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Figure 1—Steering Gear

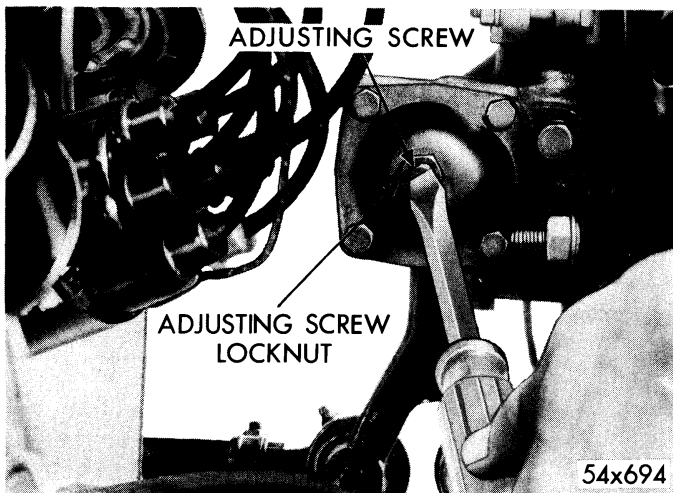


Figure 2—Roller Tooth and Worm Adjustment

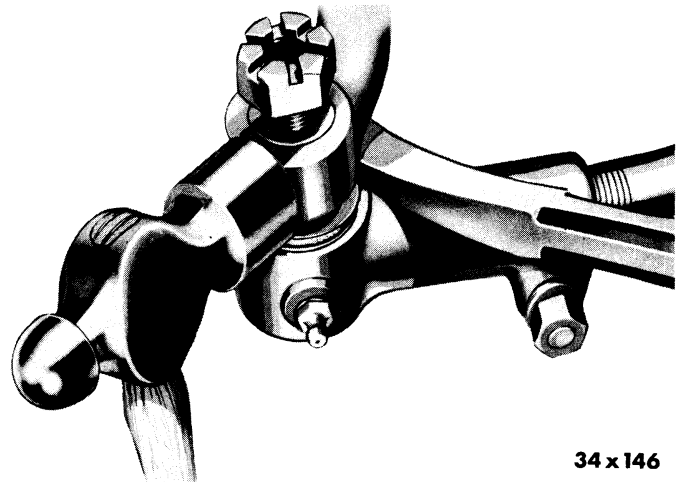


Figure 3—Removing Tie Rod End from Steering Knuckle Arm

PART ONE—CHASSIS

SECTION VII—STEERING

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1. GENERAL INFORMATION

The type of steering linkage used on Plymouth cars is known as Symmetrical Idler Arm Steering. It consists of the pitman arm, drag link, idler lever, idler lever support bracket, tie rods (right and left) and the steering knuckle arms.

In using this type of linkage, the steering gear arm link assembly (drag link) is supported at one end by the steering gear pitman arm and at the opposite end by the idler arm. The idler arm is mounted in a bushing and pivots on the idler lever support bracket which is welded to the right hand frame side rail. The steering tie rod assemblies are of equal length and are attached to the drag link with ball sockets. The outer ends of the tie rods are threaded for adjustment.

STEERING GEAR—(THREE TOOTH ROLLER AND WORM)

The steering gear used is of the worm and roller type. The steering worm is integral with the steering tube and is supported at each end by tapered roller bearings. The three tooth roller is attached to the sector shaft by means of a steel shaft and supported by two sets of ball bearings. The worm is adjusted for end play by means of shims inserted between the housing and housing cover.

The sector shaft rotates in two bronze bushings pressed into the steering gear housing. The three tooth roller on the sector shaft is meshed with the worm, and when the steering wheel is turned, the worm rotates the sector shaft and roller, moving the pitman arm which is splined to the end of the sector shaft.

Backlash between the sector shaft roller tooth and the worm is controlled by an adjusting screw that is

threaded through the shaft and roller cover. The base end of the adjusting screw is engaged in a slot in the end of the sector shaft. Correct backlash can be obtained by turning adjusting screw in or out as required.

The steering wheel and pitman arm are splined to the steering tube and sector shaft respectively. Both the steering wheel and the pitman arm have a master serration to insure correct installation.

The high point is the point of least clearance between the worm and roller and is at the midpoint of the worm and roller travel.

An oil seal is installed in the bore of the steering gear housing at the outer end of the sector shaft to prevent oil leakage and to protect the steering unit against foreign matter.

2. STEERING WHEEL

REMOVAL

Disconnect battery. Center the steering wheel in the straight ahead position then remove the two screws on the underside of the medallion and remove medallion. Disconnect horn wire from terminal on travelplate and insulator. Remove horn ring, travel plate and insulator assembly, contact spring plate and ground plate. Push horn wire aside to make room for steering wheel puller pivot.

Remove steering wheel nut. Then, attach puller Tool C-612 and remove steering wheel. When installing the steering wheel, be sure that the master serrations are in alignment and the directional signal cancelling cam on the bottom of the wheel is inserted between the switch levers (if so equipped).

**MANUAL STEERING
DATA AND SPECIFICATIONS**

Models	P-30, LP-1	P-31, LP-2
Type	Worm and 3 tooth roller	
Ratio	18.2 to 1	
Worm Thrust Bearings	Tapered roller (shim adjusted)	
Cross Shaft Bushing	Bronze	
Steering Wheel Diameter	17 inch	
Backlash at Center Position of Cross Shaft	Zero	
End Play of Tube and Worm	None	
Steering Linkage Type	Idler Arm	

TORQUE SPECIFICATIONS

Cross Shaft Nut (Pitman Arm)	120 ft. lbs.
Gear Housing to Frame	50 ft. lbs.
Steering Wheel Nut	40 ft. lbs.

3. STEERING GEAR

REMOVAL

To remove steering gear jack up the car and remove left front wheel. Remove front seat cushion and floor mat after sliding draft pad up the column then remove steering column opening cover.

Disconnect the directional signal control wires (if so equipped). Attach a length of wire to the loose ends of control wires before withdrawing through the jacket tube. This will enable all wires to be drawn back through the tube at reassembly. Be sure to disconnect battery before tying wires together.

Remove the transmission shifting mechanism at the steering column (if so equipped). Remove the bolts which hold the steering gear housing to the frame. Then, disconnect the steering gear pitman arm with Tool C-3402.

Remove steering gear post bracket cap at the instrument panel then remove the steering gear assembly by withdrawing it up through opening in floor pan and out of car.

DISASSEMBLY

Drain the lubricant from the housing then fasten the steering gear in a bench vise holding it at the frame bracket flange, with the steering column jacket horizontal. Loosen the column jacket clamp and pull the jacket off the steering gear housing.

Remove the roller tooth shaft adjusting lock nut and

plate and the cover bolts then remove the sector shaft and shaft cover from the housing. Pull the sector shaft bearing oil seal out of the housing then remove the cover and grease tube assembly with shims, from the bottom end of the steering gear housing.

Pull the steering tube and worm assembly out of the bottom end of the housing. Remove the steering arm shaft bushings by means of a puller, if replacement is necessary.

ASSEMBLY

When assembling, thoroughly clean the inside of the steering gear housing as well as the steering gear worm, steering arm shaft and bearings. Do not coat any parts with lubricant until adjustments and assembly have been completed.

If bushings have been removed, press new bushings into place. Install the steering arm shaft oil seal. Refer to Figure 1, then reassemble unit by repeating steps (in reverse order) that were used at disassembly.

Adjust pre-load of worm bearings and make necessary adjustments to roller tooth and worm as described in Gear Adjustments. Check to see if adjustment has been made correctly. This may be done with use of scale to find pound pull necessary to turn steering wheel. When properly adjusted the specified scale reading should be from $\frac{7}{8}$ to $1\frac{5}{8}$ pounds pull.

Install lubricant in steering gear housing. When installing the steering jacket tube, care should be taken to see that the slot at the bottom of the tube is in align-

ment with the small raised point of the steering gear housing.

GEAR ALIGNMENT

Before an adjustment of the steering gear is attempted, be sure the body to frame bolts are tight and the spacers in place. With the body bolts tight, loosen the gear housing mounting bolts to allow the steering gear to move in relation to the frame. Tighten the mounting bolts to a torque of 45 to 50 foot-pounds. Next loosen the steering column bolts that hold column to instrument panel, to determine if the column shifts its position in relation to the support. (Should the column be binding up against the upper bracket, the compression of the column bracket rubber would indicate too much bind.) If necessary, shim the gear housing so that the column will be in a free position, then tighten bolts.

GEAR ADJUSTMENTS

Adjustments are provided for end play of the worm shaft bearings, end play of the steering arm shaft and mesh of the roller tooth with the steering worm. Adjustments may be made while the steering gear is assembled in the car, or during the process of assembling after having been disassembled for complete overhauling.

ADJUSTING WORM BEARINGS—To adjust worm bearings when the gear is assembled in the car rotate the steering wheel to the extreme right or left and then turn back $\frac{1}{4}$ turn.

Press a finger at the joint between the bottom of the steering wheel hub and shell. Have a helper shake the front wheels hard sidewise but not enough to turn the steering wheel. Any end play in the worm bearings can then be felt at the steering wheel hub. If any excessive end play exists, disconnect the horn wire at the connector between the steering gear and the horn.

Remove the bolts which hold the grease retainer cover and tube at the bottom of the steering gear body. Remove shims, between this cover and the steering gear body, of sufficient thickness to eliminate the end play in worm but not enough to cause binding when the cover is bolted tightly in place. Shims at this point are available in the following thicknesses: .003, .006, .011 and .025 inch.

Turn steering wheel from extreme right to left. If any stiffness exists, too many shims have been removed or the steering gear assembly is misaligned on the car. Check to see if adjustment has been made correctly. This may be done with use of scale to find pound pull necessary to turn steering wheel. When properly adjusted the specified scale reading should be from $\frac{1}{4}$ to $\frac{3}{8}$ pound pull.

ADJUSTMENT OF ROLLER TOOTH AND WORM—End play of steering arm shaft and mesh of the roller tooth with the steering worm may be adjusted either during assembly or in the car.

Using Puller Tool C-143, remove the steering gear pitman arm, (with the two tie rods assembled) from the steering arm shaft and install another arm. Turn the steering wheel to mid-position. This is obtained by turning the wheel to the extreme right or left—then turning it to the opposite extreme counting the number of turns required—then turn back $\frac{1}{2}$ the number of turns required for turning from one extreme to the other extreme.

With the steering wheel in mid-position move the steering gear arm back and forth to determine whether or not there is any backlash. There should be none but if there is more than $\frac{1}{32}$ inch free movement at the end of the steering gear arm, mesh of the roller tooth and worm should be adjusted.

Loosen the roller shaft adjustment screw lock nut. Tighten the roller tooth shaft adjustment screw (Figure 2) just enough to eliminate free play between the roller tooth shaft and worm but it must not bind. Tighten the roller tooth shaft adjustment screw lock nut. Check to see if adjustment has been made correctly. This may be done with the use of scale to find pound pull necessary to turn steering wheel. When properly adjusted the specified scale reading should be from $\frac{7}{8}$ to $1\frac{5}{8}$ pound pull. Reinstall the steering gear arm with tie rods.

4. STEERING LINKAGE

Remove cotterpin and loosen nut on upper end of tie rod ball. Insert a pry bar between tie rod and steering knuckle arm. Jar tie rod ball loose by driving on rear end of steering knuckle arm (Figure 3). Tie rod balls are not removable from tie rod ends. If replacement of either is necessary, the complete tie rod end and ball assembly should be replaced. To remove a tie rod end loosen clamping bolt nut on tie rod end then unscrew tie rod end assembly from tie rod.

When assembling tie rod ends to tie rod, be sure to thread ends evenly on tie rod to obtain proper positioning of the steering wheel with respect to the straight-ahead position of the front wheels. Care must be taken to make certain the clamping bolts are beneath the tie rods to prevent interference on turns.

BALL JOINTS

Should it become necessary to remove the ball joints for installation of new parts due to damage or wear refer to the Upper and Lower Ball Joint section of the Front Suspension System.

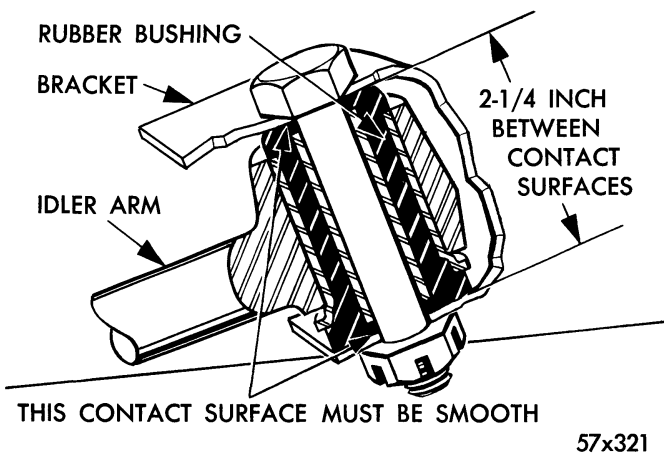


Figure 4—Idler Arm (Sectional View)

IDLER ARM

REMOVAL—To remove the idler arm, see Figure 4. Place the front wheels in the straight-ahead position. Remove the cotterpin and nut that holds the link and ball joint stud in the idler arm. Insert a pry bar between link and idler arm. Jar stud loose from arm by driving on end of arm. Separate link and arm.

Remove the cotterpin and nut that attaches the idler arm to the frame bracket. Remove mounting bolt, then slide idler arm out of bracket. If a new bushing is required, install a new idler arm and bushing assembly. The component parts are not serviced separately.

Before installing arm, be sure the bushing contact surface on the bracket is smooth. If burrs are present, especially around the mounting bolt hole (top and bottom), remove with a file. Measure the width of bracket. The distance between bushing contact surfaces should be $2\frac{1}{4}$ inches. If necessary, bend bracket to obtain this measurement.

INSTALLATION—When reinstalling idler arm, protect the ends of the bushing by two pieces of shim stock slightly larger than diameter of bushing. Sandwich the ends of bushing between protectors, then slide into position, and remove protectors. (This will protect bushing ends from damage from sharp edges of mounting bolt hole.)

Coat mounting bolt with lubriplate then slide through bracket and bushing. Install nut and tighten to 60 foot-pounds. Install cotterpin. (Again be sure wheels are in the straight-ahead position before tightening nut.) This will prevent over travel stress of the bushing which would cause premature bushing failure, and prevent lead to one side.

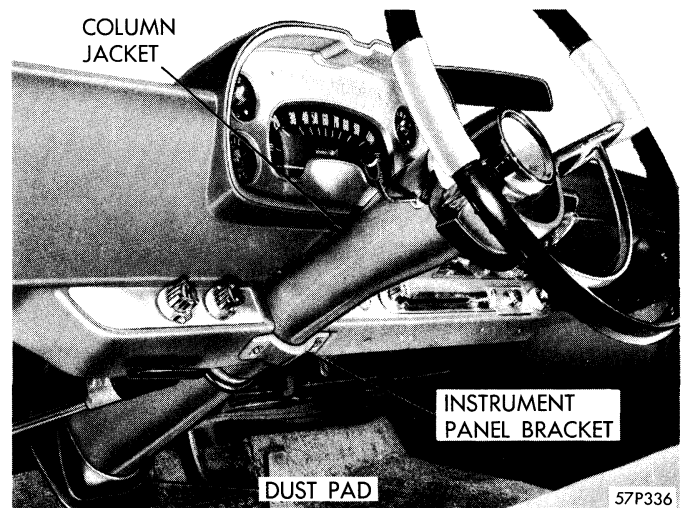


Figure 5—Steering Column Installed

5. COAXIAL POWER STEERING

OPERATING PRINCIPLES

All components of the power steering gear are fitted into an elongated, tubular-shaped housing and have been concentrically located about the axis of the steering column. The unit fastens to the steering column at the underside of the instrument panel and extends down through the dash panel and is bolted to the frame sidemember.

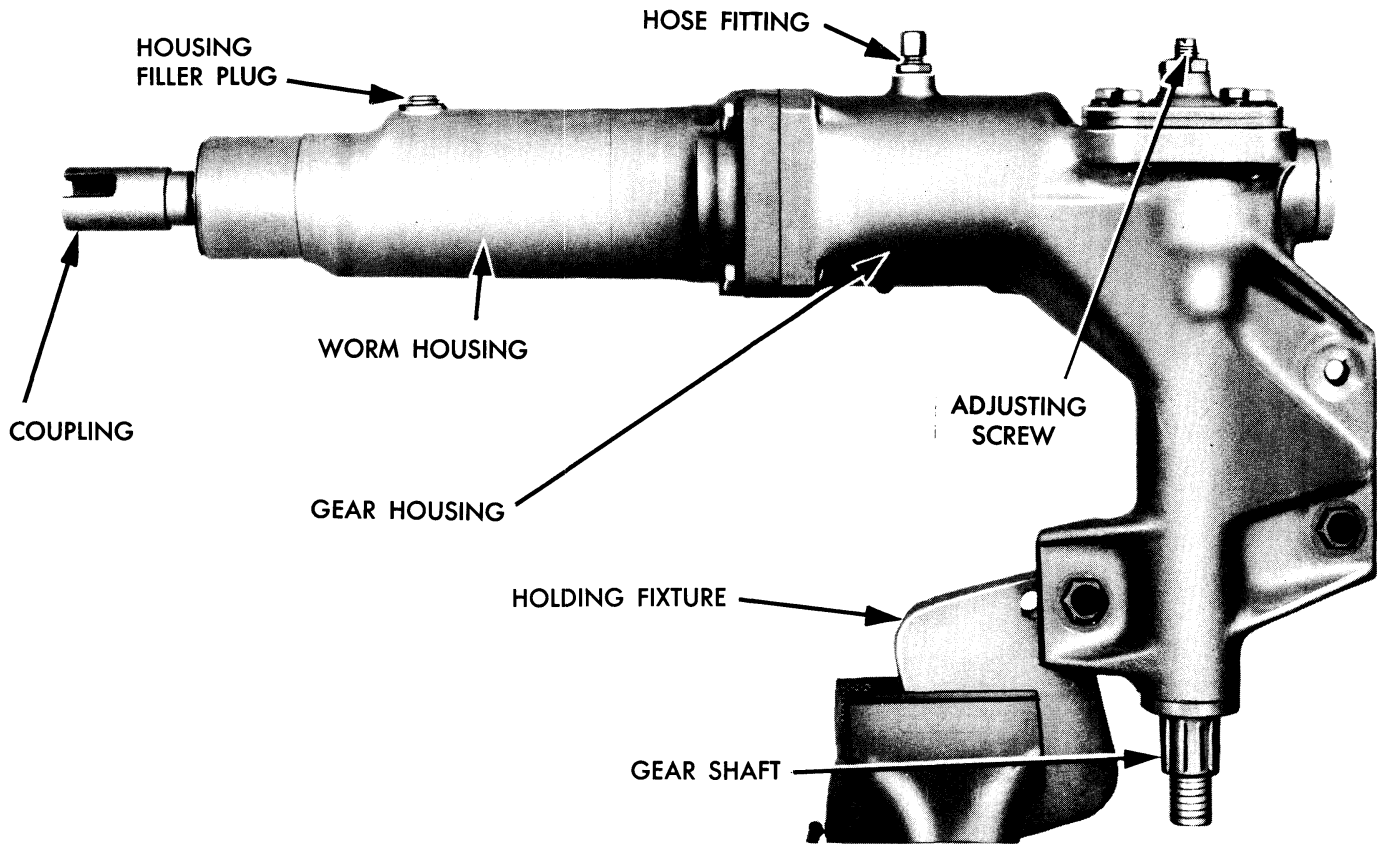
Whereas the mechanical steering system normally uses worm-and-roller action, the Coaxial power steering unit incorporates two basic gear mechanisms; a worm and worm connector and a rack and sector gear.

The worm and worm connector act in a manner similar to a bolt and nut assembly; rotation of the worm causes linear (axial) motion of the worm connector. Fastened to the worm connector, in succession, are an upper piston rod, a piston, and a lower piston rod, all concentric to the steering column axis. (This arrangement provides a means for adding power assistance to the system.)

A rack, machined in the lower portion of the lower piston rod, meshes with a sector gear. This combination produces rotation of the steering gear arm and thereby actuates the steering linkage.

The hydraulic system of the gear consists of double-acting piston, a valve (which fits inside the piston), and a hydraulic reaction chamber (which gives the driver the "feel" of the road).

Axial positioning of the valve directs high pressure oil to one side or the other of the double-acting piston. At the same time, valve movement opens an oil return line which carries oil from the lower pressure side of



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Figure 6—Steering Unit Mounted in Holding Fixture

the piston to the oil reservoir. The direction of oil flow (which depends upon the direction of steering wheel rotation), is such that hydraulic force is added to the driver's effort and is transmitted through the rack and sector gear to the steering gear arm.

Other components of the hydraulic system are, a belt-driven oil pump with a pressure relief valve and flow control valve, and a filter with the oil reservoir. The flow control valve limits the oil flow in a predetermined maximum (2 gallons per minute) and thus holds the horsepower required to drive the oil pump to a minimum.

6. SERVICING POWER UNIT

STEERING GEAR ASSEMBLY REMOVAL

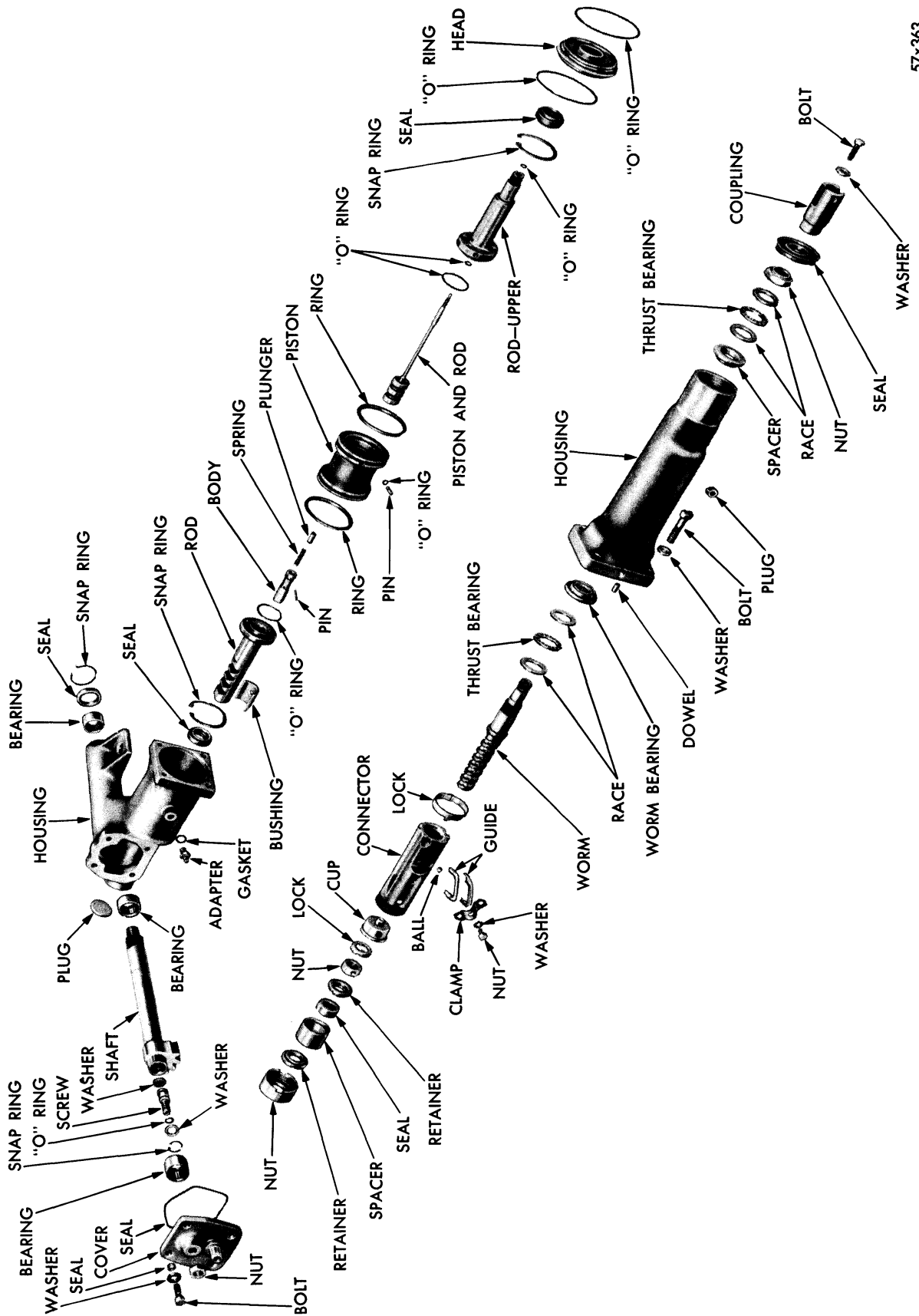
Remove two screws from horn ring ornament and remove ornament from steering wheel. Disconnect horn wire, remove three horn ring screws and remove horn ring. Remove front seat cushion.

Remove steering wheel nut and remove wheel with Tool C-612. Remove turn signal lever, steering column to instrument panel bracket and shroud, as shown in Figure 5.

Loosen steering column jacket clamp screw. Raise front of car. Remove cotter key and nut from the drag link to Pitman arm ball joint. Disengage drag link from Pitman arm, then remove Pitman arm to gear shaft retaining nut and pull Pitman arm with Tool C-3402.

Loosen three gear housing to frame attaching bolts and lower front of car to floor. Pull jacket from steering shaft then remove floor mat retaining plate, and remove rubber dust pad and access plate.

Place a large pan underneath unit, then disconnect pressure and return hoses and drain gear assembly by slowly rotating steering wheel until all oil is drained from unit. Fasten disconnected ends of hoses above oil level in reservoir to prevent further loss of oil and cap ends to prevent any foreign matter from entering.



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Figure 7—Coaxial Power Steering

Remove the steering gear attaching bolts, then lift the steering gear assembly up through the opening in the floor pan.

PRECAUTIONS DURING DISASSEMBLY AND ASSEMBLY

Cleanliness through the entire disassembly and assembly cannot be over-emphasized. Unit should be thoroughly cleaned in a suitable solvent when removed from vehicle. When disassembling, each part should be placed in the solvent, washed, then dried by compressed air. Careful handling of parts must be exercised to avoid the occurrence of nicks and burrs. Crocus cloth may be used to remove small nicks or burrs provided it is used carefully. When used on valve spool, use extreme care not to round off the sharp edge portion. The sharp edge portion is vitally important to this type of valve, it helps to prevent dirt and foreign matter from getting between the valve and bore.

REMOVAL OF WORM HOUSING

Drain the lower portion of the steering gear through the pressure and return connections, by turning the steering tube coupling from one extreme of travel to the other. Remove the worm housing filler plug, using a 3/16 inch allen wrench. Drain the upper housing.

Bolt the holding fixture C-3323 to the power steering unit, then mount the fixture in a vise, see Figure 6.

Remove the bolt and washer that attaches the coupling to the worm shaft. Slide Tool C-3392 down between the housing and the coupling, then rap sharply with a hammer, forcing the coupling off end of shaft, as shown in Figure 8.

Insert a screwdriver under the lip of the worm housing oil seal, then gently pry seal out away from housing and slide off end of worm shaft.

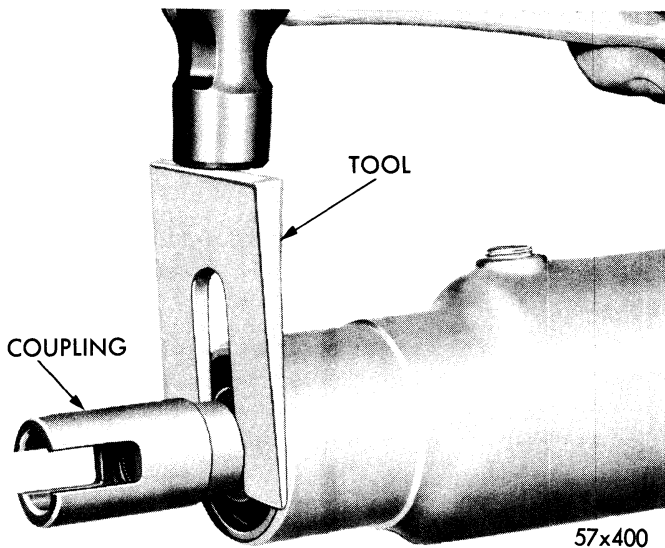


Figure 8—Removing Coupling

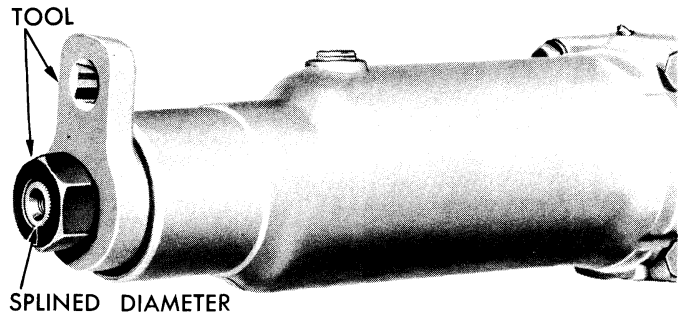


Figure 9—Tools for Removing or Installing Adjusting Nut

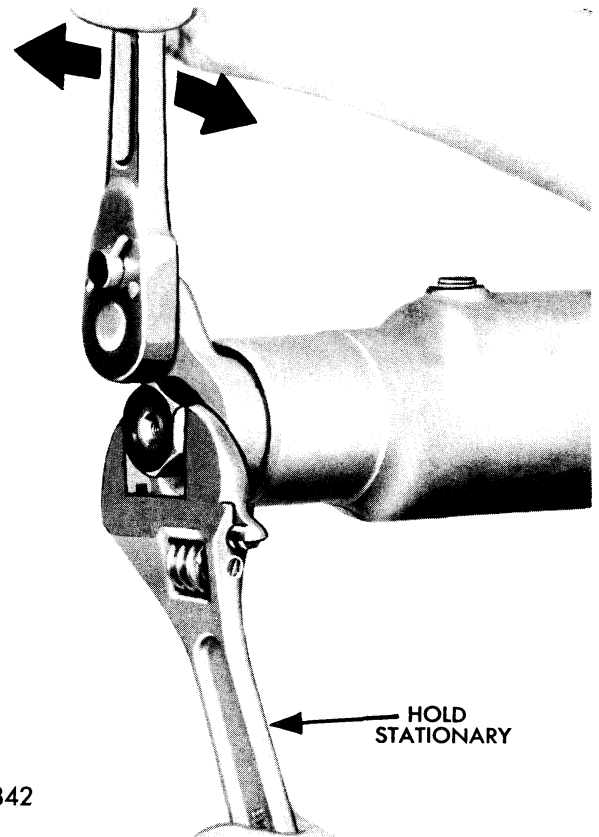
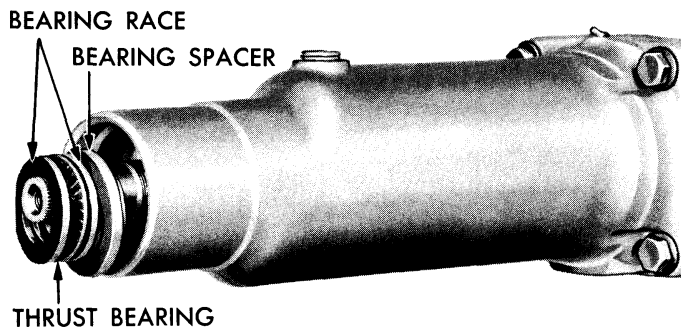


Figure 10—Removing or Installing Bearing Adjusting Nut

Using a thin blade screwdriver, pry the locking collar portion of the bearing adjusting nut out of the keyway in the worm shaft. Slide Tool C-3320A over the worm shaft and down over nut. Position Tool C-3319 over shaft end and engage serrations, as shown in Figure 9. Holding the worm shaft stationary, loosen the bearing adjusting nut, as shown in Figure 10. Remove tools, and then remove the adjusting nut. Discard the adjusting nut, use new nut at reassembly.



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Figure 11—Removing or Installing Bearing Race, Bearing and Spacer

CAUTION

Use extreme care so as not to damage threads of shaft or torque reading will be affected at adjustment.

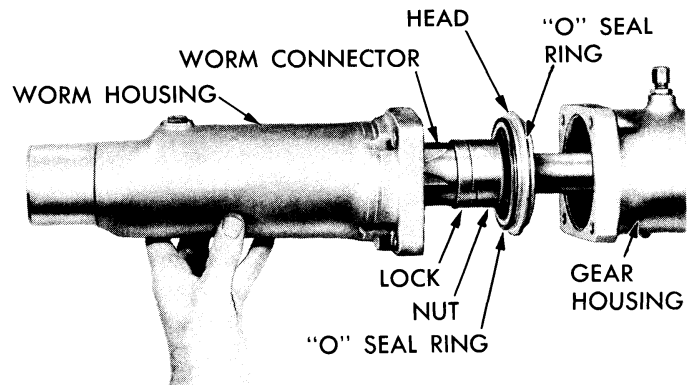
Now, slide the outer bearing race, thrust bearing inner race and spacer out of the housing, as shown in Figure 11.

