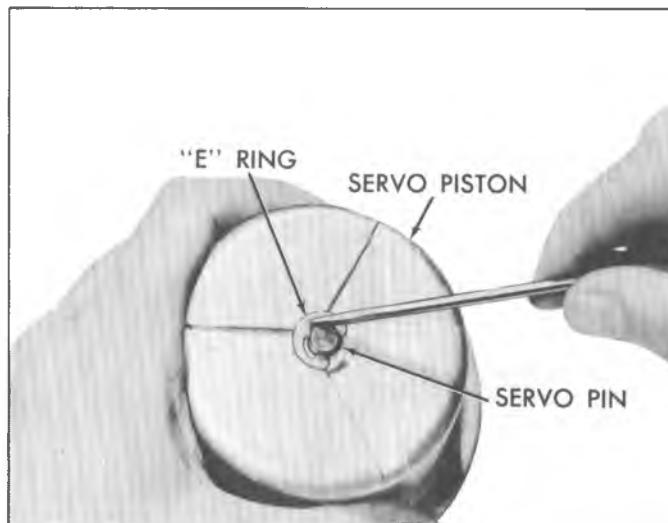


Fig. 7A-63C--Removing Retaining "E" Ring from Rear Servo Pin

### Rear Servo Assembly Disassembly

1. Remove rear accumulator piston from rear servo piston (Fig. 7A-62C-A).
2. Remove "E" ring retaining rear servo piston to servo pin (Fig. 7A-63C).
3. Remove rear servo piston and seal from servo pin (Fig. 7A-64C). (Exploded view.)
4. Remove washer, spring, and spring retainer.

### Inspection

**NOTE:** See Fig. 7A-64C. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement. If the teflon inner oil seal ring (small diameter) requires replacement, for service, use the aluminum oil seal ring.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring. If this ring requires replacement use only the teflon oil seal ring.

1. Inspect freedom of accumulator rings in piston grooves.
2. Inspect fit of servo pin in servo piston in case bore.
3. Inspect servo pin for scores or cracks.
4. Inspect accumulator and servo pistons for scoring, cracks or porosity.

### Assembly

1. Install spring retainer cup side down, spring and washer on servo pin.
2. Install servo pin, retainer, spring and washer, into bore of servo piston and secure with "E" ring.
3. Install oil seal ring on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.



Fig. 7A-62C--Removing Rear Accumulator Piston from Rear Servo Piston

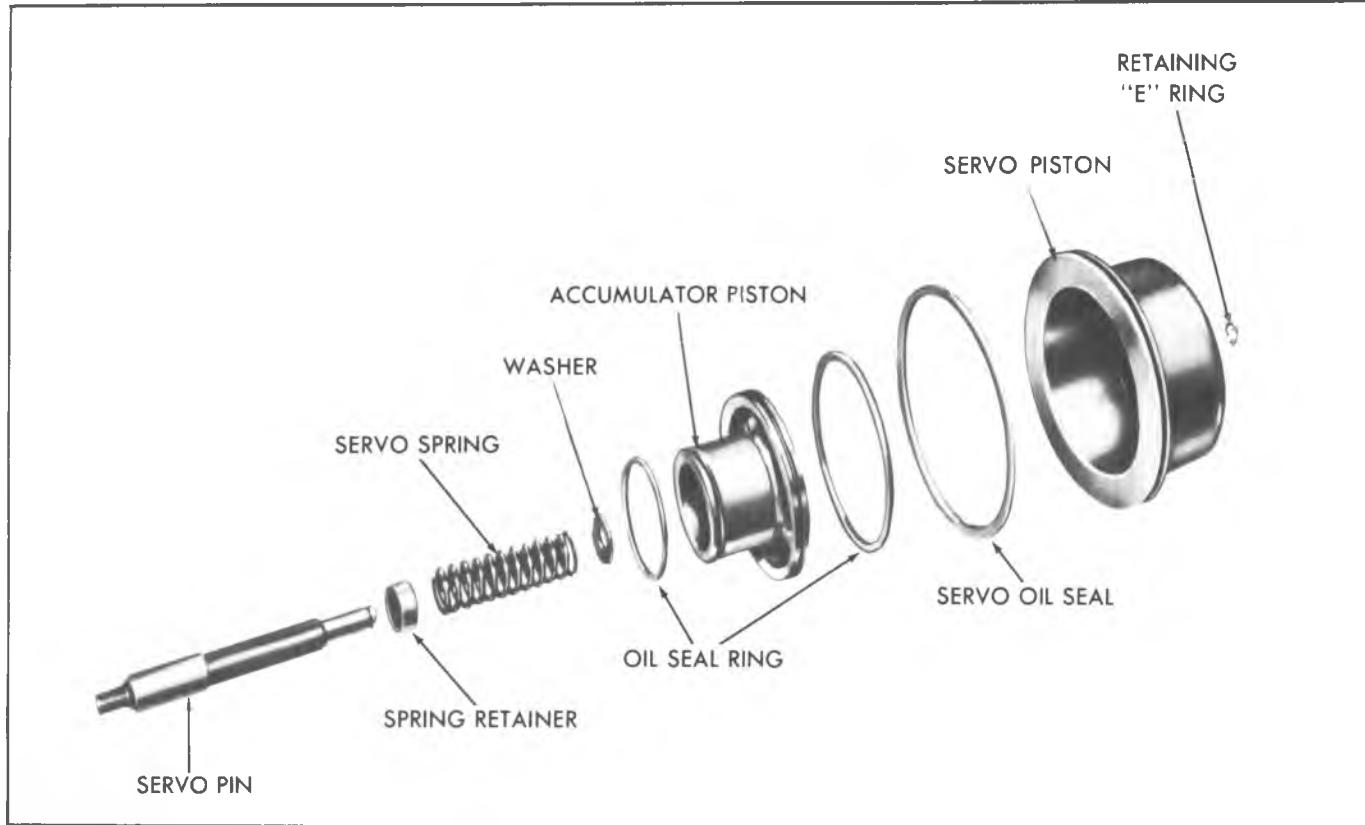


Fig. 7A-64C--Rear Servo and Accumulator Assembly--Exploded View

### CONTROL VALVE, DISASSEMBLY, INSPECTION AND RE-ASSEMBLY (Fig. 7A-67C)

#### Disassembly

1. Position control valve assembly with cored face up and accumulator pocket nearest operator.
2. Remove manual valve from upper bore.
3. Install Special Tools J-22269 and J-24675, on accumulator piston and remove retaining ring (Fig. 7A-65C).



Fig. 7A-65C--Installing Compressor Tool to Front Accumulator Piston

4. Remove front accumulator piston and spring (Fig. 7A-66C).

5. On the right side adjacent to the manual valve, remove the 1-2 valve train as follows:

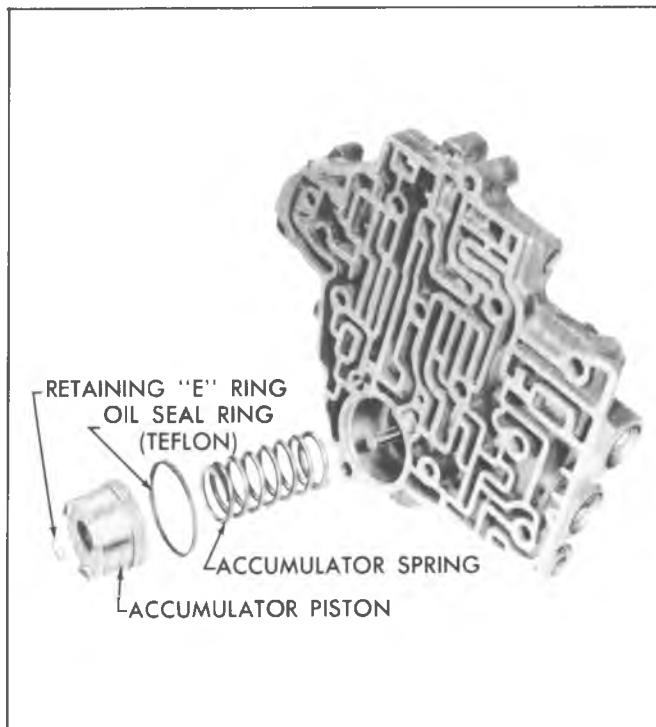


Fig. 7A-66C--Front Accumulator Assembly - Exploded View

- a. (Models CG, CJ and CP) Remove retaining pin, 1-2 modulator bushing, 1-2 valve spring, 1-2 modulator valve, and 1-2 shift valve.

- b. (All other models) Remove retaining pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 shift valve.

6. From next bore down, remove retaining pin, 2-3 shift valve spring, 2-3 modulator valve bushing, 2-3 modulator valve, 3-2 intermediate spring, and 2-3 shift valve.

7. From next bore down remove retaining pin, bore plug, spring, spacer, and 3-2 valve.

8. At other end of assembly, top bore, remove retaining pin and bore plug, detent valve, detent regulator valve, spring and spacer.

9. From the next bore down, remove the 1-2 accumulator valve train as follows:

- a. (Model CP) Remove the grooved retaining pin, bore

- plug, 1-2 accumulator valve and spring.

- b. (Models CB, CG, CJ, CL and CS) Remove the grooved retaining pin, bore plug, 1-2 accumulator valve.

- c. (Models CF, CM and CT) Remove the grooved retaining pin, bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve.

### **Inspection**

**NOTE:** See Fig. 7A-66C. Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the oil seal ring is cast iron.

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
  2. Inspect bushings for cracks, scratches or distortion.
  3. Inspect body for cracks, or scored bores.
  4. Check all springs for distortion or collapsed coils.

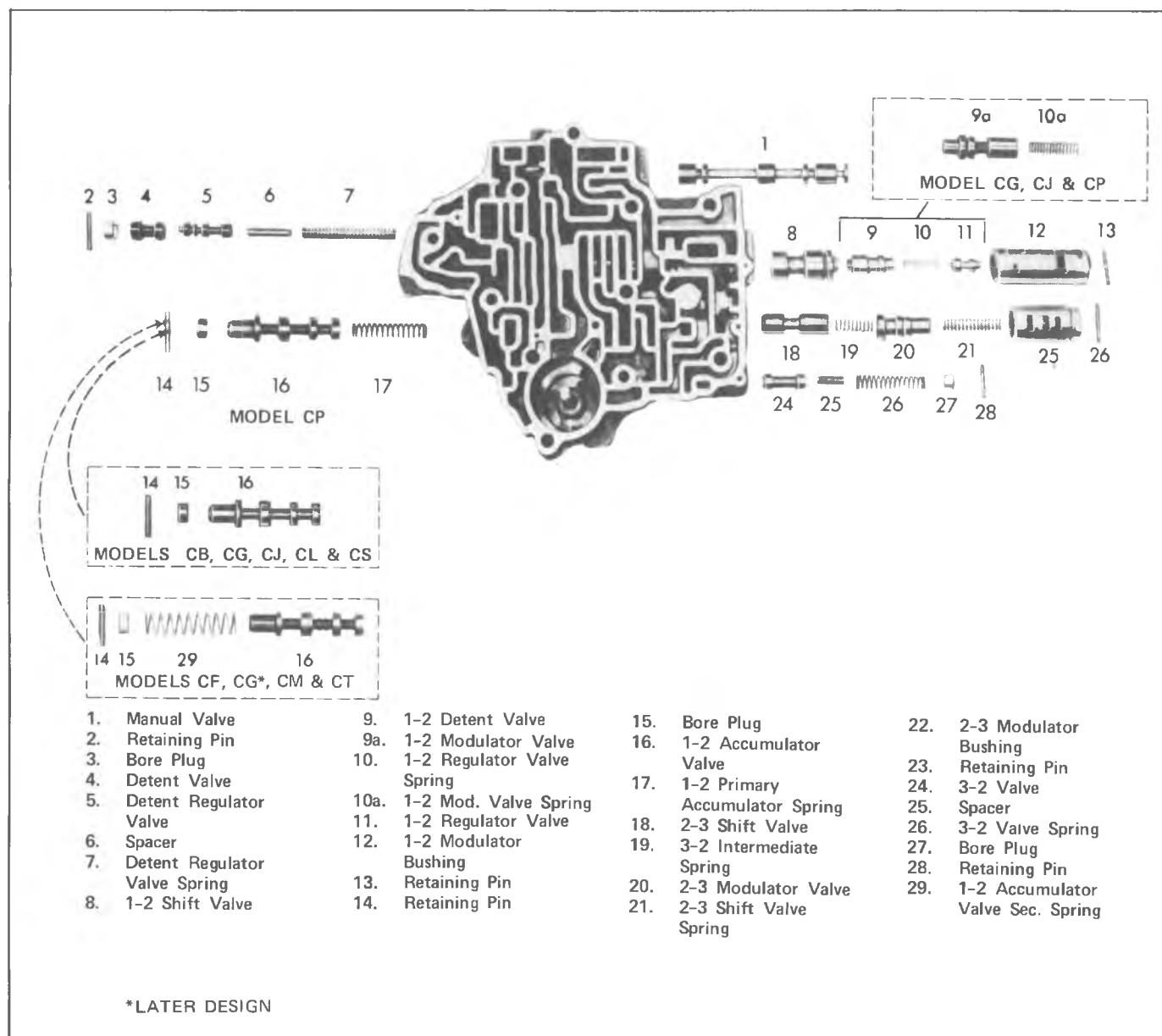


Fig. 7A-67C--Control Valve Assembly--Exploded View

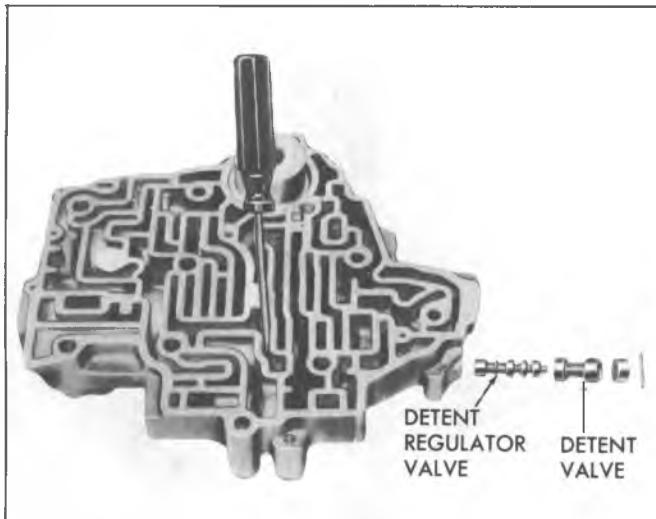


Fig. 7A-68C--Installing Detent Regulator Valve and Detent Valve

5. Inspect accumulator piston and oil seal ring for damage.

#### Reassembly

1. Install front accumulator spring and piston into valve body.
2. Install Special Tools J-22269 and J-24675 and compress spring and piston and secure with retaining "E" ring.
3. Install the 1-2 accumulator valve train into the lower left hand bore as follows:
  - (Model CP) Install the 1-2 accumulator spring and 1-2 accumulator valve, stem end out, into bore. Place the bore plug into valve bore and install grooved retaining pin from the cast surface side of the valve body, with the grooves entering the pin hole last. Tap pin with a hammer until flush with cast surface of valve body.
  - (Models CB,CG (early design), CJ, CL and CS) Install 1-2 accumulator valve stem end out, into bore. Place bore plug into valve bore and install grooved retaining pin from cast surface side of the valve body, with the groove entering the pin holes last. Tap pin with a hammer until flush with cast surface of valve body.

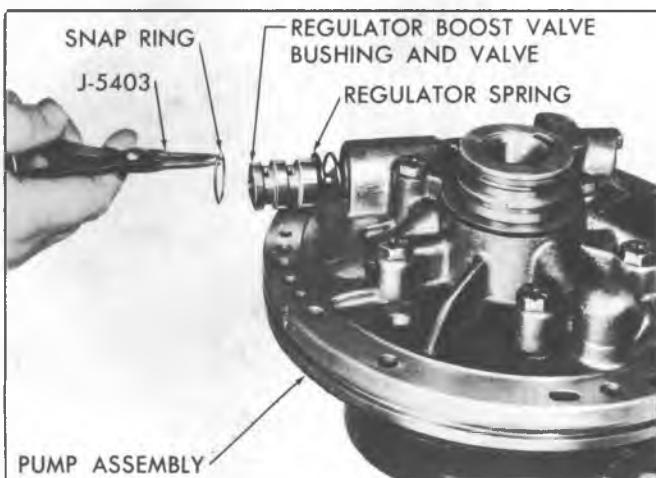


Fig. 7A-69C--Removing Pump Regulator Valve Snap Ring

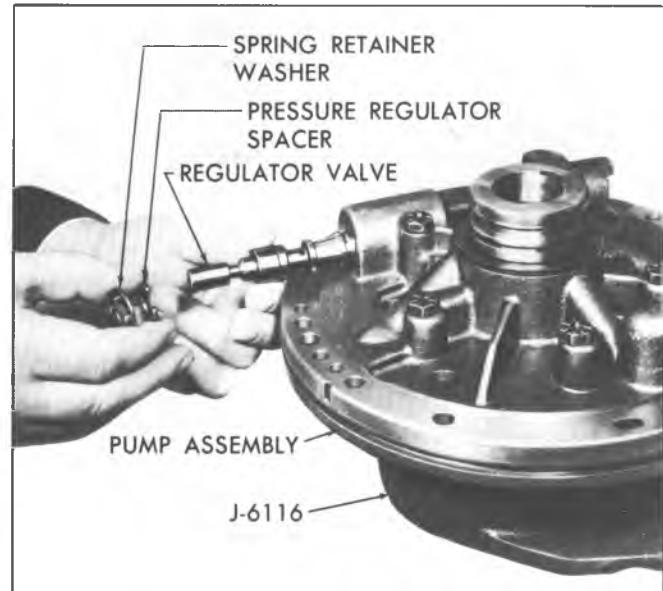


Fig. 7A-70C--Removing Pressure Regulator Valve

c. (Models CF, CG (later design), CM and CT) Install the 1-2 accumulator valve, stem end out, and 1-2 accumulator secondary spring. Install the bore plug and compress spring until grooved retaining pin can be inserted from the cast surface side of the valve body. Install retaining pin with the grooved end entering the pin hole last and tap in place until flush with cast surface of the valve body.

4. In next bore up, install detent spring and spacer. Compress spring and secure with small screwdriver (Fig. 7A-68C).
5. Install detent regulator valve, wide land first.
6. Install detent valve, narrow land first.
7. Install bore plug (hole out), depress spring by pressing in on plug, install retaining pin, and remove screwdriver.
8. In lower right hand bore, install 3-2 valve.
9. Install 3-2 spring, spacer, bore plug (hole out) and

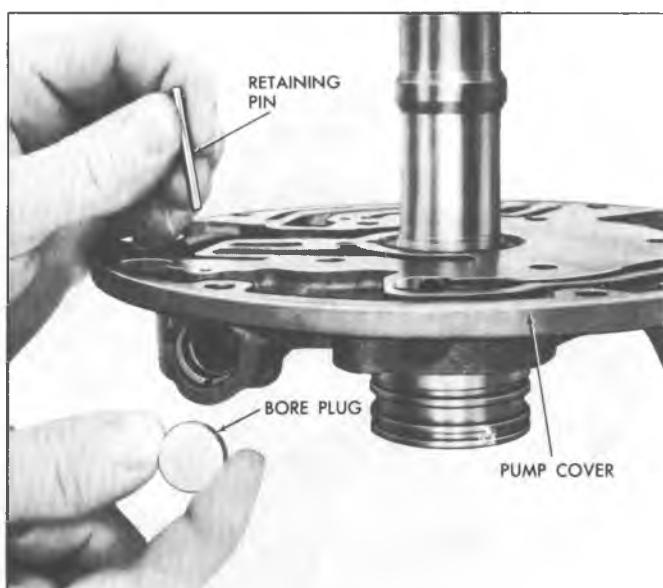


Fig. 7A-71C--Installing Pressure Regulator Retaining Pin and Bore Plug

retaining pin.

10. In next bore up, install the 2-3 shift valve, open end out, into the bore and install 3-2 intermediate spring.

11. Install 2-3 modulator valve into bushing and install both parts into valve body bore.

12. Install 2-3 valve spring and retaining pin.

13. In next bore up, install 1-2 valve, stem end out.

14. Install parts as follows:

a. (Models CG, CJ and CP) Install the 1-2 valve spring and 1-2 modulator valve into the 1-2 modulator bushing, aligning the spring in the bore of the modulator valve. Install parts into the valve body bore.

b. (All other models) Install the 1-2 regulator valve, regulator spring and 1-2 detent valve open hole first into the 1-2 modulator bushing, aligning the spring in the bore of the detent valve.

15. Compress bushing against spring and install retaining pin.

16. Install manual valve with detent pin groove to the right.

### **Oil Pump Disassembly, Inspection and Assembly Disassembly**

1. Place oil pump assembly in hole in bench or holding fixture, J-6116 with J-21364 adapter.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403 pliers (Fig. 7A-69C).

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer and spacer(s), if present (Fig. 7A-70C).

6. Remove pump cover to body attaching bolts.

7. Remove pump cover from body.

8. Remove retaining pin and bore plug from pressure regulator bore (Fig. 7A-71C).

9. Remove hook type oil rings from pump cover.

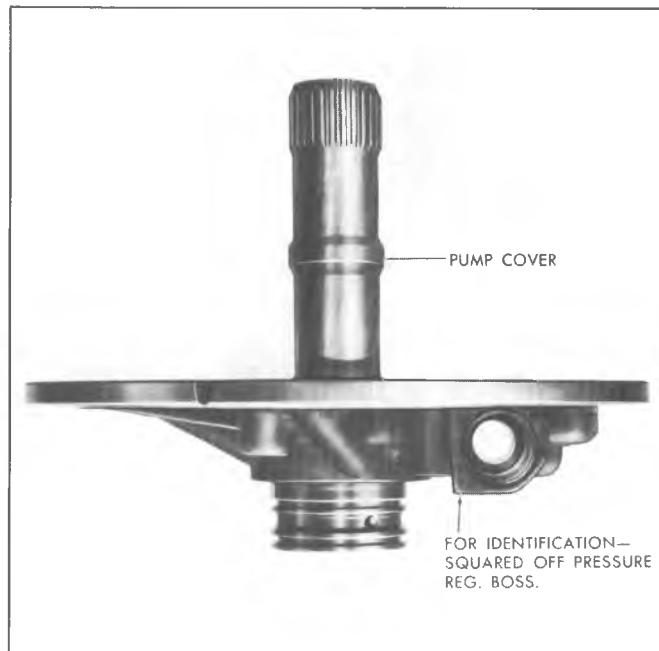


Fig. 7A-73C--Pressure Regulator Valve Identification

10. Remove pump to forward clutch housing selective washer.

11. Mark drive and driven gears for reassembly in same position and remove from the pump body. See Fig. 7A-72C.

### **Inspection of Pump Body and Pump Cover**

**NOTE:** A solid type pressure regulator valve must only be used in a pump cover with a squared off pressure regulator boss. See Fig. 7A-73C. A pressure regulator valve with oil holes and orifice cup plug may be used to service either type pump cover.

1. Inspect drive and driven gear pocket and crescent for

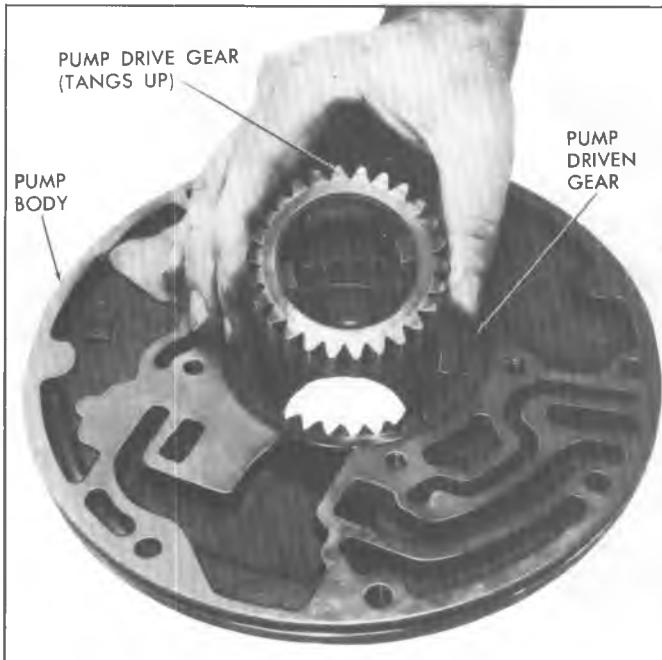


Fig. 7A-72C--Installing Pump Drive Gear



Fig. 7A-74C--Checking Pump Body Face to Gear Face Clearance

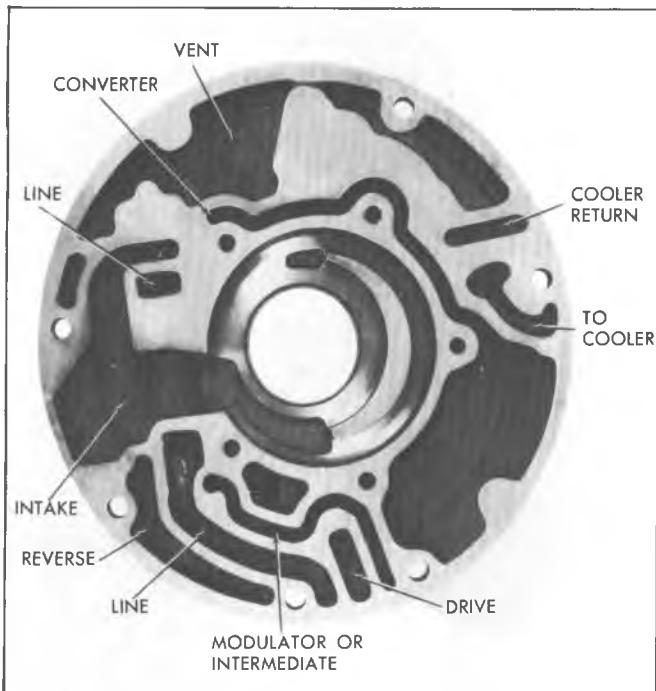


Fig. 7A-75C--Pump Body Oil Passages

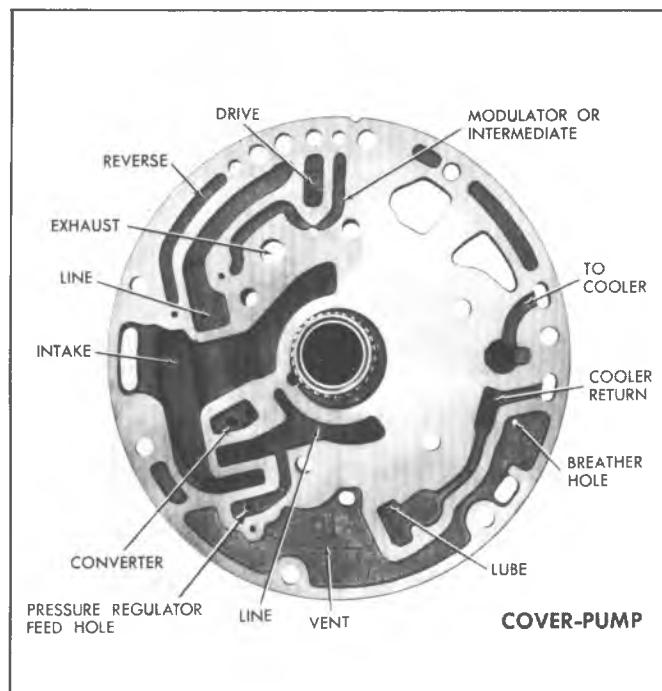


Fig. 7A-76C--Pump Cover Oil Passages

scoring, galling or other damage.

2. Place pump gears in pump body and check pump body face to gear face clearance (should be .0008" - .0035") (Fig. 7A-74C).

3. Check face of pump body for scores or nicks.  
 4. Check oil passages (Fig. 7A-75C).  
 5. Check for damaged cover bolt attaching threads.  
 6. Check for overall flatness of pump body face.  
 7. Check bushing for scores or nicks. If replacement is necessary, proceed as follows:

a. Using Tool J-21465-17 and driver Handle J-8092 remove bushing.

b. From front side of pump, using J-21465-17 and driver Handle J-8092 install new bushing flush to .010" below gear pocket face.

8. Inspect pump attaching bolt seals for damage, replace if necessary.

9. Inspect pump cover face for overall flatness.  
 10. Check for scores or chips in pressure regulator bore.  
 11. Check that all passages are open and not interconnected (Fig. 7A-76C).

12. Check for scoring or damage at pump gear face.  
 13. Inspect stator shaft for damaged splines, or scored bushings. If replacement of bushing is necessary proceed as follows:

#### **Front**

a. With pump cover and stator shaft properly supported, using Tool J-21465-15, with slide hammer tool J-2619, and adapter Tool J-2619-4 remove bushing.

b. Using Tool J-21465-3 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

#### **Rear**

c. With pump and stator shaft properly supported, using

Tool J-21465-15, with slide hammer Tool J-2619 and adapter tool J-2619-4, remove bushing.

d. Using Tool J-21465-2 with Driver Handle J-8092, press or drive replacement bushing into place until tool bottoms.

14. Inspect oil ring grooves for damage or wear.

15. Inspect selective washer thrust face for wear or damage.

16. Inspect pressure regulator and boost valve for free operation in their respective bores.

17. Inspect pump cover for open 1/8" breather hole (Fig. 7A-76C).

#### **Assembly**

1. Install drive and driven pump gears with alignment marks up into pump body (Fig. 7A-72C) drive gear tangs up.

2. Protect stator shaft and install pump cover in vise.

3. Install spacer(s) if used, retainer and spring, into pressure regulator bore (Fig. 7A-77C).

4. Install pressure regulator valve from opposite end of bore, stem end first.

5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

6. Install retaining snap ring.

7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.

8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

9. Install two (2) hook type oil seal rings.

10. Assemble pump cover to pump body with attaching bolts (Fig. 7A-78C).

**NOTE:** Leave bolts one turn loose at this time.

11. To align the pump body and cover, place the pump

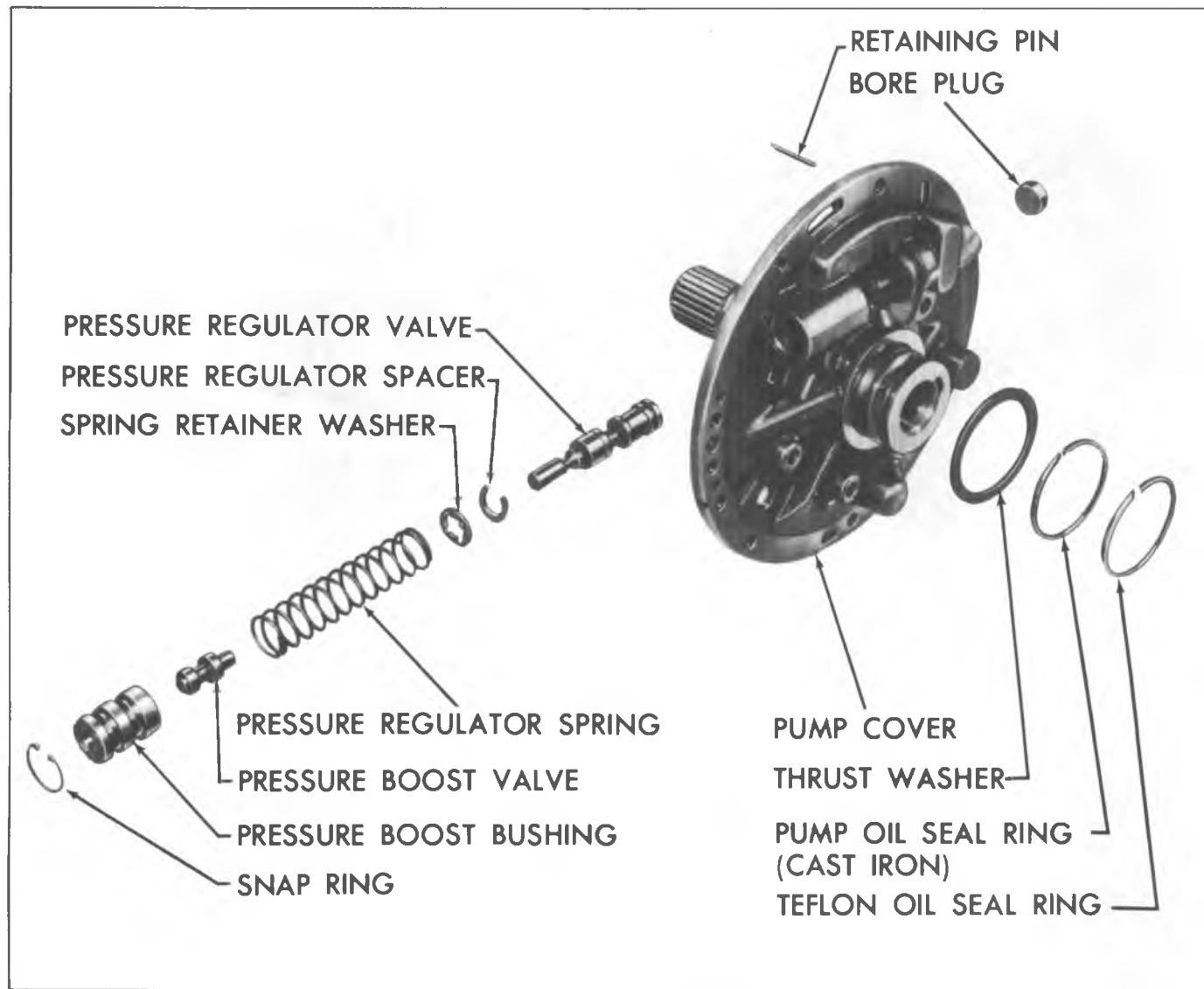


Fig. 7A-77C--Pump Cover--Exploded View

assembly, less rubber seal ring, upside down into the pump bore of the case (Fig. 7A-79C).

12. Tighten pump cover bolts to 18 foot pounds. Remove pump assembly from case bore.

13. Install pump to case "O" ring seal.

#### **FORWARD CLUTCH DISASSEMBLY, INSPECTION AND ASSEMBLY**

##### **Disassembly**

1. Place forward clutch assembly with turbine shaft through hole in bench or Holding Fixture J-6116, and remove

forward clutch housing to direct clutch hub snap ring (Fig. 7A-80C).

2. Remove direct clutch hub.
3. Remove forward clutch hub and thrust washers (Fig. 7A-81C).
4. Remove composition, steel clutch plates, and waved steel plate.

**NOTE:** Models CL and CS do not use a waved steel plate.

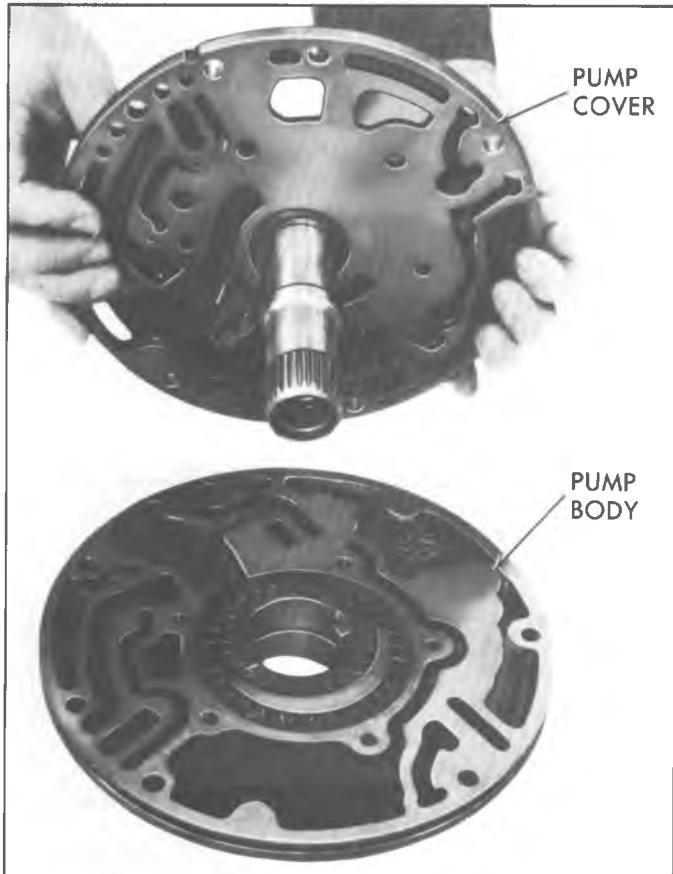


Fig. 7A-78C--Aligning Pump, Cover to Pump Body

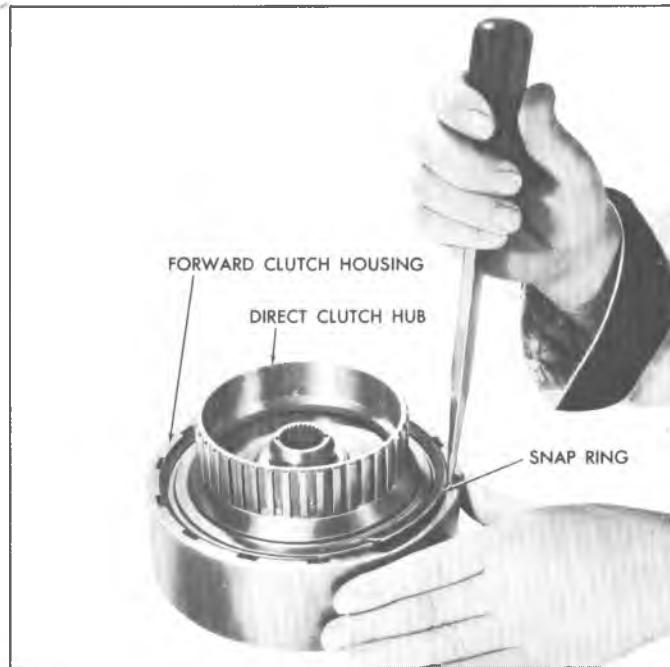


Fig. 7A-80C--Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

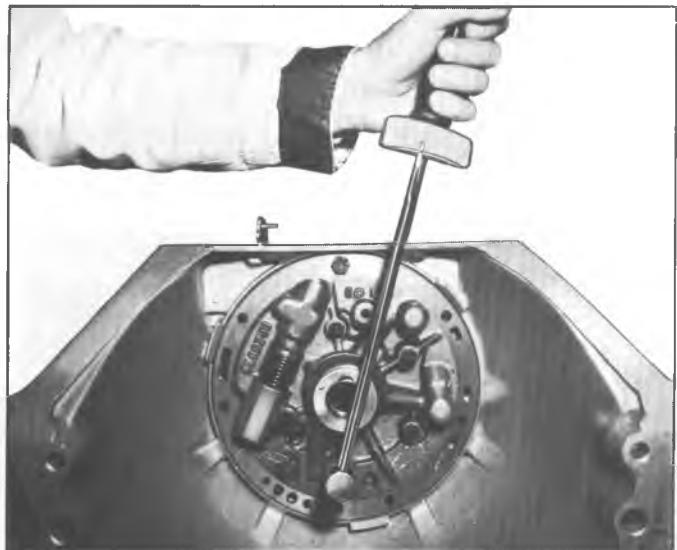


Fig. 7A-79C--Installing Pump Cover to Pump Body

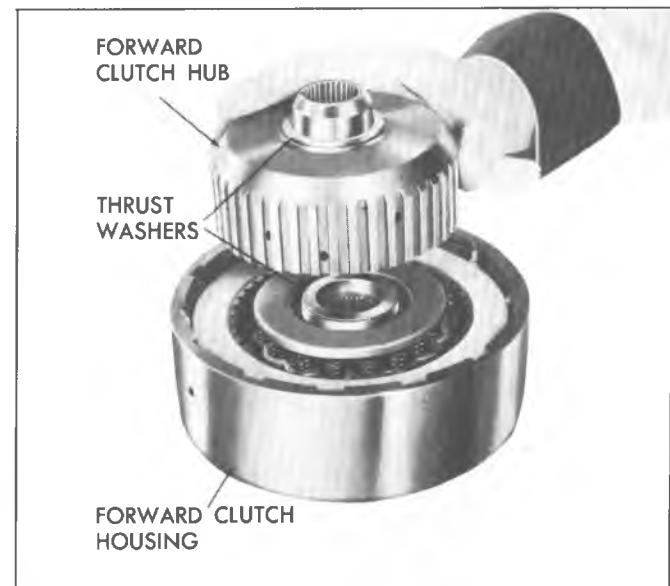


Fig. 7A-81C--Removing Forward Clutch Hub and Thrust Washers

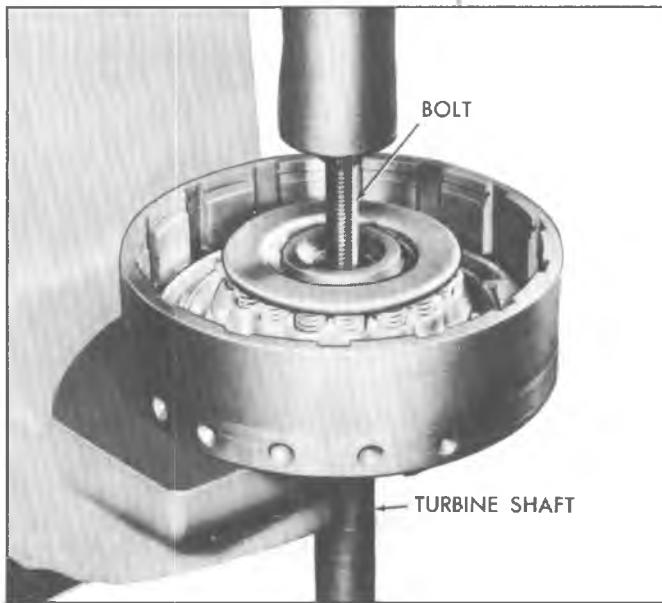


Fig. 7A-82C--Removing Turbine Shaft from Forward Clutch Housing

5. If necessary place forward clutch and turbine shaft in arbor press and remove turbine shaft (Fig. 7A-82C).

6. Using J-4670 clutch spring compressor in arbor press with Adapter J-21664, compress spring retainer and remove snap ring (Fig. 7A-83C).

7. Remove spring retainer and sixteen (16) clutch release springs.

**NOTE:** Keep springs separate from direct clutch release springs.

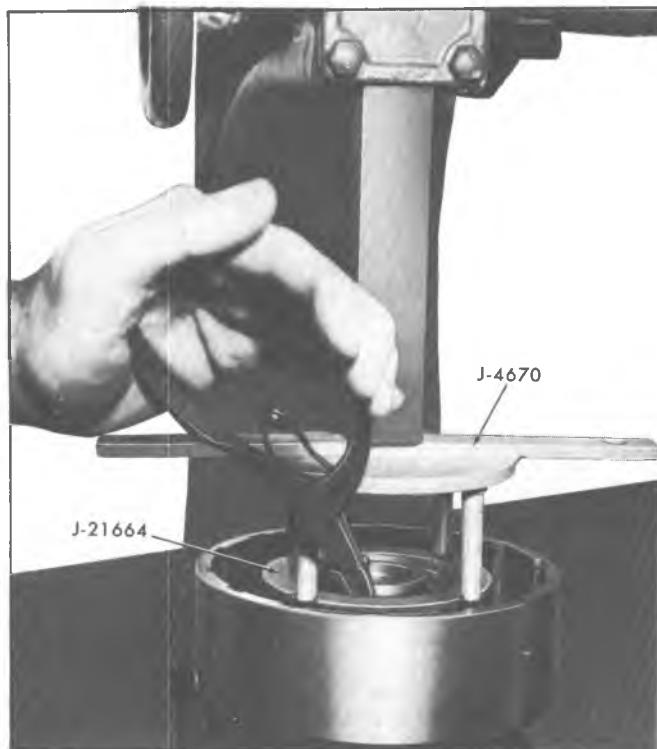


Fig. 7A-83C--Removing Forward Clutch Spring Retaining Snap Ring



Fig. 7A-84C--Removing Forward Clutch Piston Outer Seal

8. Remove forward clutch piston.
9. Remove inner and outer clutch piston seals (Fig. 7A-84C).
10. Remove center piston seal from forward clutch housing (Fig. 7A-85C).

#### Inspection

1. Inspect composition-faced and steel clutch plates for signs of burning, scoring or wear.
2. Inspect sixteen (16) springs for collapsed coils or signs of distortion.
3. Inspect clutch hubs for worn splines, proper lubrication holes or scored thrust faces.
4. Inspect piston for cracks.
5. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.
6. Inspect turbine shaft.
  - a. Inspect for open lubrication passages at each end.
  - b. Inspect splines for damage.
  - c. Inspect ground bushing journals for damage.
  - d. Inspect shaft for cracks or distortion.



Fig. 7A-85C--Removing Forward Clutch Center Seal

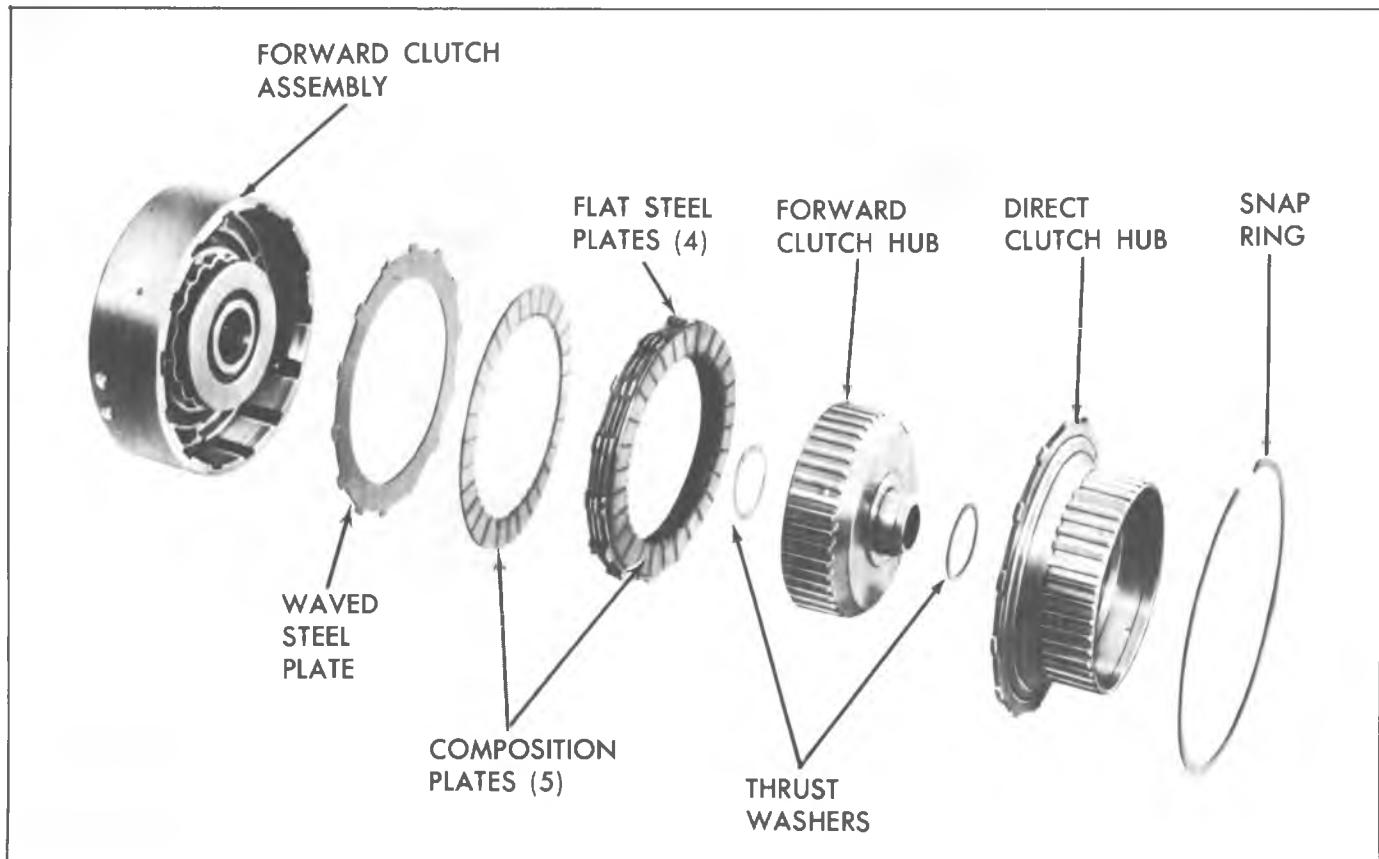


Fig. 7A-86C--Forward Clutch Assembly--Exploded View

**NOTE:** Turbine shaft and clutch housing are serviced separately. Shaft may be removed from housing by using a suitable size socket in an arbor press (Fig. 7A-82C).

#### Assembly (Fig. 7A-86C)

**NOTE:** The Turbo Hydra-Matic forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make

certain the proper piston be installed in the clutch assemblies, as shown in Figure 7A-102C.

1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets (Fig. 7A-84C).

2. Place a new center seal on clutch housing, lip faces up (Fig. 7A-85C).

**NOTE:** Apply automatic transmission oil to all seals and clutch plates.

3. Place seal protector Tool J-21362, over clutch hub and install outer clutch piston seal Protector J-21409, into clutch drum and install piston, rotating piston on drum until seated (Fig. 7A-87C).

4. Install sixteen (16) clutch release springs into pockets in piston.

5. Place spring retainer and snap ring on springs.

6. Compress springs in arbor press, using clutch compressor Tools J-4670 and J-21664, install snap ring.

7. If removed, install turbine shaft in forward clutch housing, using arbor press.

8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing.

10. Oil and install five (5) composition, and four (4) flat steel and one (1) waved steel clutch plate (with "U" notches), starting with waved steel and then alternating composition and steel clutch plates, as shown in Fig. 7A-88C.

**NOTE:** Models CL and CS do not use a waved steel clutch plate.

The model "CL" forward clutch composition-faced

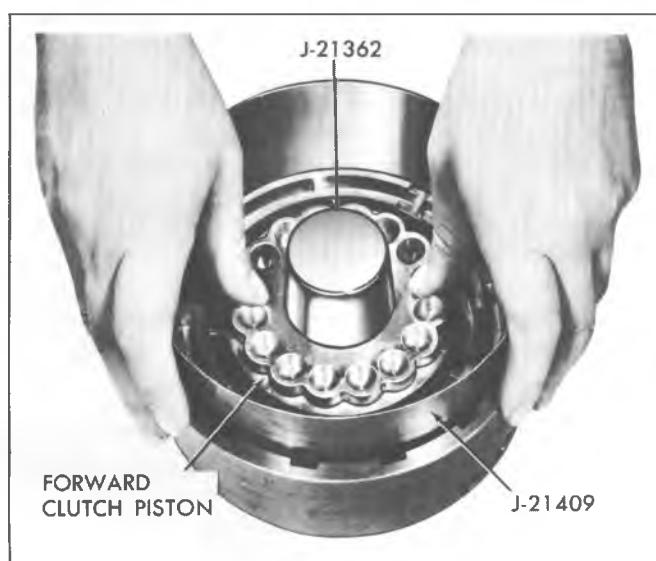


Fig. 7A-87C--Installing Forward Clutch Piston

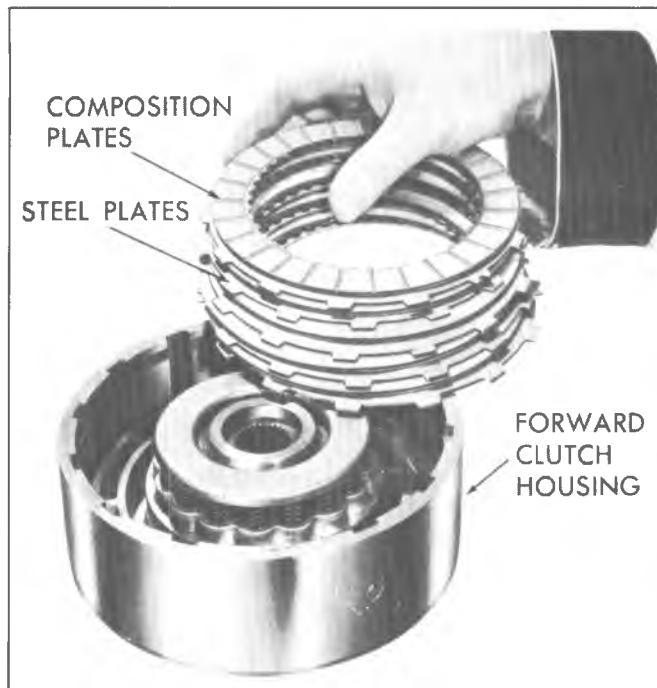


Fig. 7A-88C--Installing Forward Clutch Composition and Steel Plates

plates are different from the other models. Refer to parts catalog book for correct usage.

**CAUTION:** Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch).

**NOTE:** Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.

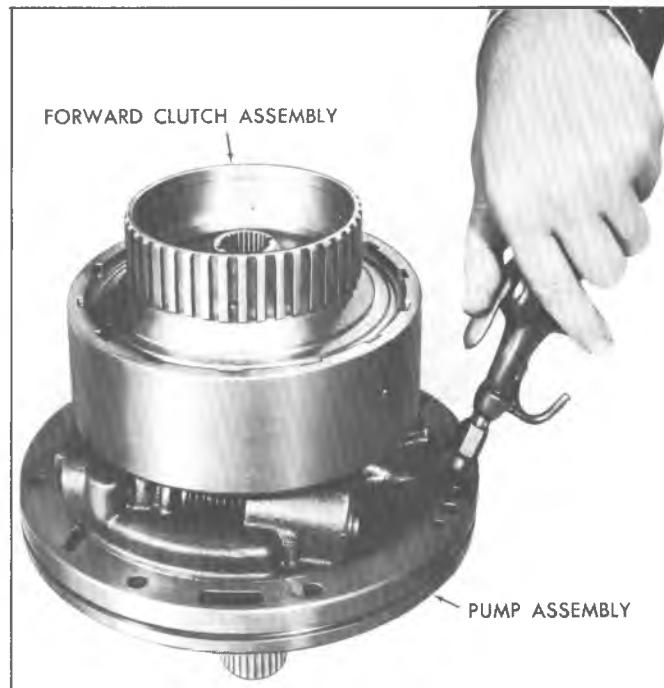


Fig. 7A-90C--Air Checking Forward Clutch Assembly

11. Install direct clutch hub and retaining snap ring (Fig. 7A-89C).

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (7A-90C).

#### DIRECT CLUTCH AND INTERMEDIATE ROLLER DISASSEMBLY, INSPECTION AND ASSEMBLY

##### Disassembly (Fig. 7A-91C)

1. Remove intermediate roller assembly retainer snap ring and retainer (Fig. 7A-92C).

2. Remove roller outer race and roller assembly.

3. Turn unit over and remove backing plate to direct clutch housing snap ring (Fig. 7A-93C).

4. Remove direct clutch backing plate, composition plates, and steel clutch plates.

5. Using clutch compressor Tool J-4670 and J-21664, compress spring retainer in arbor press and remove snap ring (Fig. 7A-94C).

6. Remove retainer and fourteen (14) piston release springs.

**NOTE:** Keep springs separate from forward clutch release springs.

7. Remove direct clutch piston (Fig. 7A-95C).

8. Remove outer seal from piston.

9. Remove inner seal from piston.

10. Remove center piston seal from direct clutch housing.

##### Inspection

1. Inspect roller assembly for popped or loose rollers.

2. Inspect inner cam and outer race for scratches or wear.

3. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.

4. Inspect composition-faces and steel clutch plates for sign of wear or burning.



Fig. 7A-89C--Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring

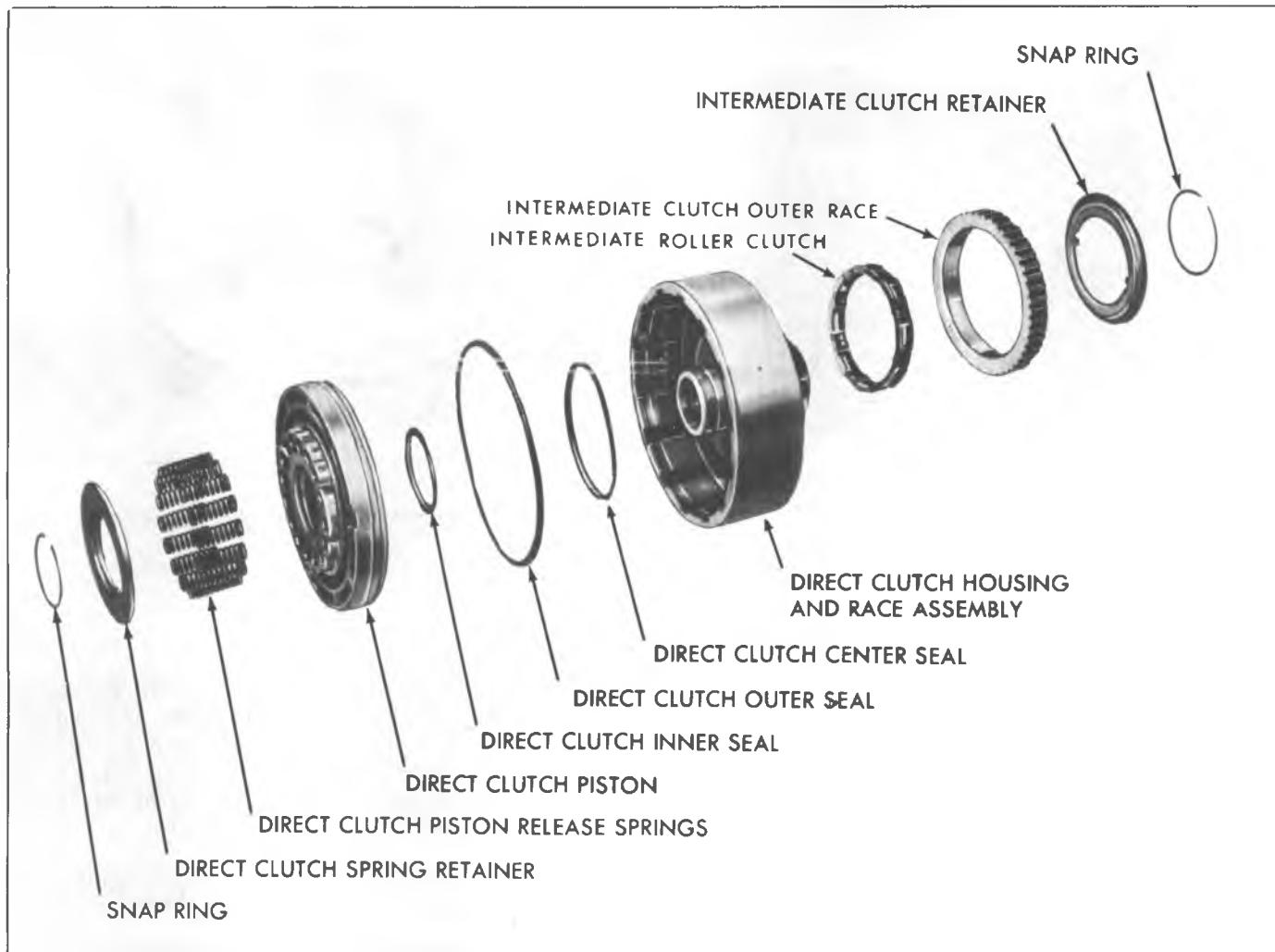


Fig. 7A-91C--Direct Clutch and Intermediate Roller Assembly

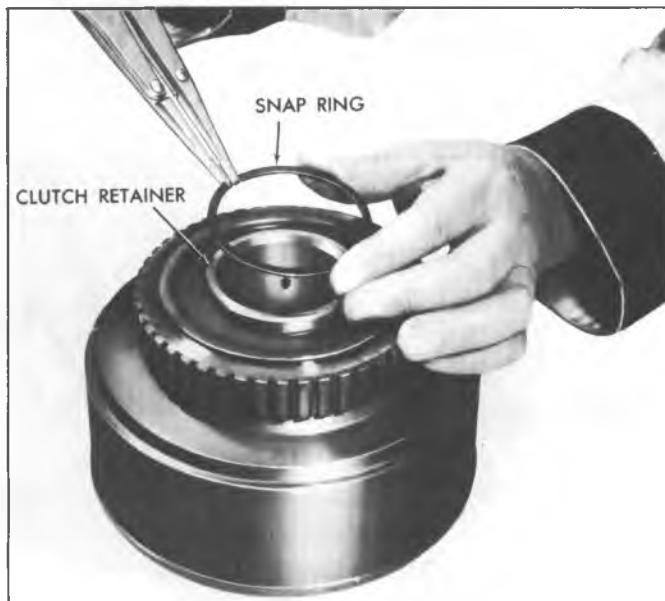


Fig. 7A-92C--Removing Intermediate Clutch Retainer Snap Ring

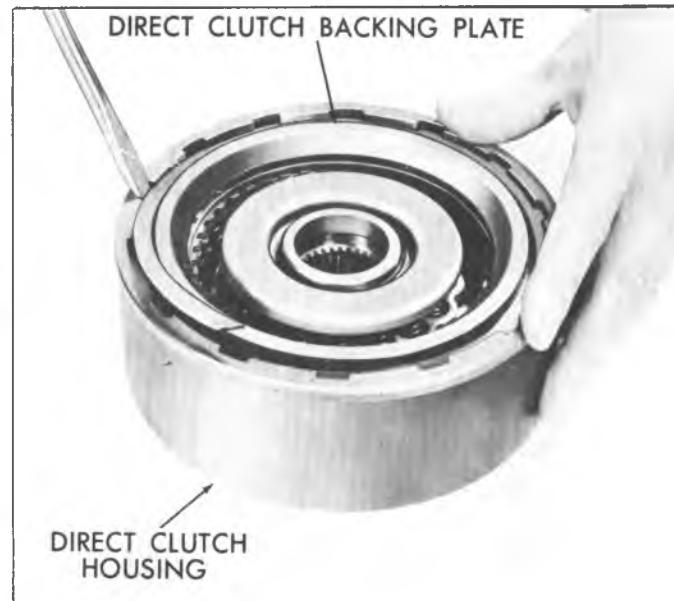


Fig. 7A-93C--Removing Direct Clutch Backing Plate Snap Ring



Fig. 7A-94C--Removing or Installing Direct Clutch Snap Ring

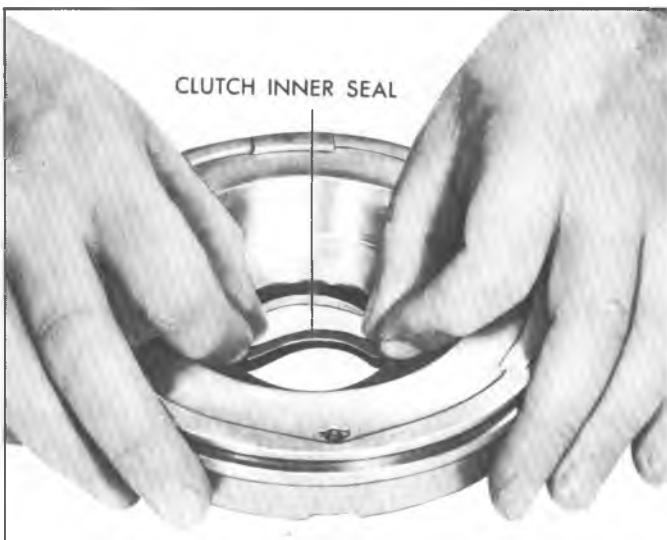


Fig. 7A-96C--Installing Direct Clutch Inner Seal

5. Inspect backing plate for scratches or other damage.
6. Inspect clutch piston for cracks.

7. Inspect fourteen (14) release springs for collapsed coils or signs of distortion.

**NOTE:** The 14 direct clutch release springs are not serviced. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

8. Inspect housing for free operation of check ball.

### Assembly

**NOTE:** The Turbo Hydra-Matic forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies, as shown in Figure 7A-102C.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets (Fig. 7A-96C).
2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7A-97C).
3. Install a new center seal on clutch housing with lip of seal facing up (Fig. 7A-98C).

**NOTE:** Apply automatic transmission oil to all seals and clutch plates before installation.



Fig. 7A-95C--Removing Direct Clutch Piston Assembly

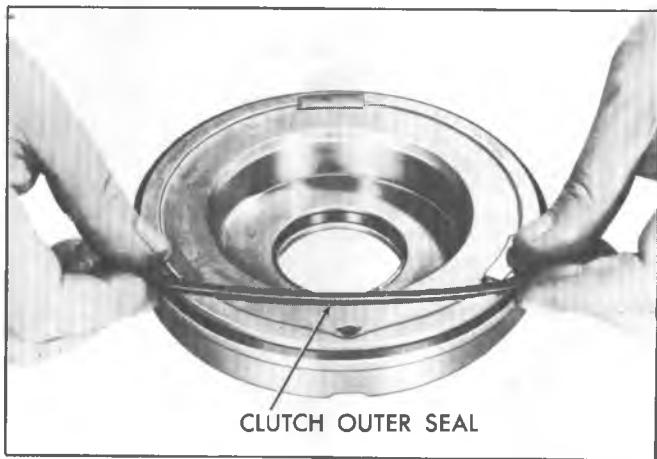


Fig. 7A-97C--Installing Direct Clutch Outer Seal

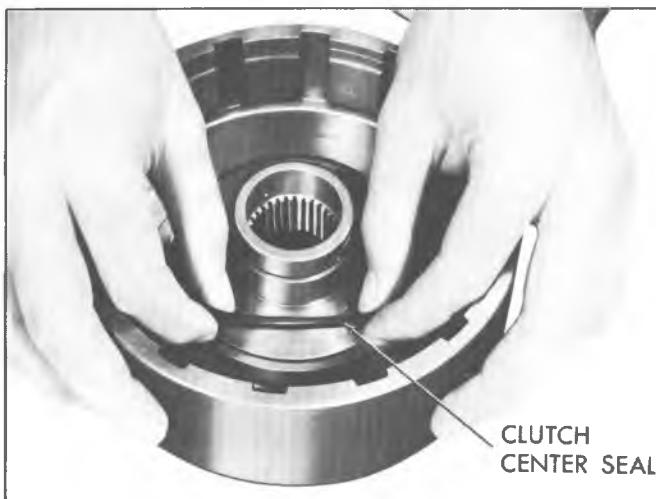


Fig. 7A-98C--Installing Direct Clutch Center Seal

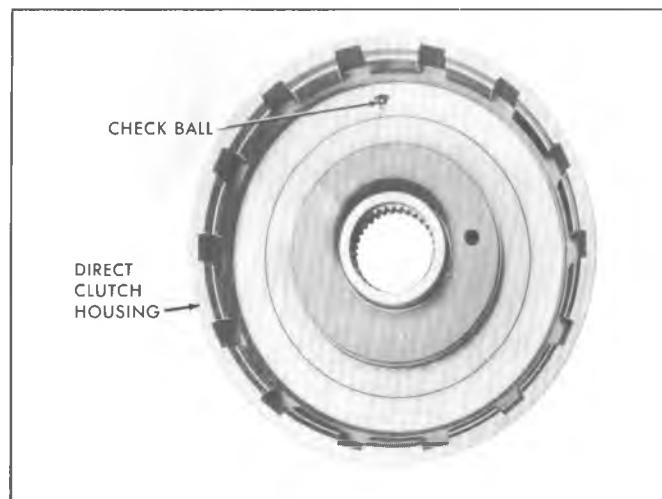


Fig. 7A-100C--Direct Clutch Housing with Check Ball

**CAUTION:** The direct clutch housing for models CB, CL and CS use the 6 plate clutch assembly.

This housing can be identified by the elimination of the inside diameter chamfer on the clutch plate end and/or a groove in the face at the base of the tower (Fig. 7A-99C). Should replacement of the direct clutch housing become necessary, extreme care must be taken in obtaining the correct part for the model involved.

Production built transmissions use a direct clutch housing with a check ball (See Fig. 7A-100C). If the housing requires replacement and the replacement housing does not contain a check ball, replace the direct clutch piston with the service piston which has a check ball (Models CL and CZ service piston has 2 check balls). **EITHER THE DIRECT CLUTCH HOUSING AND/OR THE PISTON MUST CONTAIN A CHECK BALL(S).**

4. Place seal protectors, Tools J-21362 Inner, J-21409

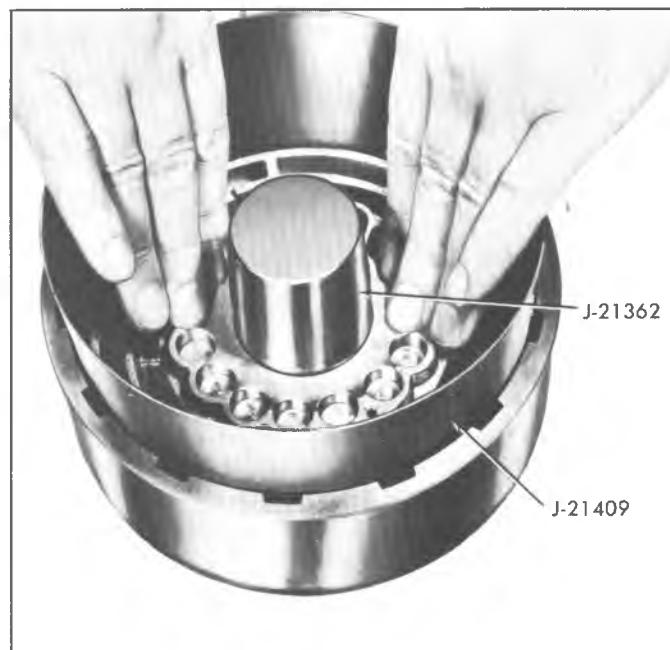


Fig. 7A-101C--Installing Direct Clutch Piston

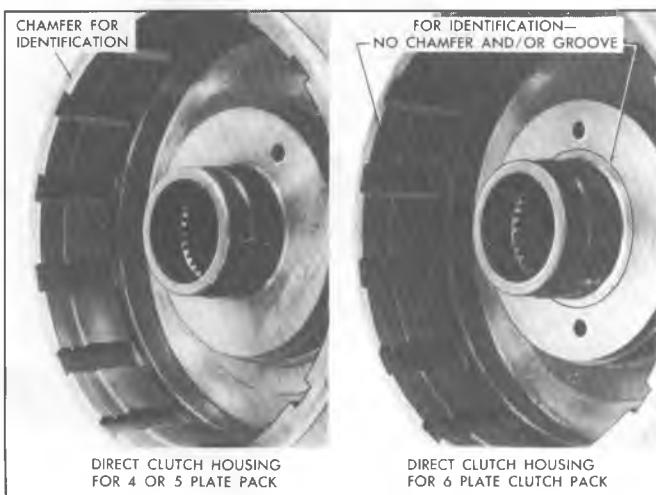


Fig. 7A-99C--Direct Clutch Housing Identification

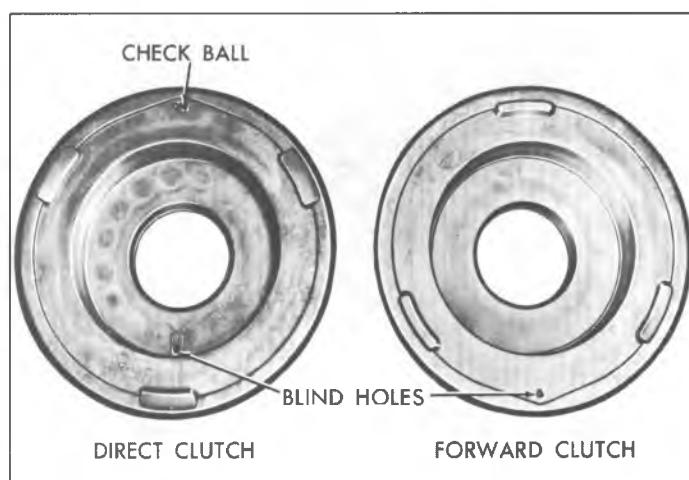


Fig. 7A-102C--Forward and Direct Clutch Piston Identification

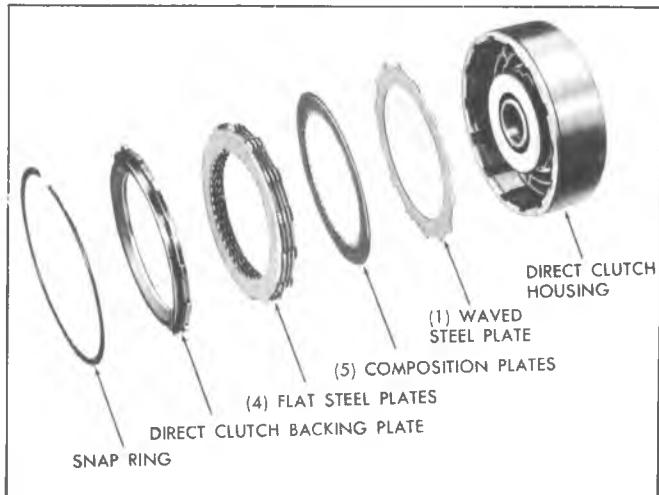


Fig. 7A-103C--Direct Clutch Assembly Exploded

Outer, over hub and clutch housing and install clutch piston, with a rotating motion (Fig. 7A-101C).

5. Install fourteen (14) springs into piston leaving two pockets diagonally opposite with no springs.
6. Place spring retainer and snap ring on retainer.
7. Using an arbor press and Tool J-4670, with J-21664, compress springs and install snap ring (Fig. 7A-94C):
8. Install direct clutch plates. See Fig. 7A-103C.
  - a. (Models CF, CG, CJ, CM, CP And CT) Oil and install five (5) composition and five (5) flat steel plates, starting with the steel plate and alternating composition clutch plates (Fig. 7A-104C).
  - b. (Models CB, CL and CS) Oil and install six (6) composition and six (6) flat steel plates, starting with a flat steel plate and alternating composition and flat steel clutch plates.

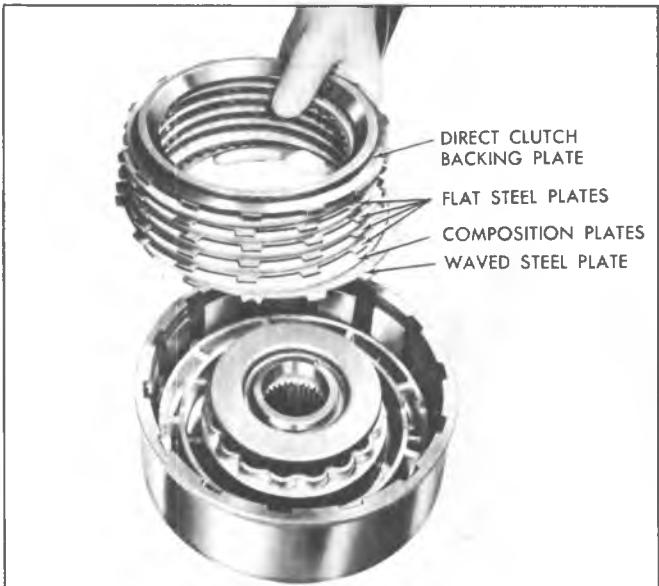


Fig. 7A-104C--Install Direct Clutch Backing Plate, Composition Plates, and Steel Plates

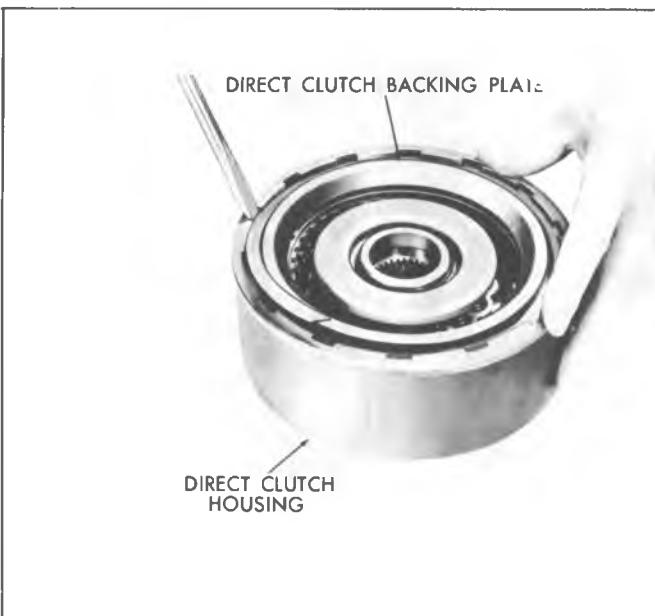


Fig. 7A-105C--Installing Direct Clutch Housing to Backing Plate Snap Ring

**NOTE:** Do not use radial grooved composition plates here.

9. Install clutch backing plate.
10. Install backing plate retaining snap ring (Fig. 7A-105C).

**NOTE:** Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

11. Turn unit over and install the intermediate clutch roller assembly onto the intermediate clutch inner cam (fig. 7A-106C).

