

PART 13-06 Ford-Thompson Power Steering

APPLIES TO F-100 THROUGH F-350 (4 x 2) MODELS ONLY

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N/A indicates that the item is not applicable to the vehicle(s) listed.

1 DESCRIPTION

POWER STEERING GEAR

The Ford integral power steering unit (Fig. 1) is a torsion-bar type of hydraulic assisted system used on F-100, 250 and 350 (4 x 2) vehicles. This system furnishes power to reduce the amount of turning effort required at the steering wheel. It also reduces road shock and vibrations.

The torsion bar power steering unit includes a worm and one-piece rack piston, which is meshed to the gear teeth on the steering sector shaft. The unit also includes a hydraulic valve, valve actuator, input shaft and torsion bar assembly which are mounted on the end of the worm shaft and operated by the twisting action of the torsion bar.

The torsion-bar type of power steering gear is designed with the one piece rack-piston, worm and sector shaft in one housing and the valve spool in an attaching housing (Fig. 1). This makes possible internal fluid passages between the valve and cylinder, thus eliminating all external lines and hoses, except the pressure and return hoses between the pump and gear assembly.

The power cylinder is an integral part of the gear housing. The piston is double acting, in that fluid pressure may be applied to either side of the

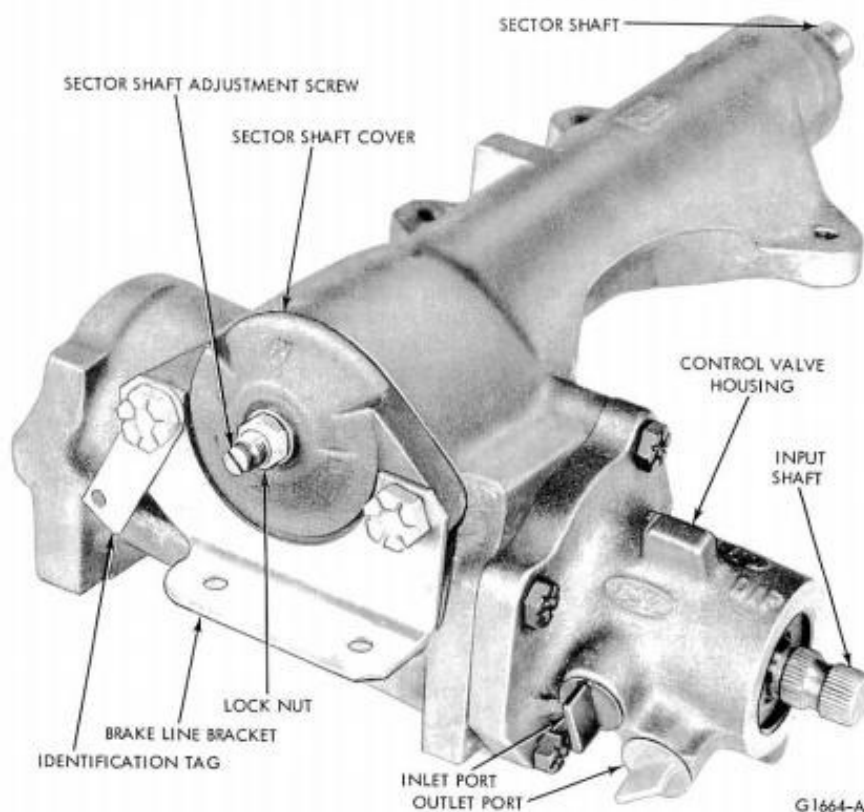


FIG. 1—Ford Integral Power Steering Gear

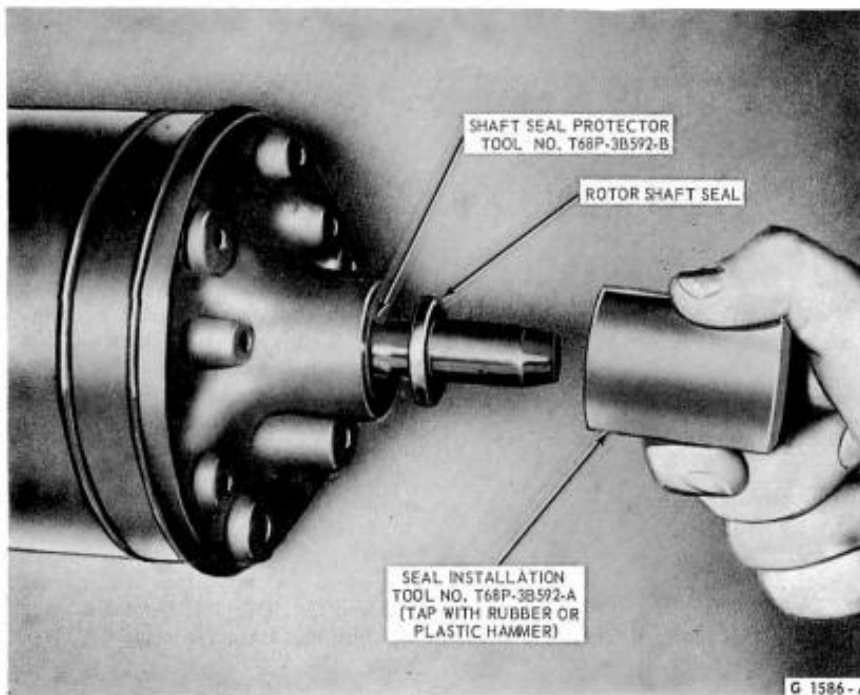


FIG. 11—Rotor Shaft Seal Installation

4 MAJOR REPAIR OPERATIONS

POWER STEERING GEAR

In most cases, complete disassembly of the power steering gear will not be necessary. It is suggested that only those assemblies that are faulty be disassembled. Disassembly and reassembly of the unit and the subassemblies must be made on a clean workbench. As in repairing any hydraulically operated unit, cleanliness is of utmost importance. Therefore, the bench, tools, and parts must be kept clean at all times. Thoroughly clean the exterior of the unit with a suitable solvent and, when necessary, drain as much of the hydraulic oil as possible. Handle all parts very carefully to avoid nicks, burrs, scratches and dirt, which could make the parts unfit for use. Do not clean, wash or soak seals in cleaning solvent.

