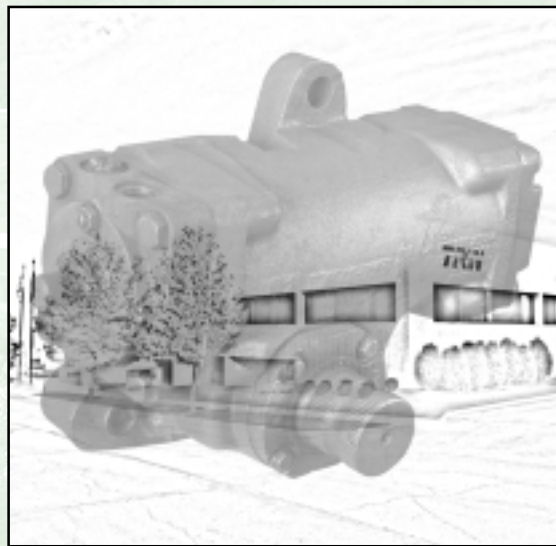


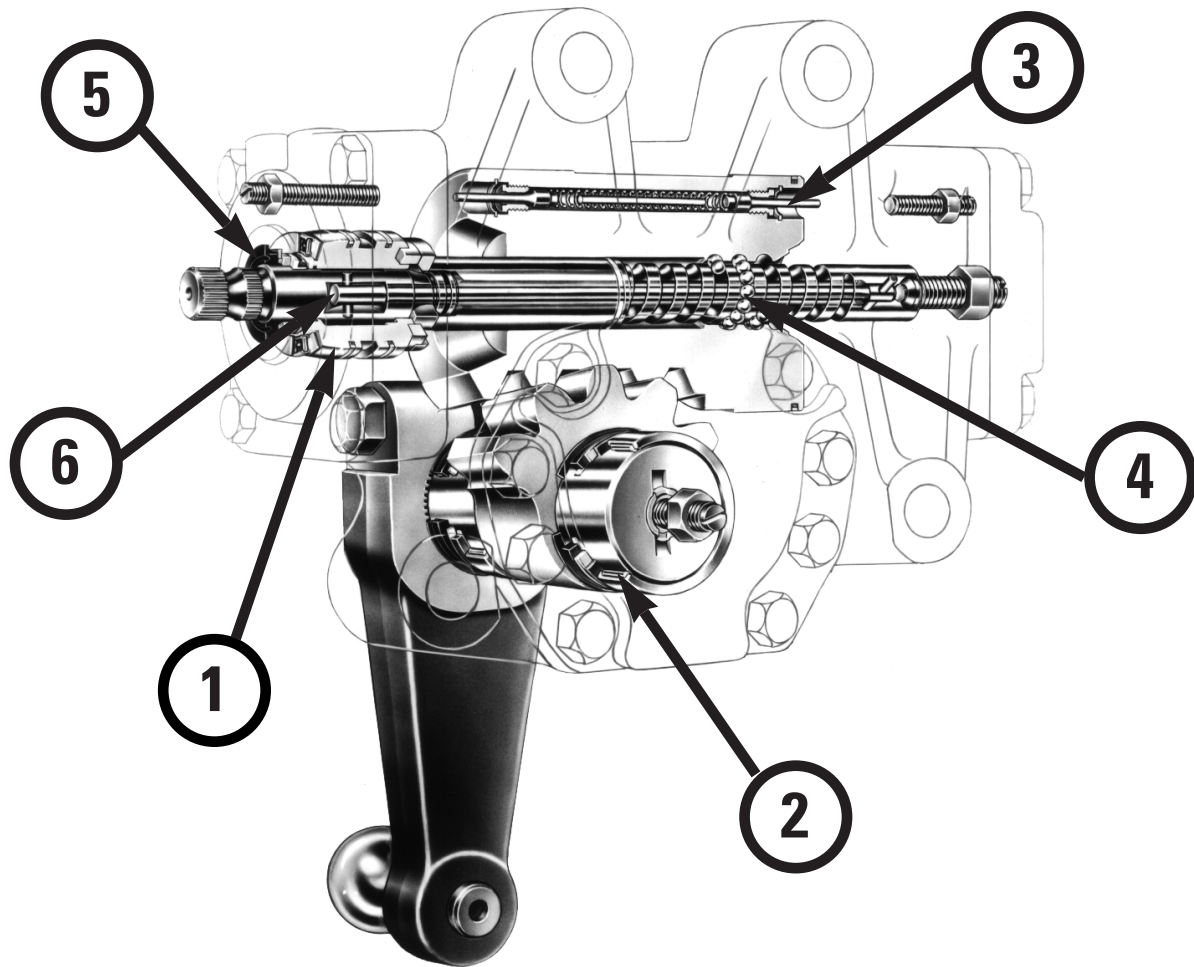
HFB Steering Gear Service Manual

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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Disassembly

Preparation

- THOROUGHLY CLEAN OFF ALL OUTSIDE DIRT, ESPECIALLY FROM AROUND FITTINGS AND HOSE CONNECTIONS, BEFORE YOU REMOVE THE GEAR.
- Drain the steering gear assembly.
- Remove input and output shaft connections per 1.1 and 2.1, Page 11 and 14.
- Remove the supply and return lines from the gear, and immediately plug all port holes and fluid lines.