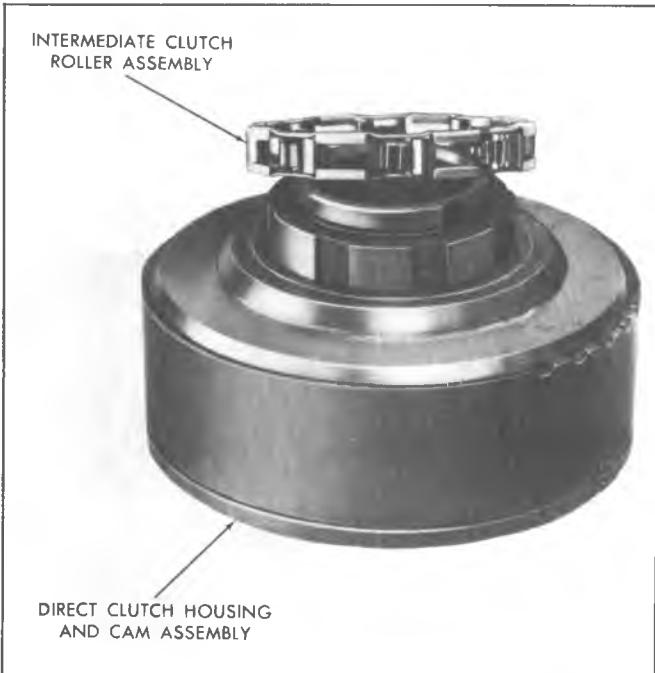


Fig. 7A-106C--Installing Intermediate Clutch Roller Assembly

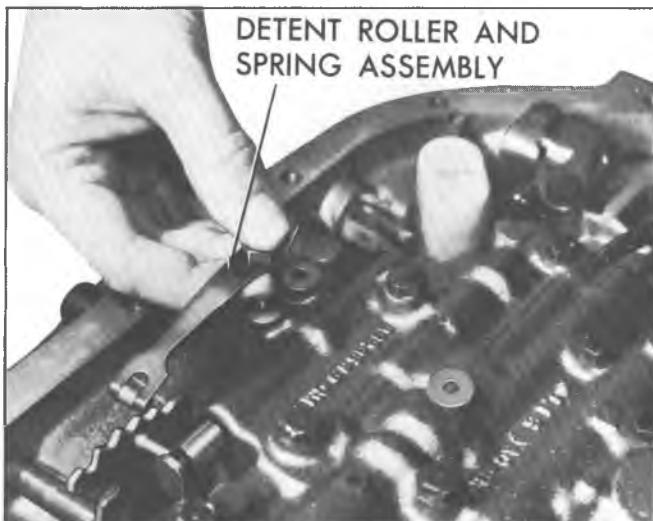


Fig. 7A-107C--Installing Intermediate Clutch Outer Race to Direct Clutch

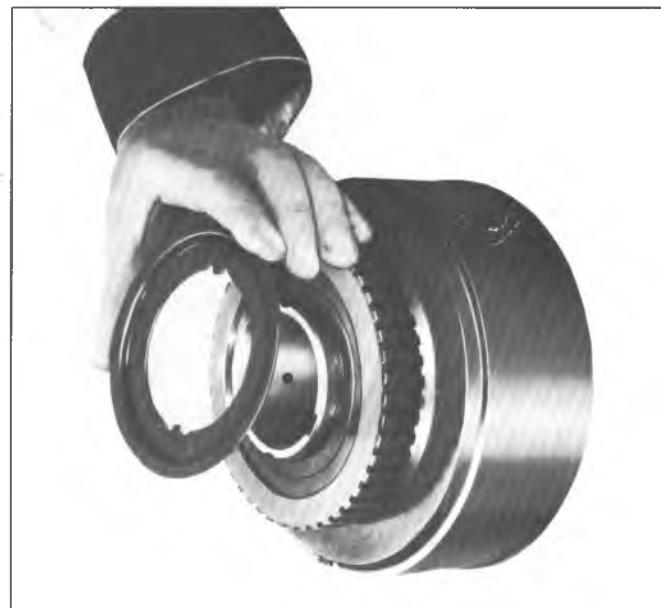


Fig. 7A-109C--Installing Intermediate Clutch Retainer

12. Install the intermediate clutch outer race with a clock wise turning motion (fig. 7A-107C).

**NOTE:** Intermediate roller clutch is not released for the CL and CZ models. The sprag assembly is released for these models.

Outer race should not turn counter-clockwise after installation. (See Figure 7A-108C).

13. Install intermediate clutch retainer and snap ring

(Fig. 7A-109C and 7A-110C).

14. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7A-111C).

**NOTE:** If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch plates.

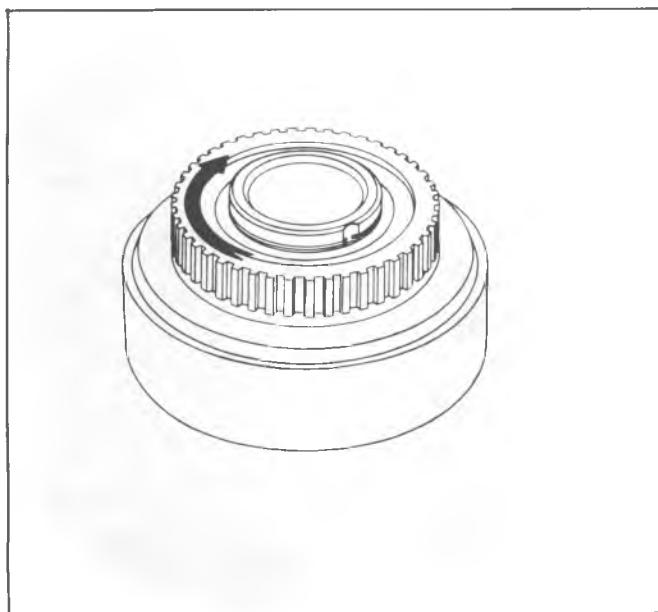


Fig. 7A-108C--Intermediate Roller Clutch Rotation

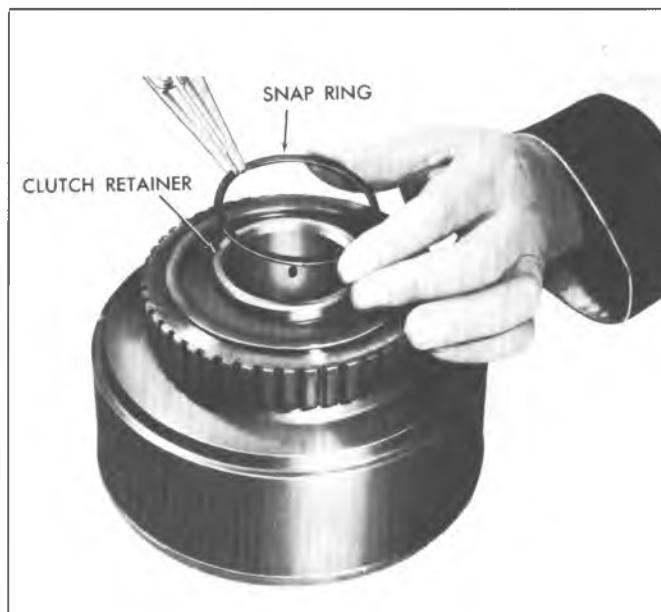


Fig. 7A-110C--Installing Intermediate Clutch Retainer Snap Ring



Fig. 7A-111C--Air Checking Direct Clutch Assembly



Fig. 7A-113C--Removing Intermediate Clutch Piston Snap Ring

## DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

### Disassembly

1. Remove four (4) oil seal rings from the center support (Fig. 7A-112C).
2. Compress spring retainer and remove snap ring (7A-113C).

3. Remove spring retainer (Fig. 7A-114C) and three (3) clutch release springs (Fig. 7A-115C).
  4. Remove intermediate clutch spring guide (Fig. 7A-116C).
  5. Remove intermediate clutch piston (Fig. 7A-117C).
  6. Remove inner and outer piston seal.
- CAUTION:** Do not remove three (3) screws

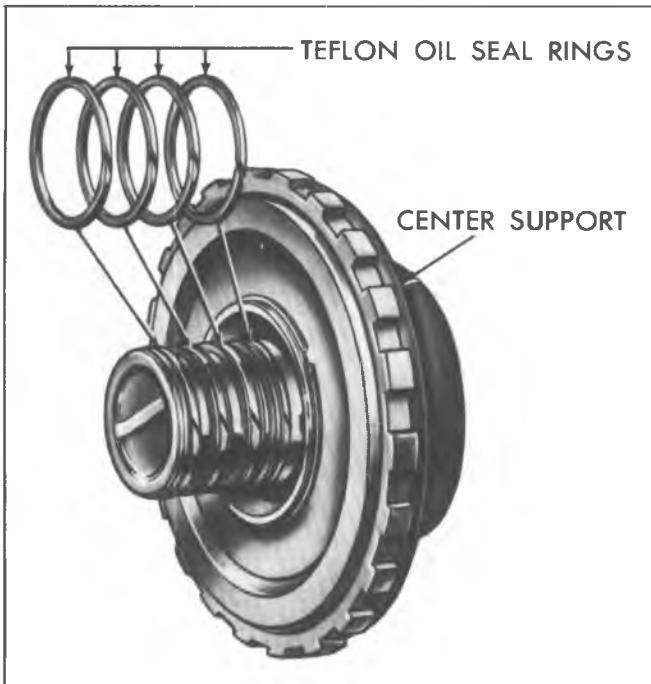


Fig. 7A-112C--Center Support and Oil Seal Rings

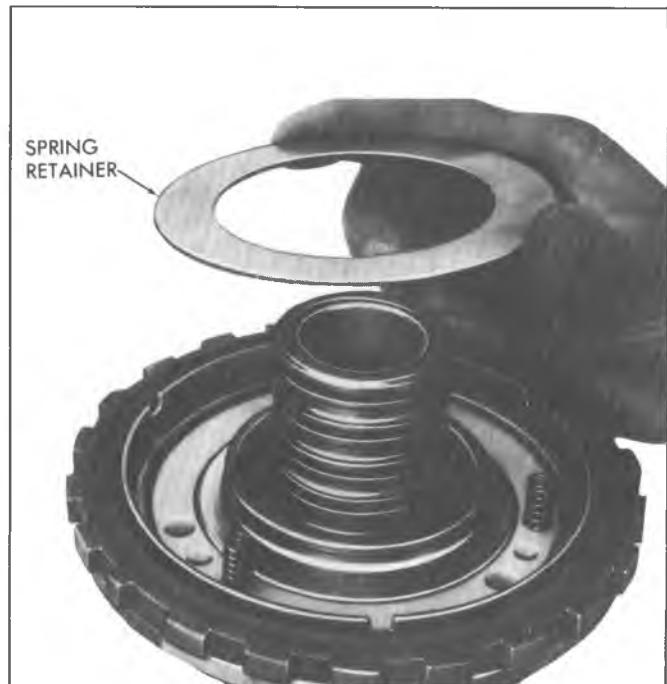


Fig. 7A-114C--Removing Spring Retainer



Fig. 7A-115C--Removing Clutch Release Springs



Fig. 7A-117C--Removing Intermediate Clutch Piston

*retaining roller clutch inner race to center support.*

#### Inspection (Fig. 7A-118C)

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open. Be sure constant bleed plug orifice, (approx. .020 dia.), is open (Fig. 7A-47C).

2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:

a. Using Tool J-21465-6 with Driver Handle J-8092 remove bushing.

b. From front side of center support, align elongated slot in the bushing with drilled hole in the oil delivery sleeve closest to the piston. Using Tool J-21465-6 and Driver Handle J-8092, drive bushing squarely into the bore until the bushing is flush to .010" below top of oil delivery sleeve.

3. Check oil ring grooves and oil rings for damage.

**NOTE:** All service center support oil seal rings are hook type cast iron.

4. Air check oil passages to be sure they are not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damage.

7. Inspect piston for cracks.

8. Inspect release springs for distortion.

9. Inspect support to case for burrs or raised edges. If present, remove with a stone or fine sandpaper.

#### Assembly

1. Lubricate and install new inner and outer seals on piston with lip of seal facing away from spring pocket (Fig. 7A-119C and 7A-120C).

2. Install inner seal protector, Tool J-21363, on center support hub, install piston, indexing spring pockets of piston into cored areas of the center support (Fig. 7A-121C).

3. Install intermediate clutch spring guide (Fig. 7A-122C).

4. Install three (3) release springs into holes of spring guide. Space equally during assembly (Fig. 7A-123C).

5. Place spring retainer and snap ring over springs.

6. Compress springs and install snap ring (Fig. 7A-124C).

7. Install four (4) oil seal rings on the center support.

**NOTE:** When installing teflon oil seal rings, make sure slit ends are assembled in same relation as cut (Fig. 7A-125C). Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during re-assembly.

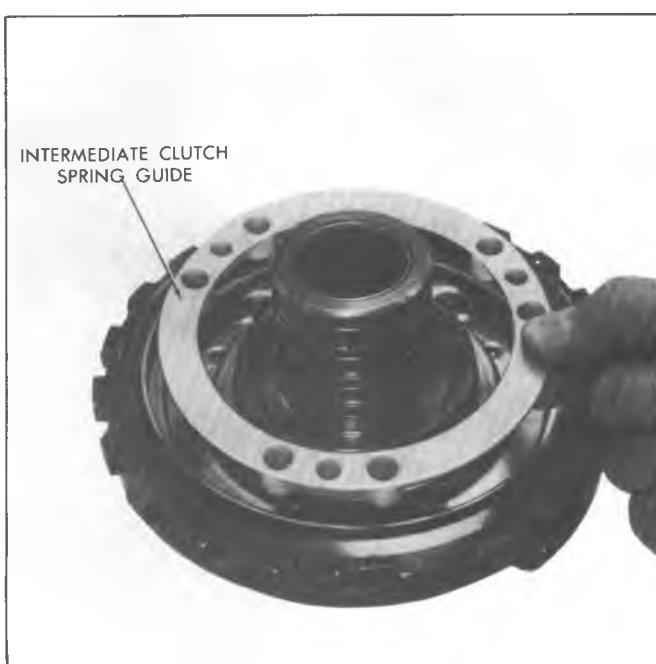


Fig. 7A-116C--Removing Intermediate Clutch Spring Guide

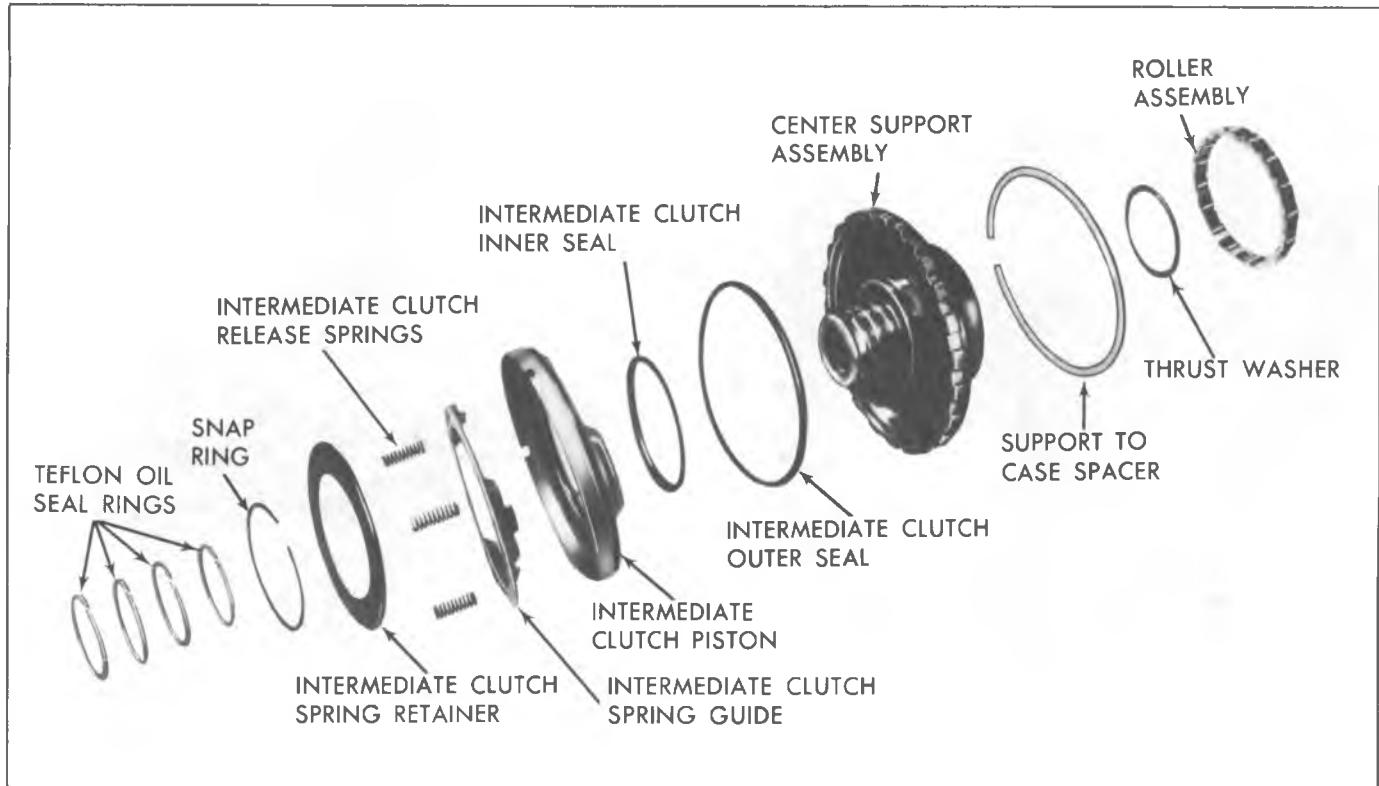


Fig. 7A-118C--Center Support Assembly--Exploded View



Fig. 7A-119C--Installing Intermediate Clutch Inner Seal



Fig. 7A-120C--Installing Intermediate Clutch Outer Seal

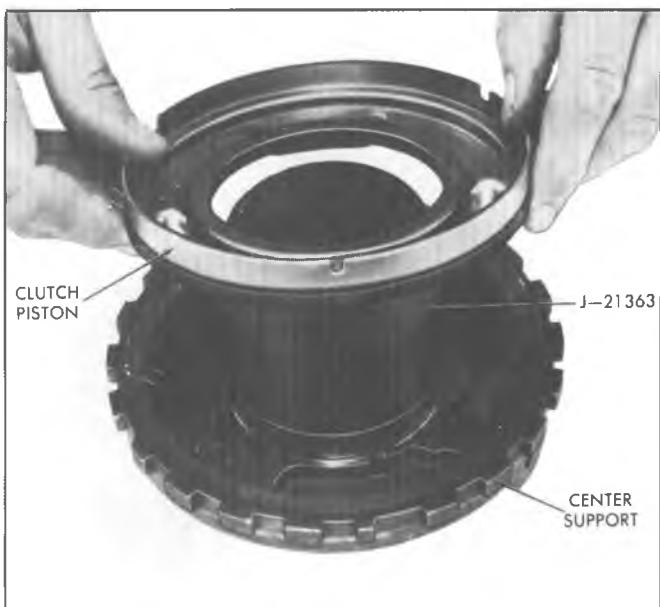


Fig. 7A-121C--Installing Intermediate Clutch Piston

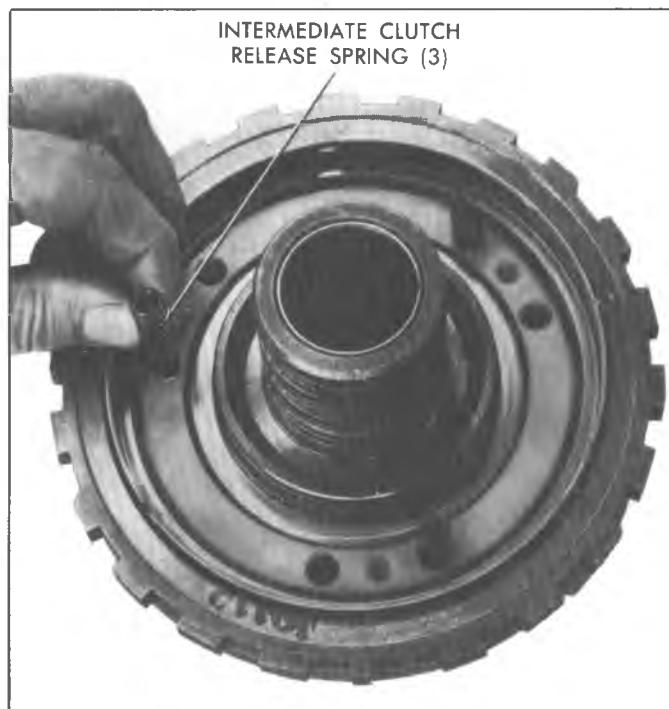


Fig. 7A-123C--Installing Intermediate Clutch Release Springs

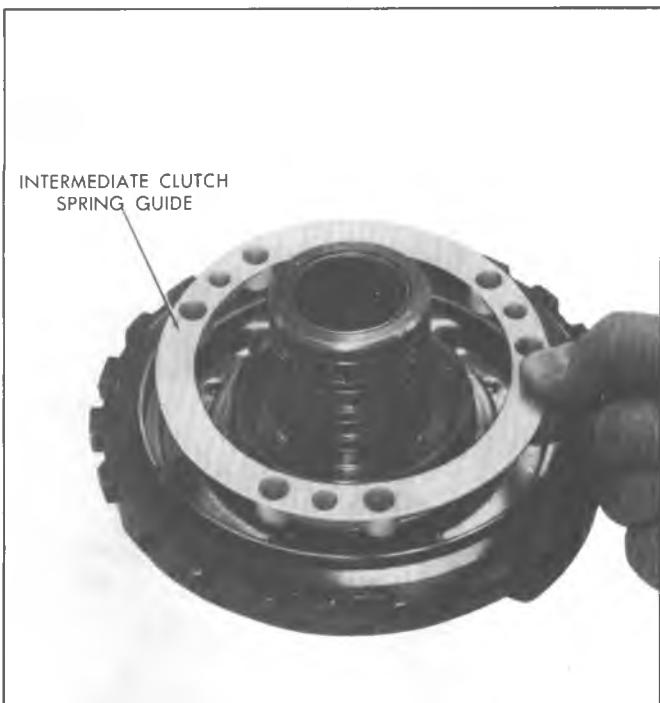


Fig. 7A-122C--Installing Intermediate Clutch Spring Guide



Fig. 7A-124C--Installing Intermediate Clutch Piston Snap Ring

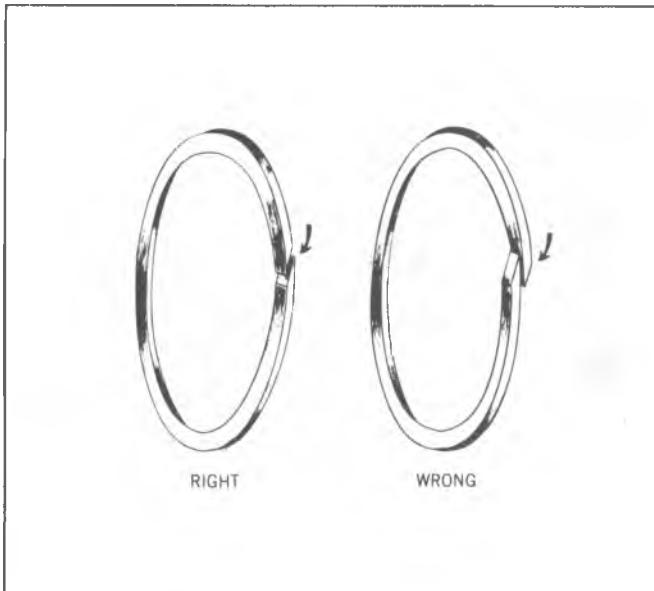


Fig. 7A-125C--Teflon Rings

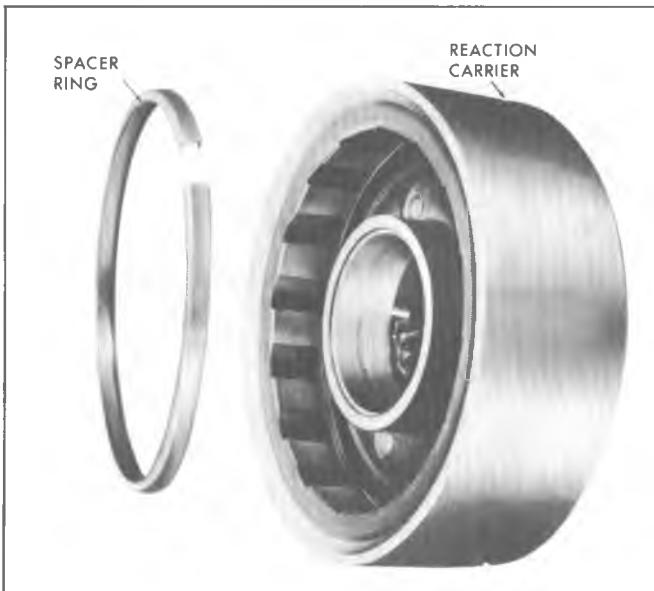


Fig. 7A-127C--Inspecting Spacer Ring

of mating parts over rings. Retain with petrolatum.

8. Air check operation of intermediate clutch piston (Fig. 7A-126C).

#### Inspection of Reaction Carrier, Roller Clutch, and Output Carrier Assembly

1. If the reaction carrier has a spacer ring in an undercut at the bottom of the roller cam ramps, inspect it for damage (Fig. 7A-127C).

**NOTE:** The reaction carrier with the undercut and

spacer ring is used optionally and interchangeably with the reaction carrier which does not have an undercut and spacer ring.

2. Inspect band surface on reaction carrier for signs of burning or scoring.
3. Inspect roller clutch outer race for scoring or wear.
4. Inspect thrust washer surfaces for signs of scoring or wear.
5. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.
6. Inspect reaction carrier pinions for damage, rough bearings, or excessive tilt.
7. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-128C).
8. Inspect roller clutch for damaged rollers.
9. Inspect roller clutch cage and springs for damage.



Fig. 7A-126C--Air Checking Intermediate Clutch Piston

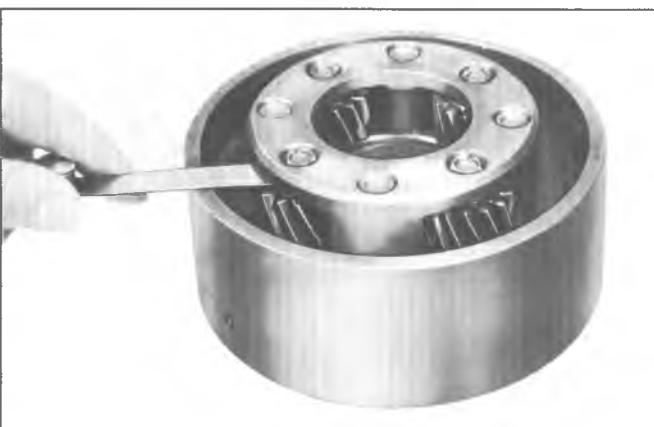


Fig. 7A-128C--Checking Pinions End Play



Fig. 7A-129C--Checking Output Carrier Pinion End Play

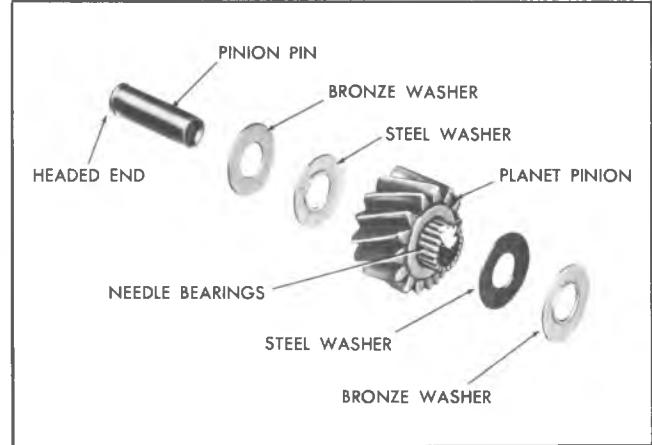


Fig. 7A-131C--Planet Pinion Assembly--Exploded View

10. Inspect front internal gear (output carrier) for damaged teeth.
11. Inspect output carrier pinions for damage, rough bearings or excessive tilt.
12. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-129C).
13. Inspect parking pawl lugs for cracks or damage.
14. Inspect output locating splines for damage.
15. Inspect front internal gear ring for flaking (Fig. 7A-49C).

#### Pinion Replacement Procedure

1. Support carrier assembly on its front face.
2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out. Do not allow drill to remove any stock from the carrier.
3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7A-130C).
4. Remove pinions, thrust washers and roller needle

5. Inspect pinion pocket thrust faces for burrs and remove if present.

6. Install eighteen (18) needle bearings into each pinion using petrolatum to hold bearings in place. Use pinion pin as guide (Fig. 7A-131C).

7. Place a bronze and steel washer on each side of pinion so steel washer is against pinion, hold them in place with petrolatum.

8. Place pinion assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

9. Drive a new pinion pin into place while rotating pinion from front, being sure that headed end is flush or below face of carrier (Fig. 7A-132C).

10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places. Both ends of pinion pins must lie below face of carrier or interference may occur.



Fig. 7A-130C--Removing Planet Pinion Pin



Fig. 7A-132C--Installing Planet Pinion Pin

## OUTPUT SHAFT, REAR INTERNAL GEAR, SUN GEAR AND SHAFT

### Output Shaft

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:

a. Thread Tool J-21465-16 into bushing and using Slide Hammer J-2619, remove bushing.

b. Using Tool J-21465-1 with drive handle J-8092, install bushing into place until tool bottoms.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

4. Inspect splines for damage.

5. Inspect drive lugs for damage.

6. Inspect speedometer drive gear.

### Inspection of Rear Internal Gear

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Inspect gear for cracks.

### Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Be sure oil lubrication hole is open.

### Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling. If necessary to replace, proceed as follows:

## SUN GEAR SHAFT BUSHING-FRONT AND REAR

### Remove

With sun gear shaft properly supported, using Tool J-21465-15, with slide hammer and Adapter J-2619, remove bushing.

### Replace

Using Tool J-21465-5 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

### INSPECTION OF MAIN SHAFT

1. Inspect shaft for cracks or distortion.

2. Inspect splines for damage.

3. Inspect ground bushing journals for damage.

4. Inspect snap ring groove for damage.

5. Make sure that lubrication holes are open.

**NOTE:** If replacement of mainshaft is required, make sure that the orifice cup plug in the service mainshaft is removed.

## INSPECTION OF FRONT AND REAR BANDS, SUPPORT TO CASE SPACER

1. Inspect lining for cracks, flaking, burning, or looseness.

2. Inspect bands for cracks or distortion.

3. Inspect end for damage at anchor lugs or apply lugs.

4. Inspect support to case spacer for burrs or raised edges, if present remove with stone or fine abrasive.

## INSPECTION OF CASE EXTENSION - ALL EXCEPT CL MODEL

1. Inspect bushing for excessive wear or damage. If replacement is necessary, remove rear seal and with extension housing properly supported, remove bushing as follows:

a. (All except CA and CB Models) Using tool J-21465-17, with Driver Handle J-8092, drive or press replacement bushing into place, flush to .010 below oil seal counter bore area. Stake bushing, using tool J-21465-10. Stake marks to be in bushing lubrication grooves.

b. (CA and CB Models) Using Tool J-21424-9 with Driver Handle J-8092, drive or press replacement bushing into place flush to .010 below oil seal counter bore area. Stake bushing, using tool J-21465-10 (or J-8400-22). Stake marks to be in bushing lubrication grooves.

2. Inspect gasket mounting face for damage.

3. Inspect housing for cracks or porosity.

4. Be sure rear seal drain back port is not obstructed.

## INSPECTION OF CASE EXTENSION-

### CL MODEL (FIG. 7A-133C)

1. Inspect seal (case extension to case) groove for damage.

2. Inspect for cracks, or porosity.

3. Inspect dowel pin in rear face for damage.

4. Inspect oil seal for damage. If replacement is required, proceed as follows:

a. Pry oil seal from extension.

b. Apply non-hardening sealer to outside of new oil seal, and install oil seal into case extension using tool (J-24057) (see Fig. 7A-171C).

5. Inspect ball bearing assemblies. If they are damaged, or if they require cleaning, proceed as follows:

a. Remove rear seal.

b. Remove snap ring.

c. Remove ball bearings and bearing spacer, using a brass rod on the outside race of bearing. An arbor press can be used if tool to press bearing out is located on outer race of bearing.

**CAUTION: DO NOT locate against inner race or balls.**

d. Install ball bearing assembly and spacer, bearing first.

e. Install ball bearing assembly and snap ring.

f. Install new rear oil seal.

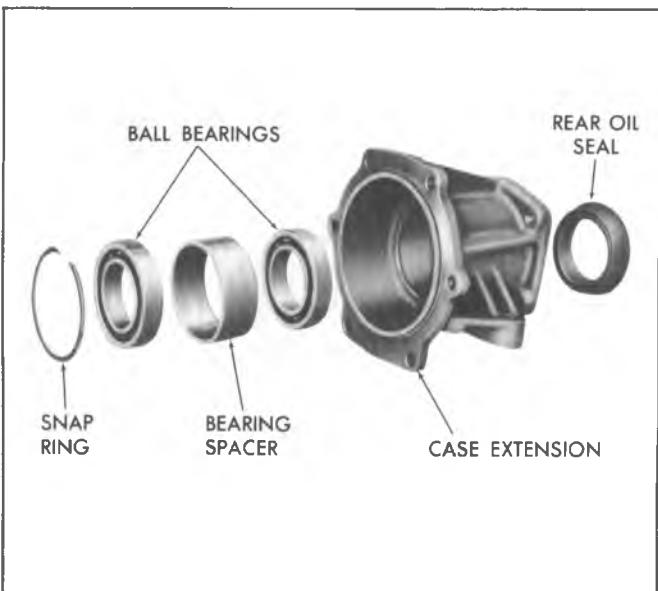


Fig. 7A-133C-Model CL Case Extension

## INSPECTION OF MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (Fig. 7A-134C).
2. Inspect "O" ring seal seat for damage.
3. Apply suction to vacuum tube and check for diaphragm leaks.
4. Check modulator bellows as outlined in Section 7 of Service Manual (modulator plunger is under pressure - 16 lbs.). If bellows is damaged plunger will have very little pressure.
5. Inspect modulator valve for nicks or damage.
6. Check freeness of valve operation in case bore.

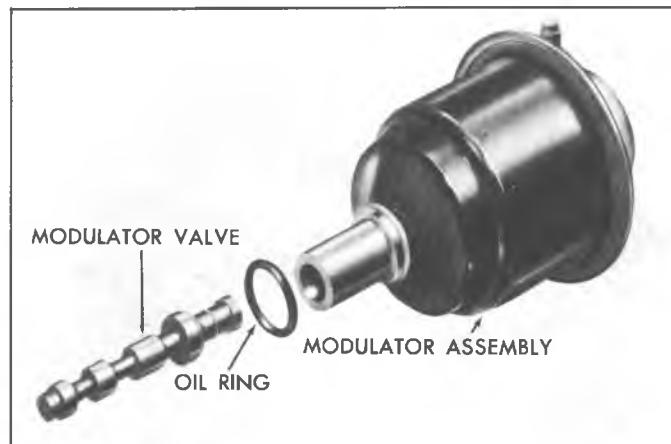


Fig. 7A-134C--Modulator Assembly and Valve

## INSPECTION OF MANUAL AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs (Fig. 7A-135C).
2. Inspect actuator spring for damage.
3. Inspect actuator for free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft for damaged threads, rough oil surface or loose lever.

6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl shaft if removed for damaged retainer groove.
8. Inspect parking pawl return spring for deformed coils or end.
9. Inspect parking bracket for cracks or wear.
10. Inspect detent roller and spring assembly.

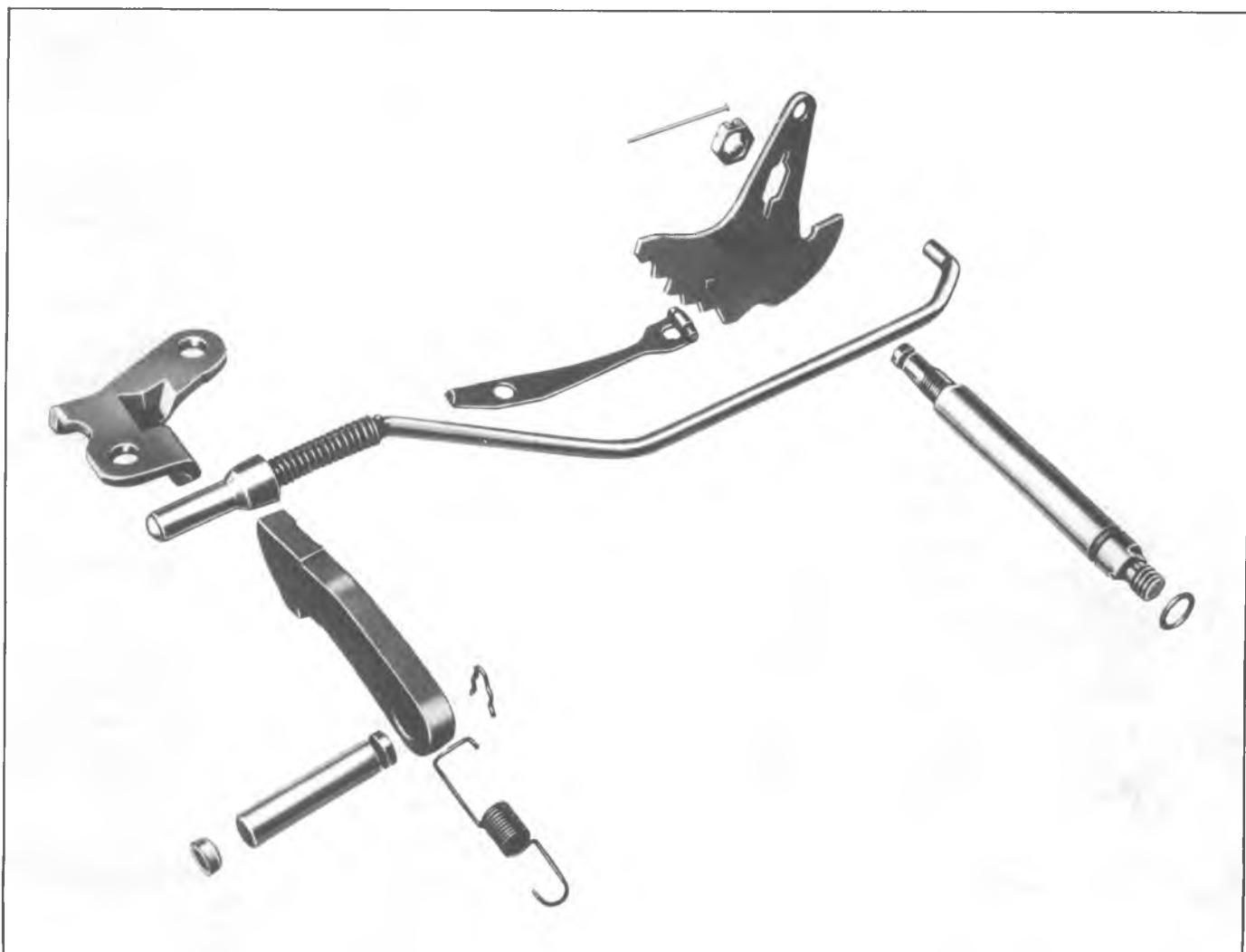


Fig. 7A-135C--Manual and Parking Linkage--Exploded View

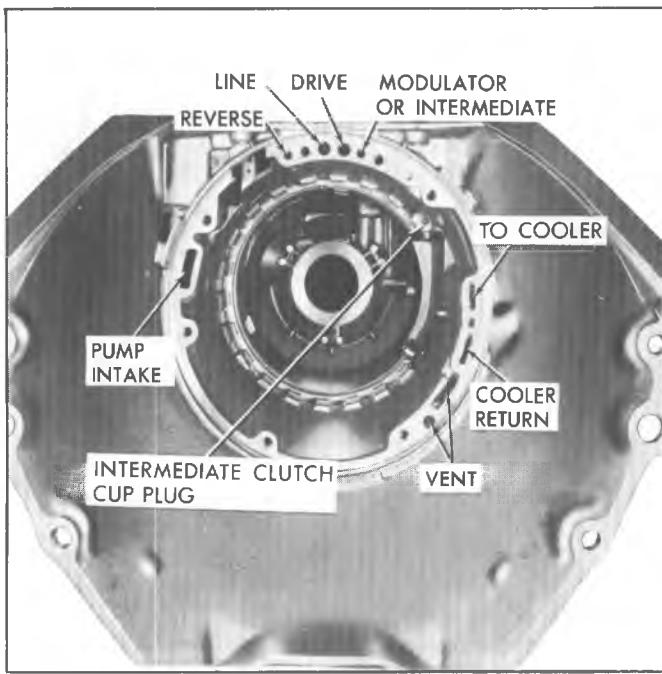


Fig. 7A-136C--Case--Front View Passage Identification



Fig. 7A-138C-Air Checking Converter

### INSPECTION OF CASE ASSEMBLY (FIGS. 7A-136C AND 7A-137C)

**CAUTION:** If the case assembly requires replacement, make sure the center support-to-case spacer is removed from the old case and reinstalled in the new case.

1. Inspect case assembly for cracks, porosity or interconnected passages.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. On model CL inspect studs for thread damage, and make sure they are tight.

**NOTE:** The two (2) studs at 9 o'clock and 11 o'clock (when viewed from the rear of case and transmission in

vehicle) are approximately 1/4" longer than the other four (4) studs. These two longer studs are required to accommodate the parking brake actuating cable bracket.

5. Inspect intermediate clutch driven plate lugs for damage or brinneling.

**NOTE:** If the case assembly requires replacement, remove the nameplate from the old case and re-install it on the new case, using the truss head nameplate attaching screw that is serviced with the case.

6. Inspect snap ring grooves for damage.
7. Inspect bore for governor assembly for scratches or scoring.
8. Inspect modulator valve bore for scoring or damage.
9. Inspect cup plug inside case for good staking and sealing.

10. Inspect case bushing. If necessary to replace, proceed as follows:

#### Case Bushing

##### Remove

With case properly supported, using tool J-21465-8, with Driver Handle J-8092, remove bushing.

##### Replace

Using tool J-21465-8 adaptor ring J-21465-9, Driver Handle J-8092, and extension J-21465-13, with lube passage facing front of transmission case, drive replacement bushing into case until .040 to .055 above selective washer face. Stake bushing with tool J-21465-10. Stake marks to be in bushing lubrication grooves.

### INSPECTION OF CONVERTER

1. Check converter for leaks as follows (Fig. 7A-138C):
  - a. Install Tool J-21369 and tighten.
  - b. Apply 80 psi air pressure to tool.
  - c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear.

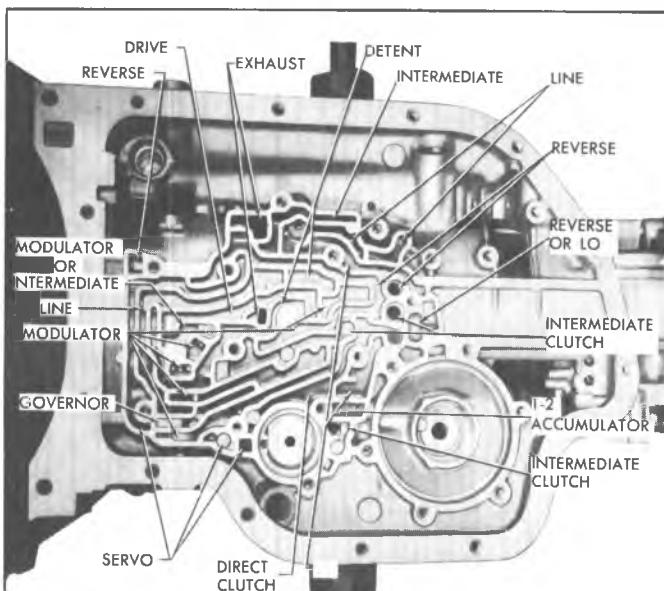


Fig. 7A-137C--Inspect Transmission Case

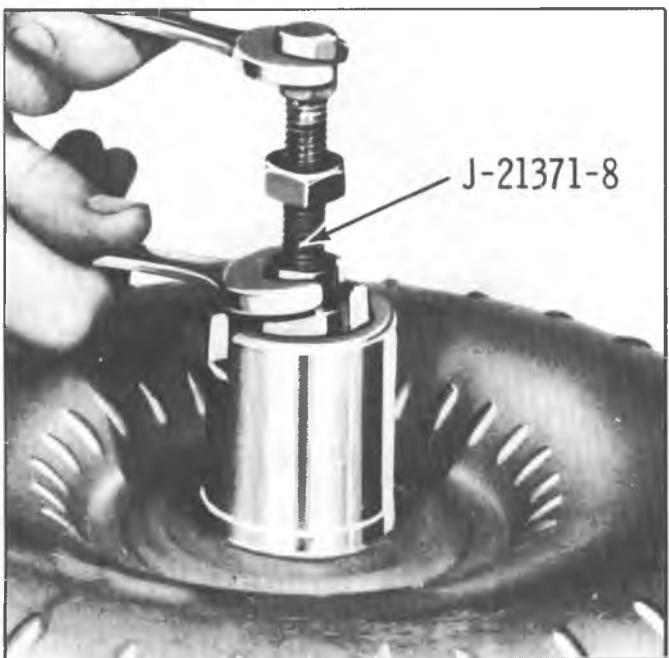


Fig. 7A-139C--Loosening Collet on Tool J-21571-8

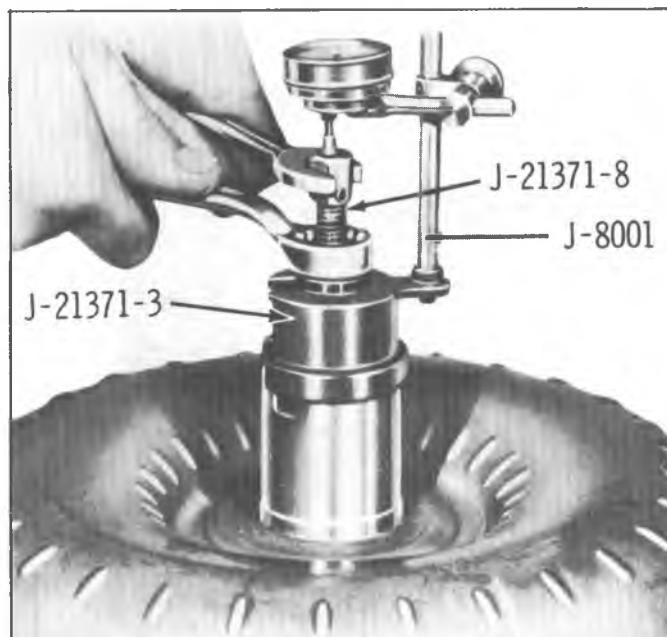


Fig. 7A-140C--Checking Converter End Clearance

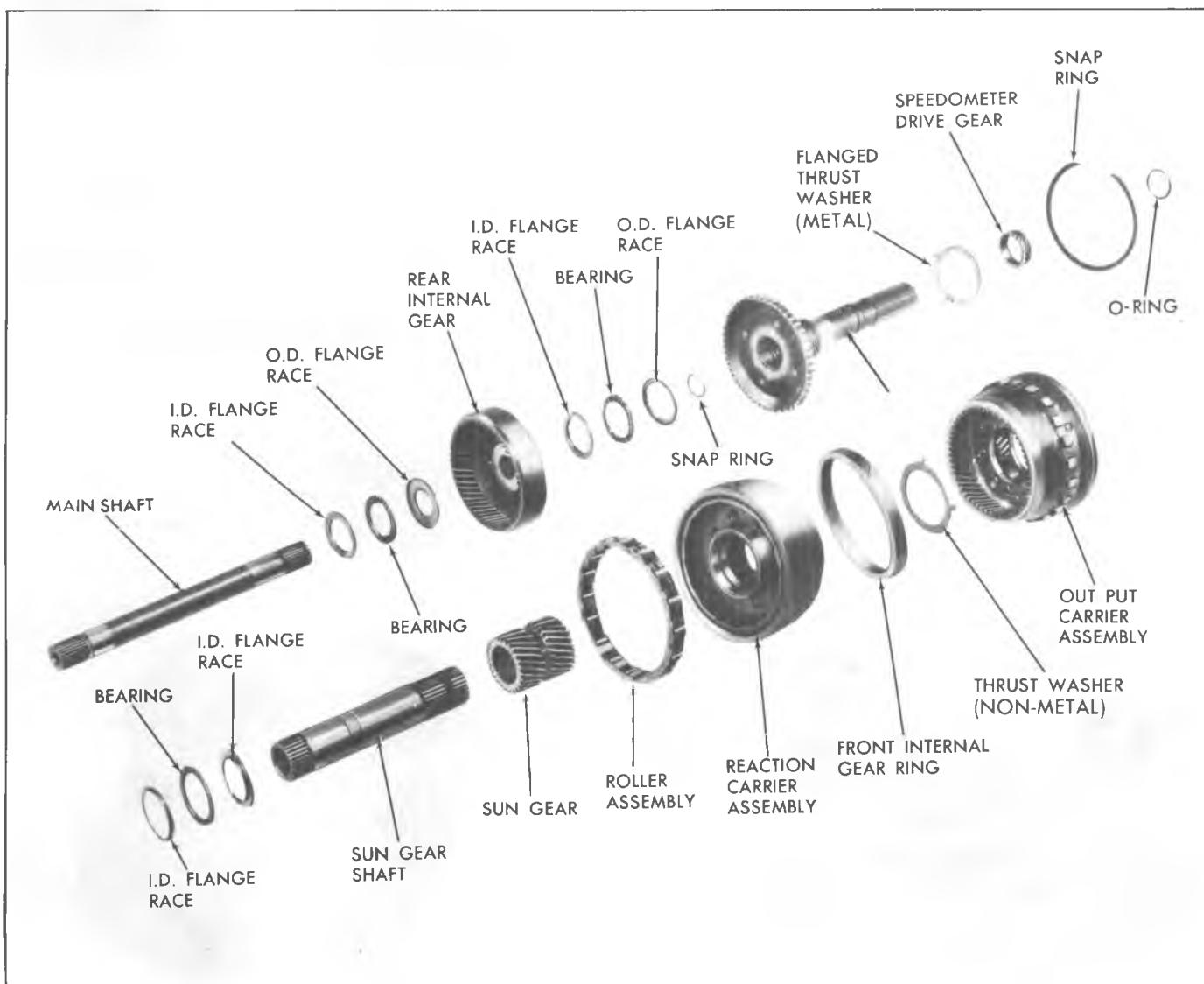


Fig. 7A-141C--Gear Unit Assembly--Exploded View

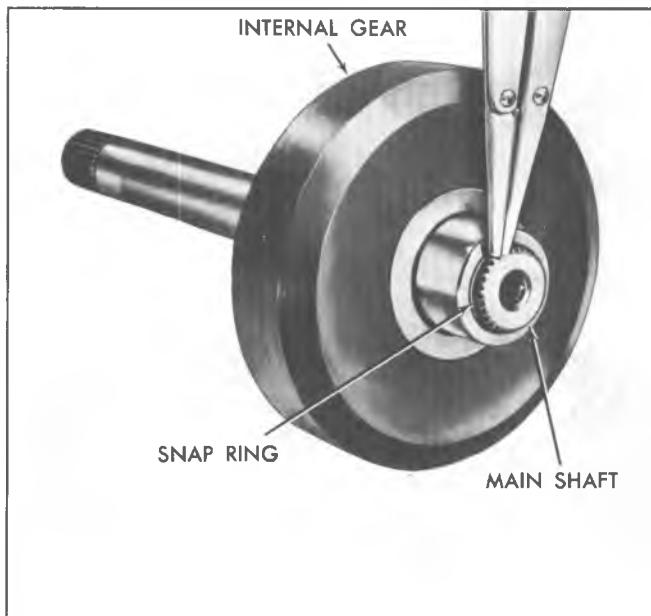


Fig. 7A-142C--Installing Rear Internal Gear Snap Ring

### Converter End Clearance Check (Figs. 7A-139C and 7A-140C)

1. Fully release collet end of Tool J-21371-8.
2. Install collet end of Tool J-21371-8 into converter hub until it bottoms; then tighten cap nut to 5 lb. ft. (Fig. 7A-139C).
3. Install Tool J-21371-3 and tighten hex nut to 3 lb. ft. (Fig. 7A-140C).
4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.
5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.

### ASSEMBLY OF REAR UNIT (FIG 7A-141C)

1. Install rear internal gear on end of main shaft.
2. Install rear internal gear retaining snap ring (Fig. 7A-142C).

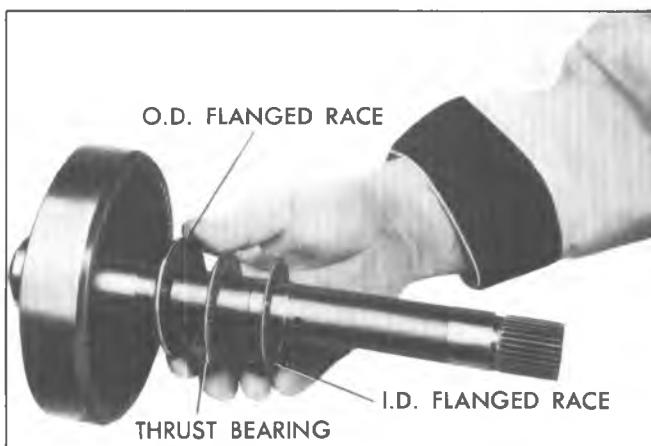


Fig. 7A-143C--Installing Rear Internal Gear to Sun Gear Bearing and Races

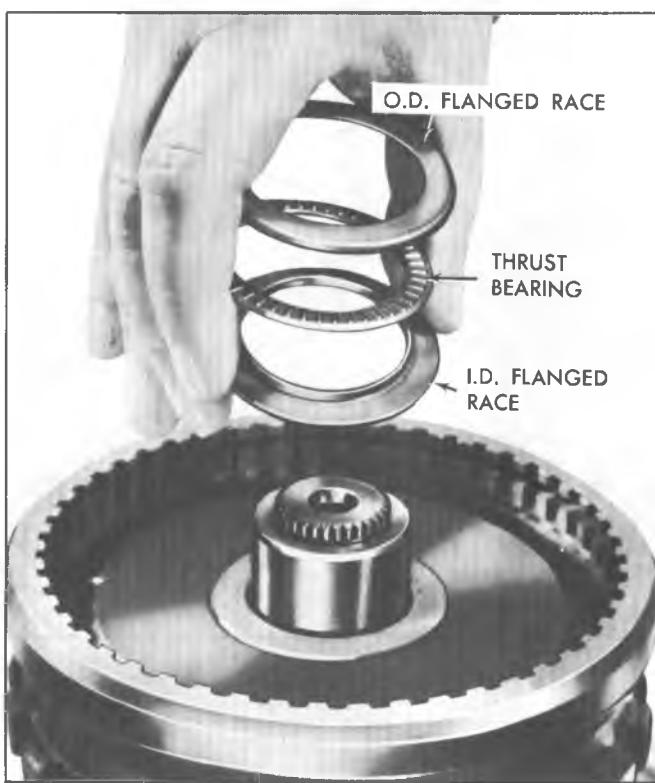


Fig. 7A-144C--Installing Rear Internal Gear to Output Shaft Bearing and Races

3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum.
- a. Place large race against internal gear with outer flange



Fig. 7A-145C--Installing Output Shaft

facing forward or up (Fig. 7A-153C).

- b. Place thrust bearing against race.
- c. Place small race against bearing with inner flange facing into bearing or down.
4. Install output carrier over mainshaft so that pinions mesh with rear internal gear.
5. Place above portion of "build-up" through hole in bench so that mainshaft hangs downward.
6. Install rear internal gear to output shaft thrust races and bearings as follows and retain with petrolatum (Fig. 7A-144C).
  - a. Place small diameter race against internal gear with center flange facing up.
  - b. Place bearing on race.
  - c. Place second race on bearing with outer flange cupped over bearing.
7. Install output shaft into output carrier assembly (Fig. 7A-145C).
8. Install output shaft to output carrier snap ring.
9. Install "O" ring on output shaft of models that use an "O" ring.
10. Turn assembly over and support so that output shaft hangs downward.
11. Install reaction carrier to output carrier metal or non-metal thrust washer with tabs facing down in pockets of output carrier and retain with petrolatum.

**NOTE:** The production built transmissions use a non-metal washer here. However, the service replacement washer is made of metal.

12. Install sun gear I.D. splines with chamfer down.
13. Install front internal gear ring over output carrier (Fig. 7A-146C).
14. Install sun gear shaft with long splined end down.
15. Install reaction carrier (Fig. 7A-147C).

**NOTE:** When a new output carrier and/or reaction carrier is being installed and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the SERVICE ring.

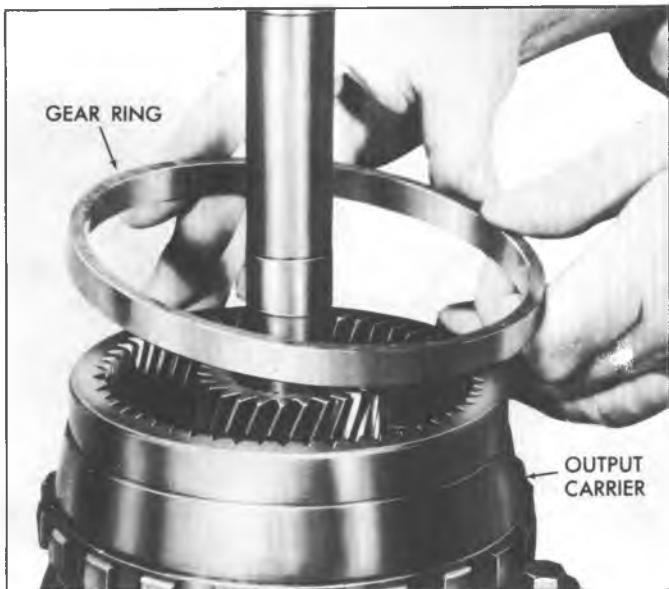


Fig. 7A-146C--Installing Front Internal Gear Ring to Output Carrier



Fig. 7A-147C--Installing Reaction Carrier

16. Install center support to sun gear thrust races and bearings as follows: (Retain with petrolatum).
  - a. Install large race, center flange up over sun gear shaft.
  - b. Install thrust bearing against race.
  - c. Install second race, center flange up (Fig. 7A-148C).

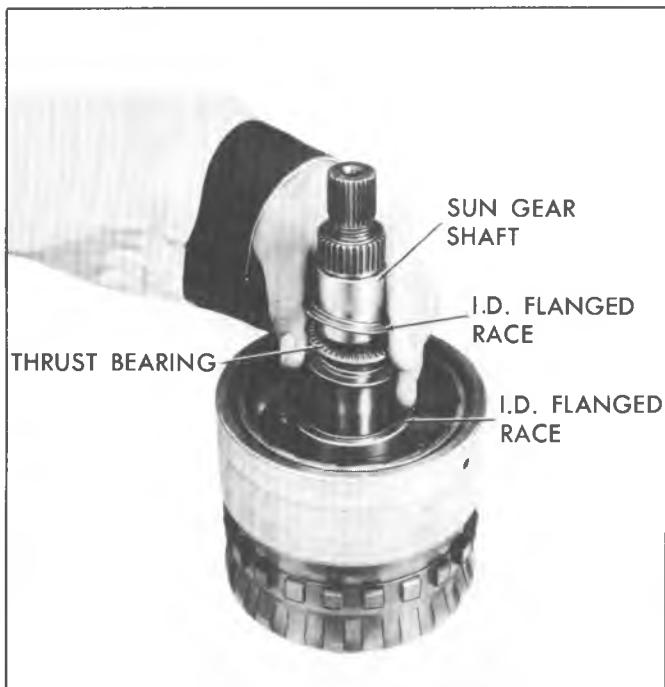


Fig. 7A-148C--Installing Center Support to Sun Gear Thrust Bearing and Races



Fig. 7A-149C--Installing Roller into Roller Clutch Cage



Fig. 7A-151C--Installing Center Support to Reaction Carrier

17. Install rollers that may have come out of the roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from the outer edge (Fig. 7A-149C).

18. Install roller clutch assembly (Fig. 7A-150C) into reaction carrier.

19. Install center support to reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7A-47C).

20. Install center support into roller clutch in reaction carrier (Fig. 7A-151C).

**NOTE:** With reaction carrier held, center support should only turn counter-clockwise after installation.

21. Install J-21795 on gear unit assembly to hold units in place.

22. Install output shaft to case thrust washer tabs in pockets (Fig. 7A-152C), and retain with petrolatum.

**NOTE:** This must be a metal washer.

#### CASE MODIFICATION-CORVETTE

**NOTE:** Due to the configuration of the body floor pan, it is necessary to modify the standard Service Case when used as a replacement part for the Corvette.

Using a "C" Clamp, clamp the transmission case firmly to a suitable bench, with the converter under pan attaching face down, as shown in Figure 7A-153C, (do not damage machined surface of the case).

Using a hacksaw, remove the two front manufacturing lugs (one on each side), as close to the wall of the case as possible, using caution not to cut into the wall of the case.

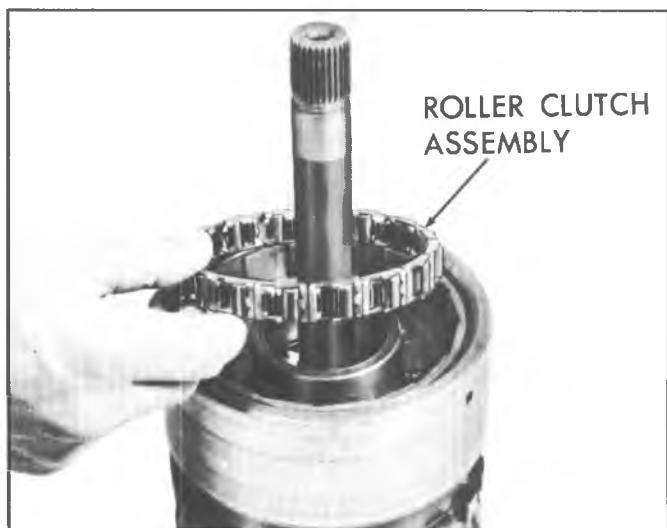


Fig. 7A-150C--Installing Roller Clutch to Reaction Carrier

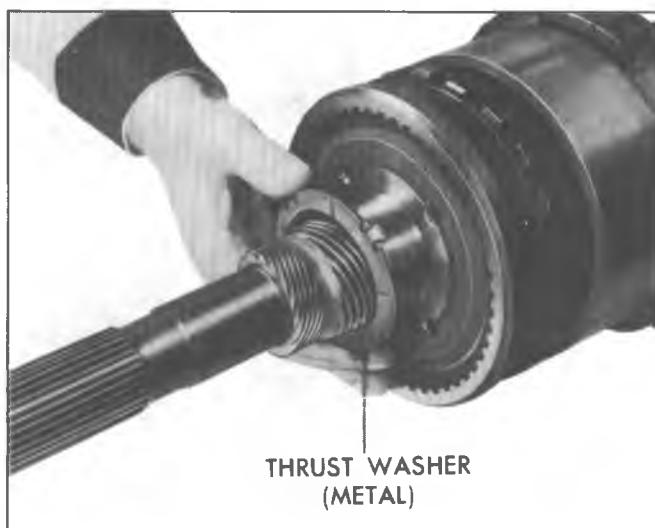


Fig. 7A-152C--Installing Case to Output Shaft Thrust Washer

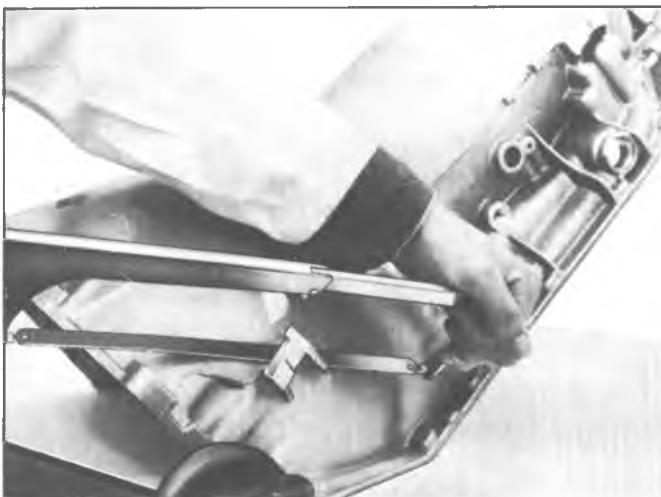


Fig. 7A-153C--Modification of Service Case for Corvette Models

### ASSEMBLY OF UNITS TO TRANSMISSION CASE

**NOTE:** The first three steps can be omitted if the parts involved were not removed on disassembly.

1. Install parking pawl tooth toward inside of case, and parking pawl shaft (Fig. 7A-154C).
2. Install parking pawl shaft retainer clip (Fig. 7A-155C).
3. Install parking pawl shaft cup plug and drive into the case, using a 3/8 dia. rod, until the parking pawl shaft bottoms on the case rib (Fig. 7A-154C).
4. Install parking pawl return spring, square end hooked on pawl and other end on case.
5. Install parking bracket with guides over parking pawl using two attaching bolts, torque to 18 ft. lbs.
6. Install rear band assembly so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (Fig. 7A-156C).



Fig. 7A-154C--Installing Parking Pawl Shaft Cup Plug

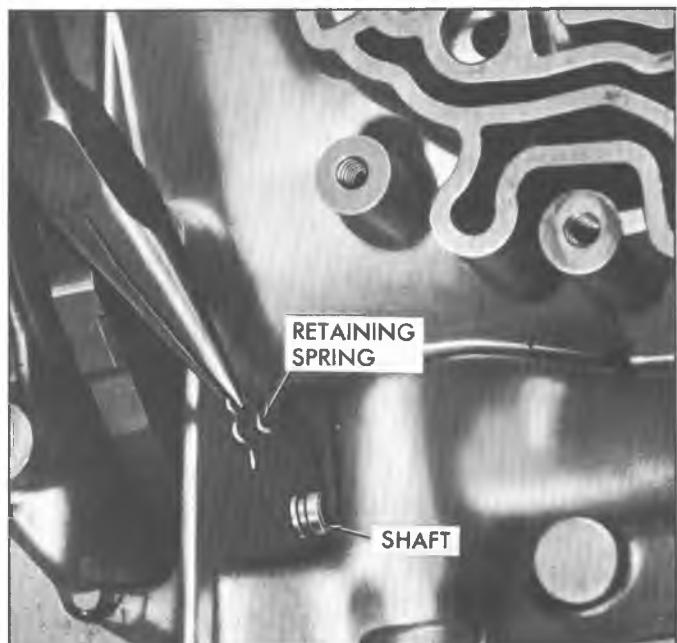


Fig. 7A-155C--Installing Parking Shaft Retaining Spring



Fig. 7A-156C--Installing Rear Band



Fig. 7A-157C--Installing Center Support to Case Spacer

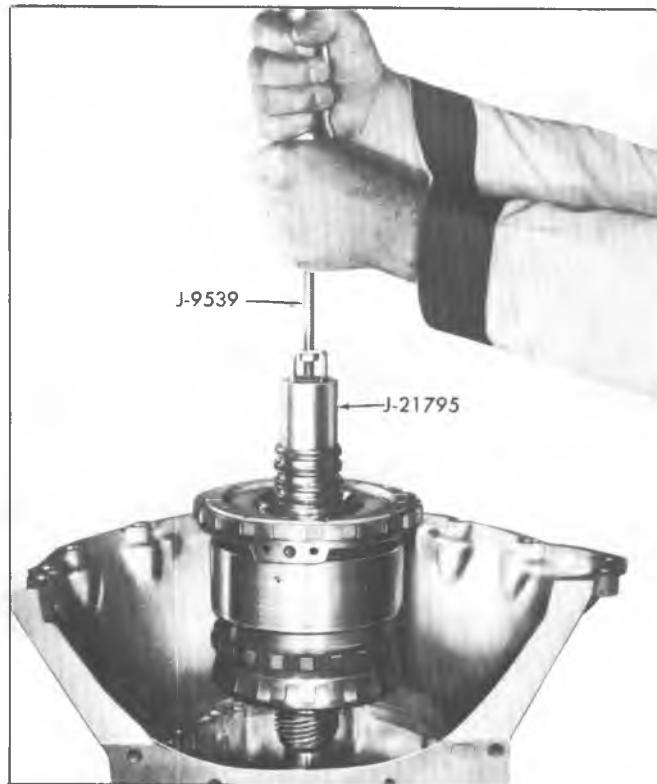


Fig. 7A-158C--Installing Center Support and Gear Unit

7. Install the center support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin (Fig. 7A-157C).

**CAUTION:** Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).

8. Install proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case.

9. Install complete gear unit assembly into case, using Tool J-21795 (Fig. 7A-158C).

10. Install center support to case retaining snap ring with bevel side up (flat surface against the center support) and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (Fig. 7A-159C).

11. Install case to center support bolt by placing the

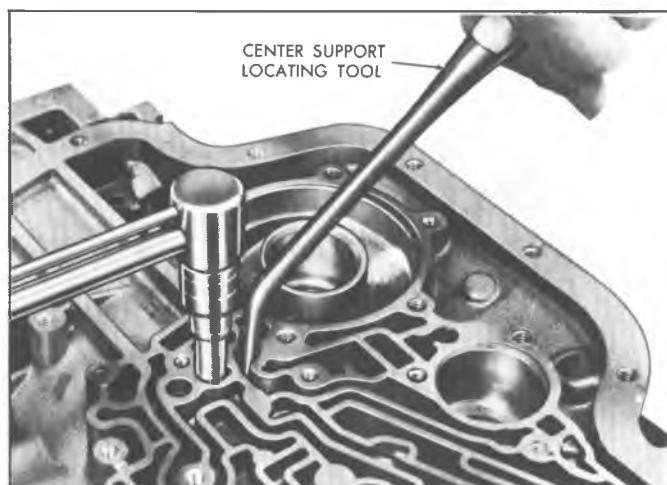


Fig. 7A-160C--Installing Center Support Bolt

center support locating tool into the case direct clutch passage, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face. Apply pressure downward on the tool handle which will tend to rotate the center support counterclockwise as viewed from the front of the transmission. While holding the center support firmly, counterclockwise against the case splines, torque the case to center support bolt to 20-25 ft. lbs., using a 3/8" 12-point thin wall deep socket (Fig. 7A-160C).

**CAUTION:** When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.

12. Install intermediate clutch plates.

a. (All models except CB, CL and CS) Lubricate with transmission oil two (2) flat steel and one (1) waved steel plates and three (3) composition-faced intermediate clutch plates and install, starting with waved steel plate and alternating composition-faced and flat steel plates (Fig. 7A-161C).

b. (Models CB, CL and CS) Lubricate with transmission oil three (3) flat steel and three (3) composition-faced intermediate clutch plates and install, starting with flat steel and alternating composition-faced and flat steel plates (Fig. 7A-161C).

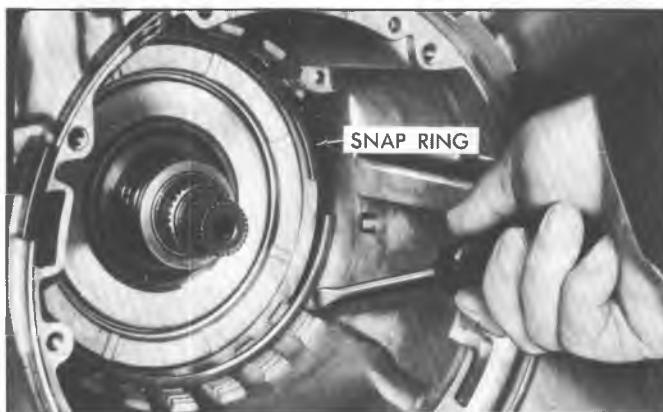


Fig. 7A-159C--Installing Center Support to Case Snap Ring

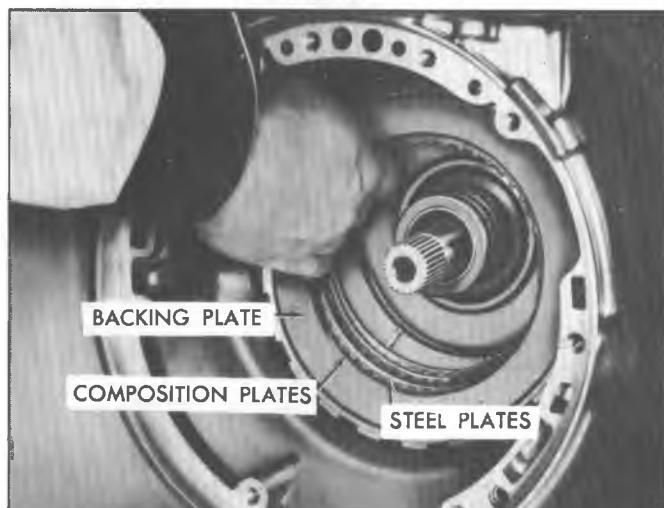


Fig. 7A-161C--Installing Intermediate Backing Plate and Clutch Plates

## REAR END WASHER THICKNESS

Thickness	Identification	Notches and/or Numeral
.074 - .078	None	1
.082 - .086	1 Tab Side	2
.090 - .094	2 Tab Side	3
.098 - .102	1 Tab O.D.	4
.106 - .110	2 Tabs O.D.	5
.114 - .118	3 Tabs O.D.	6

Fig. 7A-162C--Rear End Washer Selection Chart

**NOTE:** The models CL and CZ intermediate composition-faced plates are different from the other models. Refer to parts catalog for correct usage.

13. Install intermediate clutch backing plate, ridge up (Fig. 7A-161C).

14. Install intermediate clutch backing plate to case snap ring, locating gap opposite band anchor pin.

**NOTE:** Both sides of this snap ring are flat, and it is .093" thick.

15. Check rear end play as follows:

a. Install a 3/8"-16 bolt or J-9539, into an extension housing attaching bolt hole (Fig. 7A-37C).

b. Mount a dial indicator on a rod and index with end of output shaft.

c. Move output shaft in and out to read end play. End play should be from .007"-.019". The selective washer controlling this end play is a steel washer having 3 lugs that is located between thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specifications, it can be selected from the chart shown in Fig. 7A-162C.

16. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (Fig. 7A-163C).