VALVE CENTERING SHIM REMOVAL AND INSTALLATION

1. Hold the steering gear over a drain pan in an inverted position and cycle the input shaft several times to drain the remaining fluid from the gear.

2. Mount the gear in a soft-jawed vise.

3. Turn the input shaft to either stop, then, turn it back approximately $1\frac{3}{4}$ turns to center the gear.

4. Remove the two sector shaft cover attaching screws, the brake line bracket and the identification tag.

5. Tap the lower end of the sector shaft with a soft-faced hammer to loosen it, then lift the cover and shaft from the housing as an assembly. Discard the O-ring.

6. Remove the four valve housing attaching bolts. Lift the valve housing from the steering gear housing while holding the piston to prevent it from rotating off the worm shaft.

7. Remove the valve housing and the lube passage O-rings and discard them.

8. Place the valve housing, worm and piston assembly in the bench mounted holding fixture Tool T57L500-A with the piston on the top.

9. Rotate the piston upward (back off) $3\frac{1}{2}$ turns.

10. Insert Tool T66P-3553-C (with the arm facing away from the piston) into a bolt hole in the valve housing. Rotate the arm into position

4. Using the seal installation Tool T68P-3B592-A and a rubber or plastic hammer, tap gently on the end of the tool until the seal is completely installed (flush with the end of the seal bore).

5. Remove the tools.

6. Install the pulley on the rotor shaft as described under Power Steering Pump Pulley Installation.

under the piston (Fig. 12).

11. Loosen the Allen head race nut set screw from the valve housing.

12. Using Tool T66P-3553-B, loosen the worm bearing race nut.

13. Lift the piston-worm assembly from the valve housing. **During removal hold the piston to prevent it from spinning off at the shaft.**

14. Change the power steering valve centering shim.

15. Install the piston-worm assembly into the valve housing. **Hold the piston worm to prevent it from spinning off of the shaft.**