Remove the bolts and washers that attach the worm housing to the gear housing. Slide the worm housing up and away from gear housing, exposing the worm connector, as shown in Figure 12. Lightly tap the worm housing to overcome the interference fit of the "O" seal rings, between the worm housing and the housing head. Remove the "O" seal rings from the head and discard.

Remove the bearing races, thrust bearing and spacer (with needle bearings) from the worm housing. The spacer and needle bearing assembly are serviced as an assembly only. The bearing races should be smooth, without pits or scratches, and the wear pattern should be uniform around the race. The rollers of the bearings should be smooth, highly polished and free to turn in their retainers. The needle bearing rollers in the lower spacer should also be free to roll in the cage. The spacers should fit flat against the shoulders in the worm housing and the machined surfaces at each end of the housing must be smooth, without nicks or burrs. Replace all parts that show signs of wear.

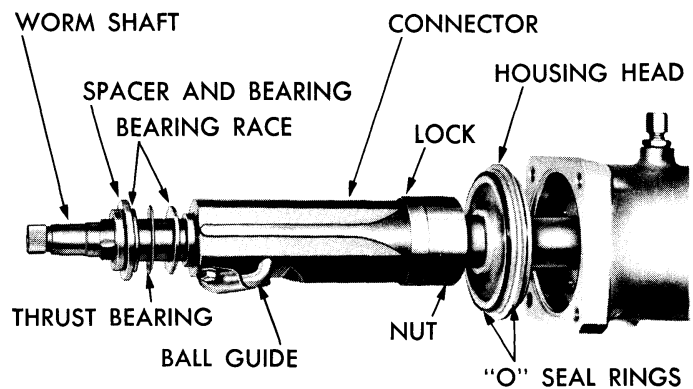
REMOVAL OF WORM CONNECTOR AND VALVE CONTROL

To remove the worm connector and valve control assembly, refer to Figure 13, then proceed as follows: Pry the worm connector nut lock from the openings in



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Figure 12—Removing or Installing Worm Housing



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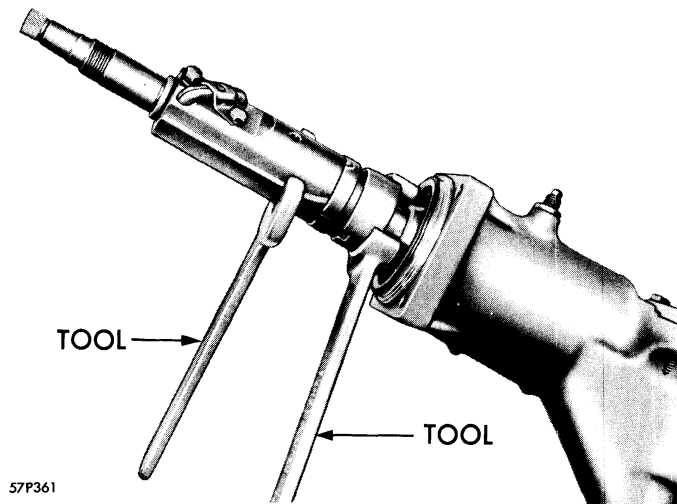
Figure 13—Worm Connector Assembly

the connector, then slide the lock up on the connector far enough to clear the nut. Slide Tool C-3321 over the rails of the connector, as shown in Figure 14. Now, rotate the steering gear shaft and raise the connector far enough to install Tool C-3326. Move the connector down to hold Tool against the housing head to keep Tool from slipping out of nut. Remove the worm connector nut, as shown in Figure 15.

Slide the worm connector assembly from the upper piston rod. Now, remove the valve adjusting cup from the inside of the worm connector.

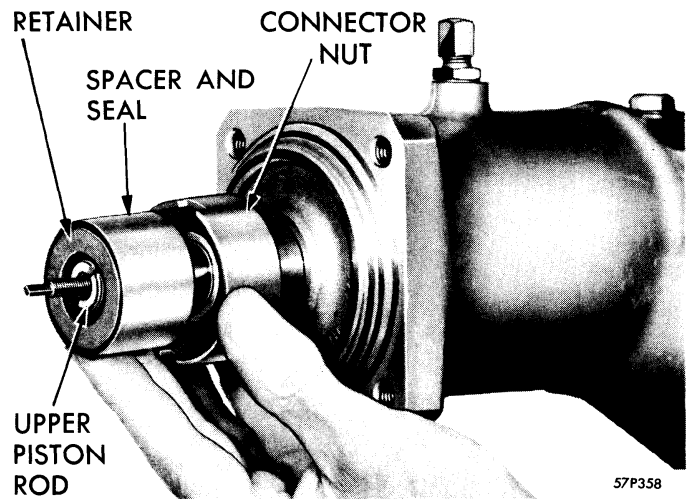
Pry the retaining portion of the piston rod nut lock from the indents in the nut. Remove the lock. (Use care when removing lock so as not to damage the control spacer.) Install Tool C-3328 in the indents in the nut, then remove the nut, as shown in Figure 16.

Slide the spacer and seal assembly and the nut from the valve rod, as shown in Figure 17. Now, slide the housing head off the end of the valve rod.



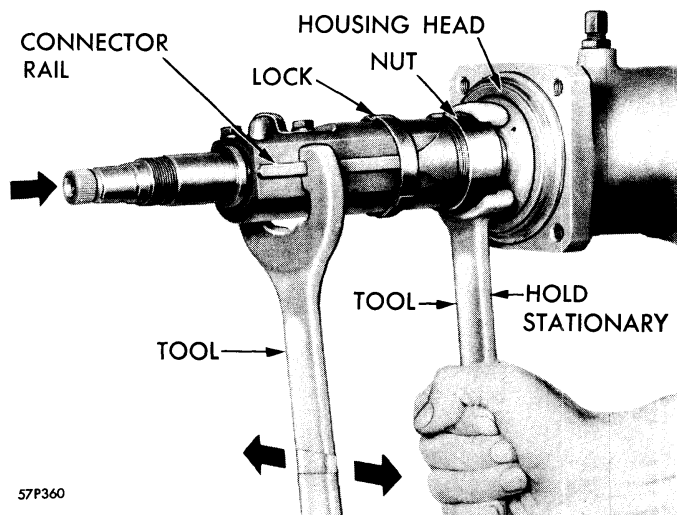
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Figure 14—Worm Connector Nut Removing or Installing Tools



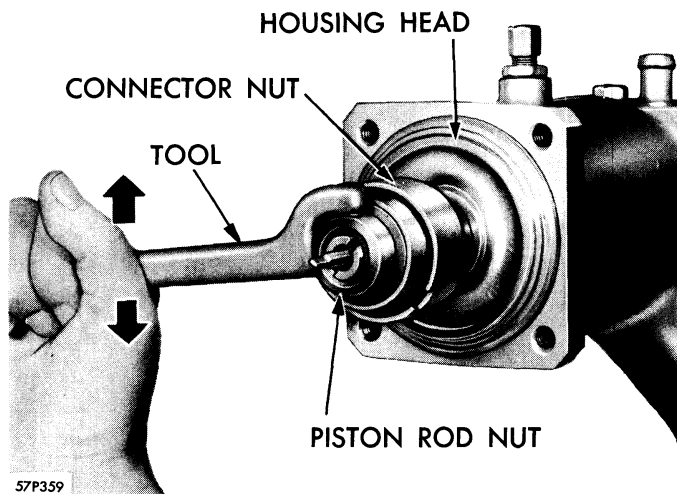
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Figure 17—Removing Spacer and Seal Assembly and Nut



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Figure 15—Removing or Installing Worm Connector Nut



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Figure 16—Removing or Installing the Piston Rod Nut

The piston rod nut must be smooth on both ends. The nylon insert nut must be tight in the valve adjusting cup. The flange inside the connector nut should be smooth and the housing head should be free from nicks or burrs.

The inner bore of the valve control spacer should show little or no wear from the retainers, and the edges should be smooth; free from nicks or burrs. If nicks or burrs are present, remove with crocus cloth spread over a flat surface.

The valve control spacer is serviced in two different lengths, with a .001 inch differential. The spacer must be exactly the same length as the spacer between the piston rod nut and the shoulder of the piston rod. With the nut tightened, the spacer should roll freely in the groove, barely holding its own weight.

DISASSEMBLY OF WORM CONNECTOR

When disassembling the worm connector, care should be taken so as not to bottom the worm shaft in either direction. Bottoming the worm shaft may damage the ball guides, which will cause either a tight or rough operating worm.

Remove the bolts and lockwashers that attach the ball guide clamp to the connector. Remove clamp, then carefully remove the guide (with balls), as shown in Figure 18.

CAUTION

Do not lose any of the balls. The worm balls are a select fit and if one or more is damaged, it is recommended that a new complete set of 40 balls be installed.

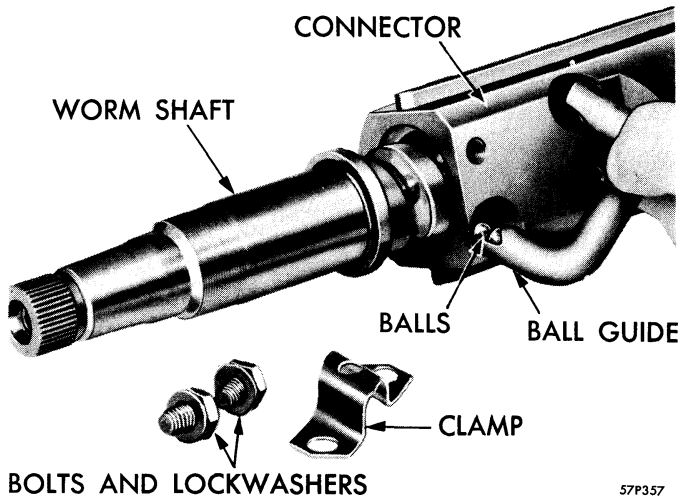


Figure 18—Removing or Installing the Ball Guide

With the worm connector held upside down, carefully remove the remaining balls by turning the worm in and out. Be sure and count the balls which were removed from the connector, so that the same number can be installed at reassembly.

Slide worm out of connector, then remove the nut lock by sliding off connector. The guide rails on the connector should be free of nicks or burrs and slide freely on the guides in the housing. The ball track on the worm should be smooth, without pitting or roughness. The balls should show no signs of brinelling, pitting or flaking. Check the fit of the adjusting cup and spacer in the connector, if loose, install new spacer; adjusting cup, or both. (Install spacer and adjusting cup in connector, then install nut. Tighten securely. Use torque wrench and socket on elastic nut to check fit.)

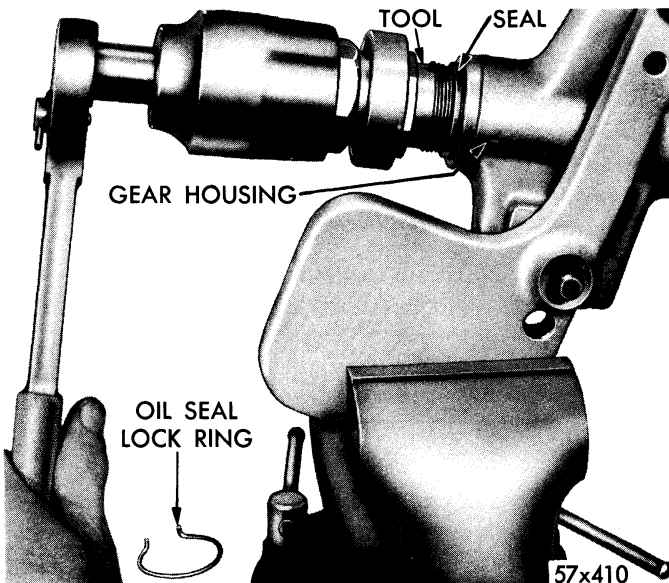


Figure 19—Removing the Gearshaft Oil Seal

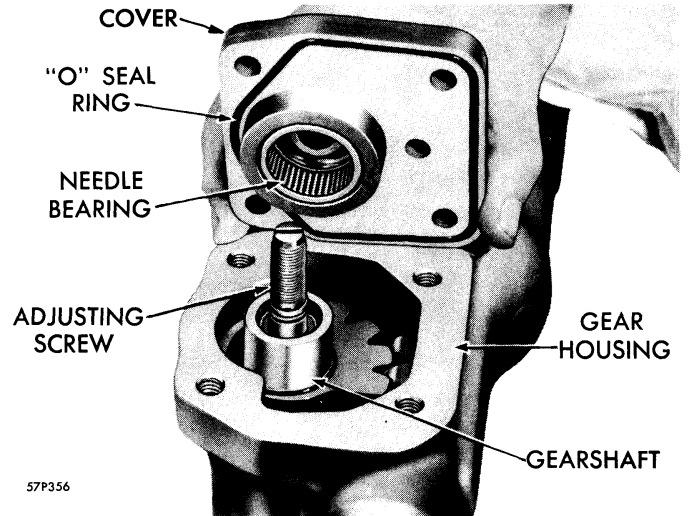


Figure 20—Gearshaft Cover Removed

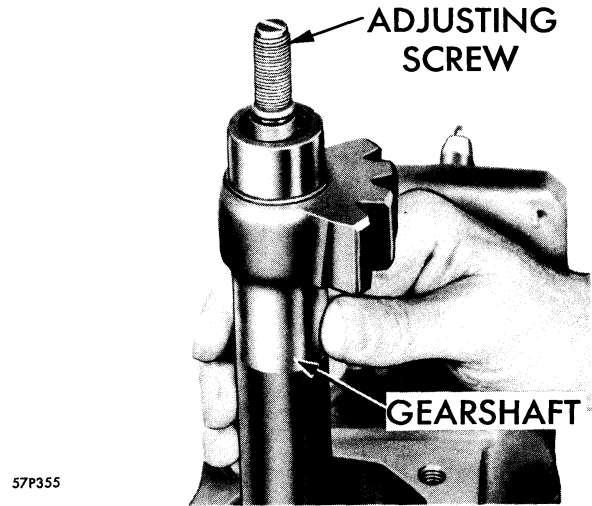


Figure 21—Removing the Gearshaft

DISASSEMBLY OF GEAR HOUSING

Remove the lock nut from the gearshaft adjusting screw then remove the gearshaft oil seal snap ring, using a pair of pliers. Slide the threaded portion of Tool C-3350 over end of gearshaft and down against seal. Install the nut on the threaded portion of shaft. Turn complete Tool until the Tool has entered seal.

Install the half collars and retainer to lock the tool together. Now, back off on the nut and pull seal out of the housing, as shown in Figure 19. Remove Tool.

Remove the bolts and washers that attach the gearshaft adjusting cover to the housing. (Two bolts have sealing washers. The bolt holes are tapped through to the inside of housing.) Discard sealing washers.

To remove the gearshaft cover, turn the adjusting screw into the cover until flush. Now, spin cover off adjusting screw and remove from housing. See Figure 20. Remove and discard the cover "O" seal ring.

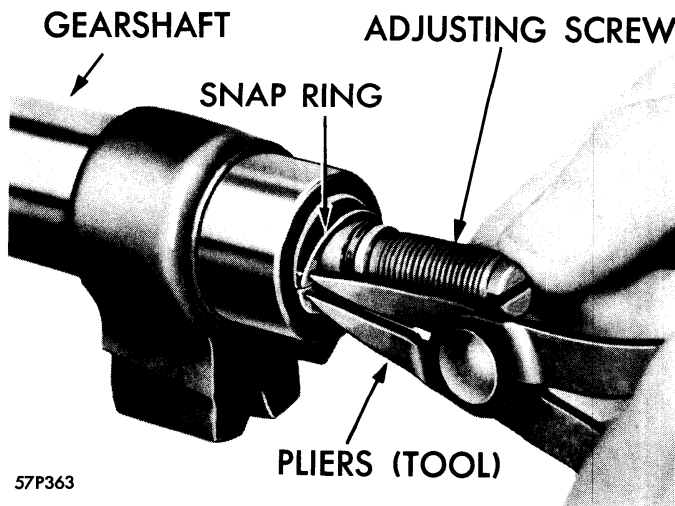


Figure 22—Removing or Installing the Adjusting Screw Snap Ring

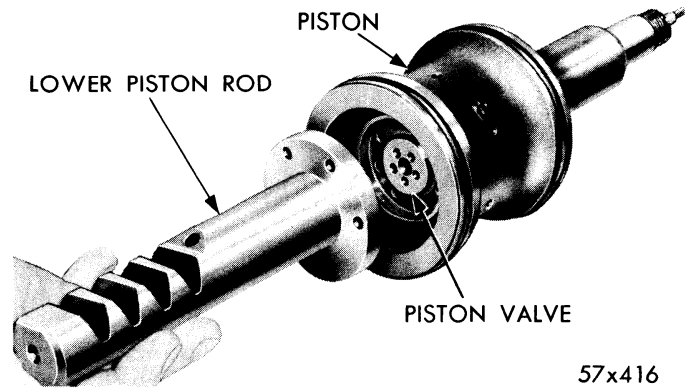


Figure 25—Removing or Installing the Lower Piston Rod

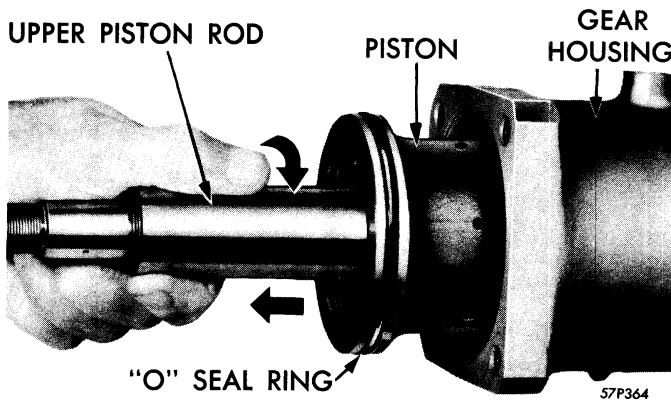


Figure 23—Removing the Piston and Rod Assembly

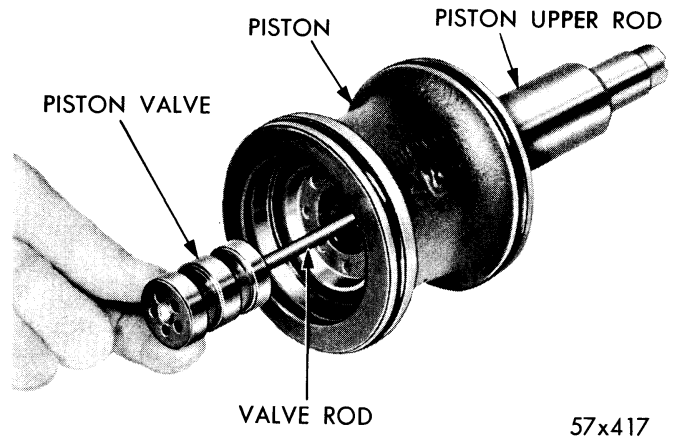


Figure 26—Removing the Piston Valve

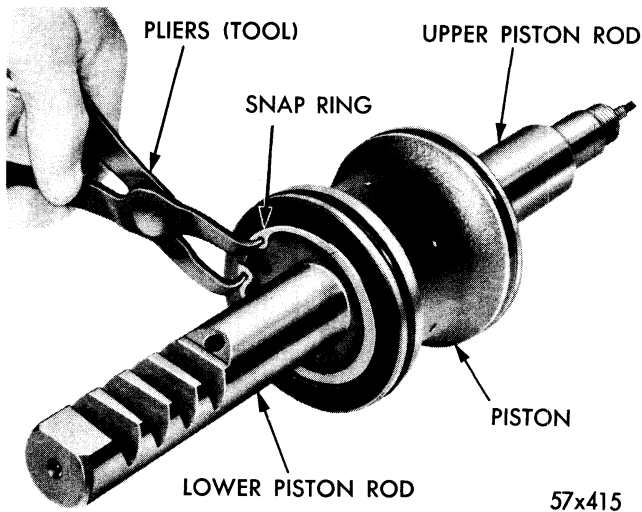


Figure 24—Removing Lower Piston Rod Snap Ring

Align the gear on the gearshaft to clear the opening in the housing, then using a fibre hammer, rap lightly on end of gearshaft. Slide gear and shaft out of housing, as shown in Figure 21.

Using Tool C-3229 pliers, remove the adjusting screw retaining snap ring, as shown in Figure 22. Slide adjusting screw, "O" seal ring and retaining washer from the end of gearshaft. Remove thrust washer from seat in end of shaft. Discard the "O" seal ring.

The gearshaft should be free of pits, scores or signs of excessive wear in the seal and bearing contact areas. The gear teeth should be smooth and show a good contact pattern. The needle bearings in the cover should be smooth and rotate freely in the race.

DISASSEMBLY OF PISTON AND RODS

Place a suitable container under the gear housing to catch the trapped oil, then remove the piston assembly and rods from the housing and disassemble. Hold the upper piston rod firmly, then twist the housing, as shown in Figure 23. Do not permit lower piston rod to touch piston bore to prevent scratching.

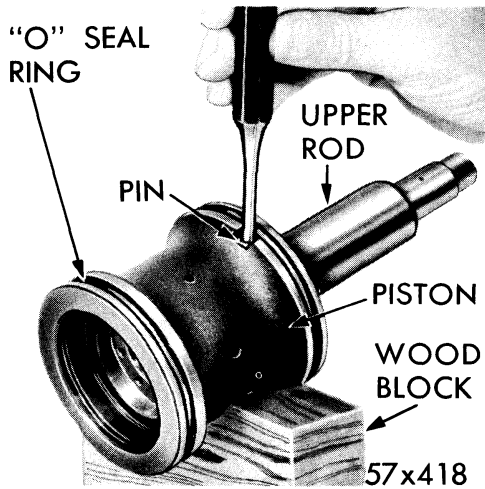


Figure 27—Driving Pin into Upper Piston Rod

Remove the snap ring that holds the lower rod in the piston, using snap ring pliers C-3106, as shown in Figure 24.

Carefully work the lower rod out of the piston, to expose the piston valve, as shown in Figure 25. Remove and discard the rod "O" seal ring. Slide the piston valve out of piston, as shown in Figure 26. Use care so as not to bend the valve rod during or after removal. Support the piston assembly (in order to protect seal ring lands) using a soft wood block, then drive the piston pin into the upper rod using a 1/4 inch round drift, as shown in Figure 27.

Using snap ring pliers C-3106, remove the upper piston rod retaining snap ring. Carefully work the upper piston rod out of piston, as shown in Figure 28. Insert a wire (or paper clip) down through the piston pin, then bend inserted end over (through oil passage hole in rod). Pull piston pin out of piston rod, as shown in Figure 29. Discard "O" seal ring.

Remove the large "O" seal ring from the base of the upper rod, then using a paper clip, remove the valve rod "O" seal rings from each end of the upper rod. (See Figure 30.) Remove and discard the "O" seal

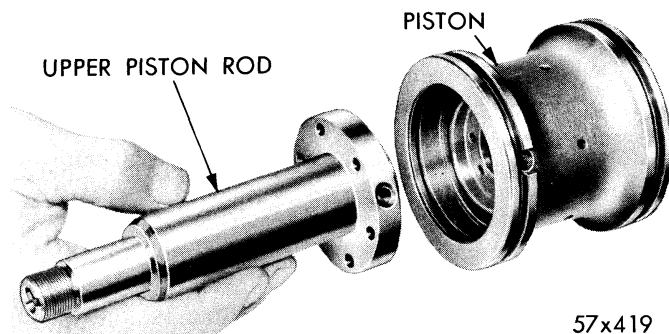


Figure 28—Removing Upper Piston Rod

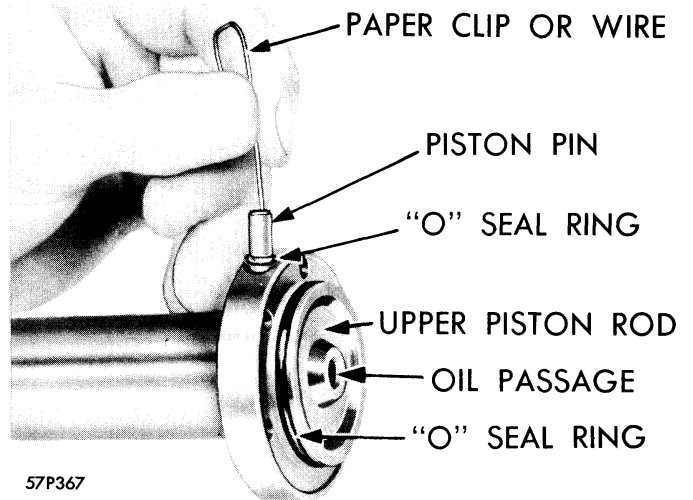


Figure 29—Removing Piston Pin from Upper Rod

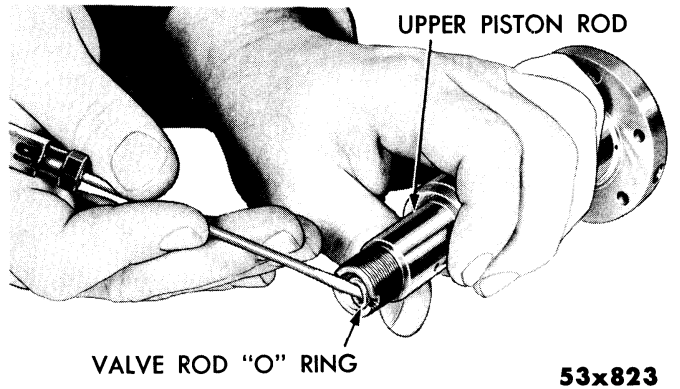


Figure 30—Removing Valve Rod "O" Rings

rings (piston rings) from each end of the piston. Using a 7/16"—14 (standard thread) bolt, remove the restrictor valve from the lower piston rod. Thread bolt into valve, finger tight. Clamp head of bolt in a vise, then rap on end of rod, using a fibre hammer. Slide valve out of rod. See Figure 31. To disassemble valve, insert a stiff wire to push out retaining pin. Remove plunger and spring.

The restrictor valve plunger should slide freely in the valve body and show no signs of sticking. The lower piston rod should be free of burrs or scratches. The upper rod should be unmarked in the seal contact area. The valve port rings inside the piston should have a

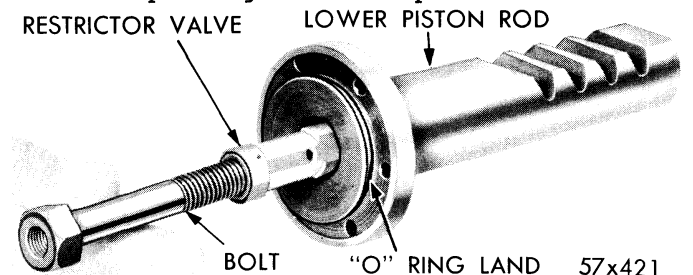


Figure 31—Removing the Restrictor Valve

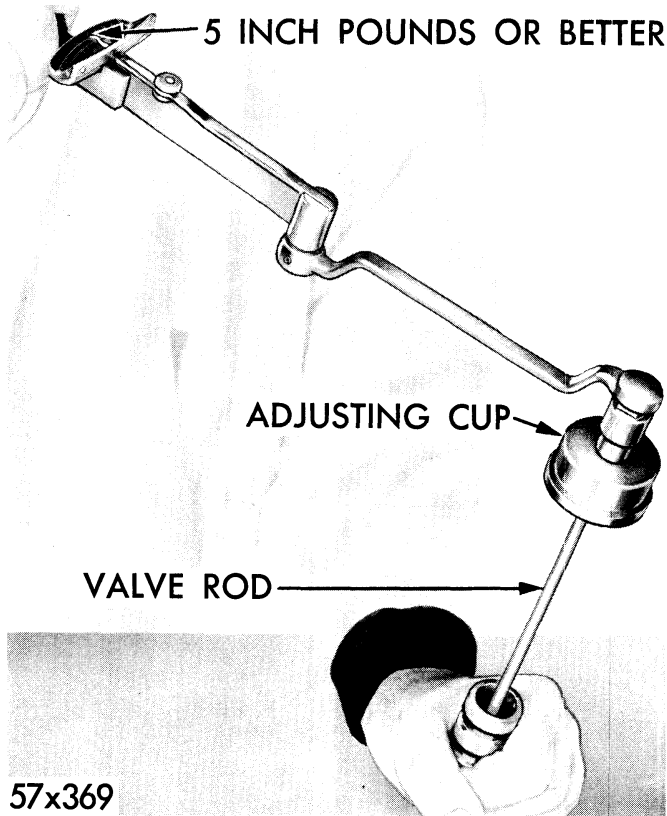


Figure 32—Testing Torque of Adjusting Cup on Valve Rod

bright, highly polished surface with sharp edges. The valve rod should slide freely through the "O" seal rings. To check the valve rod, insert valve in piston until centered. Lay piston on flat surface, then place Tool C-3333 under valve rod, as shown in Figure 33. Rotate piston slowly. If rod is bent, the distance from the tool will vary. The rod must be tight in valve. If loose, install new assembly. The adjusting cup should grip the threads of the valve rod tightly. To check, install cup on end of rod, then install Tool C-3380, as shown in Figure 33. The minimum torque reading should not be less than

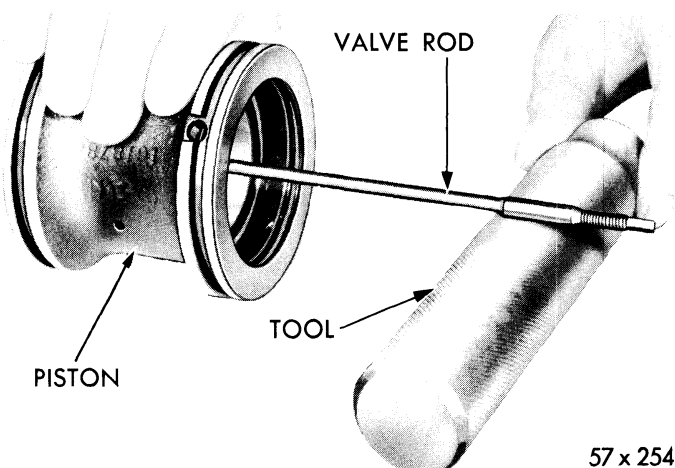


Figure 33—Checking Valve Rod

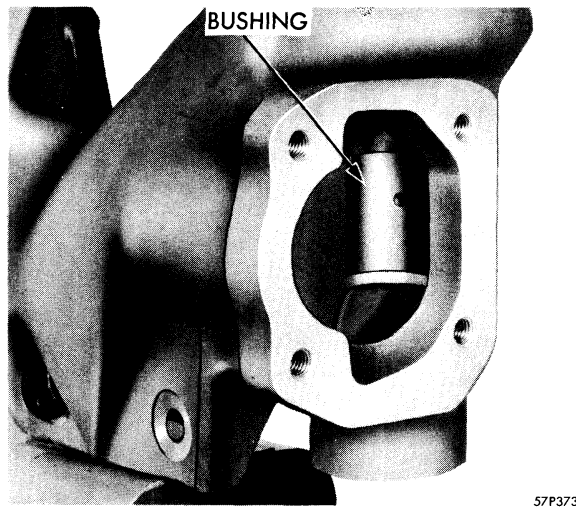


Figure 34—Lower Piston Rod Bushing

5 inch-pounds. The piston "O" ring grooves should be free from nicks or burrs, with no sharp edges around the piston pin hole.

DISASSEMBLY OF GEAR HOUSING

Using a suitable blunt drift, drive out the welsh plug in the bottom of the gear housing from the cylinder side. Do not remove plug by punching hole and flipping out. This method will damage aluminum housing.

Using a thin blade screwdriver, pry out the lower piston rod thrust pad from the gear housing. (Refer to Figure 34.)

