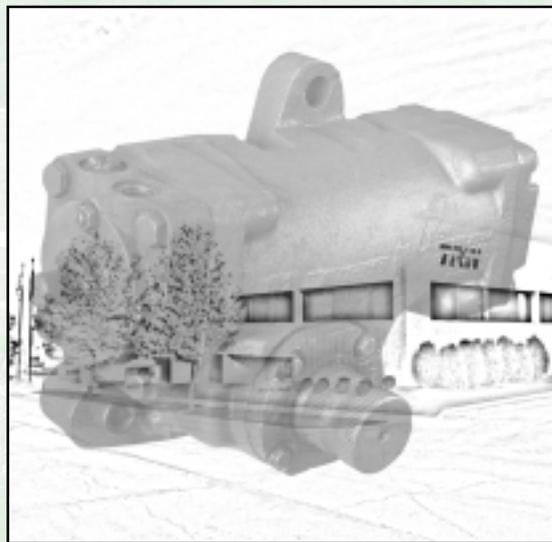


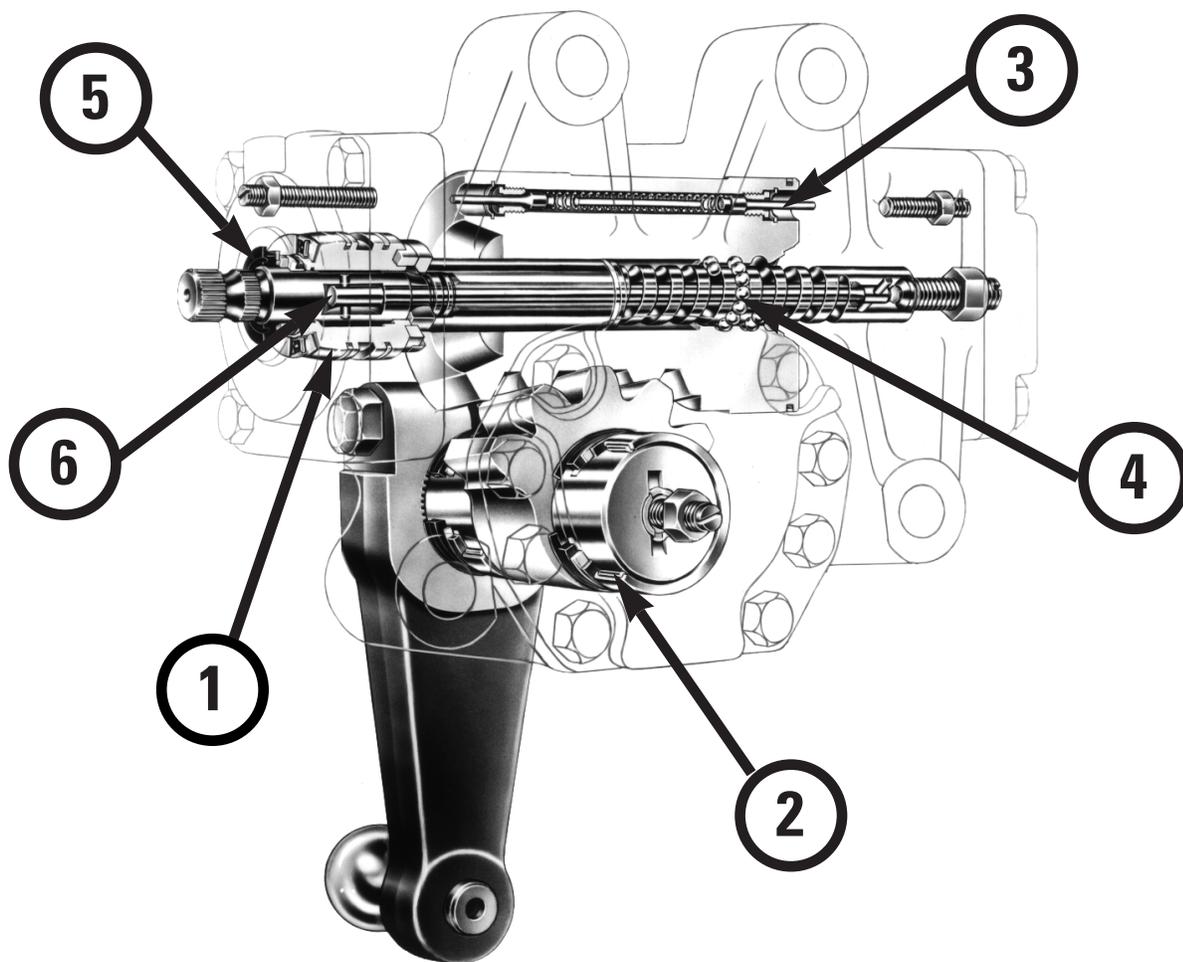
HFB Steering Gear Service Manual

HFB70 SERIES



HFB70 Integral Hydraulic Power Steering Gear

This steering gear was specifically designed for motor trucks; new design features and our design experience with previous models of integral hydraulic power steering gears have been combined into this new product.



Design Features

1. **Rotary Valve** - This device provides responsive steering control
 2. **Precision Roller Bearings** - Allow the steering gear to operate with high efficiency and reversibility
 3. **Unloading Valves** - Furnish power steering pump protection and reduce pressure to unload steering linkage at the ends of steering gear travel
 4. **Recirculating Balls** - Combines high mechanical efficiency with smooth operation
 5. **Dirt and Water Seals** - Lip type seals on both input and output shafts
 6. **Torsion Bar** - Provides positive valve centering with definitive "feel of the road"
- **Balanced Area Cylinder** - Back pressures cannot affect steering stability
 - **High Temperature Seals** - These specially developed seals may be operated intermittently at 300°F (148.9°C)
 - **Manual Steering Capability** - Provides for steering control in the event of hydraulic failure
 - **Compactness** - Lowest weight to output torque ratio in the industry
 - **Auxiliary Porting Available** - For auxiliary cylinder control
 - **Seal Protectors** - Provide protection from harsh environment

Definitions

NOTE: A NOTE gives key information to make procedures easier or clearer.

CAUTION: A CAUTION refers to those procedures which must be followed to avoid damage to the gear.

WARNING: A WARNING REFERS TO THOSE PROCEDURES WHICH MUST BE FOLLOWED FOR THE SAFETY OF THE DRIVER AND THE PERSON INSPECTING OR REPAIRING THE GEAR.

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service steering components and systems on heavy commercial vehicles. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear HFB70 Integral Power Steering Gears. However, despite the care and effort taken in preparing this general Service Manual, TRW makes no warranties that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific HFB70 steering gear, or (b) any repairs or service of a particular HFB70 steering gear will result in a properly functioning steering gear.

If inspection or testing reveals evidence of abnormal wear or damage to the HFB70 steering gear or if you encounter circumstances not covered in the Manual, STOP - CONSULT THE VEHICLE MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE AN HFB70 STEERING GEAR WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE HFB70 STEERING GEAR.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular HFB70 steering gear to (a) inspect the steering gear for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the vehicle, or the safe operation of the vehicle, and (c) fully inspect and test the HFB70 steering gear and the vehicle steering system to insure that the repair or service of the steering gear has been properly performed and that the steering gear and system will function properly.