16. Install the worm bearing race nut and torque to specification using Tool T66P-3553-B (Fig. 13).

17. Install the race nut set screw (Allen head) through the valve housing.

18. Rotate the piston upward (back off) $1\frac{1}{2}$ turn and remove Tool T66P3553-C.

19. Remove the valve housing, worm, and piston assembly from the holding fixture.

20. Position a new lube passage O-ring in the counterbore of the gear housing.

21. Apply vaseline to the teflon seal on the piston.

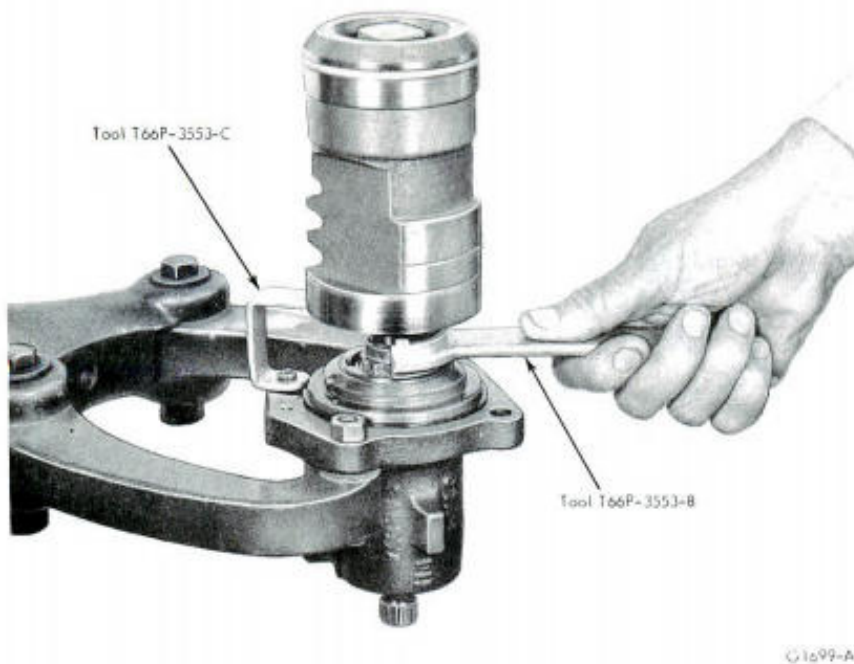


FIG. 12—Removing Worm Bearing Race Nut

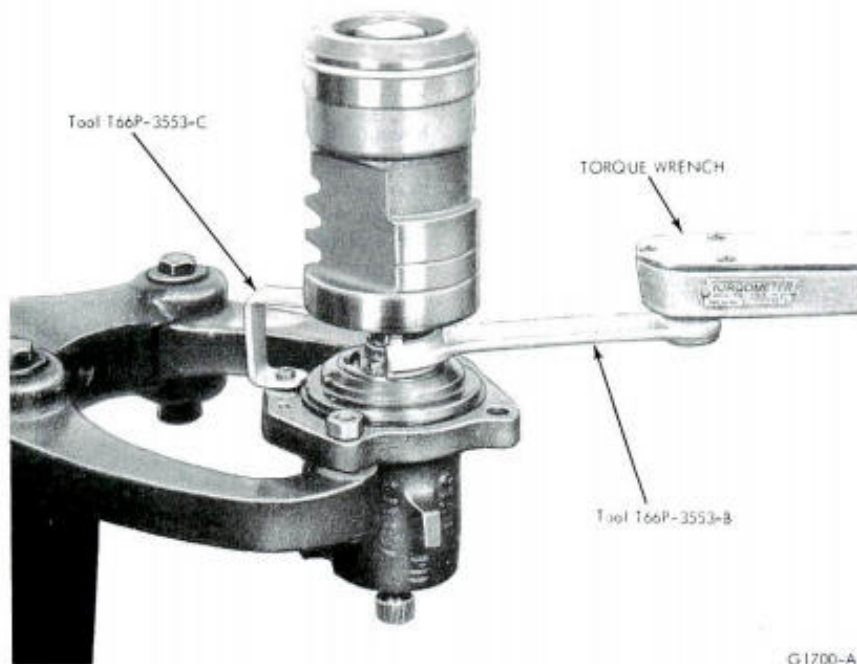


FIG. 13—Installing Worm Bearing Race Nut

22. Place a new O-ring on the valve housing.

23. Slide the piston and valve into the gear housing being careful not to damage the teflon seal.

24. Align the lube passage in the

valve housing with the one in the gear housing, and install but do not tighten the attaching bolts.

25. Rotate the ball nut so that the teeth are in the same place as the sector teeth. Tighten the four valve

housing attaching bolts to specification.

26. Position the sector shaft cover O-ring in the steering gear housing. Turn the input shaft as required to center the piston.

27. Apply vaseline to the sector shaft journal; then, position the sector shaft and cover assembly in the gear housing. Install the brake line bracket, steering gear identification tag and the two sector shaft cover attaching studs.

28. Position an in-lb torque wrench on the gear input shaft and adjust the meshload to approximately 4 in-lbs. Then, torque the sector shaft cover attaching studs to specification at the end of this Part.

29. After the cover attaching bolts have been tightened to specification, adjust the meshload to specification with an in-lb torque wrench.

STEERING GEAR DISASSEMBLY

1. Hold the steering gear over a drain pan in an inverted position and cycle the input shaft several times to drain the remaining fluid from the gear.

2. Mount the gear in a soft-jawed vise.

3. Remove the lock nut from the adjusting screw.

4. Turn the input shaft to either stop then, turn it back approximately $1 \frac{3}{4}$ turns to center the gear.

5. Remove the two sector shaft cover attaching studs, the brake line bracket and the identification tag.

6. Tap the lower end of the sector shaft with a soft-hammer to loosen it, then lift the cover and shaft from the housing as an assembly. Discard the O-ring.

7. Turn the sector shaft cover counterclockwise off the adjuster screw.

8. Remove the four valve housing attaching bolts. Lift the valve housing from the steering gear housing while holding the piston to prevent it from rotating off the worm shaft. Remove the valve housing and the lube passage O-rings and discard them.

9. Stand the valve body and piston on end with the piston end down. Rotate the input shaft counterclockwise out of the piston allowing the ball bearings to drop into the piston.