WARNING: THIS STEERING GEAR WEIGHS APPROXIMATELY 112 POUNDS, 51 KG, DRY. EXERCISE CAUTION WHEN YOU REMOVE, LIFT, OR CARRY IT. DO NOT POUND THE UNIVERSAL JOINT OR INPUT SHAFT COUPLING ON OR OFF THE INPUT SHAFT. INTERNAL DAMAGE TO THE STEERING GEAR CAN RESULT.

- Remove the steering gear from the vehicle and take it to a clean surface (a piece of wrapping paper makes an excellent disposable top)
- Clean and dry the gear before you start to disassemble it.
- As you disassemble the gear, clean all parts in clean, petroleum-based solvent, and blow them dry only.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH. WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam clean or high-pressure wash hydraulic steering components. Do not force or abuse closely fitted parts.

- Keep each part separate to avoid nicks and burrs.
- Discard all seals, O-rings, and gaskets removed from the gear. Replace them with new parts only.

Disassembly

position gear & sector shaft

1. Position the steering gear firmly in a vise with the gear's worm shaft/input shaft (16) in a horizontal direction. Prepare for fluid drainage and unplug fluid line ports. Rotate worm shaft/input shaft with an 11/16 inch or 3/4 inch 12 point socket or box end wrench, through the gear travel several times to purge hydraulic fluid from the unit. Then position the timing mark located on the end of the sector shaft (48) to a vertical direction. SEE FIGURE 40.

CAUTION

CAUTION: Clamp only against housing mounting bosses or attach a plate to the mounting bosses for this purpose. Do not clamp against the body of housing.

remove protector boot & dirt and water seal

2. Remove protector boot (60), grease fitting (61) and the dirt and water seal (26) from the trunnion cover (25). SEE FIGURE 41. Discard boot and seal.

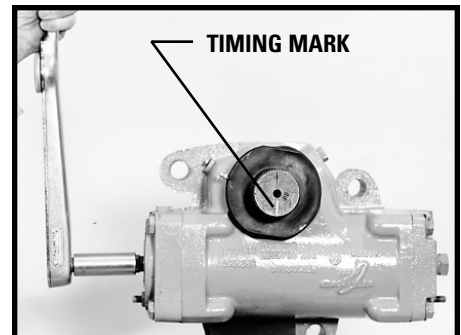


Figure 40



Figure 41

clean sector shaft and loosen jam nut

3. Remove any paint or corrosion from the exposed area of the sector shaft (48), and loosen the jam nut (58) on the sector shaft adjusting screw (49). 3/4 inch socket required.

remove trunnion cover bolts & washers

4. Remove the four bolts (28) and washers (27) from the trunnion cover with a 1/2 inch socket. SEE FIGURE 42.

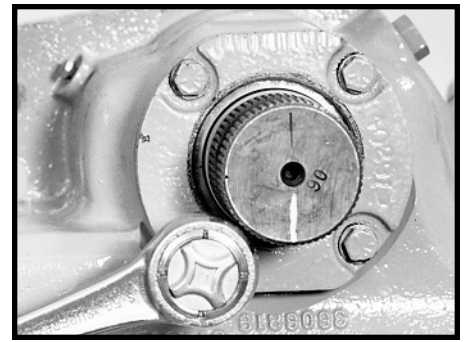


Figure 42

remove trunnion cover and seal package

5. Remove the trunnion cover (25). Remove and discard the seal ring (22), the two piece sector shaft seal (23) and the Teflon back-up washer (24) from the trunnion cover. SEE FIGURE 43.

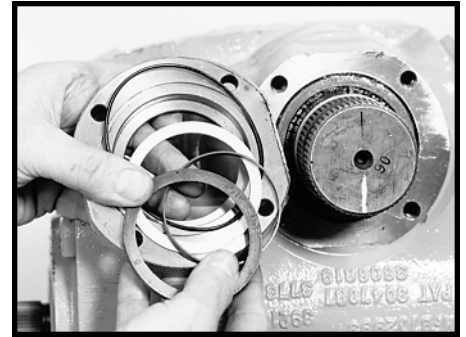


Figure 43

tape sector shaft

6. Tape the serrations and bolt groove of the sector shaft (48) with one layer of masking tape to prevent loose bearing rolls from "hanging up" the sector shaft during its removal. The tape should not extend on to the sector shaft bearing diameter. SEE FIGURE 44.