This TRW Ross Gear Division vehicle power steering gear is covered by one or more of United States patent numbers: 3,896,702; 3,606,819; 3,741,074; 3,773,081; 3,955,473; 3,935,790; and 3,921,669. Other United States patent applications are pending, and corresponding foreign patents are pending and issued.

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Assembly Preparation

- Wash all parts in clean petroleum-based solvent. Blow them dry only.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS

- Replace all seals, seal rings, and gaskets with new ones each time you disassemble the gear.
- Ross Gear does provide individual seals, seal rings, and gaskets, as well as complete and partial seal kits. SEE FIGURE 98. These parts should be available thru most OEM parts distributors. (Contact your local dealer for availability 9

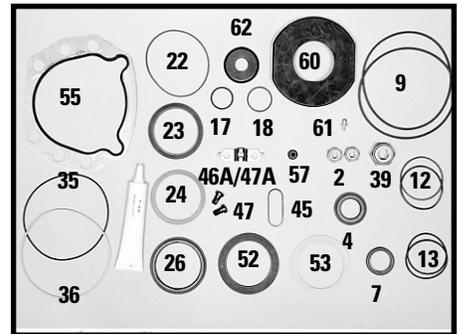


Figure 98



Figure 99

Assembly

assemble worm shaft O ring & seal ring

- Slide compression tool J26740, small diameter end first, onto the worm end of worm shaft/input shaft (16) until it is beyond the seal ring groove. Using seal installation tool J26739 assemble the new worm shaft o-ring (17), and then the new seal ring (18). SEE FIGURE 99, 100. Next, compress the seal ring by pulling the compression tool back over the seal ring. Allow the worm shaft/input shaft to set with compression tool in place for at least ten minutes. SEE FIGURE 101.

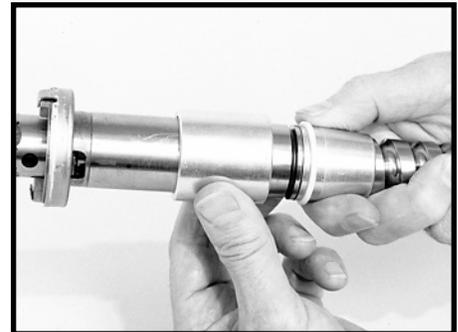


Figure 100

CAUTION

CAUTION: Be sure the compression tool is assembled correctly before assembly of the seal ring. If the tool is backwards it cannot be pulled over the new seal ring for compression or for tool removal without destroying the seal ring.

CAUTION

CAUTION: Allow for the 10 minutes to insure that the O-ring and seal ring are properly seated when you install the worm shaft into the rack piston. If you do not allow for this time, the seal may tear or be cut when you place the worm into the rack.



Figure 101

install housing bearing and retaining ring

- If you are installing a new housing bearing (20) or using the old housing and bearing assembly, apply a generous amount of clean grease to the bearing race to retain the bearing rolls. Then, place the rolls into the race, being sure you have the correct quantity of rolls for your particular bearing assembly. To install the NEW bearing assembly (20) into the housing, first install the

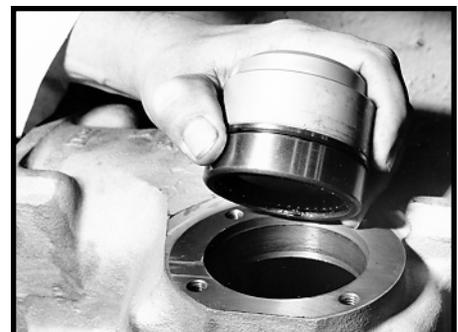


Figure 102

retaining ring (21) into the groove on the bearing's outside diameter. Then press the bearing into the housing from the trunnion side using bearing mandrel (special tool) J26743 against the lettered end of the bearing shell so that the retaining ring is away from the housing bore. SEE FIGURE 102. During this procedure be sure that the housing is square with press base and the bearing is not cocked.

NOTE

NOTE: Bearing BR 970 requires 41 rolls, and Bearing BR 970-1 requires 42 rolls.

CAUTION

CAUTION: The bearing rolls must be in place to insure proper installation of the bearing. If the rolls are improperly installed, the bearing race may collapse and fail. The flange may break, causing premature failure of the bearing. Again, do not mix the housing bearing rolls with the side cover bearing rolls. Be sure the bearing mandrel used is clean.

NOTE

NOTE: The bearing assembly (20) may be of caged (retained) roll type therefore not requiring reassembly of the rolls.

install rack piston seal and O-ring

3. Install the new rack piston backup O- ring (35) and the new Teflon rack piston seal ring (36) into the rack piston (29) ring groove. SEE FIGURES 103, 104. Do not over stretch the rings as you install them. Coat with a liberal amount of grease.

WARNING

WARNING: DURING STEP 4, YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

install poppet assembly

4. If the poppets were removed, position rack piston (29) in a soft jawed vise and install one poppet seat (31). SEE FIGURE 105. From the other end of the rack piston install one poppet (32), the spring (34), the nylon spacer rod (33), the other poppet (32), and the other poppet seat (31). Torque both poppet seats to 20-25 ft. lbs. (27-34 N m). Install both retaining rings (30). SEE FIGURES 106, 107.



Figure 103



Figure 104

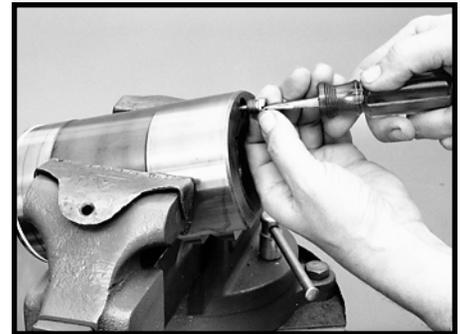


Figure 105



Figure 106



Figure 107

install worm shaft/input shaft into rack piston

5. When the 10 minute compression time has elapsed, remove the compression tool from the worm shaft/input shaft assembly (16). Grease the worm shaft seal ring (18) and the sealing surface inside the rack piston (29). Install the worm shaft/input shaft assembly into the rack piston end that will position the worm seal ring in the rack bore and the worm ball track grooves to accept the set of balls through the rack piston ball guide holes. SEE FIGURE 108.

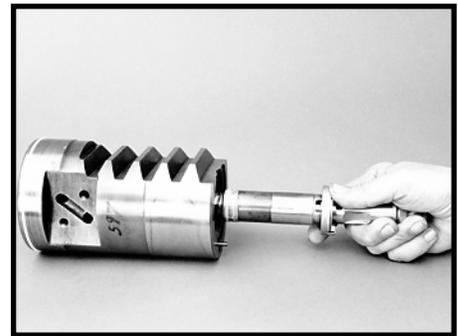


Figure 108

CAUTION

CAUTION: Steps 6-11 describe the installation of the rack piston balls, guides, and caps or clips. Read through each step carefully to determine which ones you should follow.