10. Place a cloth over the open end of the piston and turn it upside down to remove the balls.

11. Remove the two screws that attach the ball guide clamp (Fig. 14) to the ball nut and remove the clamp and the guides.

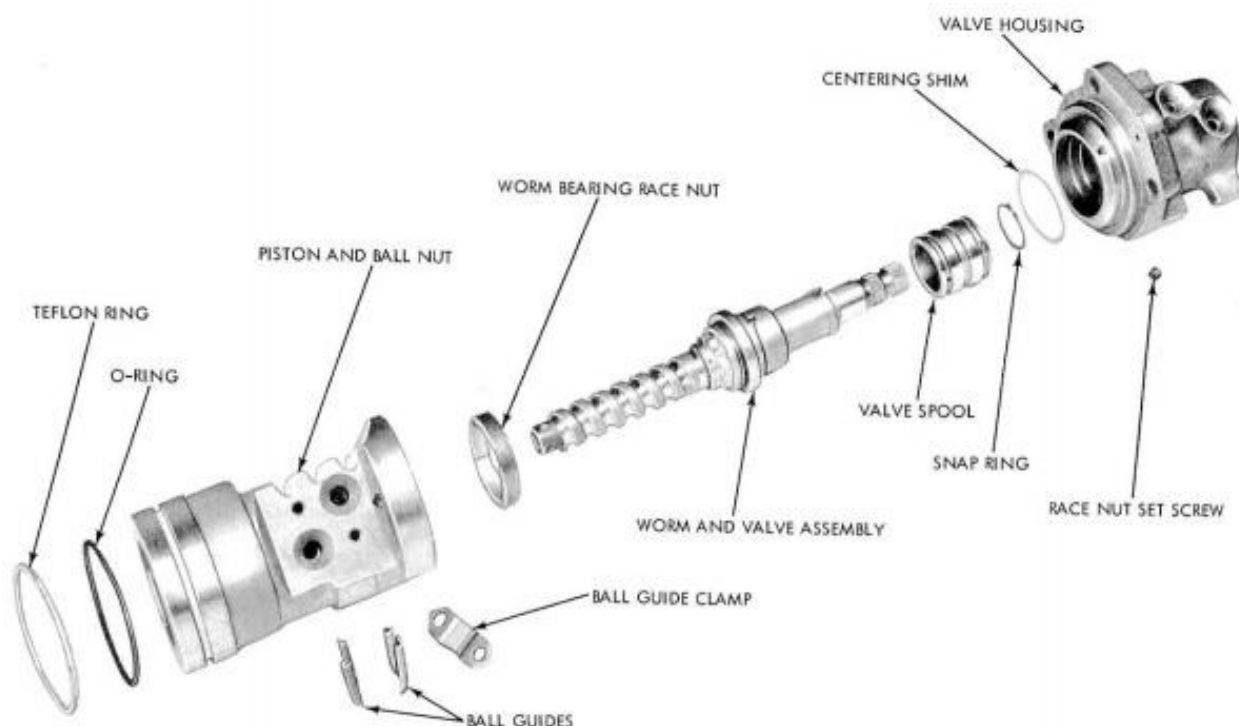


FIG. 14—Ball Nut and Valve Housing Disassembled

G1666-A

12. Install the valve body assembly in the holding fixture (do not clamp in a vise) and loosen the race nut screw (Allen head) from the valve housing and remove the worm bearing race nut as shown in Fig. 12.

13. Carefully slide the input shaft, worm and valve assembly out of the valve housing. Due to the close diametrical clearance between the spool and housing, the slightest cocking of the spool may cause it to jam in the housing.

14. Remove the shim from the valve housing bore.

PARTS REPAIR OR REMOVAL AND INSTALLATION

Valve Housing

1. Remove the dust seal (Fig. 15) from the rear of the valve housing with Tools T59L-100-B and T58L101-A and discard the seal.

2. Remove the snap ring from the valve housing.

3. Turn the fixture to place the valve housing in an inverted position.

4. Insert special tool in the valve body assembly opposite the seal end and gently tap the bearing and seal

out of the housing as shown in Fig. 16. Discard the seal. **Caution must be exercised when inserting and removing the tool to prevent damage to the valve bore in the housing.**

5. Remove the fluid inlet and outlet tube seats with an EZ-out if they are damaged.

6. Coat the fluid inlet and outlet tube seats with vaseline and position them in the housing. Install and tighten the tube nuts to press the seats to the proper location.

7. Coat the bearing and seal surface of the housing with a film of vaseline.

8. Position the bearing in the valve housing. Seat the bearing in the valve housing with the tool shown in Fig. 17. Make sure that the bearing is free to rotate.

9. Dip the new oil seal in gear lubricant; then, place it in the housing with the metal side of the seal facing outward. Drive the seal into the housing until the outer edge of seal does not quite clear the snap ring groove (Fig. 18).