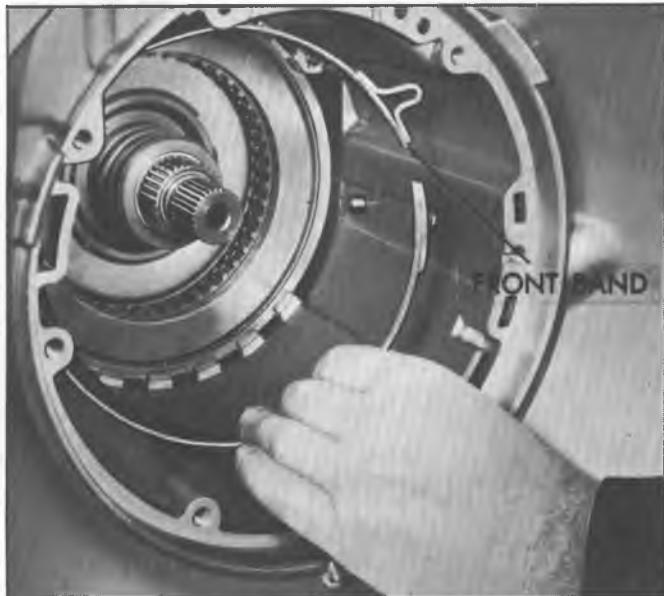


Fig. 7A-163C--Installing Front Band

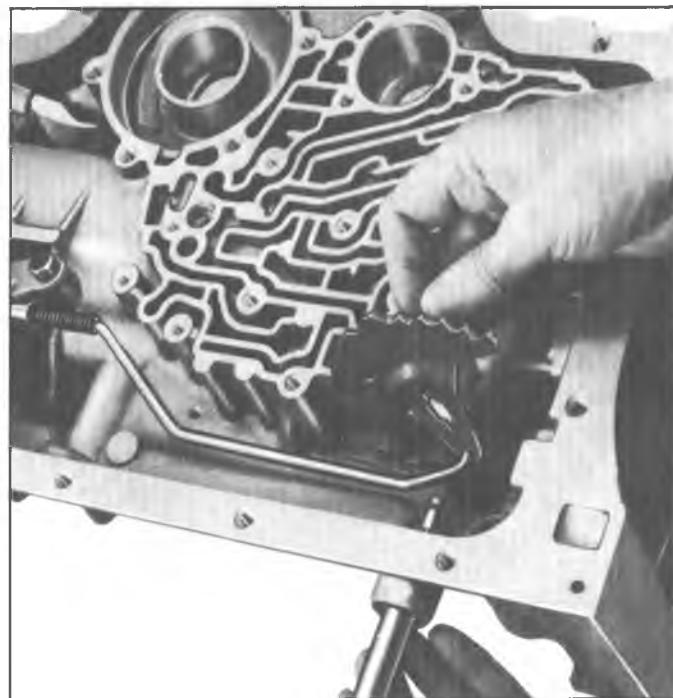


Fig. 7A-164C--Installing Manual Shaft to Case

## Install Manual Linkage

a. Install a new manual shaft seal into transmission case using a 3/4 diameter rod to seat seal.

b. If removed, insert actuator rod into manual detent lever from side opposite pin.

c. Install actuator rod plunger under parking bracket over parking pawl.

d. Install manual shaft through case and detent lever (Fig. 7A-164C).

e. Install detent jam nut on manual shaft, and tighten to 18 ft. lbs. (Fig. 7A-165C).

f. Install retaining pin indexing with groove in manual shaft. Rotate transmission to vertical position and remove J-21795.

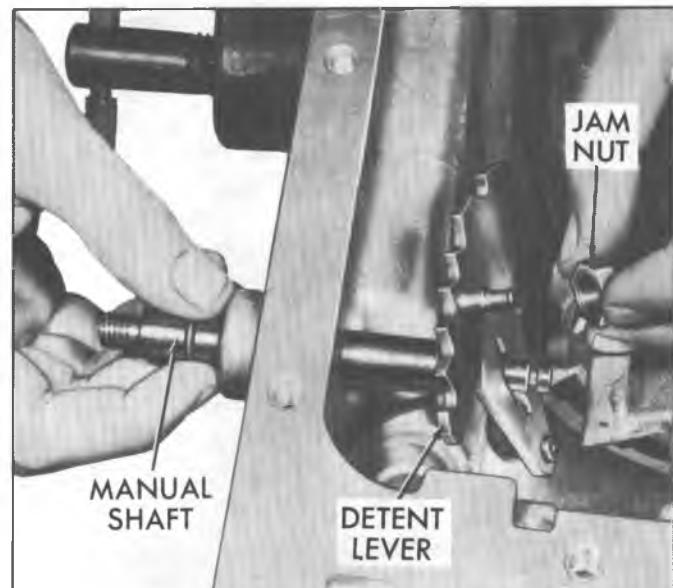


Fig. 7A-165C--Installing Detent Lever and Jam Nut to Manual Shaft

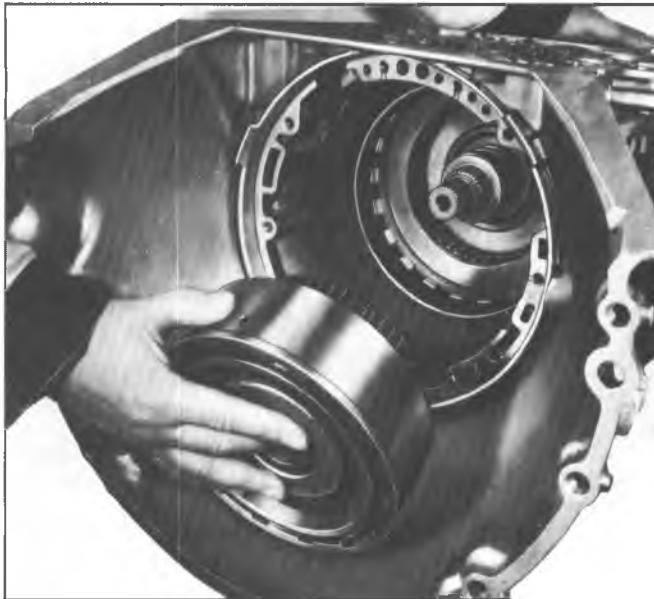


Fig. 7A-166C--Installing Direct Clutch Assembly

17. With converter end of transmission up, carefully install direct clutch and intermediate roller assembly. It will be necessary to shake and slightly twist housing to allow roller outer race to index with composition plates. Housing hub will bottom on sun gear shaft (Fig. 7A-166C).

**NOTE:** First visually line up the intermediate clutch drive lugs, one above the other to help engagement of housing hub splines. It also may be helpful to remove the direct clutch plates while installing housing.

18. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub, if not already installed. Retain with petrolatum.

19. Install forward clutch assembly and turbine shaft; indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is seated it will be approximately 1-1/4" from pump face in case (Fig. 7A-167C).



Fig. 7A-167C--Installing Forward Clutch Assembly and Turbine Shaft



Fig. 7A-168C--Installing Pump Seal

20. Install pump assembly and gasket.

**NOTE:** If turbine shaft cannot be rotated as pump is being pulled into place, forward or direct clutch housing have not been properly installed to index with all clutch plates. This condition must be corrected before pump is pulled fully into place.

21. Install all but one pump attaching bolts and seals. Torque to 18 ft. lbs. (See Figure 7A-169C for location of omitted bolt.)

22. If necessary to install a new front seal, use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (Fig. 7A-168C).

23. Check front unit end play as follows (Fig. 7A-169C).

a. Install a 3/8"-16 threaded bolt or a Slide Hammer Bolt J-9539 into bolt hole in pump.

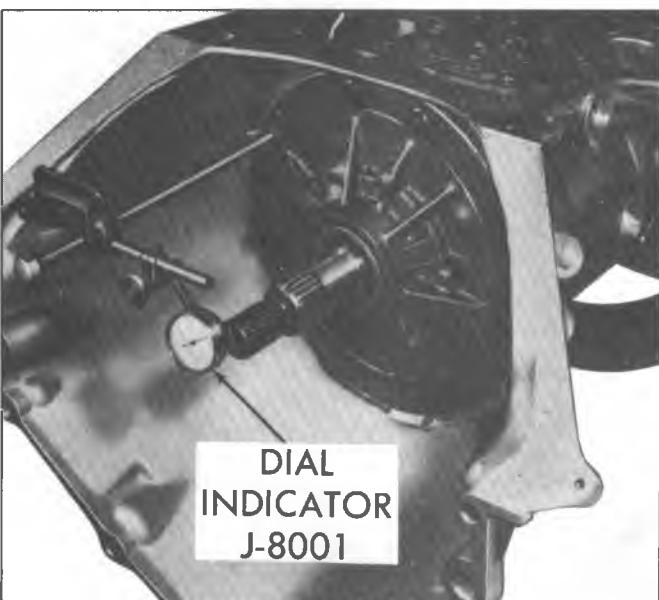


Fig. 7A-169C--Checking Front Unit End Play

**FRONT END WASHER THICKNESS**

Thickness	Color
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

Fig. 7A-170C--Front End Washer Selection Chart

b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

c. Push turbine shaft rearward.

d. Push output shaft forward.

e. Set dial indicator to zero.

f. Pull turbine shaft forward.

Read resulting travel or end play which should be .003"-.024". Selective washer controlling this end play is located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart in Fig. 7A-170C.

**NOTE:** An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

24. Install remaining front pump attaching bolt and seal. Torque 18 ft. lbs.

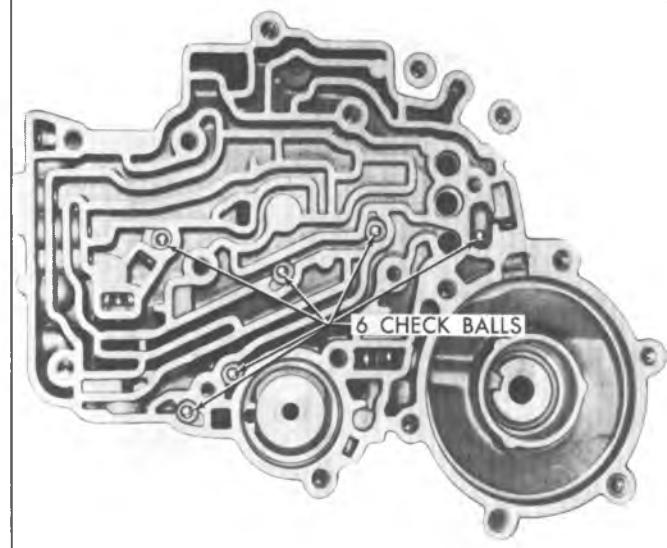


Fig. 7A-172C--Location of Check Balls

**CASE EXTENSION ASSEMBLY**

1. Install new case extension housing to case gasket on extension housing. Model CL uses a seal between the extension housing and case extension.

2. Attach extension housing to case using attaching bolts and/or studs. Torque bolts to 20-25 ft. lbs.

**NOTE:** Models CA, CG and CR use two (2) studs at 5 o'clock and 7 o'clock positions (when viewed from the rear of case and transmission in vehicle). These studs are for the installation of the catalytic converter. Torque the studs to 20-25 ft. lbs.

3. If necessary, install a new seal as follows:

a. (All except CL Models) use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (Fig. 7A-171C).

b. (Model CL) use a non-hardening sealer on outside of seal body; and using Tool J-24057 drive seal in place (Fig. 7A-171C).

**Installation of Check Balls, Control Valve Spacer Plate and Gasket,****Detent Solenoid, Front Servo Assembly, and Electrical Connector**

1. Install two control valve assembly attaching bolts with heads cut off as guide pins as shown in figure 7A-183C.

2. Install six (6) check balls into ball seat pockets in transmission case. Figure 7A-172C.

**NOTE:** If transmission is in the vehicle, install check balls into ball seat pockets on spacer plate (Fig. 7A-173C).

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid and a "C" near front servo location) (Fig. 7A-174C).

4. Install control valve spacer plate and control valve to spacer plate gasket (gasket identified with a "VB" near front servo).

5. Install detent solenoid gasket.

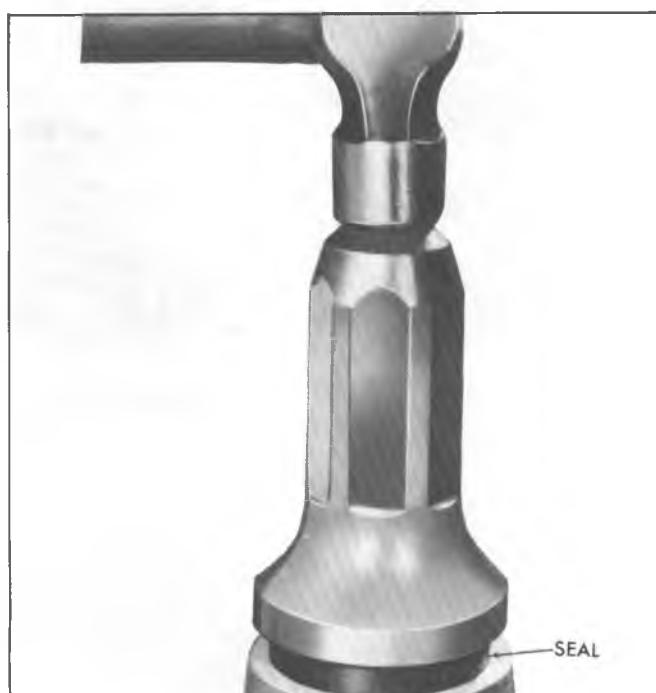


Fig. 7A-171C--Installing Extension Oil Seal (Typical)

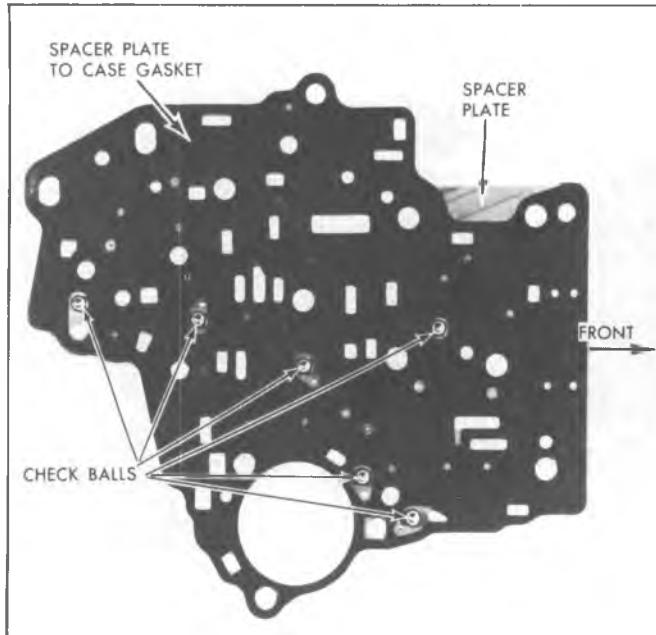


Fig. 7A-173C--Location of Check Balls--In Vehicle Installation

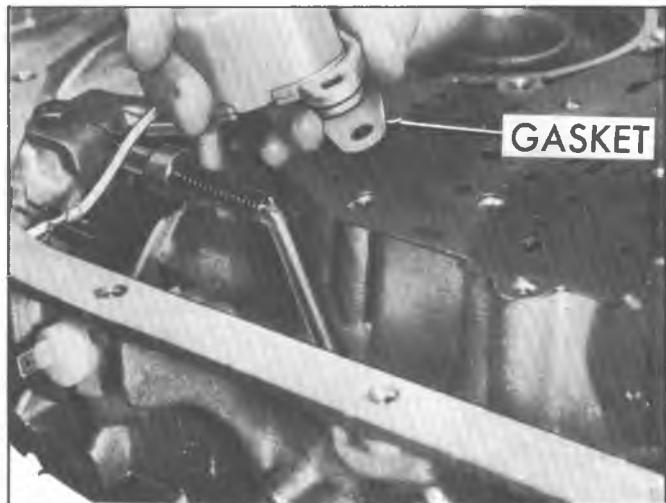


Fig. 7A-175C--Installing Detent Solenoid and Gasket

6. Install detent solenoid assembly with connector facing outer edge of case (Fig. 7A-175C). Do not tighten bolts at this time.

7. Install front servo spring and spring retainer into transmission case.

8. Install retainer pins in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.

9. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan. (Figure 7A-176C).

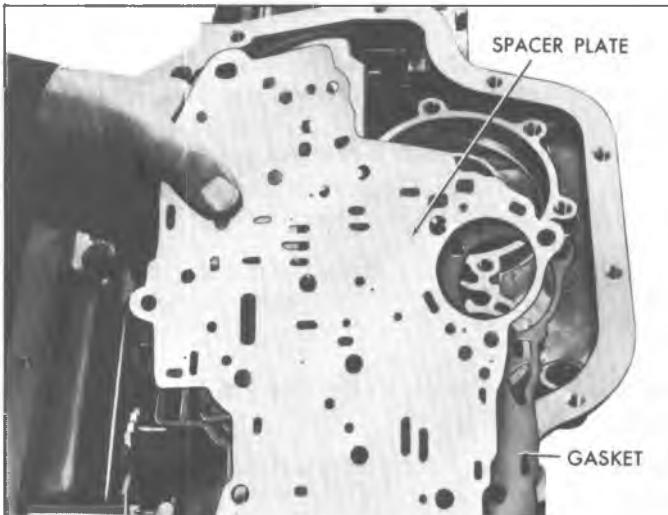


Fig. 7A-174C--Installing Control Valve Assembly Spacer Plate and Gasket

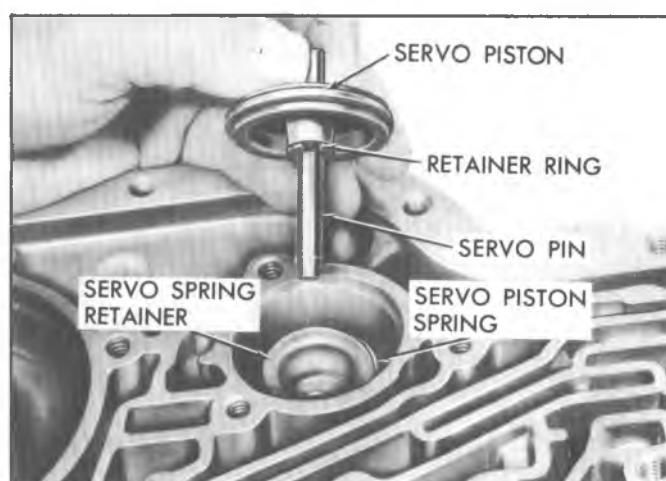


Fig. 7A-176C--Installing Front Servo Piston, Washer, and Pin

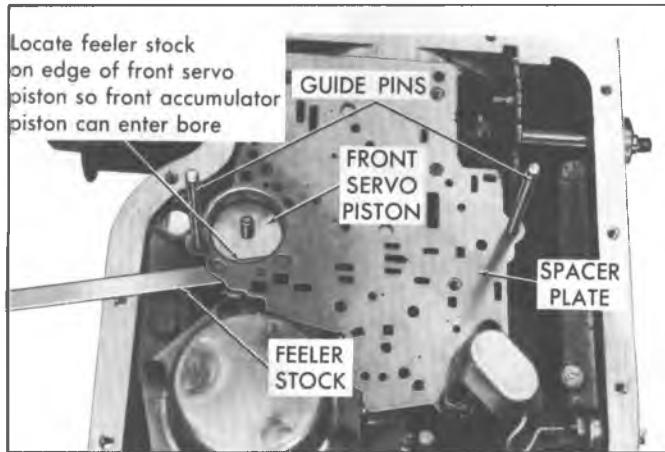


Fig. 7A-177C--Front Servo Group--In Vehicle Installation

**NOTE:** The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

If transmission is in the vehicle, assemble front servo group as shown in figure 50T and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gauge or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group. Figure 7A-177C.

10. Install "O" ring seal on electrical connector.
11. Lubricate and install electrical connector with lock tabs facing into case, positioning locator tab in notch on side of case (Fig. 7A-178C).
12. Install detent wire to electrical connector (Fig. 7A-12C).

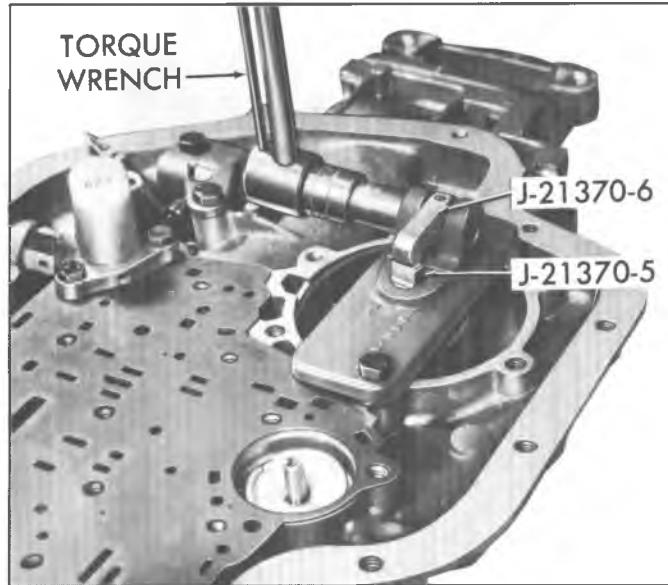


Fig. 7A-179C--Checking Rear Band Pin

### Installation of Rear Servo Assembly

1. Check rear servo band apply pin. (Fig. 7A-179C).
  - a. Attach band apply pin selection Gauge J-21370-6 and J-21370-5 to transmission case (lever pivot pin to rear) with attaching screws.

Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

- b. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two, or three rings.

There are three selective pins identified as follows:

1. If both steps are below the gauge surface, the long pin, identified by 3 rings, should be used.
2. If the gauge surface is between the steps, the medium pin, identified by 2 rings, should be used.

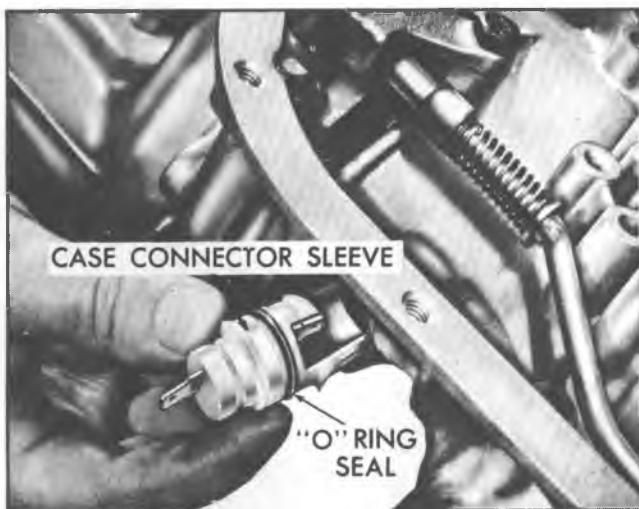


Fig. 7A-178C--Installing Electrical Connector and "O" Ring Seal



Fig. 7A-180C--Installing Rear Accumulator Spring



Fig. 7A-181C--Installing Rear Servo Assembly

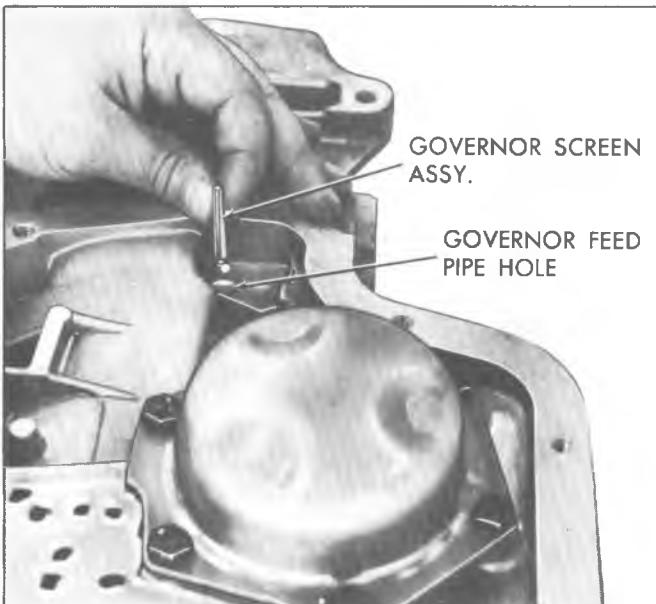


Fig. 7A-183C--Installing Governor Screen Assembly

3. If both steps are above the gauge surface, the short pin, identified by 1 ring, should be used.
2. Install rear accumulator spring into case (Fig. 7A-180C).
3. Lubricate and install rear servo assembly into case (Fig. 7A-181C).
4. Install rear servo gasket and cover (Fig. 7A-182C).
5. Install attaching screws. Torque bolts to 15-20 ft. lbs.

#### INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable.
2. Install governor screen assembly, open end first, into governor feed pipe hole in case (hole nearest the center of the transmission) (Fig. 7A-183C).

**NOTE:** If transmission is in vehicle, before installing the

control valve assembly and governor pipes as outlined in Step 3 below, insert the governor screen, closed end first, into governor feed pipe. (This pipe locates in the governor feed pipe hole in the case nearest the center of the transmission). See Figure 7A-183C.

3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen (Fig. 7A-184C). Make certain gasket and spacer do not become mispositioned.

**NOTE:** Check manual valve to make sure it is indexed properly with pin on detent lever and check governor pipes to make certain they are properly seated in case holes.

4. Start control valve assembly attaching bolts.

**NOTE:** If transmission is in the vehicle, remove feeler stock before tightening any control valve bolts.

5. Remove guide pins and install detent roller and spring assembly and remaining bolts (Fig. 7A-185C).



Fig. 7A-182C--Installing Rear Servo Cover and Gasket

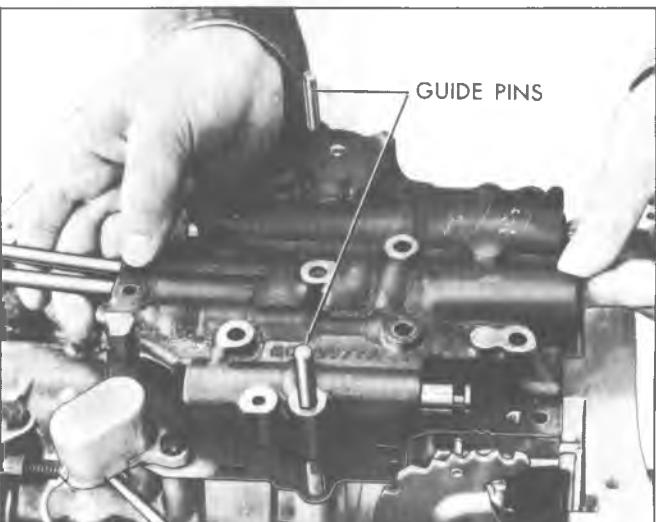


Fig. 7A-184C--Installing Control Valve Assembly and Governor Pipes

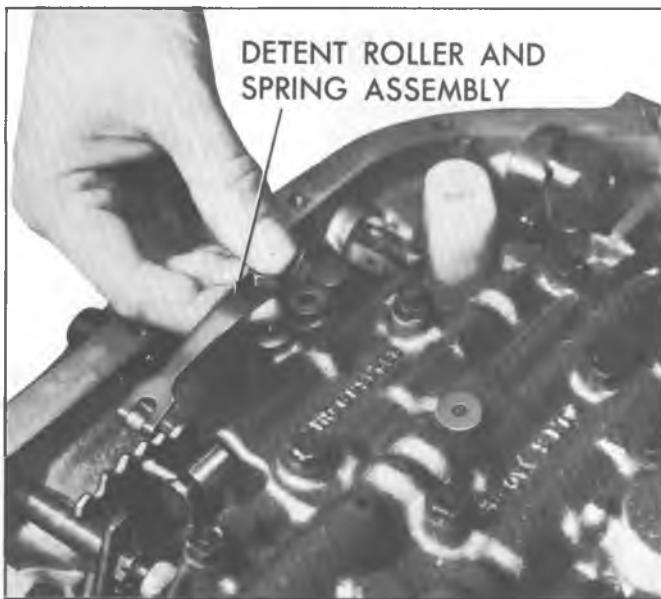


Fig. 7A-185C--Installing Detent Roller and Spring Assembly



Fig. 7A-187C--Installing Governor Assembly

#### INSTALLATION OF FILTER AND INTAKE PIPE

1. Install case to intake pipe "O" ring seal on intake pipe and assemble into filter assembly.
2. Install filter and intake pipe assembly (Fig. 7A-8C).
- NOTE:** It is recommended that the filter be replaced, rather than cleaned, whenever the transmission is disassembled.
3. Install filter retainer bolt (Fig. 7A-7C).
4. Install new bottom pan gasket and bottom pan, with attaching screws. Torque to 12 ft. lbs.

#### INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case, stem end out (Fig. 7A-186C).
2. Install "O" ring seal on vacuum modulator.
3. Install vacuum modulator into case.

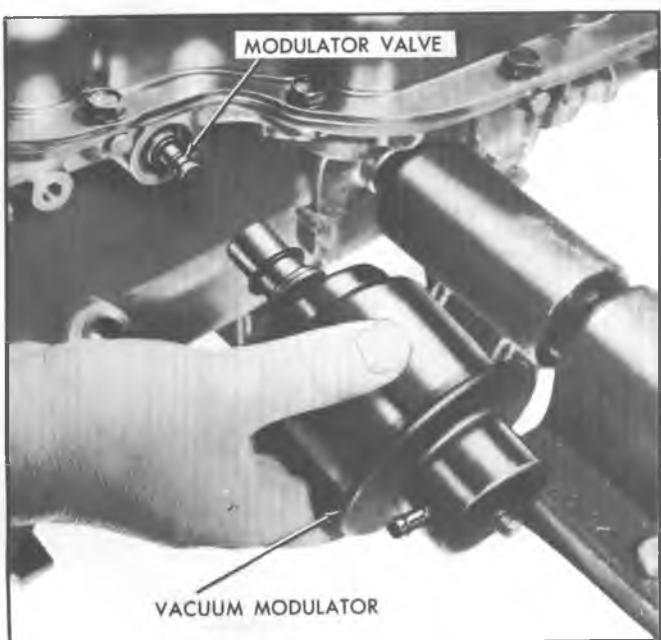


Fig. 7A-186C--Installing Vacuum Modulator and Valve

**NOTE:** Models CA and CZ use a modulator that is different than the modulator used on the other models. Refer to parts catalog book for correct usage.

4. Install modulator retainer and attaching bolt. Torque bolt 18 ft. lbs.

#### INSTALLATION OF GOVERNOR ASSEMBLY

1. Install governor assembly into case (Fig. 7A-187C).
2. Attach governor cover and gasket with four (4) attaching bolts. Torque bolts to 18 ft. lbs.

#### INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install speedometer driven gear assembly (Fig. 7A-188C).



Fig. 7A-188C--Installing Speedometer Driven Gear and Sleeve

2. Install speedometer driven gear retainer and attaching bolt.

#### INSTALL CONVERTER ASSEMBLY

With the transmission in cradle or portable jack, install the converter assembly into the pump assembly making

certain that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

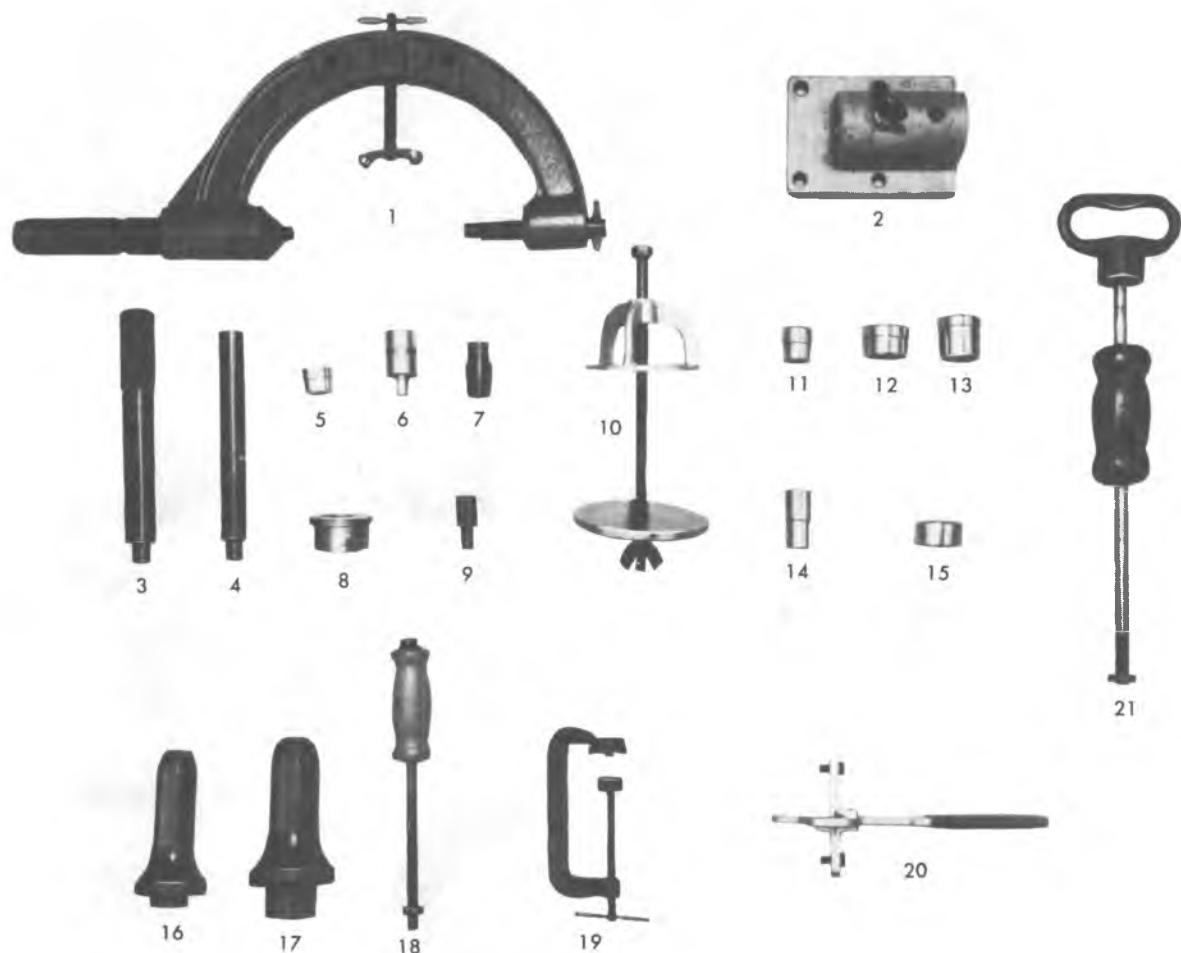
**NOTE:** The converter used in the CB, CF, CL, CM, CS and CT models has six (6) mounting lugs.

### SPECIAL TOOLS



- |              |  |            |  |
|--------------|--|------------|--|
| 1. J25015    | Oil Pump Body and Cover Alignment Band                 | 8. J25014  | Intermediate Band Apply Pin Gauge          |
| 2. J25016    | Front Oil Pump Seal Installer                          | 9. J25021  | Turbine Shaft and Direct Clutch Installer  |
| 3. J25020-01 | Converter Stator and Turbine End-Play Checking Fixture | 10. J25025 | Alignment Pin and Stud Set                 |
| 4. J25023    | Reverse Clutch Selective Shim Group                    | 11. J25013 | Output Shaft and Rear Unit Support Fixture |
| 5. J25012    | Reverse Clutch Housing Installer and Remover           | 12. J25010 | Direct Clutch Seal Protector               |
| 6. J25018    | Forward Clutch Spring Compressor                       | 13. J25011 | Reverse Clutch Seal Protector              |
| 7. J25019    | Bushing Service Set                                    | 14. J25022 | End-Play Checking Fixture Adapter          |

Fig. 7A-1ST-THM 200 Special Tools



- |               |   |                          |   |
|---------------|---|--------------------------|---|
| 1. J-8763-02  | Transmission Holding Fixture<br>(Used with J-3289-20 Base)            | 16. J-5154 or<br>J-21426 | Extension Housing Oil Seal<br>Installer   |
| 2. J-3289-20  | Transmission Holding Fixture<br>Base                                  | 17. J-21359              | Pump Oil Seal Installer   |
| 3. J-8092     | Driver Handle (Threaded type)   | 18. J-7004               | Slide Hammers (Pair) For  |
| 4. J-21465-13 | Driver Handle Extension (Used with J-8092)                            | 19. J-22269-01           | Pump Body removal (3/8" x 16 tread)<br>Direct Clutch Accumulator Piston<br>Remover and Installer (THM 350 only) |
| 5. J-23062-3  | Sun Gear and Reaction Carrier<br>Bushing                              | 20. J-23069              | Intermediate Accumulator Cover<br>Remover and Installer   |
| 6. J-23062-7  | Output Shaft Bushing Installer  | 21. J-2619-01            | Slide Hammer (5/8" x 18<br>with 1/2" x 13 Adapter)  |
| 7. J-21465-15 | Stator Shaft Front Bushing<br>Remover (Used with J-8092)              | Not Illustrated          |   |
| 8. J-23329    | Direct Clutch Bushing Installer                                       | J-21369                  | Converter Pressure Check<br>Fixture   |
| 9. J-9534-01  | Output Shaft Bushing Remover  | J-8001                   | Dial Indicator Set<br>(.001" Increments, .001" Travel)  |
| 10. J-23327   | Clutch Spring Compressor  | J-21427-1                | Speedo Gear Remover   |
| 11. J-23062-2 | Stator Shaft Rear Bushing<br>Installer (Both Rear)                    | J-9539                   | Slide Hammer Bolts (3/8" - 16 Threads)  |
| 12. J-23062-1 | Case Bushing Remover and Installer                                    | J-8105                   | Speedo Gear Remover Puller  |
| 13. J-21424-9 | Extension Housing Bushing Remover and<br>Installer (Used with J-8092) | J-5586                   | Snap Ring Pliers  |
| 14. J-21424-7 | Stator Shaft Front Bushing<br>Installer (Used with J-8092)            | J-24367                  | Transmission Band Adjuster (THM 250 only)   |
| 15. J-23062-5 | Input Ring Gear Bushing<br>Remover and Installer                      | J-24675                  | Accumulator Piston Adapter (Used with J-22269-01)   |

Fig. 7A-2ST-CBC 250/350 Special Tools

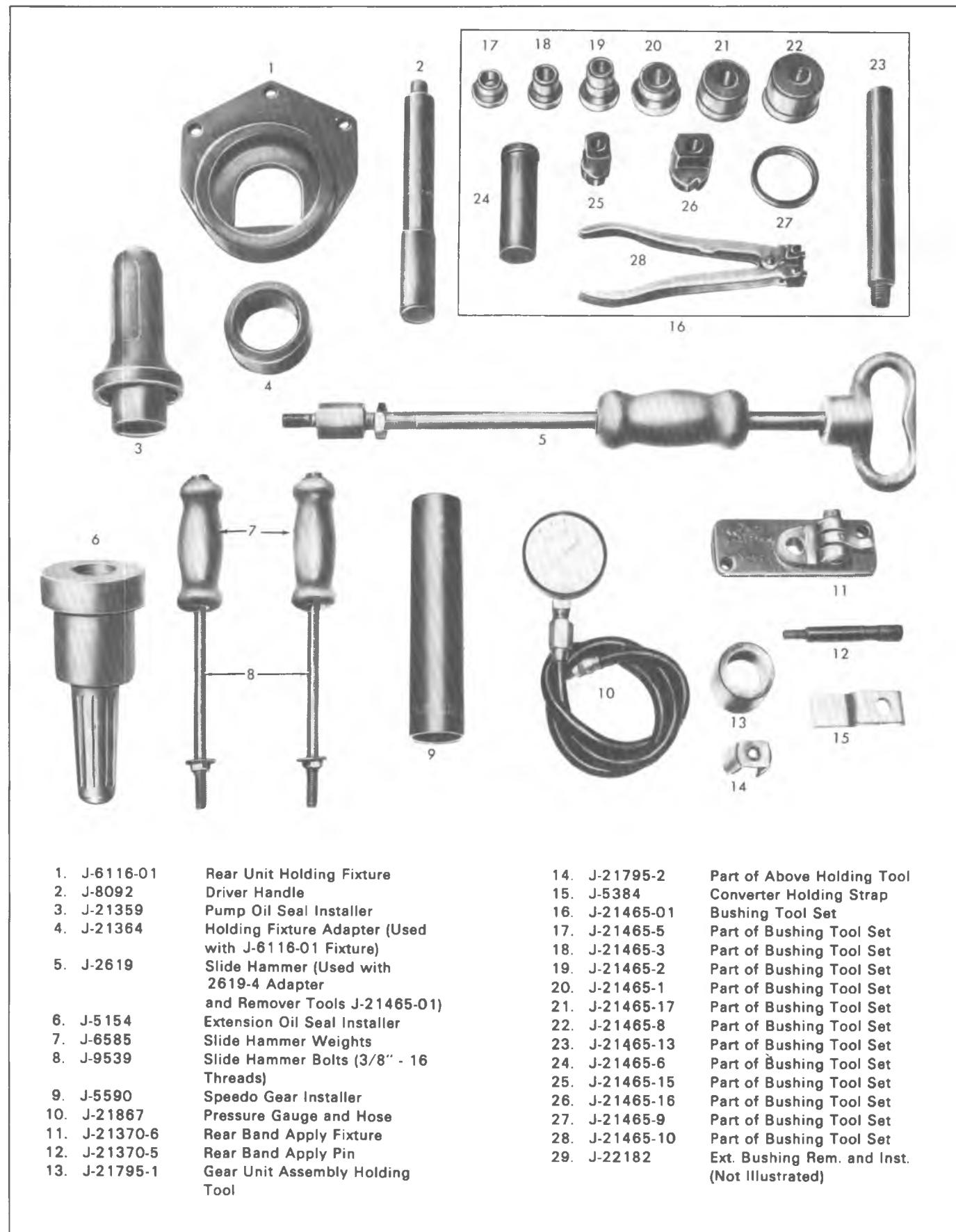


Fig. 7A-3ST-THM 400/475 Special Tools

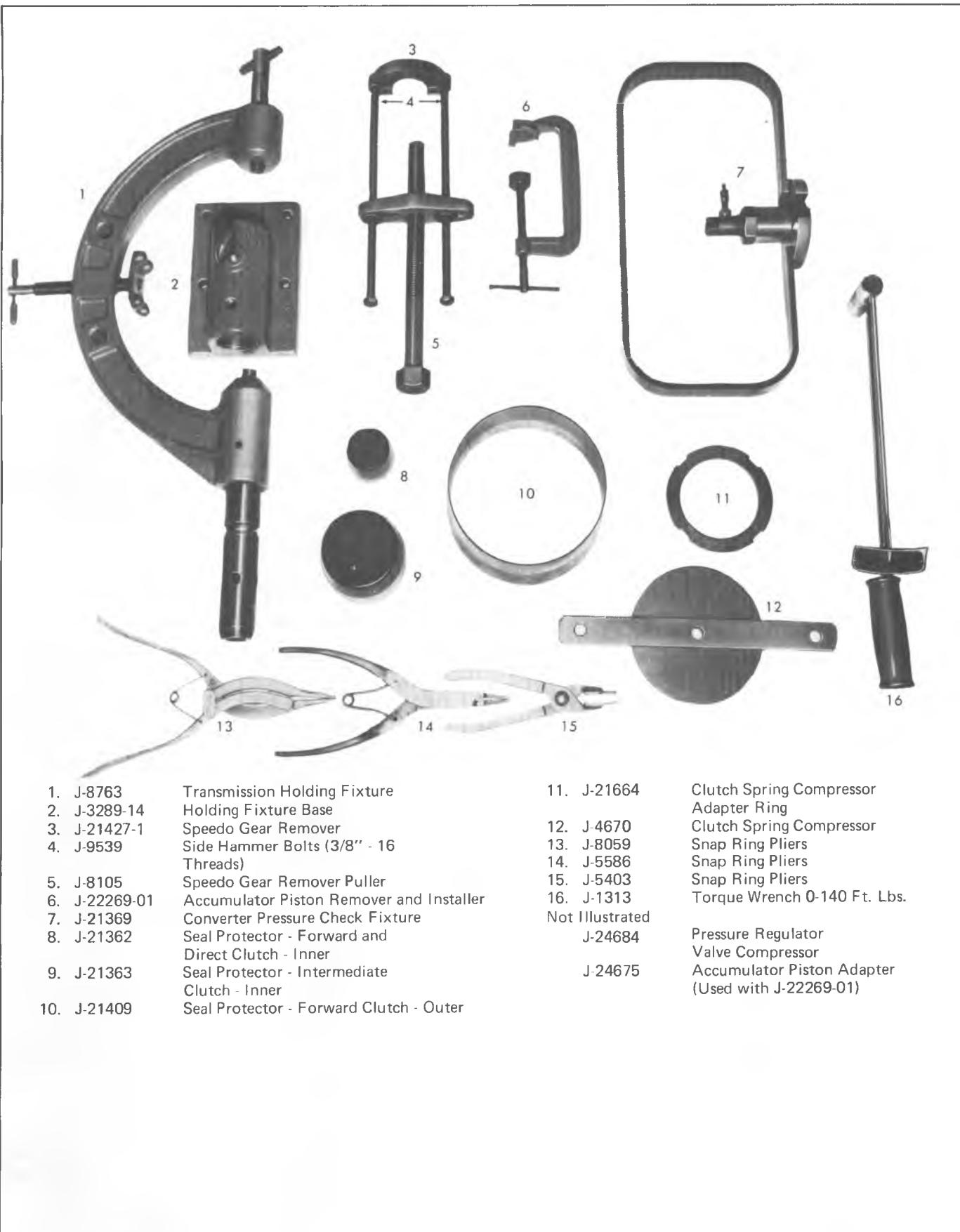


Fig. 7A-4ST--THM 400/475 Special Tools

**SPECIFICATIONS****TURBO-HYDRAMATIC "200"**

Pump Cover Bolts .....	24 N·m	(18 ft. lbs.)
Pump to Case Attaching Bolts .....	24 N·m	(18 ft. lbs.)
Parking Pawl Bracket Bolts .....	24 N·m	(18 ft. lbs.)
Control Valve Body Bolts .....	15 N·m	(11 ft. lbs.)
Oil Screen Retaining Bolts .....	15 N·m	(11 ft. lbs.)
Bottom Pan Attaching Bolts .....	16 N·m	(12 ft. lbs.)
Converter to Flywheel Bolts .....	48 N·m	(35 ft. lbs.)
Transmission to Engine Mounting Bolts .....	34 N·m	(25 ft. lbs.)
Converter Dust Shield Screws .....	11 N·m	(8 ft. lbs.)
Manual Shaft Nut .....	31 N·m	(23 ft. lbs.)
Speedometer Driven Gear Attaching Bolts .....	11 N·m	(8 ft. lbs.)
Detent Cable Attaching Screw .....	9 N·m	(6 ft. lbs.)
Oil Cooler Line to Transmission Connector .....	37 N·m	(25 ft. lbs.)
Oil Cooler Line to Radiator Connector .....	27 N·m	(20 ft. lbs.)
Linkage Swivel Clamp Nut .....	41 N·m	(30 ft. lbs.)
Shifter Assembly to Sheet Metal Screws .....	10 N·m	(8 ft. lbs.)
Converter Bracket to Adapter Nuts .....	17 N·m	(13 ft. lbs.)
Catalytic Converter to Rear Exhaust Pipe Nuts .....	23 N·m	(17 ft. lbs.)
Exhaust Pipe to Manifold Nuts .....	16 N·m	(12 ft. lbs.)
Rear Transmission Support Bolts .....	54 N·m	(40 ft. lbs.)
Mounting Assembly to Support Nuts .....	29 N·m	(21 ft. lbs.)
Mounting Assembly to Support Center Nut .....	44 N·m	(33 ft. lbs.)
Adapter to Transmission Bolts .....	44 N·m	(33 ft. lbs.)

**TURBO HYDRA-MATIC- 350****TORQUE SPECIFICATIONS**

Pump Cover to Pump Body .....	17 ft. lbs.
Pump Assembly to Case .....	18-1/2 ft. lbs.
Valve Body and Support Plate .....	130 in. lbs.
Parking Lock Bracket .....	29 ft. lbs.
Oil Suction Screen .....	40 in. lbs.
Oil Pan to Case .....	130 in. lbs.
Extension to Case .....	25 ft. lbs.
Modulator Retainer to Case .....	130 in. lbs.
Inner Selector Lever to Shaft .....	25 ft. lbs.
Detent Valve Actuating Bracket .....	52 in. lbs.
Converter to Flywheel Bolts .....	35 ft. lbs.
Under Pan to Transmission Case .....	110 in. lbs.
Transmission Case to Engine .....	35 ft. lbs.
Oil Cooler Pipe Connectors to Transmission Case (Straight Pipe Fitting) .....	25 ft. lbs.
(Tapered Pipe Fitting) .....	15 ft. lbs.
Oil Cooler Pipe to Connectors .....	10 ft. lbs.
Gearshift Bracket to Frame .....	15 ft. lbs.
Gearshift Shaft to Swivel .....	20 ft. lbs.
Manual Shaft to Bracket .....	20 ft. lbs.
Detent Cable to Transmission .....	75 in. lbs.
Intermediate Band Adjust Nut .....	15 ft. lbs.

**TURBO HYDRA-MATIC- 400****TORQUE SPECIFICATIONS**

Pump Cover Bolts .....	18 ft. lbs.
Parking Pawl Bracket Bolts .....	18 ft. lbs.
Center Support Bolt .....	23 ft. lbs.
Pump to Case Attaching Bolts .....	18 ft. lbs.
Extension Housing to Case Attaching Bolts .....	23 ft. lbs.
Rear Servo Cover Bolts .....	18 ft. lbs.
Detent Solenoid Bolts .....	7 ft. lbs.
Control Valve Body Bolts .....	8 ft. lbs.
Bottom Pan Attaching Screws .....	12 ft. lbs.
Modulator Retainer Bolt .....	18 ft. lbs.
Governor Cover Bolts .....	18 ft. lbs.
Manual Lever to Manual Shaft Nut .....	8 ft. lbs.
Manual Shaft to Inside Detent Lever .....	18 ft. lbs.
Linkage Swivel Clamp Nut .....	43 ft. lbs.
Converter Dust Shield Screws .....	93 ft. lbs.
Transmission to Engine Mounting Bolts .....	35 ft. lbs.
Converter to Flywheel Bolts .....	32 ft. lbs.
Rear Mount to Transmission Bolts .....	40 ft. lbs.
Rear Mount to Crossmember Bolt .....	40 ft. lbs.
Crossmember Mounting Bolts .....	25 ft. lbs.
Line Pressure Take-Off Plug .....	13 ft. lbs.
Strainer Retainer Bolt .....	10 ft. lbs.
Oil Cooler Pipe Connectors to Transmission Case .....	28 ft. lbs.
Oil Cooler Pipe to Connector .....	10 ft. lbs.
Gearshift Bracket to Frame .....	15 ft. lbs.
Gearshift Shaft to Swivel .....	20 ft. lbs.
Manual Shaft to Bracket .....	20 ft. lbs.
Downshift Switch to Bracket .....	30 in. lbs.

## SECTION 7B

# MANUAL TRANSMISSION

### CONTENTS

3-Speed (Saginaw) 76mm Transmission.....	7B-1	New Process Model 205 Transfer Case.....	7B-52
3-Speed (Tremac) 77mm Transmission.....	7B-9	New Process Model 203 Transfer Case.....	7B-59
3-Speed (Muncie) 83mm Transmission.....	7B-17	Adapter Assemblies .....	7B-70
4-Speed (Saginaw) 76mm Transmission.....	7B-23	Specifications .....	7B-72
4-Speed (Warner) 83mm Transmission.....	7B-30	Special Tools .....	7B-74
4-Speed (Muncie CH465) 117mm Transmission.....	7B-40		

## 3-SPEED (SAGINAW) 76MM TRANSMISSION

### INDEX

Disassembly of Transmission .....	7B-1	Repairs.....	7B-4
Disassembly of Mainshaft.....	7B-1	Clutch Keys and Spring .....	7B-4
Cleaning and Inspection .....	7B-4	Extension Oil Seal or Bushing .....	7B-5
Transmission Case.....	7B-4	Clutch Bearing Retainer Oil Seal.....	7B-5
Front and Rear Bearings.....	7B-4	Assembly of Mainshaft .....	7B-5
Bearing Rollers.....	7B-4	Assembly of Transmission.....	7B-6
Gears.....	7B-4		
Reverse Idler Gear Bushing .....	7B-4		

### DISASSEMBLY OF TRANSMISSION (FIG. 7B-1A)

1. Remove side cover attaching bolts and side cover assembly.
2. Remove drive gear bearing retainer and gasket.
3. Remove drive gear bearing-to-gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screwdriver or other suitable tool can be inserted between bearing large snap ring and case to complete removal (Fig. 7B-2A). The clutch gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of clutch gear and mainshaft assembly.)
4. Remove speedometer driven gear from extension.
5. Remove extension to case attaching bolts.
6. Remove the reverse idler shaft "E" ring (Fig. 7B-3A).
7. Remove drive gear, mainsahft and extension assembly together through the rear case opening. Remove drive gear, needle bearings and synchronizer ring from mainshaft assembly.
8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-4A) and remove the extension.
9. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case (Fig. 7B-5A). Tool J-22246 will now hold the roller bearings in

position within the countergear bore. Remove the gear, bearings and thrust washers.

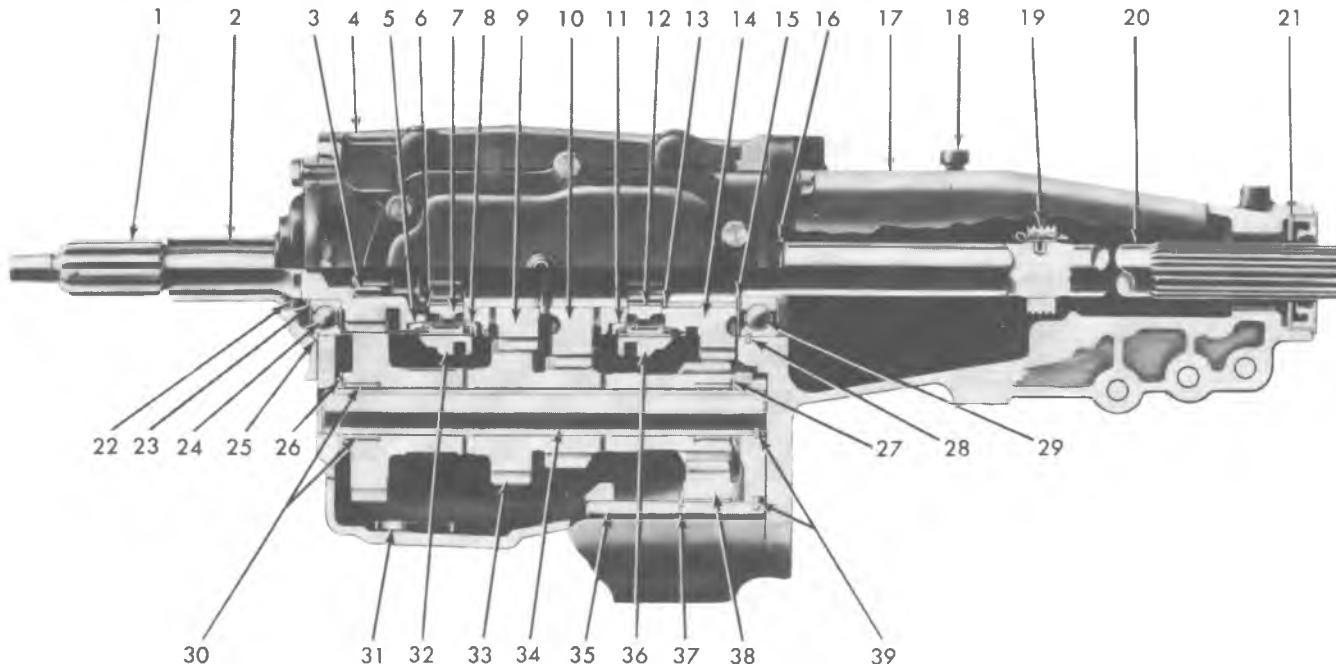
10. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (Fig. 7B-6A).

### DISASSEMBLY OF MAINSHAFT

1. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, second speed blocker ring and second speed gear from front of mainshaft. See Fig. 7B-7A.
2. Depress speedometer retaining clip and slide or tap gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove. See Fig. 7B-8A.
4. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer, spring washer, rear bearing, and snap ring from rear of mainshaft. See Fig. 7B-9A.
5. Remove the 1st and Reverse sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 1st speed blocker ring and first speed gear from rear of the mainshaft.

**NOTE:** Under certain tolerance conditions, it may be necessary to press the synchronizer hub and gear from the mainshaft.

Fig. 7B-1A-3-Speed 76mm (Saginaw) Transmission Cross-Section



- |                           |  |                                     |                                    |                             |
|---------------------------|--|-------------------------------------|------------------------------------|-----------------------------|
| 1. Clutch Gear            | 10. 1st Speed Gear                         | 16. Snap Ring-Bearing to Mainshaft  | 24. Clutch Gear Bearing            | 31. Magnet                  |
| 2. Bearing Retainer       | 11. 1st Speed Blocker Ring                 | 17. Extension                       | 25. Snap Ring-Bearing to Case      | 32. 2-3 Synch. Sleeve       |
| 3. Pilot Bearings         | 12. 1st Speed Synch. Hub                   | 18. Vent                            | 26. Thrust Washer-Front            | 33. Countergear             |
| 4. Case                   | 13. 1st Speed Synch. Snap Ring             | 19. Speedometer Drive Gear and Clip | 27. Thrust Washer-Rear             | 34. Counter Shaft           |
| 5. 3rd Speed Blocker Ring | 14. Reverse Gear                           | 20. Mainshaft                       | 28. Snap Ring-Bearing to Extension | 35. Reverse Idler Shaft     |
| 6. 2-3 Synch. Snap Ring   | 15. Reverse Gear Thrust and Spring Washers | 21. Rear Oil Seal                   | 29. Rear Bearing                   | 36. 1st Speed Synch. Sleeve |
| 7. 2-3 Synch. Hub         |  | 22. Retainer Oil Seal               | 30. Countergear Roller Bearings    | 37. "E" Ring                |
| 8. 2nd Speed Blocker Ring |  | 23. Snap Ring-Bearing to Gear       |                                    | 38. Reverse Idler Gear      |
| 9. 2nd Speed Gear         |  |                                     |                                    | 39. Woodruff Keys           |

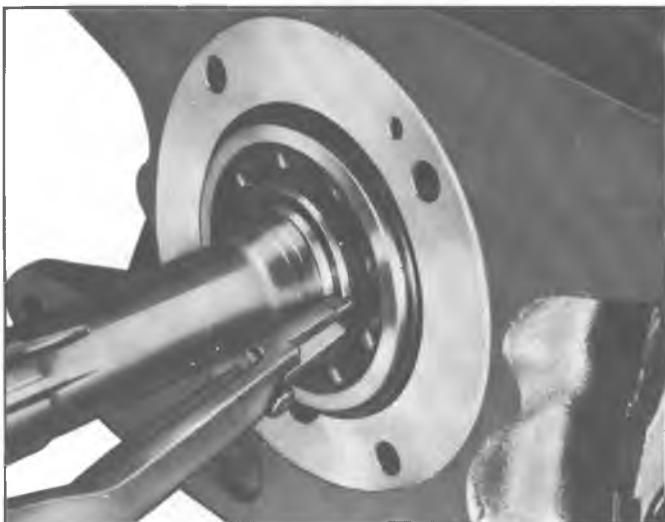


Fig. 7B-2A--Removing Clutch Gear Bearing Retaining Ring



Fig. 7B-5A--Removing Counter Gear Shaft

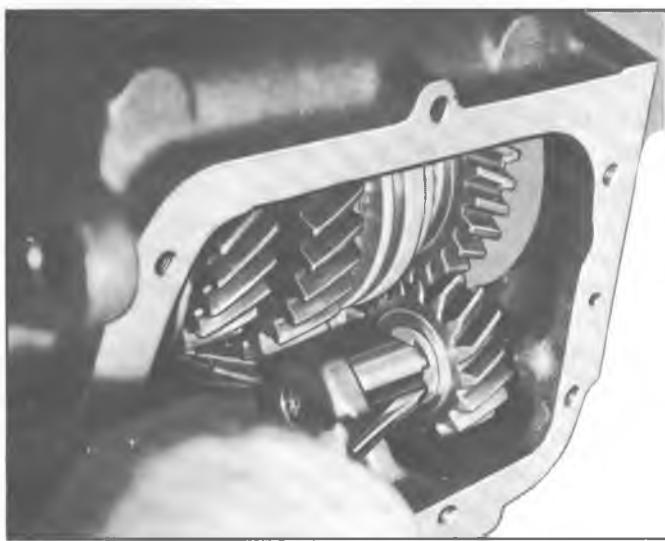


Fig. 7B-3A--Removing Reverse Idler Shaft "E" Ring

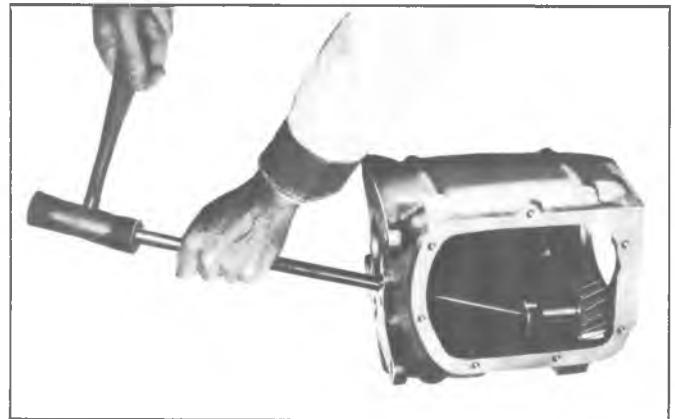


Fig. 7B-6A--Removing Reverse Idler Shaft

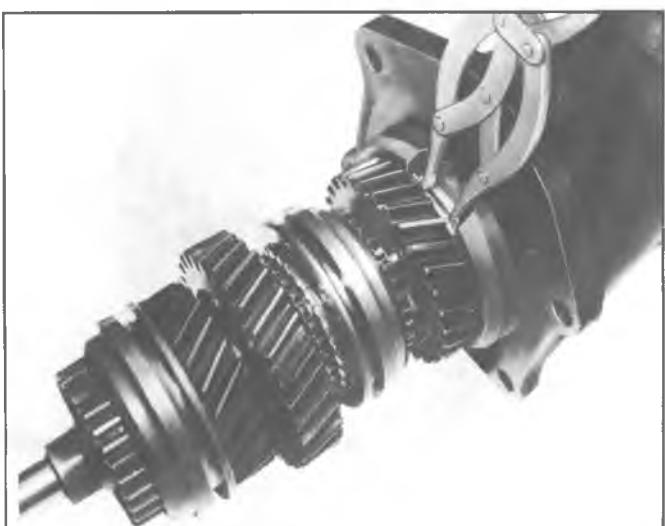


Fig. 7B-4A--Removing Rear Extension From Main Shaft

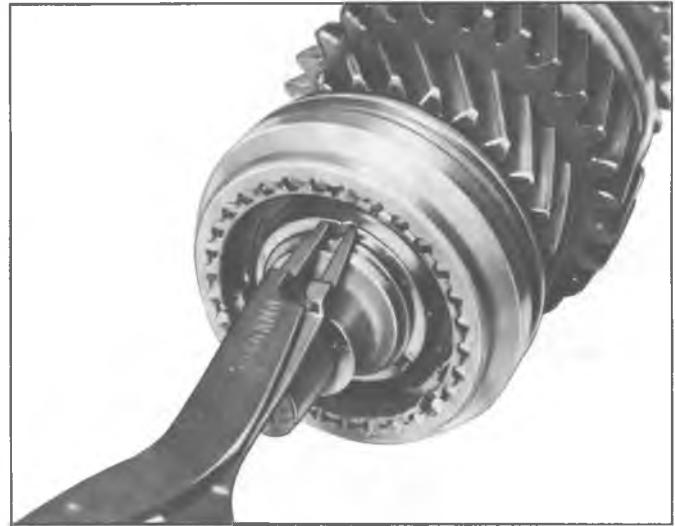


Fig. 7B-7A--Removing 2nd-3rd Clutch Hub Retaining Ring

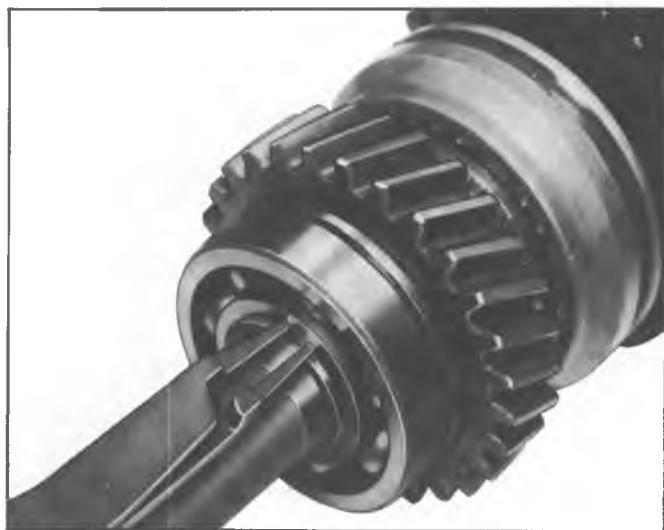


Fig. 7B-8A--Removing Rear Bearing Retaining Ring

## CLEANING AND INSPECTION

### Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.
3. Check bearing bores in case and, if damaged, replace case.

### Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

**CAUTION:** *Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings may damage the race and balls.*

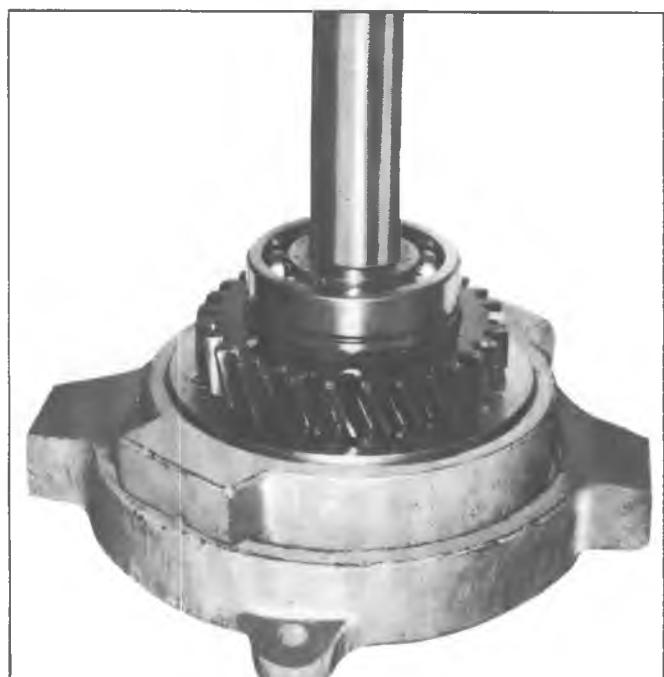


Fig. 7B-9A--Removing Rear Bearing From Mainshaft

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

### Bearing Rollers

All clutch gear and counter gear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

### Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged replace the entire gear.

**NOTE:** Reverse gear bushing is not serviced separately.

3. Check both clutch sleeves to see that they slide freely on their hubs.

### Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finished bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

### REPAIRS

#### Clutch Keys and Springs

##### Replacement

**NOTE:** The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so that they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub) so all three keys are engaged by both springs (Fig. 7B-10A). The tanged end of each synchronizer

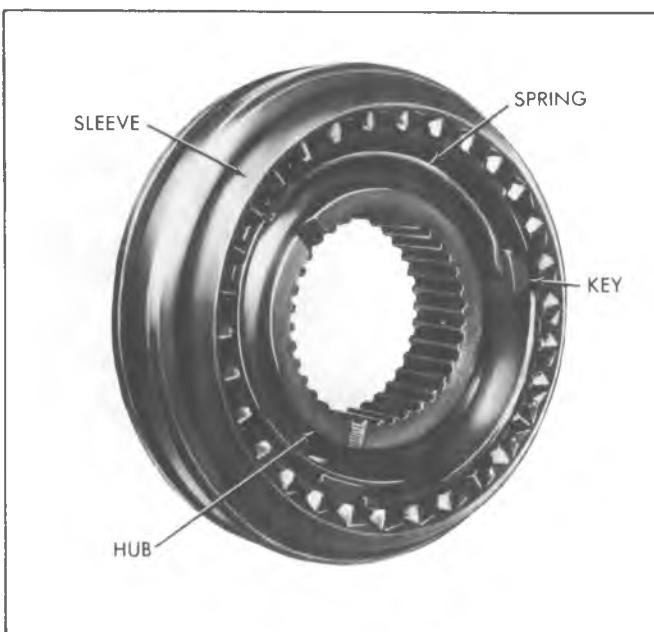


Fig. 7B-10A--Synchronizer Assembly

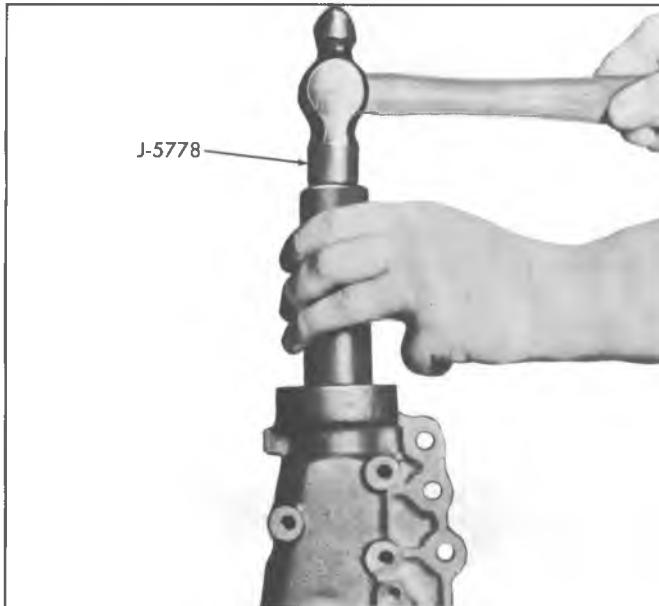


Fig. 7B-11A--Removing or Installing Rear Extension Bushing

spring should be installed into different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

**NOTE:** A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a greater recess depth.

#### Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing (Fig. 7B-11A). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-21426 or J-5154 (Fig. 7B-12A).

#### Clutch Bearing Retainer Oil Seal

If the lip seal in the reatiner needs replacement; pry the

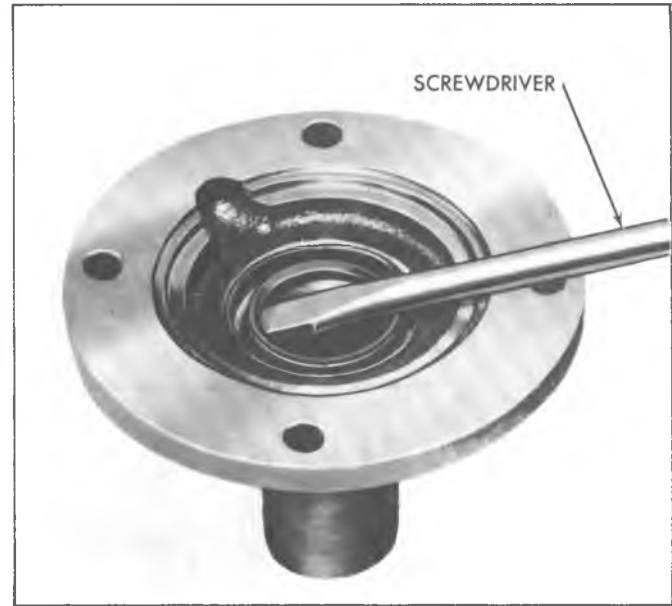


Fig. 7B-13A--Removing Drive Gear Bearing Retainer Seal

old seal out (Fig. 7B-13A) and replace with a new seal using Installer Tool J-23096, or similar tool, until seal seats in its bore (Fig. 7B-14A).

#### ASSEMBLY OF MAINSHAFT (FIG. 7B-15A)

Turn the front of the mainshaft upward. Install the following components of the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will ubtt against the flange on the mainshaft.

2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.

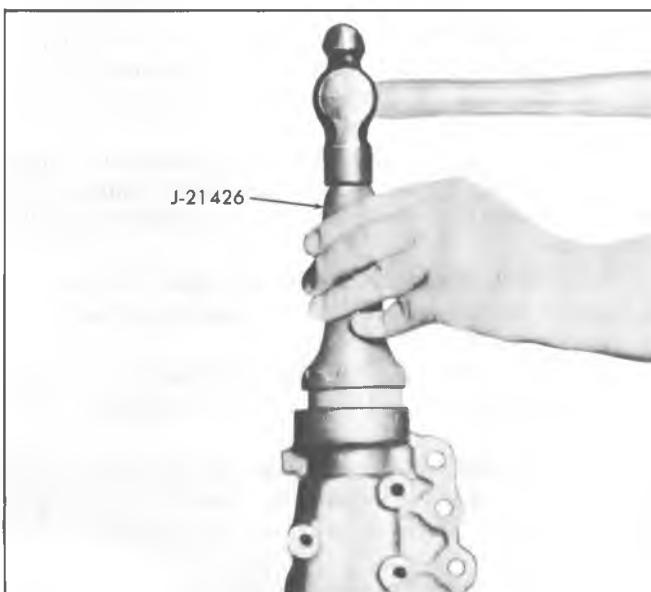


Fig. 7B-12A--Installing Rear Extension Seal

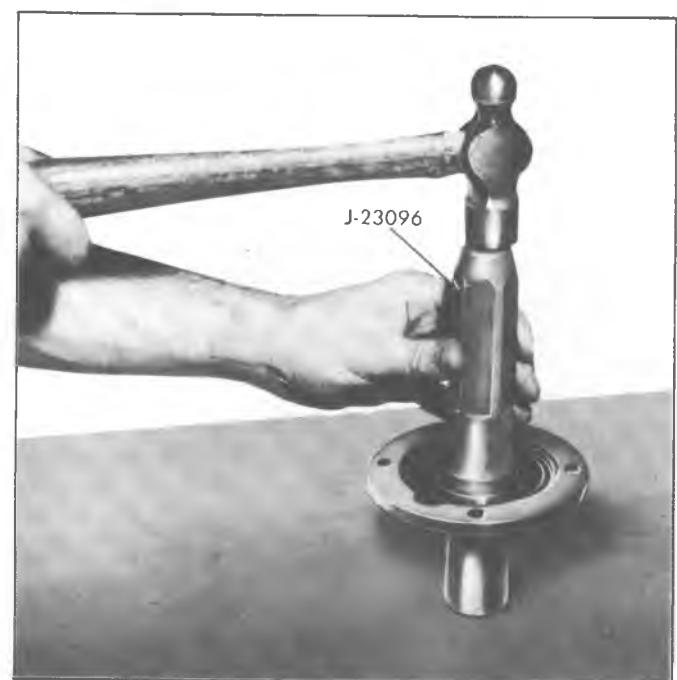


Fig. 7B-14A--Installing Clutch Gear Bearing Retainer Seal

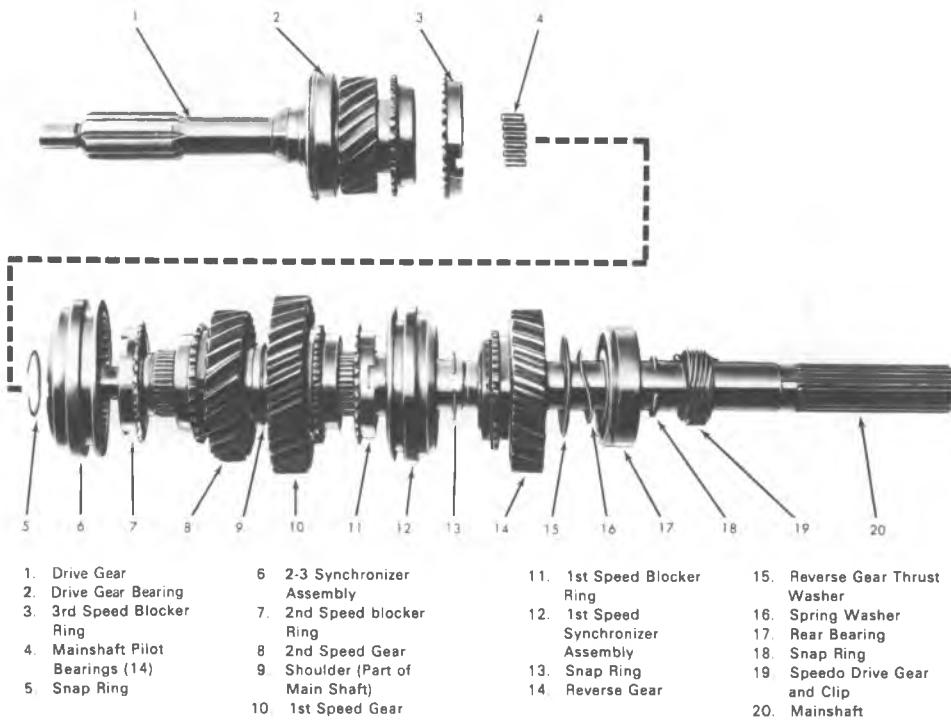


Fig. 7B-15A--Clutch Gear and Mainshaft Assembly

3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical. (If sleeve becomes removed from 2-3 hub; notches on hub O.D. face forward end of mainshaft.)