NOTE

NOTE: If your ball return guides do not have a hole in the top for loading balls, then proceed to step 8. If your ball return guides do have a hole in the top, then follow steps 6 & 7. SEE FIGURE 77 Page 28.

assemble ball return guides

6. Assemble the ball return guides (44) into the rack piston (29). Make sure that the ball return guides are seated.

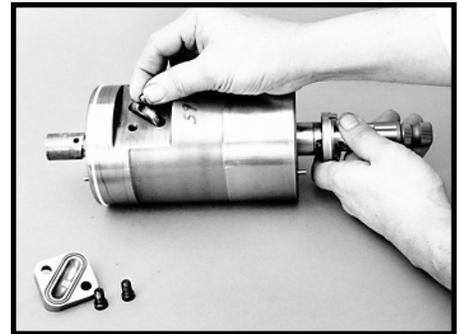


Figure 109

WARNING

WARNING: DO NOT SEAT GUIDES WITH A HAMMER. DAMAGE TO GUIDES CAN RESULT IN SUBSEQUENT LOCK-UP OR LOSS OF STEERING.

assemble balls

7. Assemble 34 balls (43) into the ball return guides (44) and rack piston (29). Drop the balls through the hole provided in the ball return guides. As you drop the balls, rotate the worm shaft/input shaft (16) to pull the balls down into the grooves. SEE FIGURE 109. Read warning, then go to step 10.

WARNING

WARNING: MAKE SURE THE BALL RETURN GUIDES STAY DOWN IN PLACE WHILE YOU ASSEMBLE THE BALLS. FAILURE TO HOLD THE GUIDES DOWN MAY RESULT IN A BALL BEING TRAPPED OUTSIDE THE CLOSED LOOP. A TRAPPED BALL CAN RESULT IN A STEERING LOCKUP, WHICH COULD CAUSE AN ACCIDENT.

assemble balls

8. For ball return guides which do not have the hole in top, follow this procedure. Insert the eraser end of a pencil into one ball return guide hole of the rack piston as far as it will go. Drop 22 balls (of the 34 total) into the other ball return guide hole of the rack piston. SEE FIGURE 110. Turn the worm shaft/input shaft (16) to advance the balls toward the other hole. You will feel resistance at the pencil after you drop the 22nd ball. At this time, a ball will be visible at the base of each hole. Remove the pencil.

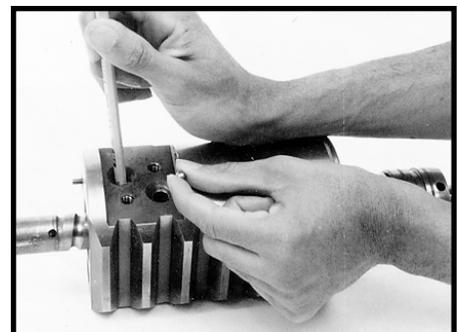


Figure 110

WARNING

WARNING: DO NOT TURN THE WORM SHAFT OR ALLOW THE RACK PISTON TO MOVE AFTER YOU REMOVE THE PENCIL. IF THE WORM SHAFT OR RACK PISTON MOVE BEFORE BALL RETURN GUIDES ARE IN PLACE, A BALL MAY MOVE INTO THE DEAD TRACK BEYOND THE BALL RETURN GUIDES. THIS CAN RESULT IN A STEERING LOCKUP, WHICH COULD CAUSE AN ACCIDENT.



Figure 111

install ball return guide halves

9. Coat the ball return guides (44) liberally with grease and insert the remaining 12 balls into a guide half. SEE FIGURES 111, 112. Join the guide halves together and install this subassembly into the rack piston.



Figure 112

NOTE

NOTE: For models with the ball return clip (46A) perform step 10. SEE FIGURE 72. For models with the ball return guide cap (46) perform step 11. SEE FIGURE 74.

assemble ball return guide clip

10. If your gear is equipped with the ball return guide clip (46A), install it so that both bolt hole faces are in full contact with the rack piston (29) surface. Install the two lock tabs (47A) and the two hexagon head bolts (47B) Torque the bolts to 14-22 ft. lbs. (19-30 N m). Finish by bending up the lock tabs against the bolt heads. SEE FIGURES 113, 114. 1/2 inch socket required.

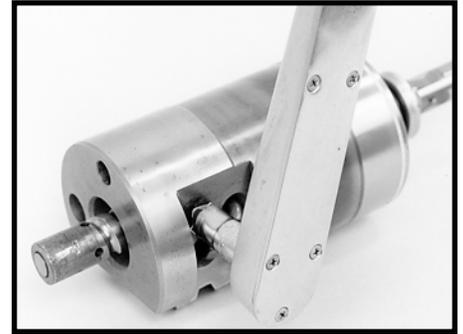


Figure 113

NOTE

NOTE: The current ball return guide clip (46A/47A) will have integral lock tabs and be included in current service seal kits.

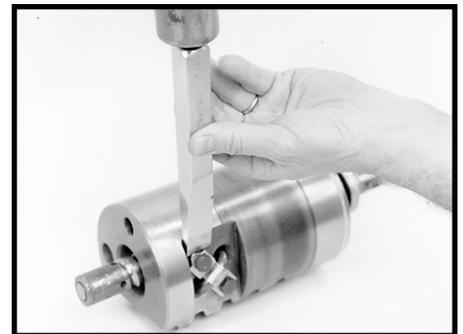


Figure 114

assemble ball return guide cap

11. If your gear is equipped with the ball return guide cap (46), instead of the clip, grease the new ball return guide cap seal (45) and place it in the seal groove of the cap. Assemble the cap so that the seal makes full contact with the rack piston surface. SEE FIGURE 115. Install the two new Allen head or Torx head screws (47) and torque them to 14-22 ft. lbs. (19-30 N m). A 5/32 inch Allen socket or a T-30 Torx socket required. SEE FIGURE 116.

WARNING

WARNING: ROTATE THE WORM SHAFT FROM END OF TRAVEL TO END OF TRAVEL, TO MAKE CERTAIN THAT YOU HAVE INSTALLED THE BALLS PROPERLY. IF YOU CANNOT ROTATE THE SHAFT, YOU WILL HAVE TO REMOVE THE BALLS AND REASSEMBLE THEM. IF YOU INSTALL THE GEAR ON A TRUCK WITH THE SHAFT UNABLE TO ROTATE, THE GEAR WILL NOT FUNCTION.