10. Place the snap ring in the housing; then, drive on the ring with the tool shown in Fig. 18 until the snap ring seats in its groove to properly locate the seal.

11. Place the dust seal in the housing with the dished side (**rubber side**) facing out. Drive the dust seal into place with the tool shown in Fig. 18. The seal must be located behind the undercut in the input shaft when it is installed.

Worm and Valve

1. Remove the snap ring from the end of the actuator.

2. Slide the control valve spool (Fig. 14) off the actuator.

3. Install the valve spool evenly and slowly with a slight oscillating motion into the flanged end of valve housing with the valve identification groove between the valve spool lands outward, checking for freedom of valve movement within the housing working area. The valve spool should enter the housing bore freely and fall by its own weight.

4. If the valve spool is not free, check for burrs at the outward edges of the working lands in the housing and remove with a hard stone.

5. Check the valve for burrs and if burrs are found, stone the valve in a **radial direction only**. Check for freedom of the valve again.

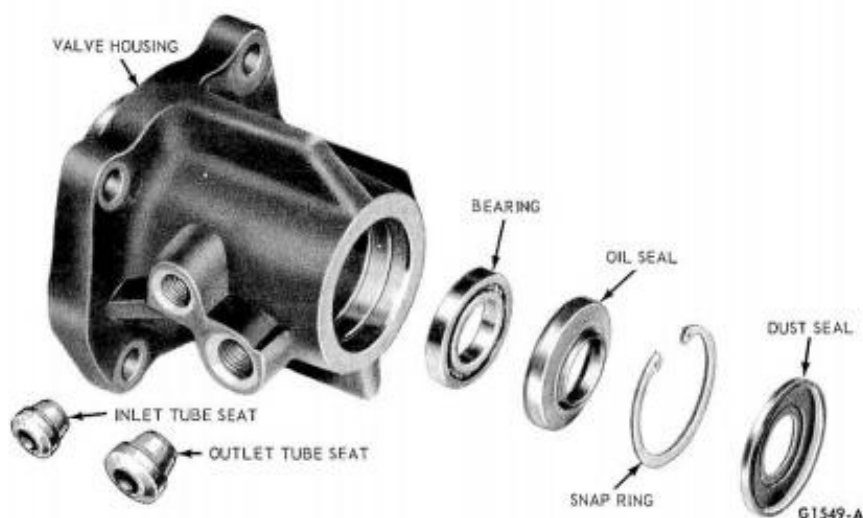


FIG. 15—Valve Housing Disassembled

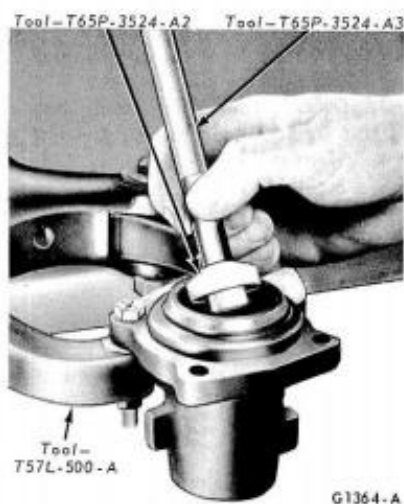


FIG. 16—Removing Bearing and Oil Seal

6. Remove the valve spool from the housing.

7. Slide the spool onto the actuator making sure that the groove in the spool annulus is toward the worm.

8. Install the snap ring to retain the spool.

9. Check the clearance between the spool and the snap ring. The clearance should be between .0005—.035 inch. If the clearance is not within these limits, select a snap ring that will allow a clearance of .002 inch.

Piston and Ball Nut

1. Remove the teflon ring and the O-ring (Fig. 14) from the piston and ball nut.

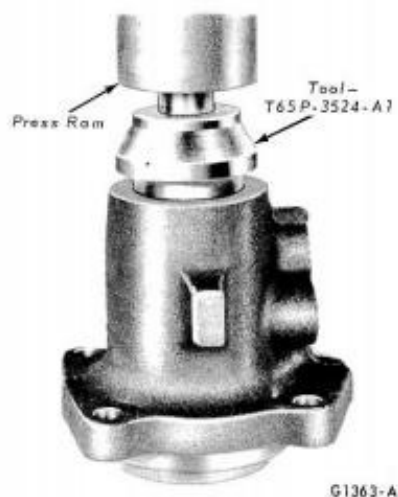


FIG. 17—Installing Valve Housing Bearing

2. Dip a new O-ring in gear lubricant and install it on the piston and ball nut.

3. Install a new teflon ring on the piston and ball nut being careful not to stretch it any more than necessary.

Steering Gear Housing

1. Remove the snap ring and the spacer washer (Fig. 19) from the lower end of the steering gear housing.

2. Remove the lower seal from the housing as shown in Fig. 20. Lift the spacer washer from the housing.

3. Remove the upper seal in the same manner as the lower seal. Some housings require only one seal and one spacer.

4. Dip both sector shaft seals in



FIG. 18—Installing Oil Seal in Valve Housing

gear lubricant.