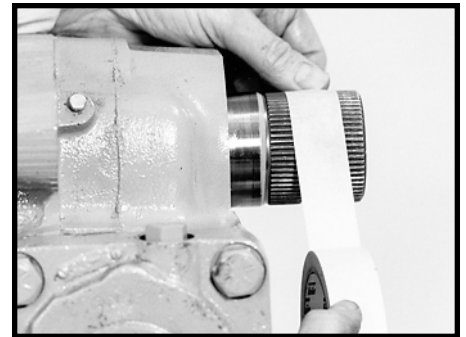


Figure 44

remove side cover bolts

7. Prepare for fluid to drain, and remove eight special ring head bolts (59) from the side cover (56) with a 13/16 inch socket. SEE FIGURE 45.

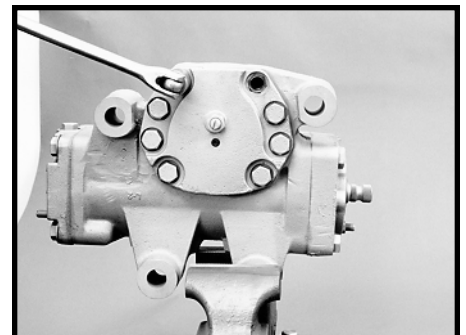


Figure 45

NOTE

NOTE: These bolts are special because they are equipped with either a ring or washer design on the underside of the head. If you replace one or more bolts, you must use bolts of either design and of the SAME SPECIAL TYPE AND LENGTH AS THOSE YOU REMOVED. Do not use a substitute. You can get these bolts through your OEM parts distributor. SEE FIGURE 46.

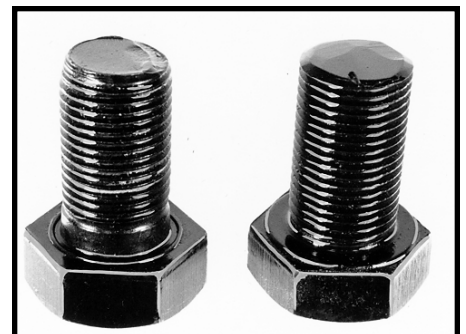


Figure 46

begin to remove side cover & sector shaft

8. Begin to remove the side cover (56) and sector shaft (48) as an assembly. SEE FIGURE 47. Stop removal when the bearing rolls in the housing bearing (20) are half exposed. Coat the bearing rolls with grease. As a means of starting the removal of the side cover and sector shaft assembly, you may use a soft hammer or wooden hammer handle. SEE FIGURE 48.

NOTE

NOTE: When the bearing rolls are half exposed and it is evident that the unit has a caged bearing (rolls retained), the following caution note does not apply.

CAUTION

CAUTION: Take care to remove this assembly slowly, or it may come out too quickly for you to retain the loose bearing rolls in the housing bearing race. Follow the shaft end with the bearing tool (J26743) to retain the rolls, or when the rolls are half exposed, be sure to coat them with grease to retain them in the housing bearing. If one or more of the rolls is lost, you must replace the entire bearing.

remove side cover and sector shaft

9. Finish removing the side cover (56) and sector shaft (48) as an assembly. Remove side cover gasket (55) and discard.

CAUTION

CAUTION: The bearing may contain 41 or 42 rolls, depending upon the type used. Bearing BR-970 has 41 rolls. Bearing BR 9701 has 42 rolls. The identification number can be found on the outside edge of the bearing race flange. There is also a set of bearing rolls in the side cover, with either 41 or 42 rolls. The quantity may not be the same as in the housing bearing. Do not mix these rolls.

remove bearing rolls

10. If the housing (19) bearing has loose rolls, the bearing rolls from the bearing (20) race, count them and put them aside as a set for cleaning, inspecting and reassembly.

remove jam nut

11. Remove the sector shaft adjusting screw jam nut (58). SEE FIGURE 49. 3/4 inch socket required.

remove sector shaft

12. Screw the sector shaft adjusting screw (49) through the side cover (56) SEE FIGURE 50. Place the side cover exterior face down and lift the sector shaft (48) out vertically. SEE FIGURE 51.