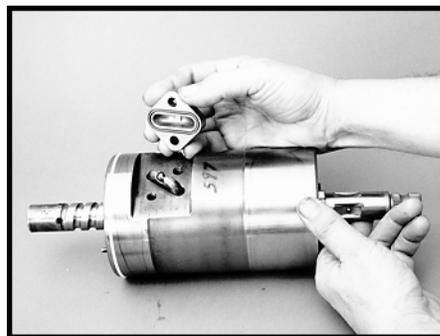


Figure 115

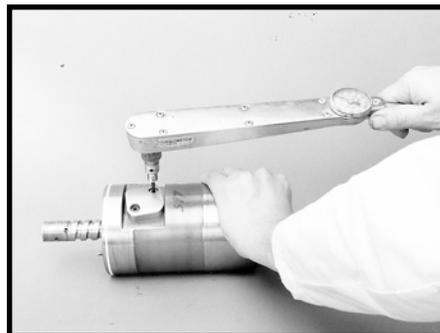


Figure 116

install rack piston worm shaft assembly into housing

12. Position the housing (19) securely in a vise as it was for the disassembly procedures. SEE FIGURE 40 page 20. Apply a generous amount of clean grease to the Teflon rack piston seal (36) and to the housing cylinder bore. SEE FIGURE 117. Install the rack piston (29) worm shaft/input shaft (16) assembly into the long end of the housing so that the Teflon rack piston seal goes in last. SEE FIGURE 118.

CAUTION

CAUTION: Be certain that the seal enters the long end last; otherwise, a large section of the seal will be cut and the vehicle will have no power steering assist.

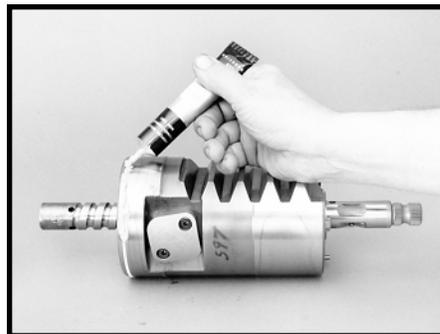


Figure 117

NOTE

NOTE: To ease the later assembly of the sector shaft (48), rotate the rack piston worm shaft assembly in the housing so that the rack piston teeth are exposed in the sector shaft cavity of the housing.

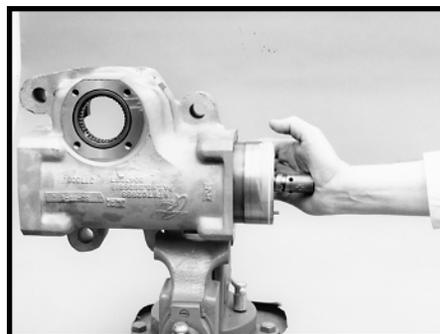


Figure 118

assemble worm shaft, poppet adjusting screws & sealing nuts

13. If disassembled, assemble a new worm shaft/input shaft adjusting screw sealing nut (39) onto the solid (non-slotted) end of the worm shaft preload adjusting screw (38), so that the seal on the sealing nut will face the end cover (37). Assemble one NEW poppet valve adjusting screw sealing nut (2) onto the poppet valve adjusting screw (42) and assemble the other NEW poppet valve adjusting screw sealing nut (2) onto the other poppet valve adjusting screw (3) in the same manner as described for parts (39) and (38).

assemble poppet screw assembly into end cover

14. Assemble poppet adjusting screw (42) and nut (2) assembly into end cover (37) a few turns. Final adjustments will be made later.

NOTE

NOTE: The poppet valve adjusting screws may or may not be of the same length. If not the same length, assemble the shorter adjusting screw (42), 2.25 in. (57 mm) long, into the end cover (37).

WARNING

WARNING: IF THE SCREWS ARE OF UNEQUAL LENGTH, YOU MUST INSTALL THE SHORTER SCREW INTO END COVER. OTHERWISE, THE POPPET ASSEMBLY MAY BREAK AND CAUSE THE STEERING GEAR TO LOCKUP, POSSIBLY RESULTING IN AN ACCIDENT.

install worm shaft preload adjusting screw

- 15. Assemble the worm shaft preload adjusting screw (38) and nut (39) assembly into the end cover (37) a few turns. Final adjustments will be made later. A slot screw driver or 5/16 inch Allen wrench socket required.

install end cover seal ring

- 16. Apply clean grease to the end cover seal ring groove on the end cover (37). Install the new end cover seal ring (9) into the end cover seal ring groove. SEE FIGURE 119.

NOTE

NOTE: When installed, the end cover seal ring should extend slightly above the machined surface of the end cover.

CAUTION

CAUTION: When performing step 17, make sure that the rack piston (29) teeth are fully visible in the sector shaft cavity of the housing. This is necessary to insure proper location of the poppets, and to insure that the poppet adjusting screw will contact the poppets.

install end cover

- 17. Position the end cover (37) so that the poppet adjusting screw (42) is aligned with the end of the poppet (32). SEE FIGURE 120.

install end cover bolts

- 18. Install the four end cover bolts (41), 1.625 in. (41 mm) long, and washers (40), and torque the bolts to 150-170 ft. lbs. (203-230 N m) if dry, or 108-128 ft. lbs. (146-174 N m) if lubricated. A 13/16 inch socket required. SEE FIGURE 121.

install valve sleeve rings & seals

- 19. Grease the two new backup O-rings (13) and the two new Teflon seal rings (12). Using seal installation tool J26741, assemble the backup O-rings and then the Teflon seal rings onto the valve sleeve (14). SEE FIGURES 122, 123.

NOTE

NOTE: Assemble each O ring and seal ring from the end closest to its groove.

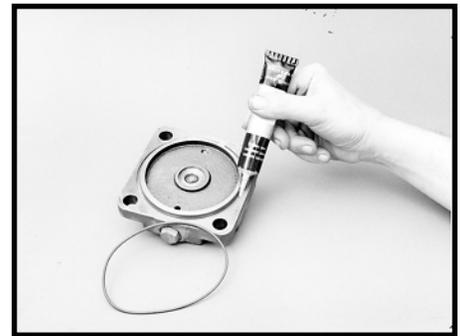


Figure 119

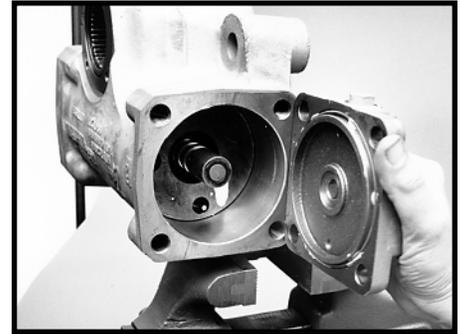


Figure 120

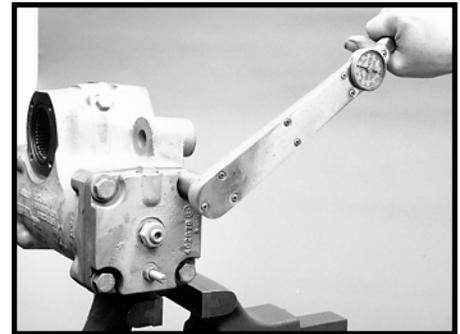


Figure 121



Figure 122



Figure 123

compress rings

- 20. Use compression tool J26742 to compress the Teflon seal rings. SEE FIGURE 124. Leave the compression tool on for 10 minutes.