Remove the lower piston rod oil seal from the housing, using Tool C-3450. To remove seal, insert the disc end of tool through the opening in end of housing, locating the disc between the seal and the housing shoulder. Using the offset (curved) section as a fulcrum, force the disc between seal and shoulder, until retainer screw

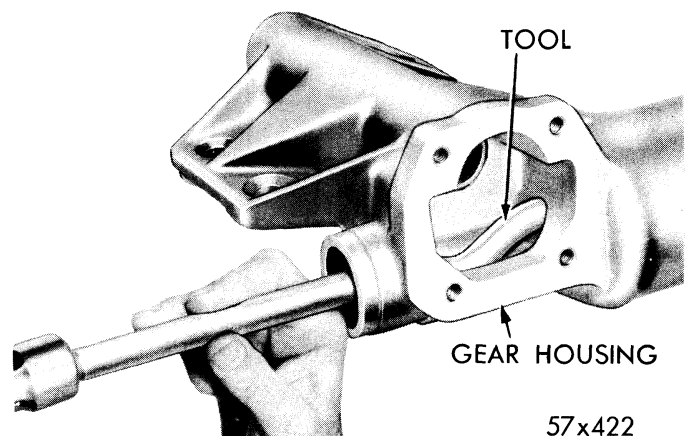


Figure 35—Removing Lower Piston Rod Oil Seal

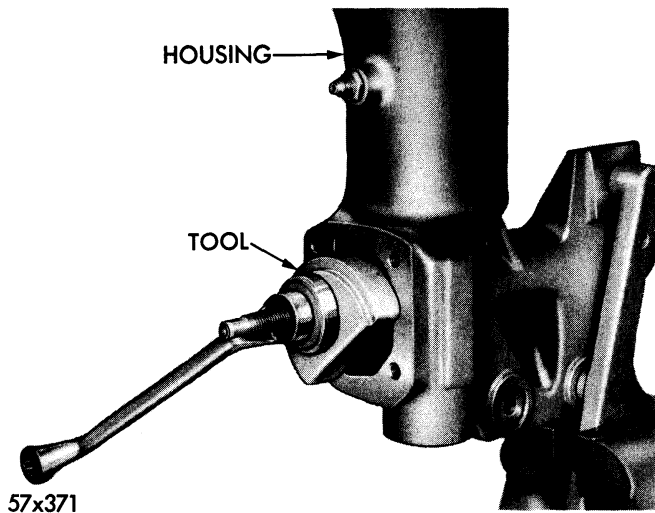


Figure 36—Removing Upper Needle Bearing

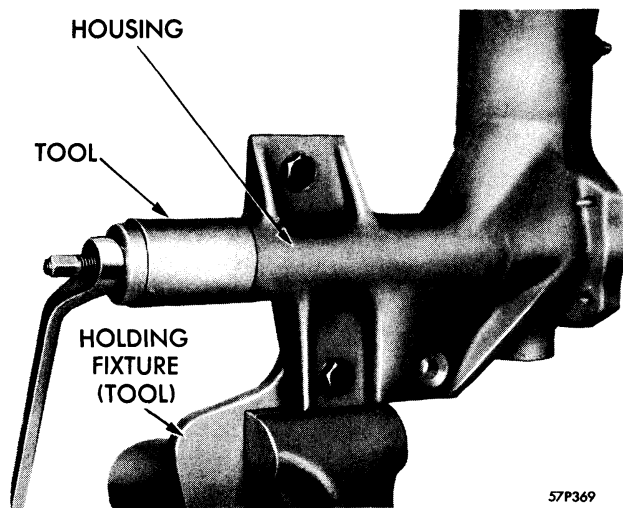


Figure 37—Removing Lower Needle Bearing

almost contacts the seal. Drive seal out of housing, using a hammer, as shown in Figure 35.

Inspect the steering gear shaft needle bearings in the gear housing, for broken or rough needles. Do not remove bearings unless inspection reveals it is necessary to do so. If necessary to remove bearings, install Tool C-3332, as shown in Figure 36 and 37 and pull the upper and lower needle bearings out of the housing.

Inspect the bearing surface of the lower piston rod thrust pad if scratched, install new one. Check the piston cylinder walls for scoring, nicks or scratches. All machined surfaces of the housing should be smooth and free from nicks or burrs. The steering gear unit has now been disassembled as far as necessary for cleaning, inspection and the replacement of parts.

Clean all parts in a suitable solvent and blow dry with compressed air. Be sure and use new "O" seal rings and seals at reassembly. Coat seals and "O" seal rings with lubriplate at installation.

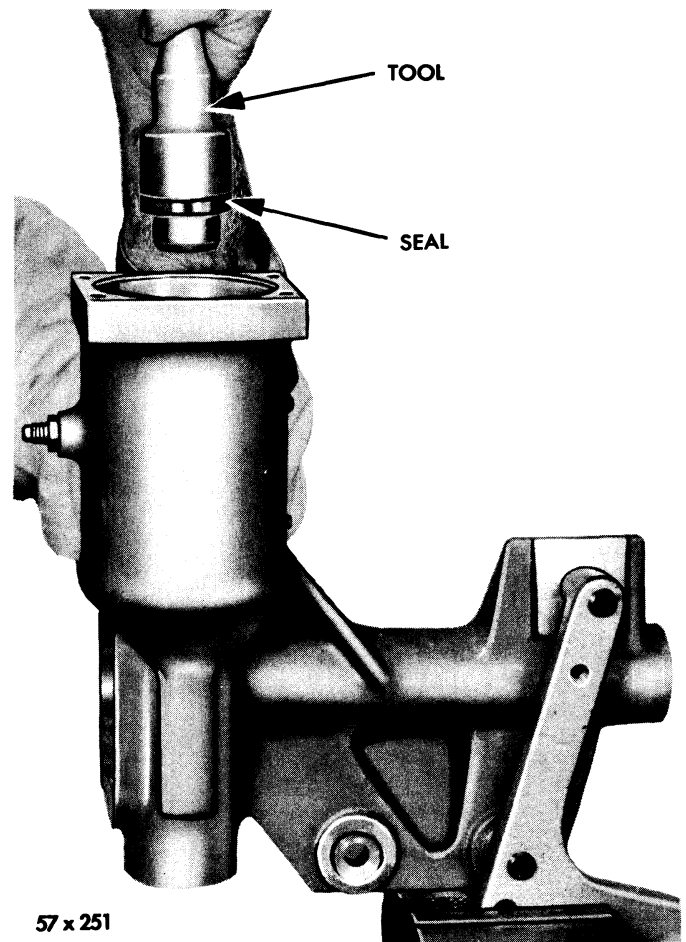


Figure 38—Installing Lower Piston Rod Seal

ASSEMBLY OF GEAR HOUSING

Remove the garter spring from a new piston rod seal then install seal on driver C-3331. (Lip of seal toward driver.) Slide pilot SP-1927 through seal and into driver until bottomed. Now insert assembly into housing (keeping tool centered in bore), as shown in Figure 38. Drive seal into position, then remove tool. Carefully work garter spring into seal with the aid of two long shank screwdrivers. (If Tool C-3331-A is used, it will not be necessary to remove garter spring.)

Slide the gear shaft lower needle bearing (if removed) over pilot of Tool C-3333, (lettered end against driver) then insert into housing. Drive needle bearing into housing, Figure 39. The outer end of bearing should be $1\frac{1}{16}$ inches from end of housing when seated.

Slide the gear shaft upper needle bearing (if removed) over pilot of Tool C-3333, (lettered end against driver) then insert into housing. Drive needle bearing into housing, as shown in Figure 40. The outer end of bearing should be flush with end of bore when properly seated.

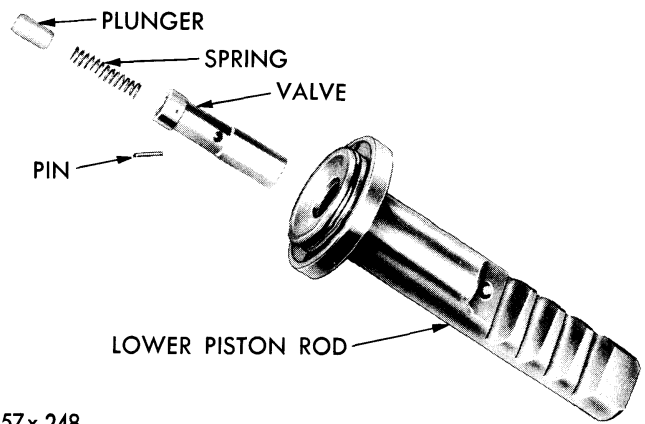
Place the lower piston rod thrust pad in position, (refer to Figure 34) align shoulder with recess in housing and press into position.

ASSEMBLY OF PISTON AND ROD

Slide the restrictor valve spring and plunger into valve body, as shown in Figure 41. Secure with pin, then install assembly into the lower piston rod bore. (Refer to Figure 31.) Press in until flush with end of bore. Check the plunger for free operation in the valve.

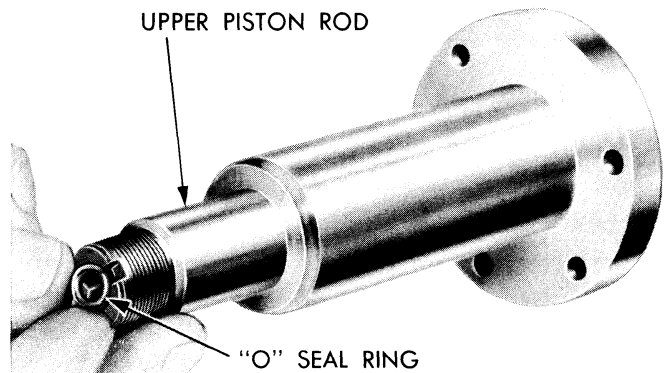
Install two new valve rod "O" seal rings in each end of the upper control rod, as shown in Figures 42 and 43. Coat a new "O" seal ring with lubriplate, then slide into position in the groove on the end of the upper piston rod. Carefully slide the rod into the piston, aligning the piston pin holes. Slide a new "O" seal ring over piston pin, then insert into opening in piston. Be sure the pin is perfectly straight, then carefully tap into piston, using a 1/4 inch drift. The pin should be flush in piston.

Using pliers C-3106, install the retaining snap ring (bevelled side out). It may be necessary to tap the snap ring, using a brass drift, to be certain it is fully expanded in the groove. Slide the valve and rod into the piston and



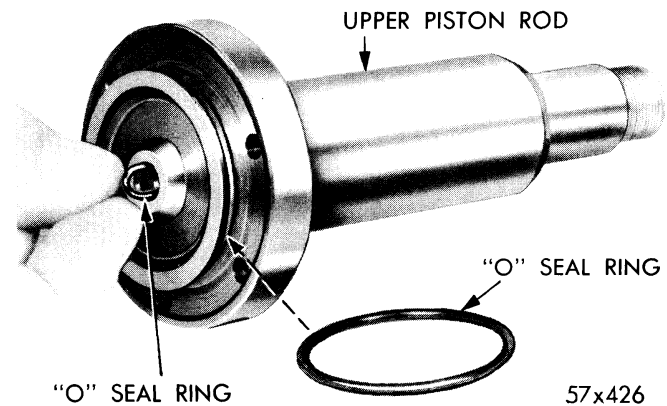
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Figure 41—Restrictor Valve



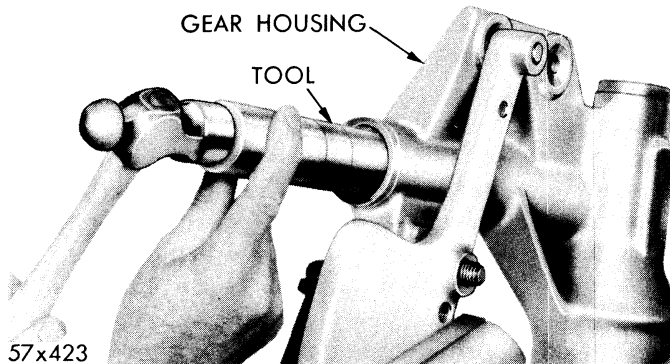
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Figure 42—Installing Valve Rod Upper "O" Seal Ring



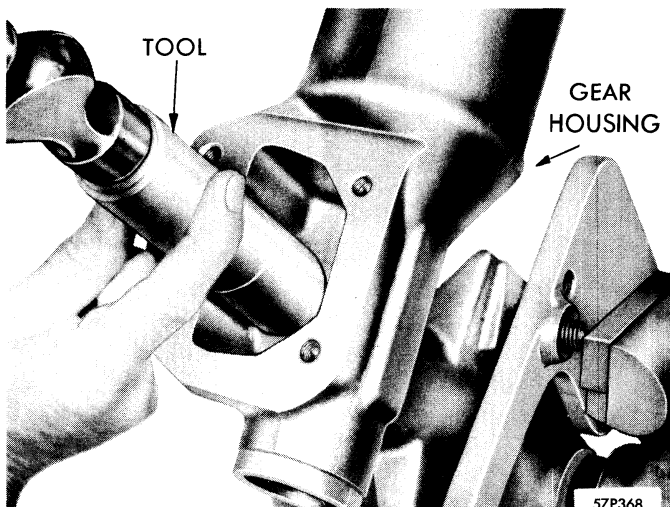
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Figure 43—Installing Valve Rod Lower "O" Seal Ring



57x423

Figure 39—Installing Gearshaft Lower Needle Bearing



57P368

Figure 40—Installing Gearshaft Upper Needle Bearing

upper rod, working carefully past the "O" seal rings previously installed, as shown in Figure 45. Be careful not to bend the rod.

Slide a new "O" seal ring into position in the groove on the bottom of the lower piston rod. Carefully slide rod into piston and down into position. Using pliers C-3106, install the retaining snap ring.

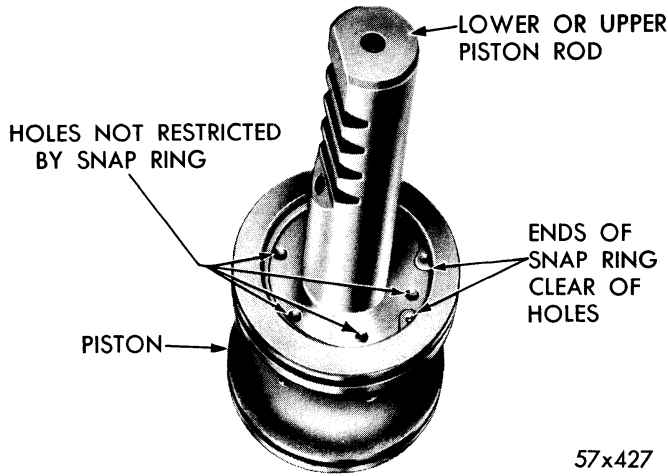


Figure 44—Snap Ring Correctly Installed

CAUTION

Be sure that the ends of the snap ring do not obstruct an oil passage, as shown in Figure 44. Any obstruction at this point will affect steering performance.

Install new "O" seal rings on each end of piston, then locate Tool C-3344 on the gear housing (around cylinder bore). Coat Tool C-3554 with lubriplate then place over teeth of the lower piston rod. Slide piston and rod assembly into cylinder bore, as shown in Figure 46. Guide seal protector Tool C-3554 out of lower housing (through cover opening), as piston is being pushed into cylinder. As piston is being installed, align teeth on lower rod for meshing with teeth on gear shaft. Remove tools.

GEAR SHAFT INSTALLATION

Slide the gear shaft adjusting screw thrust washer

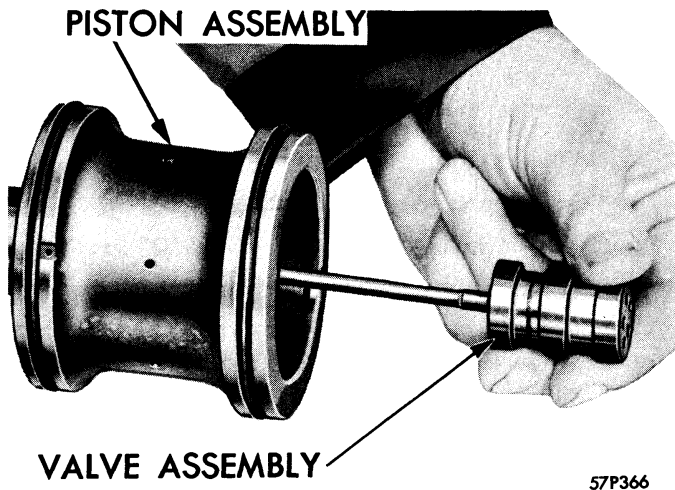


Figure 45—Installing Valve in Piston

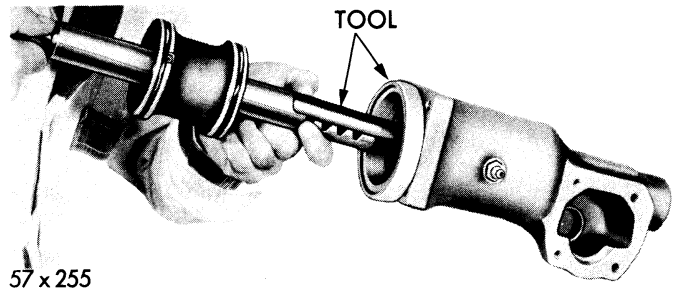


Figure 46—Installing Piston Assembly

into position in end of shaft, then install adjusting screw and retaining washer. Install snap ring, using pliers C-3229. (Refer to Figure 22.) Install Tool C-3401 over end of adjusting screw and slide down until seated. Now, slide new "O" seal ring over tool and into groove of adjusting screw, as shown in Figure 47. (This operation may be done before installing screw.) Install the sector gear to mesh with the rack, as shown in Figure 48. Seat shaft to mesh teeth. Check the gear timing, using the steering pitman arm to rotate gear shaft. Full piston travel must be approximately 2 inches. Failure to follow the timing instructions will result in a broken gear housing.

Place a new gear shaft oil seal (suitably coated with lubriplate) lip side down, on a piece of clean paper. Carefully slide the tapered end of sleeve (part of Tool C-3350) in seal and slide seal back approximately 1/4 inch on sleeve. Slide sleeve and seal over shaft (lip of seal toward housing) until seal contacts bore of housing. Now slide adaptor over sleeve, followed by coupling nut. Install seal in housing by turning nut on shaft threads until shoulder of adaptor contacts housing, as shown in Figure 49. Remove nut and adaptor. Wrap a new piece of friction tape around the sleeve to provide a firm grip. Slide sleeve off gear shaft using a twisting

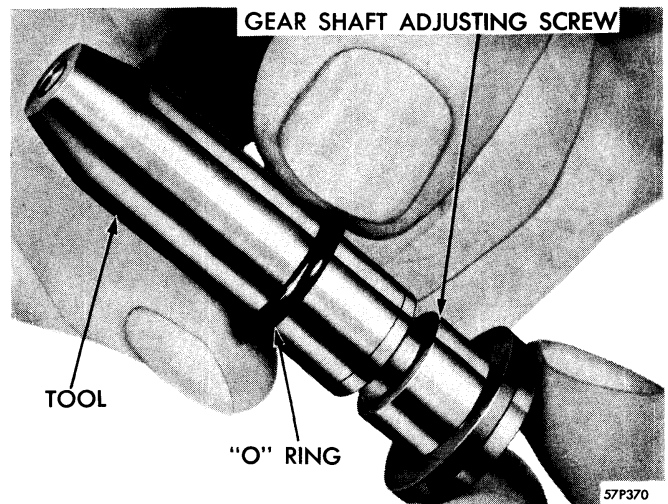


Figure 47—Installing Gear Shaft Adjusting Screw "O" Ring

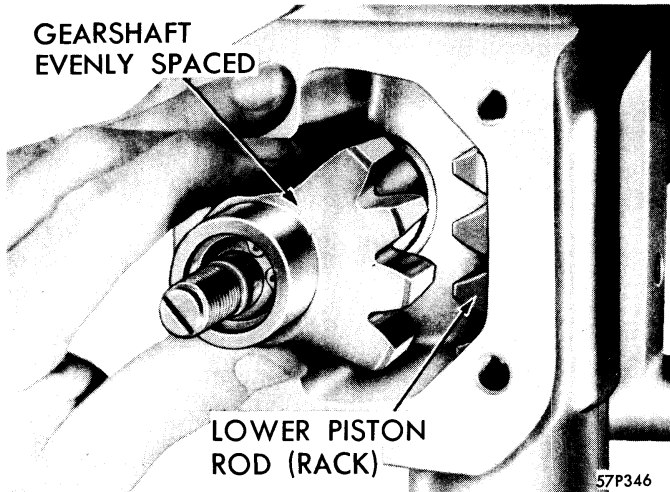


Figure 48—Gear Tooth Alignment

motion, as shown in Figure 50. Do not use any tool to remove sleeve. Install oil seal retaining snap ring.

Install a new "O" seal ring in the groove on adjusting cover, (refer to Figure 20) then place cover on adjusting screw and spin down as far as possible. Align cover with bolt holes. Using a screwdriver, move the adjusting screw out of cover until cover is seated on housing. Install bolts and washers (with seals), in the inside holes and tighten from 25 to 30 foot-pounds.

Install the adjusting screw locknut but do not tighten at this time. Place a new welsh plug in position of bottom of housing and drive into position.

VALVE CONTROL SPACER INSTALLATION

Remove the garter spring from a new upper piston rod seal, then position seal on driver C-3331 with lip of seal toward driver. Install seal aligning pilot in end of driver. (If Tool C-3331-A is used, it will not be necessary to remove garter spring.)

Place the housing head on a flat surface (single flange side up) and drive seal into head until seated, as shown in Figure 51. Remove tool, then reinstall garter spring. Position a new "O" seal ring over shoulder on the housing head, then carefully slide head over piston rod and down against housing. Be sure "O" seal ring is seated.

Slide the connector nut over piston rod with threaded end out. Slide a new control spacer seal into spacer and install retainers, as shown in Figure 52.

Place seal protector Tool C-3329 over threads on upper rod. Now, slide spacer assembly over Tool and down against shoulder of upper rod, Figure 53.

Install the upper piston rod nut and tighten with sharp rap of hammer on Tool C-3328 (Refer to Figure 16). Install new lock cap over nut and index with slots in

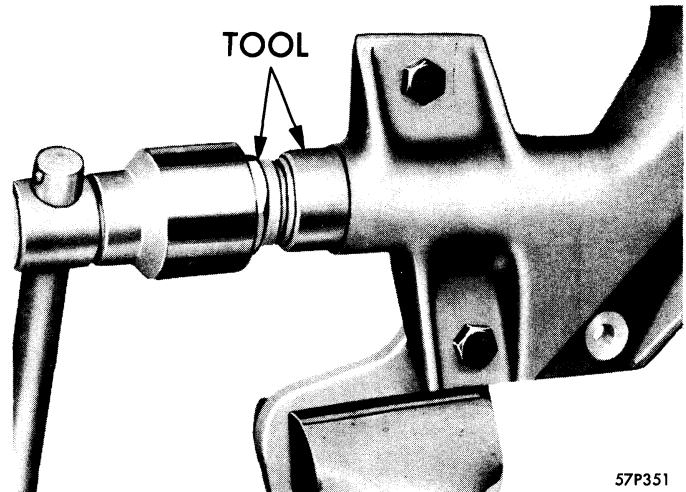


Figure 49—Installing Gearshaft Oil Seal

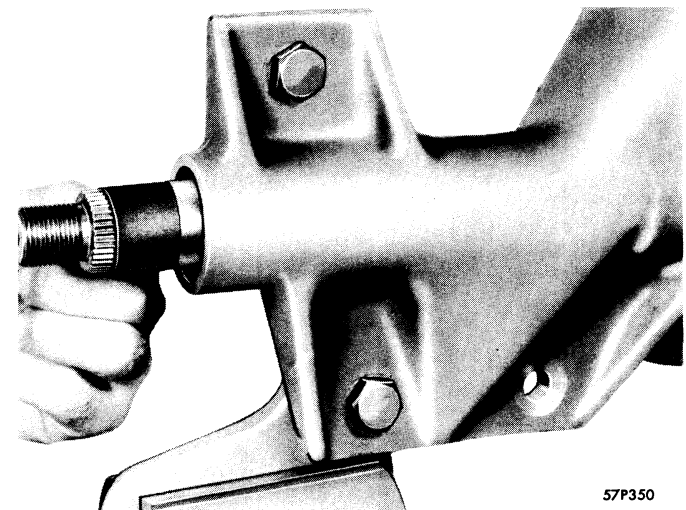


Figure 50—Removing Oil Seal Protector Sleeve

rod. Using a suitable punch, drive the outer diameter into the recess in nut, as shown in Figure 54.

WORM CONNECTOR

Slide the worm into the connector and visually align the upper portion of the passages with the ball guide holes. Insert 30 balls (no more), into lower hole by pushing them gently, using the rubber end of a pencil, and at the same time, oscillating the worm, as shown in Figure 55. When 30 balls have been inserted, they should be visible in the upper hole. Place the remaining balls (10) in either half of the ball guide. Grease the end balls to help hold them in place, then place the other half over balls.

Insert the guide and ball assembly into the holes in the connector. (Refer to Figure 18.) Install clamp, lockwashers and bolts. Tighten bolts from 10 to 12 foot-pounds. Check the operation of the worm, making sure it is free to turn the maximum travel of the worm shaft.

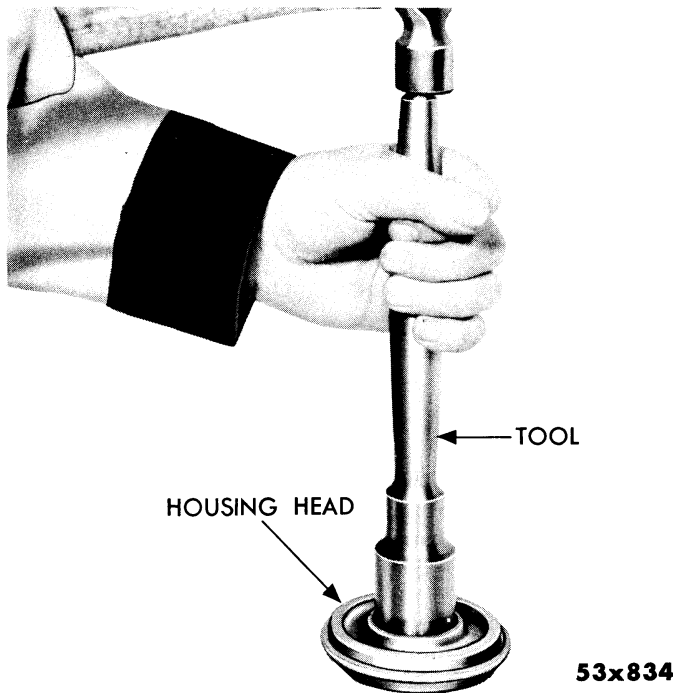


Figure 51—Installing Upper Piston Rod Seal

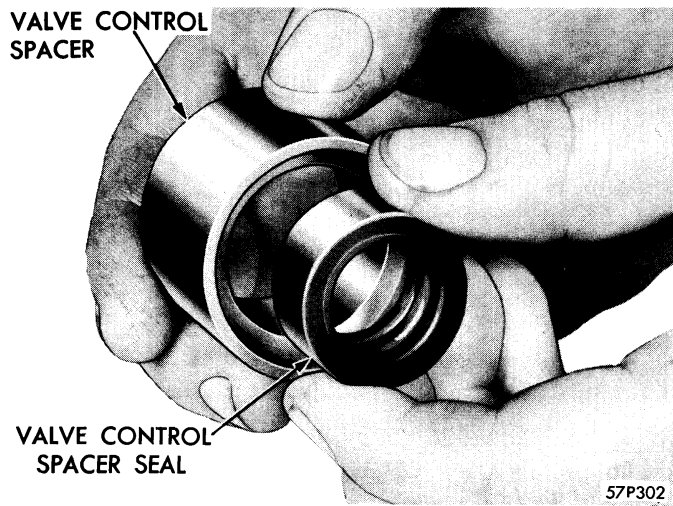


Figure 52—Removing or Installing Seal in Valve Control Spacer

The worm should rotate freely by its own weight in either direction. Do not allow worm to bottom.

Install the valve adjusting cup on the end of the valve rod. Now, slide the new worm connector nut lock over the threaded end of connector with the tang side facing threads.

Slide the worm connector over the control spacer and screw the nut on to the connector by hand. Hold the worm connector with Tool C-3321, then using Tool C-3326, tighten nut securely. (Refer to Figure 15.) Engage tang of lock with recess in nut, then stake lock in hole in connector. Remove Tools.

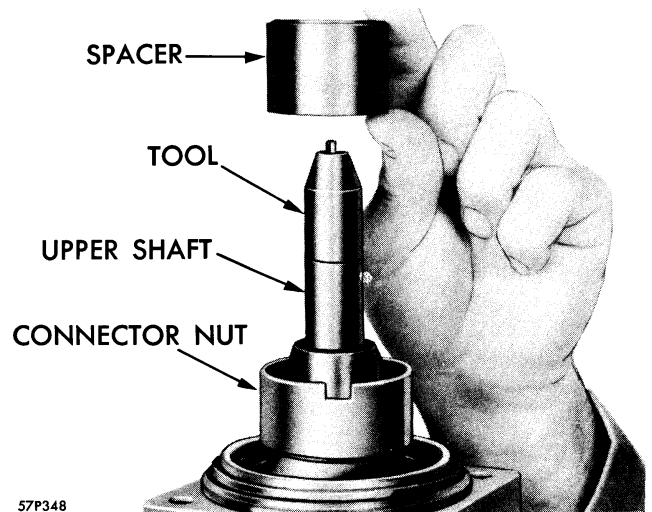


Figure 53—Installing Valve Control Spacer

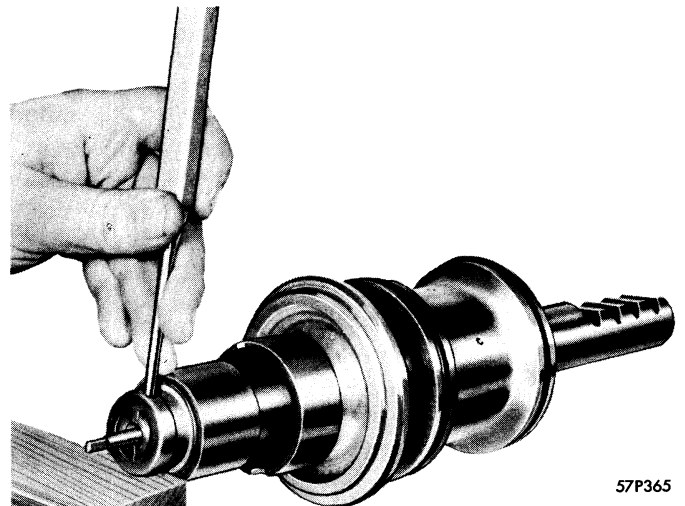


Figure 54—Locking Upper Piston Rod Nut Lock

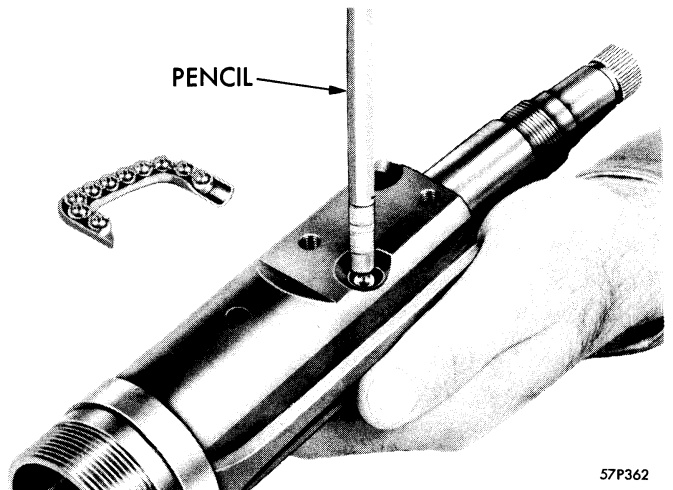


Figure 55—Installing Balls in Worm Connector

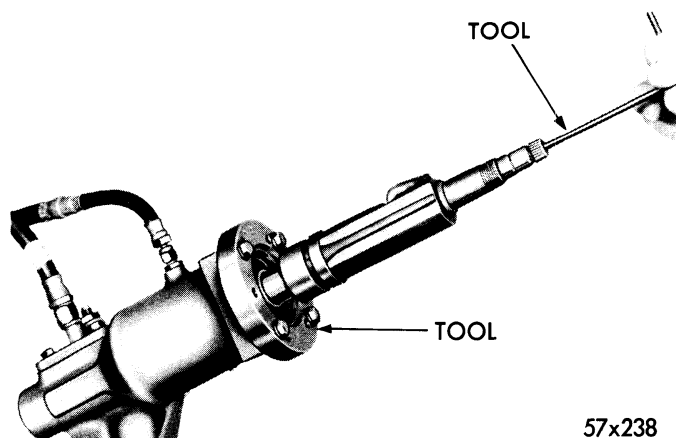


Figure 56—Testing Gear for Leaks

TESTING FOR LEAKS

Align the housing head to gear housing, then install Tool C-3555 over head. Install bolts and tighten securely. Now, install hose fittings, adaptors and test hoses from pump to unit, as shown in Figure 56.

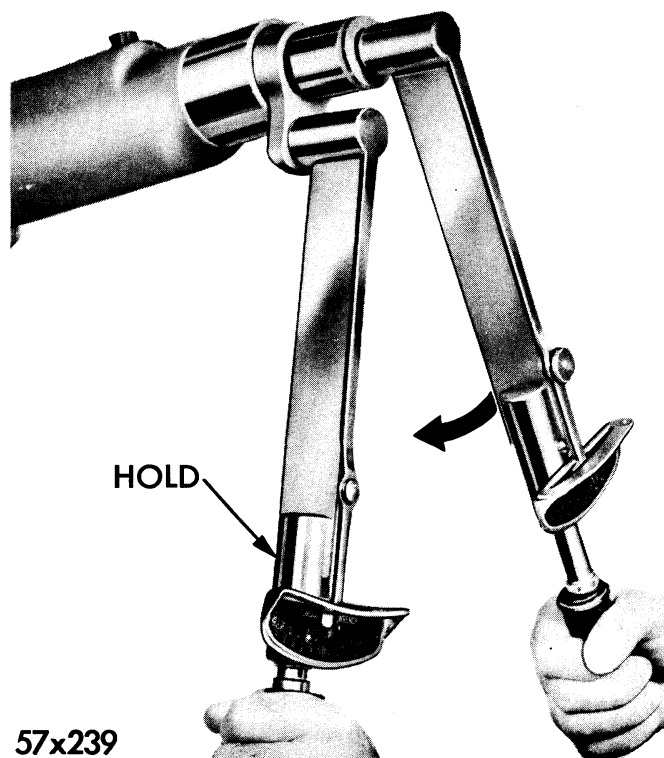
Fill the pump reservoir with type "A" Transmission fluid and have additional fluid available. Now, install Tool C-3445 through the worm shaft (forked end first) and engage valve rod.