5. Apply lubricant to the sector shaft seal bore of the housing and position the sector shaft inner seal into the housing with the lip facing inward. Press the seal into place with the tool shown in Fig. 21. Place a spacer washer (0.090 inch) on top of the seal and apply more lubricant to the housing bore.

6. Place the outer seal in the housing with the lip facing inward and press it into place as shown in Fig. 22. Then, place a 0.090 inch spacer washer on top of the seal.

7. Position the snap ring in the housing. Press the snap ring into the housing to properly locate the seals and engage the snap ring in the groove.

STEERING GEAR ASSEMBLY

Do not clean, wash, or soak seals in cleaning solvent.

1. Mount the valve housing in the holding fixture with the flanged end up.

2. Place the required thickness valve spool centering shim (Fig. 14) in the housing. Use one shim only.

3. Carefully install the worm and valve in the housing.

4. Install the race nut in the housing and torque it to specification at the end of this Part.

5. Install the race nut set screw (Allen head) through the valve housing and torque to specification at the end of this Part.

6. Place the piston on the bench with the ball guide holes facing up. Insert the worm shaft into the piston

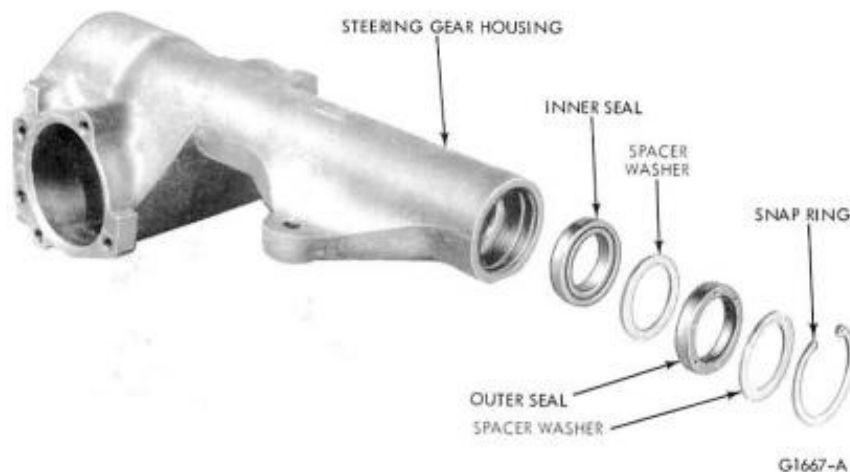


FIG. 19—Steering Gear Housing Disassembled

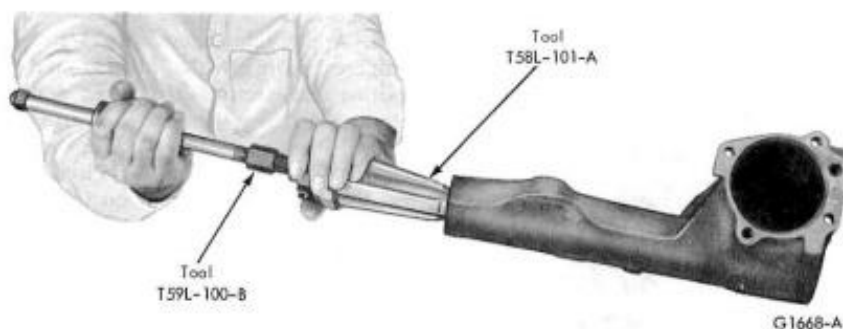


FIG. 20—Removing Upper and Lower Seals

so that the first groove is in alignment with the hole nearest to the center of the piston (Fig. 23).

7. Place the ball guide in the piston. Place the 27 or 28 balls, depending on the piston design, in the ball guide (Fig. 23) turning the worm in a clockwise direction as viewed from the input end of the shaft. If all of the balls have not been fed into the guide upon reaching the right stop, rotate the input shaft in one direction and then in the other while installing the balls. After the balls have been installed, do not rotate the input shaft or the piston more than 3 1/2 turns off the right stop to prevent the balls from falling out of the circuit.

8. Secure the guides in the ball nut with the clamp (Fig. 23).

9. Position a new lube passage O-ring in the counterbore of the gear housing.

10. Apply vaseline to the teflon seal on the piston.

11. Place a new O-ring on the valve housing.

12. Slide the piston and valve into the gear housing being careful not to damage the teflon seal.

13. Align the lube passage in the valve housing with the one in the gear housing, and install but do not tighten the attaching bolts.

14. Rotate the ball nut so that the teeth are in the same plane as the sector teeth. Tighten the four valve housing attaching bolts to specifications.