CAUTION

CAUTION: A minimum of ten minutes with the compression tool in place is required to ensure that the seal rings are properly seated. Otherwise, the valve sleeve will be difficult to assemble into the valve housing, and the seal rings may be damaged during installation.

assemble poppet adjusting screw

- 21. Assemble the poppet valve adjusting screw (3) and nut (2) assembly into the valve housing (8) 4 or 5 turns. Final adjustments will be made later. Be sure you have the correct length adjusting screw.

install valve housing seal ring

- 22. Apply clean grease to the valve housing (8) seal ring groove. Install a new valve housing seal ring (9) into valve housing seal ring groove. SEE FIGURE 125.

NOTE

NOTE: When installed, the valve housing seal ring should extend slightly above the machined surface of the valve housing.

install thrust washer

- 23. Apply a generous amount of clean grease to one thrust washer (10). Install the thrust washer into the valve housing (8), making sure to center the washer. SEE FIGURE 126.

install thrust bearing

- 24. Apply a generous amount of clean grease to the thrust bearing (11). Install the thrust bearing into the valve housing (onto the thrust washer), making sure to center the bearing on the washer. SEE FIGURE 127.

WARNING

WARNING: THE THRUST WASHER AND THRUST BEARING MUST BE FLAT AND CENTERED IN THE COUNTERBORE SURFACE, OTHERWISE, THE THRUST WASHER COULD BREAK WHEN YOU ASSEMBLE THE VALVE HOUSING INTO THE GEAR HOUSING (19). SEE FIGURE 128. A BROKEN WASHER COULD CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.



Figure 124

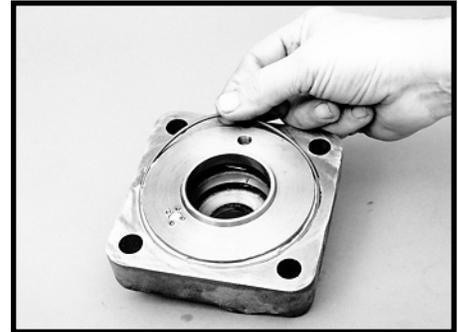


Figure 125



Figure 126

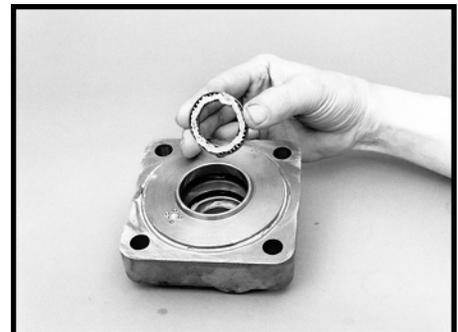


Figure 127

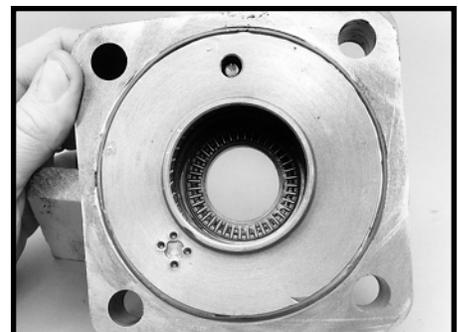


Figure 128

install thrust washer

25. When the 10 minute compression time has elapsed, remove the compression tool J26742 from the valve sleeve (14). Apply more grease to the valve sleeve seals, and grease the thrust washer face on the end of the valve sleeve without the drive slots. Place the other thrust washer (10) onto the valve sleeve end without the drive slots. SEE FIGURE 129.

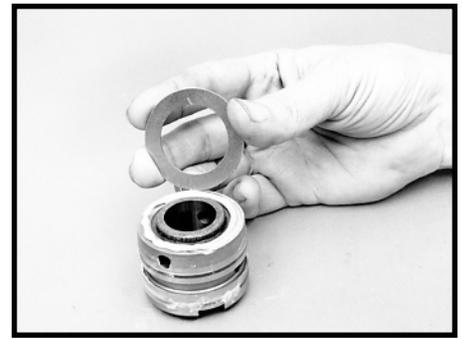


Figure 129

WARNING

WARNING: THIS THRUST WASHER MUST BE SECURELY IN PLACE ON THE VALVE SLEEVE. IF IT IS NOT, IT CAN BREAK AND CAUSE UNCONTROLLABLE STEERING, POSSIBLY RESULTING IN AN ACCIDENT.

assemble valve sleeve onto valve housing

26. Assemble the valve sleeve (14) with attached thrust washer down, into the valve housing (8). SEE FIGURE 130. When the valve sleeve is in place, it should measure between .370 and .400 inches (9.40-10.16 mm) above the face of the valve housing to the end of the valve sleeve nose. SEE FIGURE 131.



Figure 130

WARNING

WARNING: DO NOT FORCE VALVE SLEEVE DOWN INTO THE VALVE HOUSING. MAKE SURE VALVE SLEEVE SEAL RINGS ARE COMPRESSED. MISASSEMBLY OR INCORRECT MEASUREMENT MAY CAUSE THE THRUST WASHERS OR THRUST BEARING TO BREAK DURING GEAR OPERATION, WHICH WILL RESULT IN UNCONTROLLABLE STEERING.

position rack piston & rotate worm shaft

27. Position the rack piston (29) so that it is flush with the open end of the gear housing (19). Rotate the worm shaft (16) until it extends out of the rack piston as far as it will go.

WARNING

WARNING: WORM SHAFT AND VALVE SLEEVE UNITS ARE ASSEMBLED AND SOLD AS MATCHED SETS. USE ONLY PREMATCHED SETS FOR REPLACEMENT. NEVER MATE AN OLD SLEEVE WITH A NEW WORM OR AN OLD WORM WITH A NEW SLEEVE. TO DO SO MAY DAMAGE THE GEAR OR INJURE THE DRIVER, OR DO BOTH DURING OPERATION.

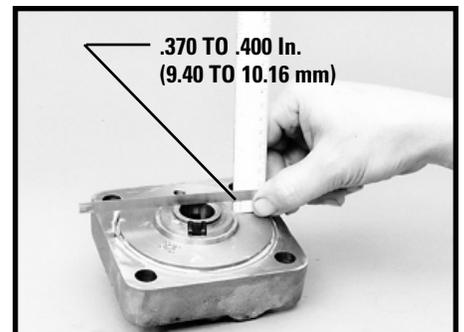


Figure 131

install valve assembly onto worm shaft/input shaft assembly

28. Locate the timing mark on the valve sleeve (14), a faint, punched mark on the chamfered edge of the valve sleeve or an indented mark on the front face, of the sleeve. SEE FIGURE 132. Locate the scribed timing mark on the worm shaft. SEE FIGURE 62, page 25. Next, grasp the valve housing/ valve sleeve assembly with your thumbs on the valve housing face and your fingers applying pressure to keep the valve sleeve in the valve housing. SEE FIGURE 133. Align the previously located timing marks and place the valve housing/valve sleeve assembly onto the input shaft end of the worm shaft/ input shaft (16) until the drive lugs are fully engaged in the valve sleeve slots. SEE FIGURE 134.