Remove coil wire and turn engine over, using the starting motor. (This will prevent damaging the steering unit should the valve be positioned to give excessively fast self steering.) As the steering gear fills, it will self steer and the reservoir will need additional fluid. Be ready to turn the valve to stop the self steering before piston reaches limit of travel. Turn the valve to the right if piston moves up, and to the left as the piston moves down. Fill the reservoir. Allow unit to warm up to full operating temperature then check for leaks. (This was a temporary valve adjustment. The final adjustment should be made after unit is completely assembled.) After leak test, stop engine and remove tools.

WORM HOUSING INSTALLATION

Slide a new "O" seal ring on the smallest land of the housing head. Now, slide a bearing race over worm shaft followed by a thrust bearing and a race. Slide the spacer and needle bearing assembly into housing past the rail guides. Press shoulder of bearing spacer into housing, using a suitable tool.

Turn the connector until the ball guide is directly down and rails are aligned. Slide the worm housing over connector with the vent on top side. Use care so as not to force the "O" seal ring off the housing head. Hold housing in alignment with connector rails, then seat against gear housing. (Worm housing must meet gear



57x239

Figure 57—Adjusting Worm Housing Bearing (Outer)

housing with hand pressure only.) Install attaching bolts and washers. Tighten from 25 to 30 foot-pounds.

Slide the bearing spacer over worm shaft (shoulder towards worm) and seat in housing. Now, slide bearing race thrust bearing and race over worm shaft and down against spacer. (Refer to Figure 11.) Install new adjusting nut with locking flange up.

Pour 14 oz. of Type "A" Transmission fluid into the upper housing, then install filler plug. Make the worm bearing adjustment, piston valve adjustment and the gear adjustments as described in the Steering Gear Adjustment Paragraph.

7. ADJUSTING THE POWER STEERING UNIT

The three adjustments, all of which can be made without removing the assembly from the car, should be made in this sequence: Worm Bearing Adjustment, Piston Valve Adjustment, and Gear Lash Adjustment.

Since a considerable amount of work is involved in making either the worm bearing adjustment or the piston valve adjustment in the car, it is suggested you make definitely sure that these are causing the difficulty before making the adjustment necessary, and all other possibilities have been checked, and you want to make the adjustment without removing the assembly from the car; then proceed as follows:

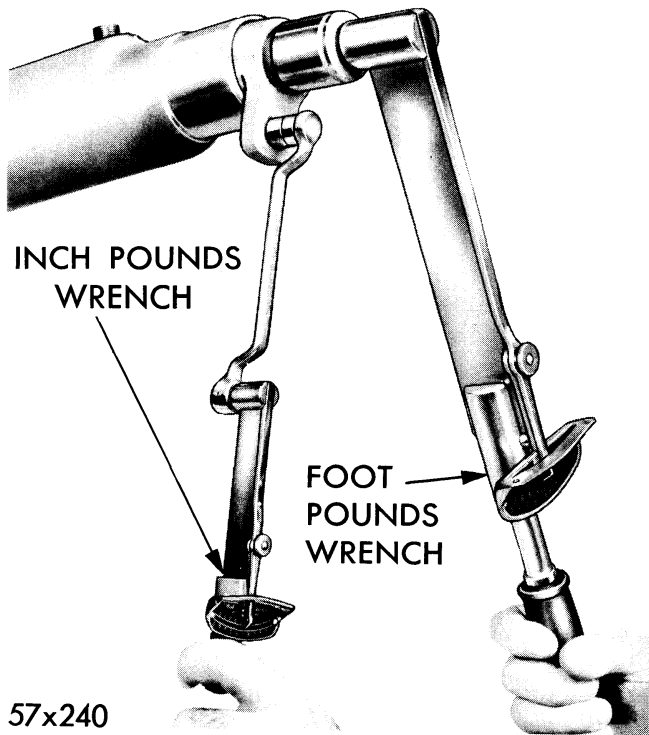


Figure 58—Adjusting Worm Housing Bearing (Final)

Remove the steering wheel using puller C-612, then remove the steering column jacket and tube. Remove tube coupling bolt and washer from the center of the coupling. Using Tool C-3392, remove the coupling from worm shaft, then remove the worm housing oil seal.

Remove steering connecting rod (drag link) from steering gear arm. Back off gear lash adjusting screw until the lash is maximum.

WORM SHAFT BEARING ADJUSTMENT

Slide Tool C-3320-A over adjusting nut, and Tool C-3319 on the splines of the worm shaft with sufficient space between tools to life C-3320-A off the adjusting nut. Turn the steering gear to the full left turn and hold in this position with a foot-pound torque wrench, as shown in Figure 57.

Attach torque wrench C-3380 to C-3320-A in an in-line position. Lift wrench off nut and re-position with torque wrench down or slightly to your left. While holding five foot-pounds (left) tension with the large wrench, loosen nut with small wrench and adjust to exactly five inch-pounds, as shown in Figure 58. Remove tools with extreme caution so as not to move adjusting nut. Crimp ring section of adjusting nut into keyway in worm shaft, with care not to move adjusting nut.

PISTON VALVE ADJUSTMENT

Start the engine and run at medium idle speed. Allow the steering gear to reach maximum normal operating

temperature. Attach a small tap handle (or equivalent) to the flat on end of Tool C-3445, then insert tool through the worm shaft over the end of piston valve rod.

With the foot-pound torque wrench on the steering arm nut, read tension while turning the steering gear to full right and full left. Wrench movement should be smooth. Turn the piston valve in the direction necessary to produce the same torque reading in both directions. Torque reading must be equal and under 40 foot-pounds.

If the torque reading is equal at less than 25 foot-pounds, a much more accurate adjustment can then be made with the 300 inch-pound torque wrench, using the same procedure.

GEAR LASH ADJUSTMENT

With engine running and steering gear at normal operating temperature, turn steering gear to the straight ahead position.

Using a very light finger-tip touch at the end of the steering gear arm, turn gear shaft adjusting screw clockwise until all gear lash has been eliminated. Turn adjusting screw $\frac{3}{4}$ turn tighter (clockwise) and tighten lock nut.

Stop engine. Install worm housing oil seal, lip of seal down. With gear still in straight-ahead position, install coupling on worm shaft with slot in up-and-down position. Install drag link on steering gear arm then install steering tube, steering wheel, etc.

FRONT END ALIGNMENT

Front end alignment is very important, not only from the point of excessive tire wear, but ease of handling as well. For procedures on checking front end alignment and specifications, refer to Front Suspension Section in this manual.

TIE RODS

Whenever it becomes necessary to install new tie rods and/or tie rod ends, make definitely sure when adjusting toe in, that both tie rod end tubes are turned an equal amount. Clamp bolts must be positioned horizontally below the tube. Make sure the tie rod ball studs are positioned so they do not bind on edges of sockets, check by turning the tie rods back and forth after the clamp bolts have been tightened.

STEERING GEAR SHAFT OIL SEAL (Unit Mounted in Car)

REMOVAL—Remove steering gear arm nut and lock-washer and remove steering arm and transverse link from steering gear shaft. Remove steering gear shaft oil seal lock ring (circular section). Using Tool C-3350, as outlined in disassembly, remove steering gear oil seal.

INSTALLATION—Before attempting to install a new seal, thoroughly clean the sealing surfaces on the gear shaft and counterbore of steering gear housing.

Lubricate a new steering gear shaft oil seal with lubricate and place (lip of seal down) on a piece of clean paper.

CAUTION

Do not remove garter spring when installing seal.

Carefully install tapered end of sleeve (part of Tool C-3350) in seal and slide seal back approximately $\frac{1}{4}$ inch on sleeve. Install this assembly (lip of seal toward housing) over steering gear shaft until seal contacts counterbore in housing. Using Tool C-3350, push seal into position by installing adaptor over sleeve, and installing coupling nut on shaft threads until shoulder of adaptor contacts housing. Remove nut and adaptor. Wrap a new piece of friction tape around sleeve to provide a firm grip and with a turning motion, remove sleeve from seal and gear shaft. Seal is then positioned properly.

Install oil seal lock ring (circular section), make sure it is properly seated. Install steering arm and transverse link then install steering gear arm lockwasher and nut, tighten from 100 to 120 foot-pounds.

LUBRICATION

Proper lubrication of the steering gear and front suspension is very important on vehicles equipped with Power Steering. Lubrication of the tie rods remain the same as specified for manual steering.

REFILLING HYDRAULIC SYSTEM

If oil has been removed from hydraulic system, bleed the steering gear as follows: Start engine and allow to run from a short time to circulate oil through the hoses. With the engine running at idle speed, turn the steering wheel back and forth several times from extreme right to left to bleed any remaining air out of the system. Check the level in reservoir. Add oil if needed to reach level mark. Total capacity approximately 2 quarts.

INSTALLATION OF COAXIAL STEERING GEAR

(In Car)

Install the steering gear assembly through the floor pan, and down into position. Install housing to frame attaching bolts, flat washers, and nuts but do not tighten. Install access plate.

Install rubber pad in coupling. Engage steering shaft with coupling and install pin. Slide steering column

housing down over steering shaft and on to housing. Install turn signal lever being sure column jacket does not restrict lever. Tighten jacket to coaxial housing clamp. Connect turn signal and horn wires. Install steering column to instrument panel bracket and shroud.

Install steering wheel. If clearance between steering column jacket and wheel is less than $\frac{1}{8}$ inch, adjust steering column jacket to provide proper clearance.

Tighten front upper and lower gear housing to frame attaching bolts to 20 foot-pounds torque. Install wedge over rear bolt between housing and frame, tapping lightly in place. Tighten three attaching bolts to 70 foot-pounds torque.

Install horn ring and horn wire in steering wheel. Install horn ring ornament. Connect hoses from steering gear to hydraulic pump.

If car is equipped with standard 3 speed transmission, install gear shift tube and connect linkage.

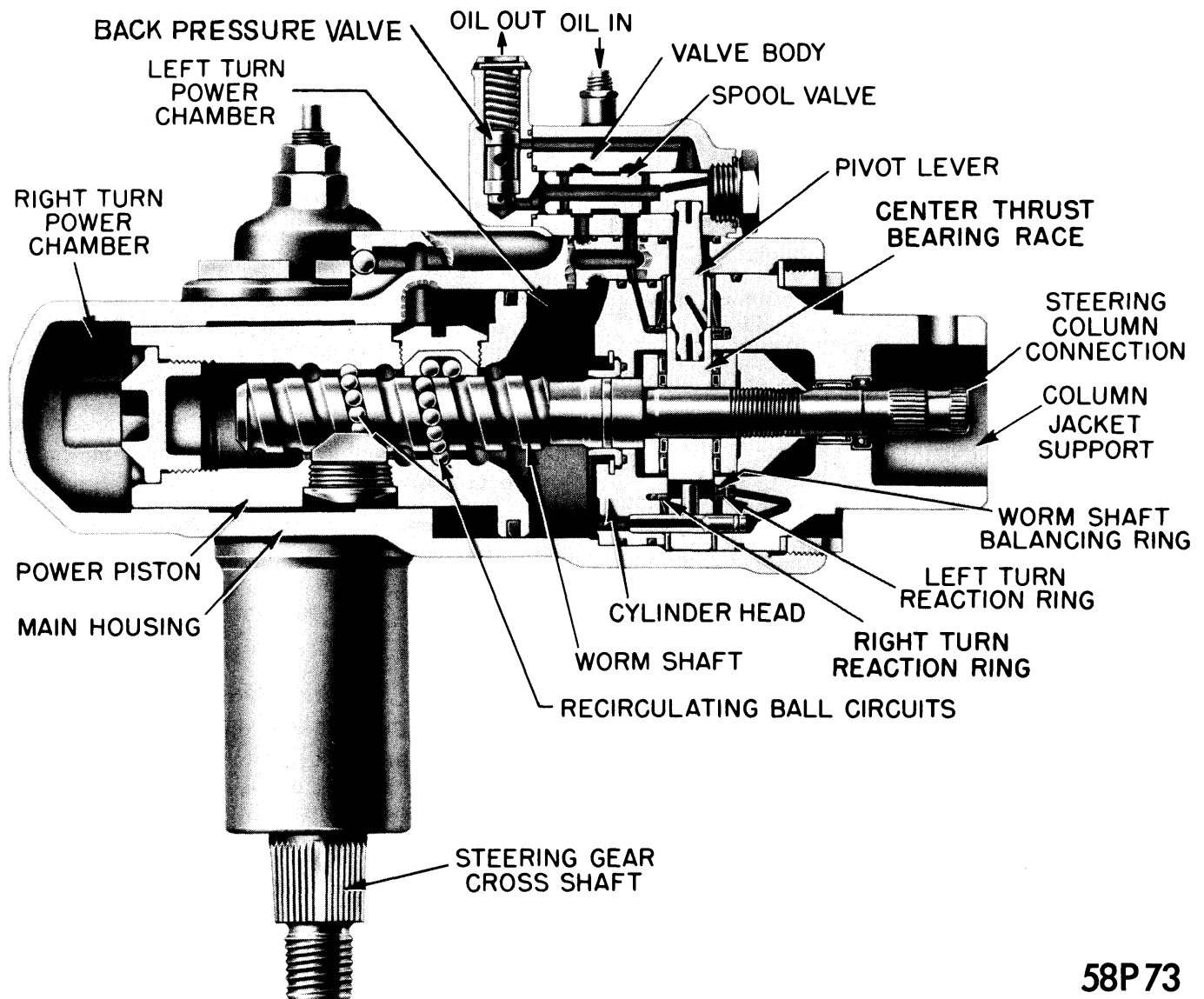
8. CONSTANT CONTROL POWER STEERING

OPERATING PRINCIPLES

The Constant Control Power Steering is a completely new power steering gear system consisting of a hydraulic pressure pump, a power steering gear and connecting hoses. The power steering gear, as shown in Figures 59 and 60, consists of a gear housing, containing a gear shaft and sector gear, and a power piston with gear teeth milled into the side of the piston. The piston is in constant mesh with the gear shaft sector teeth, and a worm shaft connects the steering wheel to the power unit piston through a coupling. Figure 60 shows how the wormshaft is geared to the piston through recirculating ball contact. At the upper end of the piston, a flange carries the rubber "D" ring which separates the power chambers of the piston.

A steering gear valve lever upper end is fitted into a spool valve in the steering gear valve body and the bottom end into a radially drilled hole in the thrust bearing center race. The valve lever pivots in the bearing center race spacer. The spacer is compressed at its outer diameter between the steering gear cylinder and the column jacket support, holding the spacer in a fixed position. The center thrust bearing race which tips the valve lever (which in turn actuates the steering valve) is held firmly against a shoulder on the worm shaft by two thrust bearings, bearing races and an adjusting nut. The center thrust bearing race is, in effect, clamped axially to the wormshaft and must therefore move with the wormshaft whenever the steering wheel is turned.

In this description the left end of the steering gear means the lower end, and the right end means the



58P73

Figure 59—Steering Gear (Sectional View)

upper end of the steering gear. For simplicity, direction of flow will be described as flowing to left or flowing to right as shown in the following illustrations.

When the car is in the straight-ahead direction, the steering valve is in the neutral (center) position and oil flow through both of the grooves in the steering valve body is equal, since, in the neutral position, as shown in Figure 61, the two lands of the steering valve are centered in the grooves of the valve body. The left oil passage directs its oil where it contacts the right end of the power piston and across into the right reaction chamber. Part of this oil is forced around the grooves of the wormshaft, inside the piston and around the recirculating balls, to the hollow area between the left end of the wormshaft and the left end of the power piston.

Pressure on end of wormshaft is balanced by the pressure against the area of the wormshaft balancing ring.

At the same time, oil from the right groove in the steering valve is directed to the left, through a galley, parallel to the wormshaft. This oil flows to the area to the left of the power piston flange. Part of this oil is then directed through the cylinder head into the left reaction chamber.

Forces exerted on the piston through oil pressure on its faces are completely balanced by two reaction rings. These are shown in cross section in Figure 62 on either side of the pivot lever through the center bearing race. The reaction ring shown to the left of the center bearing race is fed oil from the right-turn power chamber oil galley through a drilled hole, as shown in Figure 62.

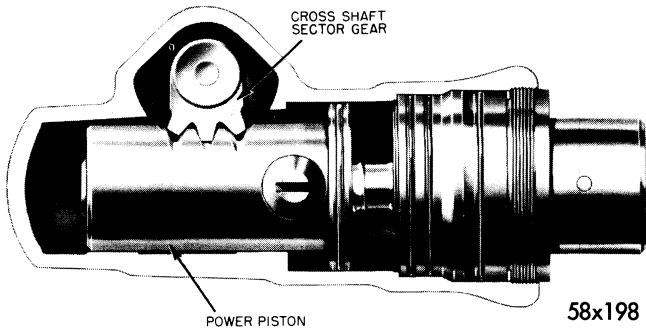


Figure 60—Steering Gear Housing (Sectional View)

When the driver makes a left turn, power is immediately provided by the unit to effect the turn. As the wormshaft rotates inside the power piston, the piston is prevented from instantly "climbing down" the wormshaft by the resisting forces which the steering linkage and wheels transmit to the steering gear cross-shaft. Instead, the wormshaft is "drawn out" of the piston a very small amount (a few thousandths of an inch). The center thrust bearing race, which is in effect clamped axially to the wormshaft, moves the same distance. The race thus tips the pivot lever and moves the spool valve to the left (down).

The oil flow diagram for a left turn is shown in Figure 63. Here it can be seen that as the left edges of the two lands on the valve approach the groove edges of the valve body, two things happen: First, flow to the right groove in the valve body is reduced. Secondly, the flow of oil to the left groove is increased because the opening is larger. Oil then flows from the power steering pump through the enlarged orifice and through the oil galley to the left turn power chamber of the piston. Since the supply of oil to the left side (right turn chamber) of the piston has been cut off by movement of the steering valve, a force unbalance on the piston exists, and it is pushed to the left. Its linear movement is translated into rotation of the cross-shaft sector gear, see Figure 60, and subsequently through the steering linkage to the front wheel.

This entire action takes place instantaneously whenever the steering wheel is turned to the left, as shown in Figure 64.

In the reaction area of the steering unit another action takes place simultaneously as the wheel is turned to the left. The restraining force of the reaction spring must be overcome before the center race can move to the right. The force of the reaction spring provides positive returnability to the unit. At the instant when power assistance is no longer desired by the driver, the reaction spring and operating oil pressure move the race and spool valve back to the neutral position. Equal oil flow then is directed through the unit, and no power assist is provided.

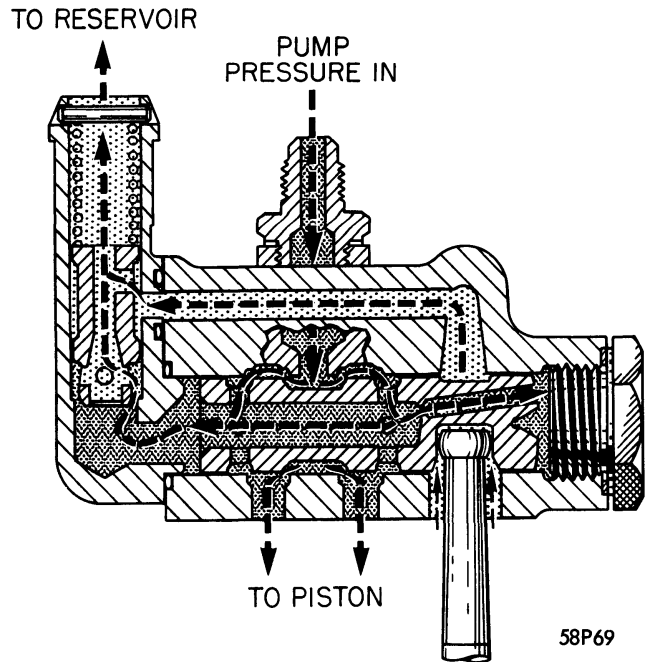


Figure 61—Steering Gear Valve (Neutral Position)

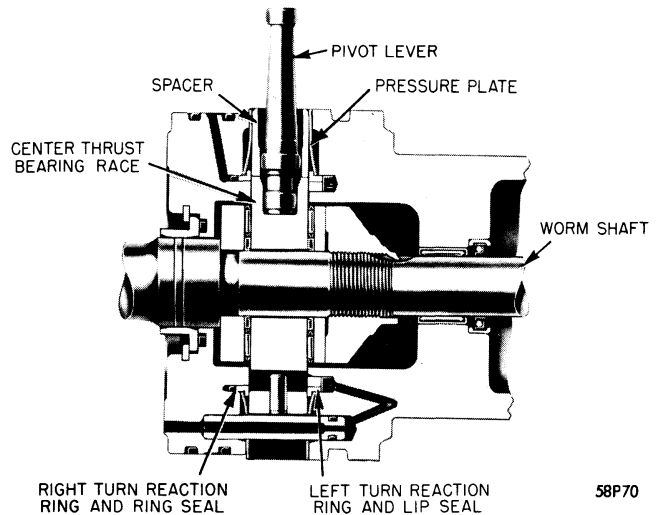


Figure 62—Reaction Area

The force of this reaction spring also contributes to increased on-center "feel". The "feel" is further provided by operating oil pressure which tends to return the center thrust bearing race to its neutral position. The driver feels this force on the reaction rings, see Figure 61, as a force proportional to operating oil pressure. It causes the driver to exert a steering effort proportional to the total force required to turn the front wheels of the car. The force he actually exerts is only a small percentage of the total force that would be required to steer the car with a manual gear. If oil pressure is interrupted in the steering gear, it would operate

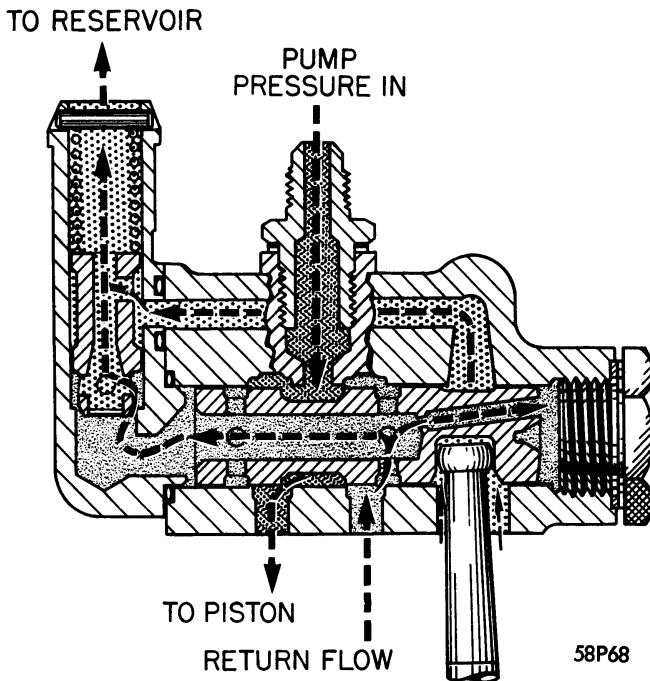


Figure 63—Steering Gear Valve in Left Turn Position

with increased effort and there would be more steering wheel free play. Steering wheel movement by the driver will turn the wormshaft inside the power piston causing it to move right or left. The steering wheel movements will travel through the wormshaft and piston to turn the cross-shaft sector gear, and through the steering linkage to the front wheels. Complete steering control is retained by the driver if a lack of power assist condition should ever arise.

9. CONSTANT CONTROL POWER STEERING — REMOVAL AND INSTALLATION

REMOVAL

Disconnect battery ground cable. Disconnect horn wire. Remove horn button and horn ring and disconnect horn wire. Remove steering wheel nut and pull steering wheel with Tool C-3428.

Disconnect the direction signal wires at the connectors. Remove the jacket tube support bracket at instrument panel. Loosen the two bolts attaching the jacket tube to steering housing, push the jacket tube upward to expose the steering tube coupling pin and remove pin.

Remove cotter key and nut at the drag link to steering arm ball joint. Disconnect the pressure and return hoses at steering gear. Fasten the disconnected ends of hoses above oil level in reservoir. Cap ends of hoses and fittings on steering gear.

Remove steering arm nut and washer at steering gear shaft. Slide Tool C-3646, Figure 65, up on steering arm

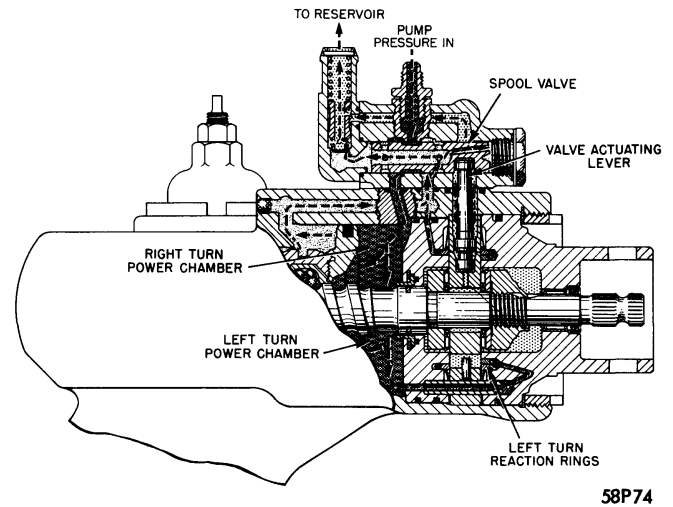


Figure 64—Oil Flow (Left Turn Position)

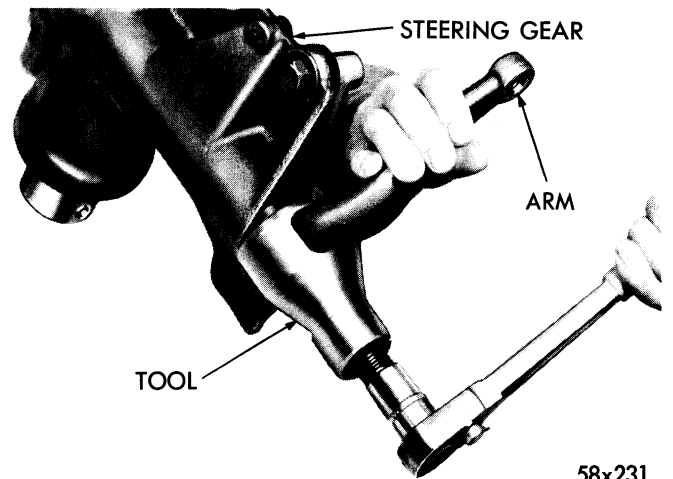


Figure 65—Removing Steering Gear Arm With Puller C-3646

and place shoe of puller behind steering arm. Tightening tool center screw against gear shaft will push steering arm from shaft. Remove the gear housing to frame bolts and remove steering gear at engine compartment.

INSTALLATION

Enter steering gear through engine compartment and install attaching bolts and spherical washers. Tighten bolts finger tight only. Align the steering tube coupling with the steering column tube and install coupling pin, insulator and inserts.

Slide the jacket tube down in position over the steering gear housing and tighten clamp bolts. Install jacket tube at instrument panel. (Do not tighten). Connect direction signal wires at connectors. Install steering wheel and steering wheel nut. Tighten nut to 40 foot-pounds torque. Install horn wire, stationary plate, bushings, horn ring and attaching screws. Do not overtighten

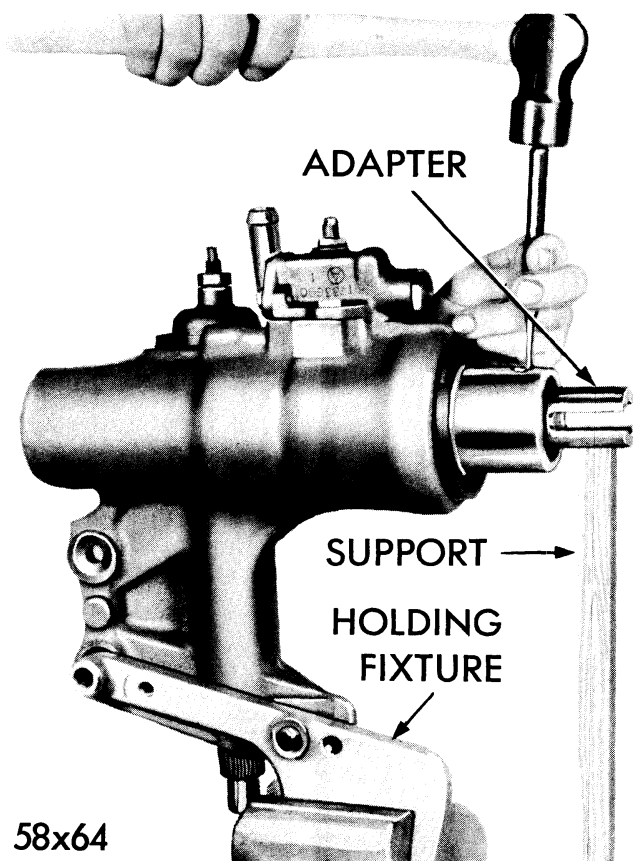


Figure 66—Removing Coupling Pin

screws (horn ring must be free to flex). Install steering wheel ornament.

NOTE

Check to make certain that cancelling dogs on steering column actuate the direction switch.

If distance between steering column jacket and steering wheel is more or less than $\frac{1}{8}$ inch, adjust column jacket and tighten jacket clamp bolt.

Tighten the jacket to dash panel support bracket screws. Tighten the steering gear housing to frame attaching bolts to 50 foot-pounds torque. Install steering arm and tighten nut to 120 foot-pounds torque. Connect the pressure hoses. Refill the reservoir and gear housing.

10. CONSTANT CONTROL POWER STEERING — SERVICE PROCEDURES

DISASSEMBLY

Clean the gear assembly thoroughly in a suitable solvent and install unit in hold fixture C-3323, as shown in Figure 66.

When disassembling, each part should be placed in a suitable solvent, washed, then dried by dry com-

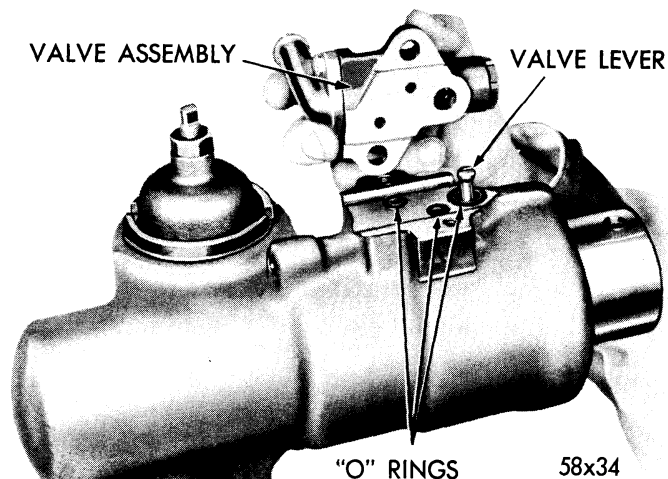


Figure 67—Removing or Installing Valve Body Assembly

pressed air. Careful handling of parts must be exercised to avoid the occurrence of nicks and burrs. Crocus cloth may be used to remove small nicks or burrs provided it is used carefully. When used on the steering gear valve, use extreme care not to round off the sharp edge portions of the two lands located between the valve drilled holes. The sharp edge portion of these two lands is vitally important to this type of valve.

Remove and discard all "O" seal rings and seals, using new ones lubricated with petrolatum when reassembling. To disassemble the power steering unit for repair or overhaul refer to Figure 60, then proceed as follows:

Drain the steering gear through the pressure and return connections by turning the steering tube coupling from one extreme of travel to the other. Remove coupling pin, as shown in Figure 66, and remove coupling.

NOTE

Support the coupling when driving the pin out to avoid damaging the bearings.

Remove the valve body housing attaching screws and remove valve body and the three "O" rings, as shown in Figure 67. Remove valve lever by prying under the spherical head, as shown in Figure 68. Do not use pliers.

NOTE

Use care not to collapse slotted end of the valve lever as this will destroy the bearing tolerances of the spherical head.

Loosen gear shaft adjusting screw locknut. Remove gear shaft cover nut with wrench Tool C-3633.