**CAUTION:** Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install snap ring retaining synchronizer hub to mainshaft. Both synchronizer snap rings are identical. Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.

6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.

7. Install the first and reverse synchronizer assembly with fork slot downward; push it onto splines on the mainshaft.

8. Install synchronizer hub to mainshaft snap ring.

**CAUTION:** Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

9. Install reverse gear with clutching teeth downward.

10. Install reverse gear thrust washer (steel).

11. Install reverse gear spring washer.

12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.

13. Install rear bearing to mainshaft snap ring.

14. Install speedometer drive gear and retaining clip.

#### ASSEMBLY OF TRANSMISSION (FIG. 7B-18A)

1. Using Tool J-22246 load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (Fig. 7B-16A).

2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

**CAUTION:** Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.

3. Install reverse idler gear and shaft with its woodruff key from the rear of case. Do not install idler shaft "E" ring yet.

4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (Fig. 7B-4A).

5. Load the mainshaft pilot bearings (14) into the clutch gear cavity and assemble the 3rd speed blocker ring onto the clutch gear clutching surface with its teeth toward the gear.



Fig. 7B-16A--Loading Countergear

6. Pilot the clutch gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

**CAUTION:** Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.

7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of case, assemble the clutch gear, mainshaft and extension to case as an assembly.

8. Install extension to case retaining bolts.

9. Install front bearing outer snap ring to bearing and position bearing over stem of clutch gear and into front case bore.



Fig. 7B-17A--Loading Pilot Bearings

10. Install snap ring to clutch gear stem, and clutch gear bearing retainer and gasket to case.

**NOTE:** The retainer oil return hole should be at the bottom.

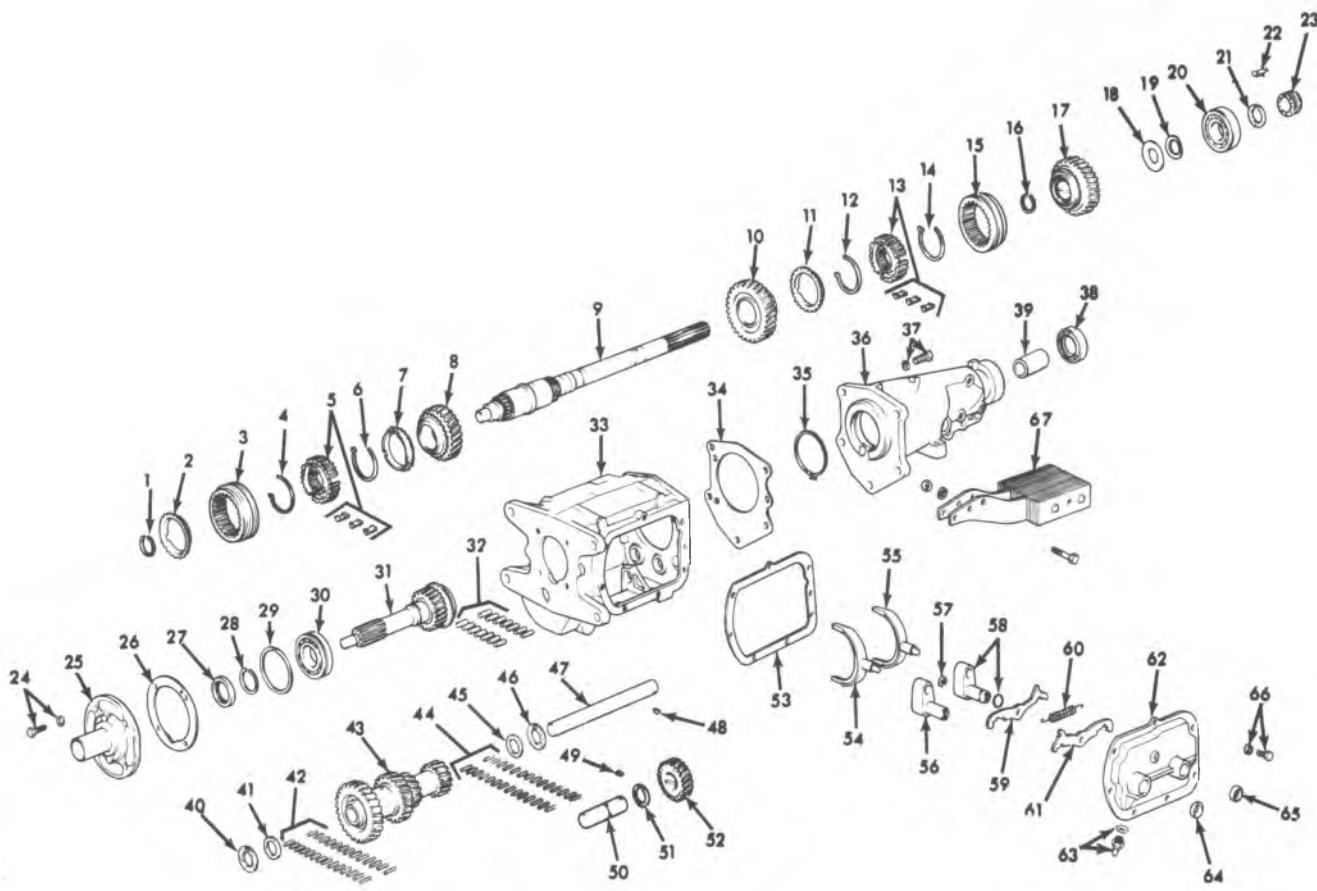
11. Install reverse idler gear retainer "E" ring to shaft.

12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.

13. Install speedometer driven gear in extension.

14. Tighten all bolts to specified torque.

15. Rotate clutch gear shaft and shift transmission to free rotation in all gears.



- |                               |   |                                       |
|-------------------------------|---|---------------------------------------|
| 1. Snap Ring                  | 24. Bearing Retainer Bolts and Washers (4)        | 46. Thrust Washer                     |
| 2. Synchronizer Ring          | 25. Front Bearing Retainer                        | 47. Countergear Shaft                 |
| 3. 2-3 Synchronizer Sleeve    | 26. Bearing Retainer Gasket                       | 48. Countergear Shaft Key             |
| 4. Synchronizer Key Spring    | 27. Bearing Retainer Oil Seal                     | 49. Idler Shaft Key                   |
| 5. Synchronizer Hub and Keys  | 28. Snap Ring                                     | 50. Reverse Idler Shaft               |
| 6. Synchronizer Key Spring    | 29. Bearing Snap Ring                             | 51. Snap Ring                         |
| 7. Synchronizer Ring          | 30. Front Bearing                                 | 52. Reverse Idler Gear                |
| 8. Second Gear                | 31. Drive Gear                                    | 53. Side Cover Gasket                 |
| 9. Main Shaft                 | 32. Pilot Bearings                                | 54. 2-3 Shift Fork                    |
| 10. First Gear                | 33. Case  | 55. 1-Rev Shift Fork                  |
| 11. Synchronizer Ring         | 34. Extension to Case Gasket                      | 56. 2-3 Shifter Shaft                 |
| 12. Synchronizer Key Spring   | 35. Rear Bearing to Extension Retaining Ring      | 57. Retaining "E" Ring                |
| 13. Synchronizer Hub and Keys | 36. Rear Extension                                | 58. 1-Rev Shifter Shaft with "O" Ring |
| 14. Synchronizer Key Spring   | 37. Extension to Case Retaining Bolts and Washers | 59. 2-3 Detent Cam                    |
| 15. 1-2 Synchronizer Sleeve   | 38. Rear Extension Bushing                        | 60. Detent Cam Spring                 |
| 16. Snap Ring                 | 39. Rear Seal                                     | 61. 1-Rev Detent Cam                  |
| 17. Reverse Gear              | 40. Thrust Washer                                 | 62. Shift Cover                       |
| 18. Thrust Washer             | 41. Spacer  | 63. TCS Switch and Gasket             |
| 19. Waved Washer              | 42. Countergear Shaft Bearings                    | 64. Shifter Shaft Seal                |
| 20. Rear Bearing              | 43. Countergear                                   | 65. Shifter Shaft Seal                |
| 21. Snap Ring                 | 44. Countergear Shaft Bearings                    | 66. Shift Cover Bolts and Washers     |
| 22. Speedometer Gear Clip     | 45. Spacer  | 67. Damper Assembly                   |
| 23. Speedometer Drive Gear    |   |                                       |

Fig. 7B-18A--3-Speed, 76mm Transmission Exploded View

# 3 SPEED (TREMAC) 77MM TRANSMISSION

## INDEX

Overhaul Operations.....	7B-9	Repairs.....	7B-13
Transmission Disassembly .....	7B-9	Synchronizer Keys and Spring .....	7B-13
Mainshaft Disassembly .....	7B-13	Extension Oil Seal or Bushing .....	7B-14
Cleaning and Inspection .....	7B-13	Clutch Bearing Retainer Oil Seal.....	7B-14
Transmission Case.....	7B-13	Mainshaft Assembly.....	7B-14
Front and Rear Bearings .....	7B-13	Transmission Assembly .....	7B-15
Roller Bearings.....	7B-13		
Gears.....	7B-13		

## OVERHAUL OPERATIONS

### TRANSMISSION DISASSEMBLY

1. Remove lower extension housing bolt and drain transmission (Fig. 7B-3B).
2. Remove top cover and gasket from case.
3. Remove long spring that retains the detent plug in the case (Fig. 7B-4B). Remove the detent plug with a small magnet.
4. Remove extension housing and gasket.
5. Press down on speedometer gear retainer and remove speedometer drive gear and retainer from output shaft.
6. Remove fill plug from right side of case (Fig. 7B-3B). Working through the plug opening drive out countergear roll pin with a 3/16 inch pin punch that has been chamfered slightly.

**NOTE:** Do not attempt to retrieve pin at this time. Pin can easily be retrieved after output shaft assembly is removed.

7. Insert dummy shaft tool J-25232 into bore at front of case, tap lightly on tool to push countershaft out rear of case (Fig. 7B-5B).

**NOTE:** With countershaft removed, allow countergear to lie at bottom of case.

8. Punch alignment mark in front bearing retainer and transmission case to ensure correct assembly and remove front bearing retainer and gasket (Fig. 7B-6B).
9. Remove large locating snap ring from front bearing and smaller snap ring from clutch gear shaft.

10. Remove clutch shaft front bearing using tool J-6654-01 and tool J-8433-1 (Fig. 7B-7B).

**NOTE:** It may be necessary to alternate the tightening of the bolts between tools J-6654-01 and J-8433-1 to remove the front bearing.

11. Remove large locating snap ring from rear bearing and smaller retaining snap ring from output shaft.

**NOTE:** It may be necessary to place a screwdriver or a piece of bar stock between the case and the first-reverse sleeve and gear assembly. This will hold the output shaft assembly in place while removing the rear bearing.

12. Remove rear bearing from output shaft using tool J-8157-01 (Fig. 7B-8B).

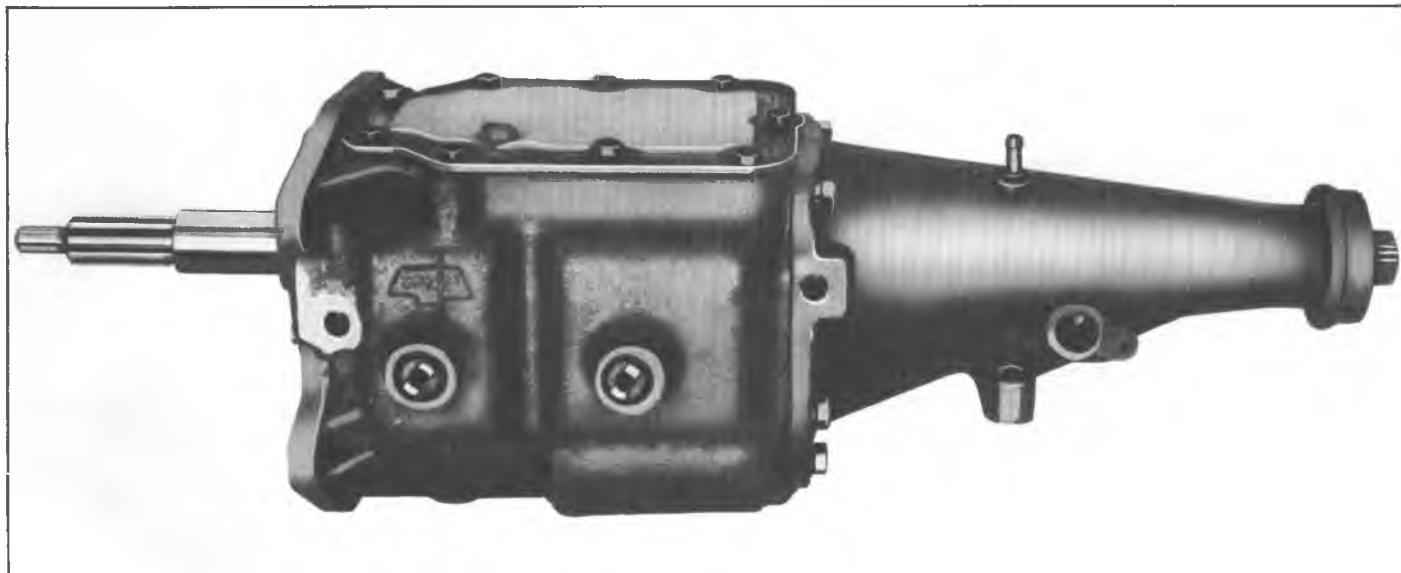
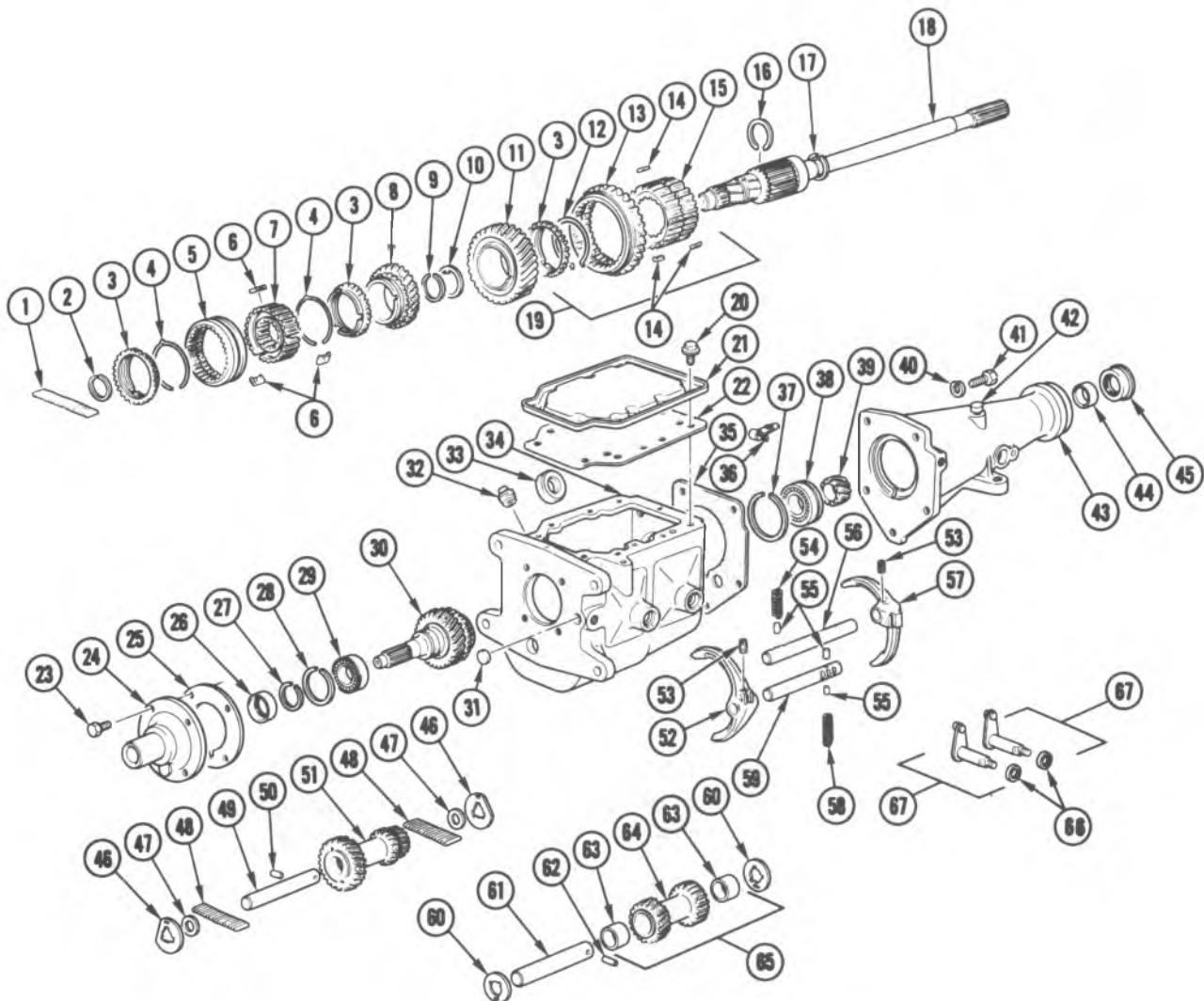


Fig. 7B-1B-3-Speed (Tremec) 77mm Transmission



1. MAINSHAFT ROLLER BEARINGS  
 2. 2ND & 3RD SYNCHRONIZER RETAINING RING  
 3. SYNCHRONIZER BLOCKER RINGS  
 4. 2ND & 3RD SYNCHRONIZER SPRING  
 5. 2ND & 3RD SYNCHRONIZER SLEEVE  
 6. 2ND & 3RD SYNCHRONIZER KEYS  
 7. 2ND & 3RD SYNCHRONIZER HUB  
 8. SECOND SPEED GEAR  
 9. 1ST SPEED GEAR RETAINING RING  
 10. 1ST SPEED GEAR TABBED WASHER  
 11. 1ST SPEED GEAR  
 12. REVERSE SYNCHRONIZER SPRING  
 13. 1ST & REVERSE SYNCHRONIZER SLEEVE & GEAR  
 14. REVERSE SYNCHRONIZER KEYS  
 15. 1ST & REVERSE SYNCHRONIZER HUB  
 16. 1ST & REVERSE SYNCHRONIZER RETAINING RING  
 17. REAR BEARING RETAINING RING  
 18. TRANSMISSION MAINSHAFT  
 19. REVERSE-SYNCHRONIZER ASSEMBLY  
 20. ACCESS COVER BOLTS  
 21. ACCESS COVER  
 22. ACCESS COVER GASKET  
 23. BEARING RETAINER - TO CASE BOLTS  
 24. BEARING RETAINER - CLUTCH GEAR  
 25. GASKET - CLUTCH GEAR BEARING RETAINER  
 26. SEAL ASSEMBLY - CLUTCH GEAR BEARING RETAINER  
 27. CLUTCH GEAR BEARING RETAINING RING  
 28. CLUTCH GEAR BEARING LOCK RING  
 29. CLUTCH GEAR BEARING ASSEMBLY  
 30. CLUTCH GEAR  
 31. EXPANSION PLUG  
 32. FILLER PLUG  
 33. TRANSMISSION CASE MAGNET  
 34. CASE  
 35. EXTENSION HOUSING TO CASE GASKET  
 36. SPEEDOMETER DRIVER GEAR RETAINING CLIP  
 37. TRANSMISSION REAR BEARING LOCK RING  
 38. MAINSHAFT BEARING ASSEMBLY  
 39. SPEEDOMETER DRIVE GEAR  
 40. EXTENSION TO CASE WASHER  
 41. EXTENSION TO CASE BOLT  
 42. TRANSMISSION EXTENSION VENTILATOR ASSEMBLY  
 43. EXTENSION HOUSING ASSEMBLY  
 44. EXTENSION HOUSING BUSHING  
 45. EXTENSION HOUSING OIL SEAL ASSEMBLY  
 46. COUNTERGEAR THRUST WASHER  
 47. COUNTERGEAR SPACER  
 48. COUNTERGEAR ROLLET BEARINGS  
 49. COUNTERGEAR SHAFT  
 50. COUNTERGEAR SPRING PIN  
 51. COUNTERGEAR  
 52. 2ND & 3RD SHIFTER FORK  
 53. SHIFT FORK LOCKING SCREW  
 54. 1ST & 2ND SHIFTER INTERLOCK SPRING  
 55. SHIFTER INTERLOCK PIN  
 56. 1ST & REVERSE SHIFT RAIL  
 57. 1ST & REVERSE SHIFT FORK  
 58. 2ND & 3RD SHIFTER INTERLOCK SPRING  
 59. 2ND & 3RD SHIFT RAIL  
 60. REVERSE IDLER GEAR THRUST WASHER  
 61. REVERSE IDLER GEAR SHAFT  
 62. SPRING PIN IDLER GEAR SHAFT  
 63. REVERSE IDLER GEAR BUSHING  
 64. REVERSE IDLER GEAR  
 65. REVERSE IDLER GEAR ASSEMBLY  
 66. SEAL TRANSMISSION SHIFTER  
 67. TRANSMISSION SHIFTER SHAFT & LEVER ASSEMBLY

Fig. 7B-2B--Exploded View - 3 Speed (Tremec) 77mm Transmission

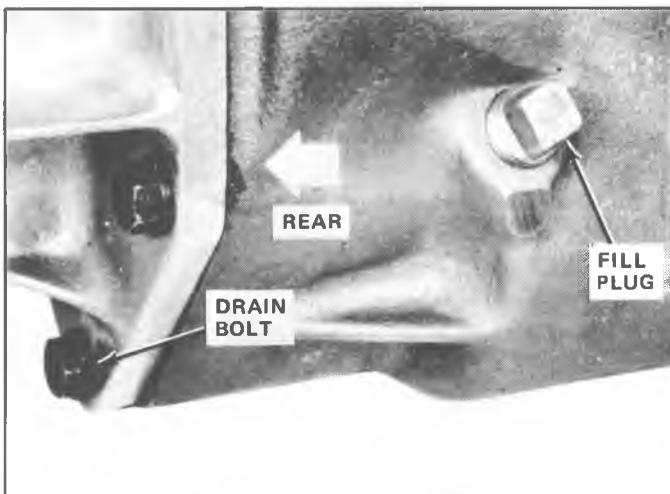


Fig. 7B-3B--Drain Transmission

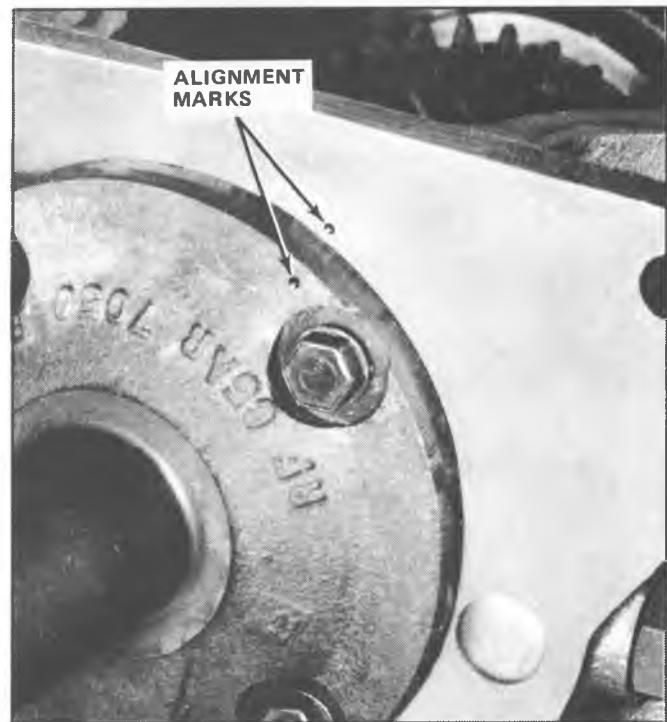


Fig. 7B-6B--Removing Front Bearing Retainer

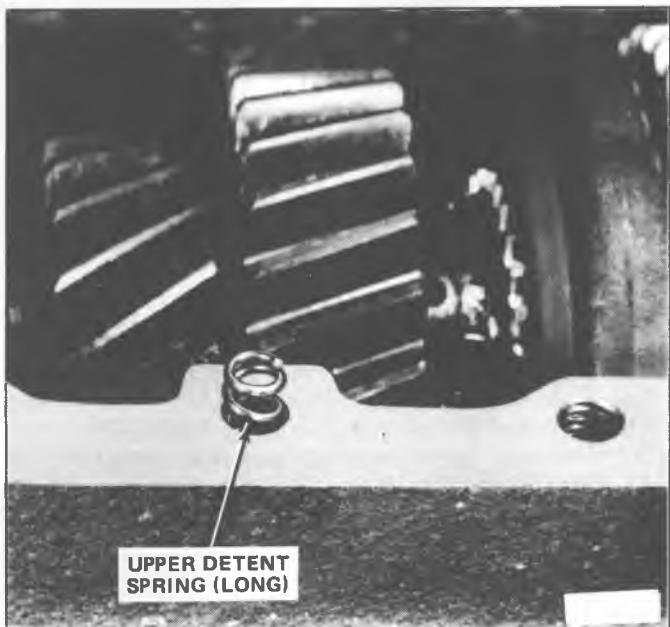


Fig. 7B-4B--Location of Upper Detent Spring

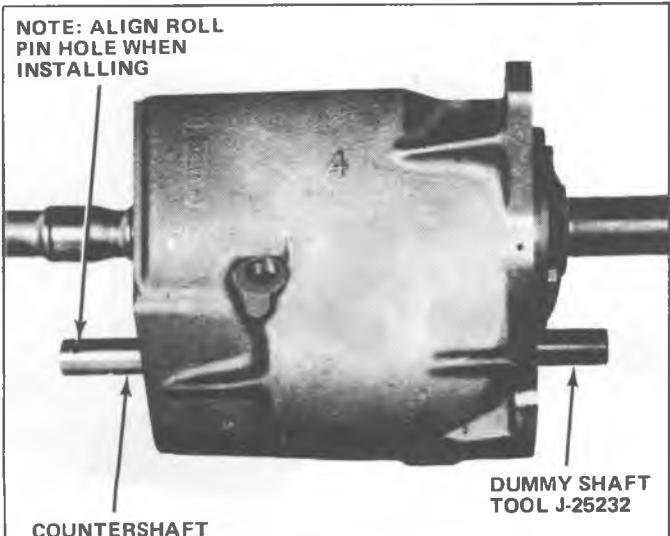


Fig. 7B-5B--Removing Countershaft

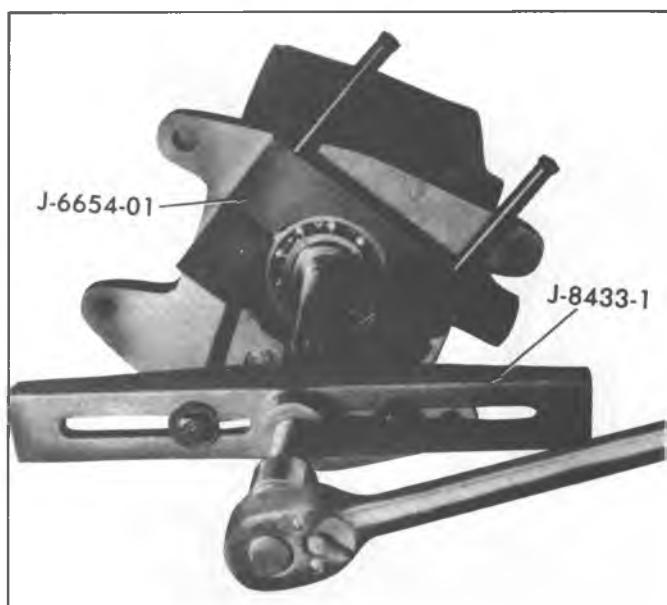
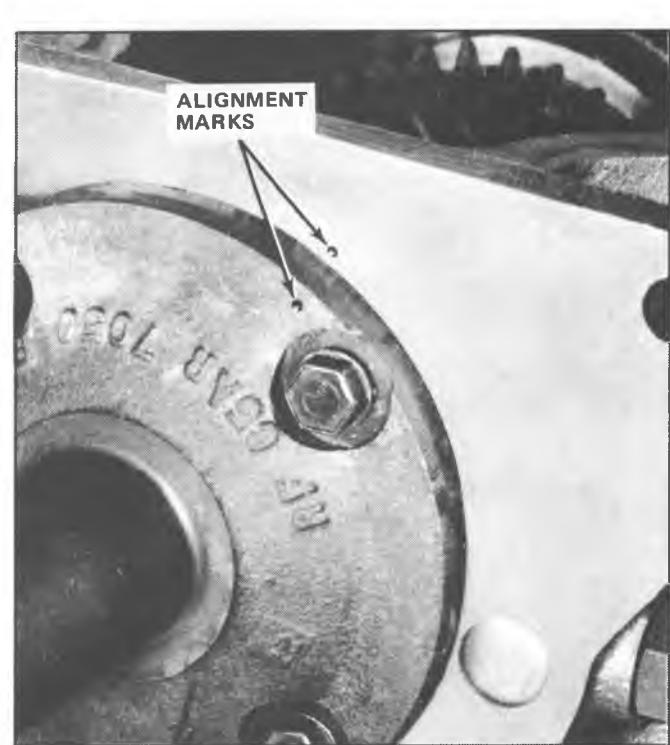


Fig. 7B-7B--Removing Front Bearing



13. Remove set screw from First-Reverse shifter fork and slide shift rail out rear of case.

14. Shift First-Reverse sleeve and gear all the way forward and rotate First-Reverse shifter fork upward and out of case. Remove First-Reverse Detent plug from case.

15. Shift Second-Third Shifter fork rearward to gain access to setscrew, remove setscrew, rotate shift rail 90° with pliers to clear bottom detent plug and remove interlock plug with magnet (Fig. 7B-9B).

16. Using a long thin punch (1/4 inch diameter or less) insert through access hole in rear case to drive out shift rail and expansion plug located in shift rail bore at front of case.

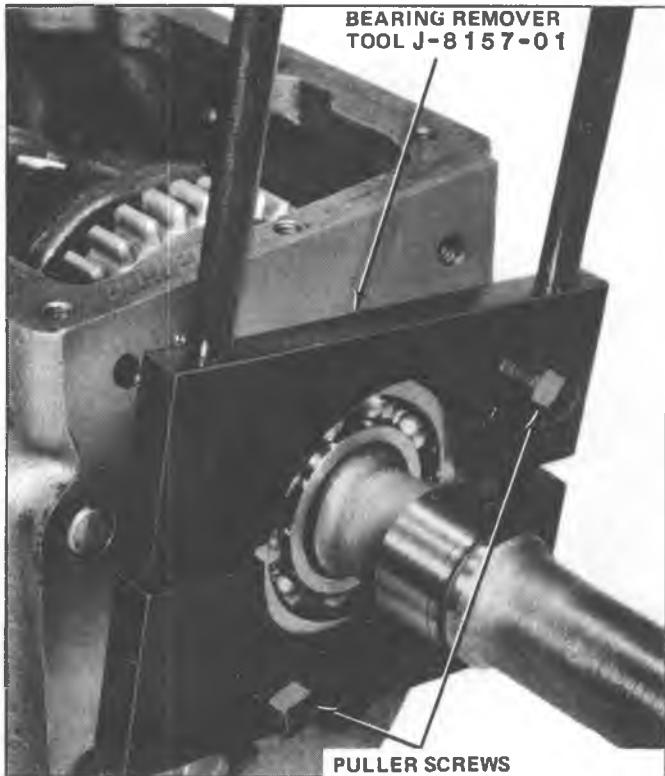


Fig. 7B-8B--Removing Rear Bearing

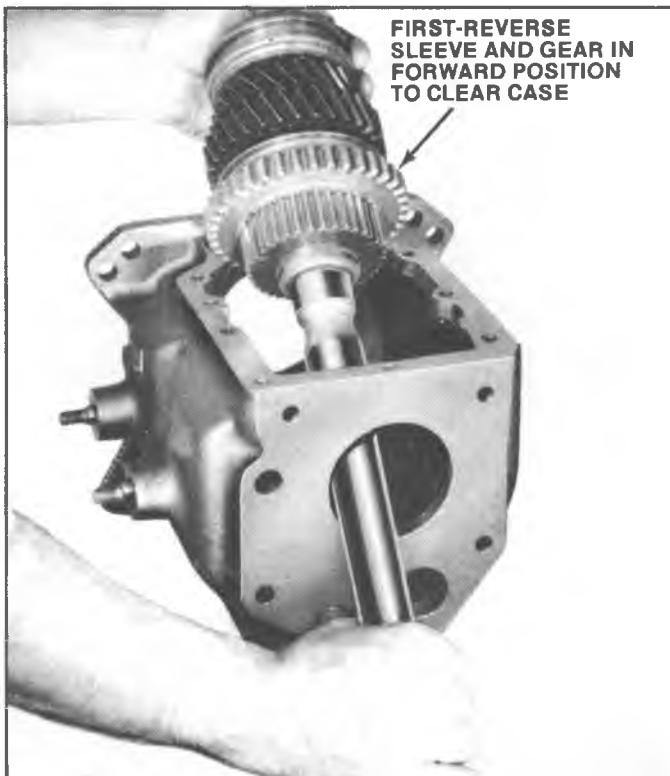


Fig. 7B-10B--Removing Output Shaft Assembly

17. Rotate second-third shifter fork upward and out of case.
18. Remove the bottom detent plug and short detent spring from case.
19. Separate clutch gear from output shaft and remove output shaft assembly (Fig. 7B-10B); tilt spline end of shaft downward and lift gear end upward and out of case.

- NOTE:** First and reverse sleeve and gear must pass through notch at right rear end of case.
20. Remove clutch gear through top of case.
  21. Remove both shifter fork shafts (Fig. 7B-11B).
  22. Remove countergear (with tool in place), thrust washers and roll pin.

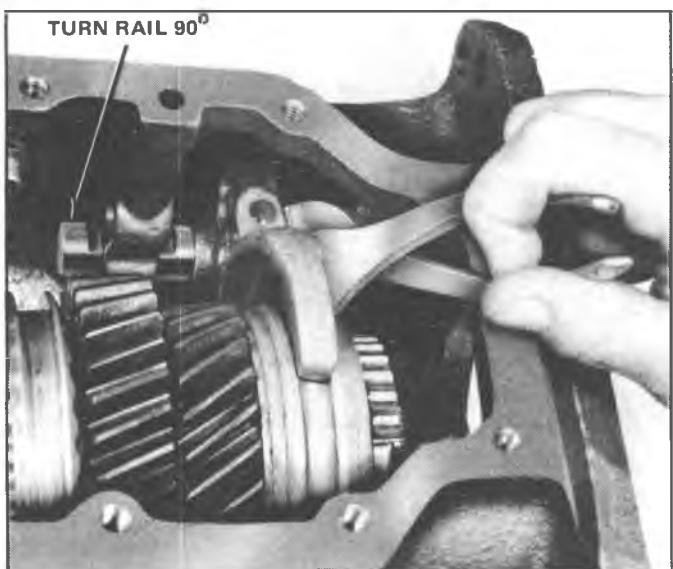


Fig. 7B-9B--Rotating Shift Rail

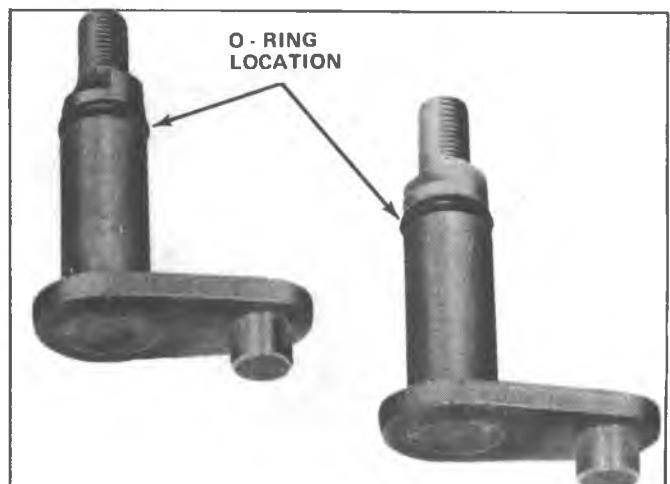


Fig. 7B-11B--Shift Fork Shafts

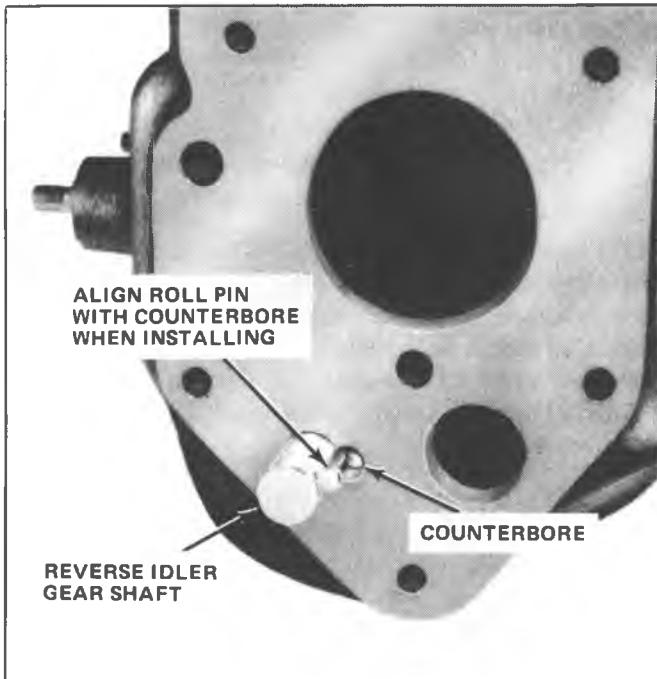


Fig. 7B-12B--Removing Reverse Idler Gear Shaft

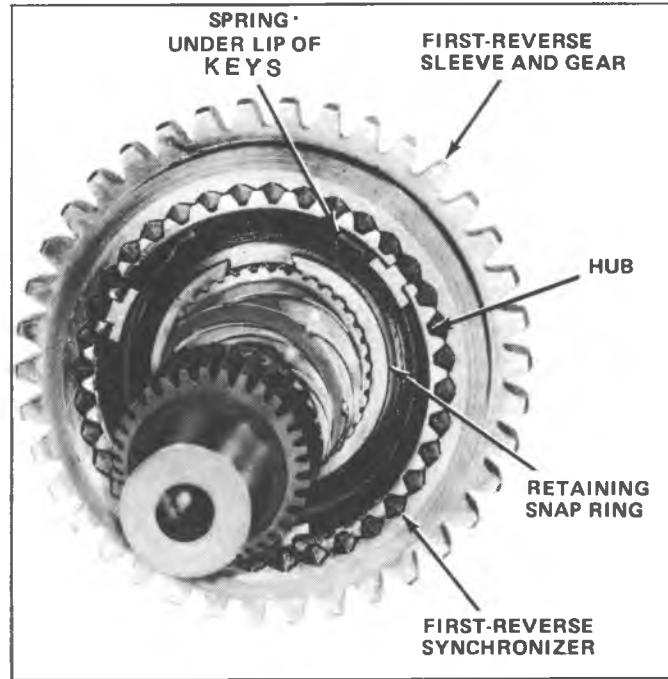


Fig. 7B-13B--First-Reverse Synchronizer Hub

23. Remove reverse idler gear and thrust washers by tapping shaft with hammer until end of idler gear shaft (end with roll pin) clears counterbore in rear of case and remove shaft (Fig. 7B-12B).

24. From the bottom of the case retrieve, clutch shaft roller bearing or countergear needle bearing that may have fallen into case during disassembly.

### MAINSHAFT DISASSEMBLY

1. Remove snap ring from front of output shaft and remove Second-Third synchronizer assembly and second gear. Mark hub and sleeve for correct assembly.

2. Remove snap ring and tabbed thrust washer from shaft and remove first gear and blocking ring.

3. Remove First-Reverse hub retaining snap ring.

**NOTE:** Observe position of spring and keys before removal, also, mark hub and sleeve for correct assembly.

4. Remove sleeve and gear, spring and three keys from hub (Fig. 7B-13B).

5. Using an arbor press, remove hub from output shaft.

### CLEANING AND INSPECTION

#### Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.

#### Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

**CAUTION:** Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings may damage the race and balls.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

#### Bearing Rollers

All clutch gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

#### Gears

1. Inspect all gears for excessive wear, chips, or cracks and replace any that are worn or damaged.

2. Check both clutch sleeves to see that they slide freely on their hubs.

### REPAIRS

#### Synchronizer Keys and Spring Replacement

##### Replacement

1. Mark hub and sleeve so they can be matched upon reassembly.

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

3. Install one spring into second-third hub. Be sure spring covers all three key slots in hub. Align second-third sleeve to hub using marks made during disassembly, and start sleeve onto hub.

4. Place the three keys into hub slots and on top of spring, then push sleeve fully onto hub to engage keys in sleeve (Fig. 7B-14B).

5. Install remaining spring in exact same position as first spring. Ends of both spring must cover same slots in hub and not be staggered.

**NOTE:** Keys have small lip on each end. When correctly installed, this lip will fit over spring (Fig. 7B-14B).

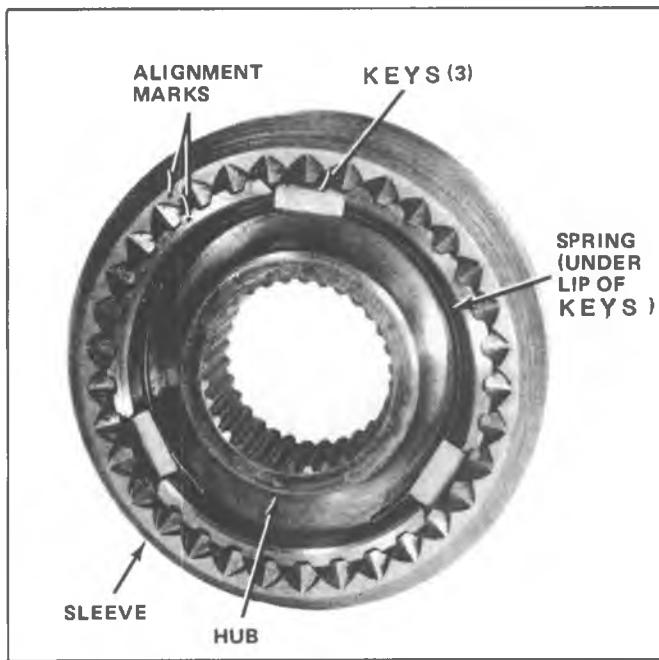


Fig. 7B-14B--Second-Third Synchronizer Assembly



Fig. 7B-16B--Installing Extension Housing Seal

### Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing (Fig. 7B-15B). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154 (Fig. 7B-16B).

### Clutch Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the old seal out and replace with a new seal using Installer Tool J-25233, or similar tool, until seal seats in its bore (Fig. 7B-17B).

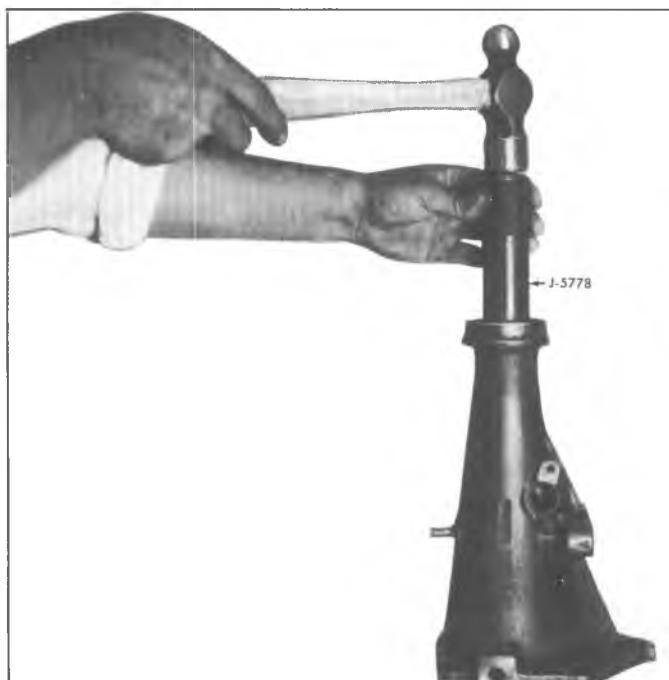


Fig. 7B-15B--Installing Extension Housing Bushing

### ASSEMBLY OF MAINSHAFT

1. Install First-Reverse synchronizer hub on output shaft splines by hand. Slotted end of hub should face front of shaft. Use an arbor press to complete hub installation on shaft and install retaining snap ring (in most rearward groove).

**CAUTION:** DO NOT attempt to drive hub onto shaft with hammer. Hammer blows will damage hub and splines.

2. Install First-Reverse sleeve and gear half-way onto hub with gear end of sleeve facing rear of shaft. Index sleeve to hub with marks made during disassembly.

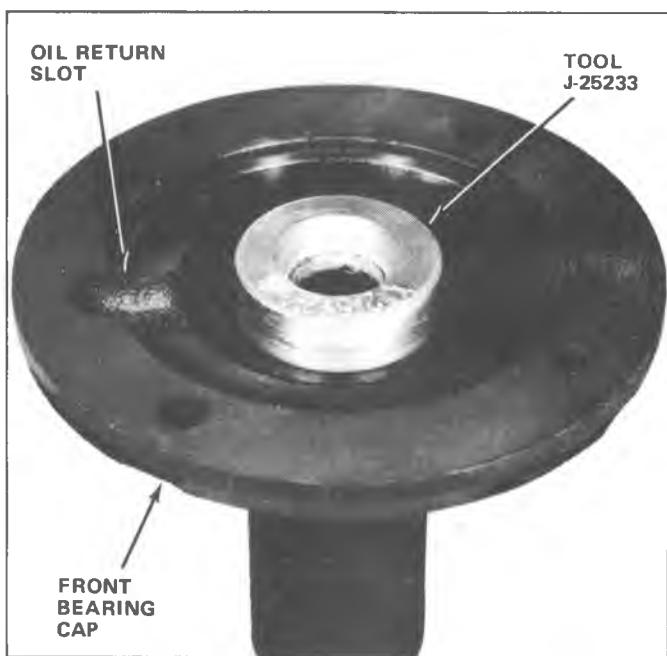


Fig. 7B-17B--Installing Clutch Bearing Retainer Seal

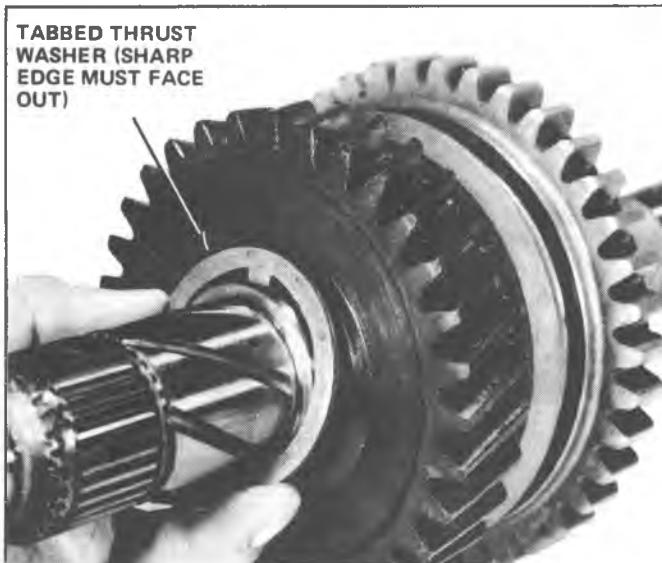


Fig. 7B-18B--Installing Tabbed Thrust Washer

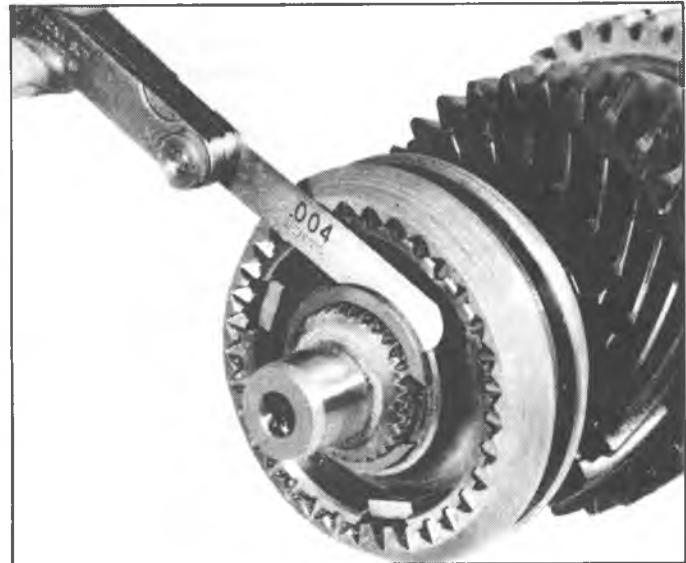


Fig. 7B-20B--Measuring Output Shaft End Play

3. Install spring in First-Reverse hub. (Make sure spring is bottomed in hub and covers all three key slots.) Position three synchronizer keys in hub, with small ends in hub slots and large ends inside hub. Push keys fully into hub so they seat on spring. Then slide First-Reverse sleeve and gear over keys until the keys engage in the synchronizer sleeve (Fig. 7B-13B).

4. Place first gear blocking ring on tapered surface of gear. Install First gear on output shaft. Rotate gear until notches in blocking ring engages keys in First-Reverse hub.

5. Install tabbed thrust washer (sharp edge facing out) and retaining snap ring on output shaft (Fig. 7B-18B).

6. Place second gear blocking ring on tapered surface of gear and install second gear on output shaft with tapered surface of gear facing front of output shaft (Fig. 7B-19B).

7. Install Second-Third synchronizer assembly with flat portion of synchronizer hub facing rearward on output shaft. Rotate Second gear until notches in blocking ring engages keys in Second-Third synchronizer assembly.

**NOTE:** It may be necessary to tap synchronizer with a plastic hammer to ease assembly.

8. Install retaining snap ring on output shaft and measure end play between snap ring and Second-Third synchronizer hub with feeler gauge (Fig. 7B-20B). End play should be 0.004 to 0.0014 inch. If end play exceeds 0.014 inch, replace thrust washer and all snap rings on output shaft assembly.

#### ASSEMBLY OF TRANSMISSION

1. Coat transmission case reverse idler gear thrust washer surfaces with Vaseline (or equivalent) and position thrust washer in case.

**NOTE:** Be sure to engage locating tabs on thrust washers in locating slots in case.

2. Install reverse idler gear with helical cut gear towards front of case. Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case.

**NOTE:** Be sure to align and seat roll pin in shaft into counterbore in rear of case.

3. Measure reverse idler gear end play by inserting feeler gauge between thrust washer and gear. End play should be 0.004 to 0.018 inch. If end play exceeds 0.018 inch, remove idler gear and replace thrust washer.

4. Install shaft tool J-25232 in bore of countergear and load a row of needle bearing (25) in each end of gear. Use heavy grease or equivalent to hold them in place. Install one needle bearing retainer on each end of gear.

5. Position countergear thrust washer in case, use vaseline or equivalent to hold washers in place.

**NOTE:** Be sure to engage locating tabs on thrust washer in locating slots in case.

6. Insert countershaft into bore at rear of case just far enough to hold rear thrust washer from being displaced when the countergear is installed.

7. Align bore in countergear with countershaft and front thrust washer, then start countershaft into countergear.

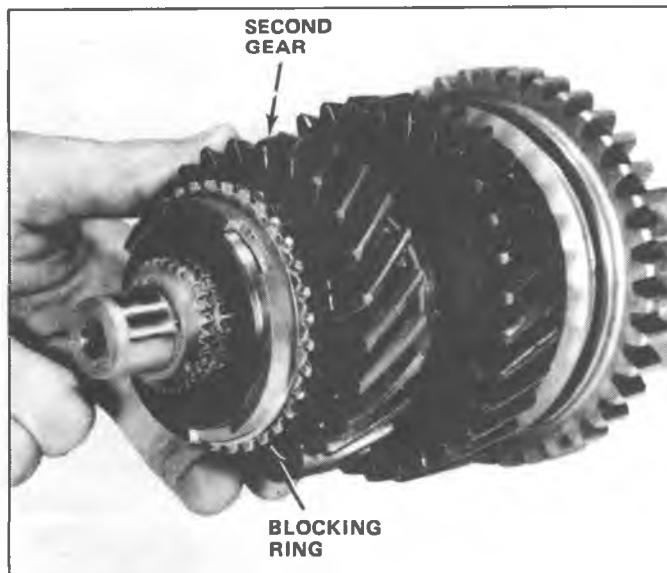


Fig. 7B-19B--Installing Second Gear

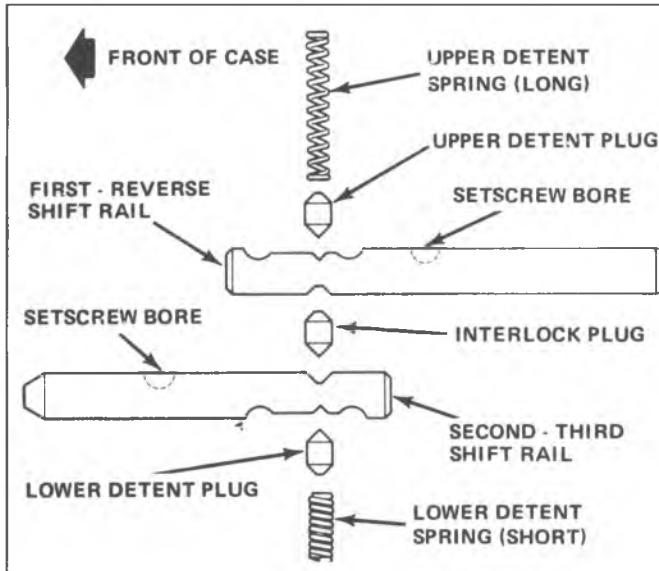


Fig. 7B-21B--Installation Sequence - Detent Plugs and Springs

Before countershaft is completely installed make sure that roll pin hole in countershaft is aligned with hole in case. When holes are aligned, tap countershaft into place, remove tool J-25232 (Fig. 7B-5B).

8. Measure countershaft end play by inserting feeler gauge between thrust washer and countergear. End play should be 0.004 to 0.018 inch. If end play exceeds 0.018 inch, remove gear and replace thrust washers.

9. After correct end play has been obtained, install roll pin in case.

10. Lower shorter detent spring in detent bore in case (Fig. 7B-21B). Allow spring to drop into place at bottom of Second-Third shift rail bore. Insert lower detent plug in detent bore on top of spring.

11. Install shifter fork shafts in their case bores with the pivot lug facing up.

**NOTE:** Shifter fork shafts are interchangeable.

12. Install (15) roller bearings in clutch shaft bore. Use vaseline (or equivalent) to hold bearings in place.

**CAUTION:** Do not use chassis grease or a similar "heavy" grease in clutch shaft bore. Heavy grease will plug the lubricant holes in the shaft and prevent proper lubrication of the roller bearing.

13. Install blocking ring on clutch gear and place clutch gear through top of case and position in front case bore.

14. Install output shaft assembly in case. Be sure First-Reverse sleeve and gear is in Neutral (centered) position on hub so gear end of sleeve will clear notch in top of case when output shaft assembly is installed.

15. Assemble the clutch gear to the output shaft.

16. Move Second-Third sleeve rearward to Second gear position and position Second-Third shifter fork in groove of sleeve. Be sure setscrew hold in shifter fork is facing up.

**NOTE:** Second-Third fork is the smaller of the two shifter forks.

17. Engage Second-Third shifter fork in shifter fork shaft and insert Second-Third shift rail through front case bore and into shifter fork.

**NOTE:** Tapered end of rail faces front of case.

18. Turn shift rail until detent notches in rail face bottom

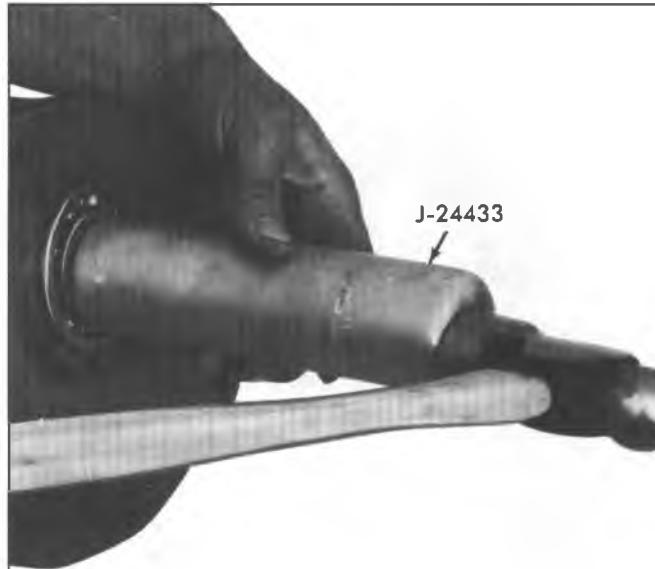


Fig. 7B-22B--Installing Front Bearing

of case. Insert a phillips screwdriver in detent bore to depress lower detent plug and push shift rail into rear bore. Move rail inward until detent plug engages forward notch in shift rail (second gear position).

19. Secure fork to rail with setscrew and move second-third synchronizer to Neutral (centered) position.

20. Install interlock plug in detent bore. With Second-Third synchronizer in Neutral position, top of plug will be slightly below surface of First-Reverse shift rail bore.

21. Move first reverse synchronizer forward to first gear position. Place First-Reverse shifter fork in groove of sleeve. Be sure setscrew hole in fork is facing up. Rotate fork into position in case, engage fork in shifter fork shaft, and insert First-Reverse shift rail through rear case bore and shifter fork.

22. Turn shift rail until detent notches in rail face

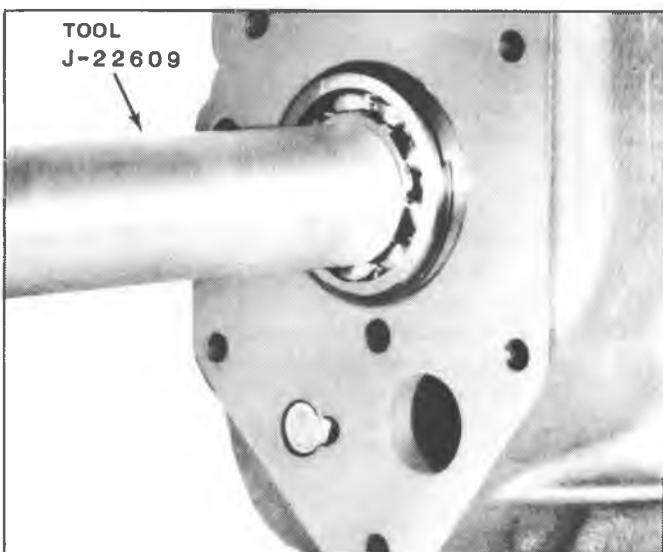


Fig. 7B-23B--Installing Rear Bearing

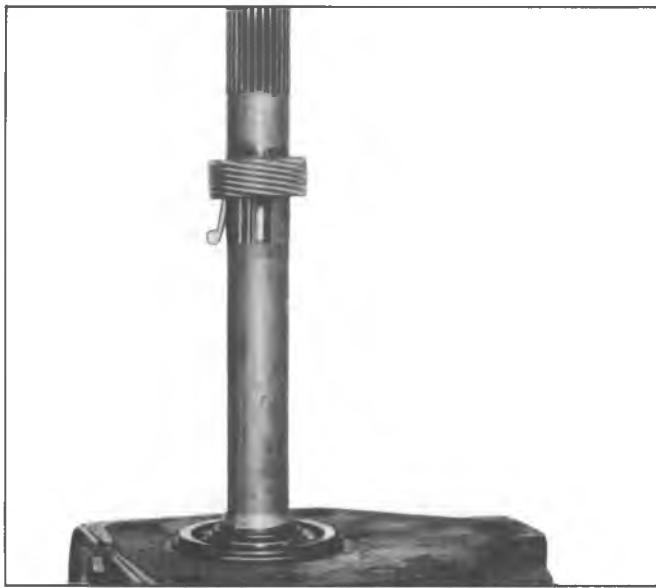


Fig. 7B-24B--Installing Speedometer Retainer and Gear

upward. Move rail inward until setscrew hole in fork and setscrew bore in shift rail are aligned. Secure fork to rail with setscrew and place First Reverse sleeve and gear into Neutral (centered) position (Fig. 7B-20B).

23. Install large snap ring on front bearing.
24. Install front bearing on clutch gear shaft by hand drive bearing on clutch gear shaft using tool J-24433 (Fig. 7B-22B).

25. Install smaller snap ring on clutch gear shaft.

26. Position bearing retainer gasket on case. Be sure cut-out in gasket is aligned with oil return hole in case.

27. Install front bearing retainer and tighten attaching bolts to 30 to 36 foot-pounds of torque. Be sure to index cap to case with alignment marks, and that oil return slot in cap is aligned with oil return hole in case.

28. Install large snap ring on rear bearing.

29. Install rear bearing on output shaft by hand. Drive bearing onto shaft and into case with tool J-22609, make sure snap ring groove is facing rear of shaft (Fig. 7B-23B).

30. Install smaller snap ring on output shaft to hold rear bearing in place.

31. Engage speedometer gear retainer in hole provided in output shaft, with retainer loop forward, slide speedometer gear over output shaft and into position (Fig. 7B-24B).

32. Position extension housing gasket on case and install extension housing to case. Tighten bolts to 42 to 50 foot pounds torque.

33. Install expansion plug in Second-Third shift rail bore in front of case. Be sure plug is fully seated in bore and is approximately 1/16 inch below front face of case.

34. Install upper detent plug in detent bore, then install long detent spring on top of plug. Install transmission fill plug and tighten 10 to 20 foot pounds torque.

35. Install top cover and gasket on case and secure with attaching bolts. Tighten bolts 20 to 25 foot pounds torque.

36. If removed, install backup light switch in extension housing and TCS switch in case. Tighten switches to 15 to 20 foot pounds torque.

## 3-SPEED (MUNCIE) 83MM TRANSMISSION INDEX

Disassembly of Transmission .....	7B-17
Disassembly of Mainshaft.....	7B-17
Cleaning and Inspection .....	7B-17
Transmission Case.....	7B-19
Front and Rear Bearing .....	7B-19
Bearing Rollers.....	7B-19
Gears.....	7B-19
Reverse Idler Gear Bushing .....	7B-19

Repairs.....	7B-19
Clutch Keys and Springs.....	7B-19
Replacement .....	7B-19
Extension Oil Seal or Bushing .....	7B-19
Clutch Bearing Retainer Oil Seal.....	7B-20
Assembly of Mainshaft .....	7B-20
Assembly of Transmission .....	7B-21

### DISASSEMBLY OF TRANSMISSION (Fig. 7B-1C)

1. Remove side cover attaching bolts, side cover assembly, gasket and shift forks.
2. Remove drive gear bearing retainer bolts, retainer and gasket.
3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on drive gear until a screw driver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal. The drive gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of drive gear and mainshaft assembly.)
4. Remove extension to case attaching bolts.
5. Rotate extension to left until groove in extension housing flange lines up with the reverse idler shaft. Using a drift or other suitable tool, drive reverse idler shaft out of gear and case (Fig. 7B-2C).
6. Remove drive gear, mainshaft and extension assembly

together through case rear opening. Remove reverse idler gear from case.

7. Remove drive gear from mainshaft. Remove pilot bearings.

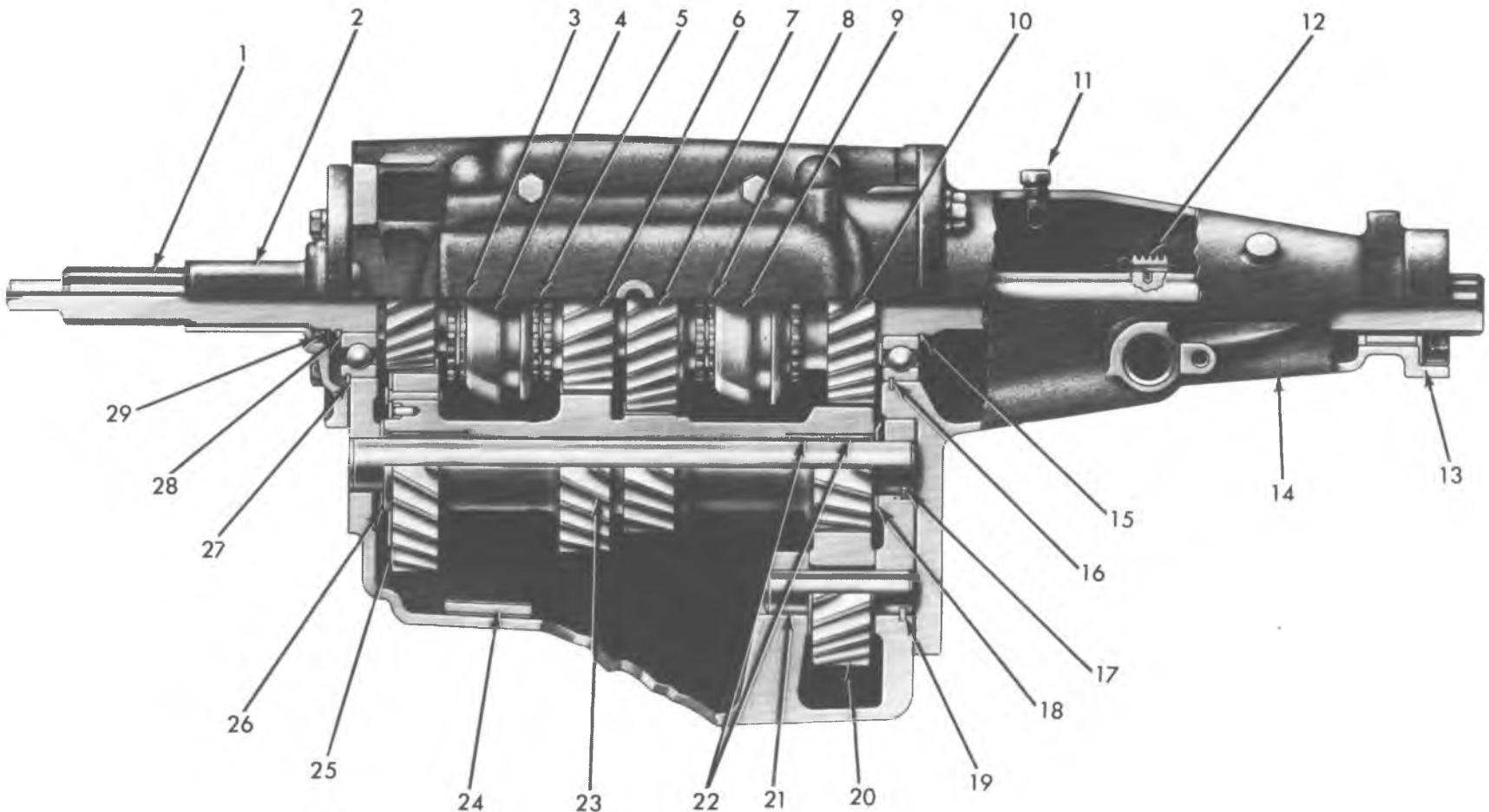
8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-3C). Tap gently on end mainshaft and remove extension from mainshaft.

9. Using a brass drift, drive countergear shaft and woodruff key from case.

### DISASSEMBLY OF MAINSHAFT (Fig. 7B-4C)

1. Depress speedometer gear retaining clip and slide gear from mainshaft.
2. Remove rear bearing snap ring from mainshaft groove.
3. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer and rear bearing from shaft.

Fig. 7B-1C--3-Speed (Muncie) 83mm Transmission Cross Section



- |                                |                                |   |  |
|--------------------------------|--------------------------------|---|--|
| 1. Drive Gear                  | 8. 1st Speed Synchronizer Ring | 15. Rear Bearing-to-Shaft Snap Ring     | 21. Reverse Idler Shaft                |
| 2. Drive Gear Bearing Retainer | 9. 1st Reverse Clutch Assy.    | 16. Rear Bearing-to-Extension Snap Ring | 22. Countergear Bearings               |
| 3. 3rd Speed Synchronizer Ring | 10. Reverse Gear               | 17. Countergear Woodruff Key            | 23. Countergear                        |
| 4. 2nd-3rd Speed Clutch Assy.  | 11. Vent                       | 18. Thrust Washer                       | 24. Case Magnet                        |
| 5. 2nd Speed Synchronizer Ring | 12. Speedometer Gear and Clip  | 19. Reverse Idler Shaft Woodruff Key    | 25. Anti-Lash Plate Assy. (Pass. Only) |
| 6. 2nd Speed Gear              | 13. Rear Extension Seal        | 20. Reverse Idler Gear                  | 26. Thrust Washer                      |
| 7. 1st Speed Gear              | 14. Rear Extension             |   | 27. Drive Gear Bearing                 |
|                                |                                |   | 28. Snap Ring                          |
|                                |                                |   | 29. Drive Gear Retainer Lip Seal       |



Fig. 7B-2C--Removing Reverse Idler Shaft

**CAUTION:** When pressing rear bearing be careful to center gear, washers, and bearing on shaft.

4. Remove 1st and reverse sliding clutch hub snap ring from the mainshaft.

5. Support 1st gear with press plates and push on rear of mainshaft to remove the clutch assembly, blocker ring and 1st speed gear.

**CAUTION:** Exercise care to prevent distortion of snap rings during expansion.

6. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft.

7. Support 2nd speed gear with press plates and press on front of mainshaft to remove clutch assembly, second speed blocker ring and second speed gear from shaft.

This completes the disassembly of mainshaft.

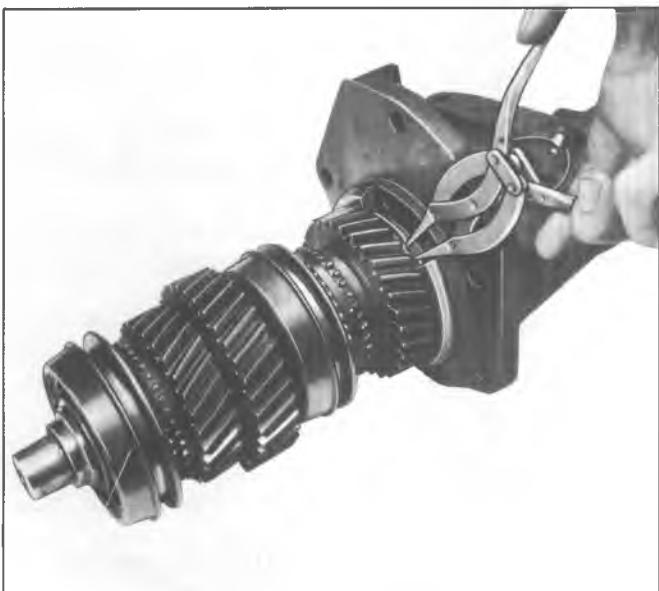


Fig. 7B-3C--Removing Rear Extension From Mainshaft

## CLEANING AND INSPECTION

### Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.

3. Check bearing bores in case and, if damaged, replace case.

### Front and Rear Bearings

1. Wash the front and rear ball bearings, thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

**CAUTION:** Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings may damage the race and balls.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

### Bearing Rollers

All drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

### Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.

2. Inspect reverse gear bushing and if worn or damaged replace the entire gear.

**NOTE:** Reverse gear bushing is not serviced separately.

3. Check both clutch sleeves to see that they slide freely on their hubs.

### Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

## REPAIRS

### Clutch Keys and Springs Replacement

**NOTE:** The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B-5C). Slide the sleeve onto the hub aligning the marks made before disassembly.

### Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing. Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154.

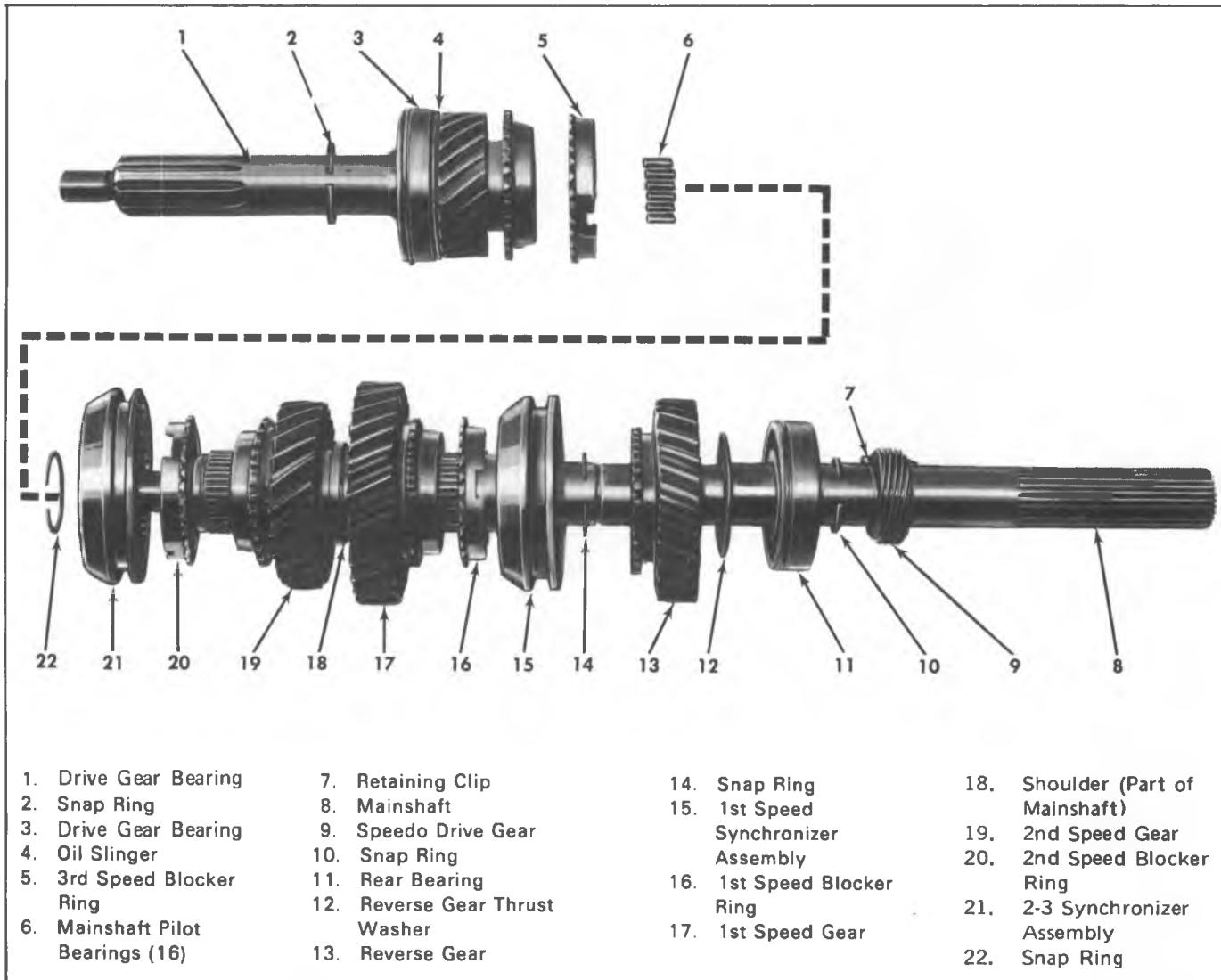


Fig. 7B-4C—Drive Gear and Mainshaft Assembly

### Clutch Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the old seal out and replace with a new seal using Installer Tool J-23096 or similar tool, until seal seats in its bore.