NOTE

NOTE: Valve sleeves are identified and matched to a right or left hand lead of the worm screw. If the screw has a right hand thread (that is, goes into the rack piston when turned clockwise), the valve sleeve will have the letter "R" stamped between the seal lands. For a left hand worm lead (which will come out of the rack piston when turned clockwise) the mating valve sleeve has no identifying letter or has the letter "L" stamped between the seal lands.

WARNING

WARNING: IF YOU PLACE AN INCORRECT VALVE SLEEVE ON A WORM AND ASSEMBLE THIS INTO THE GEAR, THE GEAR WILL NOT FUNCTION PROPERLY. INSTEAD, THE MECHANISM WILL JERK THE STEERING WHEEL WITH SUCH FORCE, THAT IT COULD INJURE THE DRIVER.

finish valve housing installation

29. Maintain pressure on the valve end of the valve housing (8) to insure continued engagement of the drive lugs and thrust bearing package. SEE FIGURE 135. While maintaining pressure, rotate the valve housing to align the poppet adjusting screw (3) with the poppet (32) in the rack piston (29). Continue pressure, and rotate the input shaft to bring the valve housing into contact with the gear housing face.

install valve housing bolts

30. Assemble four valve housing bolts (1), 2.125 in. (53.98 mm) long, into the housing (19) and torque to 150-170 ft. lbs. (203-230 N m) if dry or 108-128 ft. lbs. (146-174 N m) if lubricated. A 13/16 inch socket required. SEE FIGURE 136.

assemble adjusting screw and retainer

31. If the adjusting screw (49) has been removed from the sector shaft (48), clamp the sector shaft into a soft-faced vise by gripping the serrated end. Coat the expanded end of the new



Figure 132



Figure 133



Figure 134

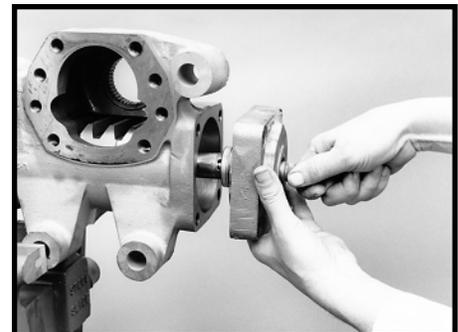


Figure 135

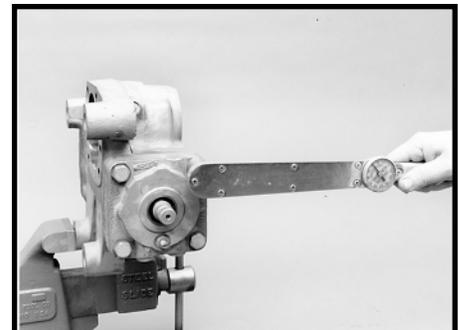


Figure 136

adjusting screw with a suitable grade of wheel bearing grease and insert into recess in end of sector shaft. Thread a new sector shaft screw retainer (50) into the sector shaft and adjust to permit free rotation of sector shaft adjusting screw by hand without perceptible end play [.000 to .002 in. (.05 mm) loose]. Stake the new retainer into the two slots provided using a suitable punch and again check freedom of adjusting screw movement and end play. SEE FIGURE 137.

WARNING

WARNING: USE CARE IN SECURELY STAKING THE RETAINER (50) INTO THE SECTOR SHAFT SLOTS. A RETAINER THAT IS BROKEN OR CRACKED DURING THE STAKING PROCEDURE MUST BE REPLACED AS IT COULD RESULT IN THE SECTOR SHAFT NOT BEING RETAINED AND THE LOSS OF MANUAL AND POWER STEERING CONTROL.



Figure 137

grease side bearing cover bearing

32. Apply a generous amount of clean wheel grease (do not substitute another type of grease) to the bearing race or caged bearing assembly inside the side cover (56).

CAUTION

CAUTION: Use only wheel bearing grease. This bearing is sealed and will receive no lubrication from the hydraulic fluid in the gear. Failure to use wheel bearing grease could result in premature bearing wear.

NOTE

NOTE: You will have 41 or 42 rolls to assemble into the side cover bearing; 41 rolls—BR-970; 42 rolls—BR-970-1. Do not use these rolls for the side cover with the rolls for the trunnion cover side of the gear housing.

assemble side cover bearing

33. If the side cover does not have a caged bearing assembly, assemble 41 or 42 rolls into the side cover bearing race. Grease must retain rolls. SEE FIGURE 138.

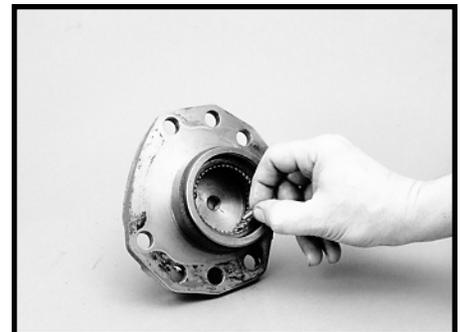


Figure 138

NOTE

NOTE: If the service replacement Teflon backup washer (53) is not an integral part of the service replacement seal (52), see alternate service construction (52/53) on exploded assembly foldout page, examine the lead in chamfer or radius on the side cover (short) end of sector shaft (48) bearing diameter. SEE FIGURE 139. If rough edges can be felt by drawing a thumb nail across the lead in chamfer or radius on the end of sector shaft, skip procedures #34, #35, #36 and follow procedures #37, #38, #39.



Figure 139

CAUTION

CAUTION: Following procedures #34, #35, #36 with a sector shaft that does not pass the “thumb nail test,” and a replacement seal (52) that does not have the Teflon washer (53) integral to it can result in the seal being destroyed when assembling sector shaft into side cover.

assemble side cover seal pack

- 34. Assemble the steel back up washer (54) into side cover (56). Assemble a new Teflon washer (53) then a new two piece seal (52), or a new two piece seal that has the integral Teflon washer (52/53) into the side cover, such that the words “Oil side” are visible after the seal is assembled. SEE FIGURE 140.



Figure 140

CAUTION

CAUTION: Be sure that a separate Teflon washer (53) is not used with a two piece seal (52/53) that has the Teflon washer integral to it.

WARNING

WARNING: THE WORDS “OIL SIDE” MUST BE VISIBLE ON THE SEAL AFTER IT IS IN PLACE. IF NOT, THE SEAL WILL NOT FUNCTION, AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.

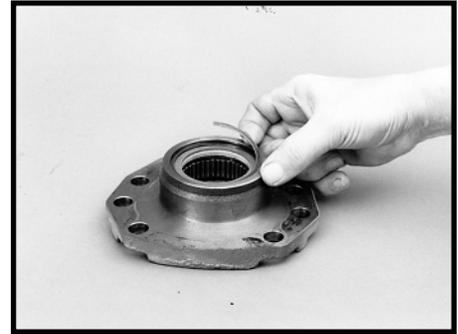


Figure 141

assemble retaining ring

- 35. Assemble retaining ring (51) into the ring groove in the side cover. SEE FIGURE 141

install sector shaft into side

- 36. Apply a generous amount of clean grease to the short bearing area of the sector shaft (48), and insert the sector shaft into the side cover (56). Screw the adjusting screw into the side cover until it reaches solid height. Then, back out the adjusting screw one turn, so that the side cover rotates freely on the sector shaft. SEE FIGURE 142.