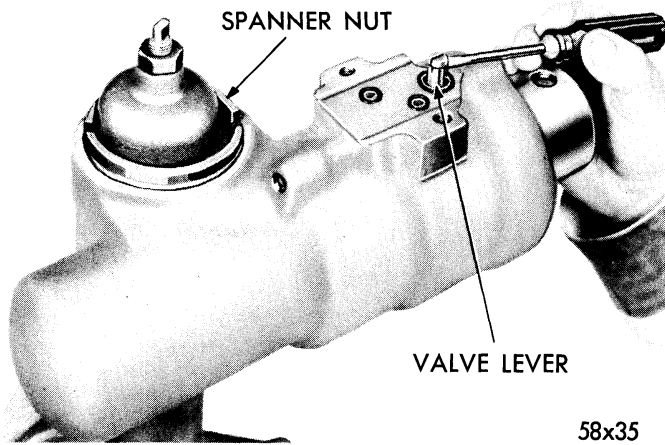


Figure 68—Removing Valve Lever

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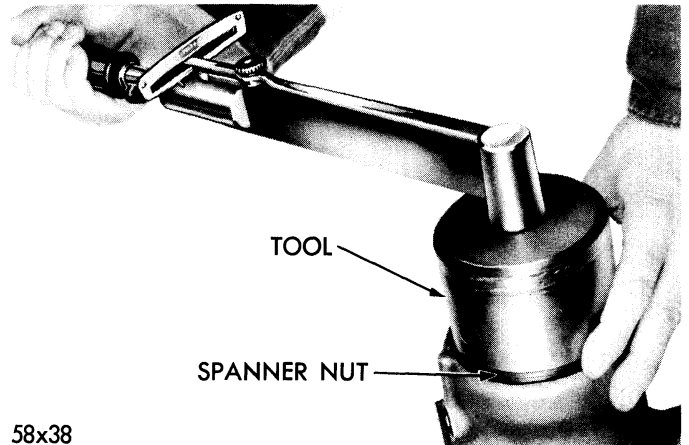


Figure 71—Removing Steering Column Support Nut With Tool C-3634

58x38

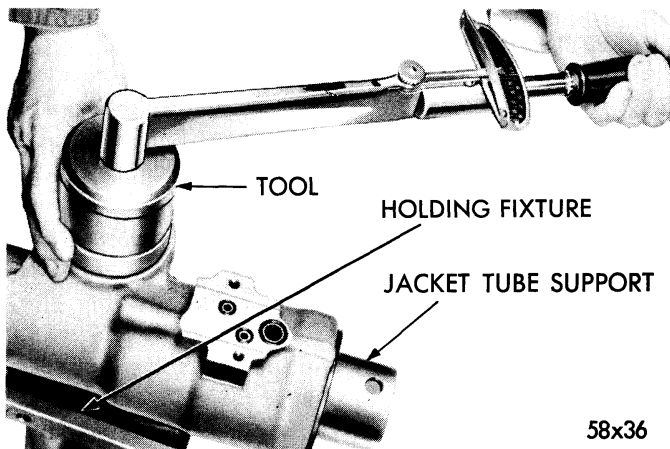


Figure 69—Removing or Installing Gear Shaft Cover Nut With Tool C-3633

58x36

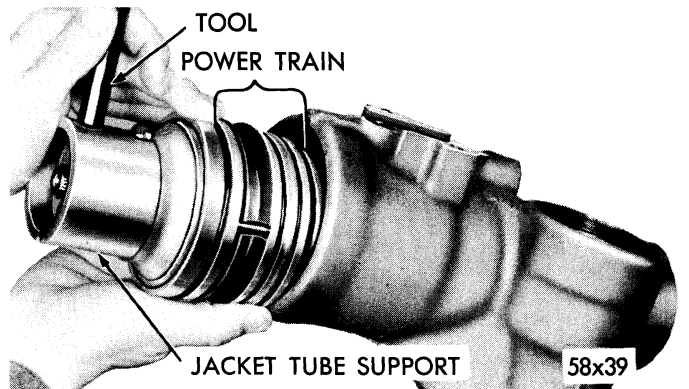


Figure 72—Removing or Installing Power Train

58x39

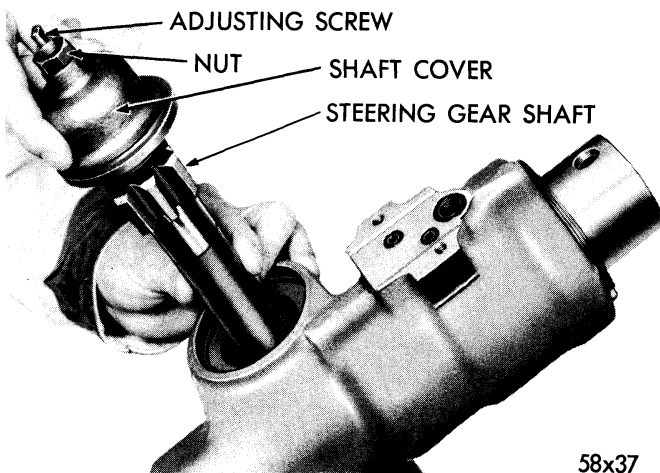


Figure 70—Removing or Installing Gear Shaft and Cover Assembly

58x37

Rotate worm shaft to full right turn, then return wormshaft and piston to center of travel to remove gear shaft and cover as an assembly, as shown in Figure 70.

Remove the steering column support nut with Tool C-3634, as shown in Figure 71, and remove tanged washer.

NOTE

There will be a discharge of oil when shaft and cover are pulled from housing.

Turn worm shaft to full right position to compress parts and back off as necessary to align holes in column and worm shaft. Enter a piece of drill rod or suitable drift through the holes in jacket support and wormshaft to keep the parts from turning and carefully remove the power train as a complete assembly, as shown in Figure 72. Remove steering gear housing from vise.

DISASSEMBLY OF POWER TRAIN

Place power train in a vise equipped with soft jaw protectors to avoid damaging the piston assembly. Remove column jacket support assembly, reaction spring, reaction ring, and spacer, ferrule "O" ring center, and bearing spacer.

Hold the worm shaft from turning, then turn nut slightly to left to shear the staked portion of the nut and carefully pick out locking portion of the bearing adjusting nut out of the notch in the worm shaft.

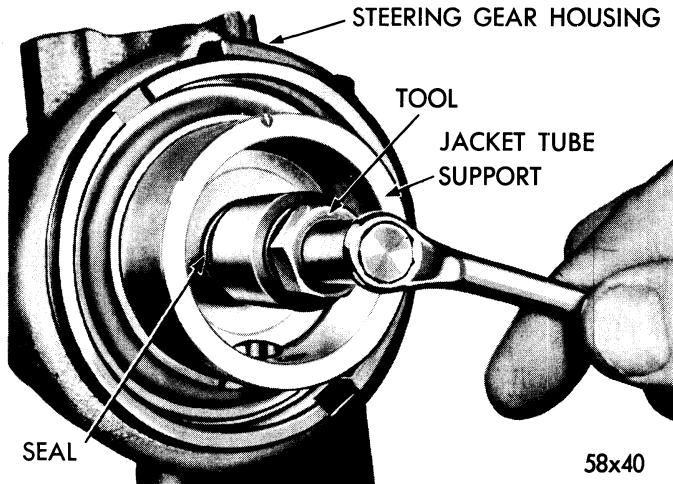


Figure 73—Removing Worm Shaft Upper Oil Seal With Tool C-3638

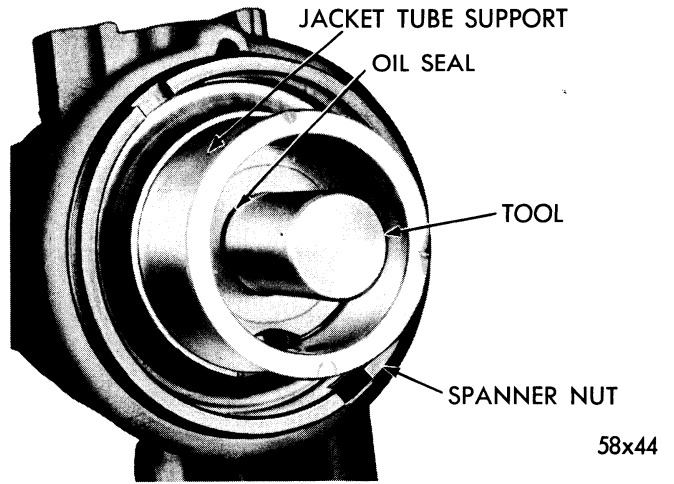


Figure 75—Installing Worm Shaft Upper Oil Seal With Tool C-3650

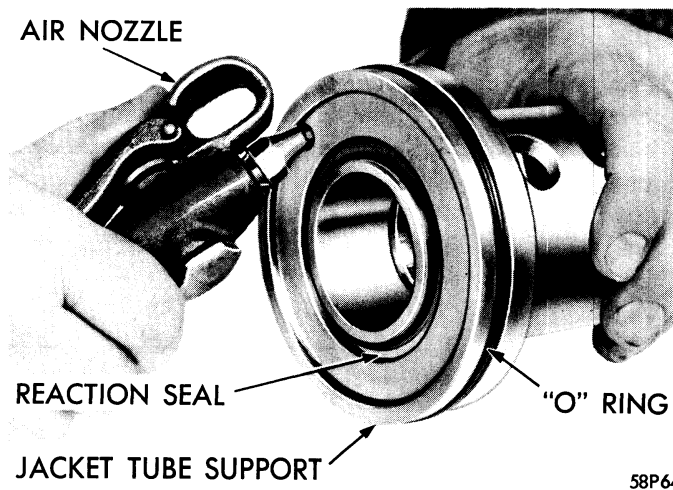


Figure 74—Removing Reaction Seal From Jacket Support

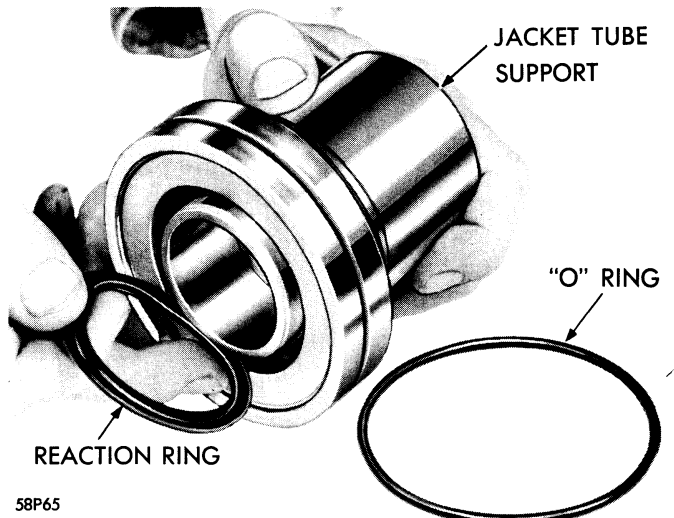


Figure 76—Installing Reaction Seal Into Jacket Support

REASSEMBLY

Install worm shaft upper oil seal with sealing lip toward bearing, as shown in Figure 75. Use Tool C-3650 and drive seal until tool bottoms on casting to obtain proper compression on rubber seal. Lubricate reaction seal and install in groove in face of column jacket support with flat side of seal out, as shown in Figure 76.

Remove thrust bearing nut, upper thrust bearing race (thin), upper thrust bearing, center bearing race, lower thrust bearing, lower thrust bearing race (thick), lower reaction ring and lower reaction spring. Remove cylinder head assembly.

NOTE

The worm and piston assembly is furnished as a complete assembly only.

COLUMN JACKET SUPPORT ASSEMBLY DISASSEMBLY

Remove worm shaft upper oil seal with puller Tool C-3638, as shown in Figure 73. Remove large "O" ring from groove in jacket support. Remove reaction seal from groove in face of jacket support by blowing air pressure into the ferrule chamber, as shown in Figure 74. Inspect grooves for burrs. Make sure passage from ferrule chamber to upper reaction chamber is unobstructed.

NOTE

Column jacket support and worm shaft upper bearing are serviced as an assembly.

CYLINDER HEAD DISASSEMBLY

Remove the two "O" rings in the two outer grooves in the cylinder head. Remove the lower reaction "O"

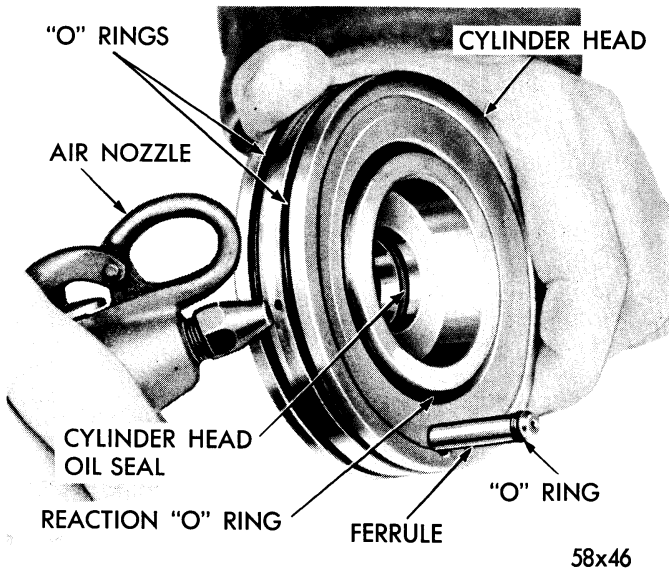


Figure 77—Removing Reaction Ring From Cylinder Head

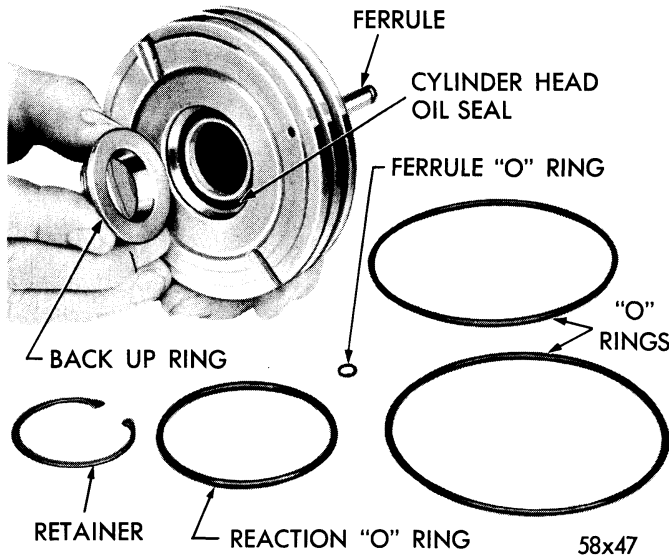


Figure 78—Removing Cylinder Head Seal

ring in groove in face of cylinder head with air pressure into oil hole located in groove between the two "O" ring grooves, see Figure 77. Inspect the worm shaft seal in the cylinder head counterbore for possible damage, replace cylinder head seal if necessary, see Figure 78. Check oil passage in ferrule for obstruction. Check lands of cylinder head for burrs.

REASSEMBLY

Lubricate the two large "O" rings and install in grooves on cylinder head. Install the lower reaction seal in groove in face of cylinder head. The small "O" ring for the ferrule groove should be installed after worm shaft bearing preload has been established otherwise "O" ring will be damaged by the reaction springs.

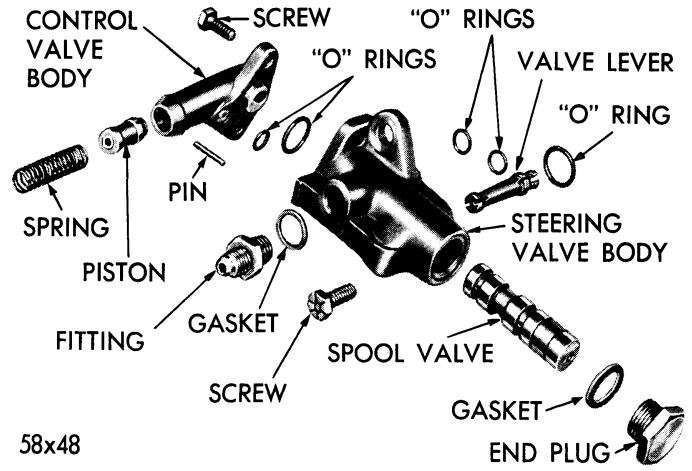


Figure 79—Control Valve (Disassembled)

STEERING VALVE DISASSEMBLY

Compress pressure control valve spring and remove spring retainer pin, spring and pressure control valve piston. Remove the two screws attaching the pressure control valve body to the steering valve and remove valve body. Carefully shake out the valve piston, see Figure 79. Do not remove the valve and plug unless inspection indicates a leak at the seal.

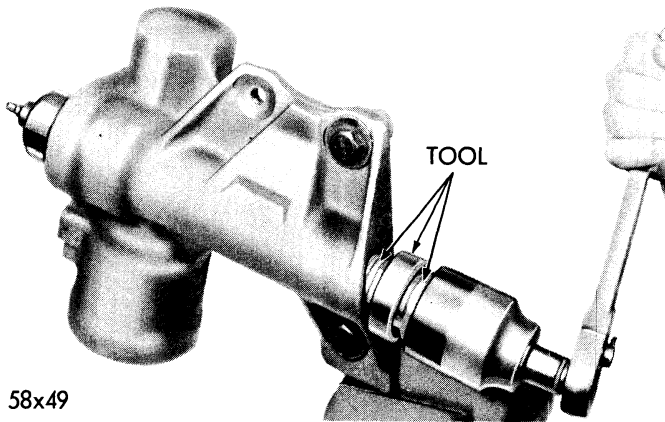
NOTE

If steering valve or valve housing is damaged, it will be necessary to replace the complete valve assembly.

REASSEMBLY

If steering valve was removed from valve housing, install the valve in the valve housing so that the valve lever hole is aligned with the steering gear valve lever opening in the bottom of the valve housing. Valve must fit smoothly in housing without sticking or binding. If valve end plug had been removed, install new seal and tighten plug to 50 foot-pounds torque.

Lubricate pressure control valve piston and slide it into the pressure control valve body (nose end first) see Figure 79. Install the pressure control valve spring on top of the valve piston. Compress spring and install the spring retainer pin through both holes at top of pressure control valve body. Assemble pressure control valve body to main valve with the two attaching screws. Tighten screws to 10 foot-pounds torque. Install new copper sealing gasket and fitting in threaded hole on top of valve body. Tighten to 30 foot-pounds torque.



58x49

Figure 80—Removing Gear Shaft Oil Seal

GEAR SHAFT DISASSEMBLY

Remove gear shaft adjusting screw lock nut and unscrew cover from adjusting screw. Remove screw and washer from "T" slot in end of gear shaft. Remove small "O" ring from top of cover and large "O" ring from base of cover.

NOTE

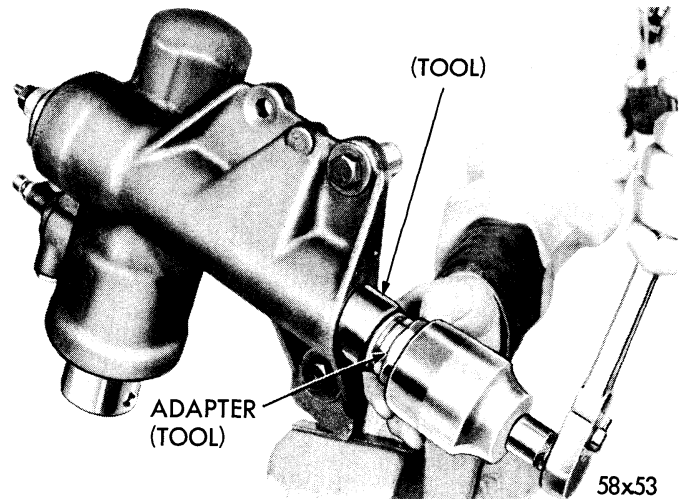
The gear shaft cover and bearing are serviced only as an assembly.

REASSEMBLY

Place adjusting screw washer over adjusting screw and slide both the "T" slot of gear shaft. Screw cover onto the adjusting screw until gear shaft bottoms in cover. Lubricate a new small "O" ring and install it over the adjusting screw into position at top of gear shaft cover. Install adjusting screw lock nut on adjusting screw but do not tighten. Lubricate a new large "O" ring and "O" ring groove heavily with petrolatum. Install "O" ring in groove on lower face of gear cover.

STEERING GEAR HOUSING DISASSEMBLY

Attach steering gear housing on holding fixture Tool C-3323 and install holding fixture in a vise. Remove oil seal snap ring with pliers Tool C-760. Remove seal back-up washer. Remove the gear shaft oil seal with adapter SP-3056 and Tool C-3350 as follows: Slide the threaded portion of adapter SP-3056 over end of gear shaft and install the threaded nut section of Tool C-3350 on the shaft, as shown in Figure 80. Maintain pressure on adapter SP-3056 with nut of Tool C-3350 while turning adapter SP-3056, forcing it into seal, until it has bottomed in the seal. Apply the two half rings and retainer over both portions of tool. As hexagon nut is removed from the shaft the seal will be pulled from the housing.



58x53

Figure 81—Installing Gear Shaft Oil Seal

NOTE

Steering gear housing with inner and outer gear shaft needle bearings is serviced as an assembly.

REASSEMBLY

Install gear shaft oil seal in gear housing (lip of seal toward needle bearing) using Adapter Tool SP-3052 and Tool C-3350. Place adapter against seal and the tool nut on the threaded end of gear shaft. Tighten tool nut until adapter shoulder contacts housing, as shown in Figure 81. Install oil seal back-up washer, and snap ring. Make sure snap ring is seated in groove.

ASSEMBLY OF POWER TRAIN

Place piston assembly on work bench in a vertical position (worm shaft up). Slide cylinder head assembly (with ferrule up) on worm shaft and against piston flange, as shown in Figure 82.

Lubricate and install in the following order. Lower thrust bearing race (thick), lower thrust bearing, lower reaction spring over ferrule, lower reaction ring (with flange up so that the ring protrudes through the reaction spring), center bearing race indexing control lever hole

NOTE

If worm shaft is turned more than one-half turn, the cylinder head seal will clear the oil ring on the worm shaft. Always check position of worm shaft oil ring before bottoming cylinder head against worn piston shoulder to avoid damaging oil ring.

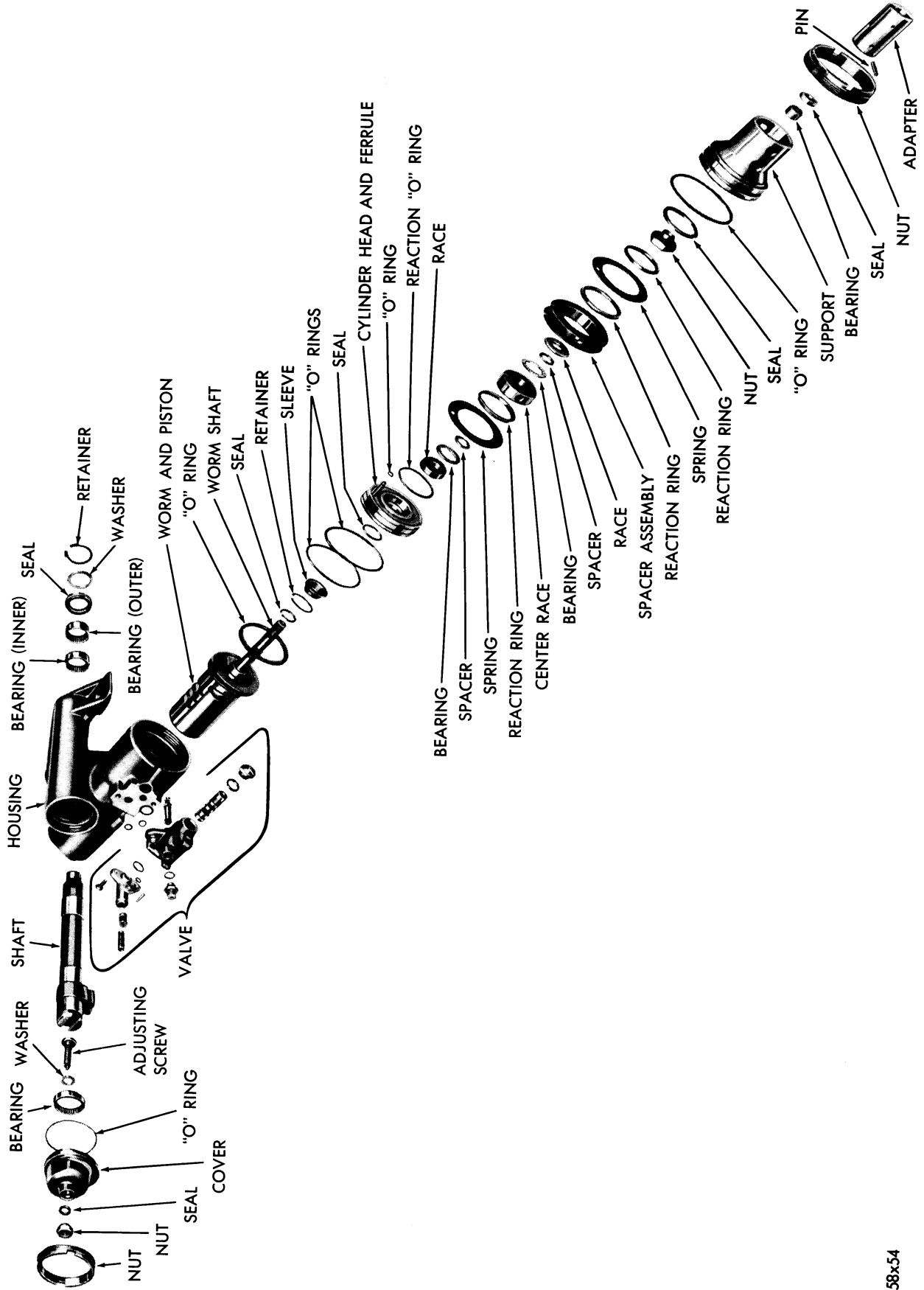


Figure 82—Steering Gear (Disassembled View)

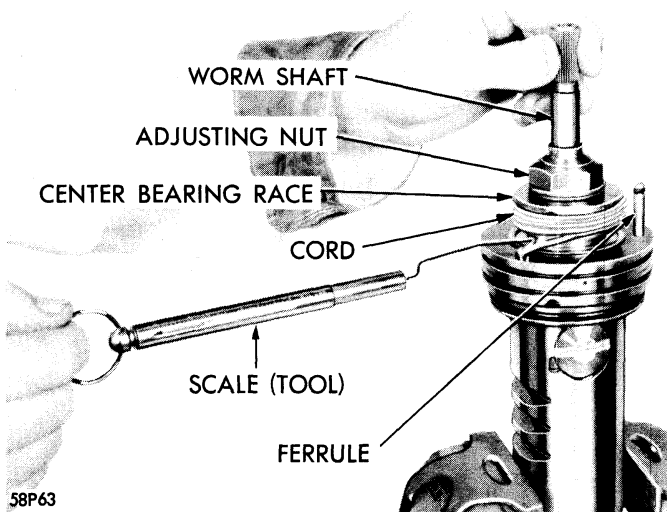


Figure 83—Checking Center Bearing Race Preload

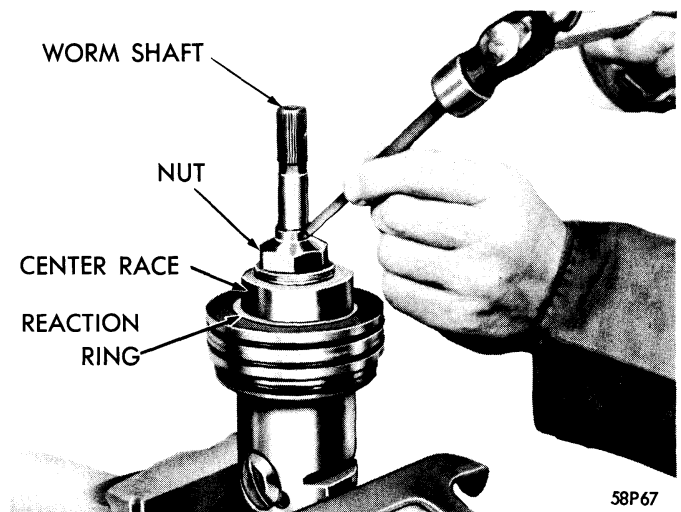


Figure 84—Locking Worm Shaft Bearing Adjusting Nut

with hole in center bearing race, see Figure 62. Install outer spacer, upper thrust bearing, upper thrust bearing race (thin) and a new worm shaft thrust bearing nut. Tighten nut as follows: Turn worm shaft counter-clockwise one-half turn and hold worm shaft in this position while tightening nut to 10 foot-pounds torque.

Rotate the worm center bearing race several turns to position all parts, then loosen adjusting nut. Retighten the worm bearing adjusting nut to give a bearing torque of 8-16 ounces. Check torque by placing several rounds of cord around the center bearing race. Make a loop in one end of cord and hook the loop of distributor breaker arm spring scale, Tool MTU-36 in the cord loop, as shown in Figure 83. Pulling on the cord will cause the bearing race to rotate. If adjusting nut is tightened properly, reading on scale should be 8 to 16 ounces. Depress flange of adjusting nut into depression in worm shaft to lock securely, as shown in Figure 84.

NOTE

The torque of 8-16 inch ounces must remain after the adjusting nut is securely locked.

Install center bearing spacer over center bearing race to engage dowel pin with slot in center bearing race, as shown in Figure 85. Place inner and outer reaction rings over center spacer and install upper reaction spring with cylinder head ferrule through hole in spring. Install a new "O" ring in ferrule groove. Place lubricant in small bore of column jacket support (for cylinder head ferrule). Install the jacket support over the worm shaft carefully engaging the cylinder head ferrule and "O" ring and making sure reaction rings enter groove in jacket support.

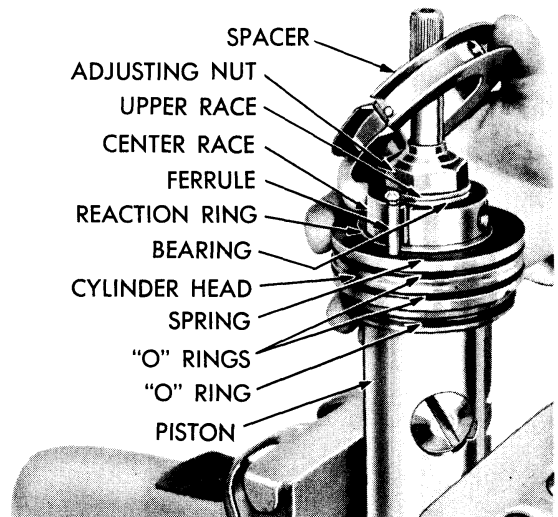


Figure 85—Aligning Center Bearing Spacer

Align parts on power train so that valve lever hole in center bearing spacer is 90 degrees counter-clockwise from piston rack teeth and lock all parts to the worm shaft by entering a drill rod or suitable drift through jacket support and worm shaft holes.

REASSEMBLY OF STEERING GEAR

With steering gear housing in holding fixture Tool C-3323 in approximate car position; lubricate bore of housing with petrolatum and carefully install power train assembly, see Figure 72, with center bearing

IMPORTANT

Place an .0015 inch feeler stock to cover the aligning notch in the steering gear housing to protect the "O" ring seals when installing the gear train.

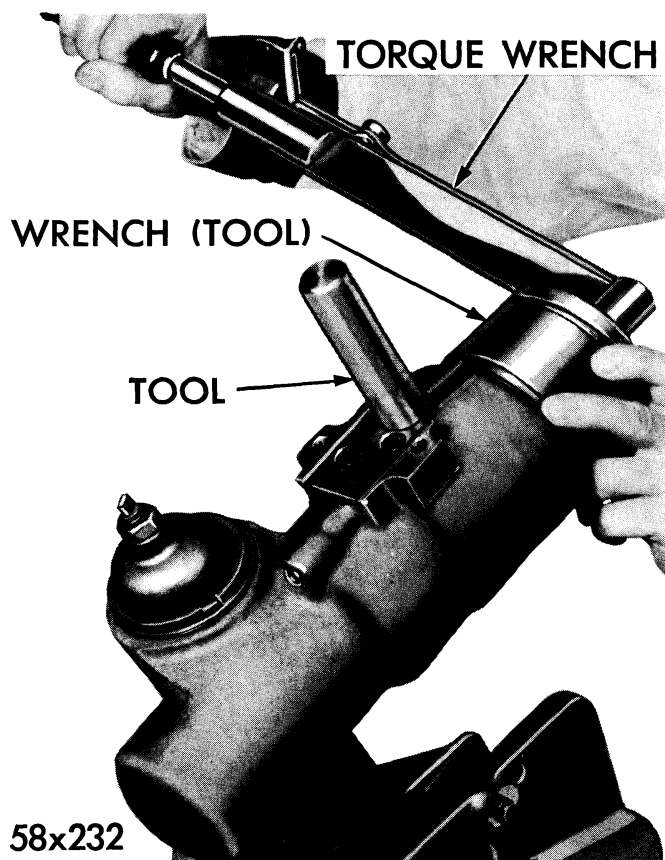


Figure 86—Alignment of Bearing Spacer and Center Bearing Race with Aligning Tool C-3649

spacer valve lever hole in "up" position to line up with control valve lever clearance hole in the steering gear housing.

Make sure cylinder head is bottomed on housing shoulder, see Figure 60. Do not remove power train locking pin, see Figure 72, until all parts are positioned in steering gear housing.