### ASSEMBLY OF MAINSHAFT (Fig. 7B-4C)

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.
3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies are identical but assembled differently. The 2nd-3rd speed hub and sleeve is assembled with the fork slot in the sleeve toward the thrust face of the hub. The 1st-reverse hub and sleeve is assembled with the fork slot in the sleeve opposite the thrust face (Fig. 7B-4C).

**CAUTION:** Be sure the notches of the blocker ring

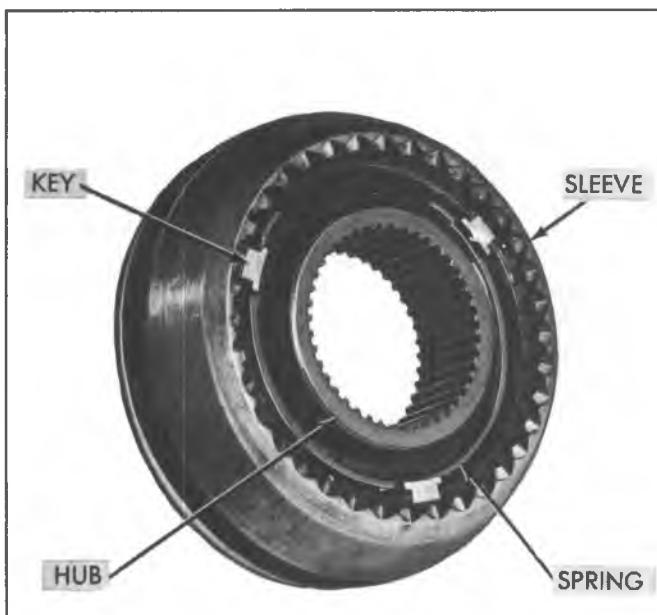


Fig. 7B-5C—Synchronizer Assembly

*align with the keys of the synchronizer assembly.*

4. Install synchronizer hub to mainshaft snap ring. Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.

6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.

7. Install the first and reverse synchronizer assembly with fork slot up; press it onto splines on the mainshaft.

**CAUTION:** *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly and that both synchronizer sleeves face the front of the mainshaft.*

8. Install synchronizer hub to mainshaft snap ring.

9. Install reverse gear with clutching teeth downward.

10. Install reverse gear steel thrust washer (align flats).

11. Install rear ball bearing with snap ring slot downward; press onto mainshaft.

12. Install rear bearing to mainshaft snap ring.

13. Install speedometer drive gear and retaining clip.

This completes the assembly of the mainshaft.

### ASSEMBLY OF TRANSMISSION (Fig. 7B-6C)

1. Load a double row of roller bearings (29) and the bearing thrust washers in the countergear (Fig. 7B-6C). Use heavy grease to hold them in place.

2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case. End of shaft must be flush with case.

**NOTE:** Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.

3. Position reverse idler gear in case. Do not install shaft until mainshaft is in place.

4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (Fig. 7B-3C).

5. Load the mainshaft pilot bearings (16) into the drive gear cavity and assemble the 3rd speed blocker ring onto the drive gear clutching surface with its teeth toward the gear.

6. Pilot the drive gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

**NOTE:** Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.

7. Place extension to case gasket on extension holding it in place with grease and, from the rear of case, assemble the clutch gear, mainshaft and extension to case as an assembly.

**NOTE:** Be sure the clutch gear engages the teeth of the countergear anti-lash plate and that the oil slinger is in place on the clutch gear.

8. Rotate extension and install reverse idler shaft and woodruff key.

9. Install extension to case retaining bolts.

**NOTE:** Apply sealer to all through bolts.

10. Install front bearing outer snap ring to bearing and install bearing on stem of clutch gear and into front case bore.

11. Install snap ring to clutch gear stem, and clutch gear bearing retainer and gasket to case.

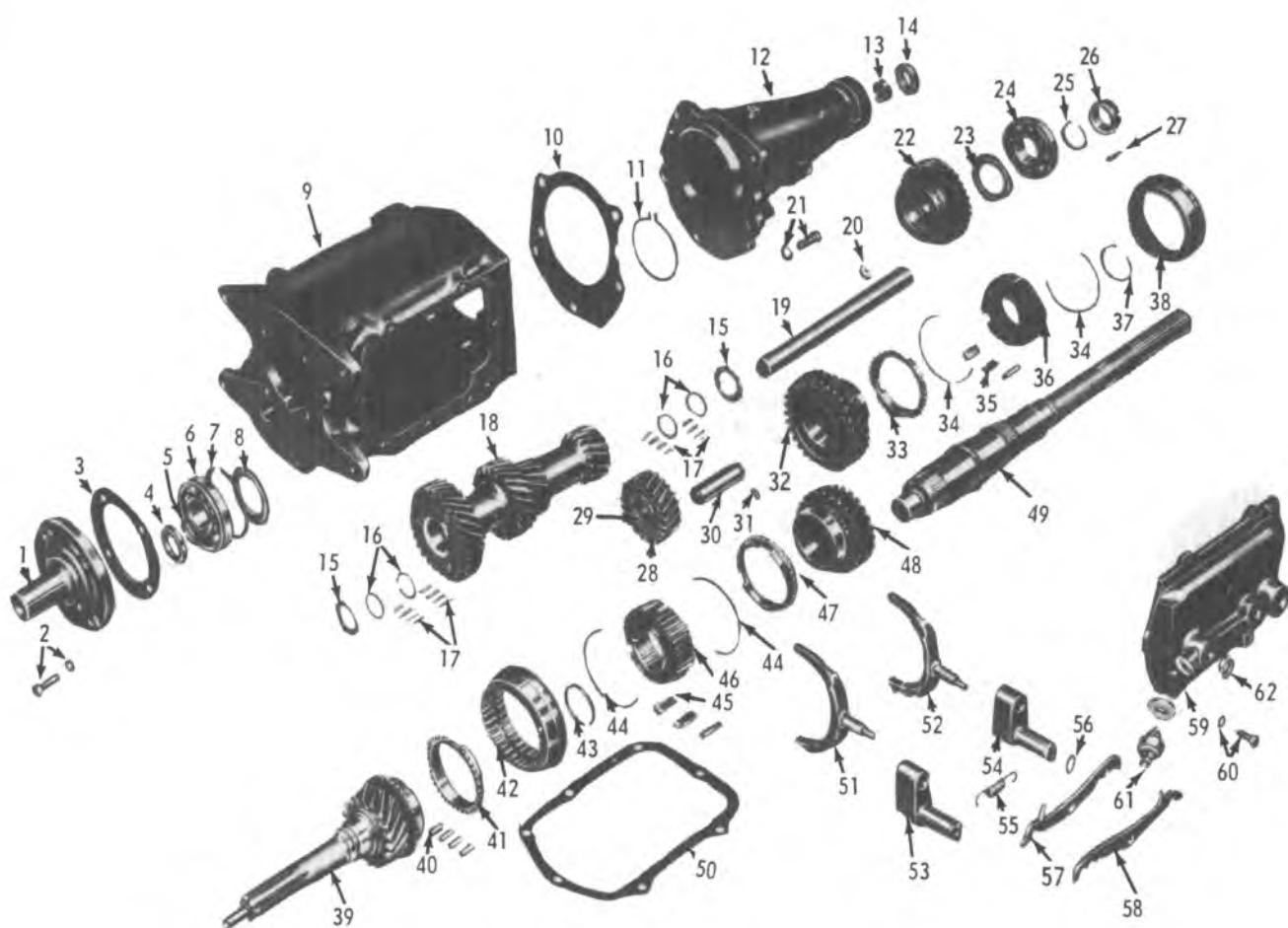
**NOTE:** The retainer oil return hole should be at the bottom.

12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.

13. Tighten all bolts to specified torque.

**NOTE:** Apply sealer to all through bolts.

14. Rotate clutch gear and shift transmission through gears to check free rotation of gears.



- |                       |                         |                       |                         |
|-----------------------|-------------------------|-----------------------|-------------------------|
| 1. Bearing Retainer   | 18. Countergear         | 35. Synchronizer Keys | 50. Gasket              |
| 2. Bolt and Lock      | 19. Countershaft        | 36. 1st and Reverse   | 51. 2nd and 3rd Shifter |
| Washer                | 20. Woodruff Key        | Synchronizer Hub      | Fork                    |
| 3. Gasket             | 21. Bolt                | Assembly              | 52. 1st and Reverse     |
| 4. Oil Seal           | 22. Reverse Gear        | 37. Snap Ring         | Shifter Fork            |
| 5. Snap Ring          | 23. Thrust Washer       | 38. 1st and Reverse   | 53. 2-3 Shifter Shaft   |
| (Bearing-to-Main      | 24. Rear Bearing        | Synchronizer Collar   | Assembly                |
| Drive Gear)           | 25. Snap Ring           | 39. Main Drive Gear   | 54. 1st and Reverse     |
| 6. Main Drive Gear    | 26. Speedometer Drive   | 40. Pilot Bearings    | Shifter Shaft           |
| Bearing               | Gear                    | 41. 3rd Speed Blocker | Assembly                |
| 7. Snap Ring Bearing  | 27. Retainer Clip       | Ring                  | 55. Spring              |
| 8. Oil Slinger        | 28. Reverse Idler Gear  | 42. 2nd and 3rd       | 56. O-Ring Seal         |
| 9. Case               | 29. Reverse Idler       | Synchronizer Collar   | 57. 1st and Reverse     |
| 10. Gasket            | Bushing                 | 43. Snap Ring         | Detent Cam              |
| 11. Snap Ring (Rear   | 30. Reverse Idler Shaft | 44. Synchronizer Key  | 58. 2nd and 3rd Detent  |
| Bearing-to-Extension) | 31. Woodruff Key        | Spring                | Cam                     |
| 12. Extension         | 32. 1st Speed Gear      | 45. Synchronizer Keys | 59. Side Cover          |
| 13. Extension Bushing | 33. 1st Speed Blocker   | 46. 2nd and 3rd       | 60. Bolt and Lock       |
| 14. Oil Seal          | Ring                    | Synchronizer Hub      | Washer                  |
| 15. Thrust Washer     | 34. Synchronizer Key    | 47. 2nd Speed Blocker | 61. TCS Switch and      |
| 16. Bearing Washer    | Spring                  | Ring                  | Gasket                  |
| 17. Needle Bearings   |                         | 48. 2nd Speed Gear    | 62. Lip Seal            |
|                       |                         | 49. Mainshaft         |                         |

Fig. 7B-6C--3-Speed (Muncie) 83mm Transmission Exploded View

# 4-SPEED (SAGINAW) 76MM TRANSMISSION

## INDEX

Disassembly of Transmission .....	7B-23	Repairs.....	7B-23
Disassembly of Mainshaft.....	7B-23	Clutch Keys and Springs Replacement .....	7B-23
Cleaning and Inspection .....	7B-23	Extension Oil Seal or Bushing .....	7B-26
Transmission Case.....	7B-23	Clutch Bearing Retainer Oil Seal.....	7B-27
Bearings .....	7B-23	Assembly of Mainshaft .....	7B-27
Gears and Bushings .....	7B-23	Assembly of Transmission.....	7B-28

### DISASSEMBLY OF TRANSMISSION (Fig. 7B-1J)

1. Remove side cover attaching bolts and remove side cover assembly.
2. Remove clutch gear bearing retainer bolts, retainer and gasket.
3. Remove clutch gear bearing to gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screwdriver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal (Fig. 7B-2J). The clutch gear bearing is a slip fit on the gear and into the case bore. This provides clearance for removal of clutch gear and mainshaft assembly.
4. Remove extension to case attaching bolts.
5. Remove clutch gear, mainshaft and extension assembly together through the rear case opening (Fig. 7B-3J).
6. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-4J) and remove the extension.
7. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. Tool J-22246 will now hold the roller bearings in position within the counter gear bore. Remove the gear and bearings (Fig. 7B-5J).
8. Remove reverse idler gear stop ring. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (Fig. 7B-6J).

### DISASSEMBLY OF MAINSHAFT

1. Using snap ring pliers, remove the 3rd and 4th speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, third gear blocker ring and third speed gear from front of mainshaft (Fig. 7B-7J).
2. Depress speedometer retaining clip and slide gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove (Fig. 7B-8J).
4. Support first gear with press plates and press on rear of mainshaft to remove first gear, thrust washer, spring washer and rear bearing from rear of mainshaft (Fig. 7B-9J).
5. Remove the 1st and 2nd sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 2nd speed blocker ring and 2nd speed gear from the rear of the mainshaft (Fig. 7B-10J).

### CLEANING AND INSPECTION

#### Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.

#### Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

**CAUTION:** *Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings may damage the race and balls.*

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

#### Bearing Rollers

All clutch gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

#### Gears

1. Inspect all gears for excessive wear, chips, or cracks and replace any that are worn or damaged.

2. Check both clutch sleeves to see that they slide freely on their hubs.

#### Reverse Idler Gear Bushings

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

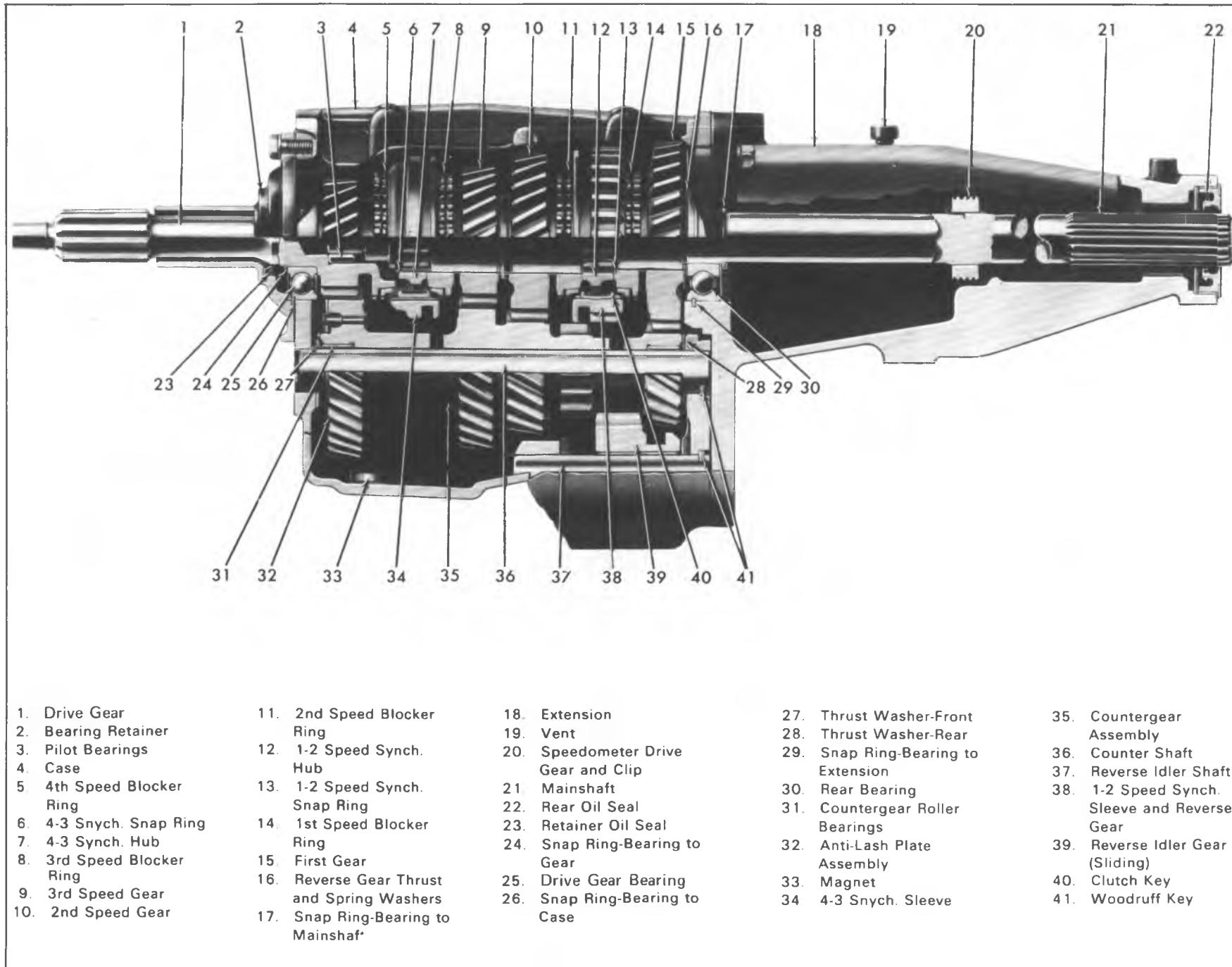
### REPAIRS

#### Clutch Keys and Springs

**NOTE:** The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.

Fig. 7B-1U-4-Speed 76mm (Saginaw) Transmission Cross Section



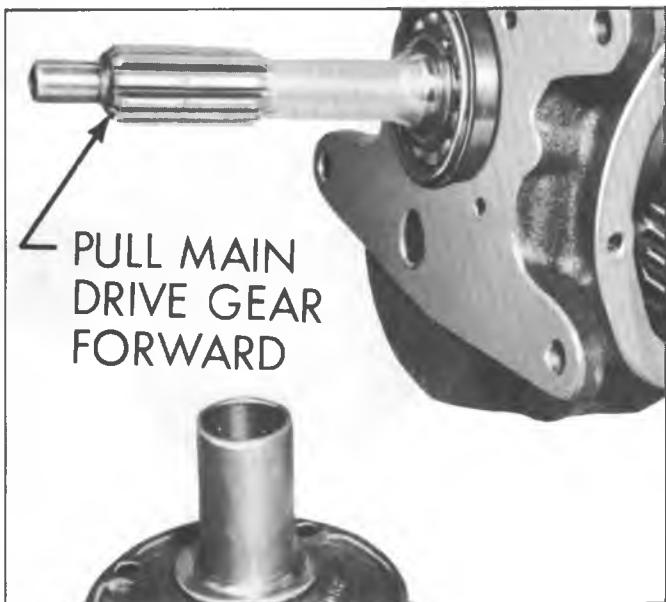


Fig. 7B-2J--Removing Clutch Gear Bearing



Fig. 7B-5J--Removing Countershaft



Fig. 7B-3J--Removing Clutch Gear and Mainshaft



Fig. 7B-6J--Removing Reverse Idler Gear Shaft



Fig. 7B-4J--Removing Extension to Rear Bearing Snap Ring

Fig. 7B-7J--Removing 3rd and 4th Synchronizer Snap Ring



Fig. 7B-8J--Rear Bearing to Mainshaft Snap Ring

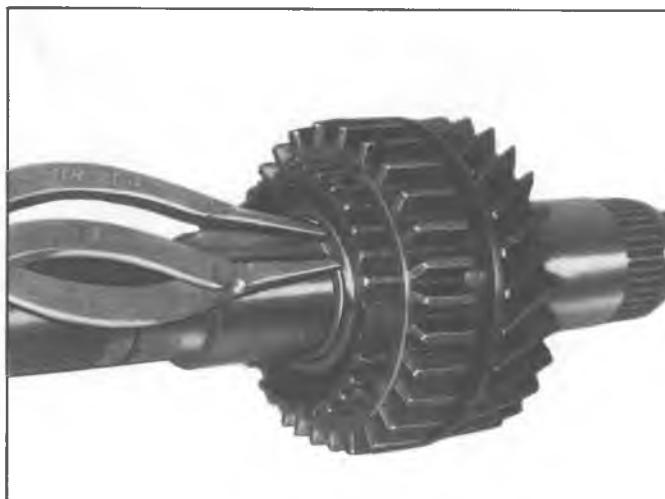


Fig. 7B-10J--Removing 1st and 2nd Synchronizer Snap Ring

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B-11J). The tanged end of each synchronizer spring should be installed into different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

**NOTE:** A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a greater recess depth.

#### Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-5778 to drive bushing into extension housing (Fig. 7B-12J). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-5154 (Fig. 7B-13J).



Fig. 7B-9J--Removing Rear Bearing and 1st Speed Gear

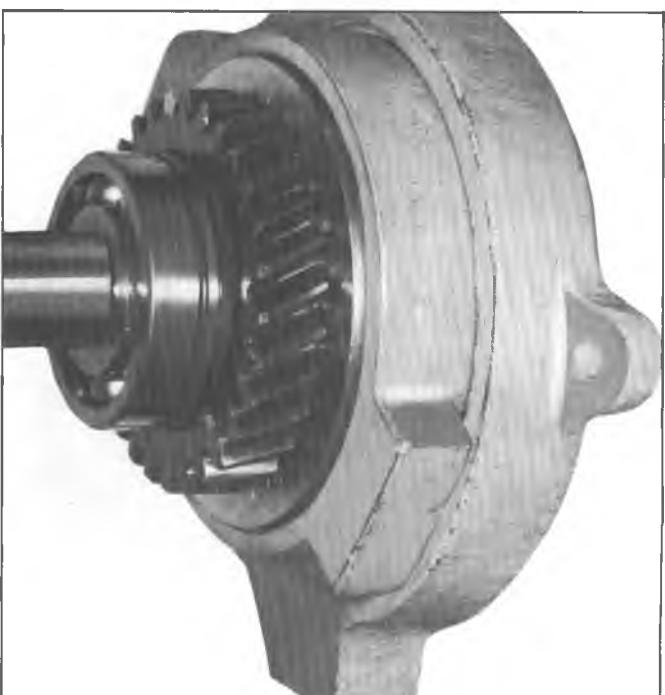


Fig. 7B-11J--3-4 Synchronizer Assembly

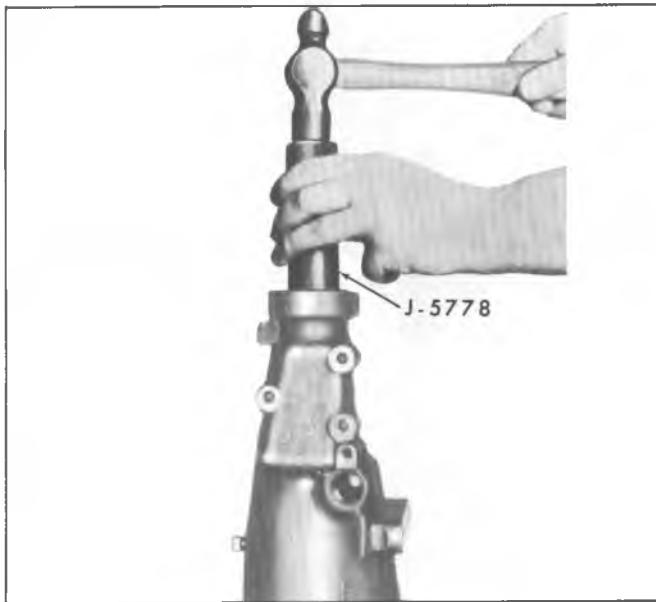


Fig. 7B-12J--Extension Bushing Replacement



Fig. 7B-14J--Removing Bearing Retainer Oil Seal

### Clutch Gear Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the oil seal out and replace with a new seal using Tool J-23096 until seal seats in its bore (Figs. 7B-14J and 7B-15J).

**NOTE:** Lip of seal must face rear of bearing retainer.

### ASSEMBLY OF MAINSHAFT (Fig. 7B-16J)

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the third speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the third speed gear. All four blocker rings used in this transmission are identical.
3. Install the 3rd and 4th synchronizer assembly with the fork slot downward on the mainshaft until it bottoms out against flange.

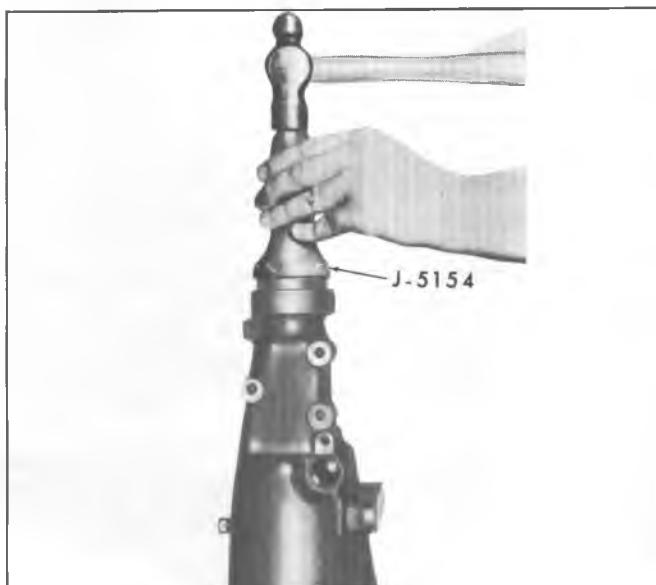


Fig. 7B-13J--Installing Extension Oil Seal

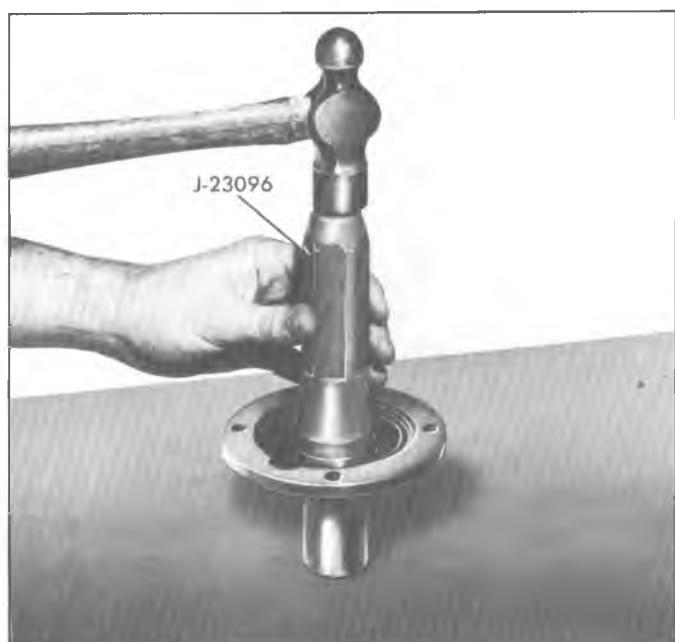


Fig. 7B-15J--Installing Bearing Retainer Oil Seal

**CAUTION:** Be sure the notches of the blocker ring align with the keys at the synchronizer assembly.

4. Install synchronizer hub to mainshaft snap ring (Fig. 7B-7J). Both synchronizer snap rings are identical. Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the second speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the second speed gear.
7. Install the first and second synchronizer assembly with fork slot downwards.
8. Install synchronizer hub to mainshaft snap ring (Fig. 7B-10J).

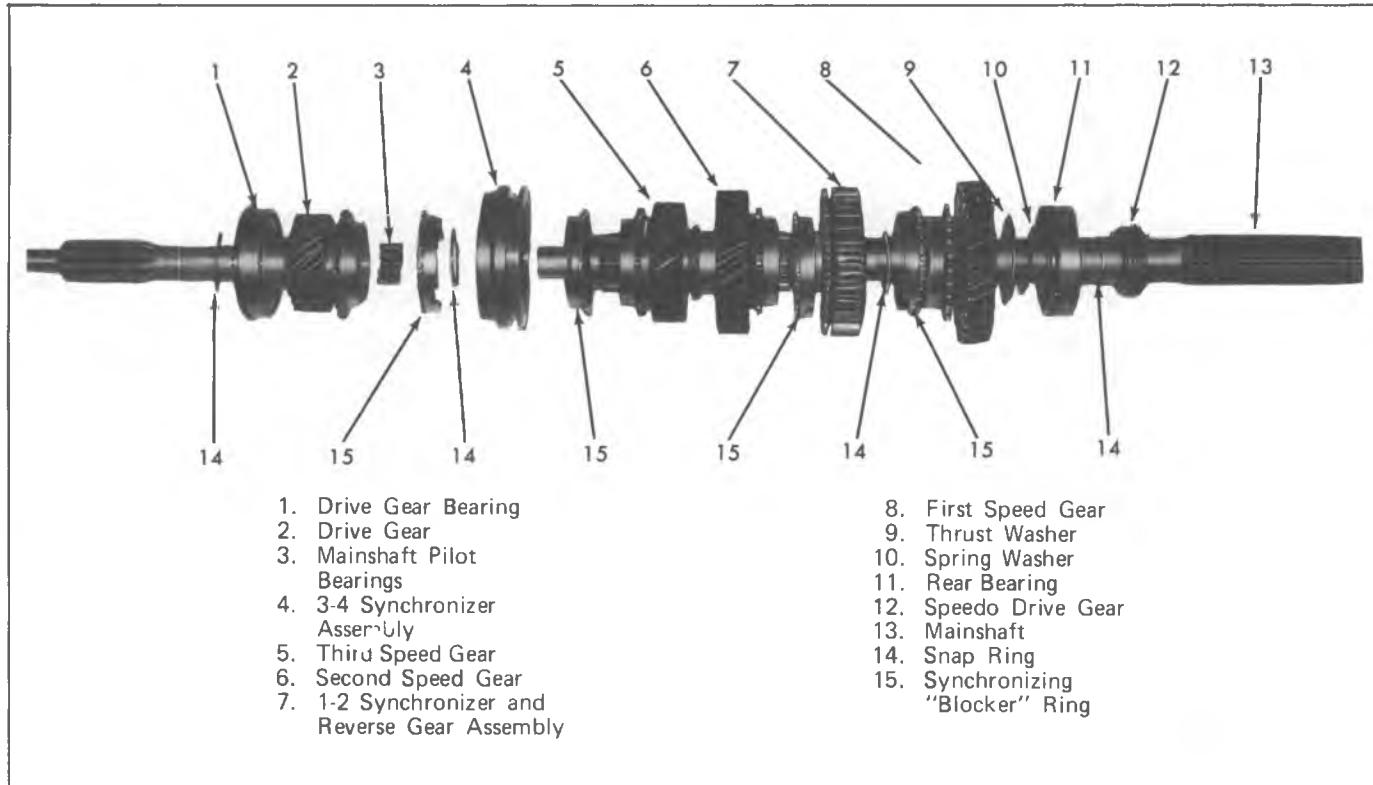


Fig. 7B-16J--Clutch Gear and Mainshaft Details

9. Install a blocker ring with notches downward so they align with the keys of the 1-2 synchronizer assembly.
10. Install first gear with clutching teeth downward.
11. Install first gear thrust washer (steel).

**CAUTION:** Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

12. Install first gear spring washer.
13. Install rear ball bearing with snap ring slot downward; press onto mainshaft (Fig. 7B-17J).
14. Install rear bearing to mainshaft snap ring (Fig. 7B-8J).
15. Install speedometer drive gear and clip.  
This completes the assembly of the mainshaft.

#### ASSEMBLY OF TRANSMISSION (Fig. 7B-18J)

1. Using Tool J-22246 load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (Fig. 7B-19J).
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.
- CAUTION:** Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.
3. Install reverse idler gear and shaft with its woodruff key from the rear of case.
4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (Fig. 7B-4J).
5. Load the mainshaft pilot bearings (14) into the clutch gear cavity and assemble the 4th speed blocker ring onto the clutch gear clutching surface with its clutching teeth toward the gear (Fig. 7B-20J).

6. Pilot the clutch gear, pilot bearings and 4th speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.



Fig. 7B-17J--Installing Rear Bearing

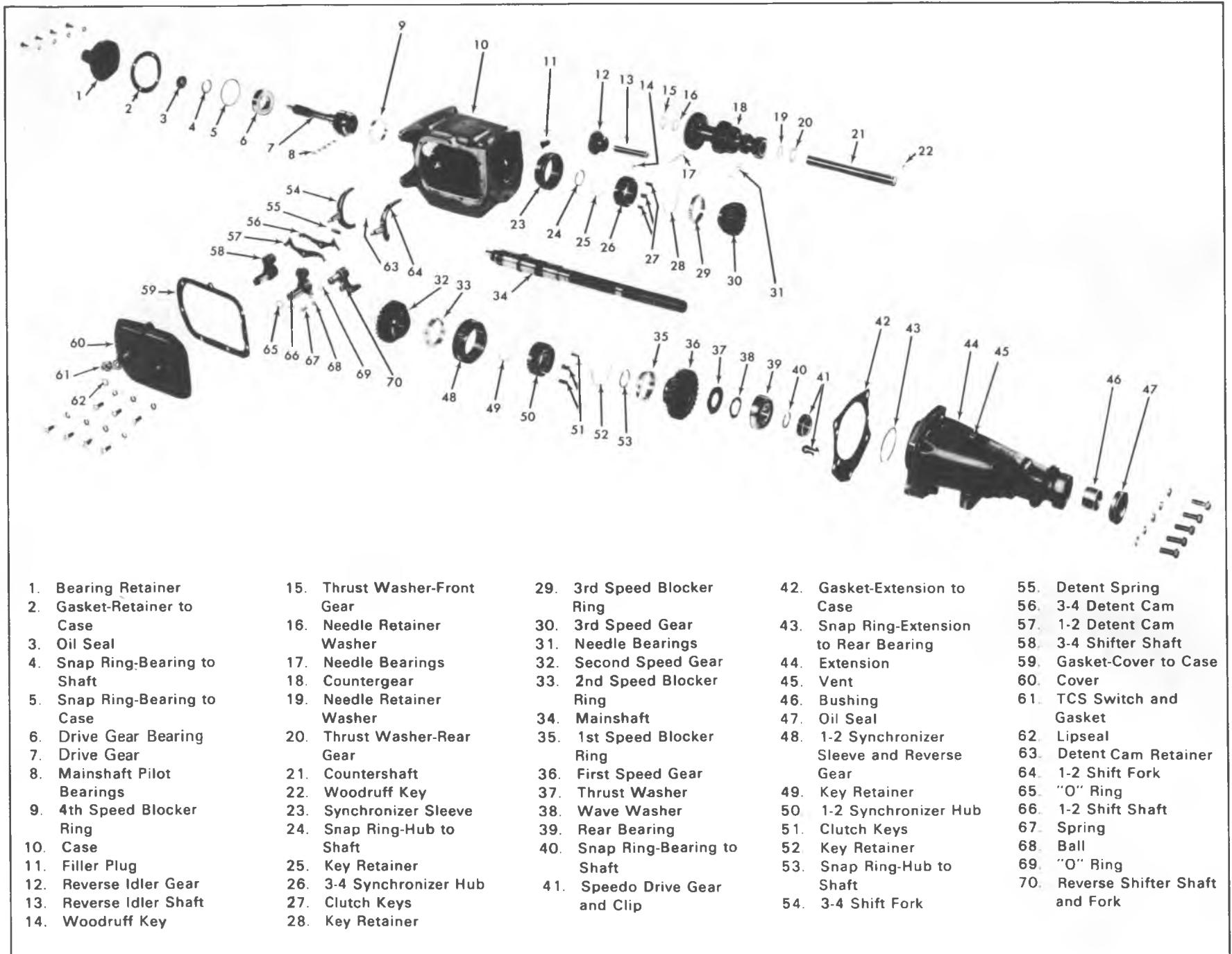


Fig. 7B-18J-4-Speed (Saginaw) 76mm Transmission-Exploded View



Fig. 7B-19J--Loading Countergear Bearing

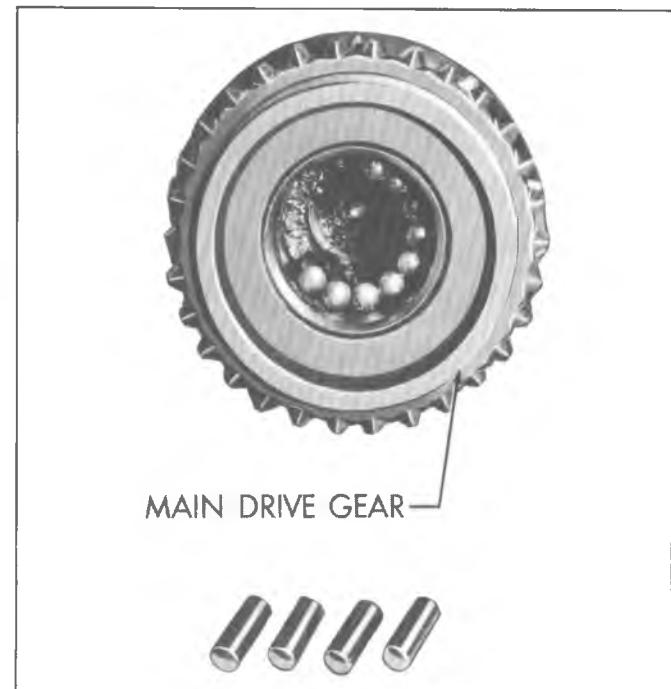


Fig. 7B-20J--Loading Mainshaft Bearings

**CAUTION:** Be sure the notches in the blocker ring align with the keys in the 3-4 synchronizer assembly.

7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of the case, assemble the clutch gear, mainshaft and extension to case as an assembly.

8. Install extension to case retaining bolts. Using seal cement on bottom bolt only.

9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.

## 4-SPEED (WARNER) 83MM TRANSMISSION

### INDEX

Disassembly of Transmission .....	7B-30
Disassembly of Mainshaft.....	7B-34
Cleaning and Inspection .....	7B-35
Transmission Case.....	7B-35
Bearing Rollers and Spacers.....	7B-35
Gears.....	7B-35
Front and Rear Bearings .....	7B-35
Repairs.....	7B-36
Clutch Keys and Springs Replacement .....	7B-36

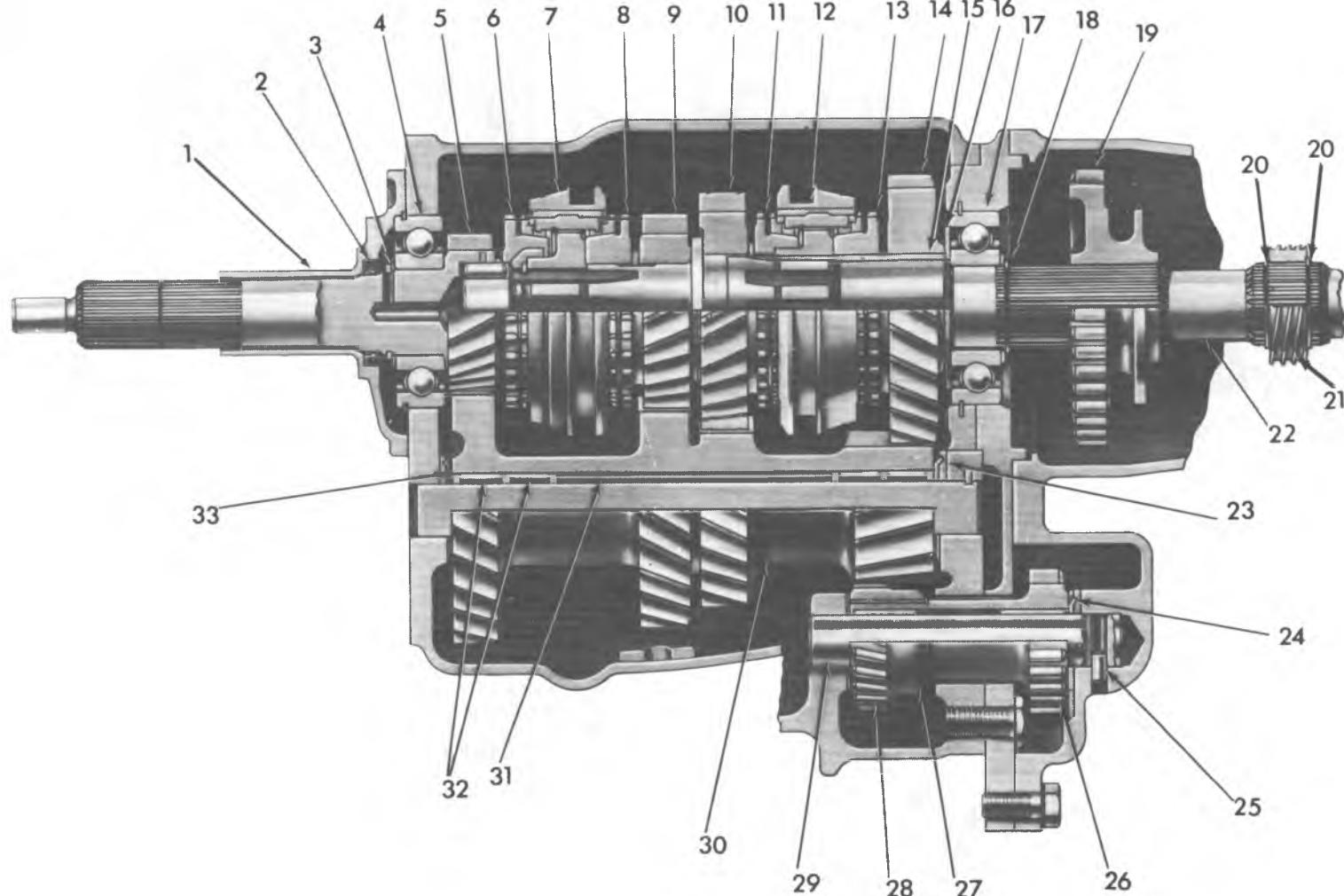
Extension Oil Seal and/or Bushing Replacement ...	7B-36
Drive Gear Bearing Retainer Oil.....	7B-37
Reverse Shifter Shaft and/or Seal Replacement .....	7B-37
Reverse Idler Shaft Replacement .....	7B-37
Transmission Side Cover .....	7B-37
Assembly of Countergear .....	7B-37
Checking Countergear End Play.....	7B-37
Assembly of Mainshaft.....	7B-38
Assembly of Transmission.....	7B-38

### DISASSEMBLY OF TRANSMISSION

**NOTE:** Sectional and exploded view of the transmission are provided in Figures 7B-1K and 7B-2K to assist in the disassembly of the transmission.

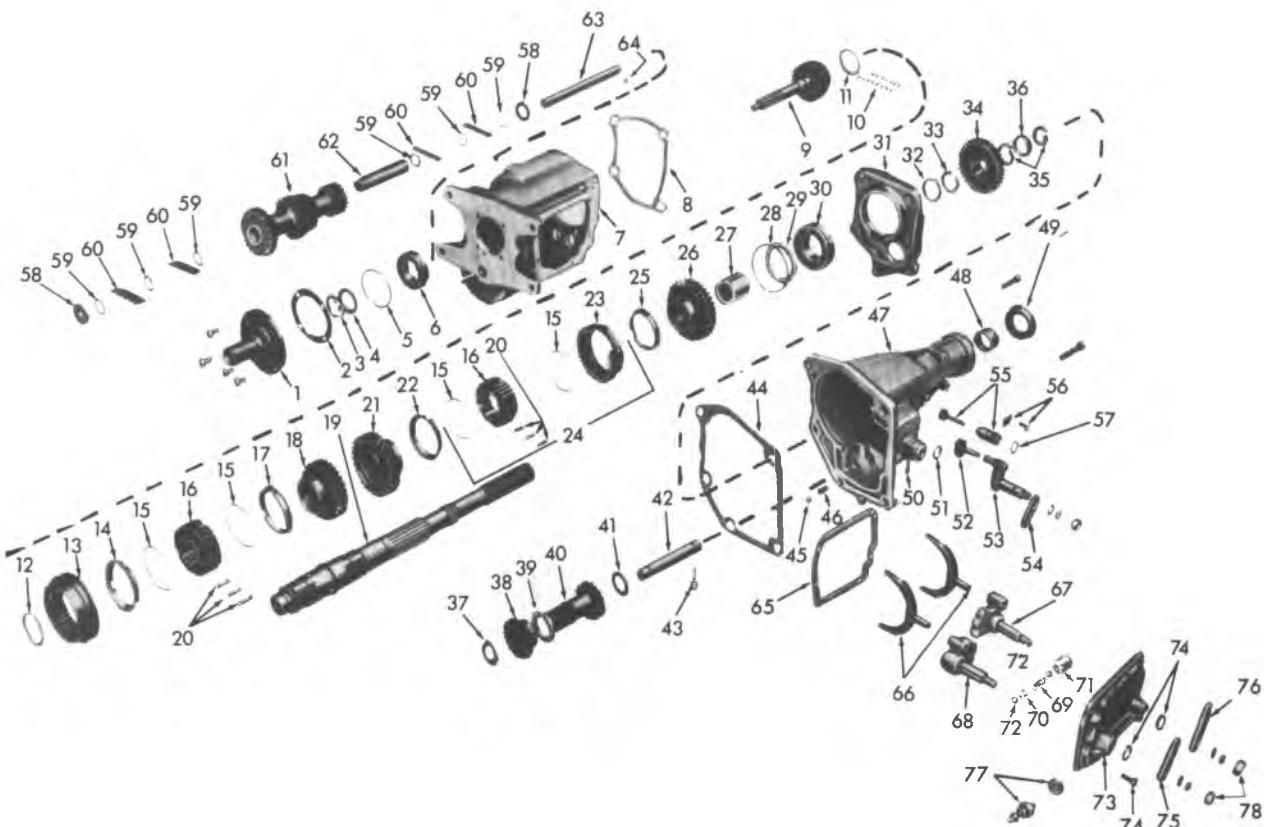
1. Thoroughly clean the exterior of the transmission assembly.

2. Shift transmission into second gear, remove drain plug from lower right of case and drain lubricant from transmission.
3. Remove nine (9) shift cover attaching bolts, cover assembly and gasket. Remove both shift forks.
4. Remove four (4) drive gear bearing retainer bolts, retainer and gasket from front of transmission.



- |                                |                                 |                                |
|--------------------------------|---------------------------------|--------------------------------|
| 1 Clutch Gear Bearing Retainer | 12 1st & 2nd Speed Clutch Assy. | 23 Thrust Washer               |
| 2 Retainer Lip Seal            | 13 1st Speed Synchronizer Ring  | 24 Thrust Washer               |
| 3 Snap Ring and Washer         | 14 1st Speed Gear               | 25 Idler Shaft Roll Pin        |
| 4 Clutch Gear Bearing          | 15 1st Speed Gear Bushing       | 26 Rear Idler Gear             |
| 5 Clutch Gear                  | 16 Spacer                       | 27 Spacer                      |
| 6 4th Speed Synchronizer Ring  | 17 Rear Main Bearing            | 28 Front Idler Gear            |
| 7 3rd & 4th Speed Clutch Assy. | 18 Snap Ring and Washer         | 29 Reverse Idler Shaft         |
| 8 3rd Speed Synchronizer Ring  | 19 Reverse Gear                 | 30 Countergear                 |
| 9 3rd Speed Gear               | 20 Snap Rings                   | 31 Countergear Sleeve          |
| 10 2nd Speed Gear              | 21 Speedometer Gear             | 32 Countergear Bearing Rollers |
| 11 2nd Speed Synchronizer Ring | 22 Mainshaft                    | 33 Thrust Washers              |

Fig. 7B-1K—Sectional View of 4-Speed (Warner) 83mm Transmission



1. Bearing Retainer
2. Gasket
3. Selective Fit Snap Ring
4. Spacer Washer
5. Bearing Snap Ring
6. Main Drive Gear Bearing
7. Transmission Case
8. Rear Bearing Retainer Gasket
9. Main Drive Gear
10. Bearing Rollers (16)
11. Washer
12. Snap Ring
13. Third and Fourth Speed Clutch Sliding Sleeve
14. Fourth Speed Gear Synchronizing Ring
15. Clutch Key Spring
16. Clutch Hub
17. Third Speed Gear Synchronizing Ring
18. Third Speed Gear
19. Mainshaft
20. Clutch Keys (3)
21. Second Speed Gear
22. Second Speed Gear Synchronizing Ring
23. First and Second Speed Clutch Sliding Sleeve
24. First and Second Speed Clutch Assembly
25. First Speed Gear Synchronizing Ring
26. First Speed Gear
27. First Speed Gear Sleeve
28. Rear Bearing Snap Ring
29. Thrust Washer
30. Rear Bearing
31. Rear Bearing Retainer
32. Washer
33. Selective Fit Snap Ring
34. Reverse Gear
35. Snap Ring
36. Speedometer Drive Gear
37. Reverse Idler Front Thrust Washer (Flat)
38. Reverse Idler Gear (Front)
39. Snap Ring
40. Reverse Idler Gear (Rear)
41. Thrust Washer (Tanged)
42. Reverse Idler Shaft
43. Reverse Idler Shaft Lock Pin and Welch Plug
44. Rear Bearing Retainer To Case Extension Gasket
45. Reverse Shifter Shaft Detent Ball
46. Reverse Shifter Shaft Ball Detent Spring
47. Case Extension
48. Extension Bushing
49. Rear Oil Seal
50. Reverse Shifter Shaft Lock Pin
51. Reverse Shifter Shaft "O" Ring Seal
52. Reverse Shift Fork
53. Reverse Shifter Shaft and Detent Plate
54. Reverse Shifter Lever
55. Speedometer Driven Gear and Fitting
56. Retainer and Bolt
57. "O" Ring Seal
58. Washer (Tanged)
59. Spacer (.050")
60. Bearing Rollers (28)
61. Countergear
62. Countergear Roller Spacer
63. Countershaft
64. Countershaft Woodruff Key
65. Gasket
66. Forward Speed Shift Forks
67. First and Second Speed Gear Shifter Shaft and Detent Plate
68. Third and Fourth Speed Gear Shifter Shaft and Detent Plate
69. Poppet Spring
70. Interlock Pin
71. Interlock Sleeve
72. Detent Balls
73. Transmission Side Cover
74. Lip Seals
75. Third and Fourth Speed Shifter Lever
76. First and Second Speed Shifter Lever
77. T.C.S. Switch and Gasket
78. Lever Attaching Nuts

Fig. 7B-2K--Exploded View of 4-Speed (Warner) 83mm Transmission

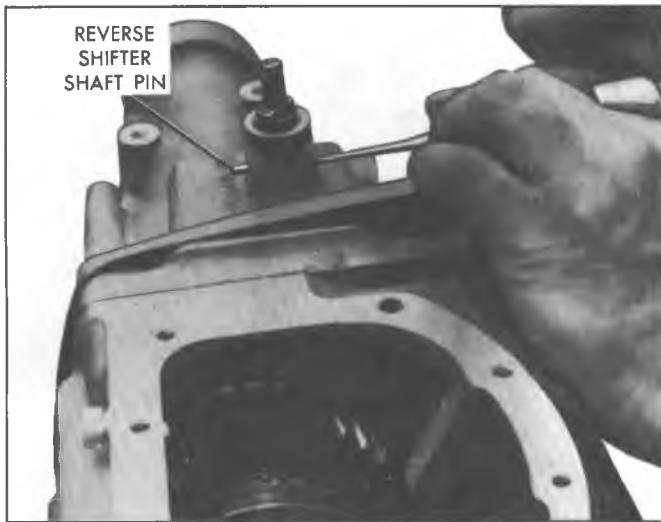


Fig. 7B-3K--Removing Reverse Shifter Shaft Lock Pin

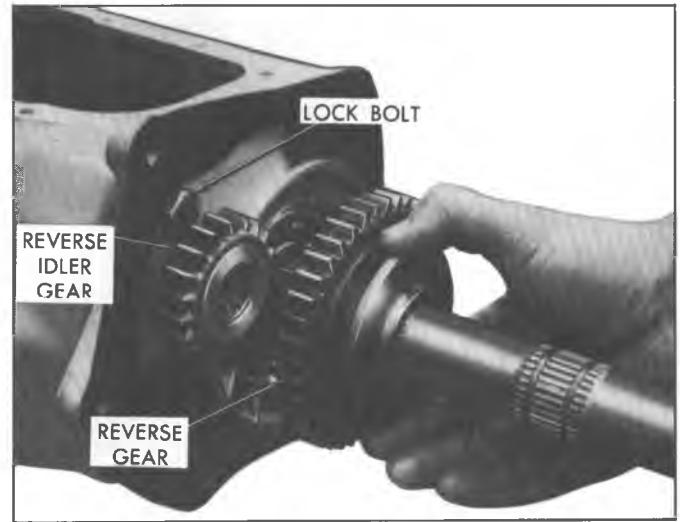


Fig. 7B-5K--Removing Reverse Gear

5. Remove lock pin from reverse shifter lever boss (Fig. 7B-3K) and pull shifter shaft partially out to disengage the reverse shifter fork from the reverse gear.

6. Remove five (5) rear extension attaching bolts, tap extension rearward with a soft hammer to start removal. Slide extension rearward until reverse idler shaft is clear of reverse idler gears. Then rotate extension to the left to free shift fork from collar of reverse gear and remove the case extension. Remove and discard gasket.

7. Remove speedometer gear outer snap ring (Fig. 7B-4K). Tap or slide speedometer gear from mainshaft, then remove second snap ring.

8. Slide the reverse gear from the mainshaft (Fig. 7B-5K), and slide the rear portion of the reverse idler gear from the transmission case.

9. Remove four (4) front bearing retainer bolts, gasket, and front bearing retainer from case.

10. Remove front bearing snap ring selective fit snap ring and spacer washer.

11. Using Tool J-6654-01, remove front main drive gear bearing from transmission case (Fig. 7B-6K).

12. Remove the rear retainer lock bolt.

13. Shift first-second and third-fourth clutch sliding sleeves forward to permit adequate clearance for mainshaft removal. Remove mainshaft and rear bearing retainer assembly from the transmission case.

14. Remove front reverse idler gear and thrust washer from case.

**NOTE:** Gear teeth face toward front of transmission.

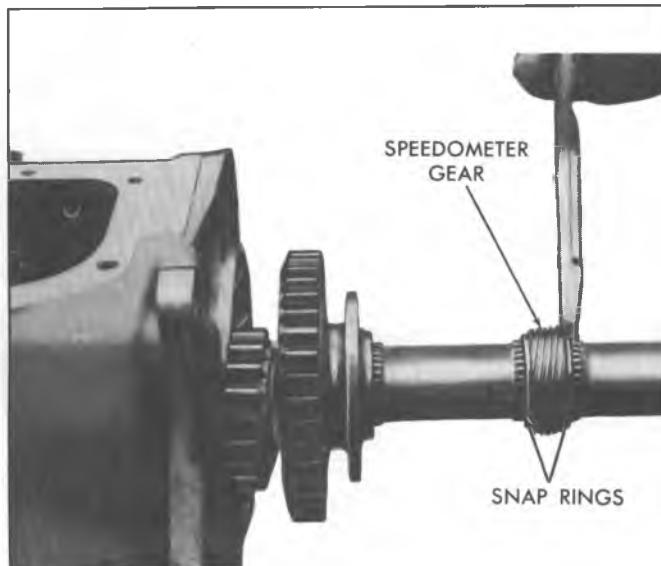


Fig. 7B-4K--Speedometer Gear and Retaining Rings

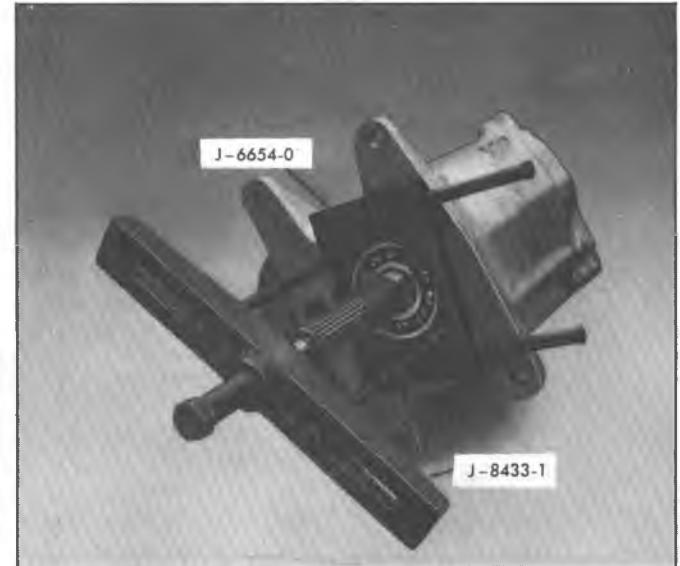


Fig. 7B-6K--Removing Main Drive Gear Bearing

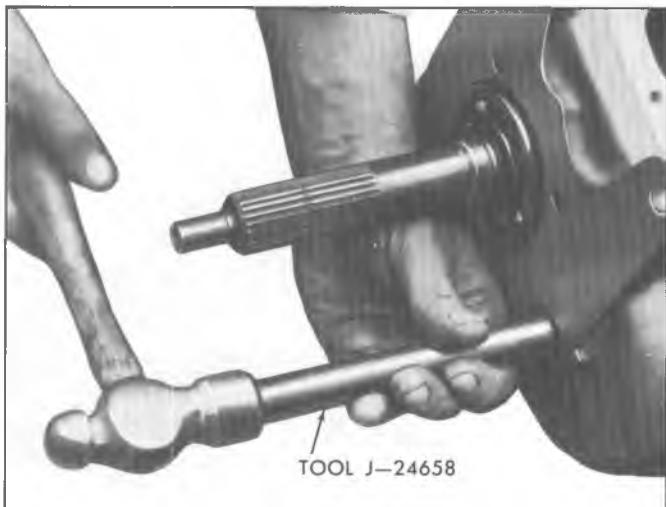


Fig. 7B-7K--Removing Countergear Shaft



Fig. 7B-9K--Removing 3-4 Clutch Assembly Retainer

- Using a dummy shaft J-24658 drive countergear shaft out of countergear (Fig. 7B-7K) and remove countergear and tanged thrust washers from case. Check bottom of case for pilot bearings or other loose components.

#### **DISASSEMBLY OF MAINSHAFT (Fig. 7B-8K)**

- Using snap ring pliers, remove 3-4 clutch assembly retaining ring at front of mainshaft (Fig. 7B-9K). Slide washer, synchronizer and clutch assembly, synchronizer ring 3rd speed gear from mainshaft.

- Spread rear bearing retainer snap ring (Fig. 7B-10K) and slide retainer from mainshaft.

- Remove rear bearing-to-mainshaft snap ring (Fig. 7B-11K).

- Support mainshaft under 2nd gear and press mainshaft from rear bearing, 1st gear and sleeve, 1-2 clutch and synchronizer assembly, and the second gear (Fig. 7B-12K).

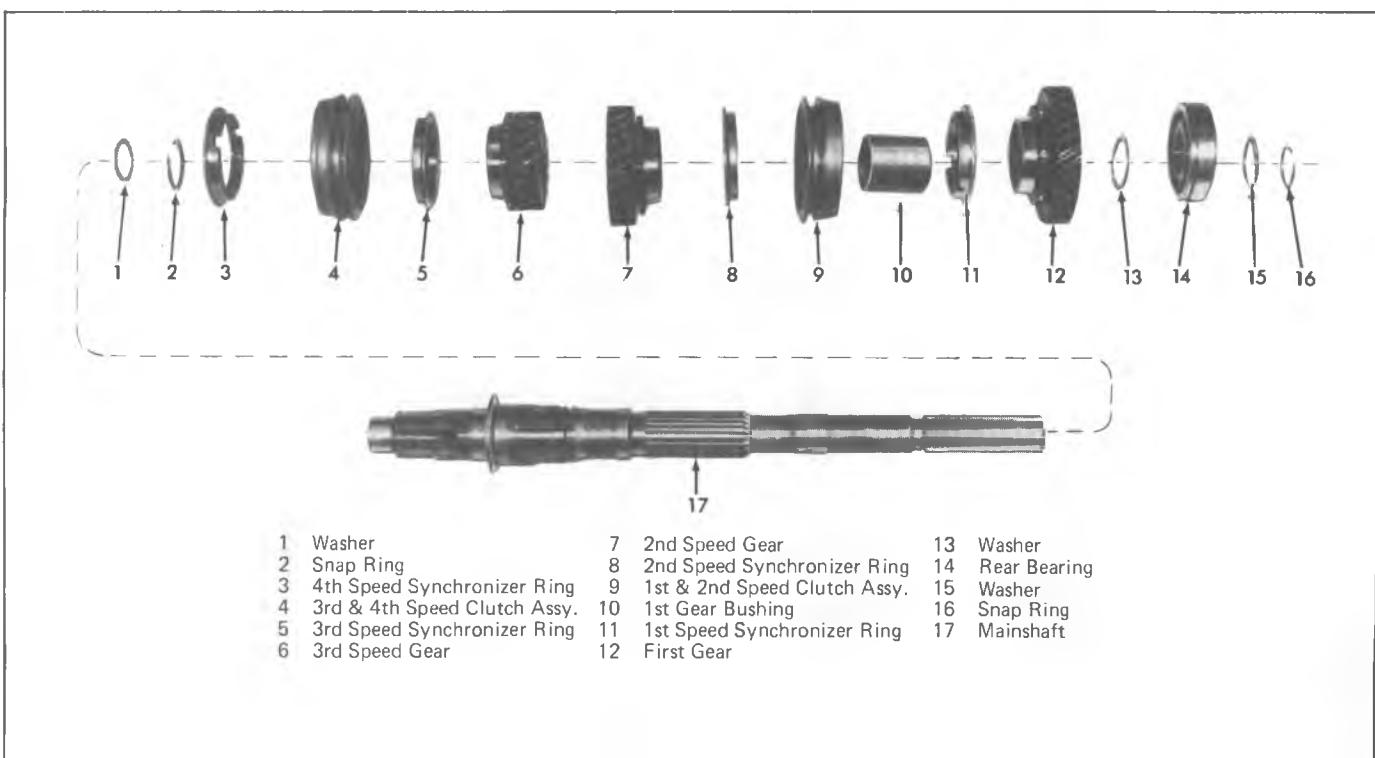


Fig. 7B-8K--Mainshaft Assembly Components

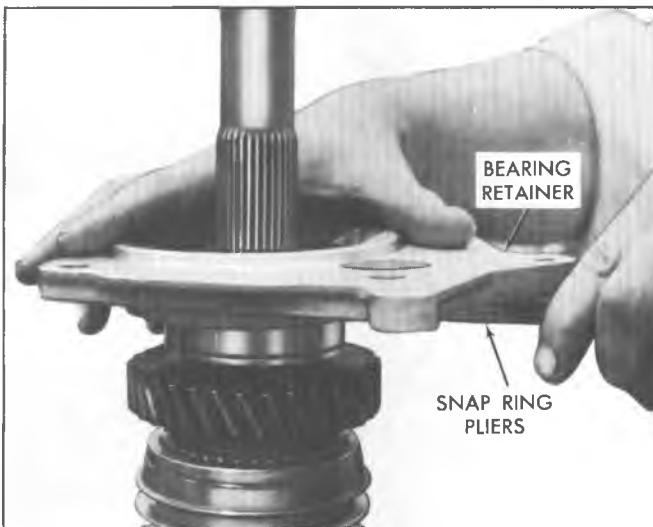


Fig. 7B-10K--Removing Rear Bearing Retainer

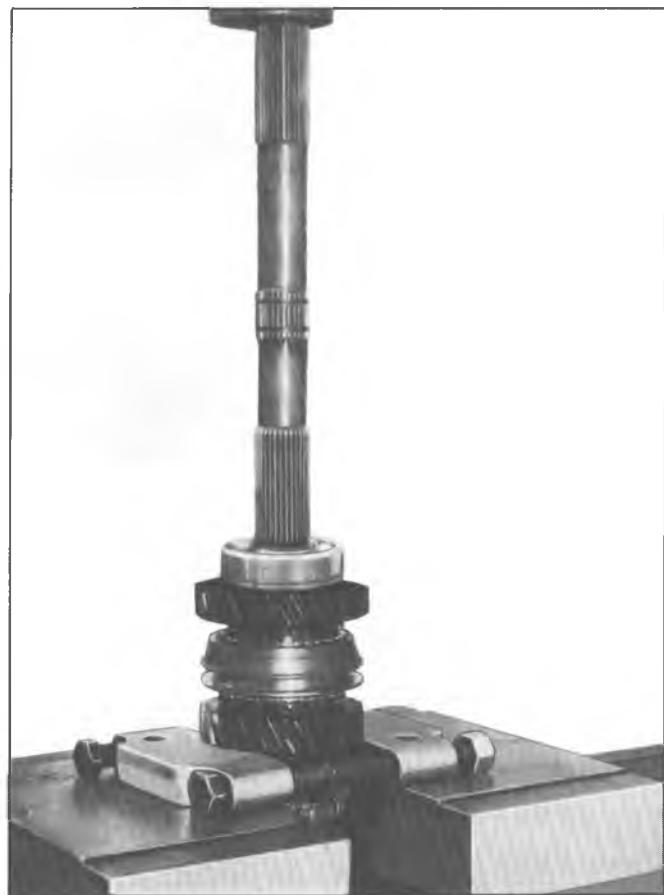


Fig. 7B-12K--Pressing Rear Bearing From Mainshaft

## CLEANING AND INSPECTION

### Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.
3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

### Roller Bearings and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn spacers.

### Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.



Fig. 7B-11K--Removing Rear Bearing Snap Ring

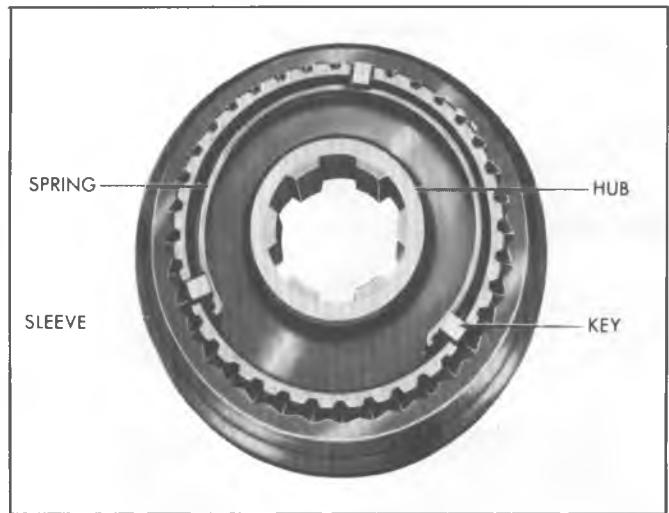


Fig. 7B-13K--Synchronizer Assembly

2. Inspect reverse gear bushing and if worn or damaged replace the entire gear (reverse gear bushing is not serviced separately).
3. Check both clutch sleeves to see that they slide freely on their hubs.

### Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.



Fig. 7B-14K--Removing Rear Extension Bushing

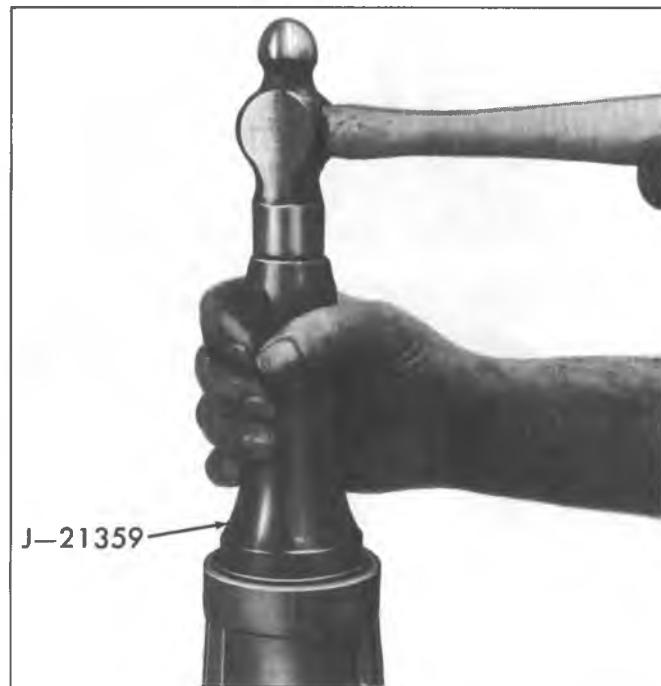


Fig. 7B-16K--Installing Drive Gear Bearing Retainer Seal

**CAUTION:** Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and balls.

## REPAIRS

### Synchronizer Keys and Springs

#### Replacement

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.
2. Push the hub from the sliding sleeve; the keys will fall free and the springs may be easily removed.
3. Place the two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B-13K).

Place the keys in position and while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.

#### Extension Oil Seal and/or

#### Bushing Replacement

1. Pry seal from rear of extension.
2. Remove bushing using Tool J-21465-17 with Handle J-8092. Drive bushing from rear of extension housing (Fig. 7B-14K).
3. Using a new bushing and Tool J-21465-17 with Handle J-8092, press bushing into extension from rear of extension.
4. Coat I.D. of bushing and seal with transmission lubricant. Install new seal using Tool J-21359 (Fig. 7B-15K).

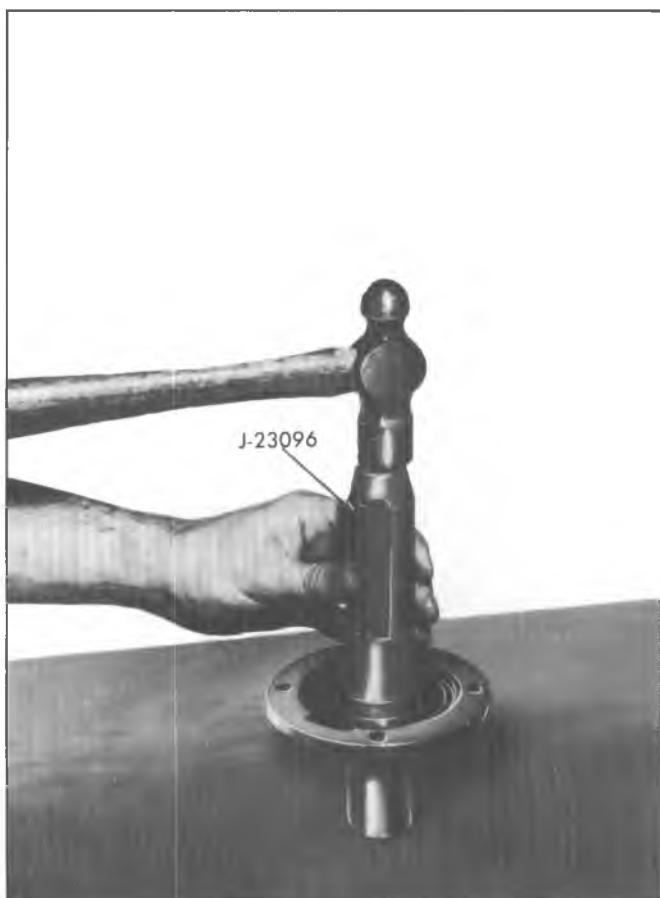


Fig. 7B-15K--Installing Rear Extension Seal

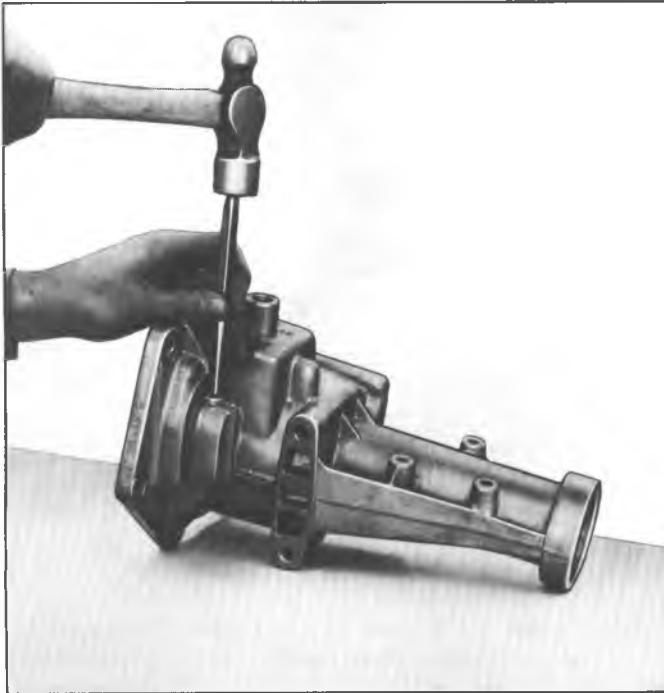


Fig. 7B-17K--Removing Reverse Idler Shaft Roll Pin

### Drive Gear Bearing Retainer Oil Seal Replacement

1. Pry out old seal.
2. Using a new seal, install new seal into retainer using Tool J-21359 until it bottoms in bore (Fig. 7B-16K). Lubricate I.D. of seal with transmission lubricant.

### Reverse Shifter Shaft and/or Seal Replacement

- #### Seal Replacement
1. With case extension removed from transmission the reverse shifter shaft lock pin will already be removed. (see Step 5 under Transmission Disassembly).
  2. Remove shift fork.
  3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft and ball detent spring. Remove "O" ring seal from shaft.
  4. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.
  5. Place detent ball on spring and while holding ball down, push the shifter shaft into place and turn until the ball drops into place in detent on the shaft detent plate.
  6. Install "O" ring seal on shaft.
  7. Install shift fork.

**NOTE:** Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

### Reverse Idler Shaft

#### Replacement

1. Place a small punch into hole in extension's reverse idler shaft boss and drive the welch plug and pin into the shaft (Fig. 7B-17K) until the shaft can be pulled from rear extension.
2. Insert new idler shaft into extension until hole in shaft lines up with hole in boss.
3. Insert roller pin in transmission boss opening and

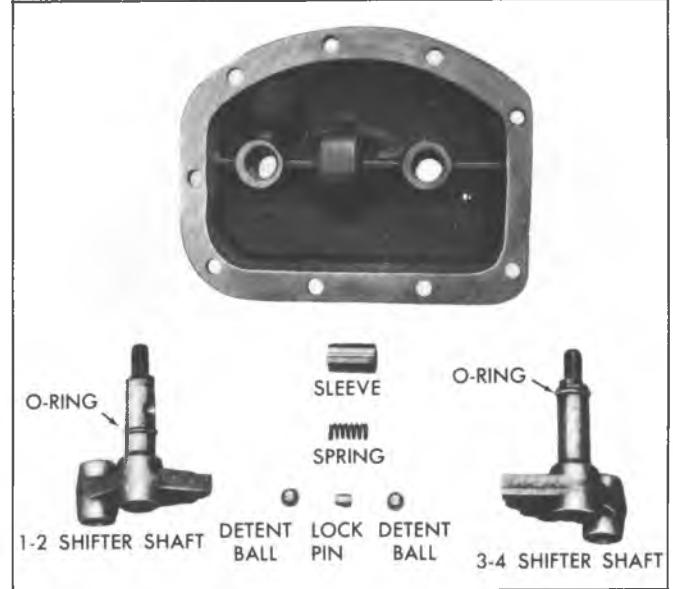


Fig. 7B-18K--Shift Cover Assembly

drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

### Transmission Side Cover

Although service of the side cover is covered here, the transmission does not have to be removed to perform these operations. To remove the side cover on-the-vehicle, simply drain the transmission, disconnect the 1st/2nd cross shaft and 3rd/4th linkage and remove the attaching bolts.

1. Remove the outer shifter lever nuts and lockwasher and pull levers from shafts.
2. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.
3. Remove interlock sleeve, interlock pin and poppet spring.
4. Replace necessary parts (Fig. 7B-18K) and assembly by reversing Steps 1-3.

### ASSEMBLY OF COUNTERGEAR

1. Install roller spacer in countergear (if removed).
2. Using heavy grease to retain rollers, install spacer, rollers, spacer, rollers, and spacer in either end of countergear. Repeat in other end of countergear (Fig. 7B-19K).
3. Insert a dummy shaft or loading Tool J-24658 into countergear.

### CHECKING COUNTERGEAR END PLAY

1. Rest the transmission case on its side with the side cover opening toward the assembler. Put countergear tanged thrust washers in place, retaining them with heavy grease, making sure the tangs are resting in the notches of the case.
2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place.
3. Position the transmission case resting on its front face.
4. Lubricate and insert countergear (pushing loading Tool J-24658 out front of case) until woodruff key slot is in its relative installed position (do not install key).
5. Attach a dial indicator as shown in Fig. 7B-20K and check end play of the countergear. If end play is greater than .025", a new thrust washers must be installed.