15. Position the sector shaft cover O-ring in the steering gear housing. Turn the input shaft as required to center the piston.

16. Apply vaseline to the sector shaft journal then position the sector shaft and cover assembly in the gear housing. Install the brake line bracket, the steering identification tag and two sector shaft cover attaching bolts. Torque the bolts to specifications.

17. Attach an in-lb torque wrench to the input shaft. Adjust the mesh load to specifications as shown in Fig. 24.

POWER STEERING PUMP— FORD—THOMPSON

DISASSEMBLY

Disassembly of the pump and its sub-assemblies (Fig. 25) must be made on a clean workbench. In repairing any hydraulically operated unit, cleanliness is of utmost importance. Clean the exterior of the unit with a suitable solvent and drain as much of the fluid as possible.

If only the reservoir is to be removed, plug the inlet and outlet openings with masking tape or plugs. Do not immerse the shaft oil seal in solvent. If only the rotor shaft seal is to be replaced, see Rotor Shaft Seal outlined in Section 3 of this part.

1. Assemble the adapter plate (Tool T69P-3A674-A) to the bench mounted holding fixture Tool T57L-500-A (Fig. 26).

2. Position the pump assembly, with pulley assembled, on the adapter plate, pulley facing down.

3. Remove the outlet fitting nut and the service identification tag.

4. Invert the pump assembly and, using a block of wood and a rubber or plastic hammer, remove the pump reservoir and seal by tapping around the flange of the reservoir and on the underside of the filler neck.

5. Again invert the pump assembly, loosen and remove the pump housing retention bolts and remove the pump housing.

6. If necessary, remove the following components from the pump housing: the housing cover, the O-ring seal and the pressure springs. These components normally will remain in the pump housing when it is removed.

7. Remove and discard the pump cover gasket.

8. Remove the retainer end plate and upper pressure plate (in some pumps, the end plate and upper pressure plate are integral).

9. Remove the loose fitting dowel pin. Be careful not to bend the fixed dowel pin which remains in the housing plate assembly.

10. Remove the rotor assembly, being careful to prevent the springs and slippers from falling out and becoming lost. Do not disassemble further unless the lower pressure plate, housing plate, rotor shaft and/or seal is to be replaced.

11. Invert the pump assembly and using Tool T63L-10300-B, remove the pulley.

12. Clean any rust, road dirt, burrs, scoring, etc. from the pulley



FIG. 21—Installing Sector Shaft Inner Seal

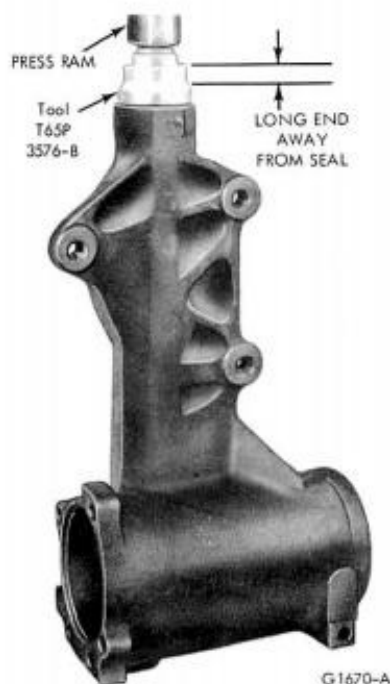


FIG. 22—Installing Sector Shaft Outer Seal

end of the rotor shaft prior to removal of the shaft from the housing plate. The shaft must come out without restrictions to prevent scoring or damage to the bushing. Remove the