Align valve lever hole in center bearing spacer exactly with clearance hole in housing with aligning Tool

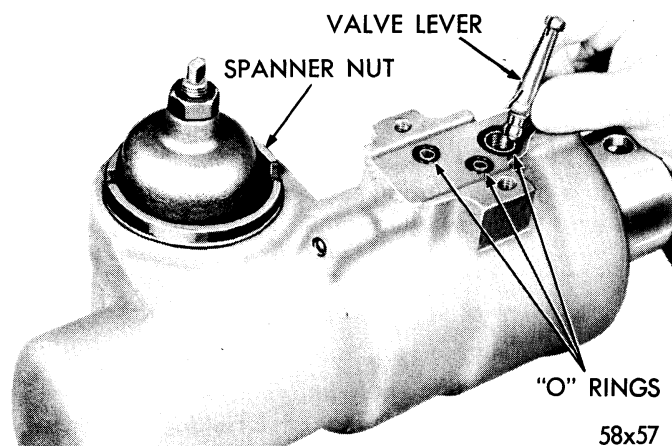


Figure 87—Installing Valve Lever

C-3649. Tool should not be removed until spanner nut is securely tightened, as shown in Figure 86.

Install column support spanner nut and tighten to 150 foot-pounds torque with Tool C-3634, see Figure 71.

Set piston at center of travel and install gear shaft and cover assembly so that sector teeth index with piston rack teeth. Make sure "O" ring is positioned in face of cover, see Figure 60.

Install cover spanner nut and tighten to 100 foot-pounds torque with Tool C-3633, see Figure 69. Install valve lever (double bearing end first) into center bearing spacer through hole in steering housing so that slots in the valve lever are parallel to worm shaft in order to engage the anti-rotation pin in center bearing race, as shown in Figure 87.

Install valve body on housing making sure that the valve lever enters the hole in the piston, see Figure 67. Be sure "O" ring seals are in place. Tighten valve mounting screws to 30 inch pounds.

11. CONSTANT CONTROL POWER STEERING — TEST AND ADJUSTMENTS

Remove oil reservoir cover and fill reservoir to level marks. Connect test hoses C-3211 and C-3318 with proper adapters to hydraulic pump on car with pressure gauge C-3309B installed between pump and steering gear to register pressures. Start engine and operate at idle to bring steering gear to normal operating temperature. Expel all air from the unit by turning steering wheel several times to the right and then to the left. Refill reservoir before proceeding with the following test and adjustments.

Turn the gear shaft adjusting screw outward through the gear shaft cover to assure no mesh adjustment preload for this phase of the test. Tighten steering valve body attaching screws to 7 foot-pounds torque. Apply oil pressure to complete unit and position steering valve by tapping lightly on one of the pressure control valve screws or on valve end plug to position valve, (up or down) on steering housing to give equal gear shaft torque (within 5 foot-pounds torque not to exceed 20 foot-pounds in either direction) when gear shaft is slowly turned. Perform this operation carefully to prevent a lockup in the steering gear. After valve body is located, tighten attaching screws to 15 foot-pounds.

With the gear shaft on center, tighten the gear shaft adjusting screw until backlash just disappears. Tighten $1\frac{1}{4}$ turns from this position and while holding adjusting screw in this position tighten lock nut.

Turn off hydraulic power to unit. Operate unit manually for a minimum of 180° from center in each direction, measured at worm shaft. Turn on hydraulic power to unit. Operate unit through a minimum of one com-

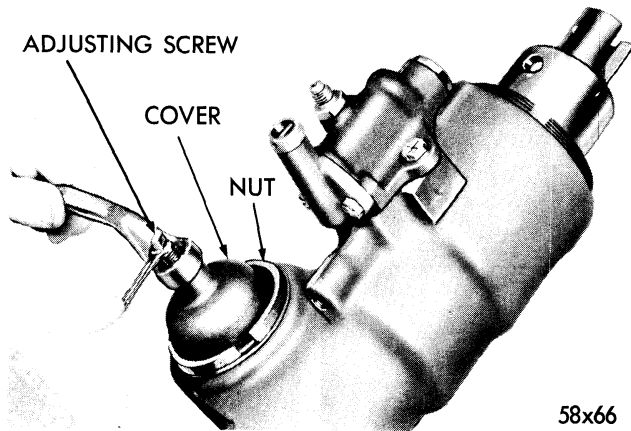


Figure 88—Adjusting Gear Shaft Adjusting Screw

plete cycle (complete rotational travel of worm shaft from one extreme of travel to the other extreme and then back). Operate unit through another cycle, this time holding unit at extreme travel in each direction while watching the oil pressure gauge. The gauge reading should be equal in each direction. If not, it indicates excessive internal leakage in the unit.

NOTE

Holding the worm shaft at either extreme position for more than a few seconds will abnormally increase the oil temperature and cause undue oil pump wear.

With oil temperature between 150°F. and 170°F., checked with thermometer in the reservoir, the oil pressure should be 850 to 950 psi. for satisfactory power steering operation.

With gear shaft on center plus or minus 2 degrees, readjust the gear shaft backlash. This will require loosening the adjusting screw until backlash is evident. Then retighten adjusting screw until backlash just disappears. Continue to tighten for $\frac{3}{8}$ to $\frac{1}{2}$ turn from this position and tighten lock lock nut to 50 foot-pounds torque to maintain this setting, as shown in Figure 88.

Starting from a point at least one full turn of the worm shaft either side of center, the torque at the gear shaft required to turn the unit through center at 2 rpm in each direction shall not exceed 20 foot-pounds or vary more than 5 foot-pounds from left to right. Position steering valve to obtain equal torque and tighten valve body attaching screws to 15 foot-pounds torque to maintain this setting.

With the unit under power, but with no load, the torque required to rotate the worm shaft through an included angle of 180° (90° either side of center) shall be 5-9 inch-pounds. Disconnect test equipment and mounting fixture. Place steering gear worm at center of travel and install worm connector. Install unit in car.

12. COAXIAL POWER STEERING PUMP (ROTOR TYPE 6 CYLINDER MODELS)

PRESSURE CHECKS

BLEEDING HYDRAULIC SYSTEM—With front wheels off of floor, turn coupling completely to the left then to the right exerting pressure at the end of each turn. Repeat this operation then system is properly bled.

Should the lack of steering assistance be encountered and other checks have been made (refer to Service Diagnosis Chart), a pressure check should be made as follows to determine if pump is at fault.

Connect gauge C-3309 in the pressure line between pump and hose with the shut-off valve on the gauge in the open position, start the engine and turn the steering wheel.

If the gauge does not show at least 750 to 800 pounds pressure at idle with 900 p.s.i. max. at 1500 R.P.M. when the steering wheel is in straight-ahead position, check the pump by turning the shut-off valve of the gauge C-3309 to its closed position. If the pressure does not gradually increase as the valve is closed, the flow control valve in the pump may be stuck in open position, or the drive coupling may be broken. If 750 pounds pressure does show on gauge with the engine idling, the pump is in good condition, look for trouble under service diagnosis. Remove gauge and connect high pressure hose to pump.

Remove cover from reservoir, start the engine and turn the steering wheel. If oil flows through the filter, a stuck flow control valve plunger is indicated. Shut off engine. Remove the high pressure hose at the pump fitting and insert a $\frac{1}{4}$ inch clean, blunt probe against valve plunger. If the plunger moves inward $\frac{3}{16}$ to $\frac{1}{4}$ inch, the plunger was stuck and will probably function correctly the next time.

Recheck pressure, and if it still registers less than 750 pounds on gauge and if oil flows through filter but still does not flex the pressure line, remove the flow control valve plunger and clean thoroughly. If this does not correct the condition, install a new pump assembly.

If oil does not flow through the reservoir filter in the above test, a broken coupling is indicated. Remove pump from generator. If either coupling is broken turn the pump shaft by hand at least ten revolutions. If the shaft turns freely, install new couplings on both the pump and generator shafts. If the pump shaft binds when turned by hand, replace both the pump and couplings. If the generator armature shaft is damaged, replace necessary parts.

POWER STEERING**(ROTOR TYPE)****DATA AND SPECIFICATIONS**

Model		P-30
Capacity of Hydraulic System		3½ pts.
Capacity of Worm Housing		14 oz.
Type of Fluid		Type "A" Automatic Trans. Fluid
Maximum Pump Pressure (psi)		900
Maximum Fluid Flow at 3000 rpm		2 gal./min.
Maximum Pump Rotor Clearances	Between Rotor Lobes	.008 inch
	Between Outer Rotor and Bushing	.006 inch
	End Clearance (Between Rotors and Face of Body)	.001 to .002 inch
Flow Control Valve Spring	Free Length	2.13 inch
	Working Length	1.20 inch
	Pressure at Working Length	14 + 1½ lbs.
Pressure Relief Valve Spring	Free Length	1.51 inch
	Working Length	1.18 inch
	Force at Working Length	30 to 33 lbs.

TORQUE SPECIFICATIONS**Foot Pounds**

Steering Knuckle Arm Nuts	55 to 75
Steering Gear Arm (Pitman) to Shaft Nut	100 to 125
Steering Gear Assembly to Frame	40 to 50
Tie Rod Clamp Bolts	10 to 15
Tie Rod to Steering Knuckle Arm Nuts	45 to 75
Gear Shaft Cover Bolts	25 to 30
Ball Guide Clamp Bolt	10 to 12
Worm Housing to Gear Housing Bolt	25 to 30

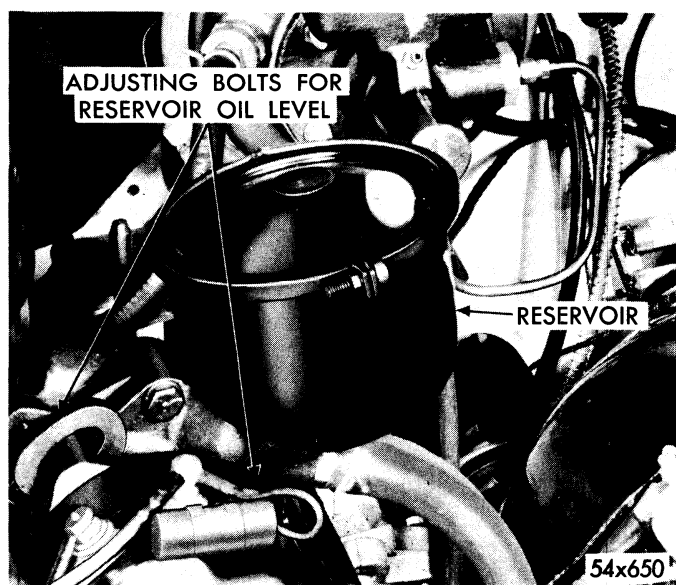


Figure 89—Leveling Oil Pump Reservoir

NOTE

If the gauge is not available, a fairly accurate way of making the test is as follows: Start the engine and turn the wheel to both extreme positions. If the high pressure hose flexes, the pump is in good condition. If the high pressure hose does not flex, lack of pressure from the pump is indicated. Shut off the engine and check the pump as described below.

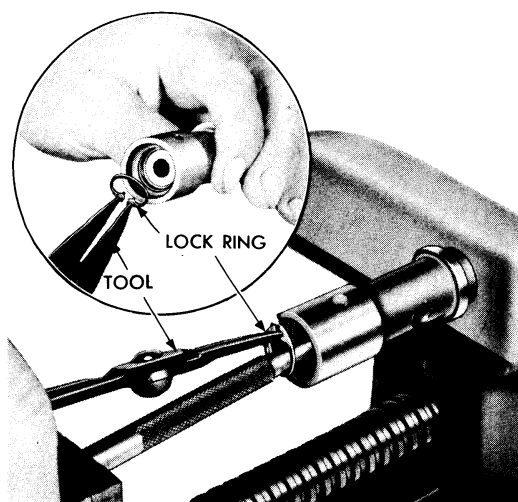
PUMP REMOVAL

Disconnect the pressure and return hoses from pump assembly. Loss of oil will be noted when hoses are removed, keep both hose ends up to prevent further loss of oil. Ends of hose should be covered or capped to prevent the entrance of foreign matter.

Remove the pump to generator mounting screws and lockwashers. Remove pump and reservoir assembly from generator. Remove the rubber coupling.

INSTALLATION

Place the rubber insulator into position in pump assembly. Place pump and reservoir assembly in position on back of generator, using care to index coupling. Install the pump to generator mounting bolts, lockwashers and washer. Draw down evenly and tighten from 12 to 17 foot-pounds. Connect the pressure and return hoses to pump and tighten. Adjust reservoir oil level by loosening the mounting bolts and rotating (Figure 89) the pump until oil level covers filter. Add oil if highest part of filter is not covered with oil.



57P371

Figure 90—Disassembly of Pressure Relief and Flow Control Valve Using Tool C-3229

DISASSEMBLY

Remove clamp that retains cover on reservoir, then remove cover. Remove the relief valve that retains the filter element in reservoir. Lift filter element out and drain oil from reservoir. Remove the two pump attaching screws and lockwasher, unscrew the filter element standpipe and separate reservoir from pump.

NOTE

There are four rubber "O" seal rings between the reservoir and pump body.

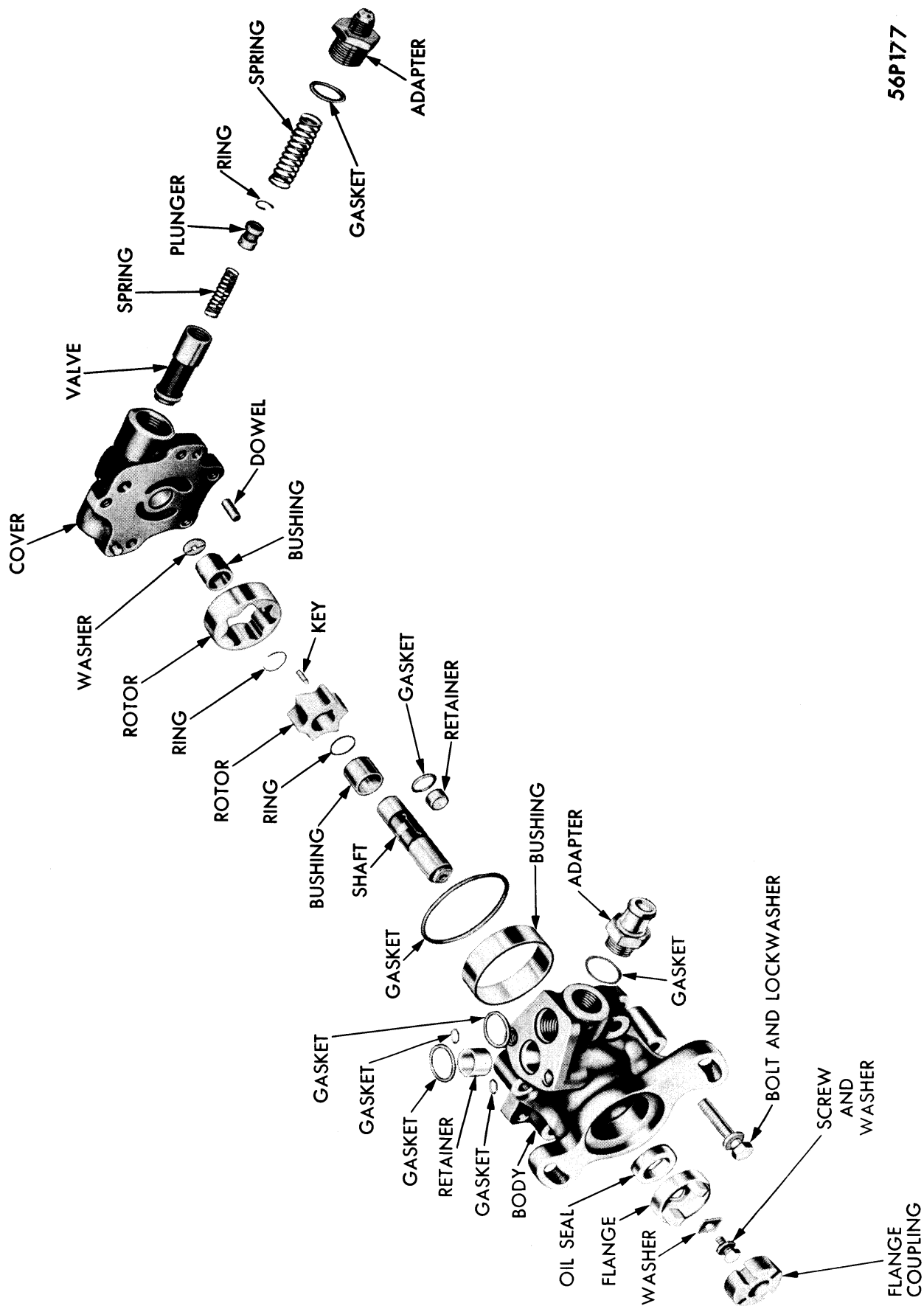
Using holding Tool C-3227, remove coupling locking screw, lockwasher and coupling.

CAUTION

The locking screw is of a special type and should not be replaced with any other type.

Place pump body in a vise equipped with protective jaws and remove the five body to cover attaching bolts. Remove cover and "O" seal ring. Remove outer pump rotor by inverting and tapping pump body on wooden block. Remove pump shaft and inner rotor from pump body. Remove inner pump rotor from pump shaft by removing the rear circular section snap ring and sliding rotor and drive key off shaft.

To remove the combination flow control and relief valve in pump cover, remove the 1¼ inch hexagon fitting and circular section rubber "O" ring. Lift out flow control valve spring. Tap cover on wooden block



56P177

Figure 91—Rotor Type Steering Pump—Disassembled

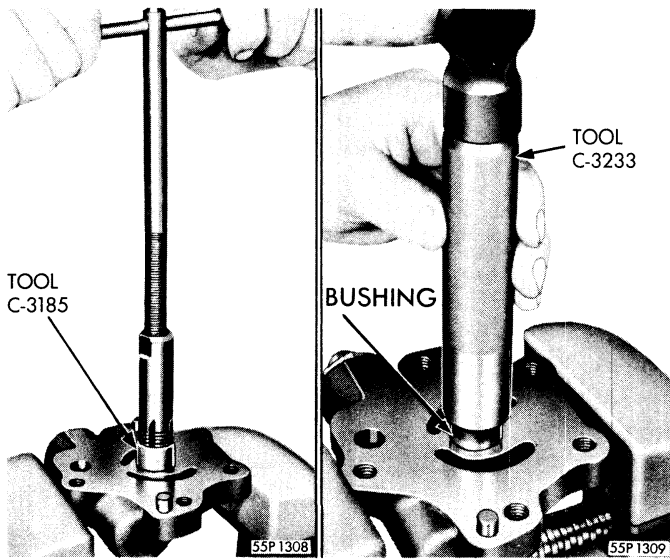


Figure 92—Removing Pump Cover Bushing—Using Tool C-3185

Figure 93—Installing Pump Cover Bushing—Using Tool C-3233

to remove the flow control and relief valve combination. To remove pressure relief valve and spring from flow control valve body, use Tool C-3229 to remove the internal snap ring, refer to Figure 91.

INSPECTION

Clean all parts in a suitable solvent and blow dry with clean filtered compressed air. Inspect the babbitt pump rotor bushing in pump body for wear or scoring. Inspect bronze pump shaft and thrust bearings in cover and pump body. Inspect pump rotors and shaft for scoring and wear. Position rotor and shaft in pump body. Using a straight edge and feeler gauge, check the end clearance. The specified limits are .001 inch to .002 inch. Inspect the pressure relief valve and the flow divider plunger for scoring, replace if necessary.

PUMP COVER BUSHING

Place pump cover in a vise equipped with protective jaws, install Tool C-3185 and tap threads into bushing with outer section of tool, as shown in Figure 92.

When tool has been threaded into bushing sufficiently, screw "T" handle section of tool into cover until it bottoms and continue turning to remove bushing. Install bushing with Tool C-3233, as shown in Figure 93.

PUMP BODY BUSHINGS

Place pump body in a vise equipped with protective jaws. Place pump cover on pump body and install attaching bolts. Install Tool C-3185 in cover bushing hole, thread tool into housing bushing and remove bushing and seal. Always use new seal when bushing is replaced. Place bushing on Tool C-3233. Start bushing squarely and drive into place.

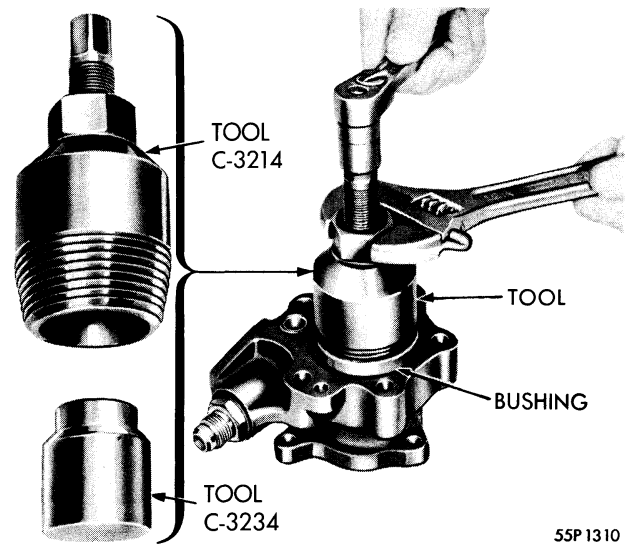


Figure 94—Removing Babbitt Bushing from Body Using Tool C-3214 and C-3234

OUTER ROTOR BUSHING

Thread Tool C-3214 into pump body (cover removed) using adaptor Tool C-3234 and remove bushing, refer to Figure 94. Clean all parts thoroughly in a suitable solvent and blow dry with compressed air. When installing bushing start squarely, then using Tool C-3251, drive into place, as shown in Figure 95.

PUMP SHAFT OIL SEAL

Reposition pump body in vise. Place seal on Tool C-3230, refer to Figure 96. Drive seal into position in pump body.

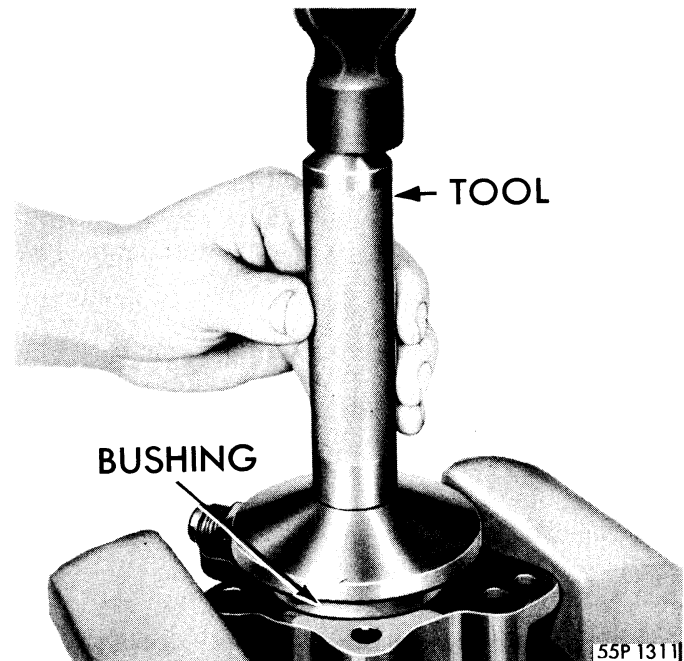


Figure 95—Installing Babbitt Bushing in Body Using Tool C-3251

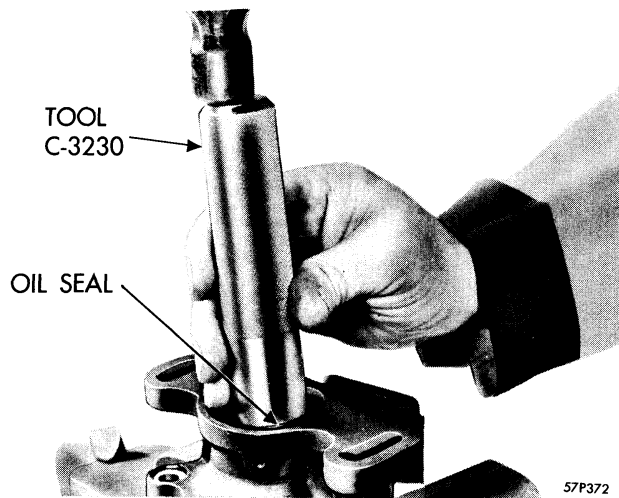


Figure 96—Installing Pump Shaft Oil Seal with Tool C-3230

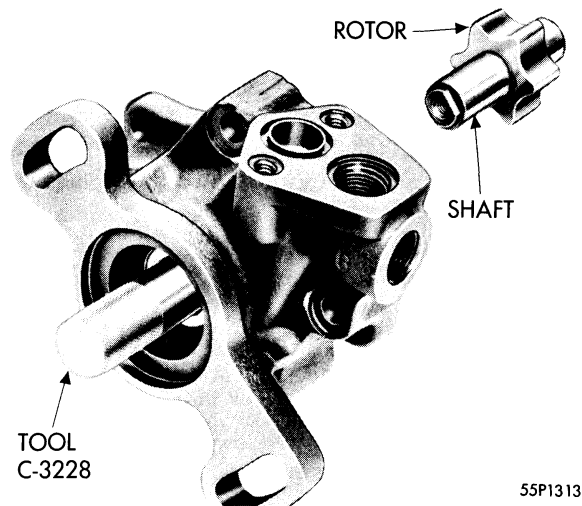


Figure 97—Installing Pump Shaft Oil Seal Thimble with Tool C-3230

ASSEMBLY OF PUMP

Lubricate all moving parts with clean SAE 10W engine oil. Coat "O" seal rings with Lubriplate.

Reassemble combination flow control and relief valve by inserting spring and relief valve with small end first. Compress valve and spring and install snap ring.

Make sure snap ring seats properly. Install the combination of flow control and relief valve assembly into pump body with the narrower land first. Insert spring, gasket and adaptor. Tighten adaptor from 45 to 50 foot-pounds. Install inner pump rotor and drive key on shaft and install snap ring. Install shaft protector thimble C-3228 in pump body until it bottoms (Figure 97).

Using care not to damage the babbitt bushings when installing rotor, insert rotor and shaft assembly with coupling end first into pump body. Insert outer rotor into pump body. Coat the "O" seal ring with Lubriplate

and position on pump body. Place cover in position on pump body and install the attaching bolts and lock-washers. Tighten from 15 to 20 foot-pounds. Tap coupling flange on pump shaft until it bottoms and install special square washer, screw and lockwasher. Using Tool C-3227 to hold coupling, as shown in Figure 98, tighten screw from 10 to 12 foot-pounds.

To attach reservoir to pump, coat the "O" seal rings with Lubriplate. Install the two large and two small "O" rings on the reservoir mounting surface of pump. Place reservoir on pump, install filter standpipe stud and two reservoir to pump attaching screws. Tighten screws from 12 to 17 foot-pounds. Install filter seat on standpipe with seating surface below the standpipe pilot. Install filter element and tighten filter retaining screw assembly until it seats on the screw shoulder.

CAUTION

Install cover to keep dirt out of pump until after it has been installed on generator.

13. COAXIAL POWER STEERING PUMP (SLEEVE TYPE 8 CYLINDER MODELS)

A sleeve type Power Steering Pump is used on all Plymouth V-8 1957 models, as shown in Figure 99.

The level of oil in reservoir will vary according to operating temperature of pump. The normal operating temperature is approximately 175° F. At 70° F., the oil level will be approximately 3¼ inches below the top of filler neck.

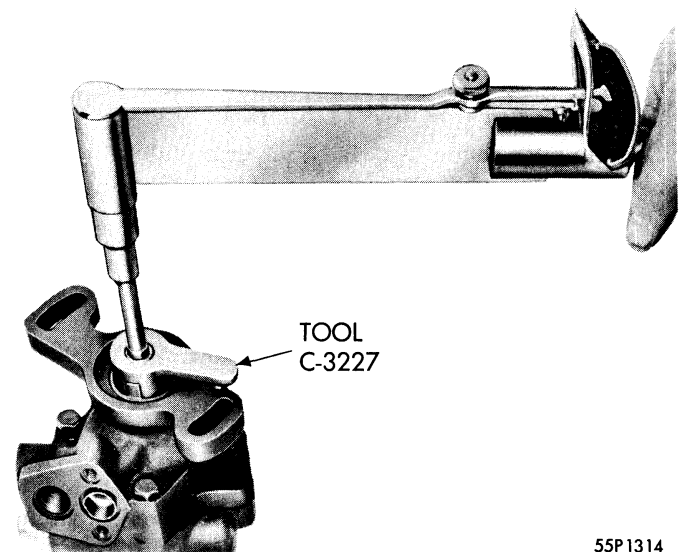


Figure 98—Tightening Coupling Screw with Tool C-3227

**POWER STEERING
(SLEEVE TYPE)
DATA AND SPECIFICATIONS**

Model		P-31
Capacity of Hydraulic System		2 qts.
Capacity of Worm Housing		14 oz.
Gear Housing		12 oz.
Type of Fluid		Type "A" Automatic Trans. Fluid
Pump Reservoir Capacity Including Hoses		28 oz.
Maximum Pump Pressure		750 to 900 psi.
Maximum Pump Rotor Clearances		.008-.012
Flow Control Valve Spring	Free Length	4.0 in.
	Working Length	1.5 in.
	Force at Working Length	12.5 ± 1.25 lbs.
Pressure Relief Valve Spring	Free Length	.825 in.
	Working Length	$3\frac{5}{64}$ in.
	Force at Working Length	12.5 to 14 lbs.

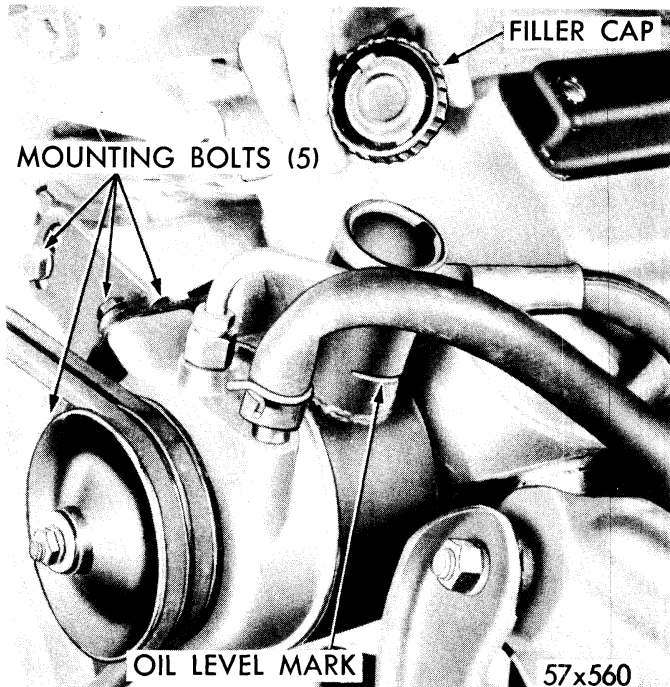


Figure 99—Sleeve Type Power Steering Pump Installed

NOTE

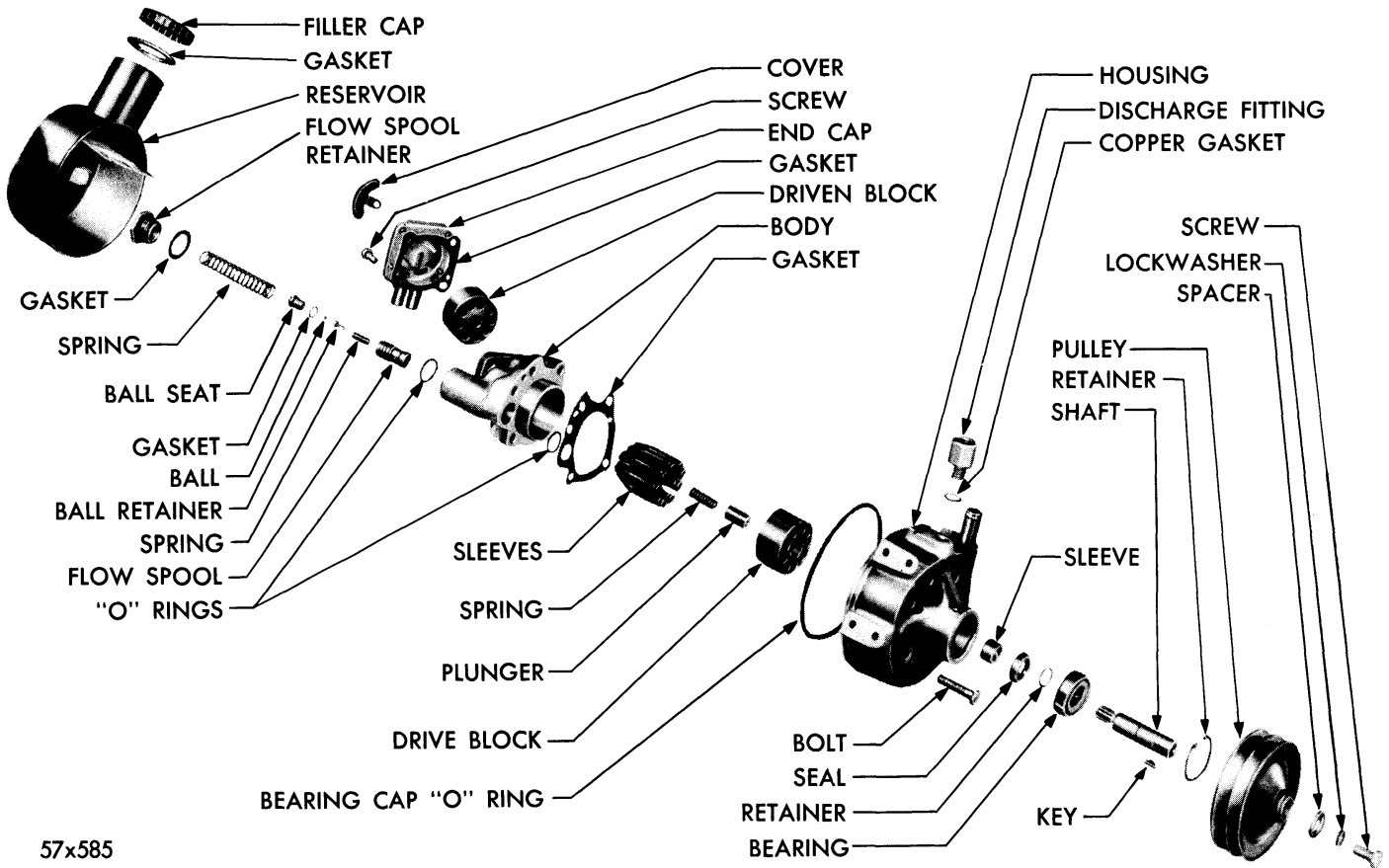
Whenever the pump is drained or removed for servicing the pump must be filled up to the "full" mark indicated on the filler neck of reservoir before and after the engine is started. Use Automatic Transmission Fluid Type "A" oil.