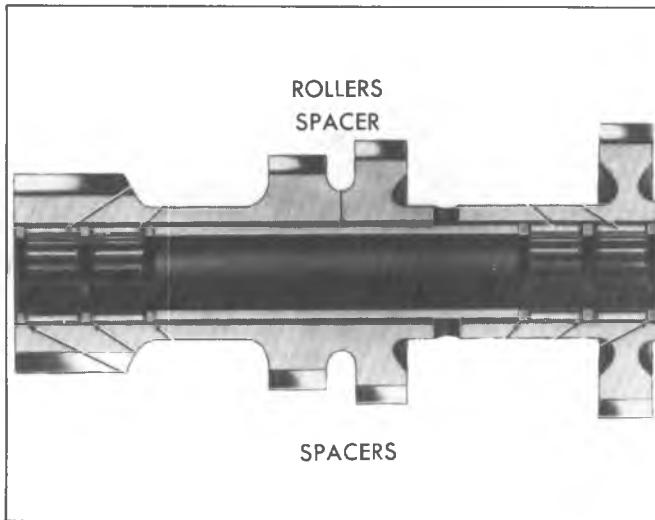


Fig. 7B-19K--Countergear Cross Section

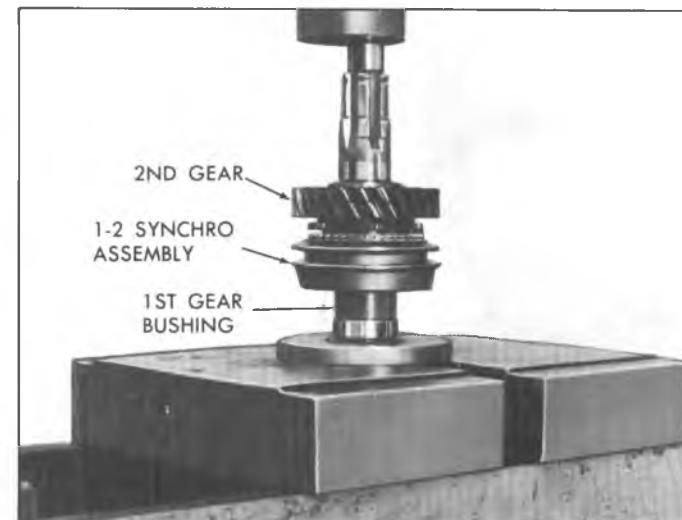


Fig. 7B-21K--Installing 1st Gear Sleeve

**ASSEMBLY OF MAINSHAFT**

1. From rear of mainshaft, assemble the 2nd speed gear (with hub of gear toward rear of shaft).
2. Install 1st-2nd synchronizer clutch assembly (sliding clutch sleeve taper toward rear, hub to front) on the mainshaft together with a synchronizer ring on both sides of the clutch assemblies.
3. Position the 1st gear sleeve on the shaft and press the sleeve onto the mainshaft until the 2nd gear, clutch assembly and sleeve bottom against the shoulder of the mainshaft (Fig. 7B-21K).
4. Install 1st speed gear (with hub toward front) and supporting inner race, press the rear bearing onto the mainshaft with the snap ring groove toward front of the transmission (Fig. 7B-22K).
5. Install spacer and new correct selective fit (thickest that will assemble) snap ring in mainshaft behind rear bearing.
6. Install the 3rd speed gear (hub to front of transmission) and the 3rd speed gear synchronizing ring (notches to front of transmission).



Fig. 7B-20K--Checking Countergear End Play

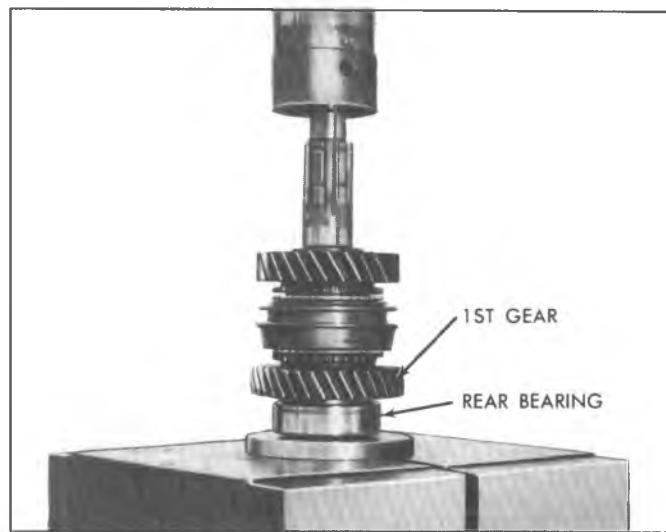


Fig. 7B-22K--Installing Rear Bearing

**ASSEMBLY OF TRANSMISSION**

1. Place the transmission case on its side with the shift cover opening toward the assembler. Position the countergear tanged washers in place, using a heavy grease to retain them.

**NOTE:** Be sure the tangs are in the notches of the thrust face.

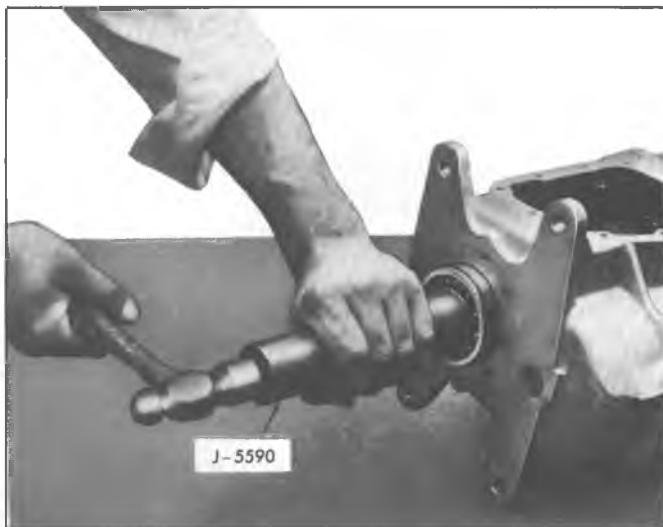


Fig. 7B-23K--Installing Front Main Bearing

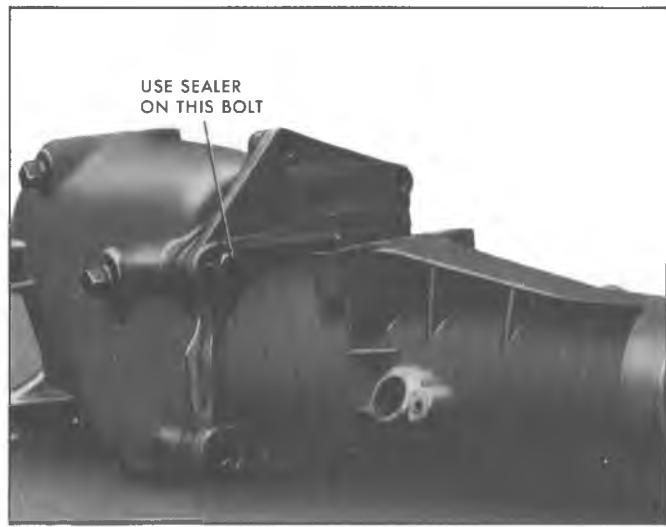


Fig. 7B-24K--Extension Bolt

2. Install the countergear in the case, aligning the bore of the countergear with the case opening. With the thrust washers in place, slide the loading tool to the front of the case and install the countergear shaft from the rear of the case. Install the woodruff key and tap shaft into gear until shaft is flush with rear face of transmission case.

3. Install front reverse idler gear (teeth forward) and thrust washer in case. Use a heavy grease to hold thrust washer in position.

4. Using a heavy grease install sixteen (16) roller bearings and washer into main drive gear. Mate main drive gear with mainshaft assembly. Position 3rd-4th clutch sliding sleeve forward. This will provide clearance for installation as well as hold the assembly together.

5. Position new rear bearing retainer to case extension gasket on rear of case. Install mainshaft and drive gear assembly into case.

6. Align rear bearing retainer with transmission case. Install retainer to case locating pin and retainer locking bolt. Torque to recommended specifications.

7. Place bearing snap ring on front main bearing. Position front main bearing to case opening and with a hollow shaft, or tool J-5590, tap bearing into case (Fig. 7B-23K). Install spacer washer and selective fit snap ring to secure main drive bearing.

8. Install front bearing retainer and gasket. Apply sealer to bolts and torque to recommended specification.

9. Install rear reverse idler gear engaging the splines with the portion of the gear within the case.

10. Place new rear bearing retainer to case extension gasket into position on rear face of bearing retainer. Slide reverse gear on shaft. Install speedometer gear and two selective fit snap rings.

11. Install idler shaft into extension until hole in shaft

lines up with hole in boss. Insert reverse idler shaft lock pin in transmission boss opening and drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

12. Install reverse shifter shaft and detent plate into extension. Locate reverse shift fork in reverse shifter shaft. Use a heavy grease to hold reverse shift fork in position.

**NOTE:** Be sure reverse shifter shaft "O" ring is placed on reverse shifter shaft after the shaft has been installed in the extension housing.

13. Install tanged thrust washer on reverse idler shaft with tang of washer in notch of idler thrust face of extension.

14. Place the 1st-2nd speed and 3rd-4th speed clutch sliding sleeve in neutral position. Pull reverse shift shaft partially out of extension and reverse shift fork as far forward in as possible. Start the extension onto the mainshaft while pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. When the fork engages, rotate the shifter shaft to move the reverse gear rearward permitting the extension to mate against the transmission case.

15. Install reverse shifter shaft lock pin.

16. Install rear extension housing-to-case bolts. Install rear extension to rear bearing retainer bolts (short bolts). Torque all bolts to recommended specification.

**NOTE:** It is essential that sealer be used on the extension bolt as indicated in Fig. 7B-24K.

17. Position 1st-2nd speed clutch sliding sleeve into 2nd gear and 3rd-4th speed clutch sliding sleeve into neutral. Position forward shift forks in sliding sleeves.

18. Position 1st-2nd speed gear shifter shaft and detent plate into 2nd gear position and using a sealer, install cover gasket and side cover assembly to transmission.

19. Check operation of transmission.

# 4-SPEED (MUNCIE CH465) 117MM TRANSMISSION

## INDEX

Disassembly of Transmission .....	7B-40	Drive Gear Bearing Retainer Oil Seal .....	7B-46
Subassembly Operations .....	7B-40	Mainshaft .....	7B-47
Transmission Cover .....	7B-40	Disassembly .....	7B-47
Disassembly .....	7B-40	Inspection .....	7B-47
Assembly .....	7B-40	Assembly .....	7B-48
Drive Gear .....	7B-44	Countershaft .....	7B-49
Disassembly .....	7B-44	Disassembly .....	7B-49
Inspection .....	7B-45	Assembly .....	7B-49
Assembly .....	7B-46	Assembly of Transmission .....	7B-50

## DISASSEMBLY OF TRANSMISSION

### Refer to Figures 7B-1L and 7B-2L

1. Mount transmission in suitable holding fixture and remove cap screws attaching transmission cover assembly to transmission case. If required, insert two 5/16 x 18 screws in cover flange threaded holes and turn evenly to raise cover dowel pins from case.

**NOTE:** Move reverse shifter fork so that reverse idler gear is partially engaged before attempting to remove cover. Forks must be positioned so rear edge of the slot in the reverse fork is in line with the front edge of the slot in the forward forks as viewed through tower opening.

2. Place transmission in two gears at once to lock gears. Remove the universal joint flange nut, universal joint front flange and brake drum assembly.

**NOTE:** On models equipped with 4-wheel drive transfer case, use Tool J-23070 to remove mainshaft rear lock nut (Fig. 7B-26L).

3. Remove parking brake and brake flange plate assembly on models equipped with propeller shaft parking brake. Refer to Section 5, Truck Service Manual.

4. Remove rear bearing retainer and gasket.

5. Slide speedometer drive gear off mainsahft.

6. Remove drive gear bearing retainers and gasket.

7. Remove countergear front bearing cap and gasket.

8. Pry countergear front bearing out by inserting screw drivers into groove at cast slots in case.

9. Remove countergear rear bearing retaining rings (snap ring) from shaft and bearing. Using Tool J-22832 and J-8433-1, remove countergear rear bearings (Fig. 7B-3L). This will allow countergear assembly to rest on bottom of case.

**CAUTION:** Make sure Tool J-22832 engages full circumference of groove in bearing to prevent tool damage.

10. Remove drive gear bearing outer race to case retaining ring.

11. Remove drive gear and bearing by tapping gently on bottom side of drive gear shaft and prying directly opposite against the case and bearing snap ring groove at the same time. Remove 4th gear synchronizer ring.

**CAUTION:** Index cut out section of drive gear in down position with countergear to obtain clearance for removing clutch gear.

12. Remove rearer mainshaft bearing retainer ring (snap ring) and using Tool J-22832 and J-8433-1, remove bearing from case (Fig. 7B-4L). Slide 1st speed gear thrust washer off mainshaft.

13. Raise rear of mainshaft assembly and push rearward in case bore, then swing front end up and lift from case. Remove synchronizer cone from shaft.

14. Slide reverse idler gear rearward and move countergear rearward until front end is free of case, then lift to remove from case.

15. To remove reverse idler gear, drive reverse idler gear shaft out of case from front to rear using a drive. Remove reverse idler gear from case.

## SUBASSEMBLY OPERATIONS

### TRANSMISSION COVER

#### Disassembly (Fig. 7B-5L)

1. Using a small punch drive out pins retaining 1st-2nd and 3rd-4th shifter forks to shifter shafts and also drive out expansion plugs.

**NOTE:** The pin retaining the third and fourth shifter fork to the shaft must be removed, and the shifter fork removed from the cover before the reverse shifter head pin can be removed.

2. With shifter shafts in neutral position, drive shafts out of cover and shafter forks.

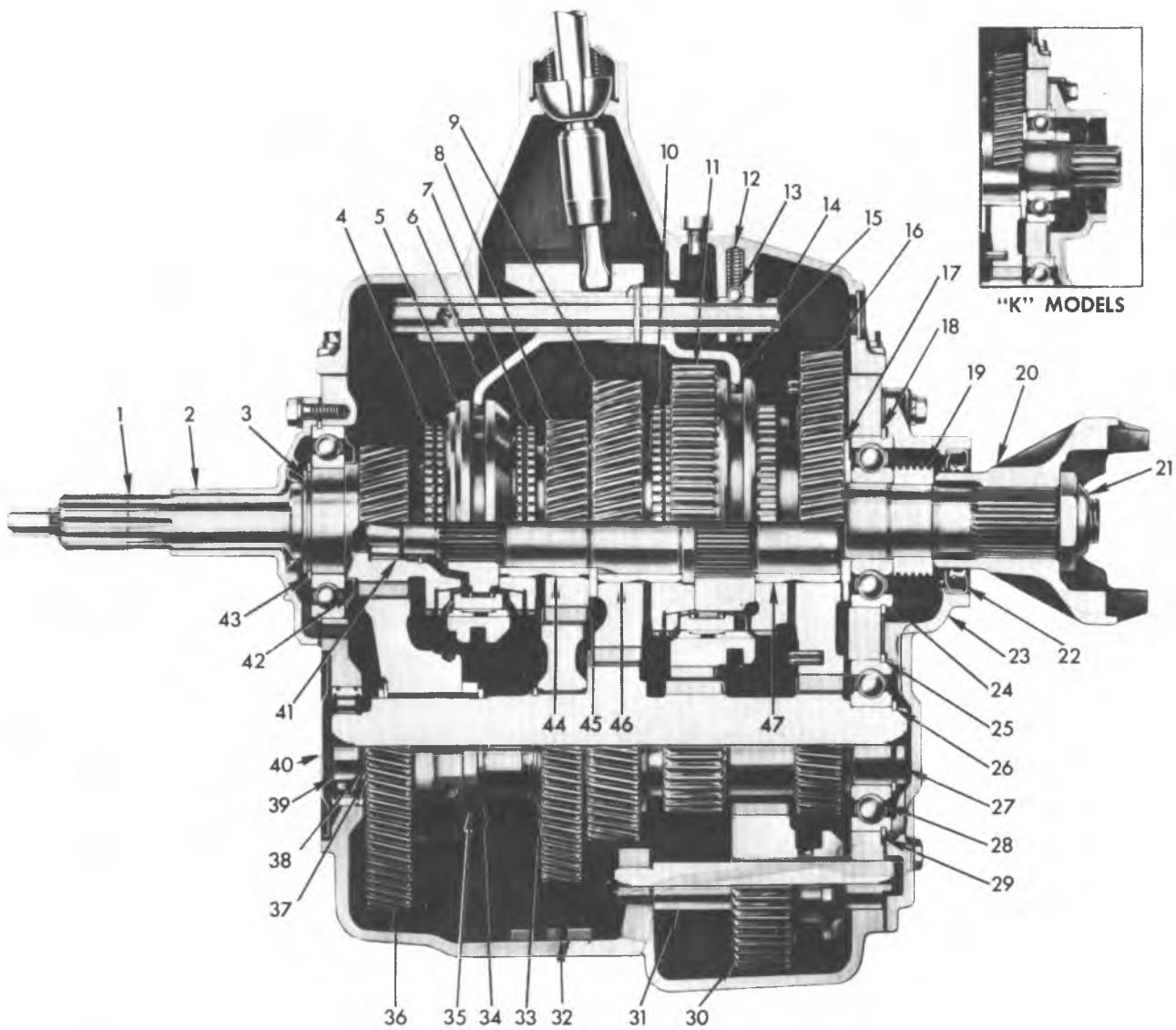
**CAUTION:** Exercise care so shaft detent balls, springs and innerlock pin located in the cover are not lost as the shifter shafts are removed.

3. Drive out pin holding reverse shifter head and drive out the shaft.

**CAUTION:** Exercise extreme care during shaft removal since detent balls are under spring tension in the rear rail boss holes.

#### Assembly (Fig. 7B-6L)

1. In reassembling the transmission cover, care must be used in installing the shifter shafts. They should be installed in the order shown in Fig. 7B-7L, namely, reverse, 3rd-4th, and 1st-2nd. Fig. 7B-6L illustrates the difference in the shafts.



- |  |                                    |                               |                                |
|--|------------------------------------|-------------------------------|--------------------------------|
| 1. Main Drive Gear                     | 11. Reverse Driven Gear            | 24. Mainshaft Rear Bearing    | 37. Thrust Washer              |
| 2. Drive Gear Bearing Retainer         | 12. Poppet Spring                  | 25. Rear Bearing Snap Ring    | 38. Snap Ring                  |
| 3. Snap Ring-Outer                     | 13. Poppet Ball                    | 26. Snap Ring                 | 39. Front Countershaft Bearing |
| 4. 3rd and 4th Synchronizer Ring       | 14. Shift Rail                     | 27. Countershaft              | 40. Countergear Front Cover    |
| 5. 3rd and 4th Synchronizer Collar     | 15. 1st and 2nd Shift Fork         | 28. Countershaft Rear Bearing | 41. Pilot Bearing Rollers      |
| 6. 3rd and 4th Shift Fork              | 16. 1st Speed Gear                 | 29. Bearing Snap Ring         | 42. Clutch Gear Oil Slinger    |
| 7. 3rd and 4th Speed Synchronizer Ring | 17. Thrust Washer                  | 30. Reverse Idler Gear        | 43. Snap Ring                  |
| 8. 3rd Speed Gear                      | 18. Bearing Snap Ring              | 31. Reverse Idler Shaft       | 44. 3rd Speed Gear Bushing     |
| 9. 2nd Speed Gear                      | 19. Speedometer Drive Gear         | 32. Case Magnet               | 45. Thrust Washer              |
| 10. 1st and 2nd Synchronizer Assembly  | 20. Output Yoke                    | 33. Snap Ring                 | 46. 2nd Speed Gear Bushing     |
|  | 21. Flange Nut                     | 34. Snap Ring                 | 47. 1st Speed Gear Bushing     |
|  | 22. Rear Bearing Retainer Oil Seal | 35. Spacer                    |                                |
|  | 23. Rear Bearing Retainer          | 36. Countergear               |                                |

Fig. 7B-1L--4-Speed (Muncie CH465) 117mm Transmission Assembly—Cross Section

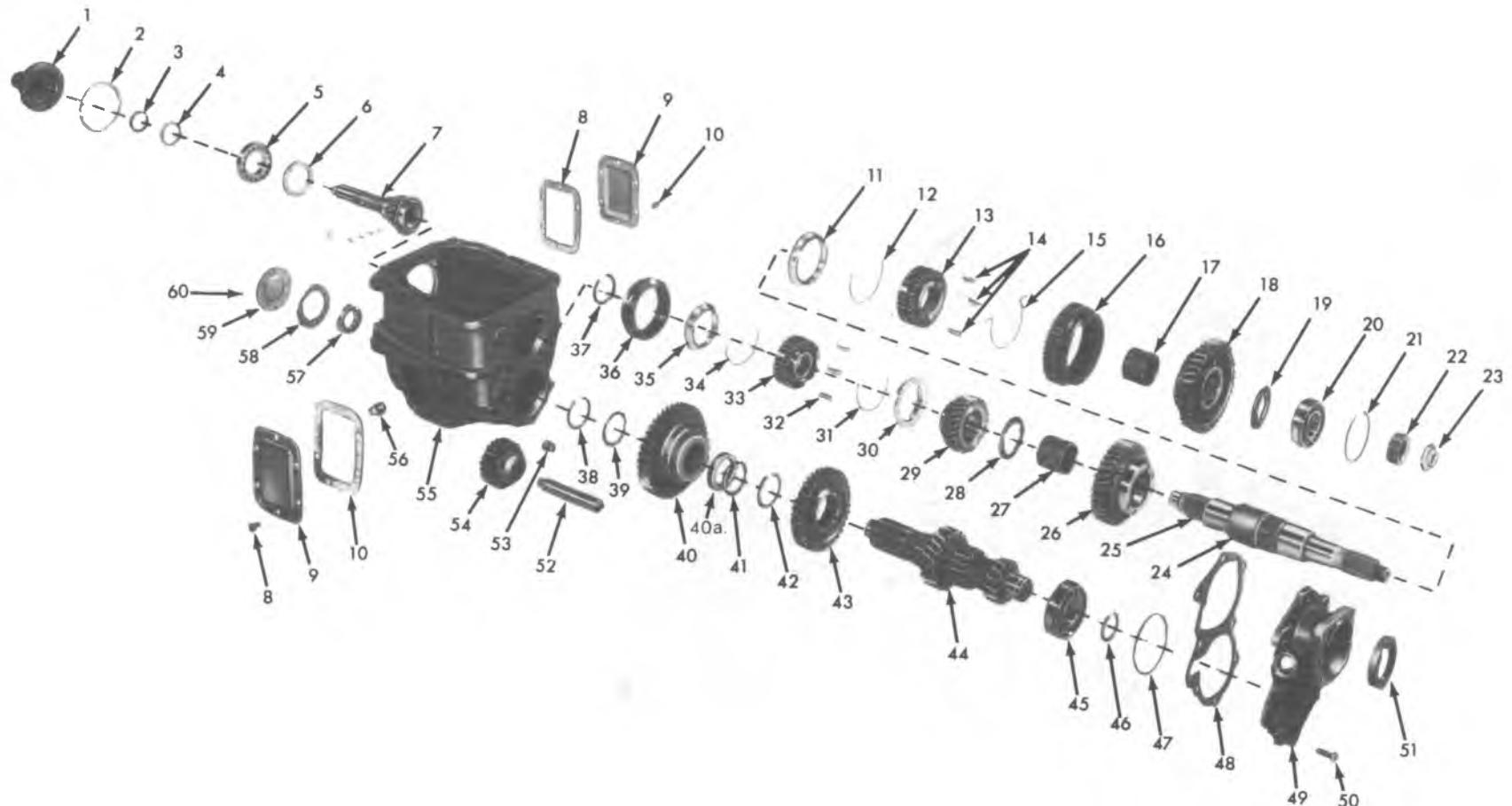


Fig. 7B-2L-4-Speed (Muncie CH465) 117mm Transmission Exploded View

- |                                  |                                    |                                       |                              |                               |
|----------------------------------|------------------------------------|---------------------------------------|------------------------------|-------------------------------|
| 1. Drive Gear Bearing Retainer   | 13. 1st-2nd Speed Synchronizer Hub | 26. 2nd Speed Gear                    | 37. Snap Ring                | 48. Rear Retainer Gasket      |
| 2. Retainer Gasket               | 14. Synchronizer Keys              | 27. 3rd Gear Bushing                  | 38. Snap Ring                | 49. Rear Retainer             |
| 3. Lip Seal                      | 15. Synchronizer Spring            | 28. Thrust Washer                     | 39. Thrust Washer            | 50. Retainer Bolts            |
| 4. Snap Ring                     | 16. Reverse Driven Gear            | 29. 3rd Speed Gear                    | 40. Clutch Countergear       | 51. Retainer Lip Seal         |
| 5. Drive Gear Bearing            | 17. 1st Gear Bushing               | 30. 3rd Speed Blocker Ring            | 40a. Spacer                  | 52. Reverse Idler Shaft       |
| 6. Oil Slinger                   | 18. 1st Gear                       | 31. Synchronizer Spring               | 41. Snap Ring                | 53. Drain Plug                |
| 7. Drive Gear and Pilot Bearings | 19. Thrust Washer                  | 32. Synchronizer Keys                 | 42. Snap Ring                | 54. Reverse Idler Gear        |
| 8. Power Take-Off Cover Gasket   | 20. Rear Main Bearing              | 33. 3rd-4th Synchronizer Hub          | 43. 3rd Speed Countergear    | 55. Case                      |
| 9. Power Take-Off Cover          | 21. Bearing Snap Ring              | 34. Synchronizer Spring               | 44. Countergear Shaft        | 56. Fill Plug                 |
| 10. Retaining Screws             | 22. Speedometer Gear               | 35. 3rd-4th Speed Blocker Ring        | 45. Countergear Rear Bearing | 57. Countergear Front Bearing |
| 11. 1st-2nd Speed Blocker Ring   | 23. Rear Mainshaft Lock Nut        | 36. 3rd-4th Speed Synchronizer Sleeve | 46. Snap Ring                | 58. Gasket                    |
| 12. Synchronizer Spring          | 24. 2nd Speed Bushing (On Shaft)   |                                       | 47. Bearing Outer Snap Ring  | 59. Front Cover               |
|                                  | 25. Mainshaft                      |                                       |                              | 60. Cover Screws              |

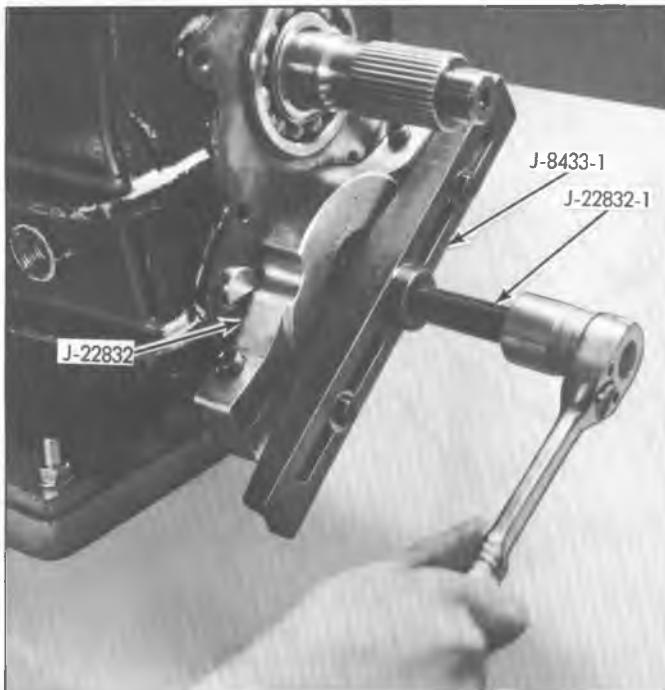


Fig. 7B-3L--Removing Countergear Rear Bearing

2. Place fork detent ball springs and balls in position in holes in cover.
3. Start shifter shafts into cover; depress detent balls with small punch and push shafts on over balls. (See Fig. 7B-7L). Hold reverse fork in position and push shaft through yoke. Install split pin in fork and shaft; then, push fork in neutral position.
4. Hold 3rd and 4th fork in position and push shaft through yoke, but not through front support bore.
5. Place two (2) interlock balls in cross-bore in front support boss between reverse and 3rd and 4th shifter shaft. Install the interlock pin in the 3rd and 4th shifter shaft hole.

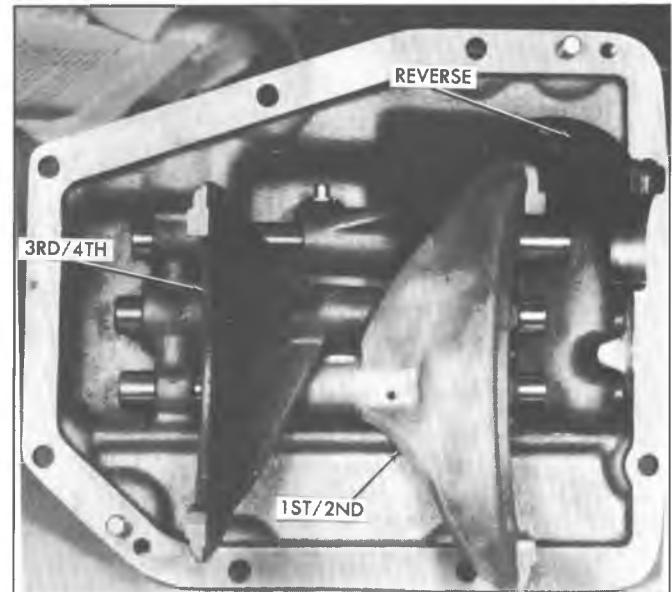


Fig. 7B-5L--Cover Assembly

Apply grease to hold in place. Push 3rd and 4th shaft through fork and cover bore, keeping both balls and pin in position between shafts until retaining holes line up in fork and shaft. Install retaining pin and move to neutral position.

6. Place two (2) interlock balls between the 1st and 2nd shifter shaft and 3rd and 4th shifter shaft in the cross-bore of the front support boss. Hold 1st and 2nd fork in position and push shaft through cover bore in fork until retainer hole and fork line up with hole in shaft. Install retainer pin and move to neutral position.

7. Install new shifter shaft hole expansion plugs and expand in place.

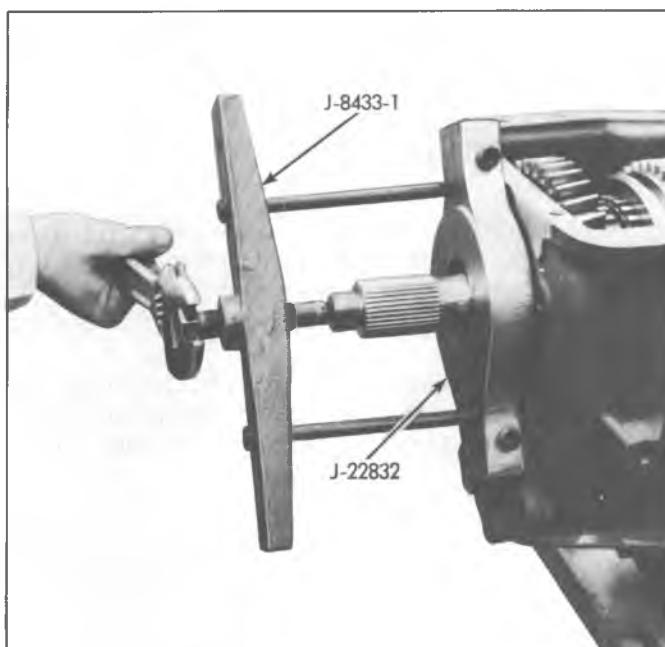


Fig. 7B-4L--Removing Mainshaft Rear Bearing

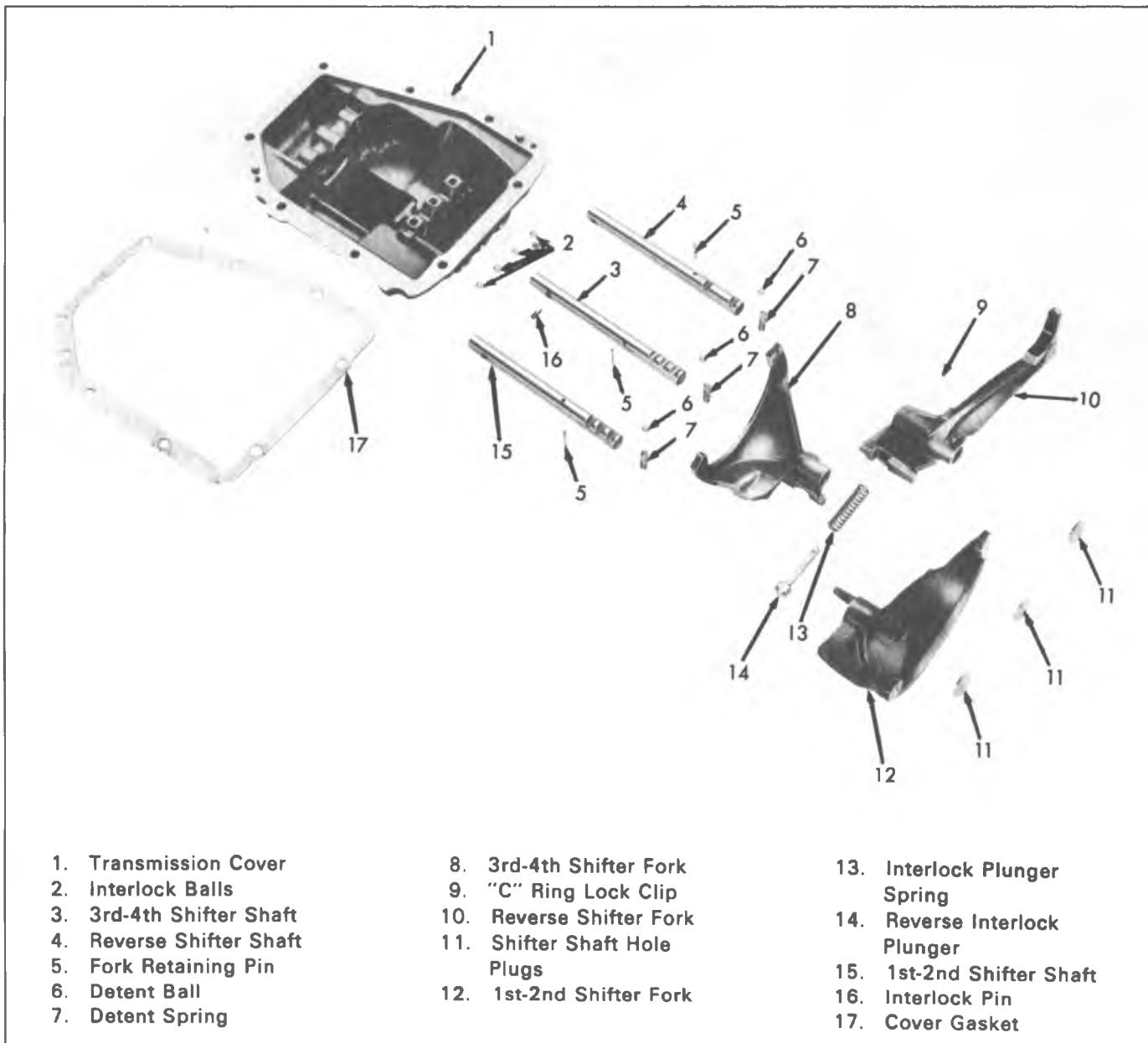


Fig. 7B-6L--Cover Assembly Exploded View

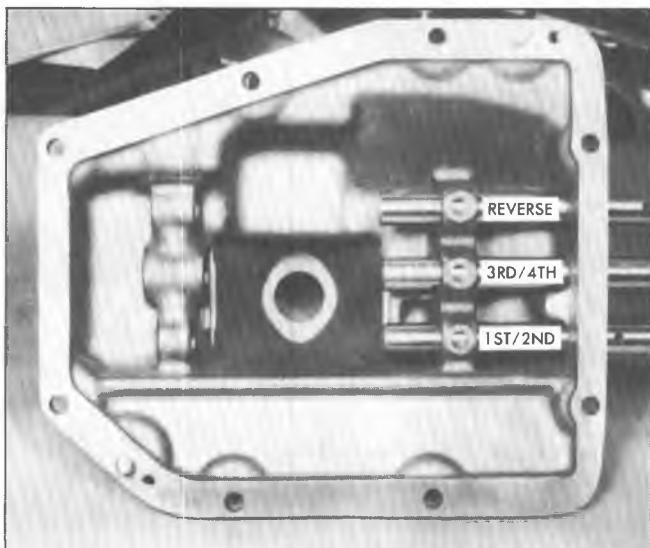


Fig. 7B-7L-Shifter Shaft Installation

**DRIVE GEAR (FIG. 7B-8L)****Disassembly**

1. Remove mainshaft pilot bearing rollers (17) from drive gear if not already removed, and remove roller retainer. Do not remove snap ring on inside of drive gear.
2. Remove snap ring securing bearing on stem of drive gear.
3. To remove bearing, position Tool J-22872 to the bearing (Fig. 7B-9L) and using an arbor press and Tool J-0358 press gear and shaft out of bearing (Fig. 7B-10L).

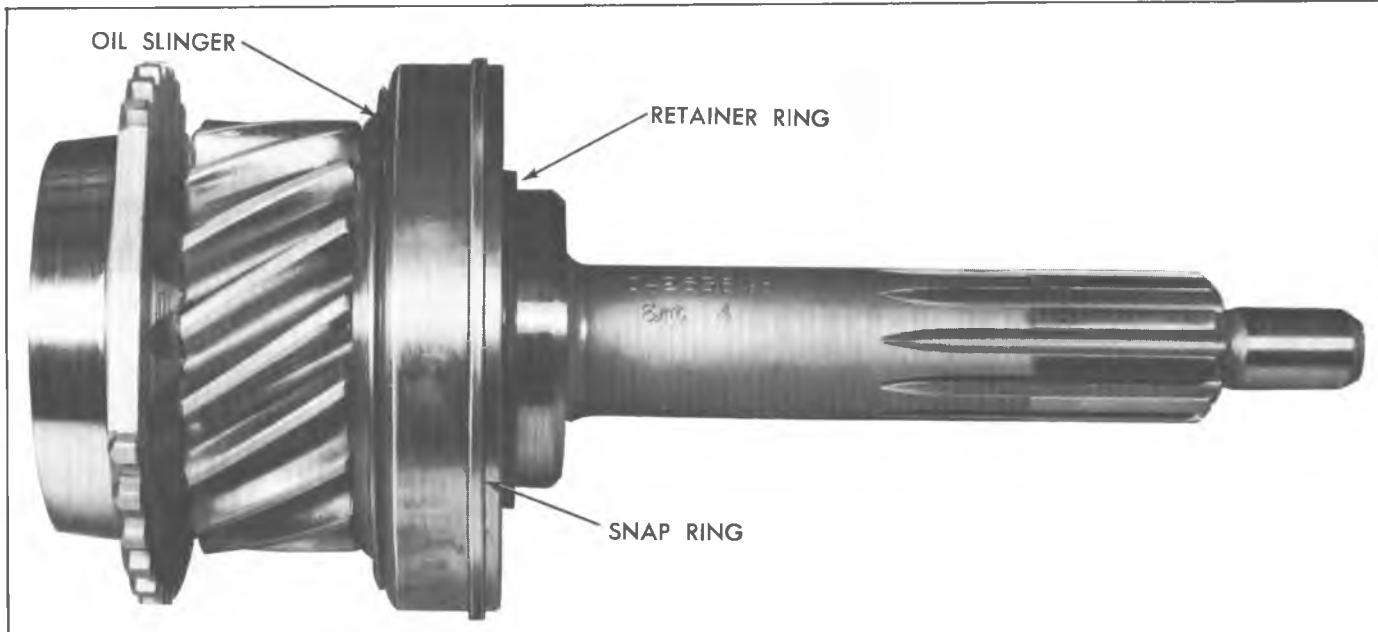


Fig. 7B-8L--Drive Gear Assembly



Fig. 7B-9L--Positioning Tool J-22872 to Drive Gear

### Inspection

1. Wash all parts in clearing solvent.
2. Inspect roller bearings for pits or galling.
3. Inspect bearing diameter in shaft recess for galling.
4. Inspect gear teeth for excessive wear.
5. Inspect clutch shaft pilot for excessive wear.
6. Re-oil bearing, then rotate drive gear bearing slowly by hand and check for roughness.

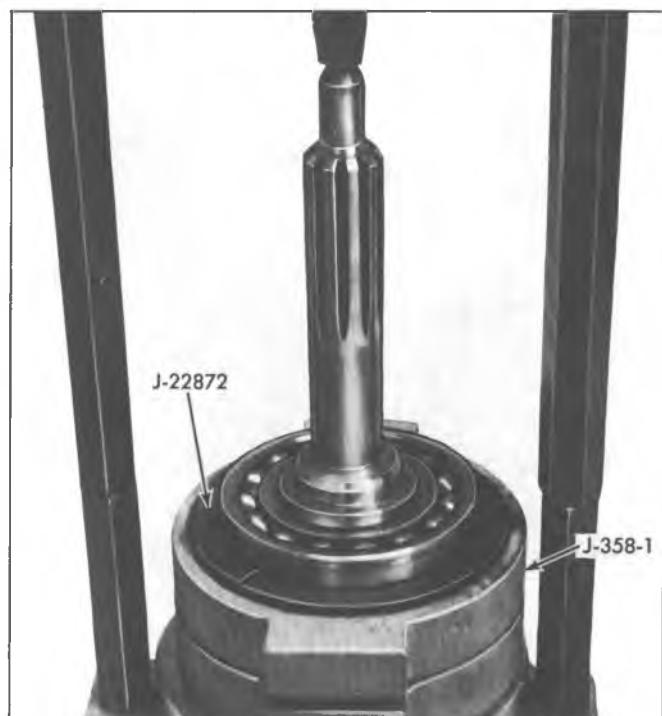


Fig. 7B-10L--Removing Drive Gear Bearing

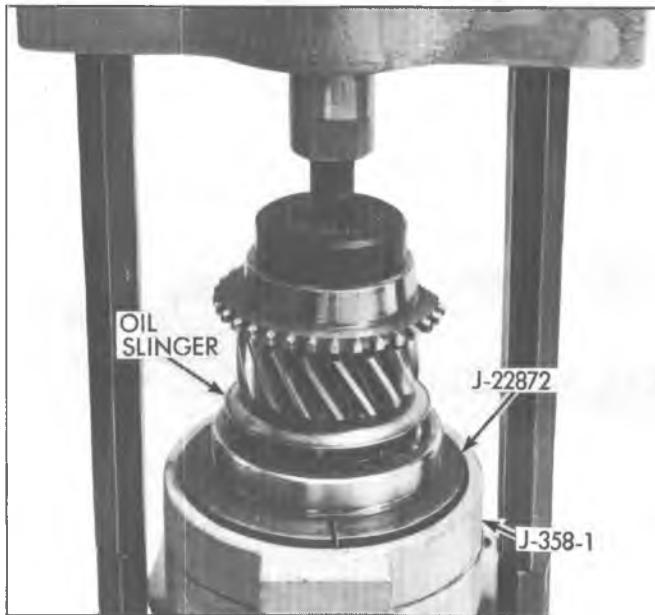


Fig. 7B-11L--Replacing Drive Gear Bearing

## Assembly

1. Press bearing and new oil slinger onto drive gear shaft using Tool J-22872 (Fig. 7B-11L). Slinger should be located flush with bearing shoulder on drive gear. See Figure 7B-8L for direction of slinger installation.

**CAUTION:** Exercise care to prevent distortion of the oil slinger.

2. Install snap ring to secure bearing on drive gear shaft.
3. Install bearing retainer ring in groove on O.D. of bearing.



Fig. 7B-12L--Pilot Roller Bearing Installed

**CAUTION:** The bearing must turn freely, after it is installed on the shaft.

4. Install snap ring on I.D. of mainshaft pilot bearing bore in clutch gear (if previously removed).

5. Apply a small amount of grease to bearing surface in shaft recess, install transmission mainshaft pilot roller bearings (17) and install roller bearing retainer (Fig. 7B-12L).

**NOTE:** This roller bearing retainer holds bearing in position and in final transmission assembly is pushed forward into recess by mainshaft pilot.

## DRIVE GEAR BEARING RETAINER OIL SEAL Replacement

1. Remove retainer and oil seal assembly and gasket.
2. Pry oil seal out of retainer.
3. Install new seal on Tool J-22833 with lip of seal toward flange of tool.
4. Support front surface of retainer in press, start seal and tool in retainer bore and drive seal into retainer until flange of tool bottoms on retainer (Fig. 7B-13L).
5. Install new gasket on retainer and install retainer on transmission case (when assembling transmission).

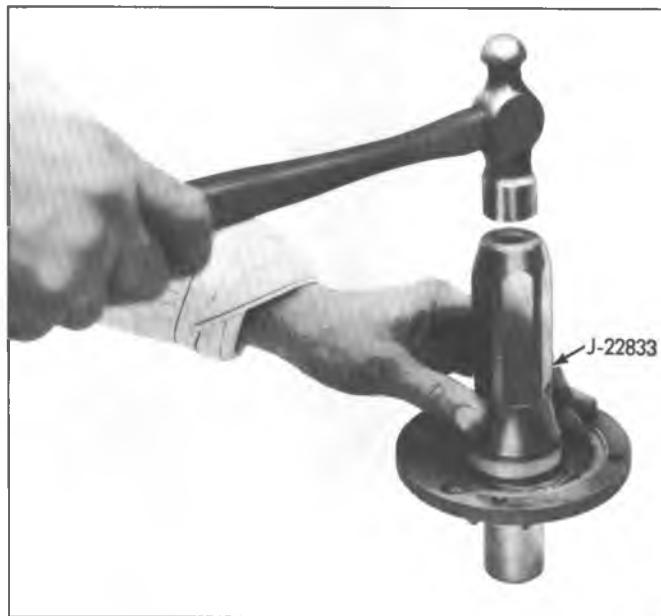


Fig. 7B-13L--Installing Bearing Retainer Oil Seal

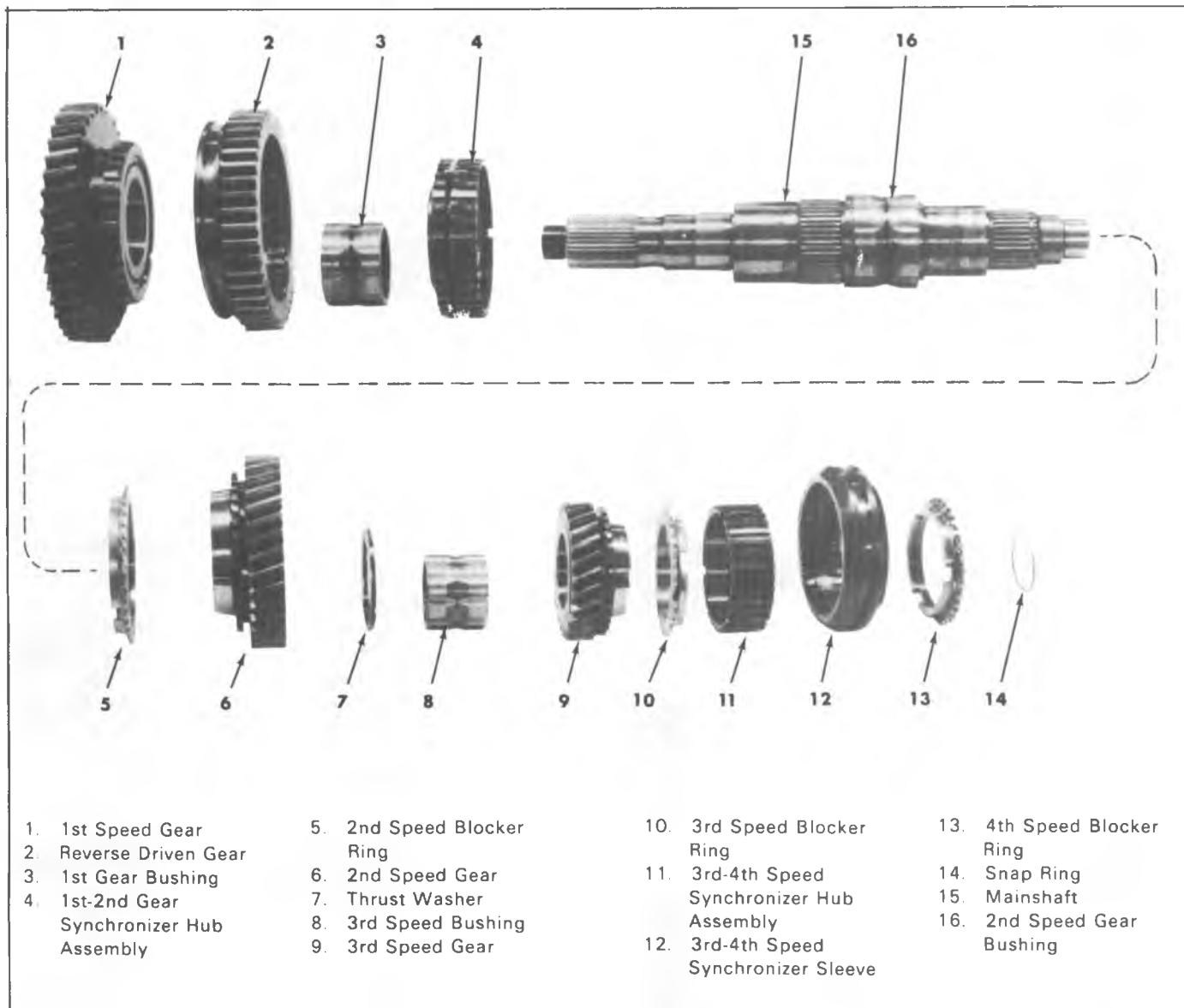


Fig. 7B-14L-Mainshaft Assembly Exploded View

**MAINSHAFT ASSEMBLY****Disassembly (Fig. 7B-14L)**

1. Remove first speed gear and thrust washer.
2. Remove snap ring in front of 3rd-4th synchronizer assembly.
3. Remove reverse driven gear.
4. Press behind second speed gear to remove 3rd-4th synchronizer assembly, 3rd speed gear and 2nd speed gear along with 3rd speed gear bushing and thrust washer (Fig. 7B-15L).
5. Remove 2nd speed synchronizer ring.
6. Supporting 2nd speed synchronizer hub at front face, press mainshaft through removing 1st speed gear bushing and 2nd speed synchronizer hub.
7. Split 2nd speed gear bushing with chisel and remove bushing from shaft.

**CAUTION:** Exercise care not to damage mainshaft.

**Inspection**

1. Wash all parts in cleaning solvent.
2. Inspect mainshaft for scoring or excessive wear at thrust surfaces or splines.

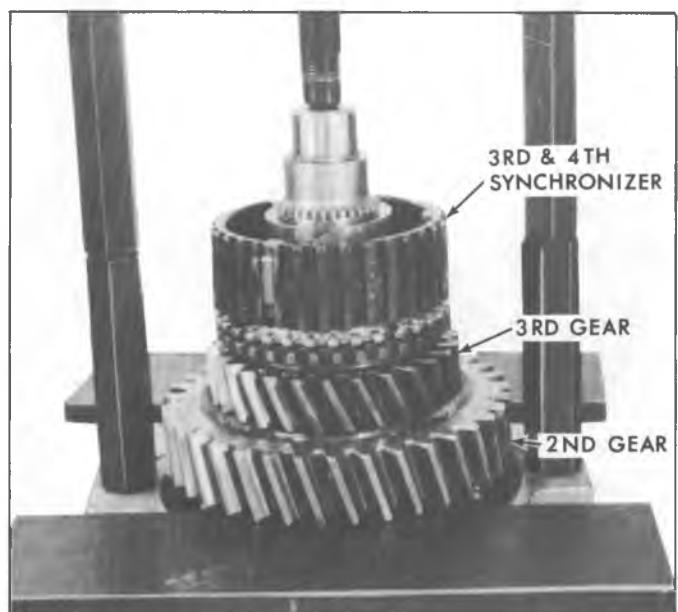


Fig. 7B-15L--Disassembly of Mainshaft

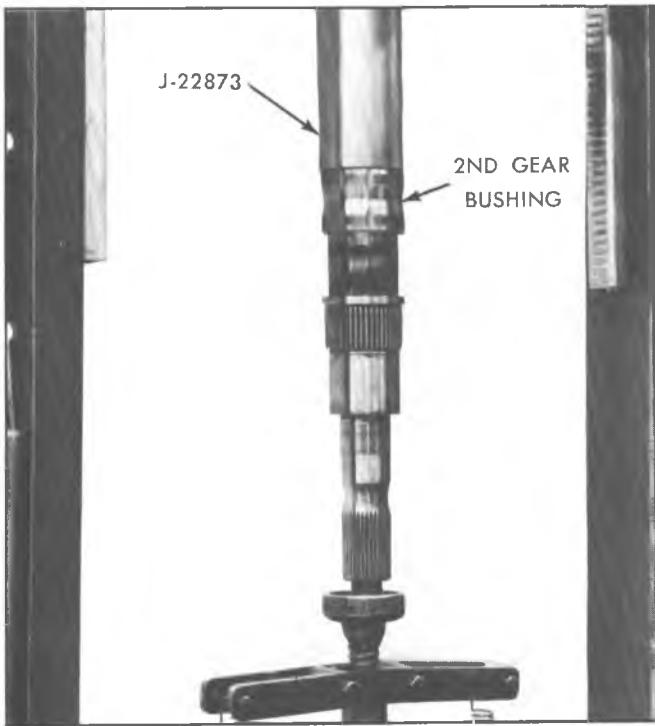


Fig. 7B-16L--Installing 2nd Speed Gear Bushing

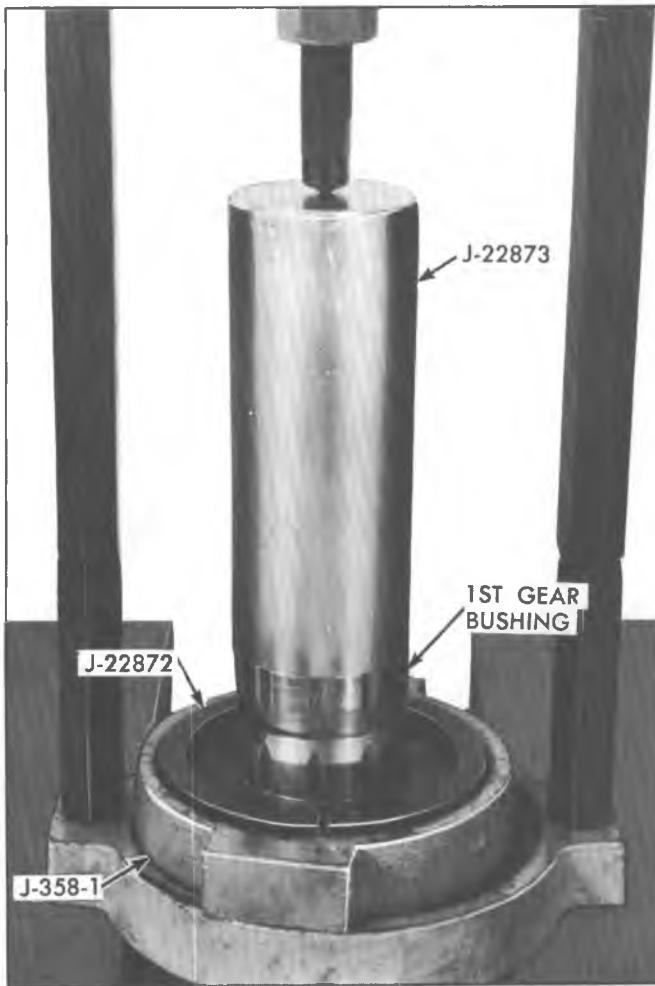


Fig. 7B-17L--Installing 3rd Speed Gear Bushing

3. Inspect clutch hub and clutch sleeve for excessive wear and make sure sleeve slides freely on clutch hub. Also check fit of clutch hub on mainshaft splines.

**NOTE:** Third and fourth speed clutch sleeve should slide freely on third and fourth speed clutch hub but clutch hub should be snug fit on shaft splines.

4. Inspect 3rd speed gear thrust surfaces for excessive scoring and inspect third speed gear mainshaft bushing for excessive wear.

**NOTE:** Third speed gear must be a running fit on mainshaft bushing and mainshaft bushing should be press fit on shaft.

5. Check second speed thrust washer for excessive scoring.

6. Inspect 2nd speed gear for excessive wear at thrust surface. Check synchronizer springs for looseness or breakage.

7. Inspect second gear synchronizing ring for excessive wear.

8. Inspect bronze synchronizer cone on 2nd speed gear for excessive wear or damage. Also inspect clutch gear synchronizer cone and third speed gear synchronizer cone for excessive wear or damage.

**NOTE:** First and reverse sliding gear must be sliding fit on synchronizer hub and must not have excessive radial or circumferential play. If sliding gear is not free on hub, inspect for burrs which may have rolled up on front end of half-tooth internal splines and remove by honing as necessary.

9. Inspect all gear teeth for excessive wear.

### Assembly

1. Using Tool J-22873 press 2nd speed bushing onto mainshaft until it bottoms against shoulder (Fig. 7B-16L).

**NOTE:** Lubricate bushing with E.P. oil before pressing.

**CAUTION:** 1st, 2nd and 3rd speed gear bushings are sintered iron, exercise care when installing.

2. Press 1st and 2nd speed synchronizer hub onto mainshaft until it bottoms against shoulder with annulus toward rear of shaft.

3. Install 1st and 2nd synchronizer keys and springs (if previously removed).

4. Using Tool J-22873 press 1st speed gear bushing onto mainshaft until it bottoms against hub (Fig. 7B-17L).

**NOTE:** Lubricate all bushings with E.P. oil before installation of gears.

5. Install synchronizer blocker ring and 2nd speed gear onto mainshaft and against synchronizer hub. Index synchronizer key slots with keys in synchronizer hub.

6. Install 3rd speed gear thrust washer onto mainshaft with tang on thrust washer in slot on shaft and against 2nd speed gear bushing. Then press 3rd speed gear bushing onto mainshaft using Tool J-22875 until it bottoms against thrust washer (Fig. 7B-18L).

7. Install 3rd speed gear synchronizer blocker ring and 3rd speed gear onto mainshaft, against 3rd speed gear thrust washer.

8. Index synchronizer ring key slots with synchronizer assembly keys and press 3rd and 4th synchronizer assembly onto mainshaft using Tool J-22875 and against 3rd speed gear bushing thrust face toward 3rd speed gear (Fig. 7B-19L). Retain synchronizer assembly with snap ring.

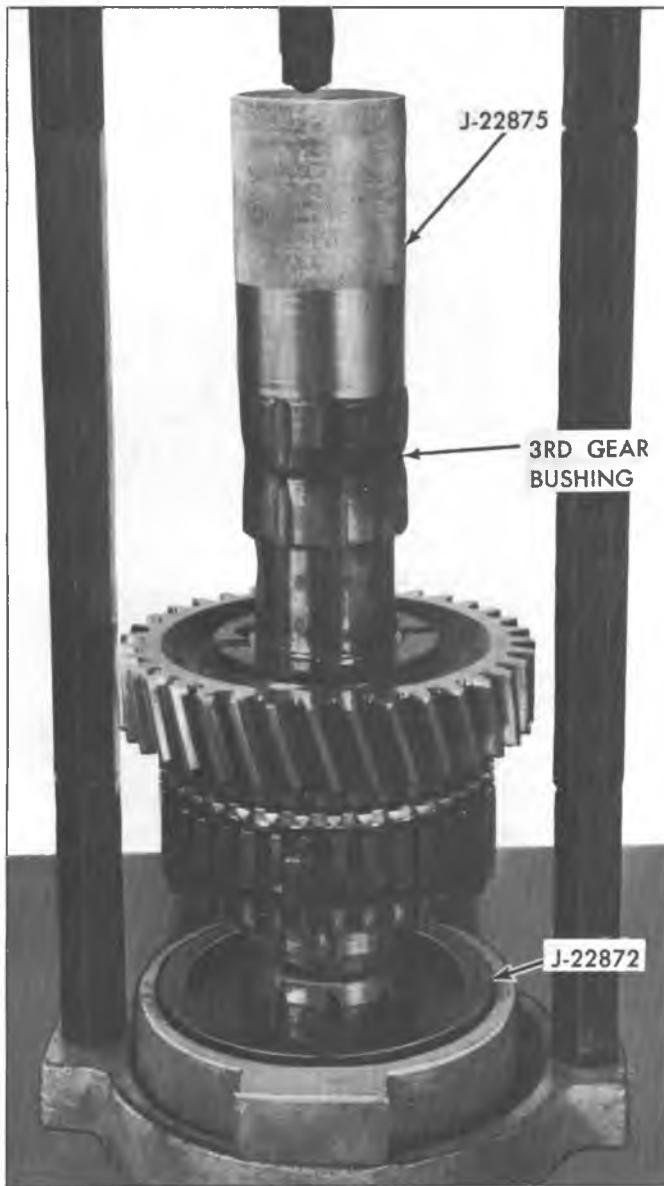


Fig. 7B-18L--Installing 3rd Speed Gear Bushing

9. Install reverse driven gear with fork groove toward rear.

10. Install 1st speed gear onto mainshaft and against 1st and 2nd synchronizer hub. Install 1st speed gear thrust washer.

## COUNTERSHAFT ASSEMBLY

### Disassembly

1. Remove front countergear retaining ring and thrust washer. Discard snap ring.

2. Install Tool J-22832 or suitable press plates on countershaft, open side to spacer, (Fig. 7B-20L); support assembly in an arbor press and press countershaft out of clutch countergear assembly.

**NOTE:** Countergear is a slip fit and pressing may not be required.

3. Remove clutch countergear rear retaining ring. Discard snap ring.

4. Remove 3rd speed countergear retaining ring. Discard snap ring.

5. Position assembly on an arbor press and press shaft from 3rd speed countergear.

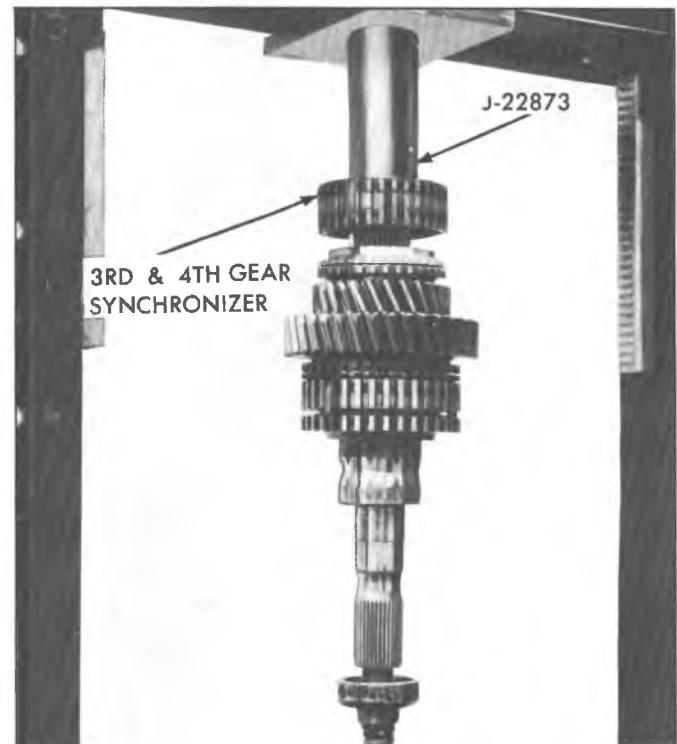


Fig. 7B-19L--Installing 3rd and 4th Gear Synchronizer

### Assembly

1. Position 3rd speed countergear and shaft in arbor press and press the gear onto the shaft. Gear should be installed on shaft with the side having the splines extending the full length of the bore towards the front of the shaft.

**NOTE:** A force of approximately 1500 lbs. is required to press the gear onto the shaft.

2. Install new 3rd speed countergear retaining ring using snap ring pliers.

3. Install new clutch countergear rear retaining ring using Tool J-22830, J-22873 and snap ring pliers as follows: Install Tool J-22830 on end of shaft and position snap ring

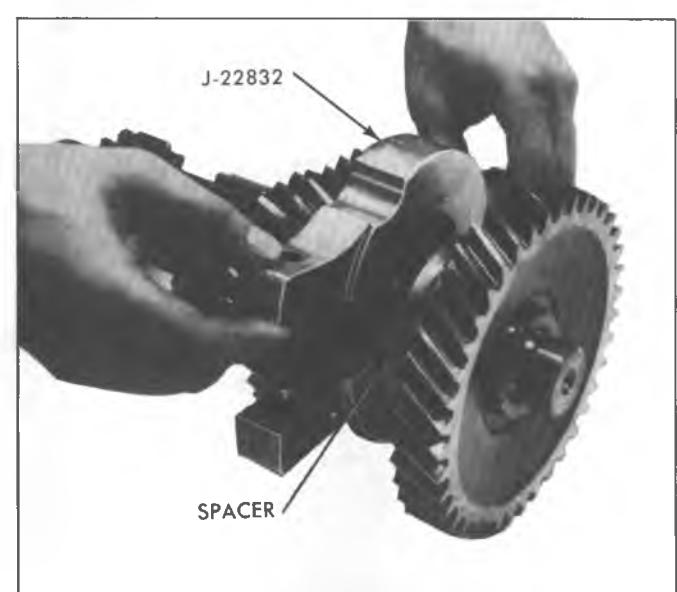


Fig. 7B-20L--Positioning Tool J-22832 on Countershaft

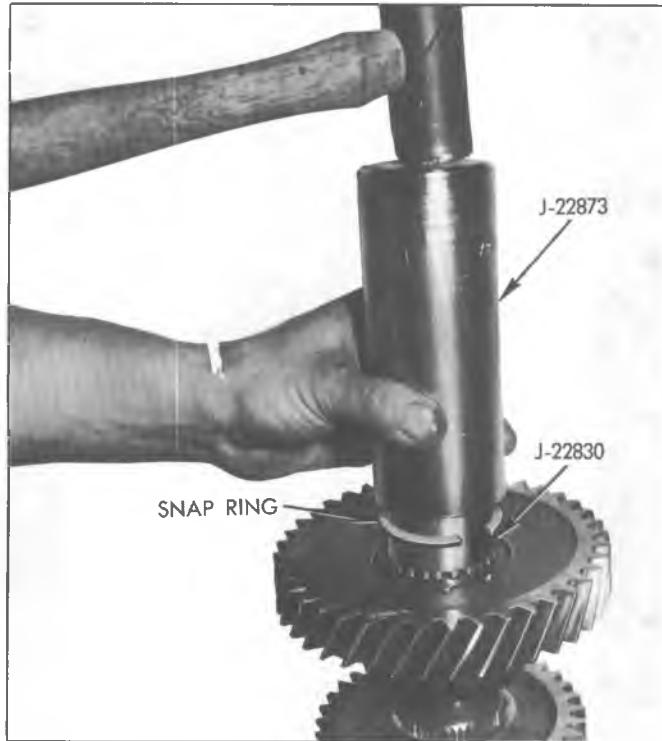


Fig. 7B-21L--Installing Counter Gear Snap Ring

on Tool (Fig. 7B-21L). Using Tool J-22873, push down on snap ring until it engages groove on shaft. Using snap ring pliers, carefully expand ring until it just slides onto splines, then push ring down shaft until it engages groove on shaft.

**CAUTION:** Do not over stress snap ring.

4. Position clutch countergear and spacer on shaft and press countergear onto shaft against snap ring using Tool J-22873, (Fig. 7B-22L).

**NOTE:** Countergear is a slip fit and pressing may not be required.

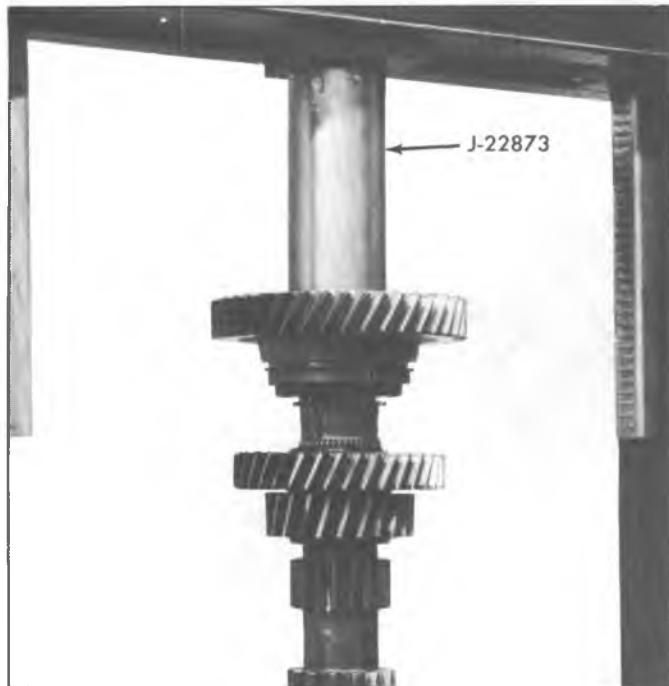


Fig. 7B-22L--Installing Clutch Countergear

5. Install clutch countergear thrust washer and front retaining ring using Tool J-22830 and J-22873 (Fig. 7B-21L).

**CAUTION:** Do not over stress snap ring. Ring should be tight in groove without side play.

## ASSEMBLY OF TRANSMISSION

1. Lower the countergear into the case until it rests on bottoms of case.

2. Place reverse idler gear in transmission case with gear teeth toward the front. Install idler gear shaft from rear to front, being careful to have slot in end of shaft in facing down. Shaft slot face must be at least flush with case.

3. Install mainshaft assembly into case with rear of shaft protruding out rear bearing hole in case. Position Tool J-22874 in clutch gear case opening and engaging front mainshaft (Fig. 7B-23L). Rotate case onto front end.

**NOTE:** Install 1st speed gear thrust washer on shaft, if not previously installed.

4. Install snap ring on bearing O.D. and position rear mainshaft bearing on shaft. Using Tool J-22874-1 drive bearing onto shaft and into case (Fig. 7B-23L). Rotate case and remove Tool J-22874-5.

5. Install synchronizer cone on pilot end of mainshaft and slide rearward to clutch hub.

**CAUTION:** Make sure three cut out sections of 4th speed synchronizer cone align with three clutch keys in clutch assembly.

6. Install snap ring on drive gear bearing O.D. Index cut out portion of drive gear teeth to obtain clearance over countershaft drive gear teeth, and install clutch gear assembly onto case. Raise mainshaft to get clutch gear started and tap bearing outer race with plastic tip hammer.

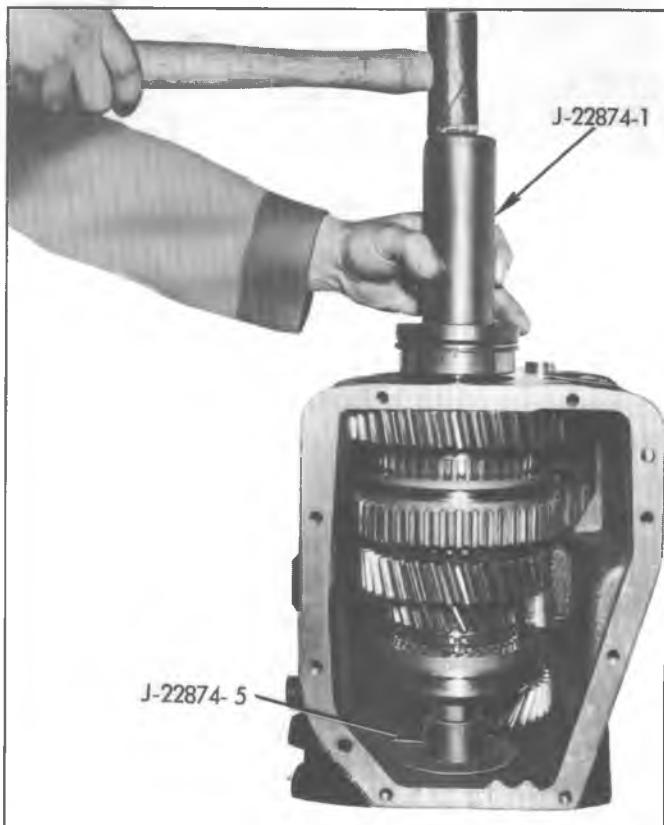


Fig. 7B-23L--Installing Mainshaft Rear Bearing

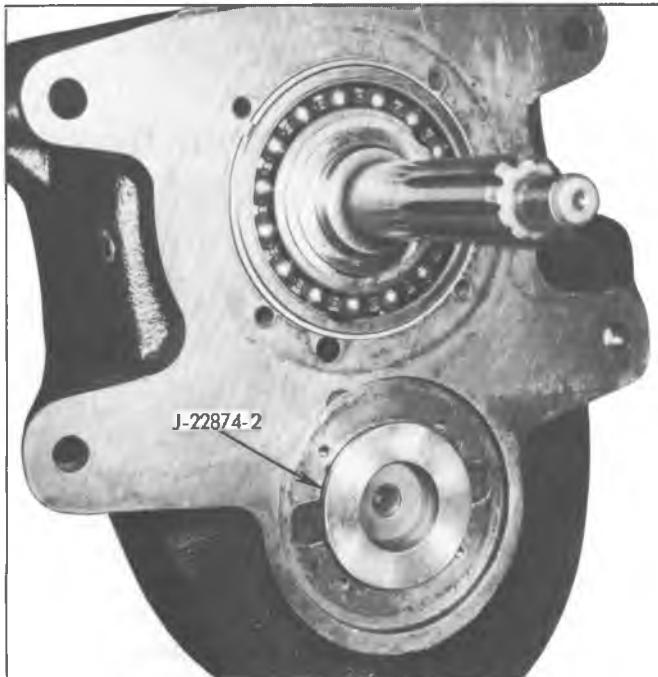


Fig. 7B-24L--Countergear Front Support Tool



Fig. 7B-25L--Installing Countergear Rear Bearing

7. Install drive gear bearing retainer using a new gasket. Install bolts and tighten to 15-18 ft. lbs.

8. Install Tool J-22874-2 in countergear front bearing opening in case to support countergear and rotate case onto front end. (Fig. 7B-24L).

9. Install snap ring on countergear rear bearing O.D., position bearing on countergear and using Tool J-22874-2, drive bearing into place (Fig. 7B-25L). Rotate case, install snap ring on countershaft at rear bearing and then remove Tool J-22874-2.

10. Tap countergear front bearing assembly into case.

11. Install countergear front bearing cap and new gasket. Torque screws to 20-30 in. lbs.

12. Slide speedometer drive gear over mainshaft to bearing.

13. Install rear bearing retainer with new gasket. Be sure snap ring ends are in lube slot and cut out in bearing retainer. Install bolts and tighten to 15-18 ft. lbs. Install brake backing plate assembly on models equipped with propeller shaft brake.

**NOTE:** On models equipped with 4-wheel drive, install rear lock nut and washer using Tool J-23070 (Fig. 7B-26L). Torque lock nut to 120 ft. lbs. and bend washer tangs to fit slots in nut.

14. Install parking brake drum and/or universal joint flange.

**NOTE:** Apply light coat of oil to seal surface.

15. Lock transmission in two gears at once. Install universal joint flange locknut and tighten to 90-120 ft. lbs.

16. Move all transmission gears to neutral except the

reverse idler gear which should be engaged approximately 3/8 of an inch (leading edge of reverse idler gear teeth lines up with the front edge of the 1st speed gear). Install cover assembly with new gasket to transmission case. Shifting forks must slide into their proper positions on clutch sleeves and reverse idler gear. Forks must be positioned as in removal.