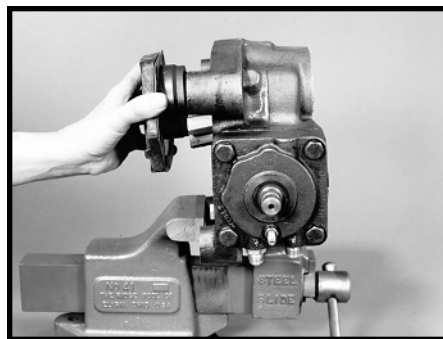


Figure 47

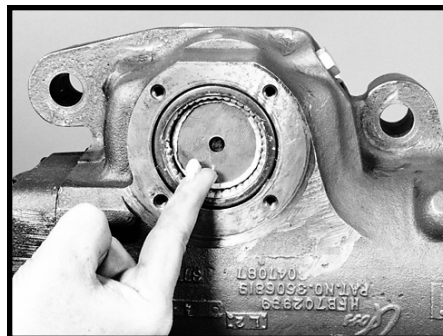


Figure 48

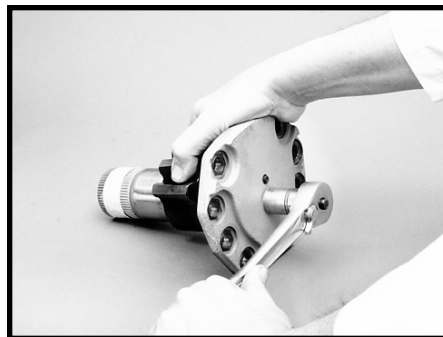


Figure 49

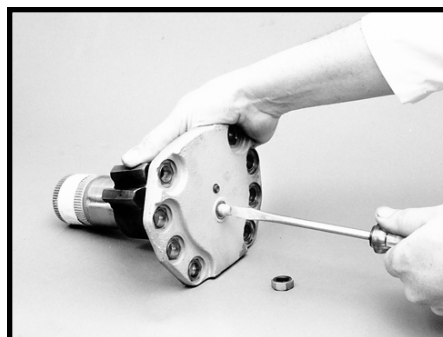


Figure 50



Figure 51

NOTE

NOTE: If the side cover bearing assembly has uncaged (loose) rolls, the vertical position will allow the side cover bearing rolls to fall into the side cover, where you may easily collect and count them. Immediately gather all of the side cover bearing rolls and count them.

CAUTION

CAUTION: Take care not to lose any rolls during disassembly and assembly, or you will have to replace the complete side cover assembly.

WARNING

WARNING: IF THE BEARING IS THE UNCAGED (LOOSE) ROLL TYPE, DO NOT MIX THE ROLLS FROM THE SIDE COVER WITH THE ROLLS FROM THE HOUSING BEARING. THE BEARING RACE AND ROLLS ARE A MATCHED SET. INTERCHANGING THE ROLLS COULD RESULT IN PREMATURE BEARING OR SEAL FAILURE, WHICH COULD CAUSE A LOSS OF POWER STEERING.

remove side cover seal pack

- 13. Remove the retaining ring (51), the two-piece side cover seal (52), the Teflon backup washer (53), and the steel backup washer (54) from the side cover. Discard seal and Teflon washer. SEE FIGURES 52, 53. Remove and discard vent plug (57).

remove retainer and adjusting screw

- 14. Only if replacement of the retainer (50) and or adjusting screw (49) is required (see inspection procedure 8 page 33), place the sector shaft (48) firmly in a soft jawed vise and unstake the retainer using a suitable chisel. Turn the retainer out of the sector shaft pocket and remove the adjusting screw. Discard the retainer. SEE FIGURE 54.

loosen worm shaft & poppet nuts & screws

- 15. Loosen the worm shaft adjusting screw sealing nut (39) with a 1-1/16 inch box end wrench, and loosen the worm shaft preload adjusting screw (38) approximately two turns with a 5/16 inch allen socket or screw driver. SEE FIGURE 55. Loosen the poppet adjusting screw sealing nut (2) and the poppet adjusting screw (42) approximately two turns. An 11/16 inch box end required.

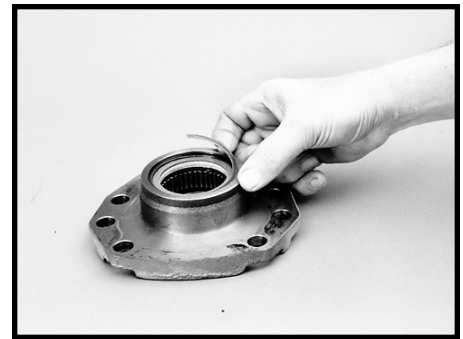


Figure 52



Figure 53



Figure 54



Figure 55

remove end cover bolts

16. Remove the four end cover bolts (41) with a 13/16 inch socket and remove four washers (40). SEE FIGURE 56.

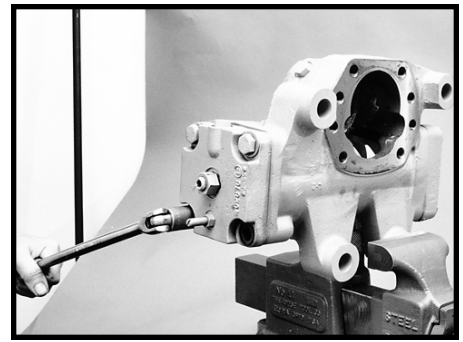


Figure 56

remove end cover

17. Remove the end cover (37). Some fluid will drain. SEE FIGURE 57.

NOTE

NOTE: The worm shaft adjusting screw and sealing nut and poppet adjusting screw and sealing nut do not have to be removed from the end cover (37) unless apparent fluid leaks at the adjusting screws indicate the sealing nuts and or screws be replaced.