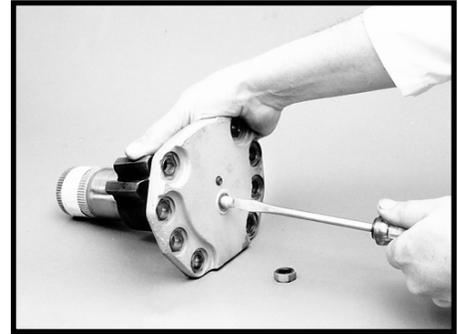


Figure 142

CAUTION

CAUTION: Be sure that one or more bearing rolls do not become dislodged during assembly of sector shaft into side cover.

assemble steel & Teflon washers into side cover (alternate)

- 37. If the replacement Teflon washer (53) is not an integral part of the two-piece seal (52) and the sector shaft (48) did not pass the “thumb nail test,” assemble the steel backup washer (54) and then the Teflon washer (53) into the side cover (56) bearing bore. SEE FIGURE 143.



Figure 143 - ALTERNATE

assemble retaining ring and seal (alternate)

- 38. Assemble retaining ring (51) onto the side cover end of sector shaft (48). Assemble the two- piece seal (52) onto the end of the sector shaft about 1 inch (25.4 mm). The words “oil side” on the seal must face toward the sector shaft. SEE FIGURE 144.



Figure 144 - ALTERNATE

CAUTION

CAUTION: Be sure the two piece seal and the side cover bearing rolls remain correctly assembled and that the vent plug (57) has been removed during these procedures.

install sector shaft into side cover (alternate)

- 39. Be sure the side cover bearing, the sector shaft bearing diameter and seal are well greased, then insert sector shaft (48) assembly into the side cover (56) bearing only until the shaft will retain the loose side cover bearing rolls in place (about 8 turns of adjusting screw) Slowly and carefully work the two piece seal (52) down the sector shaft and squarely into the side cover until it is past the retaining ring groove. Then work the retaining ring (51) into the retaining ring groove. Use an appropriate blunt end punch or punches. SEE FIGURE 145. Carefully turn the adjusting screw (49) through side cover until it reaches solid height then back screw one turn, so that the side cover rotates freely on sector shaft.



Figure 145 - ALTERNATE

assemble vent plug

- 40. Assemble the vent plug (57) into the hole provided on the side cover (56). Press the vent plug in flush with the side cover. SEE FIGURE 146.

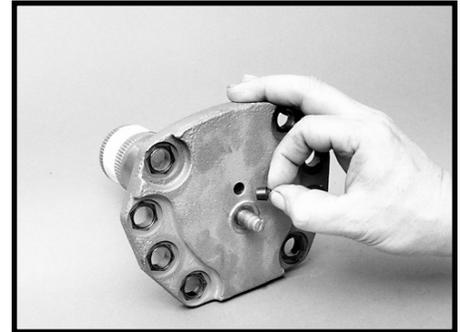


Figure 146

WARNING

WARNING: DO NOT WELD OR OTHERWISE PLUG THIS HOLE IN ANY PERMANENT MANNER. THIS IS A SAFETY VENT WHICH FUNCTIONS ONLY IF THE SIDE COVER SEAL FAILS. IF THE SEAL FAILS AND THE PLUG CANNOT VENT, THE STEERING GEAR MAY LOCKUP OR OTHERWISE MALFUNCTION.

assemble jam nut

- 41. Assemble the jam nut (58) onto the adjusting screw (49) a few threads. Final adjustment will be made later.

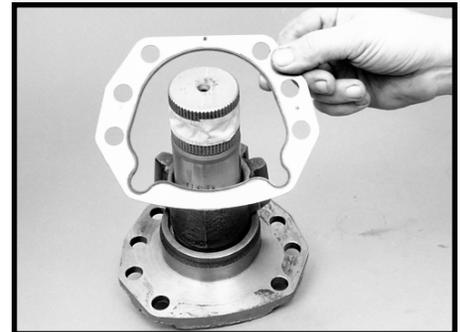


Figure 147

install side cover gasket

- 42. Apply clean grease to the new side cover gasket (55), and assemble it onto the side cover (56) There must be enough grease to hold the gasket in place. SEE FIGURE 147.

center rack piston

- 43. There are four teeth on the rack piston (29) SEE FIGURE 148. Position the tooth space between the second and third teeth in the center of the housing sector shaft cavity. SEE FIGURE 149. This will center the rack piston in the cavity.

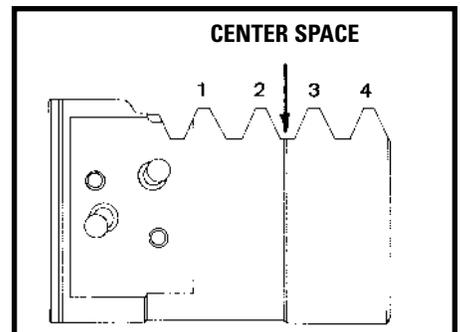


Figure 148

CAUTION

CAUTION: If the rack piston is not centered when sector shaft is installed, the gear travel will be severely limited in one direction of travel, and significant internal damage to the steering gear can occur when the gear is operated.



Figure 149

make initial worm preload adjustment

44. With the rack piston (29) in its center position, torque the worm shaft/input shaft adjusting screw (38) using a 5/16 inch Allen wrench socket into solid height (15 to 20 ft. lbs. [20.3 to 27.1 N m]). Then loosen the adjusting screw 1/4 to 1/2 turn and note torque required to rotate worm shaft/ input shaft (16) through 90° each side of center, using a 12 point socket that will fit input shaft serrations and an appropriate torque wrench. SEE FIGURE 150. Loosen adjusting screw if noted input shaft torque exceeds 15 in. lbs. (17 N m). Return rack piston to center position.

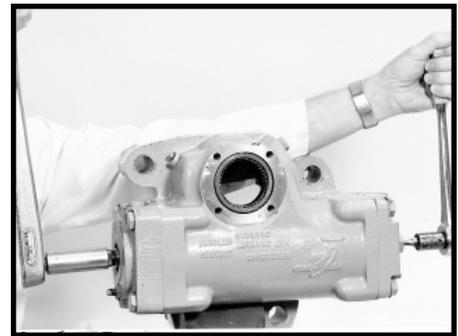


Figure 150

WARNING

WARNING: AS YOU PLACE THE SECTOR SHAFT THROUGH THE HOUSING BEARING (20), BE CAREFUL NOT TO KNOCK OUT ANY OF THE BEARING ROLLS. SEE FIGURE 151. BE CAREFUL ALSO NOT TO PINCH THE SIDE COVER GASKET (55). SHOULD THE BEARING ROLLS BE KNOCKED OUT, OR THE SIDE COVER GASKET PINCHED, PREMATURE BEARING AND SEAL FAILURE MAY OCCUR, WHICH COULD RESULT IN A LOSS OF POWER STEERING ASSIST.