17. Install cover attaching bolts and torque to 20-25 ft. lbs.

18. Using Tool J-8109, replace gearshift lever and check operation of transmission.

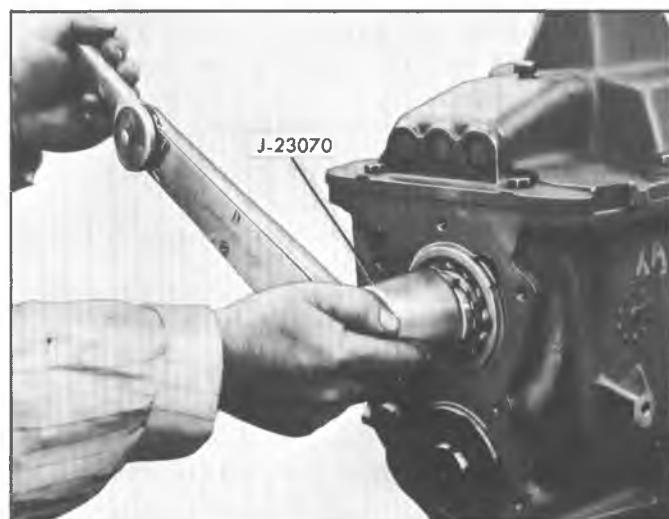


Fig. 7B-26L--Installing Mainshaft Rear Bearing Lock Nut (4-Wheel Drive only)

# NEW PROCESS MODEL 205 (PART TIME) TRANSFER CASE

## INDEX

Disassembly of Transfer Case .....	7B-52
Rear Output Shaft Assembly .....	7B-52
Front Output Shaft Assembly .....	7B-52
Shift Rail and Fork Assemblies .....	7B-52
Idler Gear .....	7B-52
Cleaning and Inspection .....	7B-52

Assembly of Transfer Case .....	7B-55
Idler Gear .....	7B-55
Shift Rail and Fork Assemblies .....	7B-55
Front Output Shaft Assembly .....	7B-57
Rear Output Shaft Assembly .....	7B-58
Miscellaneous .....	7B-59

### DISASSEMBLY OF TRANSFER CASE (FIG. 7B-1R)

#### Rear Output Shaft and Yoke Assembly

1. Loosen rear output shaft yoke nut.
2. Remove rear output shaft housing bolts and remove housing and retainer assembly from case.
3. Remove retaining nut and yoke from shaft, then remove shaft assembly from housing.
4. Remove snap ring using Tool J-23432 and discard.
5. Remove thrust washer and washer pin.
6. Remove tanged bronze washer. Remove gear needle bearings (32 per row), spacer and second row of needle bearings.
7. Remove tanged bronze thrust washer from shaft.
8. Remove pilot rollers (15), retainer ring and washer.
9. Remove oil seal retainer, ball bearing, speedometer gear and spacer. Discard all gaskets. Press out bearing as required.
10. Remove oil seal from the retainer.

#### Front Output Shaft Assembly (Fig. 7B-3R)

1. Remove lock nut, wahser and yoke.
2. Remove front bearing retainer attaching bolts and retainer.
3. Remove front output shaft rear bearing retainer attaching bolts.
4. Tap on output shaft with a soft hammer (Fig. 7B-4R) and remove shaft, gear assembly, and rear bearing retainer from case.

**NOTE:** Remove the sliding clutch from output high gear, washer, and bearing which will have remained in the case.

5. Using large snap ring picks, such as J-23432-1, remove the gear retaining ring from the shaft (Fig. 7B-5R) and discard.

6. Remove thrust washer and pin from shaft.
7. Remove gear, needle bearings (32 per row) and spacer.
8. If necessary to replace front output shaft rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover and using a piece of pipe or wood to cover outside diameter of bearing, press bearing into cover until flush with opening.

#### Shift Rail and Fork Assemblies

1. Remove the two poppet nuts on top of case, two poppet springs, and using a magnet, remove the poppet bails.
2. Drive cup plugs into case using a 1/4 inch punch.
3. Position both shift rails in neutral and using a long, narrow punch, drive shift fork pins through shift rails into the case (Fig. 7B-6R).
4. Remove clevis pins and shift rail link.
5. Remove shift rails (Fig. 7B-7R), upper (range) rail first, then lower (4-wheel) rail.
6. Remove shift forks and sliding clutch from case.
7. Remove the front output high gear, wahser, and bearing from the case. Remove the shift rail cup plugs and pins from the case.

#### Input Shaft Assembly

8. Remove snap ring in front of bearing. Using a soft hammer, tap shaft out rear of case. Tap bearing out front of case.
9. Tip case on P.T.O. and remove two interlock pins from inside of case.

#### Idler Gear

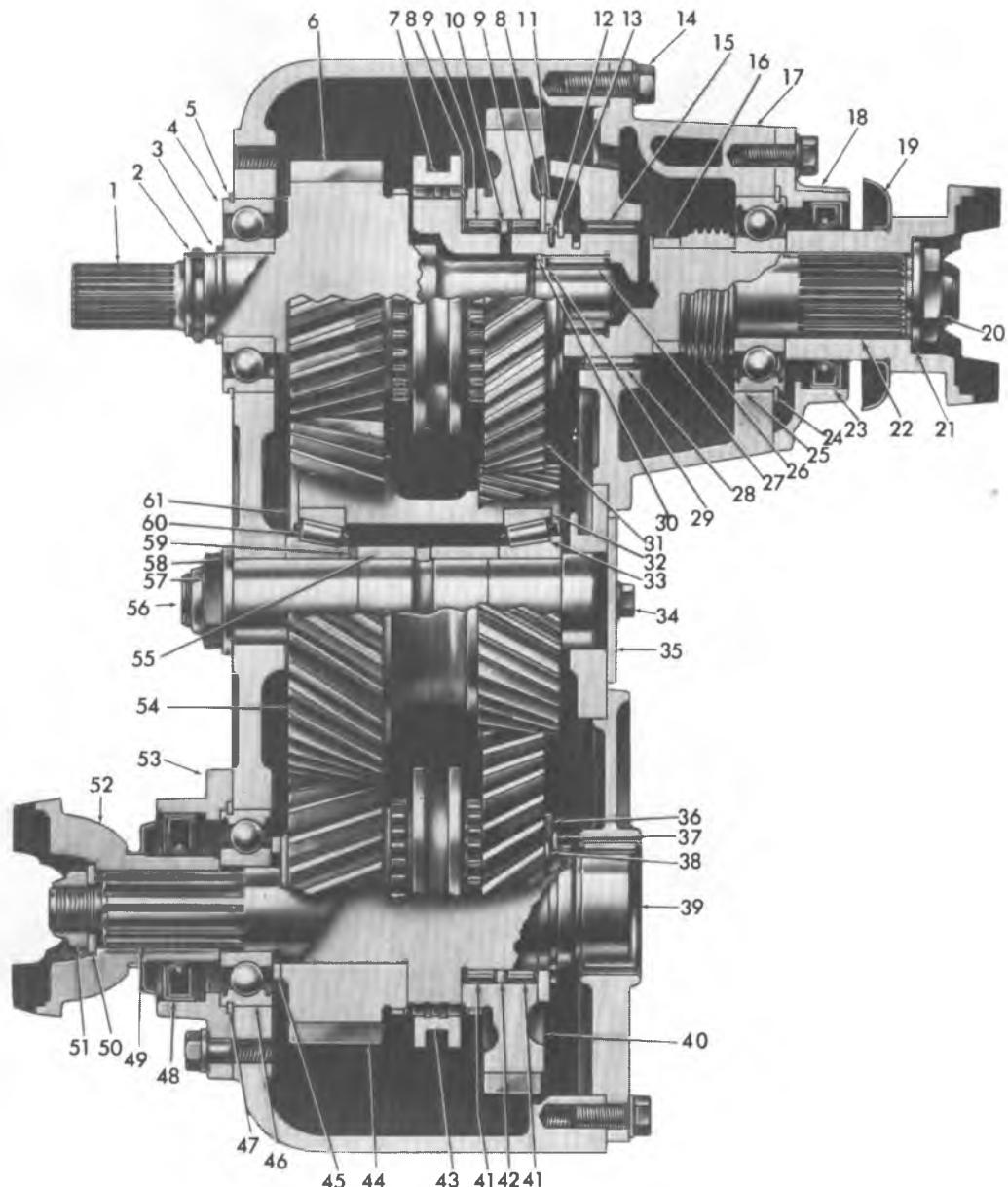
1. Remove idler gear shaft nut.
2. Remove idler shaft rear cover.
3. Remove idler gear shaft using a soft hammer and tool J-23429 (Fig. 7B-8R).
4. Roll idler gear to front output shaft hole and remove from case.
5. Remove bearing cups (2) as required from idler gear.

#### CLEANING AND INSPECTION

**Bearings** --Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow out with compressed air, being careful to direct air across bearing so that bearings do not spin.

**Shafts and Gears** --Clean all shafts in cleaning solution to remove all accumulations. Dry with compressed air.

**Case, Cover and Bearing Cups** --Transfer case, cover, and bearing cups must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surface where used.



- |     |                             |     |                                 |     |  |     |                     |
|-----|-----------------------------|-----|---------------------------------|-----|--|-----|---------------------|
| 1.  | Input Shaft                 | 18. | Rear Bearing Retainer           | 32. | Idler Gear Shaft Bearing Cup           | 43. | Sliding Clutch      |
| 2.  | "O" Ring                    | 19. | Rear Yoke Assembly              | 33. | Idler Shaft Bearing Cone               | 44. | Front Wheel Hi-Gear |
| 3.  | Snap Ring                   | 20. | Locknut                         | 34. | Idler Shaft Cover Bolts and Lockwasher | 45. | Spacer              |
| 4.  | Bearing                     | 21. | Washer                          | 35. | Idler Shaft Gear Cover and Gasket      | 46. | Bearing             |
| 5.  | Snap Ring                   | 22. | Rear Output Shaft               | 36. | Thrust Washer                          | 47. | Snap Ring           |
| 6.  | Input Shaft Gear            | 23. | Bearing Retainer Seal           | 37. | Snap Ring                              | 48. | Seal                |
| 7.  | Sliding Clutch              | 24. | Snap Ring                       | 38. | Thrust Washer Pin                      | 49. | Front Output Shaft  |
| 8.  | Tanged Bronze Thrust Washer | 25. | Bearing                         | 39. | Rear Bearing Retainer and Output       | 50. | Washer              |
| 9.  | Roller Bearings             | 26. | Speedometer Gear                | 40. | Shaft Cover                            | 51. | Locknut             |
| 10. | Spacer                      | 27. | Pilot Bearings                  | 41. | Front Wheel Drive Low Gear             | 52. | Output Yoke         |
| 11. | Thrust Washer               | 28. | Rear Output Shaft Front Bearing | 42. | Roller Bearings                        | 53. | Bearing Retainer    |
| 12. | Thrust Washer Pin           | 29. | Washer                          | 43. | Spacer                                 | 54. | Idler Gear          |
| 13. | Snap Ring                   | 30. | Bearing Retainer                | 44. | Idler Gear Spacer                      | 55. | Idler Shaft         |
| 14. | Bolt and Lockwasher         | 31. | Rear Wheel Drive Low Gear       | 45. | Locknut                                | 56. | Idler Shaft         |
| 15. | Needle Bearings             |     |                                 | 46. | Washer                                 | 57. | Washer              |
| 16. | Spacer                      |     |                                 | 47. | Bearing Cone                           | 58. | Bearing Cup         |
| 17. | Rear Output Shaft Housing   |     |                                 | 48. | Front Wheel Hi-Gear                    | 59. | Sliding Clutch      |

Fig. 7B-1R--New Process Model 205 Transfer Case Cross Section

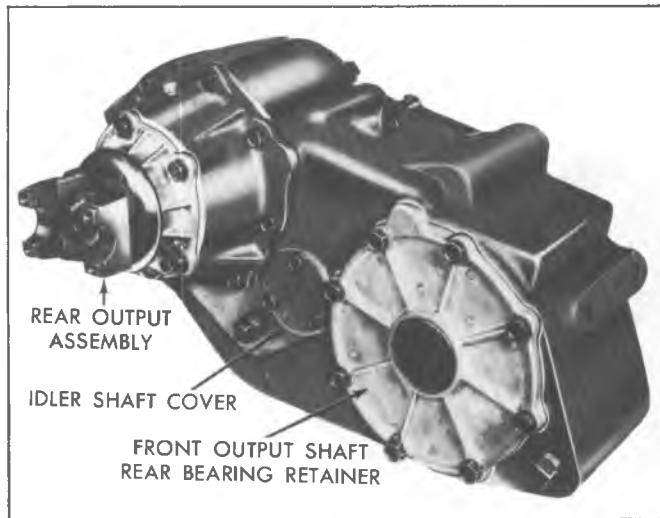


Fig. 7B-2R--Rear View of Transfer Case

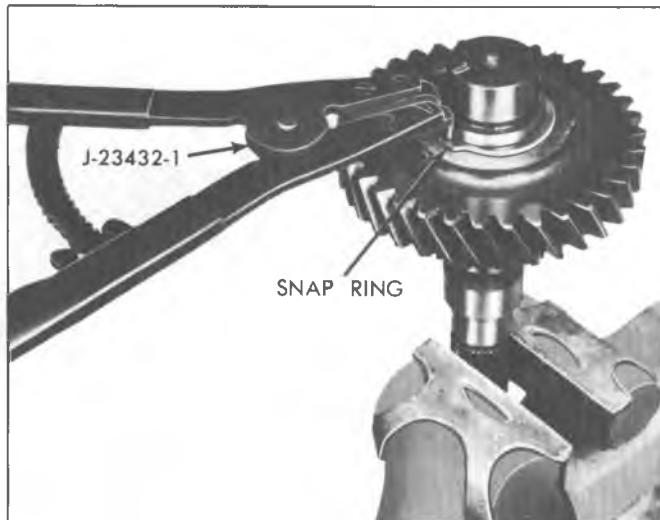


Fig. 7B-5R--Removing Gear Retaining Ring

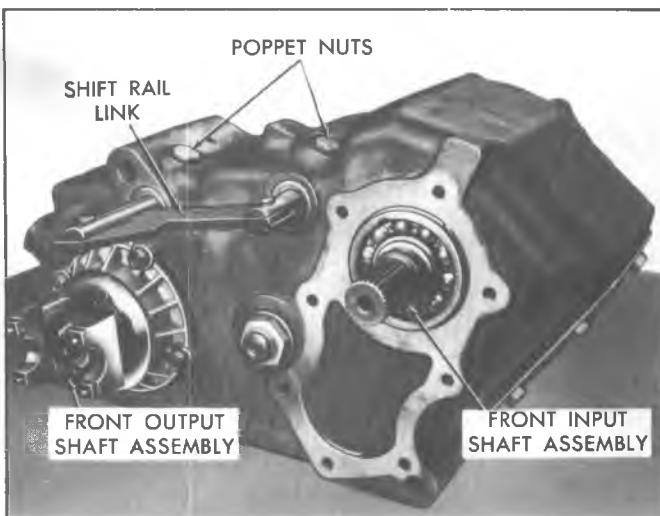


Fig. 7B-3R--Front View of Transfer Case



Fig. 7B-6R--Removing Shift Fork Pins

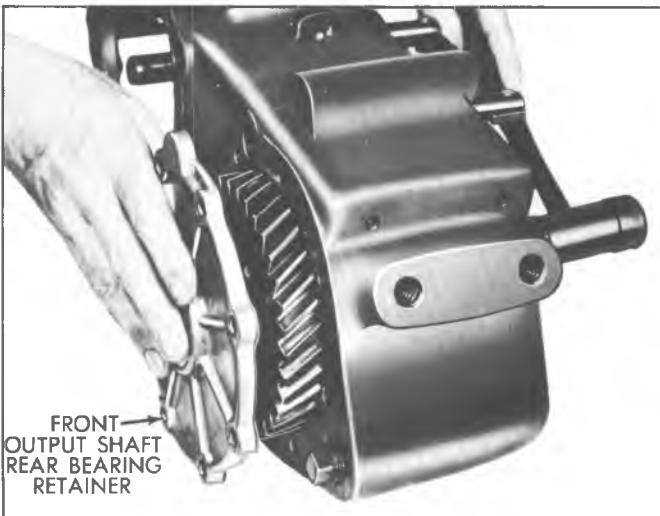


Fig. 7B-4R--Removing Front Output Shaft Rear Bearing Retainer

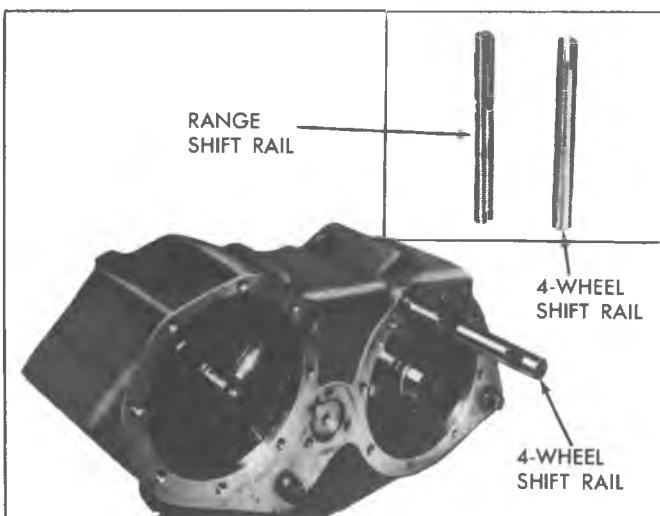


Fig. 7B-7R--Shift Rail Removal



Fig. 7B-8R--Removing Idler Gear Shaft

**Inspection**--Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts.

Inspect shaft splines and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

#### ASSEMBLY OF TRANSFER CASE (FIG. 7B-9R)

##### Idler Gear

1. Press the two bearing cups in the idler gear (if previously removed) using Tool J-9276-2 and Handle J-8092 (Fig. 7B-10R).

2. Assemble the two bearing cones, spacer, shims and idler gear on dummy shaft J-23429 with bore up. Check end play (Fig. 7B-11R). Limits are .001 to .002 inch.

3. Install idler gear assembly with dummy shaft into case through front output bore, large end first (Fig. 7B-12R).

4. Install idler shaft from large bore side and drive through using a soft hammer (Fig. 7B-13R).

5. Install washer and new locknut. Check for end play and free rotation. Torque nut to 150 ft. lbs.

6. Install idler shaft cover and gasket. Torque bolts to 20 ft. lbs.

**NOTE:** Flat on cover must be located adjacent to front output shaft rear cover (Fig. 7B-14R).

#### Shift Rail and Fork Assemblies

1. Press the two rail seals into the case. Seals should be installed with metal lip outward.

2. Install interlock pins through large bore or P.T.O. opening.

3. Start front output drive shift rail into case from back, slotted end first, with poppet notches up.

4. Install shift fork (long end inward) into rail, push rail through to neutral position.

5. Install input shaft bearing and shaft into case.

6. Start range rail into case from front, with poppet notches up.

7. Install sliding clutch onto fork, place over input shaft in case. Position to receive range rail and push rail through to neutral position.

8. Install new lock pins through holes at top of case and drive them into the forks (Fig. 7B-15R).

**NOTE:** Tip case on P.T.O. opening when installing range rail lock pin.

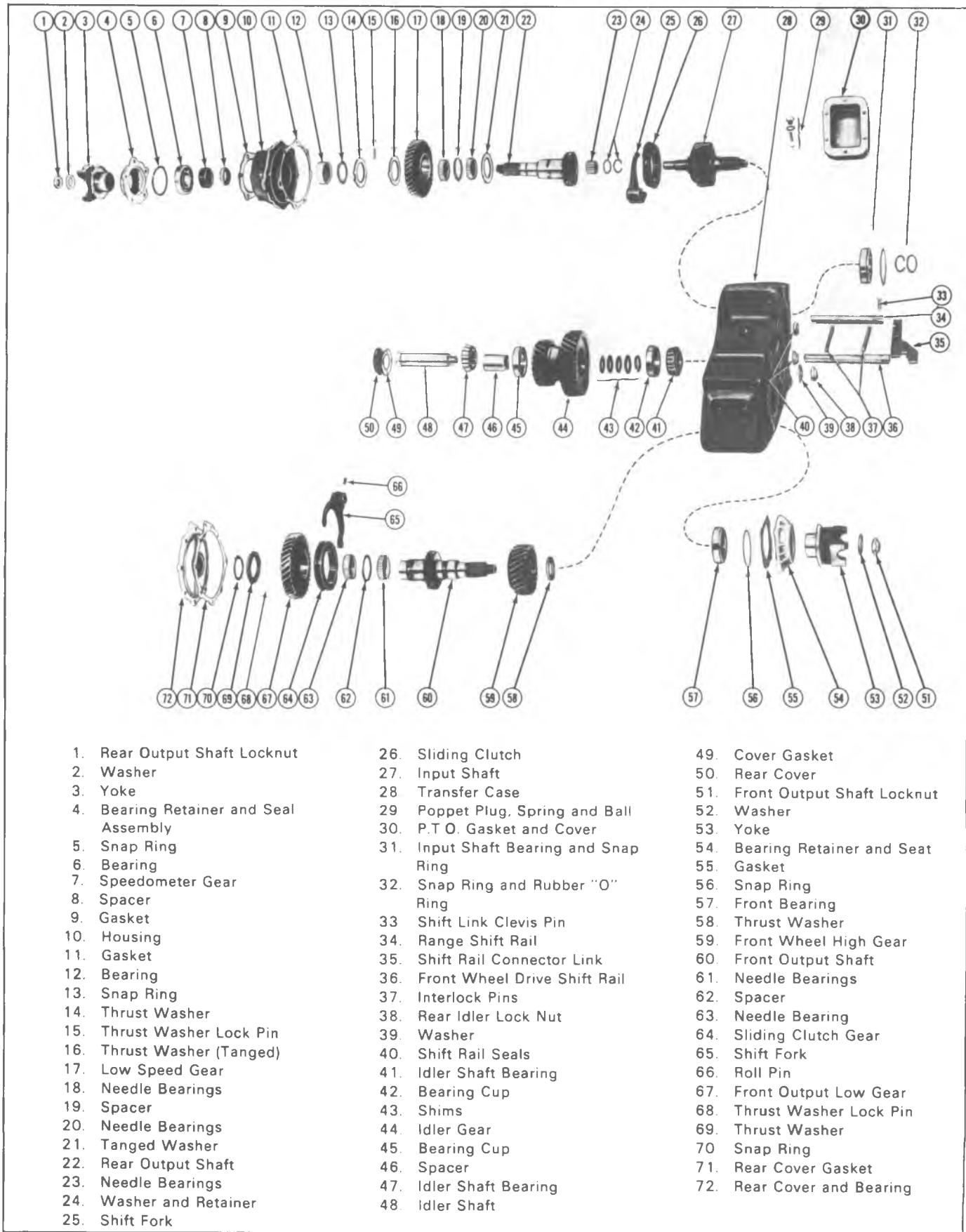


Fig. 7B-9R-New Process Model 205 Transfer Case Exploded View

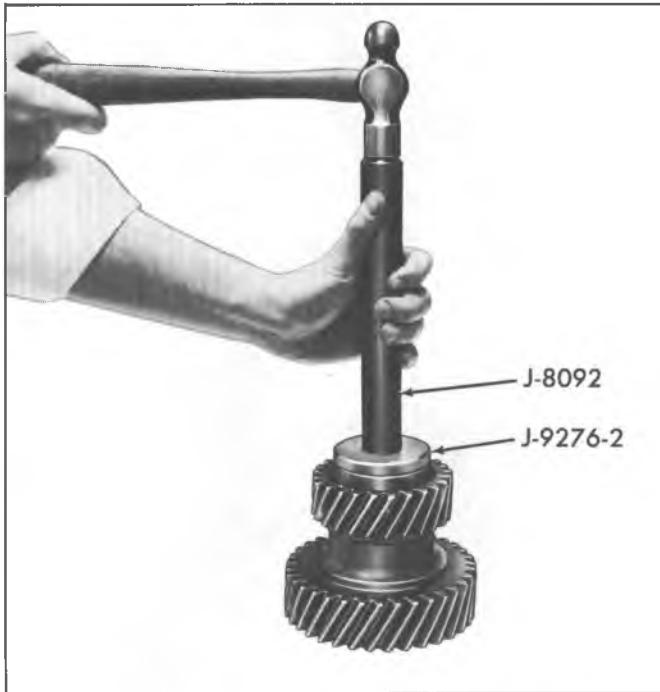


Fig. 7B-10R--Installing New Bearing Cups



Fig. 7B-12R--Installing Idler Gear

### Front Output Shaft and Gear Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer in the front low output gear and retain with a sufficient amount of grease.

2. Place front output shaft in soft jawed vise, spline end down. Install front low gear over shaft with clutch gear facing down and install thrust washer pin, thrust washer and new snap ring using Tool J-23432.

**NOTE:** Position the snap ring so that the opening is opposite the pin.

3. Position front wheel hi-gear and washer in case. Install sliding clutch in the shift fork, then put fork and rail in the front wheel drive (4-Hi) position with the clutch teeth in mesh with the teeth of the front wheel hi-gear.

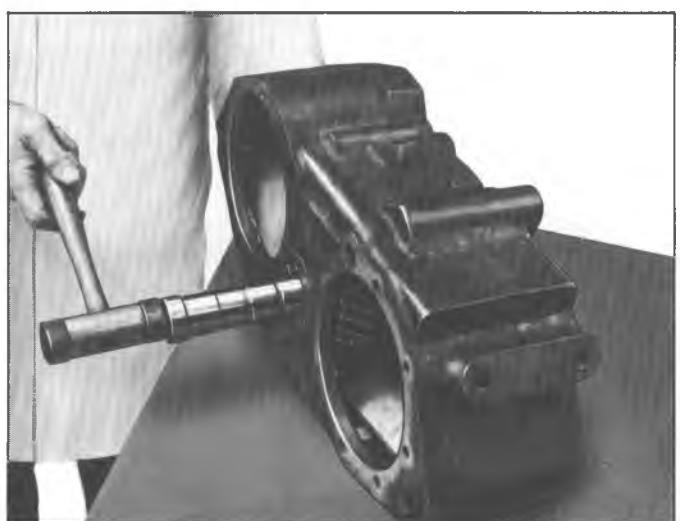


Fig. 7B-13R--Installing Idler Shaft

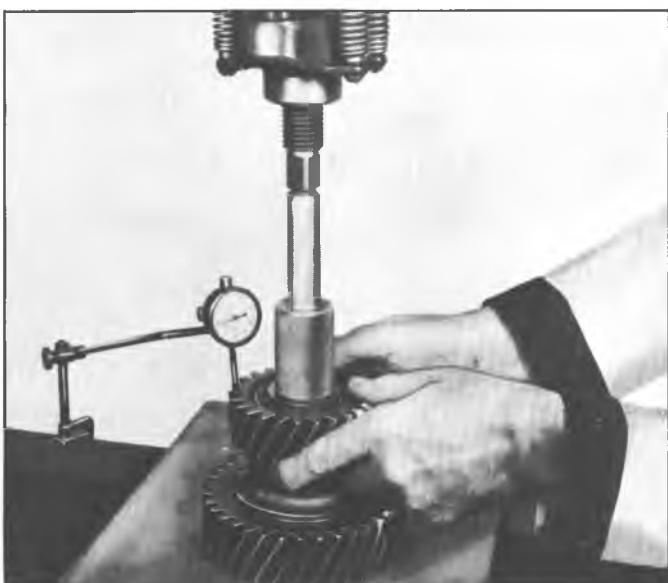


Fig. 7B-11R--Checking Idler Gear End Play

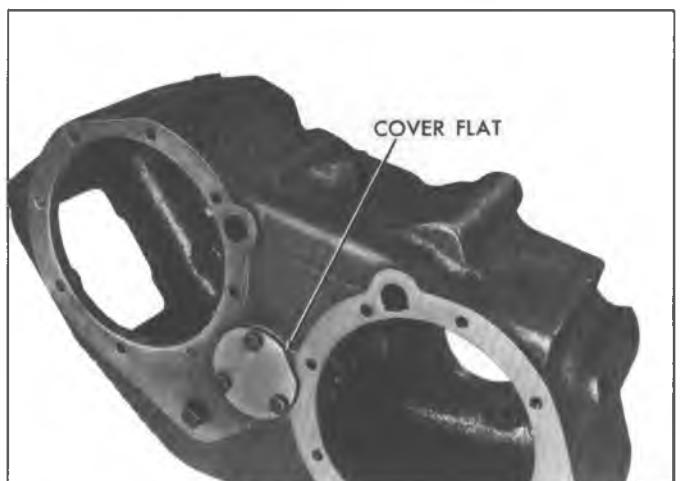


Fig. 7B-14R--Installing Idler Shaft Rear Cover

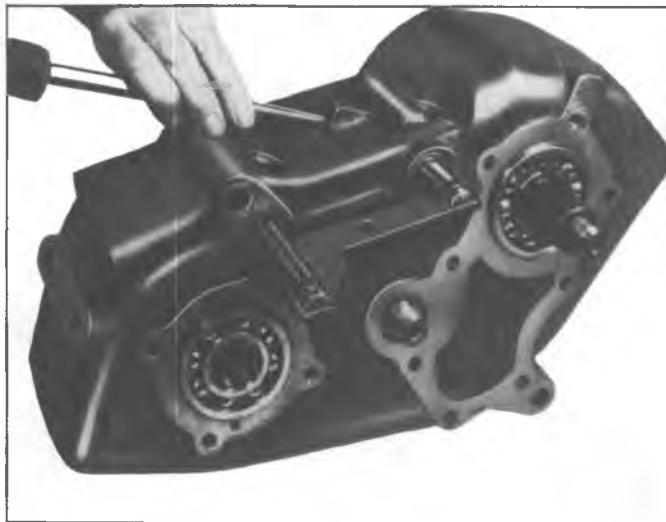


Fig. 7B-15R--Installing Shift Rail Lock Pins

4. Line up washer, high gear, and sliding clutch with bearing bore. Insert front output shaft and low gear assembly through the high gear assembly.

5. Install new seal in bearing retainer using Tool J-22836 (Fig. 7B-16R) and install the front output bearing and retainer in the case.

6. Clean and grease rollers in front output rear bearing retainer. Install onto case using one gasket. Dip bolts into sealant. Install bolts and torque to 30 ft. lbs.

7. Install front output yoke, washer and lock nut. Torque nut to 150 ft. lbs.

### Rear Output Shaft Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer into the output low gear.

**NOTE:** Use sufficient grease to retain needles.

2. Install thrust washer onto rear output shaft, tang



Fig. 7B-17R--Installing Rear Output Shaft Housing Bearing

down in clutch gear groove. Install output low gear onto shaft with clutch teeth facing down.

3. Install thrust washer over gear with tab pointing up and away from gear. Install washer pin and also large thrust washer over shaft and pin. Rotate washer until tab fits into slot approximately 90 degrees away from pin. Finally, install snap ring using Tool J-23423 and J-23423-1 and check end play which should be within .002-.027 inch.

4. Grease pilot bore or rear output shaft and install needle bearings (15). Install thrust washer and new snap ring in bore.

5. Clean, grease, and install new bearing in retainer housing using Tool J-23431 (Fig. 7B-17R).

6. Install housing onto output shaft assembly, install spacer and speedometer gear, then install bearing (Fig. 7B-18R).

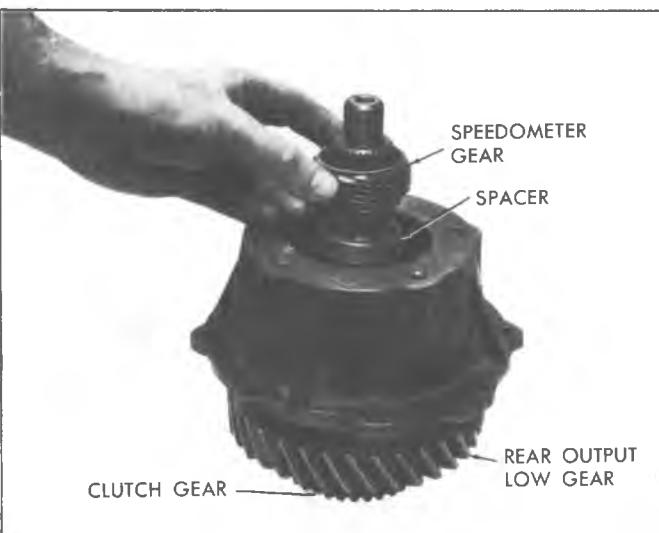


Fig. 7B-18R--Installing Rear Output Shaft Spacer and Speedometer Gear



Fig. 7B-16R--Installing Front Output Bearing Retainer Seal

7. Install rear bearing retainer seal using Tool J-21359 or J-22834-2 (Fig. 7B-19R).

8. Install bearing retainer assembly onto housing with one or two gaskets, depending on clearance. Torque bolts to 30 ft. lbs.

9. Install yoke, washer, and lock nut output shaft.

10. Position range rail in 'high' and install output shaft and retainer assembly on transfer case. Torque housing bolts to 30 ft. lbs.

### Miscellaneous

1. Install P.T.O. cover and gasket. Torque bolts to 15 ft. lbs.

2. Install and seal cup plugs at rail pin holes, if not previously done.

3. Install drain and filler plugs and torque to 30 ft. lbs.

4. Install shift rail cross link, clevis pins and lock pins.

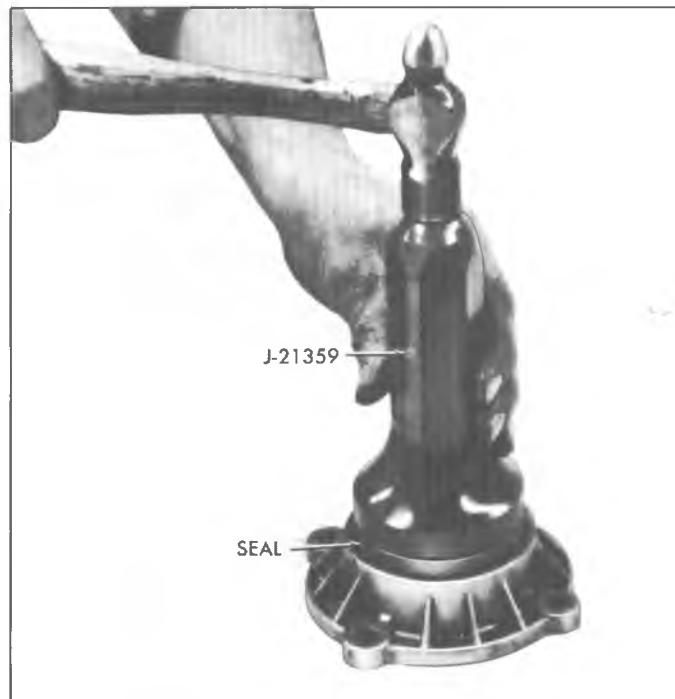


Fig. 7B-19R-Installing Rear Bearing Retainer Seal

## NEW PROCESS MODEL 203 (FULL TIME) TRANSFER CASE

### INDEX

Disassembly of Transfer Case .....	7B-59	Input Gear Bearing Replacement .....	7B-66
Cleaning and Inspection .....	7B-62	Input Gear Bearing Retainer Seal Replacement .....	7B-67
Subassembly Repairs.....	7B-63	Rear Output Shaft Housing Assembly .....	7B-67
Differential Carrier Assembly .....	7B-63	Front Output Shaft Bearing Retainer	
Lockout Clutch Assembly .....	7B-63	Seal Replacement .....	7B-68
Input Shaft Assembly .....	7B-63	Front Output Shaft Rear Bearing Replacement.....	7B-68
Range Box Assembly.....	7B-63	Assembly of Transfer Case.....	7B-68

### DISASSEMBLY OF TRANSFER CASE

Refer to Figs. 7B-1S, 7B-11S and 7B-12S for cross sectional and exploded views of the transfer case.

1. Position transfer case on work bench or suitable work table.

**NOTE:** If lubricant was not drained from unit prior to removal from vehicle, remove front output rear cover and P.T.O. cover lower bolts and drain lubricant into waste container.

2. Using Tool J-8614-1, loosen rear output shaft flange retaining nut (Fig. 7B-4S).

3. Using Tool J-8614-1, remove front output shaft flange retaining nut, washer and flange.

**NOTE:** Tap dust shield rearward on shaft (away from bolts) to obtain clearance to remove bolts from flange and allow installation of Tool J-8614-1.

4. Remove bolts retaining front output shaft front bearing retainer (Fig. 7B-5S). Remove bearing retainer and gasket from transfer case. Discard gasket.

5. Using a hoist or other suitable lifting tool, position assembly on blocks (Fig. 7B-6S).

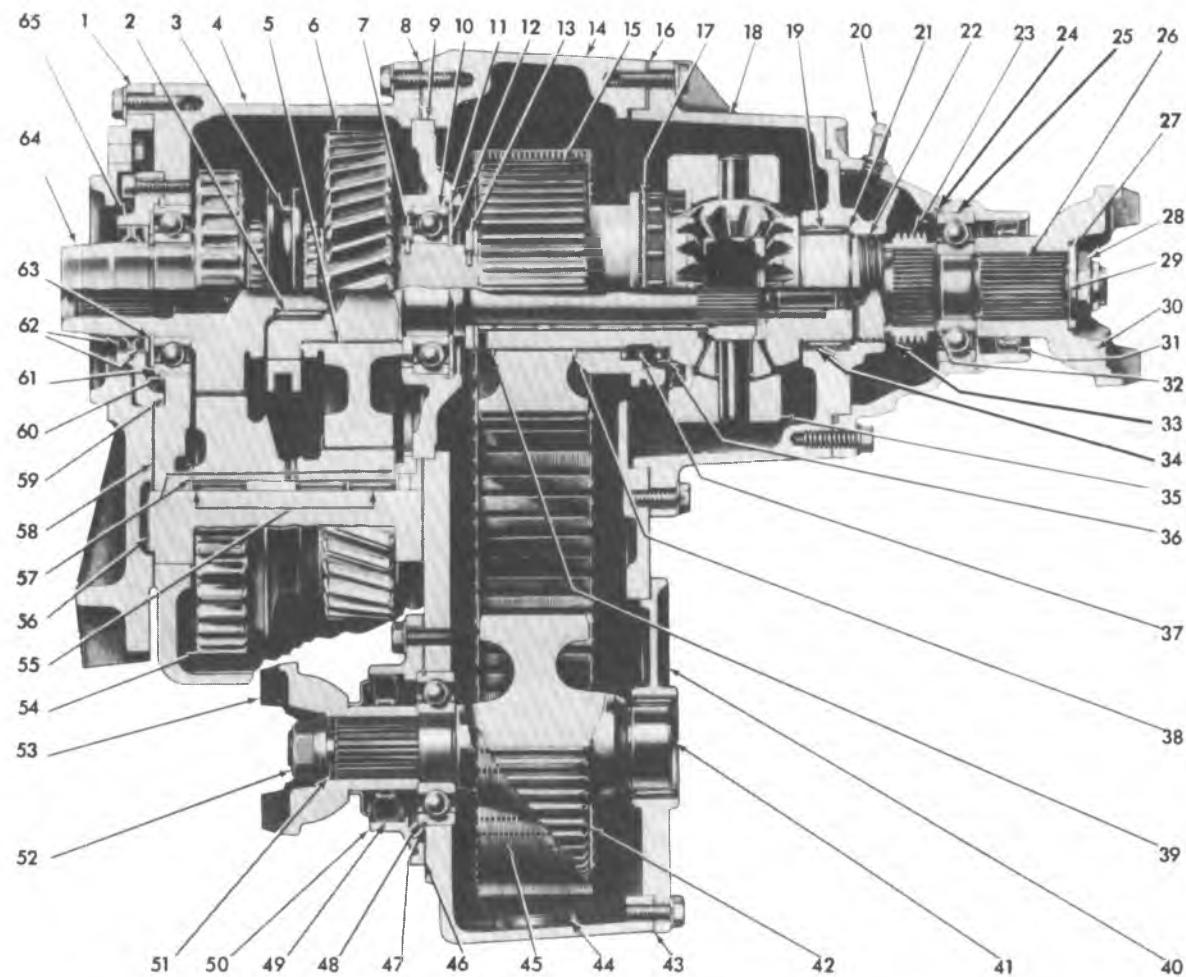
6. Remove bolts retaining rear section of rear output housing from front section of rear output housing, and disengage. Remove shims and speedometer gear from output shaft.

a. Remove bolts retaining front section of rear output housing assembly from transfer case. Remove housing from case.

b. Remove "O" ring seal from front section of rear output housing and discard.

c. Disengage rear output shaft from differential carrier assembly.

7. Slide carrier unit from shaft.



1. Adapter
2. Input Drive Gear Pilot Brgs.
3. Range Selector Sliding Clutch
4. Range Selector Housing
5. Low Speed Gear Bushing
6. Low Speed Gear
7. Thrust Washer & Locating Pin
8. Gasket
9. Input Brg. Retainer
10. Input Brg.
11. Brg. Outer Ring
12. Brg. Retaining Ring
13. Thrust Washer, Locating Pin, Lubricating Washer & Spacer
14. Intermediate (Chain Housing)
15. Drive Shaft Sprocket
16. Gasket
17. Sliding Lock Clutch
18. Rear Output Housing
19. Rear Output Front Brg.
20. Vent
21. Oil Seal
22. Oil Pump
23. Speedometer Drive Gear
24. Brg. Retainer Ring
25. Rear Output Rear Brg.
26. Rear Output Shaft
27. Washer
28. Locknut
29. Rubber Spline Seal
30. Rear Output Yoke
31. Rear Output Seal
32. Shims
33. Input Shaft "O" Ring
34. Input Shaft Pilot Bearings
35. Differential Carrier Assembly
36. Spring Washer Cup
37. Lockout Clutch Spring
38. Snap Ring
39. Snap Ring
40. Front Output Rear Brg. Cover
41. Front Output Rear Brg.
42. Front Output Drive Sprocket
43. Gasket
44. Magnet
45. Drive Chain
46. Gasket
47. Brg. Outer Ring
48. Front Output Front Brg.
49. Front Output Shaft Seal
50. Front Output Brg. Retainer
51. Rubber Spline Seal
52. Locknut
53. Front Output Yoke
54. Countergear
55. Countergear Spacers and Brgs.
56. Countergear Shaft
57. Countergear Thrust Washer
58. Gasket
59. Brg. Retainer Gasket
60. Brg. Outer Ring
61. Input Gear Brg.
62. Input Gear Seals (2)
63. Brg. Snap Ring
64. Input Gear
65. Input Gear Brg. Retainer

Fig. 7B-1S—Model 203 Transfer Case Cross Sectional View

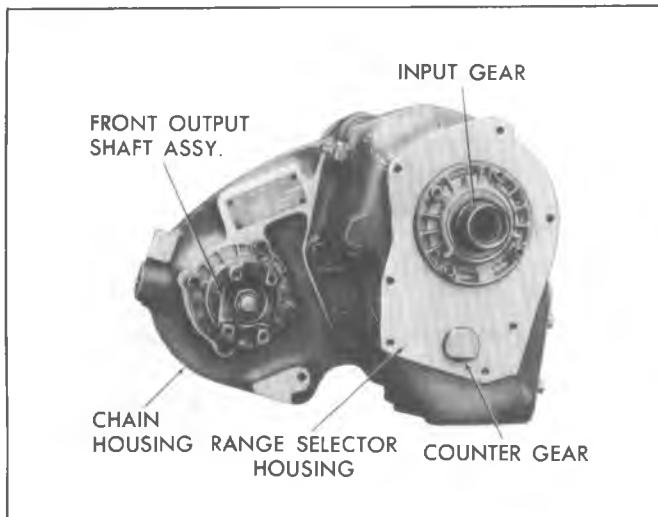


Fig. 7B-2S--Front View of Transfer Case

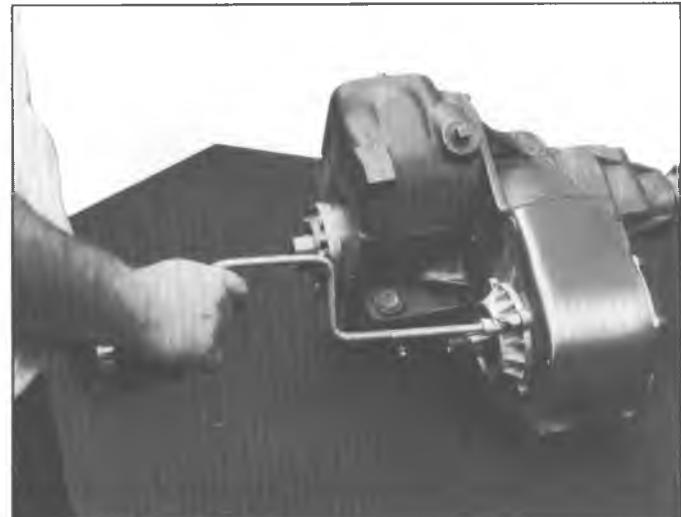


Fig. 7B-5S--Removing Front Output Shaft Front Bearing Retainer

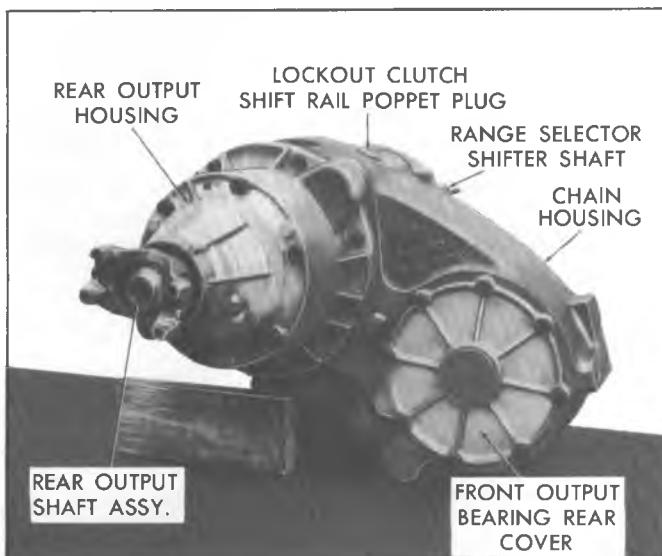


Fig. 7B-3S--Rear View of Transfer Case

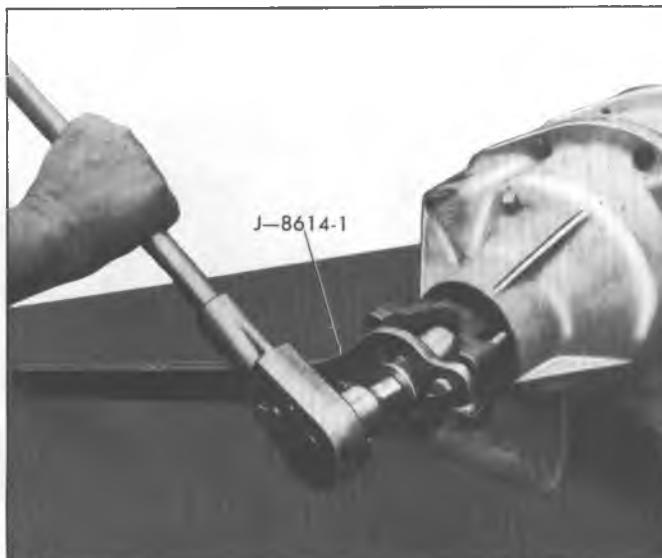


Fig. 7B-4S--Removing Rear Output Shaft Flange Nut

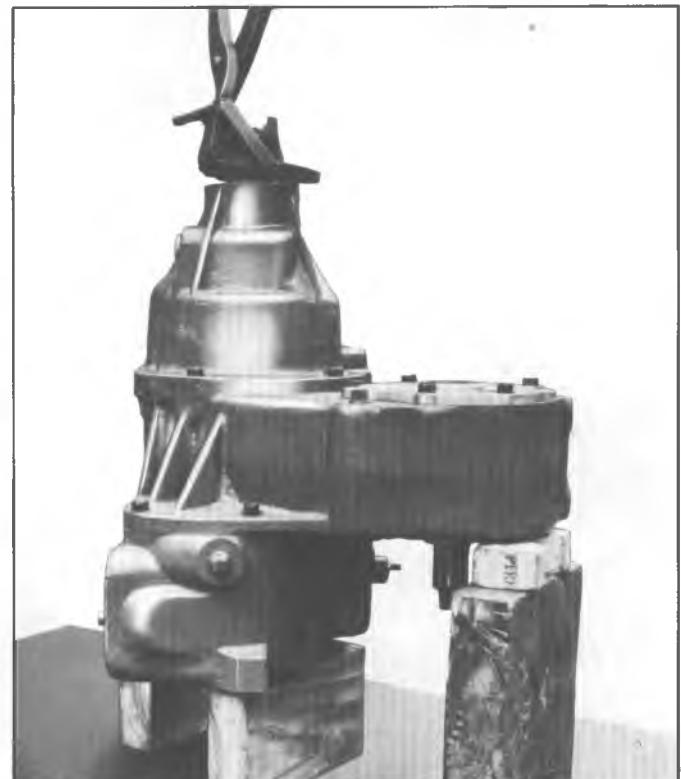


Fig. 7B-6S--Positioning Transfer Case for Disassembly

**NOTE:** A 1-1/2" to 2" water hose band type clamp may be installed on the input shaft at this time to prevent loosening bearings when removing input shaft assembly from the range box.

8. Raise shift rail and drive out pin retaining shift fork to rail (Fig. 7B-7S).
9. Remove shift rail poppet ball plug, gasket spring and ball from case (Fig. 7B-8S). A small magnet may be used to remove ball from case.
10. Push shift rail down, lift up on lockout clutch and remove shift fork from clutch assembly.
11. Remove bolts retaining front output shaft rear



Fig. 7B-7S--Removing Shift Fork Retaining Pin

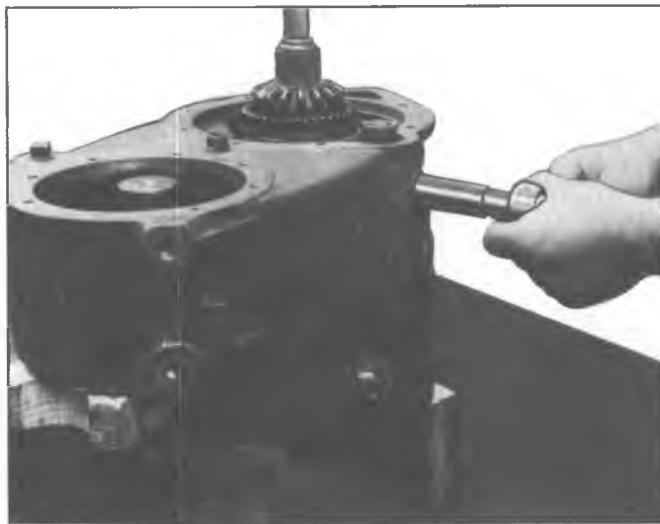


Fig. 7B-8S--Removing or Installing Poppet Ball Plug

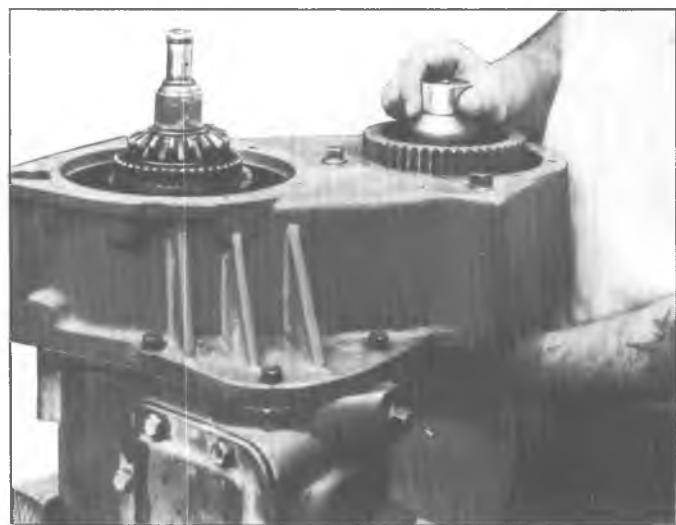


Fig. 7B-9S--Removing Front Output Shaft

bearing retainer to transfer case. Tap on front of shaft or carefully pry retainer away from case. Remove retainer from shaft and discard gasket. Recover any roller bearings which may fall from rear cover.

**NOTE:** If necessary to replace rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover and press bearing into cover with a .06 inch overhang.

12. From lower side of case, remove (pry) output shaft front bearing.

13. Disengage front output shaft from chain and remove shaft from transfer case (Fig. 7B-9S).

14. Remove bolts attaching intermediate chain housing to range box. Lift or using a chain hoist, remove intermediate housing from range box (Fig. 7B-10S).

15. Remove chain from intermediate housing.

16. Remove lockout clutch, drive gear and input shaft assembly from range box.

**NOTE:** A 1 1/2" to 2" hose clamp may be installed on end of the input shaft to prevent loosing the roller bearings (123) which may fall out of clutch assembly if it is pulled off the input shaft.

17. Pull up on shift rail and disconnect rail from link.

18. Remove (lift) input shaft assembly from range box.

**NOTE:** At this point the transfer case is completely disassembled into its subassemblies. Each of these subassemblies should then be disassembled fro cleaning and inspection.

## CLEANING AND INSPECTION

**BEARINGS**--Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow dry with compressed air, being careful to direct air across bearing so that bearings do not spin.

**SHAFTS AND GEARS**--Clean all shafts and gears in cleaning solution to remove all accumulations. Dry with compressed air.

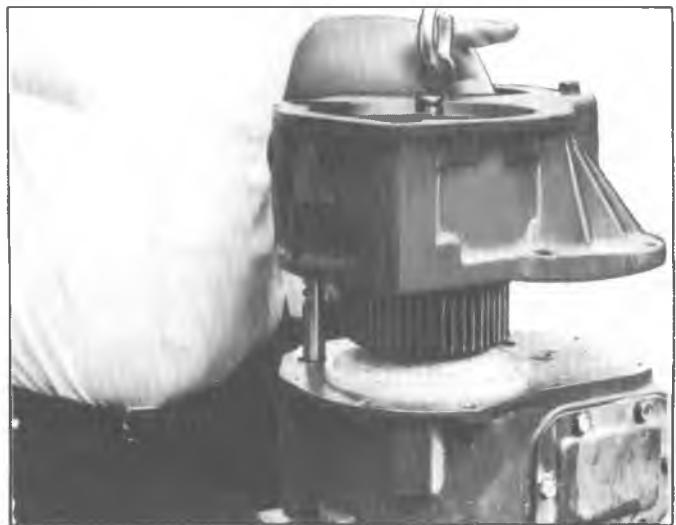


Fig. 7B-10S--Removing Intermediate (Chain) Housing

**CASE, COVER AND HOUSINGS**--Transfer case, cover, and housings must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surfaces where used.

**INSPECTION**--Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are non-adjustable and if worn or damaged, must be replaced with new parts. Inspect shaft splines drive chain and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

### SUBASSEMBLY REPAIRS

**NOTE:** Refer to figure 7B-12S for exploded view of subassemblies.

### Differential Carrier Assembly (Fig. 7B-12S)

#### Disassembly

1. Remove bolts from carrier assembly and separate carrier sections.
2. Lift the pinion gear and spider assembly from carrier.
- NOTE:** Observe that undercut side of pinion gear spider faces toward front side gear.
3. Remove the pinion thrust washers, pinion roller washers, pinion gears and roller bearings from the spider unit.
4. Clean and inspect all components. Replace all worn or broken parts.

#### Assembly

1. Using a petroleum jelly, load roller bearings in pinion gears (132 required, 33 each pinion).
2. Install pinion roller washer, pinion gear, roller washer and thrust washer on each leg of spider.
3. Place the spider assembly in the carrier (front half) with undercut surface of spider thrust surface facing downward or toward gear teeth.
4. Align marks on carrier sections and position carrier halves together. Install retaining bolts and tighten to specifications.

### Lockout Clutch Assembly (Fig. 7B-11S)

#### Disassembly

1. Remove front side gear from input shaft assembly and remove thrust washer, roller bearings (123) and spacers from front side gear bore. Note position of spacers to facilitate reassembly.
2. Using snap ring pliers, remove the snap ring retaining drive sprocket to clutch assembly. Slide the drive sprocket from the front side gear.
3. Using snap ring pliers, remove lower snap ring.
4. Remove sliding gear, spring and spring cup washer from front side gear.
5. Clean and inspect all components. Replace all worn or defective parts.

#### Assembly

1. Install spring cup washer, spring and sliding clutch gear on front side gear.
2. Install snap ring retaining sliding clutch to front side gear.
3. Using a petroleum jelly, load roller bearings (123) and spacers in the front side gear.
4. Install thrust washer in gear end of front side gear.

5. Slide drive sprocket on to clutch splines and install retaining ring.

### Input Shaft Assembly (Fig. 7B-11S)

#### Disassembly

1. Slide thrust washer and spacer from shaft.
2. Using snap ring pliers, remove snap ring retaining input bearing retainer assembly to shaft (Fig. 7B-13S) and remove bearing retainer assembly from shaft.
3. Support low speed gear (large gear) and tap shaft from gear and thrust washer.
- NOTE:** Observe thrust washer pin(s) located in shaft (Fig. 7B-11S).
4. Using a screw driver, pry behind open end of large snap ring retaining input bearing in bearing retainer (Fig. 7B-14S) and remove ring from retainer. Tap bearing from retainer.
5. Remove pilot roller bearings (15) from end of input shaft.
6. Remove "O" ring from end of shaft and discard.
7. Clean and inspect all components. Replace as required.

#### Assembly

1. Position bearing to retainer and tap or press into place. Ball loading slots should be toward concave side of retainer.
2. Install large snap ring securing bearing in retainer.
- NOTE:** Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.
3. Install low speed gear on shaft with clutch end toward gear end of shaft.
4. Position thrust washers on shaft, aligning slot in washer with pin in shaft. Slide or tap washer into place.
5. Position input bearing retainer on shaft and install snap ring, holding bearing in place on shaft.
- NOTE:** Snap ring is a select fit. Use size A, B, C or D as required to provide tightest fit.
6. Slide spacer and thrust washer onto shaft. Align spacer with locator pin.
7. Using a heavy grease, install roller bearings (15) in end of shaft.
8. Install new rubber "O" ring on end of shaft.

### Range Selector Housing (Range Box)

#### Disassembly (Fig. 7B-11S)

#### Removing Shifter Assembly

1. Remove poppet plate spring, plug and gasket. Discard gasket.
2. Disengage sliding clutch gear from input gear and remove clutch fork and sliding gear from case.
3. Remove shift lever assembly retaining nut and upper shift lever from shifter shaft.
4. Remove shift lever snap ring and lower lever.
5. Push shifter shaft assembly downward and remove lockout clutch connector link.

- NOTE:** Long end of connector link engages poppet plate.
6. Remove shifter shaft assembly from case and separate the inner and outer shifter shafts. Remove and discard "O" rings.
  7. Inspect poppet plate for damage. If necessary to remove, drive pivot shaft from case. Remove poppet plate and spring from bottom of case.

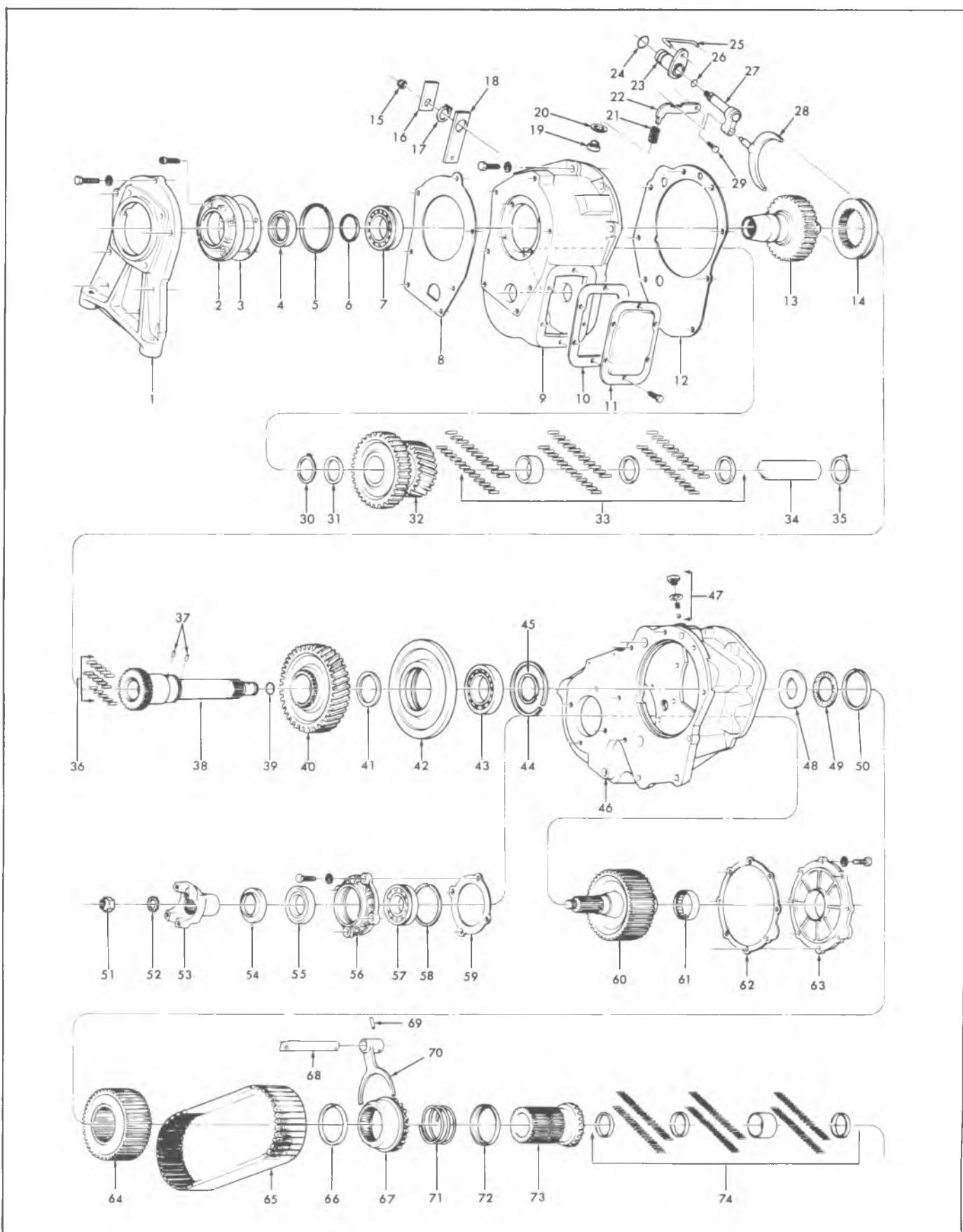
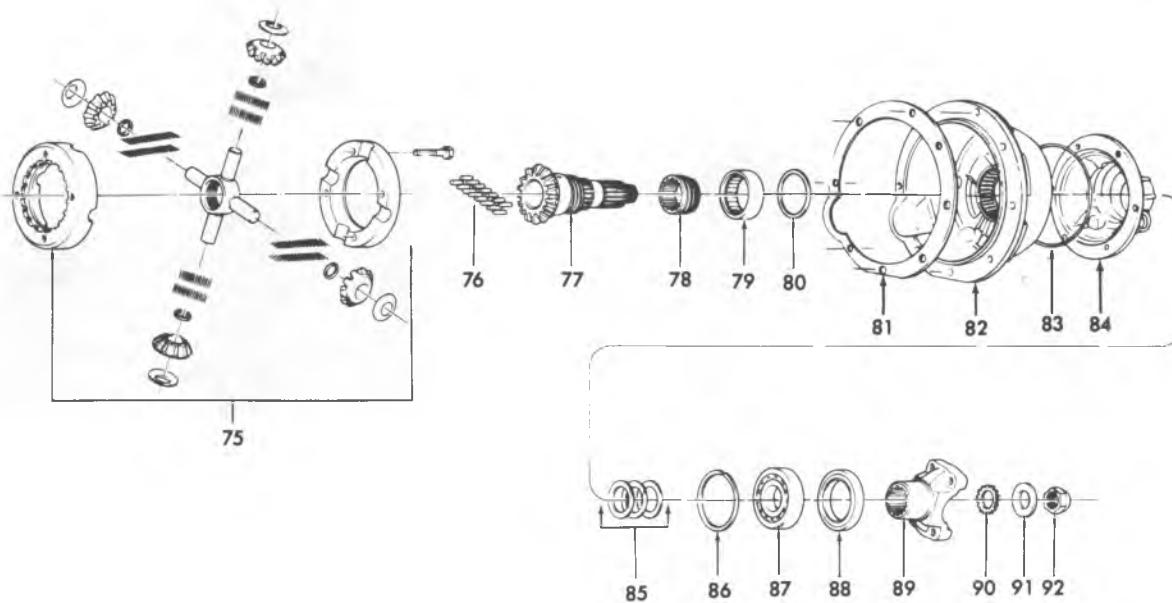


Fig. 7B-11S—Model 203 Transfer Case Exploded View



1. Adapter
2. Input Gear Bearing Retainer
3. Input Gear Bearing Retainer Gasket
4. Input Gear Bearing Retainer Seals
5. Bearing Outer Ring
6. Bearing to Shaft Retaining Ring
7. Input Gear Bearing
8. Adapter to Selector Housing Gasket
9. Range Selector Housing (Range Box)
10. P.T.O. Cover Gasket
11. P.T.O. Cover
12. Selector Housing to Chain Housing Gasket
13. Main Drive Input Gear
14. Range Selector Sliding Clutch
15. Shift Lever Lock Nut
16. Range Selector Shift Lever
17. Shift Lever Retaining Ring
18. Lockout Shift Lever
19. Detent Plate Spring Plug
20. Detent Plate Spring Plug Gasket
21. Detent Plate Spring
22. Detent Plate
23. Lockout Shifter Shaft
24. "O" Ring Seal
25. Lockout Shaft Connector Link
26. "O" Ring Seal
27. Range Selector Shifter Shaft
28. Range Selector Shift Fork
29. Detent Plate Pivot Pin
30. Thrust Washer
31. Spacer (short)
32. Range Selector Counter Gear
33. Countergear Roller Bearings and Spacers (72 Bearings Req'd.)
34. Countergear Shaft
35. Thrust Washer
36. Input Shaft Roller Bearings (15 Req'd.)
37. Thrust Washer Pins (2 Req'd.)
38. Input Shaft
39. "O" Ring Seal
40. Low Speed Gear and Bushing
41. Thrust Washer
42. Input Shaft Bearing Retainer
43. Input Shaft Bearing
44. Input Shaft Bearing Retaining Ring (Large)
45. Input Shaft Bearing Retaining Ring
46. Chain Drive Housing
47. Lockout Shift Rail Poppet Plug, Gasket, Spring and Ball.
48. Thrust Washer
49. Lubricating Thrust Washer
50. Retaining Ring
51. Flange Lock Nut
52. Seal
53. Front Output Yoke
54. Dust Shield
55. Front Output Shaft Bearing Retainer Seal
56. Front Output Shaft Bearing Retainer
57. Front Output Shaft Bearing
58. Bearing Outer Ring
59. Bearing Retainer Gasket
60. Front Output Shaft
61. Front Output Shaft Rear Bearing
62. Front Output Rear Bearing Retainer Cover Gasket
63. Front Output Rear Bearing Retainer
64. Drive Shaft Sprocket
65. Drive Chain
66. Retaining Ring
67. Sliding Lock Clutch
68. Lockout Shift Rail
69. Shift Fork Retaining Pin
70. Lockout Shift Fork
71. Lockout Clutch Spring
72. Spring Washer Cup
73. Front Side Gear
74. Front Side Gear Bearing and Spaces (123 Bearings Req'd.)
75. Differential Carrier Assembly (132 Bearings Req'd.)
76. Rear Output Shaft Roller Bearings (15 Req'd.)
77. Rear Output Shaft
78. Speedometer Drive Gear
79. Rear Output Shaft Front Roller Bearing
80. Oil Pump "O" Ring Seal
81. Rear Output Housing Gasket
82. Rear Output Housing (Front)
83. "O" Ring Seal
84. Rear Output Housing (Rear)
85. Shim Pack
86. Bearing Retainer
87. Rear Output Rear Bearing
88. Rear Output Shaft Seal
89. Rear Output Flange
90. Rear Output Shaft Rubber Seal
91. Washer
92. Flange Nut

Fig. 7B-12S--Model 203 Transfer Case Exploded View Continued

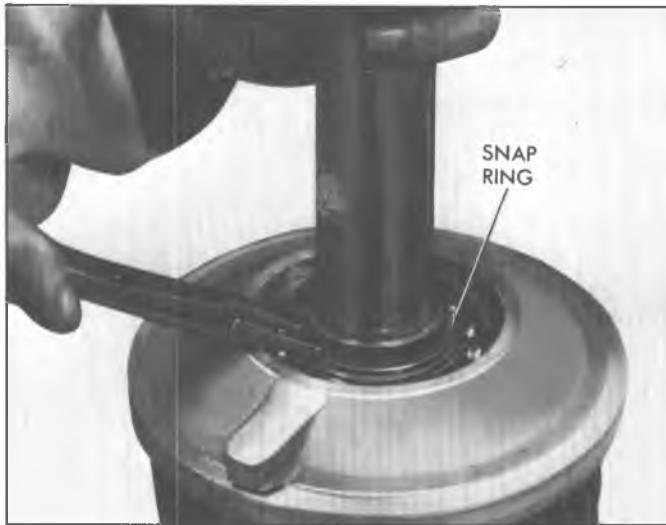


Fig. 7B-13S--Removing Input Shaft-to-Bearing Snap Ring

#### **Removing Input Gear Assembly**

8. Remove input gear bearing retainer and seal assembly. Discard gasket.
9. Remove large snap ring from bearing outer diameter.
10. Tap input gear and bearing from case.
11. Remove snap ring retaining input shaft bearing to shaft and remove bearing from input gear.

**NOTE:** This is a select fit snap ring. Snap rings, size A, B, C, and D are released for service. Select tightest fit.

#### **Removing Cluster Gear Assembly (Fig. 7B-15S)**

12. From intermediate case side, remove counter shaft from cluster gear and case using Tool J-24745. Remove cluster gear assembly from case.

**NOTE:** Recover roller bearings (72 required) from gear case and shaft.

13. Remove cluster gear thrust washers from case.
14. Clean and inspect all components. Replace worn and defective parts.

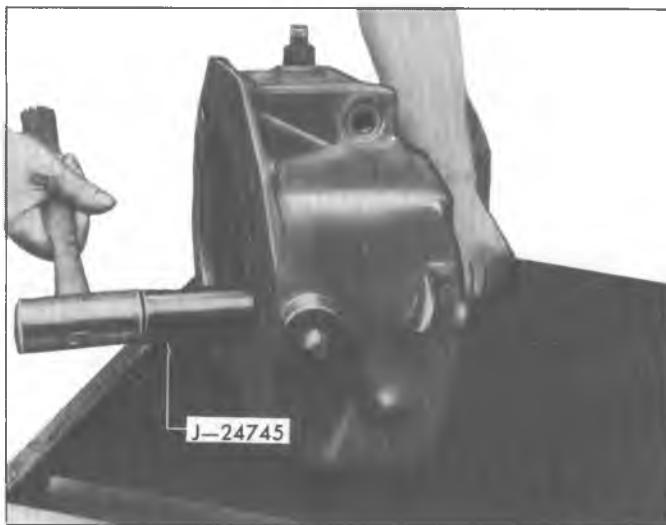


Fig. 7B-15S--Removing Cluster Gear Shaft

#### **Assembly (Fig. 7B-11S)**

##### **Installing Countergear Assembly**

1. Using Tool J-24745 and a heavy grease, install roller bearings (72 required) and spacers in clustergear bore.
2. Using a heavy grease, position countershaft thrust washers in case. Engage tab on washers with a slot in case thrust surface.
3. Position cluster gear assembly in case and install countershaft through front face of range box into gear assembly. Countershaft face with flat should face forward and must be aligned with case gasket.

##### **Installing Input Gear Assembly**

4. Install bearing (without large snap ring) on input gear shaft positioning snap ring groove outward and install new retaining ring on shaft. Position input gear and bearing in housing.

**NOTE:** The retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.

5. Install snap ring in outside diameter of bearing.
6. Align oil slot in retainer with drain hold in case and install input gear bearing retainer, gasket and retaining bolts. Tighten bolts to specifications.

##### **Installing Shifter Shaft Assembly**

7. If removed, install poppet plate and pivot pin assembly in housing. Use sealant on pin.
8. Install new "O" rings on the inner and outer shifter shafts. Lubricate "O" rings and assemble inner shaft in the outer shaft.
9. Push the shifter shafts into the housing, engaging the long end of the lockout clutch connector link to the outer shifter shaft before the shaft assembly bottoms out.
10. Install lower shift lever and retaining ring.
11. Install upper shift lever and shifter shaft retaining nut.
12. Install shift fork and sliding clutch gear. Push fork up into shifter shaft assembly to engage poppet plate, sliding clutch gear forward onto the input shaft gear.
13. Install poppet spring, gasket and plug in top of housing. Check spring engagement with poppet plate.

#### **Input Gear Bearing Replacement**

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.

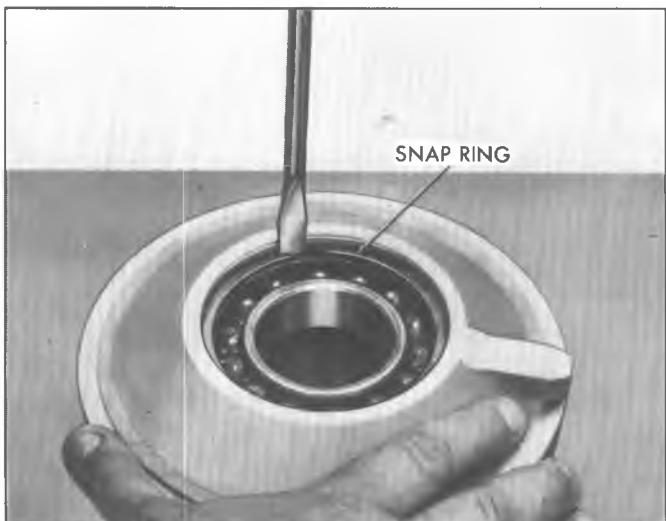


Fig. 7B-14S--Removing Input Shaft Bearing-to-Retainer Snap Ring

2. Using snap ring pliers, remove snap ring retaining bearing on shaft. Discard snap ring.
3. Using a screwdriver or other suitable tool, pry the bearing from case and remove it from the shaft.

**NOTE:** Inspect input gear for defects such as burrs, scoring, heat discoloration, etc. Inspect seal in bearing retainer. Replace as required.

4. Install new bearing with snap ring on input gear shaft. Position bearing to case and tap into place with a soft hammer.

**NOTE:** Select service ring, size A, B, C or D, that will provide tightest fit.

5. Install new snap ring to retain bearing on the shaft.

6. Position new gasket and the bearing retainer to housing. Install retaining bolts, tightening to specifications.

### Input Gear Bearing Retainer Seal Replacement

1. Remove bearing retainer attaching bolts, retainer and gasket from housing. Discard gasket.
2. Pry seal out of retainer and discard.
3. Position new seal to retainer and install using tool J-21359 (Fig. 7B-16S).
4. Position bearing retainer and gasket to housing. Install attaching bolts and tighten to specifications.

### REAR OUTPUT SHAFT HOUSING (REAR)

#### Disassembly

1. Remove speedometer driven gear from rear section of rear output housing.
2. Pry old seal out of bore, using screwdriver or other suitable tool.
3. Using a screwdriver, pry behind open ends of snap ring and remove snap ring retaining rear bearing in housing (Fig. 7B-17S).
4. Pull or tap bearing from housing.
5. To remove the front bearing, insert a long drift through rear opening and drive the bearing from the housing (Fig. 7B-18S). Remove and discard rubber seal.