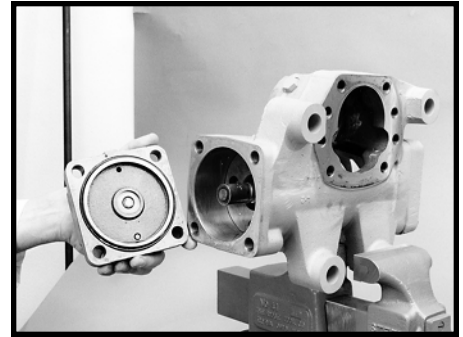


Figure 57

remove seal ring

18. Remove and discard the end cover seal ring (9) from the end cover (37). SEE FIGURE 58.

remove seal protector

19. Remove seal protector (62) from worm shaft/input shaft (16) and discard.

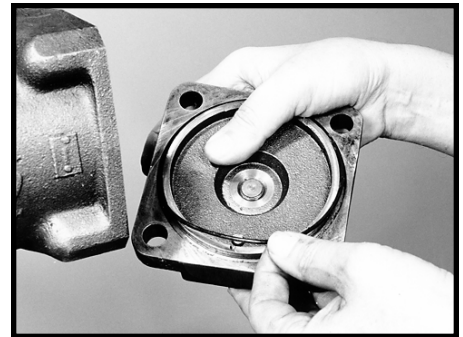


Figure 58

clean input shaft

20. Clean any paint or foreign material from the input shaft with a fine grade emery paper. SEE FIGURE 59.

loosen poppet nut & screw

21. Loosen the poppet adjusting screw sealing nut (2) and the poppet adjusting screw (3) in the valve housing (8) approximately two turns.

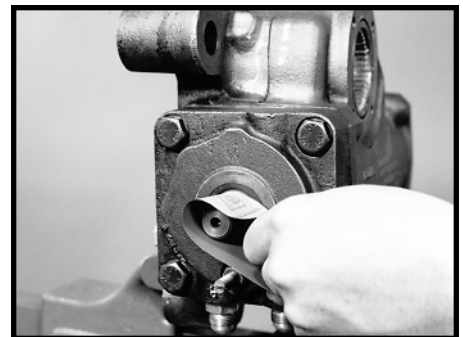


Figure 59

remove valve housing bolts

22. Remove the four valve housing bolts (1) with a 13/16 inch socket. SEE FIGURE 60.



Figure 60

remove valve housing

23. Remove the valve housing (8). Some fluid will drain.
SEE FIGURE 61.

NOTE

NOTE: The valve sleeve (14) will probably remain in the valve housing.

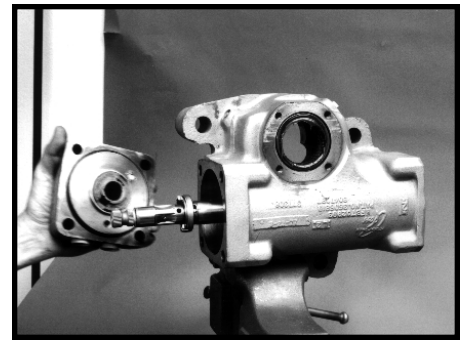


Figure 61

WARNING

WARNING: DO NOT DISASSEMBLE THE WORM SHAFT/INPUT SHAFT ASSEMBLY (16), WHICH INCLUDES THE WORM SHAFT, INPUT SHAFT, TORSION BAR, TORSION BAR PINS, DRIVE RING AND DRIVE RING RETAINER, AND INSERT. DO NOT UNBEND THE DRIVE RING RETAINER TANGS THAT HOLD THE DRIVE RING IN PLACE. SEE FIGURE 62. DOING EITHER WILL ALTER THE VALVE TIMING, WHICH COULD CAUSE THE VEHICLE TO PULL TO ONE SIDE OR THE OTHER.

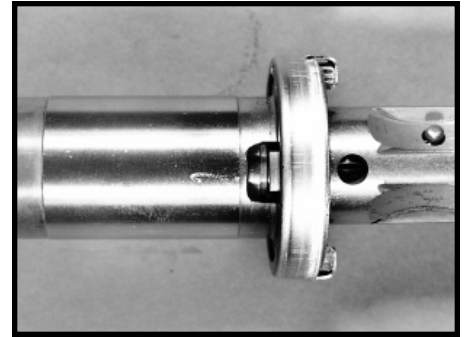


Figure 62

remove valve sleeve

24. Remove the valve sleeve (14) from the valve housing (8).
SEE FIGURE 63.



Figure 63

remove thrust washers & bearing

25. Remove the first thrust washer (10) and the thrust bearing (11) and then the second thrust washer (10) from the valve housing.
SEE FIGURE 64.

NOTE

NOTE: The first thrust washer may stay on the end of the valve sleeve.