The oil level should never be allowed to fall below the baffle of the reservoir.

REMOVAL

Remove hose clamp and hose from discharge outlets. Loosen bracket fan belt adjusting screw and remove fan belts.

Do not disassemble the hydraulic pump in dirty surroundings or on a dirty work bench. Use clean paper on bench. After the pump has been disassembled, place the parts in a suitable cleaning solvent; clean and protect from dirt and grit. Drain oil from pump and reservoir. Cap discharge and return line fittings with



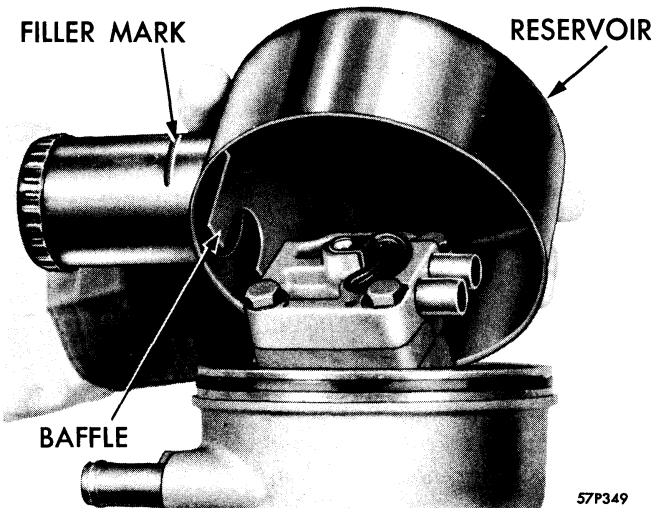
57x585

Figure 100—Power Steering Oil Pump (Disassembled View) (Sleeve Type)

protective covering to keep dirt from pump. Thoroughly clean exterior of pump. Mount pump in a vise. Remove cap screw and reservoir. See Figure 101. Loosen four cap screws at the inlet end cap. See Figure 102. Remove flow valve spring retainer fitting.

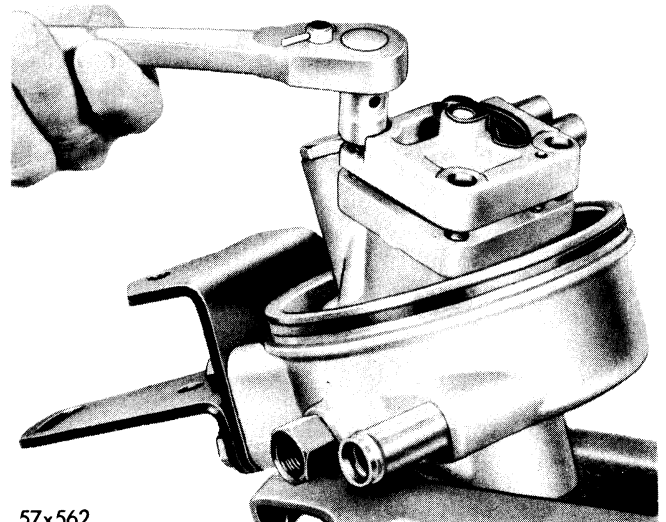
The cylinder blocks will push out of body slightly due to pressure of plunger spring between blocks. Remove cylinder drive blocks and nine sleeve from pump body and the cylinder plunger spring. See Figure 104.

Remove ball bearing retainer ring from housing,



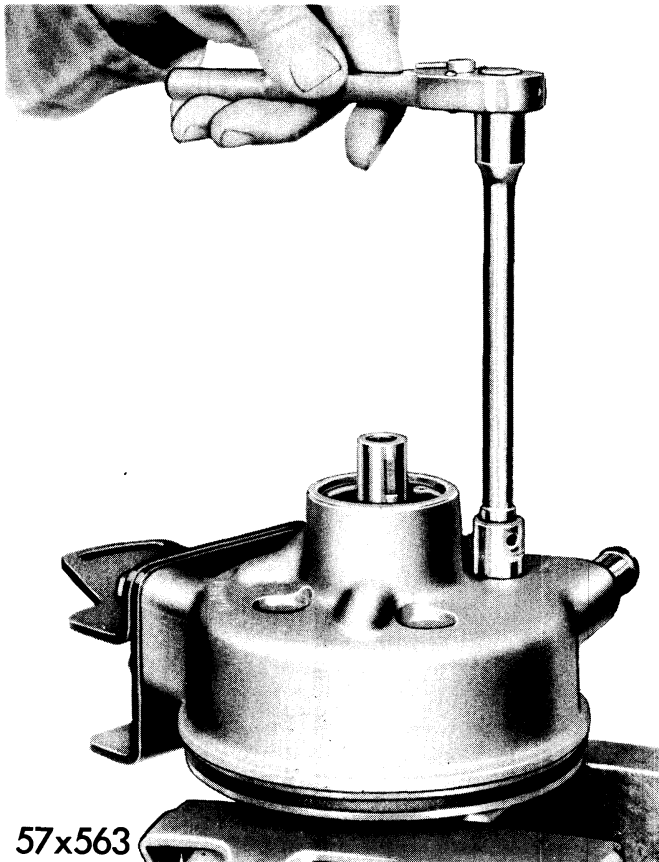
57P349

Figure 101—Removing or Installing Power Steering Pump Reservoir



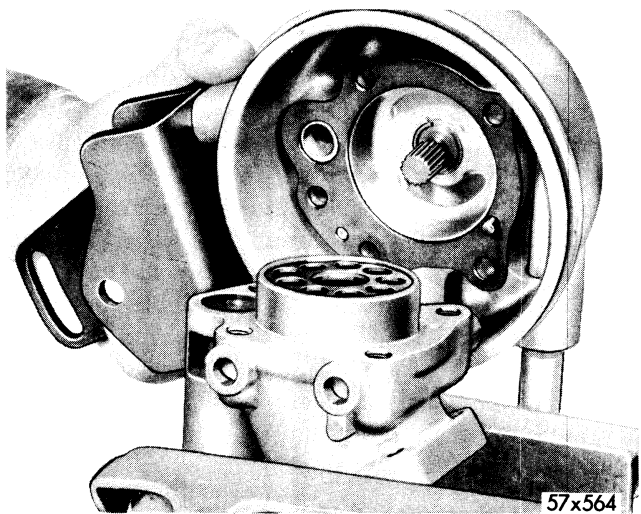
57x562

Figure 102—Removing or Installing Inlet Cap Bolts



57x563

Figure 103—Removing or Installing Pump Body from Housing



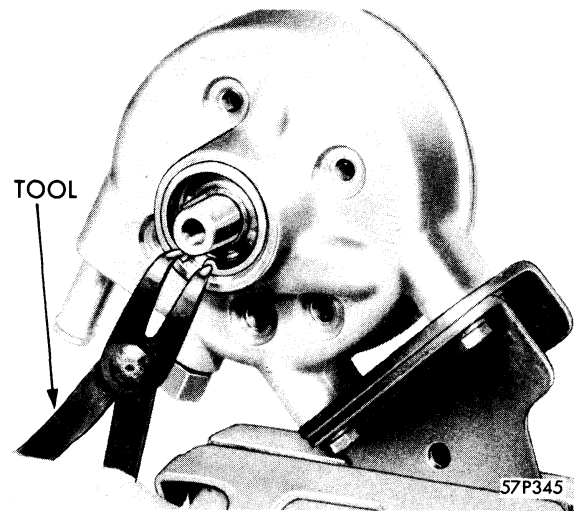
57x564

Figure 104—Removing or Installing Housing from Pump Body

using snap ring pliers Tool C-3106. See Figure 105. Remove shaft and bearing. See Figure 106.

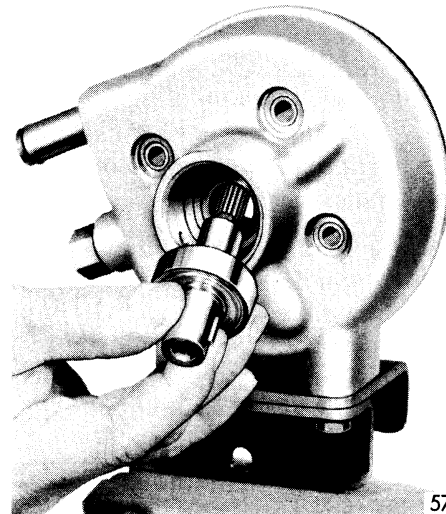
Wipe bearing and shaft assembly with clean, lint free cloths. Do not soak in cleaning solvent; the lubricants sealed into the ball bearing may become diluted by the solvent.

Inspect shaft for wear and check the ball bearing



57P345

Figure 105—Removing or Installing Snap Ring Bearing Retainer (Tool C-3106)



57x566

Figure 106—Removing or Installing Shaft and Bearing

CAUTION

Flow and plunger springs are under pressure. Use care when removing cap and retainer to prevent spring and fitting from escaping due to spring force. Remove flow valve and spring. Remove and disassemble both end caps from inlet cap body and pump housing, as shown in Figures 102 and 103. Plunger spring will tend to push the cylinder blocks out of body. Use care when disassembling.

for roughness or noisy operation. If bearing must be replaced, remove shaft key, press bearing from shaft away from splined or serrated end of shaft. Examine retaining ring groove in housing, replace worn or distorted parts. If ball is to be replaced, support bearing on inner race and press shaft through bearing until retaining ring stops against inner race of bearing. The retaining ring must always be located between the bearing and splined or serrated end of pump shaft.

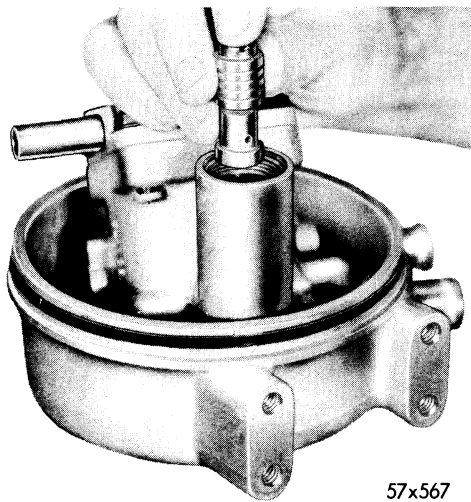


Figure 107—Checking Flow Valve in Housing

Check fit of sleeves in cylinder block bores. Sleeves must slide freely. Examine mating surfaces of sleeves and bores. Heavy scoring, if present, can effect pumping efficiency; cylinder blocks showing such scoring should be replaced. *Hairline marking seen on sleeves are normal. Sleeves bearing such marks need not be replaced.*

Examine flow valve spool and valve liner. Slight hair line scratches are permissible. Burrs from heavy gouges or scratches which may cause the flow spool to stick must be removed. This may be done by polishing with a smooth stone.

CAUTION

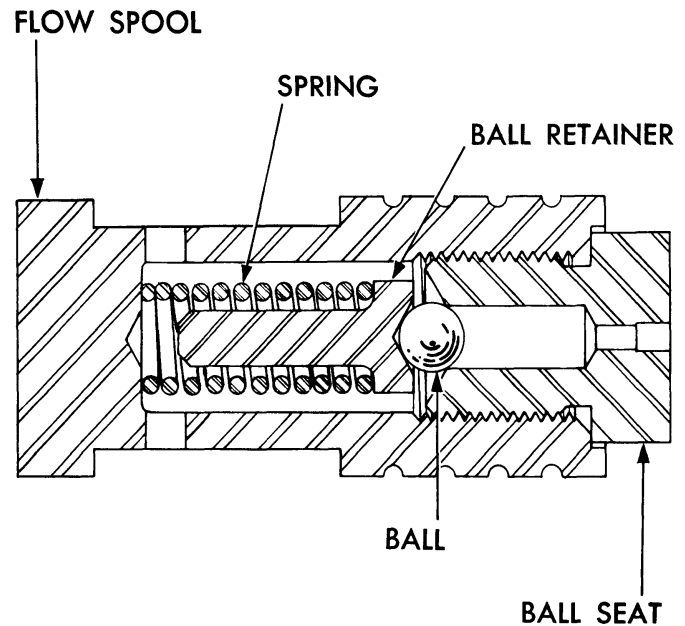
Do not break the sharp edges of the spool or liner.

Insert flow valve in valve body. By means of a pencil or other such rod which will not mar the internal diameter of valve liner, move flow spool back and forth to inspect. On each pass, rotate spool slightly. The spool must slide freely. If spool sticks or drags, remove it from liner. Remove dirt, nicks, and burrs, using above caution and check by repeating above procedure. See Figure 107.

Examine shaft seal in bearing cap. If worn or damaged, replace seal.

NOTE

The lips of seal must point toward the casting. Examine running surfaces of bearing cap and inlet end cap. If heavy scratches are present or if port edges are damaged, the part should be replaced.



57x568

Figure 108—Flow Spool Valve

Press seal in until the shoulder stops against the bearing cap casting. Care must be used to see that seal is properly aligned. This operation should be performed on an arbor press.

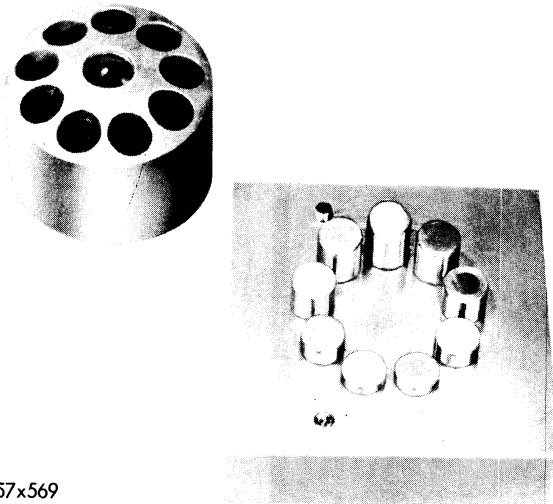
Check the pressure relief valve. The pressure relief valve is located in flow valve spool. See Figure 108.

The valve must not leak at any pressure below 750 psi. and must open completely at 900 psi. Evidence of leakage will be seen at small holes in the side of flow spool. If relief valve leaks, disassemble by removing valve seat for dirt or nicks. Clean all valve parts and reassemble, replacing valve seat if nicked or damaged. Check the pressure again. If the pressure still falls below the minimum requirements, disassemble the valve again and replace the pressure relief spring or place a $\frac{1}{32}$ inch washer between spring and ball retainer. To correct pressures exceeding the maximum requirement, remove valve seat and place a $\frac{1}{32}$ inch washer between valve seat and the flow spool body.

Examine the pump body for signs of unusual wear or damage. Small scratches or burrs can be removed with fine emery paper. If body is scored or damaged, a new pump should be used.

ASSEMBLY

Clean parts thoroughly and assemble pump. Press drive shaft and bearing subassembly into bearing cap. Check rotation of shaft to make certain shaft turns freely. Use a sleeve which bears on outer race of ball bearing, and press the sub-assembly in place.



57x569

Figure 109—Drive Block Assembling Fixture—C-3602

CAUTION

Make certain that the shaft bearing sub-assembly are properly aligned, otherwise the shaft may push sleeve bearing out of bearing cap or may scratch or mar the inside diameter of sleeve bearing.

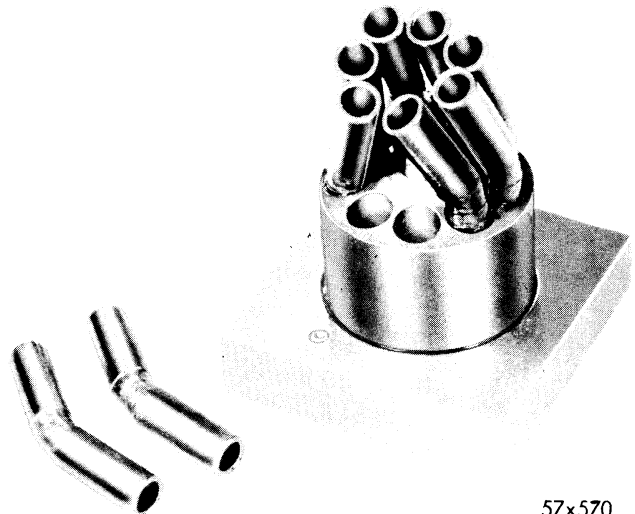
Use an assembly fixture, as shown in Figure 109, and place driven cylinder block (without spline or serration) on assembly fixture C-3602.

Lubricate (SAE 10W) and insert plunger spring, plunger, and seven sleeves in drive block, as shown in Figure 110. Place the pump body, square end down, over the cylinder drive block and fixture locating pins, use a pointed probe to align the sleeves to a uniform spacing and install the two other remaining sleeves.

Position the drive splined block with serration over the sleeves. Sighting through the bores in the drive block for alignment, lower the cylinder block until it engages the two sleeves in the forward position. Again use pointed probe slightly smaller in diameter than the sleeve bores. Correct the alignment of sleeves in the 5 and 7 o'clock position at the same time guiding cylinder block downward. Continue this procedure to the 4 and 8 o'clock positions until all the sleeves are aligned and engaged; the block may then be pushed in all the way, as shown in Figure 111.

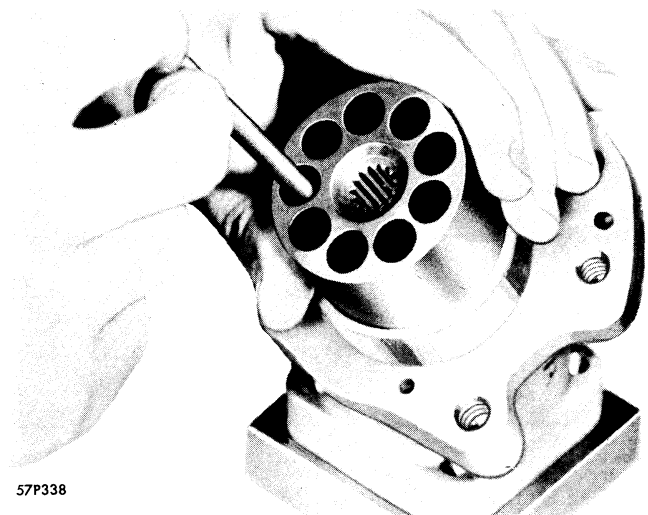
CAUTION

Do not force the cylinder block forcibly in place; proper alignment of the block and sleeves will allow the block to be pushed easily into place without excessive pressure. Tighten body to housing.



57x570

Figure 110—Assembling Sleeves in Drive Cylinder



57P338

Figure 111—Installing Drive Block

Remove body and cylinder block assembly from fixture, using care to see that blocks are not forced out of body by plunger spring. Assemble a new end cap gasket on pump body. Install end cap on body, tighten cap screws finger tight.

Insert a new "O" ring in counterbore at the flow valve liner in body. Install a new bearing cap gasket, assemble the bearing cap to the body.

NOTE

It may be necessary to exert hand pressure on the bearing cap to get drive block down into body after bearing cap is seated.

Tighten five cap screws finger tight. Grip end of pump shaft in a vise and rotate pump. The pump should rotate

freely without binding. After making sure pump rotates freely tighten cap screws uniformly to 25 foot-pounds torque. Check pump again for rotation. Mount pump in a vise in a vertical position, gripping on the bearing hub. Install the flow valve spool with the $\frac{3}{16}$ " land down. Place flow valve spring on top of flow spool. Replace "O" ring on flow spring retainer fitting. Compress flow spring with fitting, and screw fitting into place. Tighten to 20 foot-pounds torque.

Install and align a new reservoir "O" ring on bearing cap. Lubricate "O" ring for ease in assembling reservoir. Align reservoir so that the indentation on back will mate with angular boss on suction end cap.

NOTE

Reservoir alignment may be achieved by sighting thru the 9/32 inch hole in the back of the reservoir. Push the reservoir into place applying force around its outside diameter.

Replace the copper gasket between the head of the $\frac{1}{4}$ inch hex head cap screw and the back of reservoir. Tighten the $\frac{1}{4}$ inch cap screw to 15 foot-pounds torque.

CAUTION

Do not attempt to align or pull the reservoir into place on the angular boss with the $\frac{1}{4}$ inch cap screw.

Install shaft key, and pulley. Tighten pulley attaching bolt to 20 foot-pounds torque. Refill pump with Automatic Transmission Fluid Type "A" oil. Adjust fan belt.

14. CONSTANT CONTROL POWER STEERING PUMP (SLIPPER TYPE)

The slipper-type power steering oil pump is a constant displacement pump, bracket-mounted to the engine water pump housing, and belt-driven by the engine fan pulley.

Elimination of pulsation in oil flow is achieved by the cam surface of the pressed-in insert which evens out oil flow through the pump. Recirculation of oil from rotor outlet to rotor inlet results in a reduction of torque required to drive the pump and thus reduces the amount of engine horse power necessary to drive the pump.

OPERATION

In operation, the slippers, as shown in Figure 112, push the oil through the pump. Continuous slipper contact is assured by the spring loaded slippers against the eccentric inside diameter and by centrifugal action at higher speeds.

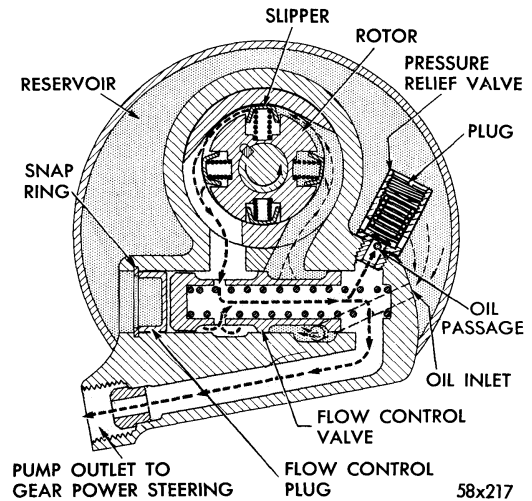


Figure 112—Power Steering Pump

The amount of flow through the pump is limited by the flow control valve. As oil flows from the rotor outlet, it passes through orifices in the flow control valve on its way to the pump outlet and the power steering gear. Flow through the orifice causes a pressure differential to exist across the valve from the closed end to the open end. The higher pressure oil outside the valve is exposed to the left end of the valve. The difference in pressure, forces the flow control valve to the right a sufficient amount to cause the center valve land to expose the inlet port allowing recirculation of oil from the rotor outlet, back to the rotor inlet. This action takes place when oil flow reaches the allowed maximum of approximately two gallons per minute.

Maximum oil pressure in the unit is limited to 850-950 psi. by the pressure relief valve. When pressure in the unit reaches this amount, it overcomes the force of the spring on the relief valve, forcing the valve plunger off its seat and allowing the oil to flow through the opening around the plunger. Openings in the pressure relief valve body return the oil to the reservoir.

REMOVAL

Relieve tension and remove fan belt. Place a suitable container under the pump. Disconnect the pressure and return hoses, cap the hoses and keep the ends high to prevent loss of fluid in the power steering unit. Remove the screws attaching the pump brackets to the water pump housing. Clean all exterior surfaces of the pump before starting disassembly.

DISASSEMBLY

Remove filler cap and dipstick assembly. Drain reservoir and pump. Remove the front and rear brackets from the pump reservoir and pump. Carefully pry the

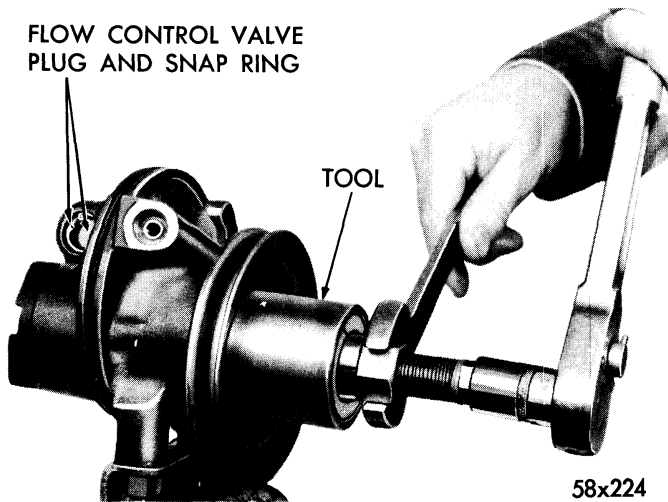


Figure 113—Removing Fan Pulley With Tool C-3615

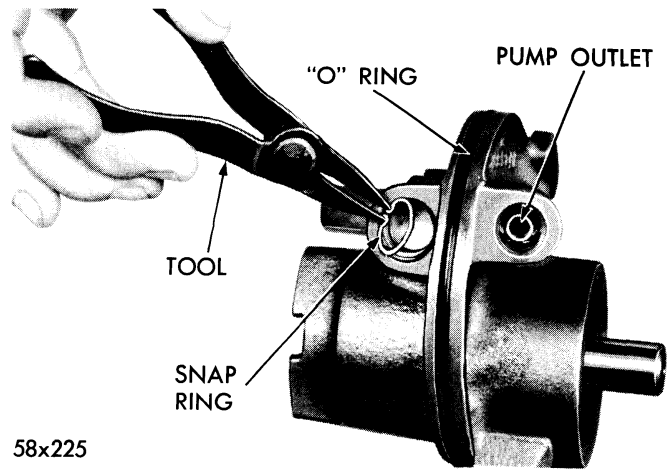


Figure 115—Removing Flow Control Valve Snap Ring

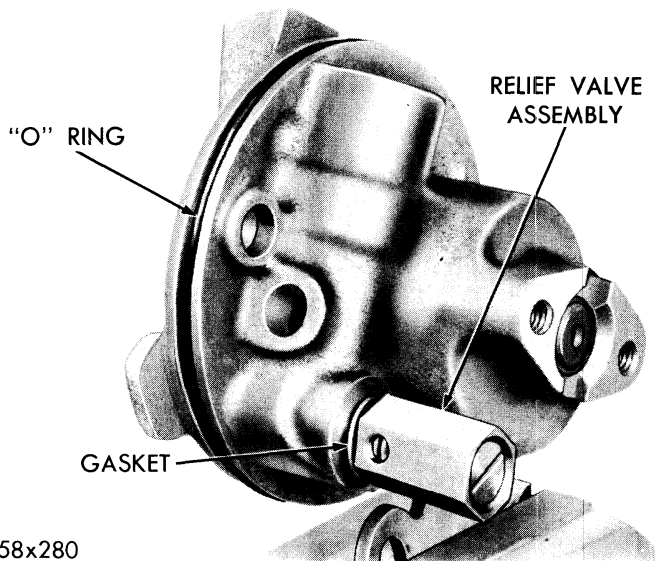


Figure 114—Removing Relief Valve

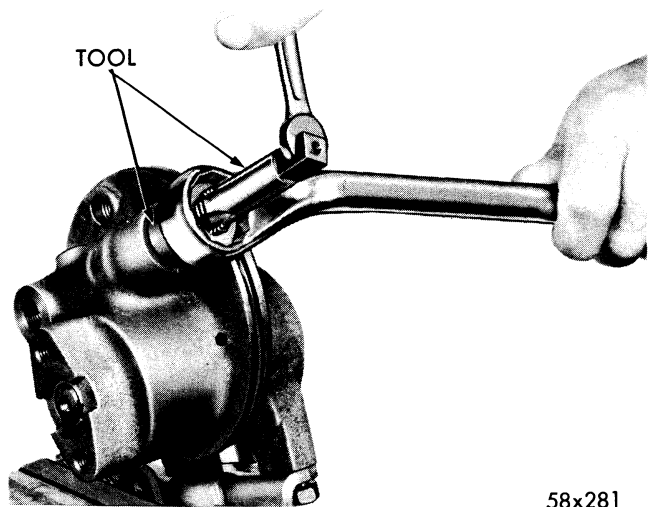


Figure 116—Removing Flow Control Valve Plug With Tool C-3655

reservoir from the pump. Reinstall the front bracket to the pump to be used as a holding fixture. Use spacer washers between pump body and bracket to make sure bolts do not bottom in pump housing.

Install pulley removing Tool C-3615, as shown in Figure 113, by engaging the two half collars under the pulley hub flange (tapered ends toward pulley) and the flat ends of the collars engaging the collar locking the retainer of the puller screw. Install the collar sleeve to hold the collars and screw in position. While holding locknut, turn center screw to remove pulley. Remove the relief valve assembly and gasket, as shown in Figure 114.

NOTE

Relief valve is serviced only as an assembly.

If there was evidence of a malfunction in the flow control valve, remove the flow control valve snap ring with snap ring pliers C-3229, as shown in Figure 115. Remove the flow control valve plug by threading a tap Tool C-3655 into the plug, as shown in Figure 116. With the tap securely threaded in plug, install tool spacer and nut over tap. Tightening nut while holding tap from turning will force the plug from the housing bore. The flow control valve is spring-loaded and care should be used when removing the plug.

Thread the puller portion of Tool C-3642 into oil seal far enough to engage the metal portion of the seal, as

NOTE

Further disassembly of the pump is not recommended as component parts of the pump other than the reservoir, "O" ring and relief valve are not serviced separately.

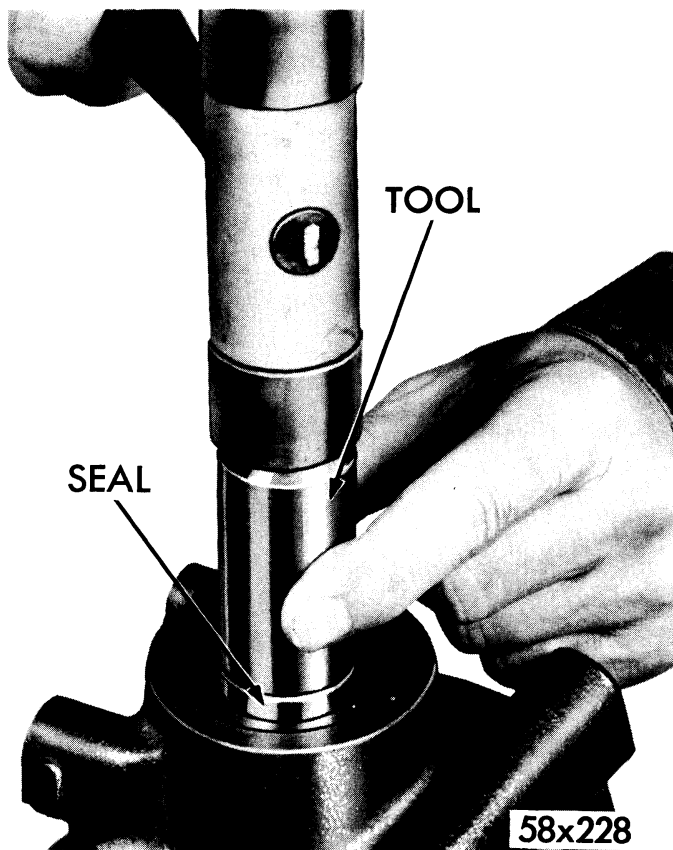


Figure 117—Removing Oil Seal

shown in Figure 117. Turning puller center screw while holding puller body will force the seal from the pump insert.

CLEANING AND INSPECTION

Clean all parts thoroughly in a clean solvent, discard body to reservoir "O" ring and pump shaft oil seal. Check flow control valve and bore for burrs and scratches. Valve must operate freely in bore. Small scratches can be carefully removed with crocus cloth. Do not round off the square edges as they are vitally important to this type of valve.

The housing bore for the flow control valve should not be honed or machined. If the bore is scratched or worn, the pump should be replaced.

ASSEMBLY

Install flow control valve spring, valve and a new valve plug and snap ring. Drive valve plug with Tool C-3233, as shown in Figure 118, far enough into bore to install snap ring, then drive snap ring and plug with Tool C-3233 until snap ring seats in its groove in housing bore. Install relief valve and gasket assembly.