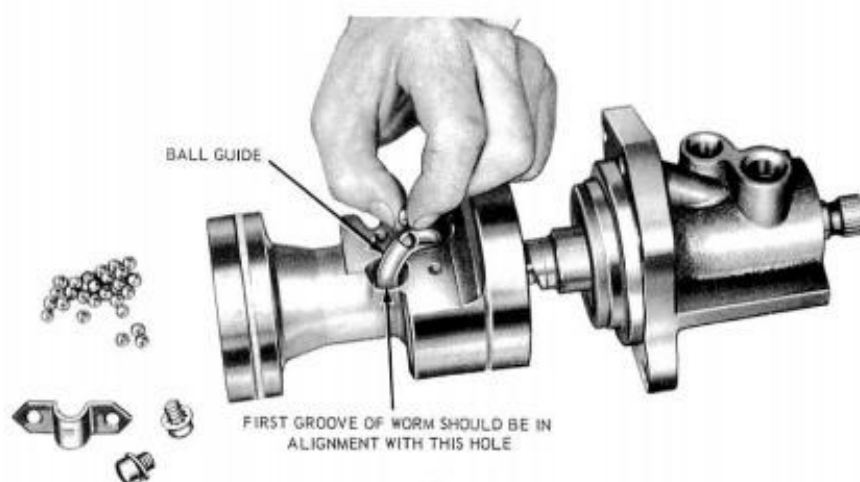


FIG. 23—Assembling Piston on Worm Shaft

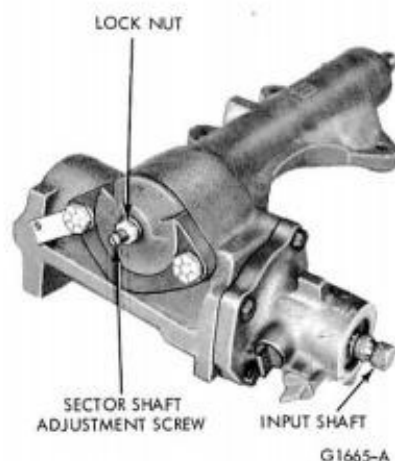


FIG. 24—Adjusting Mesh

pump rotor shaft.

13. Remove the lower pressure plate.

ASSEMBLY

1. Assemble adapter plate (Tool T69P-3A674-A) to the bench mounted holding fixture Tool T57L-500-A. Position the pump assembly on the adapter plate, pulley side facing down. (If the lower pressure plate and rotor shaft have not been disassembled, omit steps 2 and 3.)

2. Insert the lower pressure plate on the anchor pin with the wide chamfered slots at the center hole facing up (Fig. 27).

3. Dip the rotor shaft in specified steering gear lubricant (C1AZ19582A); then insert the rotor shaft into the lower pressure plate and housing plate.

4. If the rotor assembly is disassembled, hold the cam insert with the notch on the OD of the cam at the top and the arrow on the OD of the cam pointing downward.

5. Insert the rotor in the cam with the double step in the ID of the rotor facing upward.

6. With the rotor extended upward approximately one half way out of the cam, insert a spring into a rotor spring pocket working in the rotor cavity directly beneath the cam notch.

7. Use one of the slippers to compress the spring and install the slipper with the groove in the slipper facing upward (toward the cam notch). The flat on the side of the slipper should be on the left (Fig. 28).

8. Hold the cam stationary and turn the rotor either to the right or left, one space at a time. Repeat Step 7 until all the rotor cavities have been filled. Be careful when turning the rotor that the springs and slippers already inserted do not fall out.

9. Install the cam and rotor assembly onto the pump housing plate with the fixed dowel passing through the first hole to the left of the cam notch when the arrow on the cam OD is pointing toward the lower pressure plate (Fig. 29). If the cam and rotor assembly will not seat, turn the rotor shaft slightly until the spline teeth mesh, allowing the cam and rotor to drop down into position.

10. Insert the loose fitting dowel

29. Install the service identification tag on the outlet valve fitting.

30. Install the outlet valve fitting

nut and torque to 43–47 ft–lbs.

31. Invert the pump assembly.

32. If the pulley was removed, in-

stall the correct pulley using Tool T65P–3A733–A.

5 SPECIFICATIONS

INTEGRAL POWER STEERING GEAR SPECIFICATIONS

Description	Ford Design (XR-60)
Type	Recirc. Ball Torsion Bar
Ratio	17:1
Turns of Steering Wheel (Lock to Lock-Linkage Disconnected)	4
Fluid Specifications	C1AZ-19582-A
Fluid Capacity (Included in Pump Reservoir Fill)	1.6 Pints (Approx.)
Phosphorescent Dye Additive (For Leak Detection)	M99B103-A (4 oz. per qt.)
Sector Shaft End Play – Linkage Disconnected	None
Sector Shaft Mesh Load, Total Over Mechanical Center Position. Must be Ⓢ Greater Than Worm Bearing Preload Torque, Shown Below	17 In.-Lb. (Max.)
Worm Bearing Preload	2-8 In.-Lb.
Clearance Between Valve Spool & Retaining Ring	.0035–.0005" Preferable .002"
Pressure Variation Between Right & Left Turn (At 250 P.S.I.)—Check Efforts Each Side of Center	4 In.-Lb. Max. Variation
Clearance Between Inner Sector Seal and Housing	.025"
Ⓢ9-13 In.-Lb.	
Ⓢ3 In Lb in Excess of Valve Assy. Drag Total Worm Bearing Preload and Seal Drag not to Exceed 8 In Lb.	

CG1725-A

SPECIAL SERVICE TOOLS

Tool No.	Description
T56L-33610-D	Pressure Testing Gauge Assembly
T64P-3590-F	Steering Pitman Arm Remover
T57L-500-A	Bench Mounted Holding Fixture
T66P-3553-C	Spacer
T66P-3553-B	Spanner Wrench
T59L-100-B	Slide Hammer-Short
T58L-101-A	Puller Attachment
T65P-3524-A1, A2, A3	Bearing Remover and Installer

CG1726-A