Figure 64

remove seal rings

26. Remove and discard the valve housing seal ring (9) from the valve housing (8)

remove dirt & water seal

27. Remove and discard the dirt and water seal (4). SEE FIGURE 65.

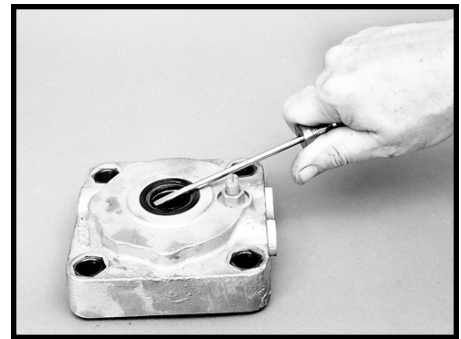


Figure 65

remove retaining ring

28. Remove retaining ring (5). SEE FIGURE 66.

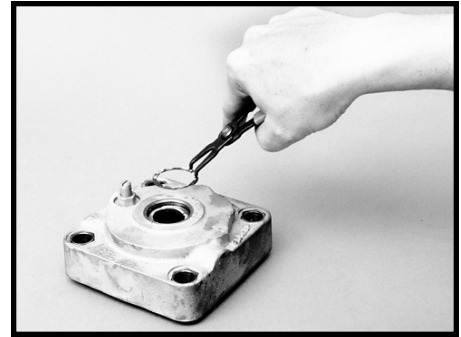


Figure 66

remove valve housing seal pack

29. Remove steel backup washer (6), and two-piece input shaft seal (7) from the valve housing (8). SEE FIGURE 67. Discard seal.

NOTE

NOTE: The poppet adjusting screw (3) and sealing nut (2) do not have to be removed from valve housing unless apparent leaks at the adjusting screw indicate sealing nut and or adjusting screw be replaced.



Figure 67

remove seal rings

30. Remove and discard the two Teflon seal rings (12) from valve sleeve (14). SEE FIGURE 68.



Figure 68

remove "O" rings

31. Remove the two backup "O" rings (13) from the valve sleeve grooves. SEE FIGURE 69.



Figure 69

remove rack piston & worm shaft

32. Remove the rack piston (29) worm shaft/ input shaft (16) assembly from the gear housing (19). SEE FIGURE 70. Lay the rack piston (29) worm shaft (6) assembly on a clean rag to keep the piston from rolling.

NOTE

NOTE: The worm shaft part of the assembly will be inside the rack piston, with the input shaft part of the worm protruding from the rack piston. Take care when removing this assembly from the housing. To prevent the teflon rack piston seal (36) from getting caught in the sector shaft cavity, remove the worm shaft rack piston assembly from the long end of the housing.

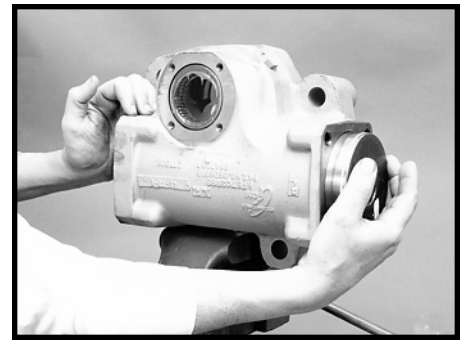


Figure 70

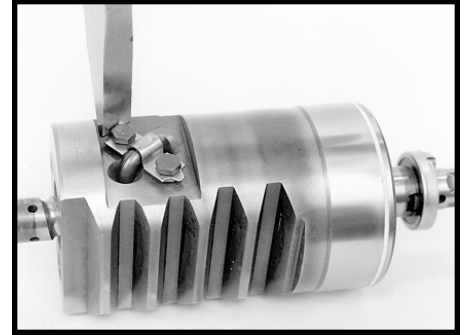


Figure 71

remove ball return guide clip, if equipped

33. For rack pistons with the ball return guide clip (46A), bend the tangs down that are on the clip or on the two locking tabs (47A). SEE FIGURE 68. Remove the two hex head bolts (47B), lock tabs and clip. Discard lock tabs. SEE FIGURE 72. 1/2 inch hex socket required.

NOTE

NOTE: The current HFB70 units and seal kits will utilize a ball return guide clip (46A/47A) with the two tabs integral to it.

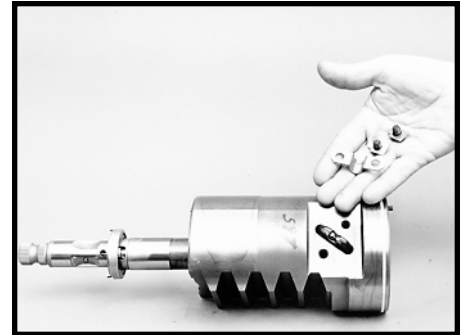


Figure 72

NOTE

NOTE: If the seal kit being used includes a ball return guide clip (46A/47A) with integral lock tabs, discard the ball return guide clip removed from the unit.