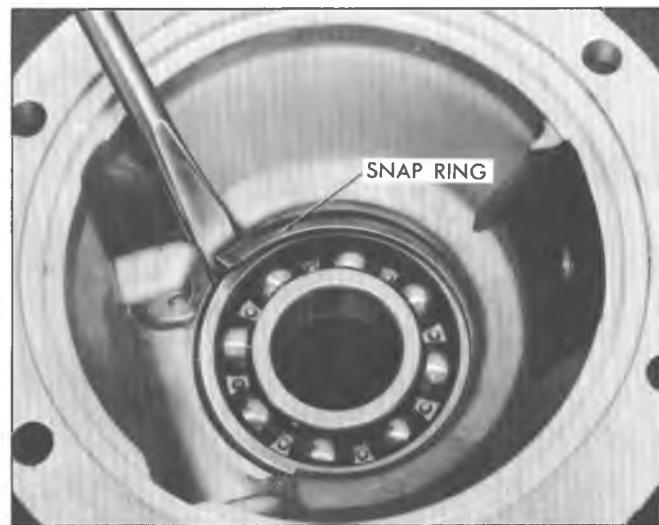


Fig. 7B-17S--Removing Rear Output Bearing Retaining Ring

#### Assembly

1. Position rear bearing in housing and tap into place.
2. Install snap ring retaining bearing to case.

**NOTE:** Retaining ring is a select fit. Use service ring size A, B, C or D as required to provide tightest fit.

3. Position rear seal to bore and drive into place using tool J-22388 (Fig. 7B-19S) or other suitable tool until approximately  $1/8"$  to  $3/16"$  below housing face.

4. If the vent seal falls out or is knocked out during disassembly, reinstall new seal or thoroughly clean and dry the area and re-cement the old seal in place.

### REAR OUTPUT SHAFT HOUSING (FRONT)

#### Disassembly

1. Remove "O" ring from rear output shaft housing (front) and discard.

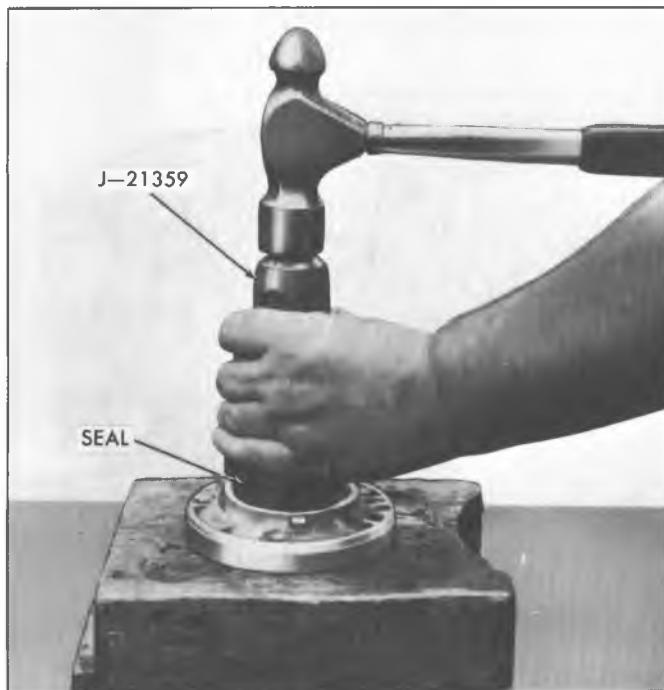


Fig. 7B-16S--Installing Input Shaft Bearing Retainer Seal



Fig. 7B-18S--Removing Rear Output Shaft Front Bearing



Fig. 7B-19S--Installing Rear Output Shaft Seal

- To remove roller bearings from housing, insert a long drift through rear opening and drive bearing from housing (Fig. 7B-18S). Remove and discard rubber seal.

### Assembly

1. Position rubber seal in bearing bore. Use grease to hold in place. Position roller bearing in bore and press into place until bearing bottoms out in housing.

- Position new "O" ring on housing.

### Front Output Shaft Bearing Retainer Seal Replacement (Fig. 7B-20S)

- Pry or drive out existing seal from retainer bore.
- Clean and inspect retainer.
- Apply sealer to outer diameter of new seal.
- Position seal to retainer bore and using Tool J-22836 or equivalent, install seal in retainer.

### Front Output Shaft Rear Bearing Replacement

- Remove rear cover from transfer case. Remove gasket and discard.
- Support rear cover and press bearing from cover.
- Position new bearing to outside face of cover and using a piece of wood to cover bearing, press bearing into cover until flush with opening.
- Position gasket and cover to transfer case and tap into place.
- Install cover retaining bolts and torque to specifications.

### ASSEMBLY OF TRANSFER CASE (FIGS. 7B-1S and 7B-11S)

- Place range box on blocks, with input gear side toward bench (Fig. 7B-21S).

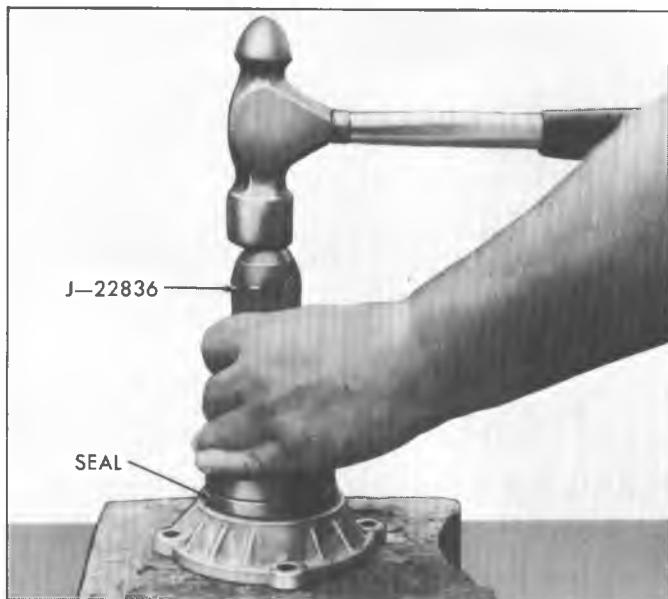


Fig. 7B-20S--Installing Front Output Bearing Retainer Seal

- Position range box-to-transfer case housing gasket on input housing.

- Install lockout clutch and drive sprocket assembly on the input shaft assembly.

**NOTE:** A 2" band clamp may be installed on end of shaft to prevent loosing bearings from clutch assembly.

- Install input shaft, lockout clutch and drive sprocket assembly in the range box, aligning tab on bearing retainer with notch in gasket.

- Connect lockout clutch shift rail to the connector link and position rail in housing bore (Fig. 7B-22S). Rotate shifter shaft while lowering shift rail into the housing, to prevent the link and rail from being disconnected.

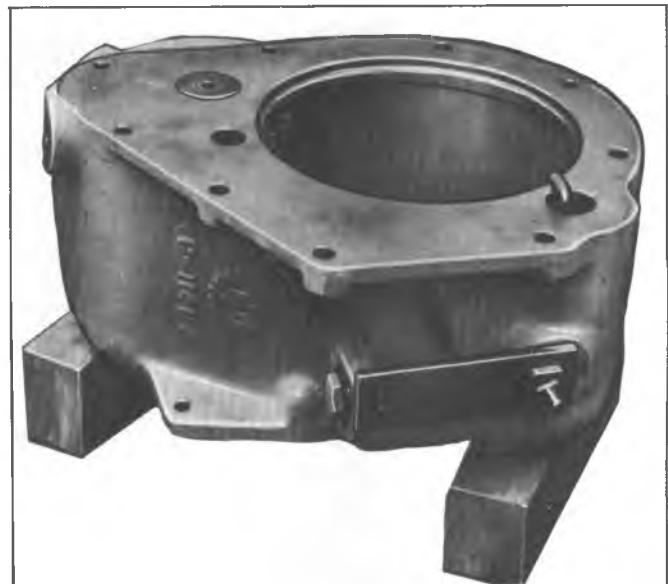


Fig. 7B-21S--Positioning Range Box for Assembly

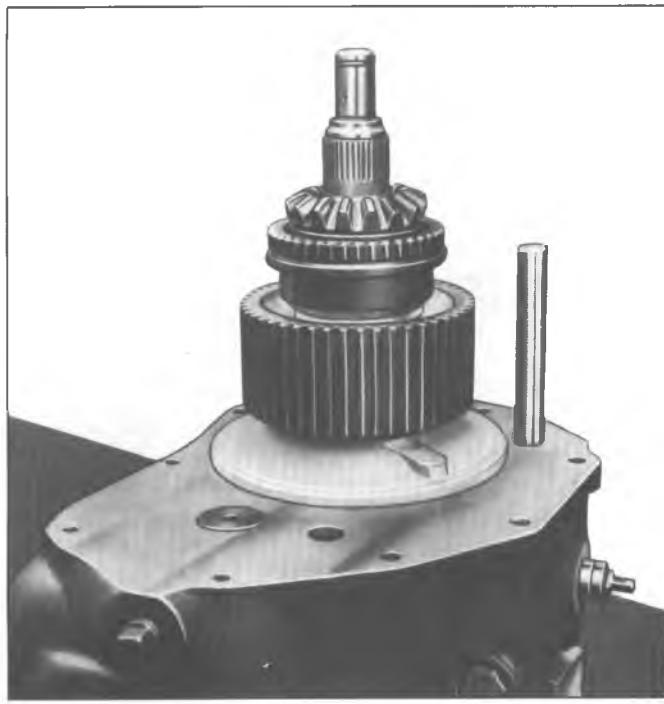


Fig. 7B-22S--Drive Gear and Lockout Clutch Assembly Installed

6. Install drive chain in chain housing, positioning the chain around the outer wall of the housing.
7. Install the cahin housing on the range box (Fig. 7B-23S), engaging the shift rail channel of the housing to the shift rail. Position chain on the input drive sprocket.
8. Install the front output sprocket in the case, engaging the drive chain to the sprocket. Rotate clutch drive gear to assist in positioning chain on the drive sprocket.
9. Install the shift fork on the clutch assembly and the shift rail, then push the clutch assembly fully into the drive sprocket. Install roll pin retaining shift fork to shift rail.



Fig. 7B-23S--Installing Intermediate Housing to Range Box

10. Install front output shaft bearing.
  11. Install front output shaft bearing retainer, gasket and retaining bolts.
  12. Install the front output shaft flange, gasket, seal, washer and retaining nut. Tap dust shield back in place after installing bolts in flange.
  13. Install front output shaft rear bearing retainer, gasket and retaining bolts.
- NOTE:** If rear bearing was removed, position new bearing to outside face of cover and press into cover until bearing is flush with opening.
14. Install differential carrier assembly on the input shaft. Carrier bolt heads should face rear of shaft.
  15. Position rear output shaft to differential carrier assembly (load bearings in pinion shaft).
    - a. Install rear output housing (front) assembly, gasket, and retaining bolts.
    - b. Install speedometer gear and shims (approximately .050 inch thickness) on output shaft.
    - c. Position rear output housing (rear) assembly to rear output housing (front). Be sure "O" ring is in proper position on front section of output housing.
- NOTE:** Be sure vent is in upward position.
- d. Install flange, washer, and retaining nut. Leave nut loose (approximately .060 inch) until shim requirements are determined.
  16. Install shim pack onto shaft, in front of rear bearing, to control end play to within .001" to .005". Hold rear flange and rotate front output shaft to check for binding of the rear output shaft (Fig. 7B-24S).
  17. Install speedometer driven gear in housing.
  18. Install lockout clutch shift rail poppet ball, spring and screw plug in case.
  19. Install poppet plate spring, gasket and plug, if not installed during reassembly of range box.



Fig. 7B-24S--Checking Rear Output Shaft End Play

20. Install shift levers on the range box shifter shaft, if not left on linkage in vehicle.

21. Torque all bolts, locknuts and plugs (except filler plug) to specifications.

22. Fill transfer case to proper level with specified lubricant.

23. Install and tighten filler plug to specifications.

## ADAPTER ASSEMBLIES

### ADAPTERS USED WITH MANUAL TRANSMISSIONS

#### Adapters Used With The Model 205 (Part Time) Transfer Case

##### Disassembly of Adapter (Figs. 7B-1T and 7B-2T)

1. Using a brass drift or other suitable tool, tap sleeve from adapter.

2. Using a brass drift, punch out oil seal from adapter bore.

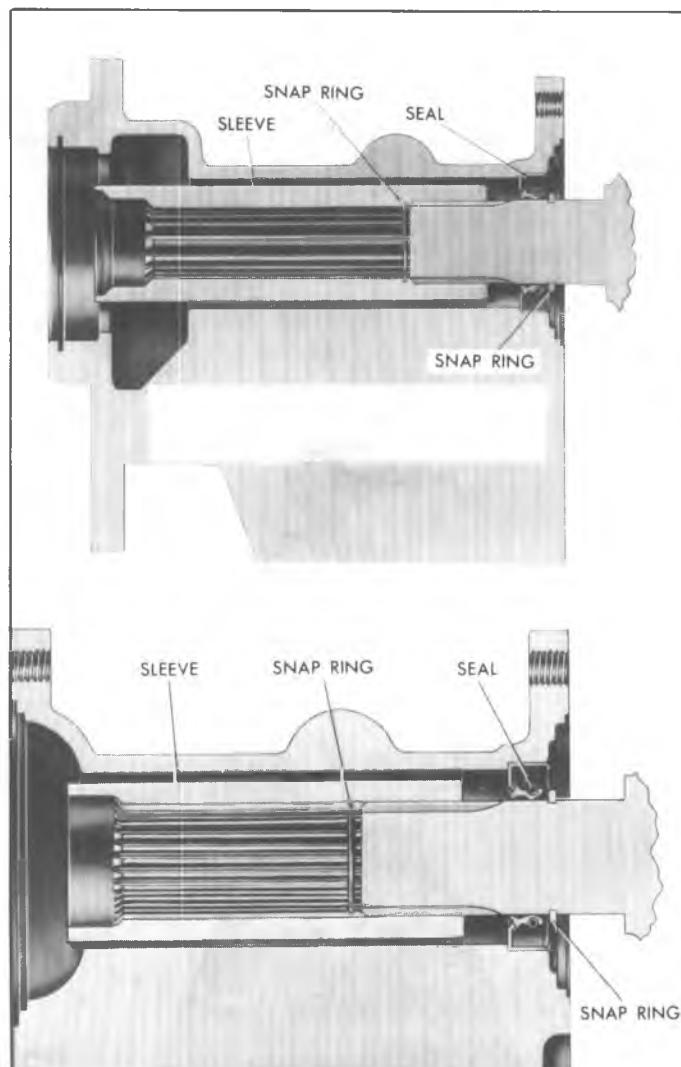


Fig. 7B-1T-Manual Transmission Adapter Assemblies  
Used With Model 205 (Part Time) Transfer Case

##### Inspection

Inspect the sleeve for any indication of failure. If the sleeve has chipped teeth or excessive wear, it should be replaced. Check internal snap ring in sleeve. Replace if bent or broken.

##### Assembly of Adapter

1. Position sleeve to adapter bore and tap into place using a suitable piece of pipe.

**NOTE:** Assemble drive sleeve with oil groove facing transmission side. Lubricate sleeve spline with transmission oil before assembly.

2. Coat O.D. of seal with sealing compound and install seal using Tool J-23504 and Handle J-8092 in a similar manner as shown in Fig. 7B-3T.

#### Model 203 (Full Time) Transfer Case Assemblies

Adapters used with the full time 4-wheel drive transfer case assemblies do not require service since there are no internal components such as seals, sleeves or bearings (Fig. 7B-3T).

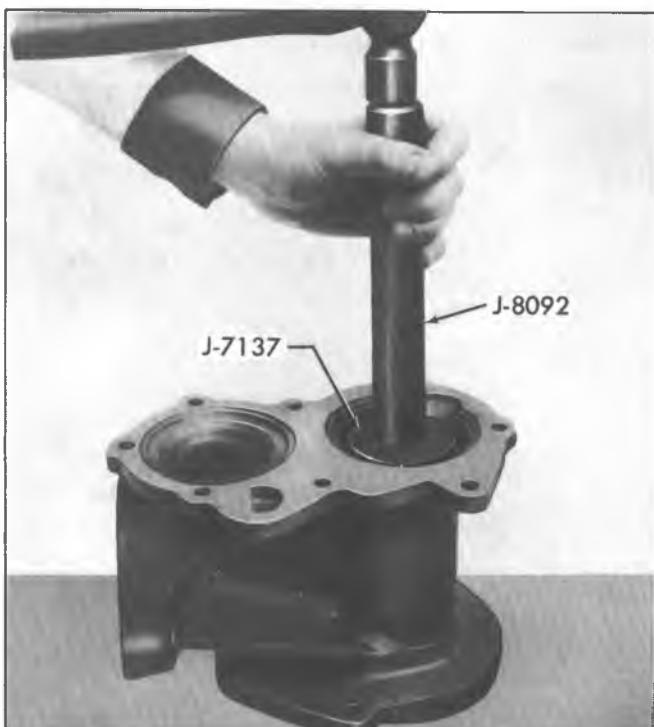
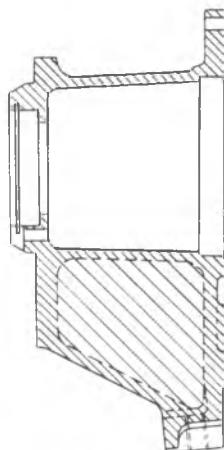
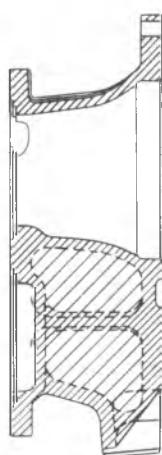


Fig. 7B-2T-Installing Adapter Seal

**3 SPEED TRANSMISSION****4 SPEED TRANSMISSION****AUTOMATIC TRANSMISSION**

## ADAPTERS USED WITH AUTOMATIC TRANSMISSIONS

### All Except Full Time 4-Wheel Drive Units

#### Disassembly of Adapter (Fig. 7B-4T)

1. Using a brass drift or other suitable tool, tap sleeve through seals and out of adapter.
2. Using a suitable punch or drift, drive seals from adapter.

#### Inspection

Inspect the sleeve for any indication of failure. If the sleeve has chipped teeth or excessive wear, it should be replaced. Check internal snap ring in sleeve. Replace if bent or broken.

#### Assembly of Adapter

1. Install new seals in adapter using Tool J-7137 and J-8092 as shown in Figure 7B-2T.
2. Insert sleeve through seals into adapter bore and tap into place.

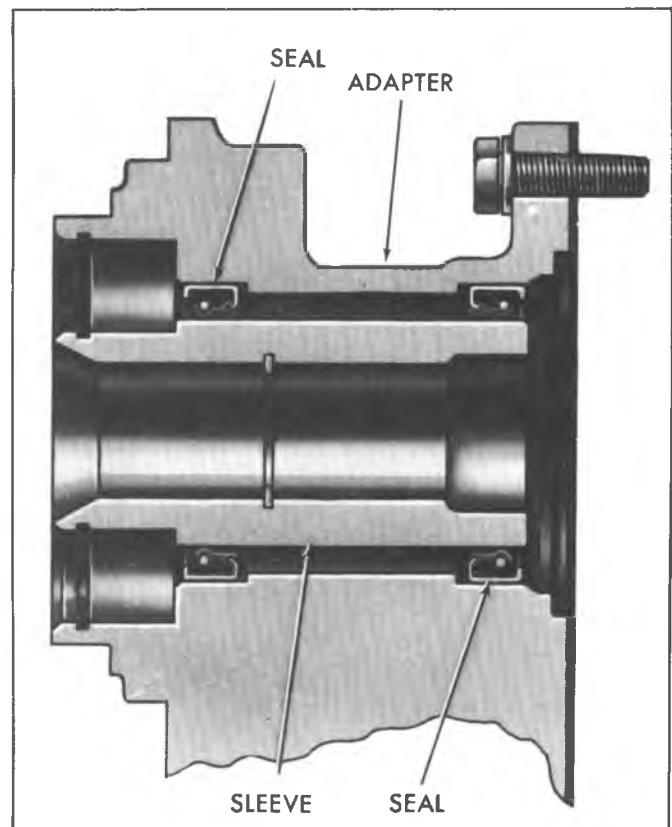


Fig. 7B-3T-Adapter Assemblies Used With the Model 203  
(Full Time) Transfer Case

Fig. 7B-4T-Automatic Transmission AdapterUsed With Model  
205 (Part Time) Transfer Case

## SPECIFICATIONS

### THREE SPEED SAGINAW (76mm)

Clutch Gear Retainer to Case Bolts .....	15 ft. lbs.
Side Cover to Case Bolts .....	15 ft. lbs.
Extension to Case Bolts .....	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts .....	25 ft. lbs.
Lubrication Filler Plug .....	13 ft. lbs.
Transmission Case to Clutch Housing Bolts ..	75 ft. lbs.
Crossmember to Frame Nuts .....	25 ft. lbs.
Crossmember to Mount Bolts .....	40 ft. lbs.
2-3 Cross Over Shaft Bracket Retaining Nut ..	18 ft. lbs.
1-Rev. Swivel Attaching Bolt .....	20 ft. lbs.
Mount to Transmission Bolt .....	50 ft. lbs.

### THREE SPEED TREMEC (77mm)

Clutch Gear Retainer to Case Bolts .....	35 ft. lbs.
Top Cover to Case Bolts .....	30 ft. lbs.
Extension to Case Bolts .....	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts .....	25 ft. lbs.
Lubrication Filler Plug .....	15 ft. lbs.
Transmission Case to Clutch Housing Bolts ..	75 ft. lbs.
Crossmember to Frame Nuts .....	25 ft. lbs.
Crossmember to Mount Bolts .....	40 ft. lbs.
2-3 Cross Over Shaft Bracket Retaining Nut ..	18 ft. lbs.
1- Rev. Swivel Attaching Bolt .....	20 ft. lbs.
Mount to Transmission Bolt .....	50 ft. lbs.

### THREE SPEED MUNCIE (83mm)

Clutch Gear Retainer to Case Bolts .....	15 ft. lbs.
Side Cover to Case Bolts .....	15 ft. lbs.
Extension to Case Bolts .....	45 ft. lbs.
Shaft Lever to Shifter Shaft Bolts .....	25 ft. lbs.
Lubrication Filler Plugs.....	13 ft. lbs.
Transmission Case to Clutch Housing Bolts ..	75 ft. lbs.
Crossmember to Frame Nuts .....	25 ft. lbs.
Crossmember to Mount Bolts.....	40 ft. lbs.
Transmission Drain Plug .....	30 ft. lbs.
2-3 Cross Over Shaft Bracket Retaining Nut ..	18 ft. lbs.
1-Rev. Swivel Attaching Bolt .....	20 ft. lbs.
Mount to Transmission Bolt .....	50 ft. lbs.

### NEW PROCESS TRANSFER CASE MODEL 205

Idler Shaft Lock Nut .....	200 ft. lbs.
Idler Shaft Cover Bolts .....	18 ft. lbs.
Front Output Shaft Front Bearing	
Retainer Bolts .....	30 ft. lbs.
Front Output Shaft Yoke Lock Nut .....	200 ft. lbs.
Rear Output Shaft Bearing Retainer Bolts...	30 ft. lbs.
Rear Output Shaft Housing Bolts .....	30 ft. lbs.
Rear Output Shaft Yoke Lock Nut .....	150 ft. lbs.
P.T.O. Cover Bolts .....	15 ft. lbs.
Front Output Shaft Rear Bearing	
Retainer Bolts .....	30 ft. lbs.
Drain and Filler Plugs .....	30 ft. lbs.
Transfer Case to Frame Bolts .....	130 ft. lbs.
Transfer Case to Adapter Bolts .....	25 ft. lbs.
Adapter Mount Bolts .....	25 ft. lbs.
Transfer Case Bracket to Frame Nuts (Upper) ..	30 ft. lbs.
Transfer Case Bracket to Frame Nuts (Lower) ..	65 ft. lbs.
Adapter to Transmission Bolts -(Manual	
Transmission) .....	22 ft. lbs.
Adapter to Transmission Bolts - (Automatic	
Transmission) .....	35 ft. lbs.
Transfer Case Control Mounting Bolt .....	100 ft. lbs.

## FOUR-SPEED (SAGINAW) 76mm

Clutch Gear Retainer to Case Bolts . . . . .	15 ft. lbs.
Side Cover to Case Bolts . . . . .	15 ft. lbs.
Extension to Case Bolts . . . . .	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts . . . . .	25 ft. lbs.
Lubrication Filler Plug . . . . .	18 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	75 ft. lbs.
Crossmember to Frame Nuts . . . . .	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	40 ft. lbs.
Mount-To-Transmission Bolts . . . . .	32 ft. lbs.

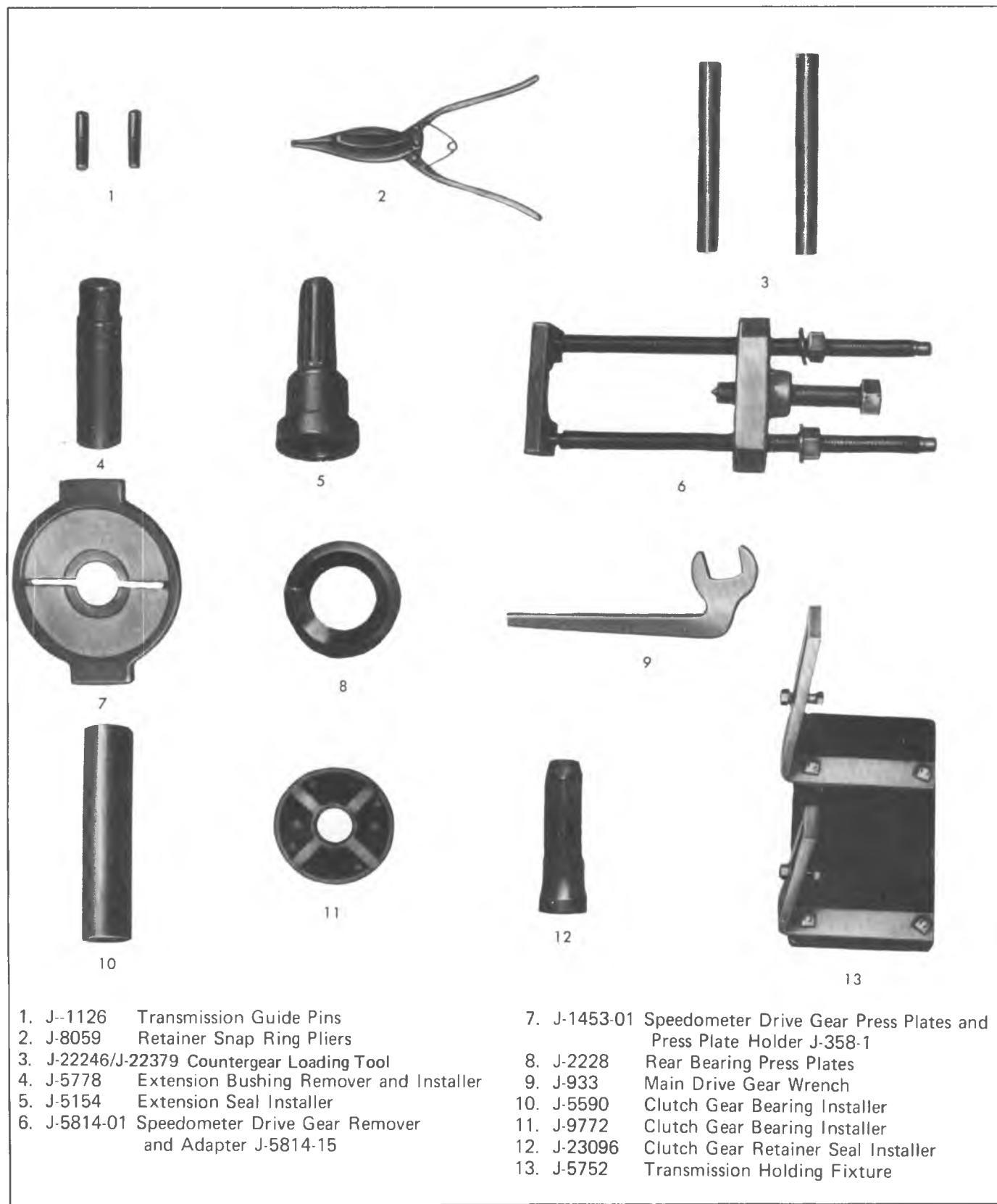
## FOUR-SPEED (WARNER) 83mm

Clutch Gear Retainer to Case Bolts . . . . .	18 ft. lbs.
Side Cover to Case Bolts . . . . .	18 ft. lbs.
Extension to Case Bolts . . . . .	40 ft. lbs.
Shift Lever to Shifter Shaft Bolts . . . . .	20 ft. lbs.
Lubrication Filler Plug . . . . .	15 ft. lbs.
Transmission Case to Clutch Housing Bolts . . . . .	52 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts . . . . .	25 ft. lbs.
Rear Bearing Retainer to Case Bolts . . . . .	25 ft. lbs.
Extension to Rear Bearing Retainer Bolts (Short) . . . . .	25 ft. lbs.
Retainer to Case Bolt . . . . .	35 ft. lbs.
Transmission Drain Plug . . . . .	20 ft. lbs.

## FOUR-SPEED (MUNCIE CH465) 117mm

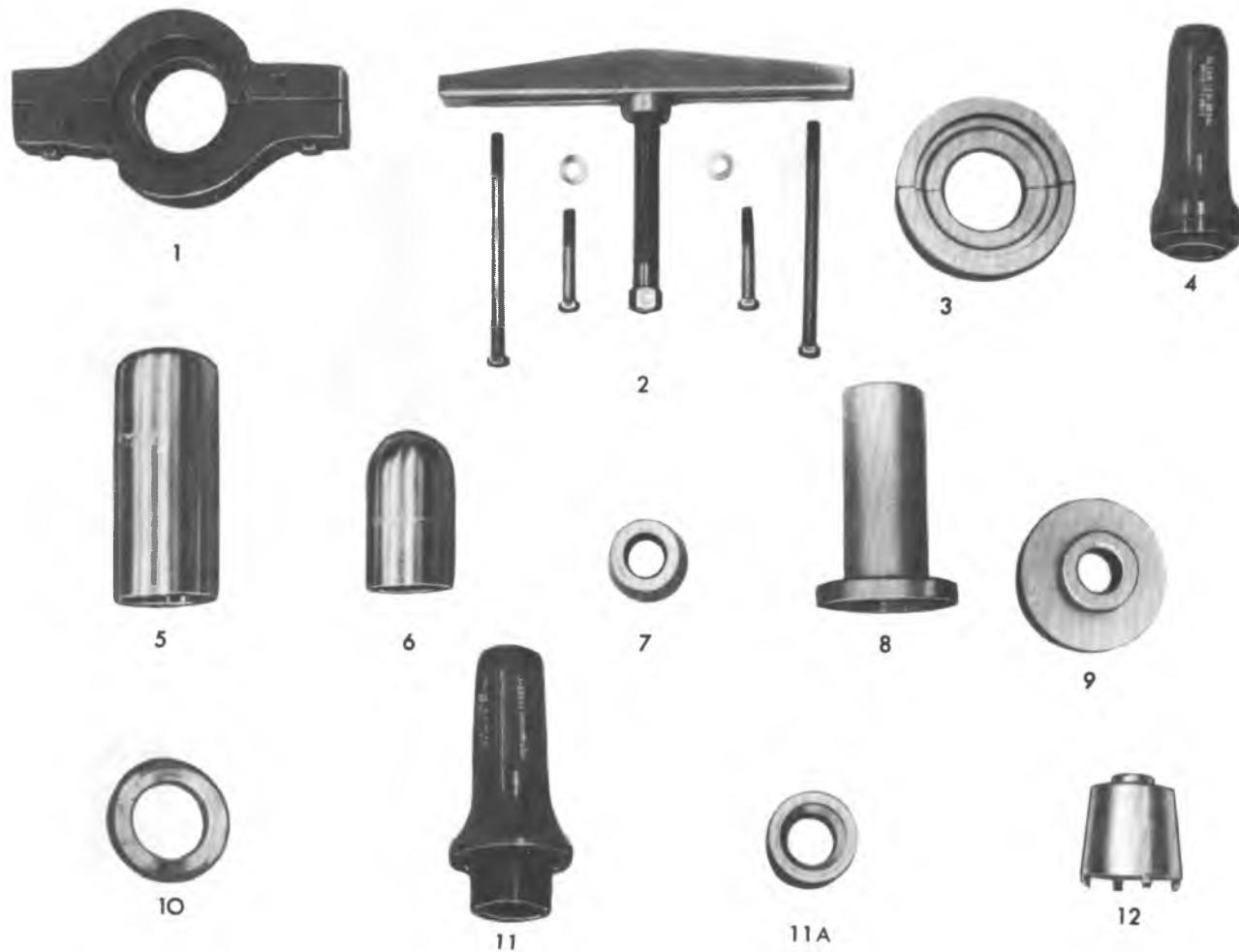
Clutch Gear Bearing Retainer to Case Bolts . . . . .	25 ft. lbs.
Cover to Case Bolts . . . . .	20 ft. lbs.
Extension and Retainer to Case Bolts—(Upper) . . . . .	20 ft. lbs.
—(Lower) . . . . .	30 ft. lbs.
Lubrication Filler Plug . . . . .	30 ft. lbs.
Shift Lever to Shifter Shaft Nut . . . . .	20 ft. lbs.
Mount-To-Transmission Bolts . . . . .	32 ft. lbs.

## SPECIAL TOOLS



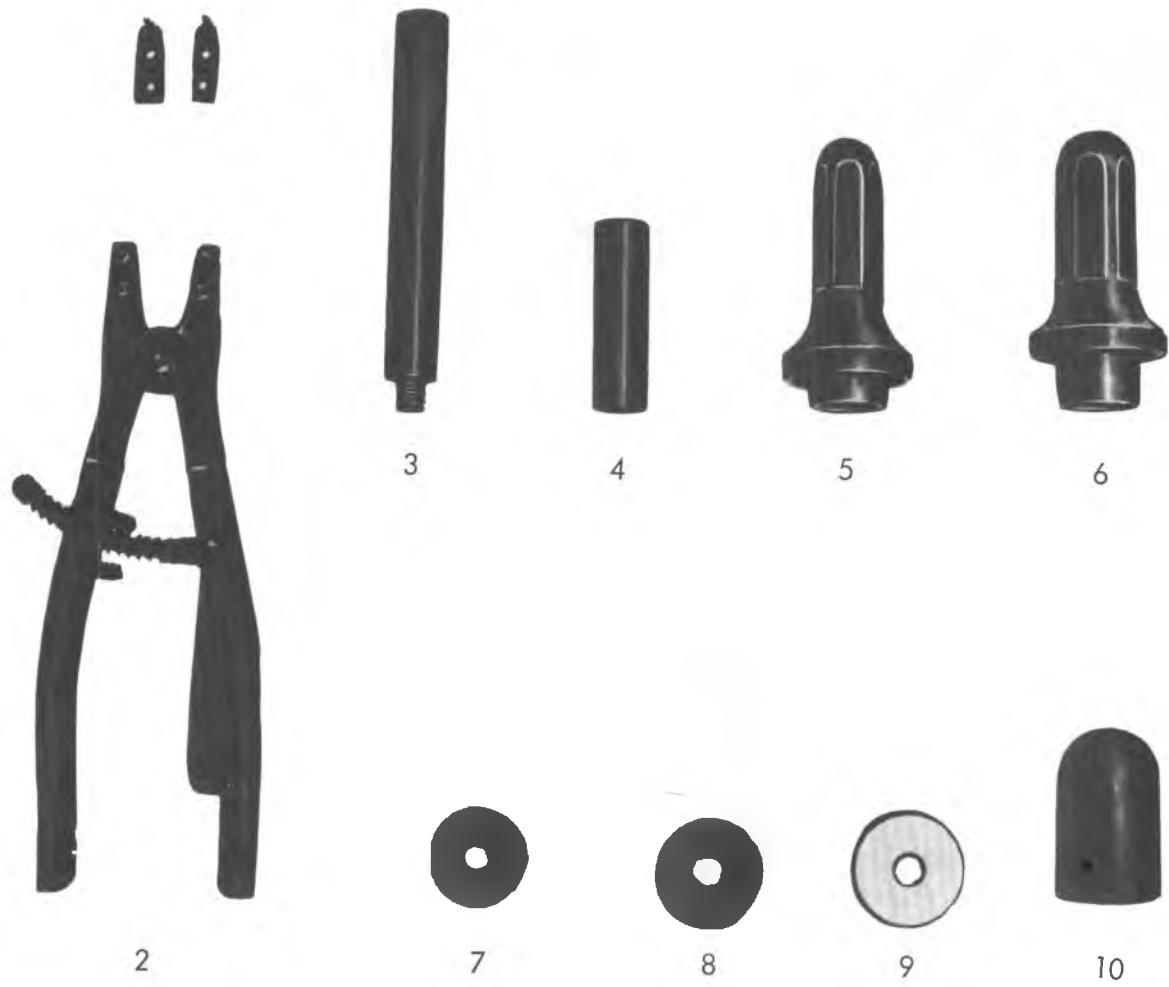
- |                    |   |              |   |
|--------------------|---|--------------|---|
| 1. J-1126          | Transmission Guide Pins                                 | 7. J-1453-01 | Speedometer Drive Gear Press Plates and<br>Press Plate Holder J-358-1 |
| 2. J-8059          | Retainer Snap Ring Pliers                               | 8. J-2228    | Rear Bearing Press Plates   |
| 3. J-22246/J-22379 | Countergear Loading Tool                                | 9. J-933     | Main Drive Gear Wrench  |
| 4. J-5778          | Extension Bushing Remover and Installer                 | 10. J-5590   | Clutch Gear Bearing Installer   |
| 5. J-5154          | Extension Seal Installer                                | 11. J-9772   | Clutch Gear Bearing Installer   |
| 6. J-5814-01       | Speedometer Drive Gear Remover<br>and Adapter J-5814-15 | 12. J-23096  | Clutch Gear Retainer Seal Installer                                   |
|                    |   | 13. J-5752   | Transmission Holding Fixture  |

Fig. 7B-1ST--Manual Transmission Special Tools (Except 4-Speed Muncie 117mm, CH465)



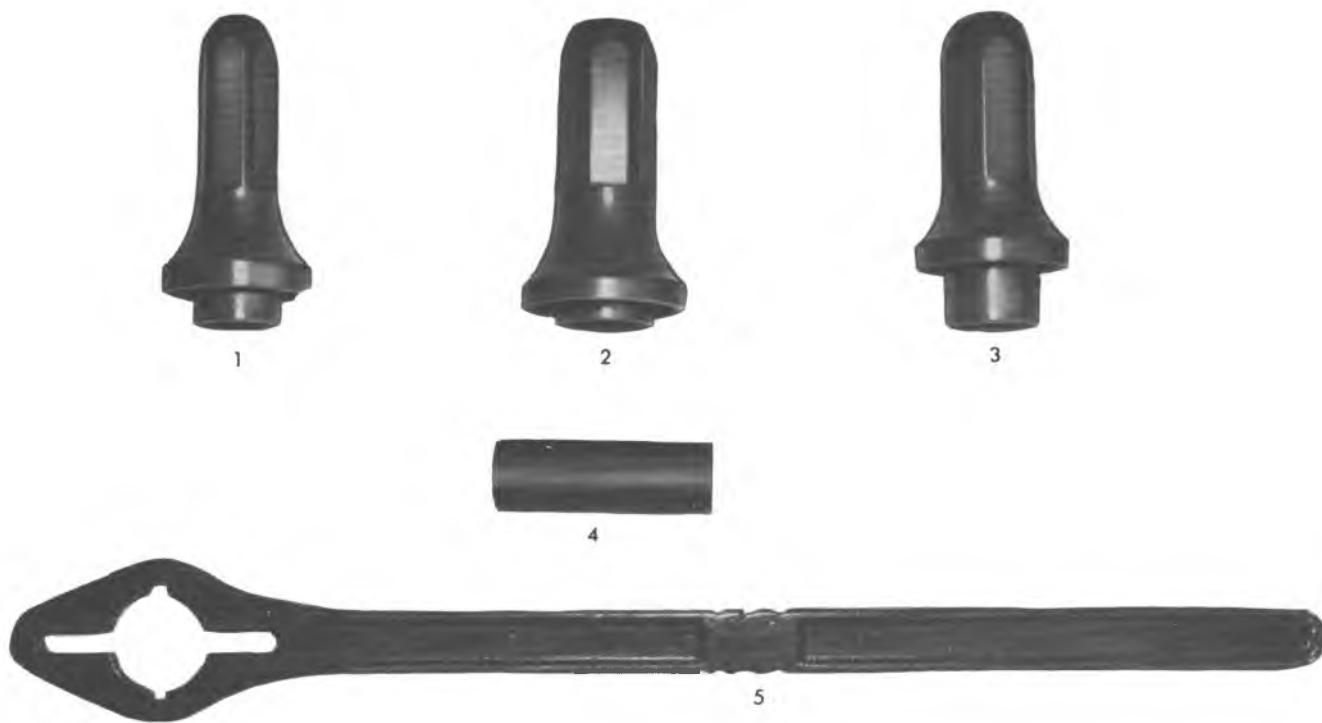
- |             |   |                |   |
|-------------|---|----------------|---|
| 1. J-22832  | Countergear Rear Bearing Remover          | 8. J-22874-1   | Bearing Installer                         |
| 2. J-8433-1 | Bearing Puller                            | 9. J-22874-5   | Mainshaft Support Tool                    |
| 3. J-22872  | Clutch Gear Bearing Remover and Installer | 10. J-22874-2  | Countershaft Support Tool                 |
| 4. J-22833  | Front Bearing Retainer Seal Installer     | 11. J-22834-2  | Rear Bearing Retainer Seal Installer      |
| 5. J-22873  | 2nd Speed Bushing Installer               | 11a. J-22834-1 | Adapter                                   |
| 6. J-22875  | 3rd Speed Bushing Installer               | 12. J-23070    | Mainshaft Rear Bearing Lock Nut Installer |
| 7. J-22830  | Snap Ring Installer                       |                |   |

Fig. 7B-2ST--4-Speed Muncie Transmission Model CH 465 Special Tools



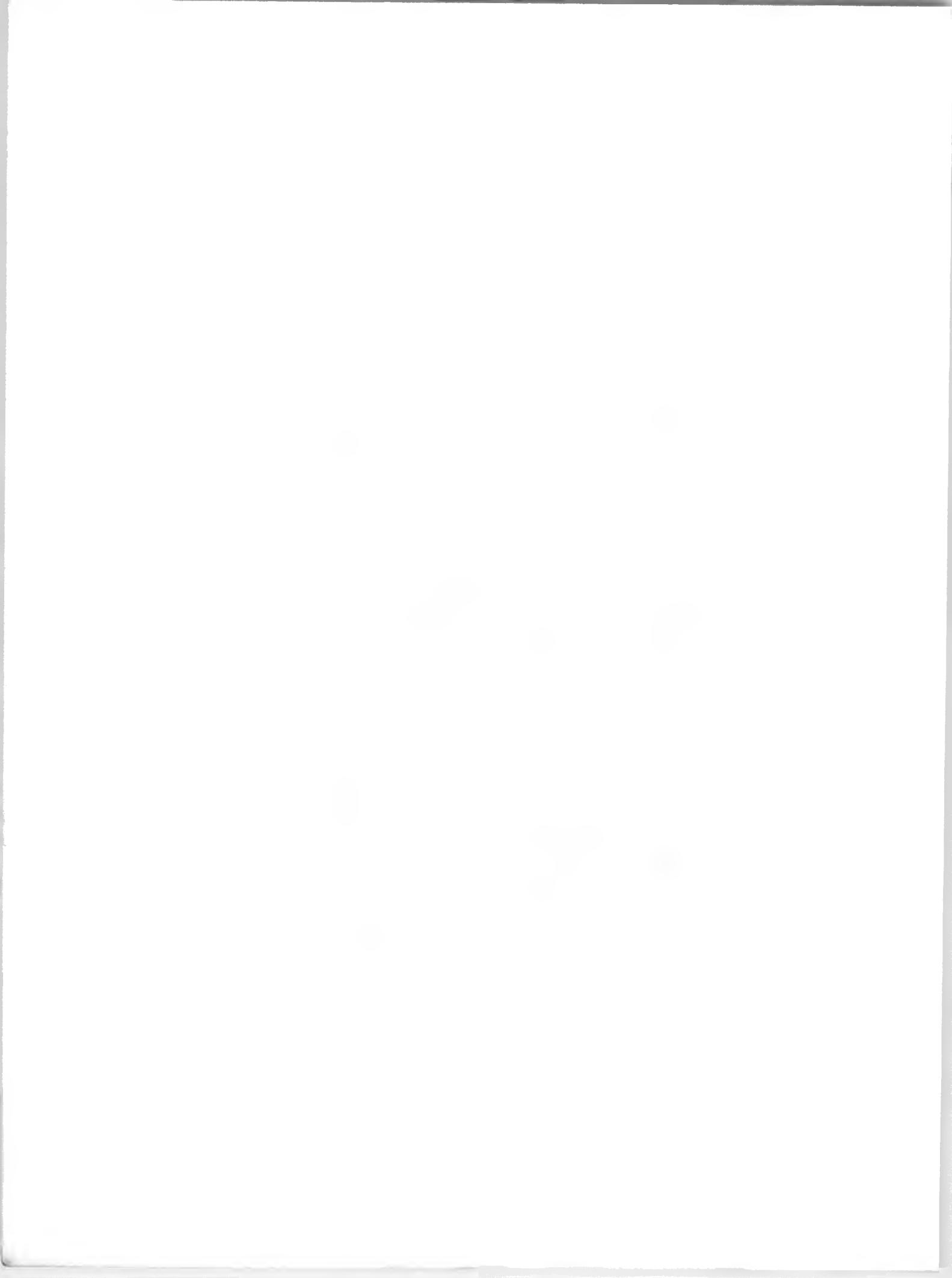
1. J-23432-1 Snap Ring Picks.
2. J-23432 Snap Ring Pliers.
3. J-8092 Handle.
4. J-23429 Intermediate Shaft Remover and Installer.
5. J-22836 Front Output Shaft Bearing Retainer Seal Installer.
6. J-21359 Rear Output Shaft Bearing Retainer Seal Installer.
7. J-23431 Rear Output Shaft Housing Bearing Remover and Installer.
8. J-7137 Adapter Seal Installer.
9. J-9276 2 Intermediate Gear Bearing Cup Installer.
10. J-22875 Rear Output Shaft Rear Bearing Installer.

Fig. 7B-3ST--New Process Model 205 (Part Time) Transfer Case Special Tools



1. J-22836 — Front Output Shaft Bearing Retainer Seal Installer
2. J-22388 — Rear Output Shaft Seal Installer
3. J-21359 — Input gear Bearing Retainer Seal Installer
4. J-24745 — Cluster Gear Loading Tool
5. J-8614-1 — Companion Flange Remover

Fig. 7B-4ST—New Process Model 203 (Full Time) Transfer Case Special Tools



## SECTION 7C

# CLUTCHES

### CONTENTS

Single Plate Diaphragm Spring Clutch .....	7C-1
Single Plate Coil Spring Clutch .....	7C-4
Special Tools.....	7C-7

## SINGLE PLATE DIAPHRAGM CLUTCH

### INDEX

Disassembly .....	7C-1
Inspection.....	7C-1
Assembly.....	7C-2
Pilot Bearing Replacement.....	7C-3

#### **DISASSEMBLY (FIG. 7C-3A)**

**NOTE:** When disassembling, mark edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

1. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.
2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

#### **INSPECTION**

1. Check drive straps for looseness at the clutch cover and evidence of looseness at pressure plate bolt holes.
2. Wash all parts, except driven disk and throwout bearing, in cleaning solvent.

**NOTE:** The throwout bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this will dissolve the lubricant.

3. Inspect pressure plate and flywheel for scores on the contact surfaces. Use a straight-edge and check for flatness of contact surfaces.

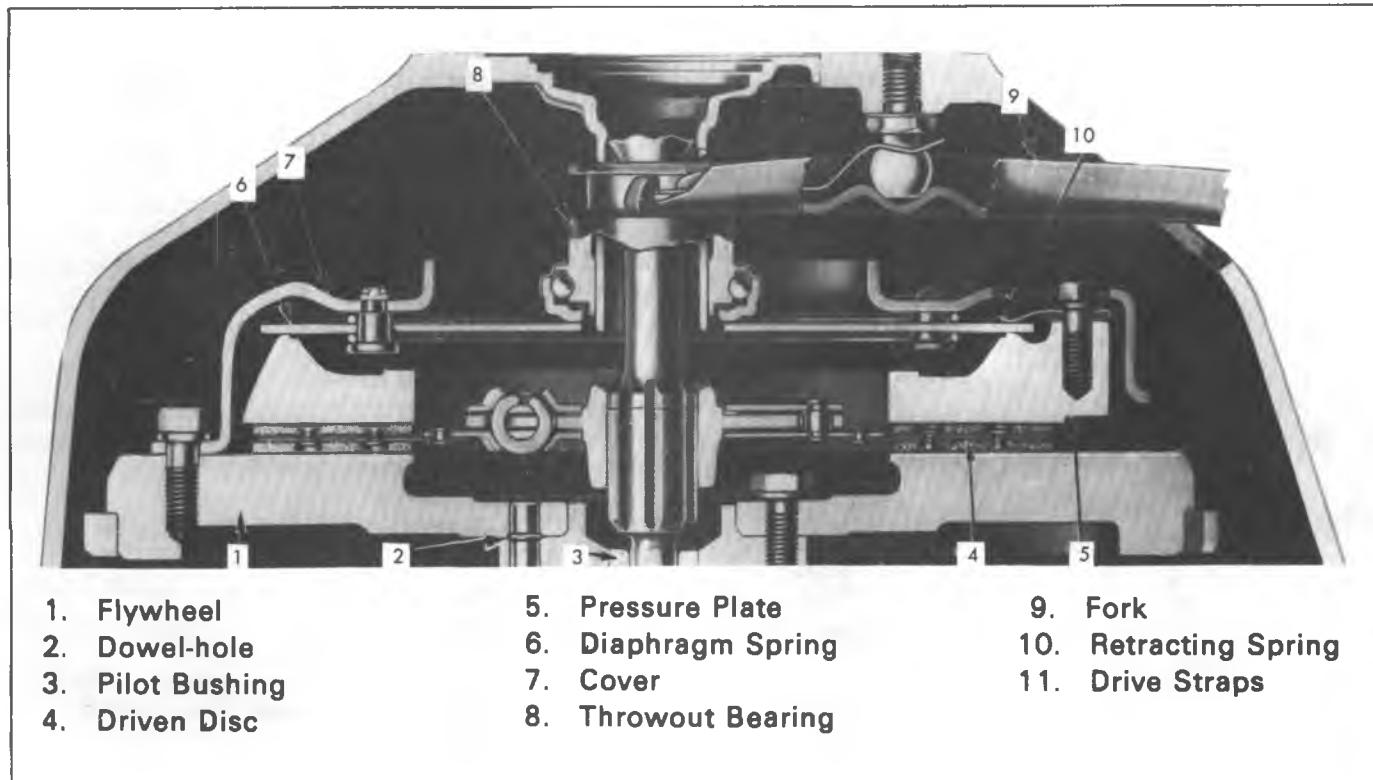
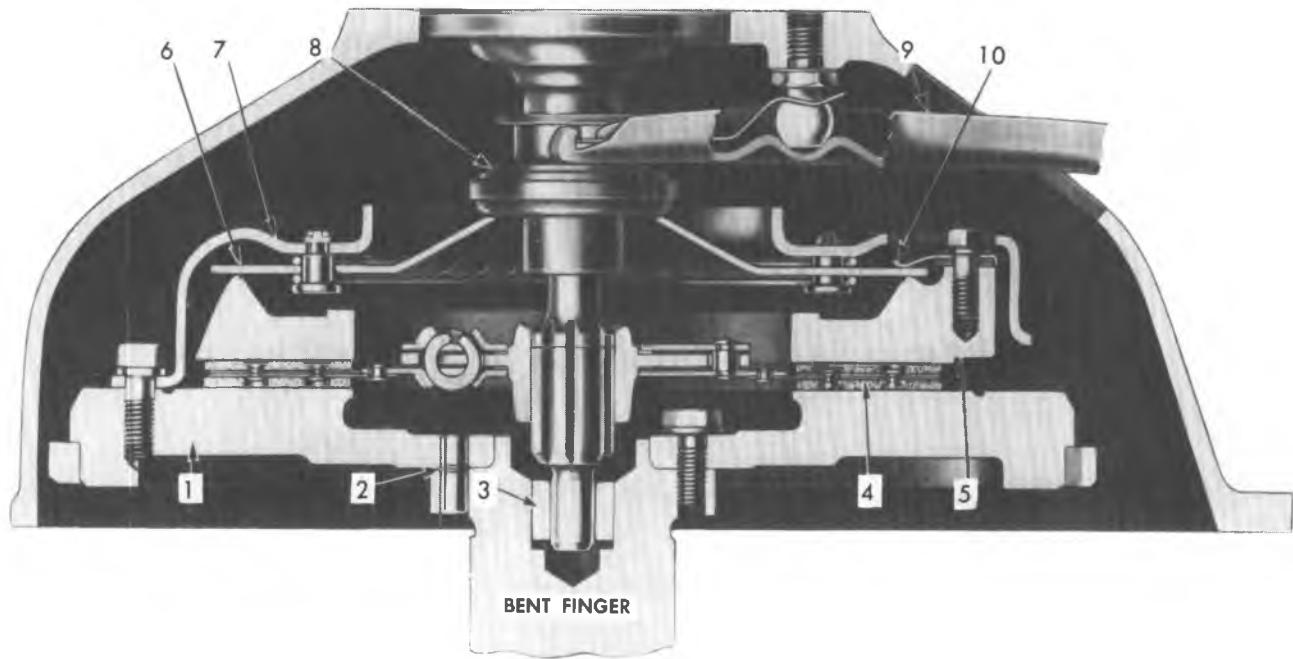


Fig. 7C-1A--Flat Finger Clutch Cross-Section (Typical)



- 1. Flywheel
- 2. Dowel-hole
- 3. Pilot Bushing
- 4. Driven Disc

- 5. Pressure Plate
- 6. Diaphragm Spring
- 7. Cover

- 8. Throwout Bearing
- 9. Fork
- 10. Retracting Spring

Fig. 7C-2A-Bent Finger Clutch Cross-Section (Typical)

4. Check throwout bearing for roughness and free fit on the sleeve of the transmission clutch gear bearing retainer. Replace retainer if rough.

5. Inspect clutch disc for worn, loose or oil soaked facings, broken springs, loose rivets, etc. Replace if necessary.

6. Examine splines in hub and make sure they slide freely on splines of transmission clutch shaft. If splines are worn, the clutch disc or clutch gear should be replaced as necessary.

7. Inspect clutch fork ball socket and fingers for wear and ball retaining spring for damage. Spring should hold fork tightly to ball stud.

**NOTE:** Ball spring on fork may be bent in toward fork if necessary.

8. Inspect ball stud for wear. Replace if scored.

9. Check run out of transmission pilot hole in clutch housing by removing a flywheel bolt and installing a dial indicator. The run out should be within .000-.015".

10. Lubricate ball stud before reassembly.

#### ASSEMBLY

1. Install the pressure plate in the cover assembly, lining up the punch marks on the edge of the pressure plate with the punch marks on the edge of the cover.

2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers and tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

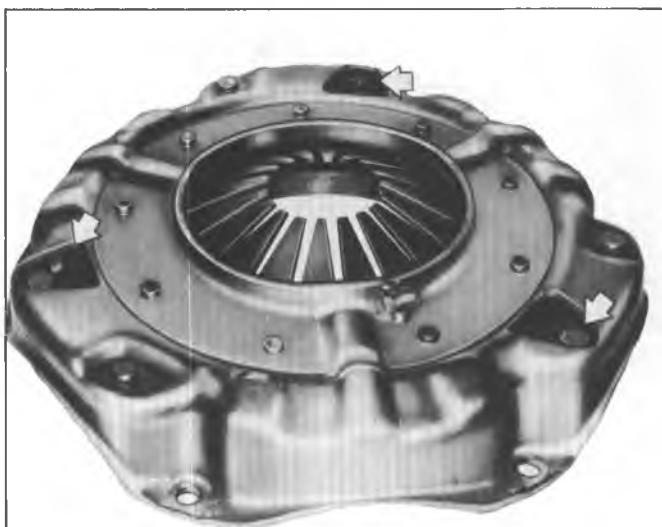


Fig. 7C-3A--Retracting Spring Location (Typical)

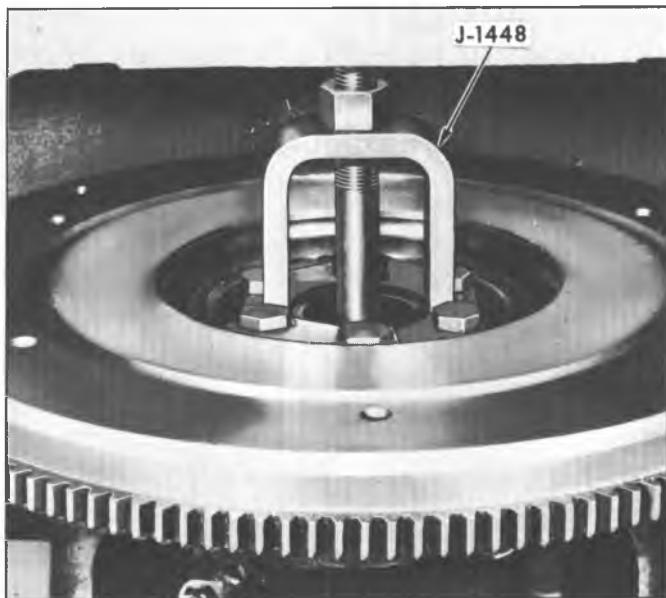


Fig. 7C-4A-Clutch Pilot Bearing Removal (Typical)

#### PILOT BEARING REPLACEMENT

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J-1448 and remove bearing from crankshaft, as shown in (Fig. 7C-4A). In replacing this bearing, use Tool J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.

# SINGLE PLATE COIL SPRING CLUTCH INDEX

Disassembly .....	7C4
Inspection.....	7C4
Assembly.....	7C5
Adjusting Levers.....	7C6

## DISASSEMBLY

1. Place the cover assembly on the bed of an arbor or drill press with a block under the pressure plate so arranged that the cover is left free to move down.

2. Place a block or bar across the top of the cover with the spindle. Hold compressed while the adjusting nuts are removed, as shown in Fig. 7C-2E. Then slowly release pressure to prevent springs flying out.

3. Lift off cover and all parts will be available for inspection. Note carefully the location of all parts including arrangement of springs. See Fig. 7C-3E.

4. To remove levers grasp lever and eyebolt between thumb and fingers as shown in Figure 7C-4E, so that inner end of lever and upper end of eyebolt are close together, keeping eyebolt pin seated in its socket in lever.



Fig. 7C-2E--Compressing Clutch

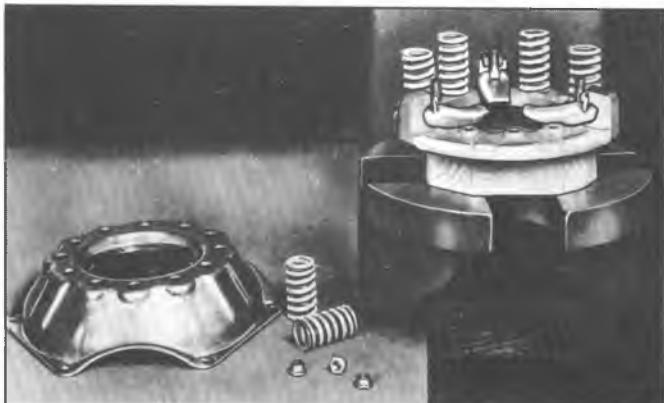


Fig. 7C-3E--Disassembly of Clutch

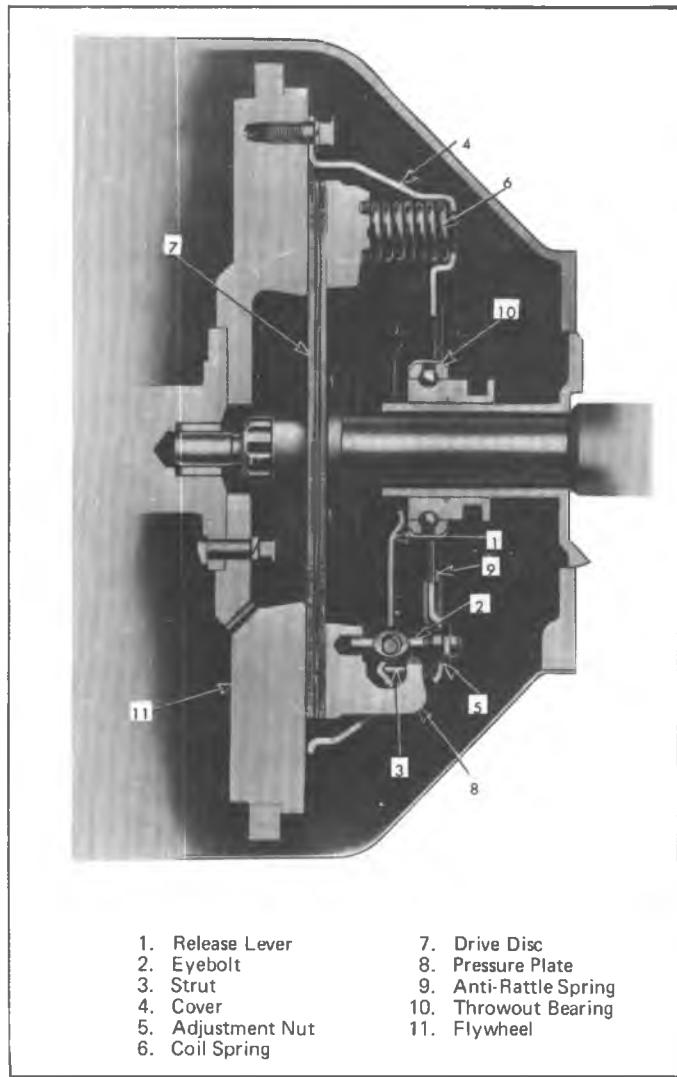


Fig. 7C-1E--Coil Spring Clutch Cross-Section (Single Plate)

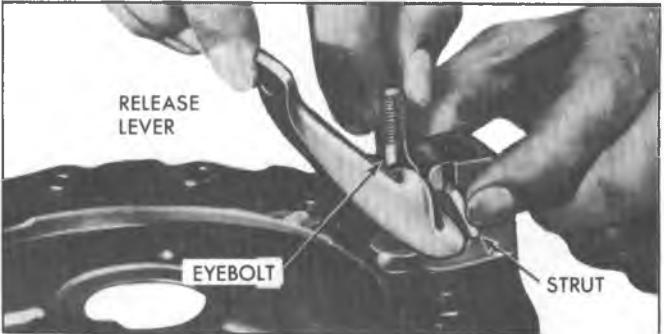


Fig. 7C-4E--Grasping Lever and Strut

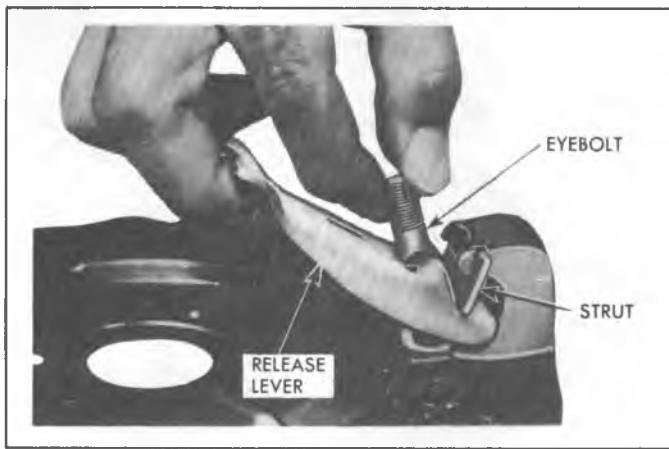


Fig. 7C-5E--Removing or Installing Lever

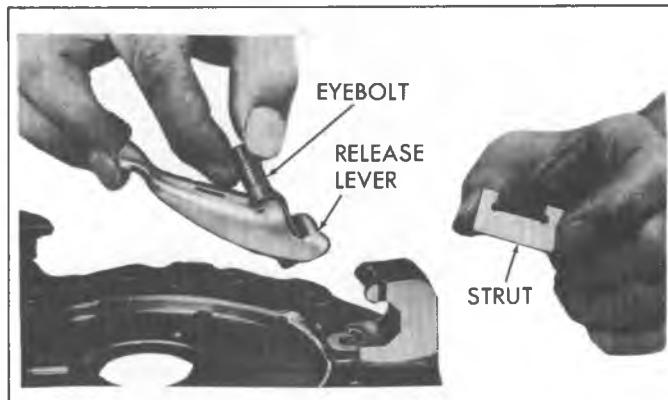


Fig. 7C-7E--Installing Lever

5. Lift strut over ridge on end of lever, as in Fig. 7C-5E.
6. Lift lever and eyebolt off pressure plate.

**NOTE:** It is important to replace all parts which show wear.

## INSPECTION

In addition to applicable items listed under Diaphragm Clutch Inspection, check the following items.

1. Check driving lugs for wear.
2. Check clutch cover for distortion or cracks.
3. Check release levers for wear or cracks.

## ASSEMBLY

1. Lay the pressure plate on the block in the press and coat the lugs with a thin film of approved lubricant such as lubriplate. See Fig. 7C-6E.

2. Assemble lever, eyebolt and pin, holding eyebolt and lever as close together as possible and with the other hand grasp strut as shown in Fig. 7C-7E.

3. Insert strut in the slots in the pressure plate lug, drop slightly and tilt the lower edge until it touches vertical milled surface of lug.

4. Insert lower end of eyebolt in hole in pressure plate. The short end of the lever will then be under the hook of the pressure plate and near the strut, as in Fig. 7C-5E.

5. Slide the strut upward in the slots of the lug, lifting it over the ridge on the short end of the lever and drop it into the groove in the lever, as shown in Fig. 7C-4E.

6. Assemble the pressure springs, on the small bosses of the pressure plate in accordance with Fig. 7C-8E in order to retain original balance.



Fig. 7C-6E--Greasing Lug

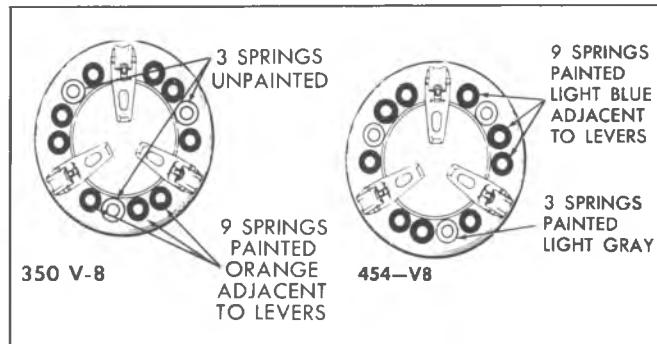


Fig. 7C-8E--Spring Arrangement Diagram

**NOTE:** If there are spaces for more springs than specified for the particular assembly, or if two different colors of springs are used, Fig. 7C-8E shows the proper sequence. It is very important that each group be arranged in like sequence.

7. Assemble anti-rattle springs in cover. See Fig. 7C-9E. The spring to the left is in operating position.

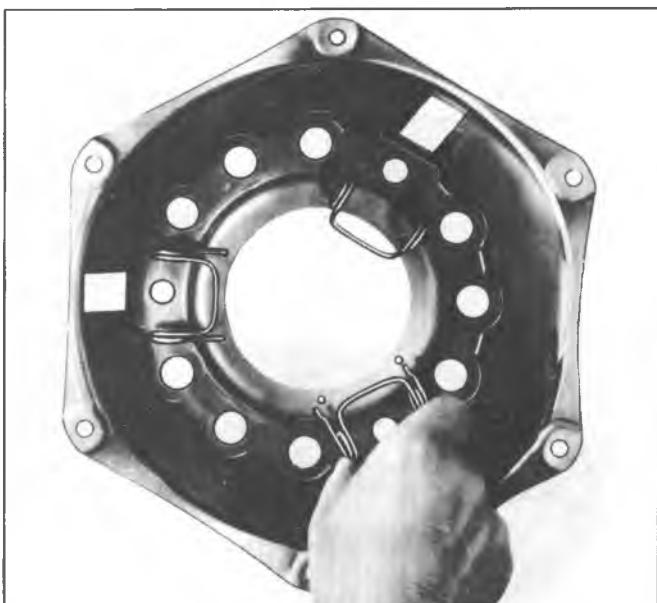


Fig. 7C-9E--Installing Anti-Rattle Spring



Fig. 7C-10E--Assembling Cover and Pressure Plate

8. Lower the cover on top of the assembled parts, as in Fig. 7C-10E. Be sure that the anti-rattle springs are in correct position and also that the punch marks made before dismantling are matched to insure retaining the original balance.

9. Place a bar across the cover and slowly compress, guiding the holes in the cover over the pressure plate lugs and all springs into their spring seats in the cover.

10. Assemble adjusting nuts on the eyebolts and screw them down until their tops are flush with the tops of the eyebolts. Slowly release pressure of spindle and remove cover assembly from press.

#### ADJUSTING LEVERS

While no wear adjustment is needed because of the coil spring design, it is imperative that the clutch release levers are each set to exactly the same height at the time of rebuild to insure uniform clutch application. To obtain exactly the same adjustment at each release lever, use gauge plate J-1048 and release lever height gauge J-6456 as follows:

1. Place gauge plate J-1048 on the flywheel in position normally occupied by driven plate. See Fig. 7C-11E.

**NOTE:** It is recommended that a spare flywheel be obtained so that this operation may be performed at the bench.

2. Bolt cover on flywheel with gauge plate center.



Fig. 7C-11E--Gauge Plate Position



Fig. 7C-12E--Depressing Lever

**NOTE:** On assemblies with three levers, the three flat machined lands of the gauge plate must be located directly under the levers.

3. Depress each lever several times with a hammer handle to settle all parts into working position, as shown in Fig. 7C-12E.

4. Position height gauge J-6456-01 on the hub of the gauge plate and the bearing surface of one lever. Refer to Fig. 7C-13E. Turn adjusting nut until lever is flush with the 12" step of J-6456-01. Adjust remaining levers in same manner.

5. Stake adjusting nut, as shown in Fig. 7C-14E, to eyebolt with a dull punch to lock adjustment.

6. Loosen the cover to flywheel bolts a turn or two at a time and in rotation until spring pressure is relieved to allow clutch and gauge plate to be removed.

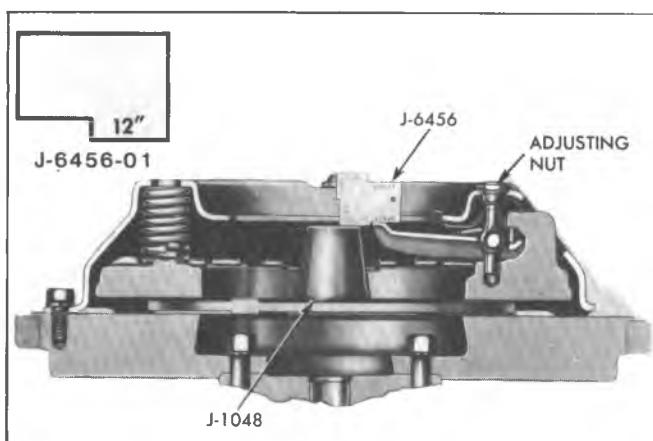
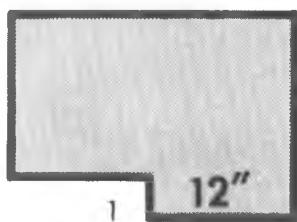


Fig. 7C-13E--Coil Spring Clutch Adjustment



Fig. 7C-14E--Staking Nut

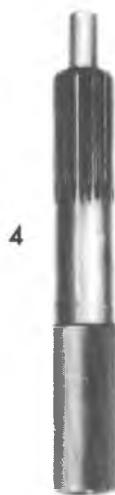
## SPECIAL TOOLS



1



3



4



2

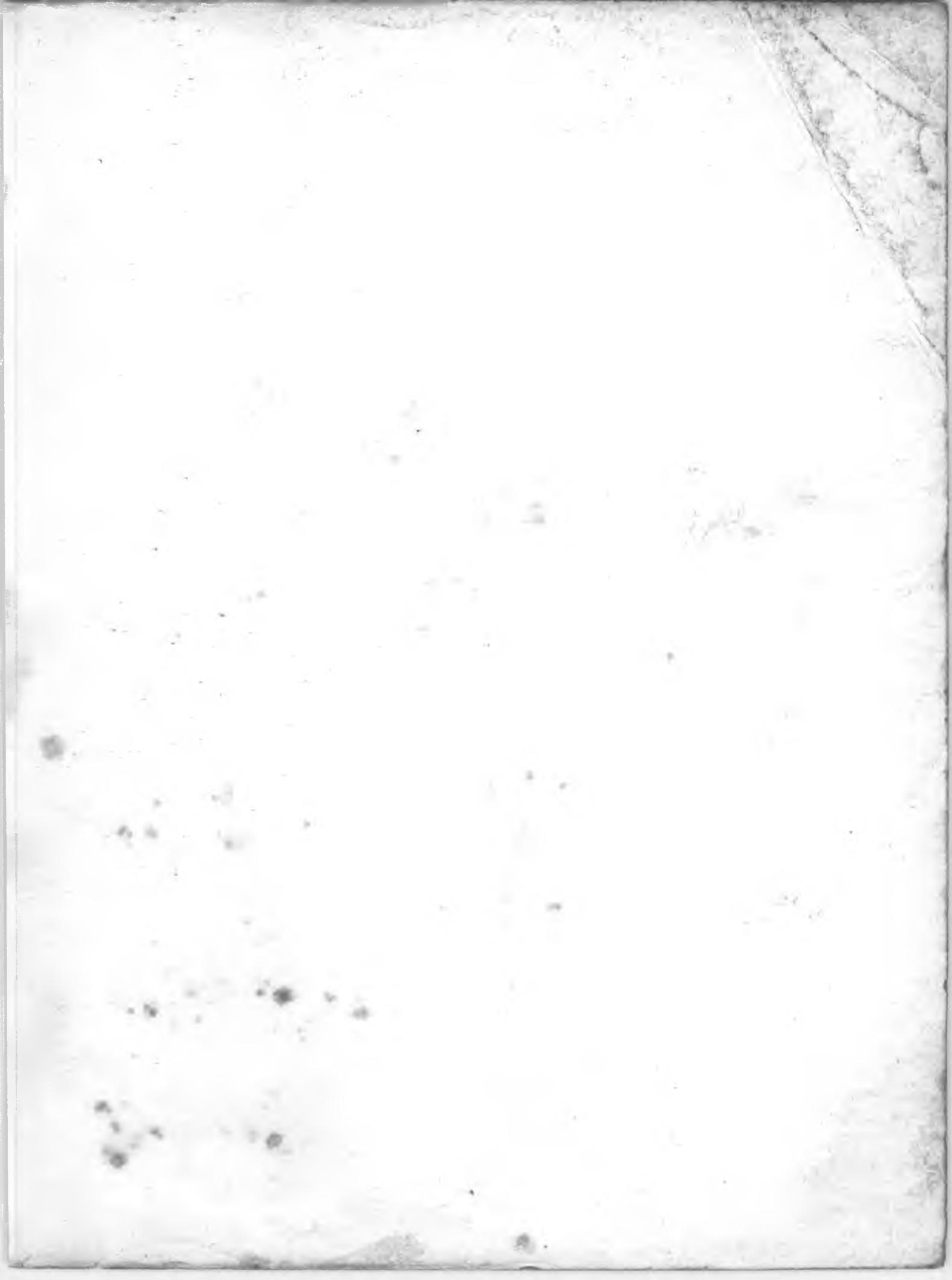


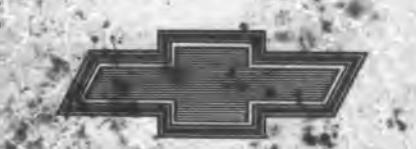
5

1. J-6456-01 Height Gauge
2. J-1048 Gauge Plate
3. J-1522 Pilot Bearing Driver
4. J-23720 Clutch Pilot Tool
5. J-1448 Pilot Bearing Puller

Fig. 7C-1ST--Clutch Special Tools







**CHEVROLET**

**SERVICE**