Figure 151

install sector shaft/side cover into housing

45. Clean off any old tape on the sector shaft (48) serrations. Retape the serrations and bolt groove with one layer of tape. Assemble the sector shaft (48) side cover (56) assembly into the gear housing (19), with the center tooth of the sector shaft engaging the tooth space between the second and third teeth on the rack piston. SEE FIGURE 152.

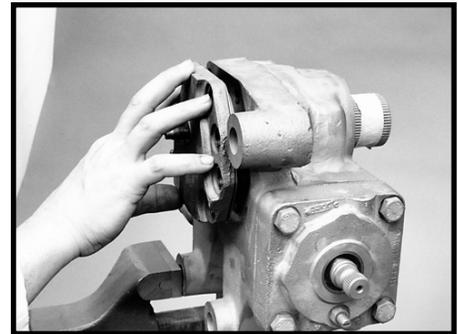


Figure 152

install side cover bolts

46. Assemble the eight special ring head bolts (59) and torque them to 150-170 ft Lbs. (203-230 N m) if dry or 108-125 ft. lbs. (146-174 N m) if lubricated. 13/16 inch socket required.

assemble trunnion cover seal pack

47. Place the trunnion cover (25) on a bench to install the new seal package. Start with the Teflon backup washer (24).

assemble seal

48. Assemble the two-piece sector shaft seal (23) so that the words "oil side" are visible. SEE FIGURE 153.

WARNING

WARNING: THE WORDS "OIL SIDE" MUST BE VISIBLE. IF NOT, THE SEAL WILL NOT FUNCTION AND A LOSS OF POWER STEERING ASSIST MAY OCCUR.



Figure 153

install trunnion cover seal ring

49. Grease the new trunnion cover seal ring (22) and install it into the trunnion cover seal ring groove.

install trunnion cover, bolts, washers & seal

50. Before installing the trunnion cover (25) and seal assembly onto the housing (19), visually inspect the housing bearing (20) to insure that all bearing rolls are properly in place. Then, install the trunnion cover. SEE FIGURE 154. Install four trunnion cover bolts (28) and washers (27) and torque the bolts to 15-22 ft. lbs. (20-30 N m) if dry or 11-16 ft. lbs. (15-22 N m) if lubricated. SEE FIGURE 155. A 1/2 inch socket required. Pack clean high temperature industrial grease per Ross specification 045231. * Mobil Temp 1 or 2 grease or equivalent around the seal area of sector shaft (48). Install a new dirt and water seal (26) using a suitable blunt end drift.

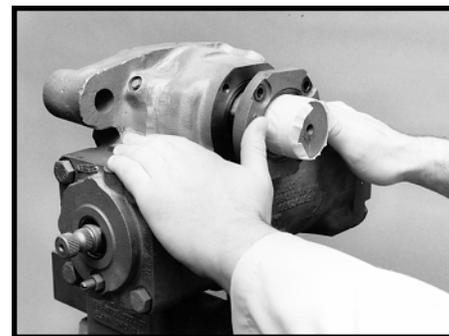


Figure 154

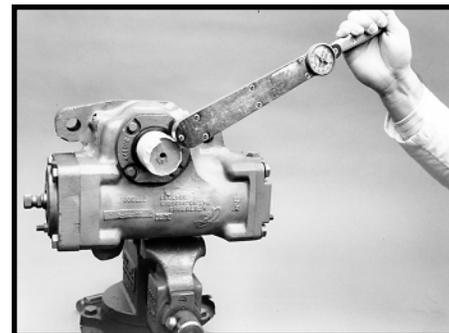


Figure 155

assemble seal protector boot & grease fitting

51. Apply more of the special grease around the seal area of sector shaft and to the new protector boot (60) in the area inside of the smaller diameter ring. Assemble the protector boot onto the sector shaft and trunnion cover. Locate the boot grease fitting hole toward the input shaft end of gear assembly. SEE FIGURE 156. Insert grease fitting (61) into protector boot.



Figure 156

install input shaft seal pack

52. Apply clean grease in the input shaft seal assembly (7), washer (6) and to the input shaft. Install the new two-piece input shaft seal (7) flat side out and the steel backup washer (6), using seal driving tool J28490. Install the retaining ring (5). SEE FIGURES 157, 158.

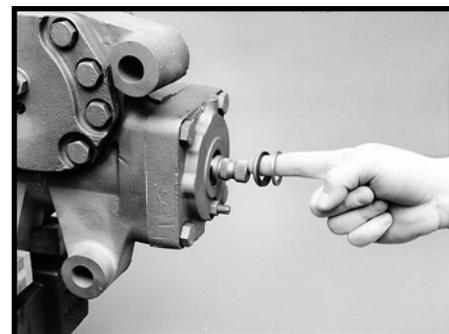


Figure 157

pack with grease and install dirt and water seal

53. Pack the area around the input shaft with high temperature industrial grease per Ross specification 045231, Mobil Temp 1 or 2 or equivalent, and install the dirt and water seal (4), using seal driving tool J28490 or suitable blunt ended drift.

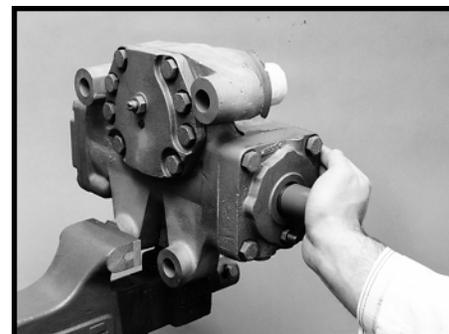


Figure 158

*Mobil Temp is a Registered Trademark of Mobil Oil Co.

assemble seal protector

54. Apply more of the special grease to the cupped side of the new seal protector (62) and assemble it, cupped side in on to the worm shaft/input shaft (16) and into the serration relief groove. SEE FIGURE 159.

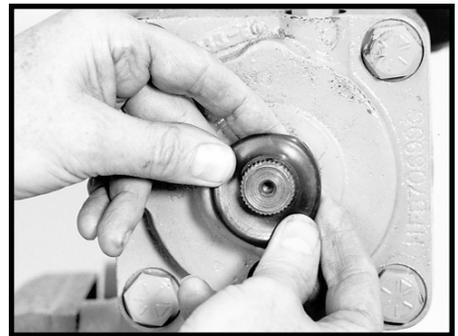


Figure 159

install manual bleed screw, if equipped

55. If your gear is equipped with the manual bleed screw (19A), install it into the gear housing (19) and torque it to 27-33 in. lbs. (3.1-3.7 N m). SEE FIGURE 160. 5/16 inch hex socket required.



Figure 160

This completes assembly of the HFB70 steering gear. Before you install the gear onto the vehicle, make final adjustments described on next page. All ports should be plugged until unit is installed on vehicle.



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