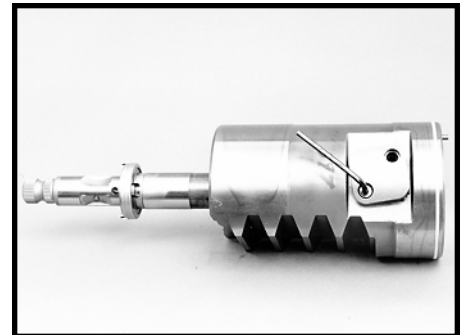


Figure 73

remove ball return guide cap, if equipped

34. For a rack piston with the ball return guide cap (46) instead of the clip, remove the two special screws (47) which will require either a 5/32 inch allen wrench or a T-30 Torx wrench. SEE FIGURE 73. Remove the ball return guide cap and the ball return cap seal (45). SEE FIGURE 74. Discard screws and cap seal.

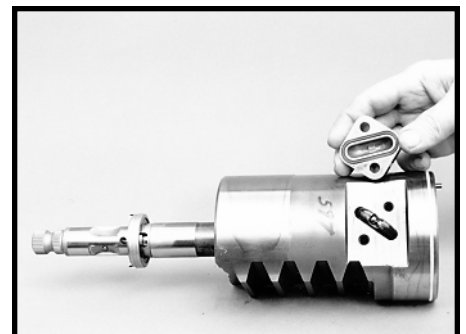


Figure 74

remove guides & balls

35. Remove the two ball return guide halves (44). SEE FIGURE 75.
Remove the balls (43) from the rack piston (29) by rotating the worm shaft/input shaft (16) until the 34 balls fall out. SEE FIGURE 76.

CAUTION

CAUTION: Assembly contains a set of 34 matched balls, and you must take special care not to lose any. If any balls are lost, a complete, new set of matched balls will be required.

WARNING

WARNING: INCORRECT MATCHING OF BALLS, WORMSCREW AND RACK PISTON CAN RESULT IN LOSS OF STEERING, WHICH COULD RESULT IN AN ACCIDENT.

NOTE

NOTE: Ball return guides are closely fitted with the rack piston and you may have to remove them by carefully inserting a screw driver between the rack piston and the ball return guides. See composite picture of both types of rack piston assemblies and two types of ball guides. SEE FIGURE 77.