Install oil seal with Tool C-3640. Lip of seal must face toward pump body and top of seal must be flush with front insert, as shown in Figure 119. Support pump body

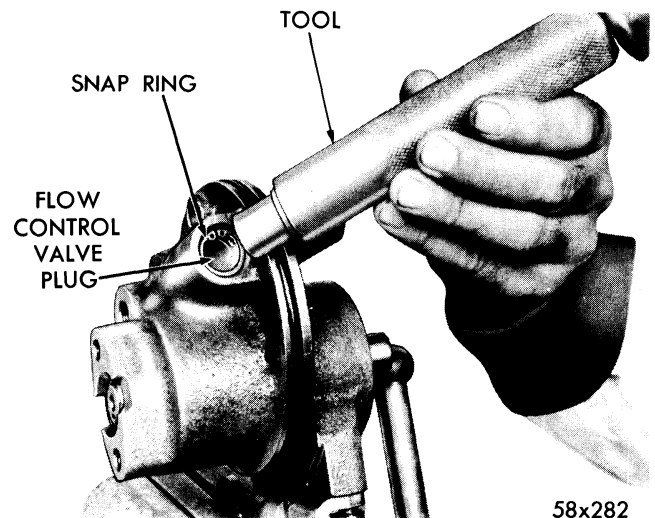


Figure 118—Installing Flow Control Valve Plug

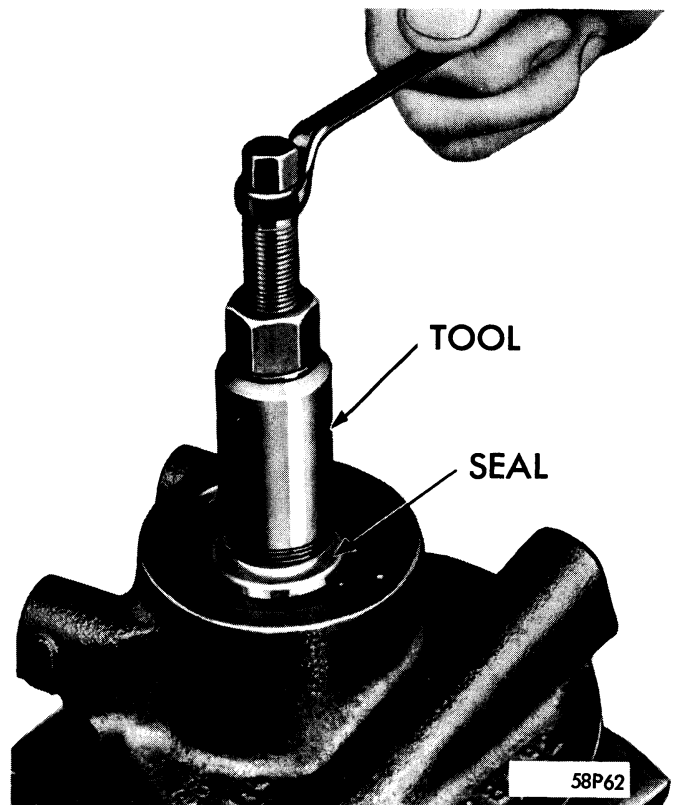


Figure 119—Installing Oil Seal

in holding fixture Tool C-3643, as shown in Figure 120, so that the pressure will be absorbed by the lower end of the pump shaft. Install pulley with a heavy duty arbor press. Pulley hub must be flush with end of shaft.

Lubriplate large "O" ring and install in outer groove in pump body. Install reservoir gasket, reservoir and reservoir attaching screws. Tighten screws to 10 foot-pounds. Install pump bracket.

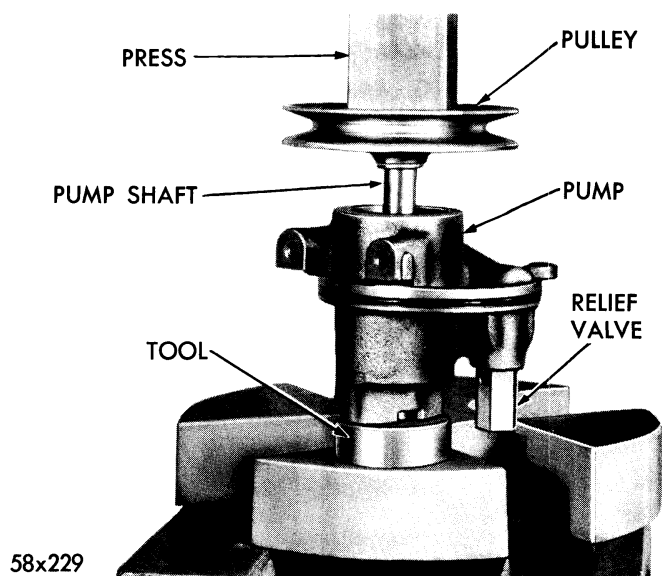


Figure 120—Installing Pump Pulley

CAUTION

Pump must be supported in a manner in which all pressing force will be applied to the shaft only, otherwise pump body and rotor will be damaged.

INSTALLATION

Position pump on engine and install and tighten attaching bolts securely. Connect the pressure and return hoses. Fill reservoir to the full mark with Automatic Transmission oil Type "A".

15. DIAGNOSIS PROCEDURES

CARS WITH STANDARD STEERING

Hard steering is usually due to binding in the steering assembly and may be accompanied by wander. Before testing for this condition, make sure the tires are inflated to the recommended pressure and the front wheel alignment is correct. Test steering action with the weight of the car on the front wheels and the front wheels on turntables. If hard steering is evident, inspect the following:

1. **TIE ROD ENDS**—Lubricate the rod ends and check alignment. The sockets should rotate freely on the ball studs. The tie rod end sockets on the same tie rod should be parallel with each other. If one socket is level and one is at an angle, a binding action may occur on extreme turns.

2. **CROSS SHAFT**—Turn the steering wheel from right to left through the center position. If binding is

evident at the center position, the cross shaft adjustment is too tight. Raise the front wheels and repeat the test. If binding is no longer evident, the cross shaft roller tooth may be binding on the pin. The roller tooth should be free enough to turn with the fingers. If binding is evident with or without the weight of the car on the front wheels the cross shaft bushings may be scored.

3. **WORM AND TUBE ASSEMBLY**—Inspect for binding near the extreme right or left position of the steering wheel. If binding is evident, the bearings are damaged, or are adjusted too tightly. Inspect the tube by turning the steering wheel from the extreme right to the extreme left. If intermittent drag is felt the tube may be bent.

4. **JACKET AND JACKET BUSHING**—Loosen the instrument panel bracket and check the free position of the steering column. If the jacket does not line up with the center of the bracket, binding may occur. Turn the steering wheel from left to right. If drag is evident, the jacket bushing may be scored or too tight.

LOOSE STEERING

If any part of the steering system is unusually loose, wander, excessive road shock, or wheel shimmy may result. To determine where excessive looseness exists, remove the Pitman arm from the cross shaft and make the following tests:

1. **TIE ROD ENDS**—To test for looseness, check for end play in the tie rods with the weight of the car on the wheels.

2. **CROSS SHAFT**—Check for backlash at the center position of the Pitman arm. Inspect for side play in the cross shaft. See "Steering Gear Adjustments" on Page 83.

3. **WORM AND TUBE**—To check for end play at the upper end of the tube, move the Pitman arm back and forth without turning the steering wheel. There should be no up-and-down movement of the steering wheel at the steering column jacket.

4. **JACKET BUSHING**—To determine if the jacket bushing is loose or worn, check for side play in the tube at the upper end by moving the steering wheel from side to side.

5. **STEERING WHEEL**—Check the position of the steering wheel. The spokes should be equally spaced when the front wheels are in the straight-ahead position.

CARS WITH COAXIAL POWER STEERING

When a check is made on a report of an oil leak, be sure to keep in mind the difference between oil leakage

and oil seepage. An oil spot on driveway, or one that drops on outside of gear housing, doesn't necessarily mean there's an oil leak in power steering unit. The only way to tell whether it's seepage or leakage is to find out whether owner has had to add oil to reservoir to maintain proper level.

Seepage can be caused by one or more of the following:

1. Overfilling of upper housing. If a unit is filled level with filler plug opening, instead of using proper measured amount of oil, (14 oz.) it may show signs of seepage at vent due to expansion.

2. The normal breathing action of unit will leave a slight film of oil around vent opening.

3. Recently installed units. Oil becomes trapped in vent passage during shipping and drains out when unit is operated at mating surface between upper and lower housing.

If turning force is applied on steering wheel after front wheels have reached their limit of travel and engine is accelerated excessively, it is possible to build up pump pressure in excess of 1,000 psi., which causes the power steering unit to flex at point when two housings are bolted together. Constant flexing at this point will cause seepage at the "O" ring. This is definitely an abnormal operating condition.

If some doubt exists as to whether or not a unit has internal leakage into the upper housing, insert a pipe cleaner into upper housing vent to absorb any oil which may be trapped in opening. Start engine and turn steering wheel from one extreme of travel to other, holding it a short time against each wheel stop.

CAUTION

Do not exceed 1,400 engine r.p.m. or hold against stops longer than 15 seconds, as it is possible to damage power units, fan belt and/or oil pump.

If there was no escape of oil from vent during this test, the condition existing was one of seepage, or all of oil has been lost from upper housing due to neoprene plug missing from vent passage inside housing.

LEAKAGE

If oil was observed coming from vent during above test, remove chuck assembly from the vehicle to determine source of leak. Special Service Tool C-3555 Dummy Flange Bulkhead Retainer has recently been released. This tool is desirable in locating leaks in power steering unit. Place chuck in holding fixture Tool C-3323. Connect

test hoses Tool C-3211 and C-3318 so gear can be operated under pressure. Drain and remove upper housing. Using Tool C-3555 secure housing head. Remove all traces of oil around housing head, upper piston and connector assembly. Start engine and check for source of leaks.

NOTE

To build up pressure in unit when testing, it will be necessary to move control valve off center in each direction with adjusting Tool C-3445.

REACTION SEAL

Determined by oil coming from connector assembly. Inspect seal for signs of shrinkage or being damaged and replace with new seal. Check new seal prior to installation for snug fit in valve control spacer. Also inspect upper rod for being scratched at seal sealing surface.

CONTROL VALVE ROD UPPER "O" RING

Determined by oil coming from connector assembly. Remove "O" ring and inspect "O" ring seat for foreign material, nicks, or burrs. Install new "O" ring making sure it is seated properly in groove and cannot possibly come out of groove when pressure is applied. Always install new upper and lower valve rod "O" rings whenever gear is disassembled.

UPPER PISTON ROD SEAL

Due to oil leaking around the upper piston rod at housing head. Replace seal, at the same time inspecting seat in housing head for nicks and burrs; also check sealing surface on upper piston rod for scratches. Make sure seal is properly seated in housing head.

POROUS HOUSING HEAD

This can be noted by oil seeping through pores in housing head. If this condition exists, replace housing head.

LEAKAGE AT MATING SURFACE BETWEEN THE UPPER AND LOWER HOUSINGS

May be caused by looseness of attaching screws which secure upper and lower housings. These screws should be torqued to 30 foot-pounds. If leakage was not caused by looseness of attaching screws, or an abnormal operating condition, inspect for improper seated or damaged "O" rings on housing, especially the one located on pressure side. Inspect the "O" ring seating

surfaces on housing head and gear housing for nicks, burrs, and foreign material. Install new "O" rings.

CAUTION

Make sure upper "O" ring is installed properly, on upper or smaller diameter step, or damage to housing will occur when bolts are tightened.

LOWER HOUSING PLUG

Caused by improperly installed plug.

GEAR SHAFT OIL SEAL

Caused by damaged or improperly seated seal and/or snap ring. Replace seal. Remove steering arm with puller Tool C-3402. Remove old seal and install new seal with Tool C-3350.

GEAR SHAFT COVER

Leaks at gear shaft cover can be corrected without removal of unit from vehicle.

1. *Between gear shaft cover and housing*—Due to loose cover attaching screws or damaged "O" ring. Tighten attaching screws to 20 foot-pounds torque. If leak persists, remove cover and replace "O" ring. Inspect mating surfaces of cover and housing for nicks, burrs, etc.

2. *Around cover attaching screws*—Two of these screws have neoprene seals, the two adjacent to engine do not. Make sure seals are installed properly or replaced with new ones if needed.

3. *Around threads of gear shaft adjusting screw*—Due to damaged "O" ring. Remove cover and replace adjusting screw "O" ring.

Check for porosity of housing.

NOISE IN CHUCK ASSEMBLY

Squealing (high pitched). If squeal is encountered only while applying turning force to steering wheel, it is an indication that pump drive belt adjustment is too loose. Make sure belts are adjusted to proper tension.

HISSING NOISE (NO LOAD)

Caused by low oil level or improper operation of back pressure valve, in lower piston rod. Fill reservoir to proper level and recheck for noise. If noise is not eliminated, make following pressure checks:

Connect pressure gauge Tool C-3309 between the pump and pressure hoses. Open gauge valve and run

engine at idle (475-500 r.p.m.). With engine idling, no turning effort being applied to steering wheel, and unit at operating temperature the gauge should show a pressure between 70-100 psi. If pressure is below 70 psi., it is an indication that lower piston rod relief valve is not operating properly. If pressure is considerably above 100 psi., the plunger may be sticking and preventing normal return pressure. If pressure is not within limits, install new back pressure valve assembly, making sure end plug is seated tightly against valve body.

HISSING NOISE (RIGHT TURN ONLY)

This is caused by oil leaking past lower piston rod gear housing seal. Remove seal, with Tool C-3450, inspect lower piston rod and seal seat in gear housing for nicks, burrs, scratches, etc. Install new seal being sure it is properly seated in gear housing. Install seal with Tool C-3331.

HISSING NOISE ACCOMPANIED BY LOSS OF OIL THROUGH UPPER HOUSING VENT (LEFT TURN ONLY)

This is caused by oil leaking past upper piston rod housing head oil seal. Remove seal, inspect upper piston rod and seal seat in housing head for nicks, scratches, burrs, etc. Install new seal being sure it is properly seated in housing head. Use same tools that were used on lower piston rod seal.

CREAKING NOISES ON TURNS

Probably due to loose gear to frame mounting bolts. Tighten bolts 60 foot-pounds torque.

SNAPPING NOISES

This is usually an intermittent noise which is produced when direction of steering wheel rotation is suddenly reversed. Tighten steering gear to frame mounting bolts. If noise still exists, remove steering chuck from vehicle and proceed as follows:

1. Check coupling screw for tightness.

2. Check lower piston rod bushing dowel pin for being too high.

3. Remove bushing and inspect for any foreign matter which may be under bushing, preventing it from seating properly.

4. Inspect bearing surface of bushing for signs of excessive roughness.

5. Install new bushing if needed, making sure it is seated properly in gear housing and head of dowel pin is slightly below bearing surface of bushing.

6. Check lower piston to assure a tight fit exists at piston. If looseness exists, it could possibly be due to

too thin a snap ring or too wide a snap ring groove.

7. Replace necessary parts to assure a tight fit.

CHUCKLE NOISE

This noise will be most noticeable when vehicle is being operated on rough or choppy roads and usually is accompanied by wheel wander. This condition can be caused by any one or more of following items, each of which should be checked in following procedure:

1. *Steering gear arm nut loose on gear shaft*—Tighten 120 foot-pounds torque.
2. *Loose front wheel bearing*—Adjust bearings.
3. *Gear shaft adjusted too loose*—Adjust gear shaft.
4. *Steering tube coupling screw loose*—Tighten screw.
5. *Worm bearing preload adjustment too loose*—Adjust to proper preload with Tool C-3319 and C-3320 in combination with correct torque wrenches.
6. *Excessive worm shaft end play in connector assembly*—Replace worm and connector as an assembly.

WANDER (STEERING WHEEL FREEPLAY)

This is a condition whereby operator has to constantly turn steering wheel in order to hold vehicle in a straight course. To determine whether or not this condition is caused by power steering unit, proceed as follows:

With front wheels in straight-ahead position and resting on floor, start engine. Using a very light feather touch on steering wheel, check for freeplay. This should not exceed $\frac{5}{8}$ inch.

CAUTION

Extreme care should be used when checking steering wheel freeplay, as it is rather difficult to check exact point where freeplay begins and ends.

If steering wheel freeplay exceeds $\frac{5}{8}$ inch, without moving steering linkage, it is an indication that this difficulty is caused by one of following items in power unit, and should be checked in following sequence:

1. *Gear Shaft adjustment too loose*—Adjust gear shaft.
2. *Steering tube coupling screw loose*—Tighten screw.
3. *Worm bearing preload adjustment too loose*—Adjust to proper preload with Tools C-3319 and C-3320 and in combination with correct torque wrenches.
4. *Excessive worm shaft end play in connector assembly*—Replace worm and connector as an assembly.

If steering wheel freeplay does not exceed $\frac{5}{8}$ inch, it is an indication that the difficulty is caused by one of the following:

1. *Steering gear arm nut loose on gear shaft*—Tighten 120 foot-pounds torque.
2. *Loose front wheel bearings*—Adjust.
3. *Steering linkage*—Check for worn or loose tie rod ends, loose steering knuckle arms, drag links, etc. Tighten or replace necessary parts to eliminate freeplay.
4. *Front wheel alignment*—Align front wheels.

POOR RETURNABILITY (BOTH DIRECTIONS)

This is a condition whereby front wheels will not return to straight ahead position without assistance of operator. A primary cause of this condition is often due to low tire pressure, therefore, prior to checking further, inflate tires to proper pressure and road test. If condition exists, check returnability of power unit as follows to determine if condition is caused by power unit or front wheel alignment.

Disconnect linkage from steering gear arm and start engine. With engine idling, use torque wrench on steering gear arm nut and check torque required to turn gear shaft through center from one extreme to the other.

The torque reading should be approximately equal in each direction and should not exceed 40 foot-pounds, + or - 10 pounds. If torque reading does not exceed 40 foot-pounds + or - 10 pounds, it is an indication that difficulty is caused by one of following and not power steering unit.

1. *Check all tie rod ends and steering knuckles for binding*—If a bind is found to exist in any of these parts, replace as necessary.
2. *Front wheel alignment*—Align front wheels.

If torque readings exceed 40 foot-pounds, + or - 10 pounds in either direction, it is an indication that the condition is caused by the power steering unit. To determine an exact source, it will be necessary to start engine and recheck amount of torque required to turn gear shaft each time one of following items is checked.

3. *Steering wheel to column jacket interference*—Adjust to give necessary clearance.
4. *Steering column jacket bearing*—Remove steering wheel, with puller, Tool C-3428, jacket and shroud assembly and steering tube. Recheck torque, if reading is 40 foot-pounds or below, the difficulty is caused by steering column jacket bearings, replace bearings. If reading was not below 40 foot-pounds, proceed as follows:

5. Gear shaft adjustment too tight—Adjust gear shaft.

Worm bearing preload too tight. Place unit in special holding fixture Tool C-3323, connect test hoses and refill reservoir. Remove worm shaft oil seal. Start engine and recheck torque reading. If torque reading remains above 40 foot-pounds, check worm bearing preload for being too tight.

Readjust preload. If reading still remains above 40 foot-pounds, proceed as follows:

6. *Worm shaft binding in connector*—Remove upper housing and using Tool C-3555 secure housing head. Start engine and recheck torque reading. If reading is 40 foot-pounds or below, difficulty is due to either worm shaft binding in connector or connector guide rails binding on housing. Inspect and replace necessary parts.

POOR RETURNABILITY (ONE DIRECTION ONLY)

This is a condition whereby front wheels will not return to straight ahead position without assistance of operator. A primary cause of this condition is often due to low tire pressure, therefore, prior to checking further, inflate tires to proper pressure and road test. If condition still exists, check returnability of power unit as follows to determine if condition is caused by power unit or front wheel alignment:

1. Disconnect linkage from steering gear arm and start engine.

2. With engine idling, use a torque wrench on steering gear arm nut, and check torque required to turn gear shaft through center from one extreme to other. The readings should be approximately equal and not exceed 40 foot-pounds, then difficulty is caused by front wheel alignment and not power unit.

3. Align front wheels. If this does not correct condition, proceed as follows:

To align gear assembly place wheels in straight ahead position, loosen the idler arm bushing bolt nut, and retighten to 60 foot-pounds, making sure there is no preload in the rubber bushing in the straight ahead position. Loosen the steering column jacket clamp at the instrument panel. Loosen the three bolts that mount the gear to the frame. Then tighten front upper and lower gear housing to frame attaching bolts to 20 foot-pounds torque. Install wedge over rear bolt between housing and frame, tapping lightly in place. Tighten three attaching bolts to 70 foot-pounds torque.

UNEQUAL STEERING EFFORT (Severe Cases of Self Steering)

A condition whereby operator finds that it takes very little effort to turn steering wheel in one direction,

while considerable force is required, in the opposite. In severe cases of unequal steering effort it is possible that vehicle will have a tendency to self steer unless steering wheel is held.

Unequal steering effort is often mistaken for "lack of assist in one direction," make sure difficulty is diagnosed properly before attempting to correct. To establish which condition exists, check turning effort of steering wheel as follows:

1. With engine idling and front wheels resting on floor, turn steering wheel at normal rate of r.p.m. from one extreme to other, noting amount of turning force required. Turn steering wheel in same manner except at much higher rate of r.p.m. and again noting amount of turning force required.

CAUTION

Do not exceed 60 steering wheel r.p.m.'s when making this check.

If turning force did increase considerably with higher rate of steering wheel r.p.m.'s then refer to "lack of assist" (one direction). If amount of turning force did not increase appreciably with increased steering wheel r.p.m. then it is reasonable to assume that condition is unequal steering effort.

2. Disassemble unit as required.

CONTROL VALVE ADJUSTMENT

Disconnect linkage and center control valve so that an equal amount of torque is required to turn gearshaft from one extreme to other. If proper adjustment cannot be maintained after it has been set, then refer to "inability to maintain control valve adjustment."

UPPER PISTON ROD MOVEMENT IN PISTON

Check fit of snap ring which retains upper piston rod in piston, by attempting to rotate it. If snap ring can be rotated, it will allow upper piston rod to move axially with respect to piston thus displacing control valve in relation to valve body. This can cause self steering in either direction; however, it is usually most noted to be the left. To correct, replace piston making sure snap ring seats properly.

CONNECTOR NUT

Anything which will cause valve rod adjusting disc to be loose in connector, will result in self steering. Check for connector nut not tightened sufficiently to lock valve rod adjusting disc and reaction assembly in

connector. To accomplish this, remove worm connector and reaction assemblies from upper piston rod. Reassemble by placing the adjusting disc, adjusting disc retainer and valve control spacer in their respective positions in worm connector. Install worm connector nut and tighten securely. Insert small punch or screw driver through bottom of connector and attempt to rotate adjusting disc. If it cannot be rotated, it is properly locked.

CONTROL VALVE LOOSE ON ROD

The control valve rod is connected to control valve by peening. Check for any movement between the two. If movement exists, replace control valve and rod. Do not attempt to tighten by peening.

UPPER PISTON ROD NUT LOOSE

Tighten to proper torque.

UPPER PISTON ROD

Inspect upper piston rod for being scored at reaction seal retainer bearing surfaces and replace if needed.

REACTION ASSEMBLY

If above mentioned items have failed to correct unequal steering effort, replace all reaction parts. Make definitely sure valve control spacer is matched to upper piston rod. The length of valve control spacer must be identical to distance between the seat of lower valve control spacer retainer and the seated upper piston rod nut.

INABILITY TO MAINTAIN CONTROL VALVE ADJUSTMENT

This condition can be caused by one of the following: Reaction spacer being too long, too short, or by burrs, or out of squareness of any reaction area parts which are held inside connector by connector nut, including nut. Anything which causes unseating of reaction retainers when no turning force is applied will make accurate valve adjustment impossible. This can also be caused by one of following:

CAUTION

The turning torque for valve control rod in threads of valve rod adjusting disc should be 10-12 inch-pounds to prevent any looseness at this point. Do not exceed 20 inch-pounds, otherwise damage to valve rod and/or adjusting tool may result.

1. Valve control rod loose in nut valve rod adjusting cap assembly. Replace the valve rod adjusting assembly as required.

2. *Upper piston rod nut loose*—Tighten to proper torque.

3. *Control valve loose on rod*—The control valve rod is connected to control valve by peening. Check for any movement between the two. If movement exists, replace control valve and rod. Do not attempt to tighten by peening.

4. *Upper piston rod loose in piston*—Check for movement of upper piston rod in piston. If movement exists, replace piston.

LACK OF ASSIST (ONE DIRECTION)

This is a condition whereby operator finds that considerable more effort is required to turn steering wheel in one direction than it does the other. Since lack of assist in one direction is often mistaken for "Unequal Steering Effort" and causes for each are entirely different, make sure difficulty is properly diagnosed before attempting to correct. To determine which condition exists, refer to "Unequal Steering Effort" for method of establishing. Lack of assist in one direction usually is found to be caused by one of following:

1. *Piston Ring (Neoprene)*—Check for damaged neoprene piston ring.

2. *Housing Head Oil Seal Upper Piston Rod*—A damaged or improperly seated housing head oil seal will cause lack of assist when turning to left, and will also be accompanied by loss of oil out vent in upper housing. Inspect sealing surface on upper piston rod for being scratched. Replace if necessary. Install new housing head oil seal making sure it is properly seated in housing head.

3. *Lower Piston Rod Oil Seal*—A damaged or improperly seated lower piston rod oil seal will cause lack of assist when turning to right. Inspect sealing surface on lower piston rod for being scratched. Replace if necessary. Install new lower piston rod oil seal making sure it is properly seated in housing.

4. *Valve Rod Lower "O" Ring*—Inspect for damaged lower valve rod "O" ring in upper piston rod. Inspect groove for any foreign matter. Install new "O" ring making sure it is seated properly in groove.

5. *Piston Rod "O" Rings*—Inspect for damaged "O" rings on both upper and lower piston rods which may be causing leakage between piston and rods. Install new "O" rings making sure they fit properly in grooves.

LACK OF ASSIST (BOTH DIRECTIONS)

This is a condition whereby operator notes that considerable amount of effort is required to turn steering wheel in both directions. To locate cause of condition, check following possibilities in manner in which listed:

1. *Tire pressure too low*—Inflate to proper pressure.
2. *Pump Drive Belt Slipping or Broken*—Adjust belts to proper tension, or replace if needed.

CAUTION

Where two belts are used, make definitely sure both top and bottom belts are adjusted, otherwise condition will remain.

3. *Low fluid level*—Fill reservoir to proper level.
4. Should lack of assist still be encountered, a pressure check should be made to determine if pump is at fault.

PUMP NOT PRIMING

1. *PLUNGER SPRING*—Weak or broken (compress to a height of $6\frac{1}{64}$ inch, the spring should exert a force of 29.7 to 36.3 pounds when compressed).
2. *FLOW VALVE*—Stuck in open position. Check for dirt or burrs on flow spool or in valve liner.

REDUCED OR NO FLOW

1. *FLOW VALVE*—Stuck in open position—check for dirt or burrs on flow spool or in valve liner.
2. *RELIEF VALVE*—Leaking—check for dirt or nicks on relief valve seat.
3. *RELIEF VALVE SPRING*—Weak or broken—when compressed to a height of $3\frac{5}{64}$ inch, the spring should exert a force of 12.5 to 14 pounds when compressed.
4. *FLOW VALVE SPRING RETAINER*—Loose, torque to maximum specifications.
5. *CAP SCREWS*—On either end of pump—loose—torque to indicated specifications.
6. *FLOW VALVE SPRING*—Weak or broken—When compressed to a height of $1\frac{1}{2}$ inch, the spring should exert a force of 11.25 to 13.75 pounds when compressed.

LOW SHUT-OFF OR RELIEF PRESSURE

1. *RELIEF VALVE SPRING*—Weak or broken—replace.
2. *RELIEF VALVE*—Leak—check for dirt or nicks on relief valve seat.
3. *FLOW VALVE*—Stuck in open position—check for dirt or burrs on flow spool or in flow valve liner.
4. *CAP SCREWS ON EITHER END OF PUMP*—Loose—torque to indicated specifications.

PUMP NOISE

1. *CHECK OIL LEVEL IN RESERVOIR*—Oil level should be up to mark on filler neck when pump is at 175°F.
2. *AIR IN STEERING SYSTEM*—Check all connections to make certain that they are tight.
3. *DISCHARGE AND RETURN LINE HOSES*—The hoses must not touch any part of the body or frame except where they are attached to the pump or steering column.
4. *LOOSE PULLEY.*
5. *WATER IN OIL.*

HARD OR JERKY STEERING TOWARD END OF FULL LEFT OR RIGHT TURN

DRIVE BELT—Tighten drive belts to specified torque.

OIL LEVEL IN THE RESERVOIR

The following precautions should be observed for best performance of the sleeve-type power steering pump.

The oil level in reservoir will vary according to the operating temperature. The normal operating temperature of the pump is approximately 175°F. At this temperature, the oil should be up to the oil level mark on the filler neck. At 70°F. the oil will be approximately $3\frac{1}{4}$ inches from top of the filler neck.

NOTE

The oil level should never be allowed to fall below the baffle in the reservoir.

Automatic Transmission Fluid Type "A" is used in the steering system; however, S.A.E. 10W may be used to bring the oil level to the proper place if the level is low. If the steering system is drained, it should be filled with transmission fluid. The pump must be full before the engine is started. After starting the engine, add sufficient oil to make up for the pump consumption to bring oil up to operating level.

BELT TENSION

The belt tension may be checked by applying torque wrench to the bolt which holds the pulley in place. Turning in the direction which will tighten the bolt, the torque should be 20 foot-pounds.

CARS WITH CONSTANT CONTROL POWER STEERING

HARD STEERING

- A. Tires not properly inflated.
- B. Low oil level (Usually accompanied by pump noises).
- C. Loose Pump Belt.
- D. Oil on pump belts.
- E. Steering linkage needs lubrication.
- F. Power steering pump output low.
- G. Steering gear malfunction.
 - (1) Cross shaft adjustment too tight.
 - (2) Pressure control valve stuck in closed position.
 - (3) External oil leakage at the following points:
 - Lower sector shaft oil seal. Sector shaft adjusting screw seal. Sector shaft cover "O" ring seal.
 - Valve housing-to-gear housing "O" rings.
 - (4) Defective or damaged valve lever .
 - If pressure gauge will build up to 850 to 950 psi., check the following points:
 - Defective or damaged gear shaft bearings.
 - Dirt or chips in steering gear.
 - Damaged column support worm shaft bearings.
 - Damaged thrust bearing or excessive preload adjustment.
 - Rough, hard to turn worm and piston assembly.
 - (5) Excessive internal leakage. If pressure gauge will not build up to 850 to 950 psi., check the following points:
 - Cylinder head "O" rings.
 - Cylinder head reaction seal.
 - Cylinder head worm shaft oil seal assembly.
 - Column support-to-ferrule "O" ring seal.
 - Column support reaction seal.
 - Cylinder head "O" rings.

POOR RECOVERY FROM TURNS

- A. Tires not properly inflated.
- B. Steering linkage binding.
- C. Improper wheel alignment.
- D. Damaged or defective steering tube bearing.
- E. Steering wheel column jacket and steering unit not properly aligned.
- F. Steering gear malfunctions.
 - (1) Improper cross shaft mesh adjustment.
 - (2) Pressure control valve piston stuck in open position.
 - (3) Column support spanner nut loose.
 - (4) Defective or damaged valve lever.
 - (5) Improper worm thrust bearing adjustment.
 - (6) Burrs or nicks in reaction ring grooves in cylinder head or
 - (7) Defective or damaged cylinder head worm shaft seal ring.
 - (8) Dirt or chips in steering gear unit.
 - (9) Rough or catchy worm and piston assembly.

TEMPORARY INCREASE IN EFFORT WHEN TURNING STEERING TO RIGHT OR LEFT

- A. Low oil level.
- B. Loose pump belt.
- C. Oil on pump belts.
- D. Binding steering linkage.
- E. Engine idle too slow.
- F. Defective power steering pump.
- G. Air in system. (Work steering wheel from right to left until air is expelled).
- H. Gear malfunction.
 - (1) External leakage.
 - (2) Improper cross shaft adjustment.
 - (3) Excessive internal leakage.

EXCESSIVE STEERING WHEEL FREE-PLAY

- A. Improper cross shaft adjustment.
- B. Column support spanner nut loose.
- C. Improper worm thrust bearing adjustment.

LACK OF ASSISTANCE—One Direction

- A. Oil leaking past worm shaft cast iron oil seal ring or ferrule "O" ring.

—Both Directions—

- A. Broken "D" ring on worm piston.
- B. Piston end plug loose.
- C. Reaction seal missing.
- D. Pump belt slipping.
- E. Pump output low.

NOISES

- A. Buzzing noise in neutral, stops when steering wheel is turned—sticking pressure control valve.
- B. Noisy power pump.
- C. Damaged hydraulic lines.
- D. Pressure control valve sticking.
- E. Improper sector shaft mesh adjustment.
- F. Air in system.

SELF-STEERING OR LEADS TO EITHER SIDE

- A. Tires not properly inflated.
- B. Improper wheel alignment.
- C. Steering wheel off center when car is traveling straight ahead.
- D. Valve body out of adjustment:
 - Steering to the left—Move steering valve housing down on steering housing.
 - Steering to the right—Move steering valve housing up on steering housing.
- E. Valve lever damaged.
- F. Column support spanner nut loose.