remove worm shaft

36. Remove the worm shaft/input shaft (16) from the rack piston (29). SEE FIGURE 78.

remove seal ring

37. Remove and discard the rack piston seal ring (36). SEE FIGURE 79.

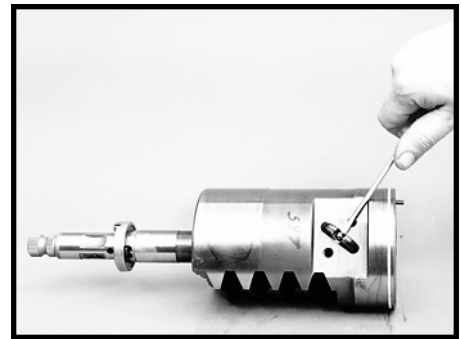


Figure 75

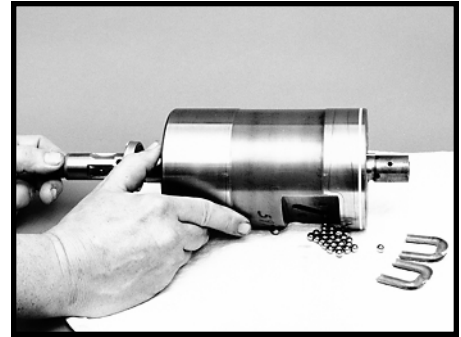


Figure 76

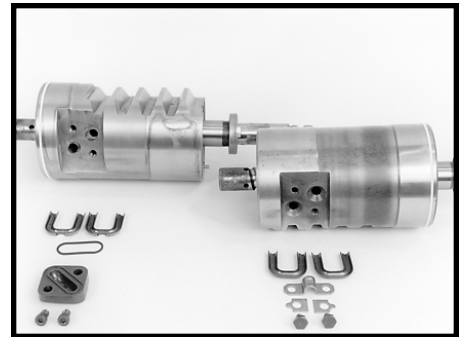


Figure 77

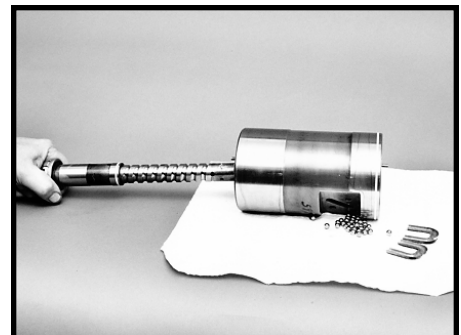


Figure 78

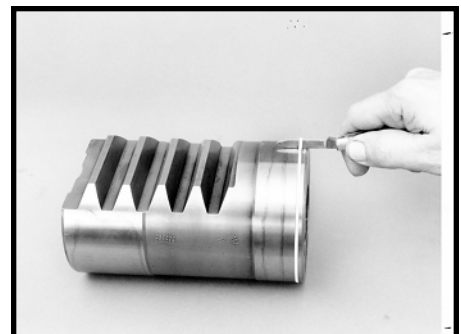


Figure 79

**remove rack piston
piston "O" ring**

38. Remove and discard the rack piston backup "O" ring (35) from the rack piston. SEE FIGURE 80.

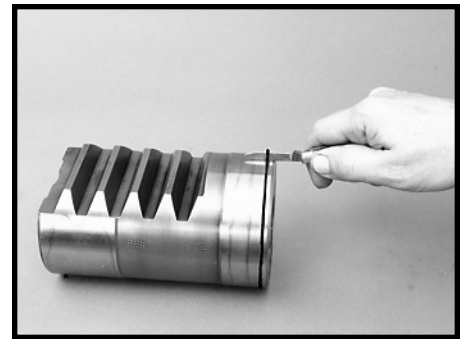


Figure 80

**remove worm
shaft seal and
"O" ring**

39. Remove and discard the worm shaft seal ring (18). Then, remove and discard the worm shaft "O" ring (17) from the worm shaft/input shaft (16). SEE FIGURE 81.

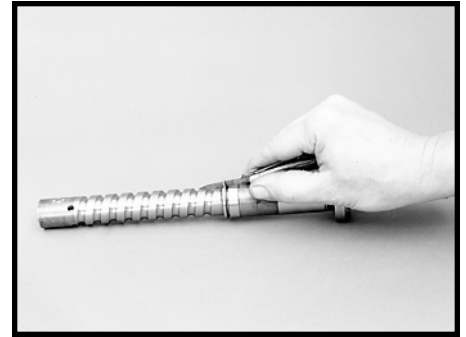


Figure 81

CAUTION

CAUTION: This completes the extent that the worm shaft/input shaft (16) may be disassembled for service. See Warning on Page 25.

WARNING

WARNING: DURING STEP 40 YOU SHOULD WEAR EYE PROTECTION, AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

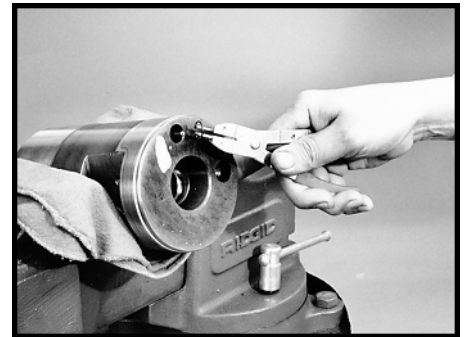


Figure 82

**remove poppets,
if necessary**

40. It is not usually required to service the poppet assembly. If required, however, position the rack piston (29) carefully in a vise equipped with soft jaws. Then, remove two retaining rings (30), two poppet seats (31), two poppets (32), nylon spacer rod (33), and spring (34). SEE FIGURES 82, 83, 84



Figure 83

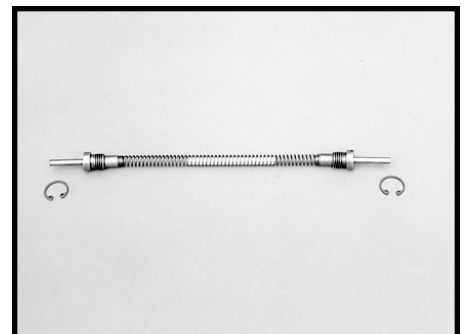


Figure 84

remove housing bearing if necessary

41. The housing bearing assembly (20) or race should only be removed if you determine that the bearing must be replaced after following inspection procedures 4, 5 and 6 on page 32. Remove the bearing in the following manner: Use bearing mandrel (special tool) J26743 to apply pressure from the side cover opening and press the bearing out through the trunnion cover opening. SEE FIGURE 85. Maintain a good, square contact between the housing and press base to avoid damaging the housing bearing bore. Remove retaining ring (21) from bearing. Discard bearing.

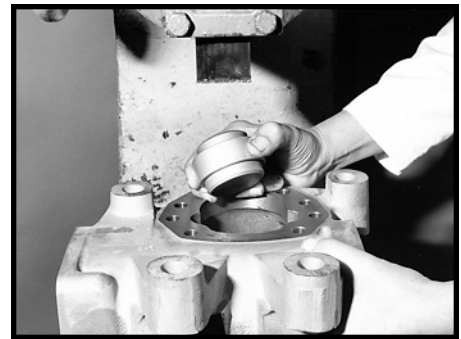


Figure 85

CAUTION

CAUTION: If the bearing is cocked while you press it out, it will burnish the bore, causing it to become oversized. You will then have to replace the gear housing.

NOTE

NOTE: Service housing assembly includes: housing (19), bearing assembly (20), retaining ring (21) and bleed screw (19A).

remove bleed screw

42. Remove bleed screw (19A). A 5/16 inch socket required. SEE FIGURE 86.

This completes the disassembly of the HFB70 steering gear.



Figure 86



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