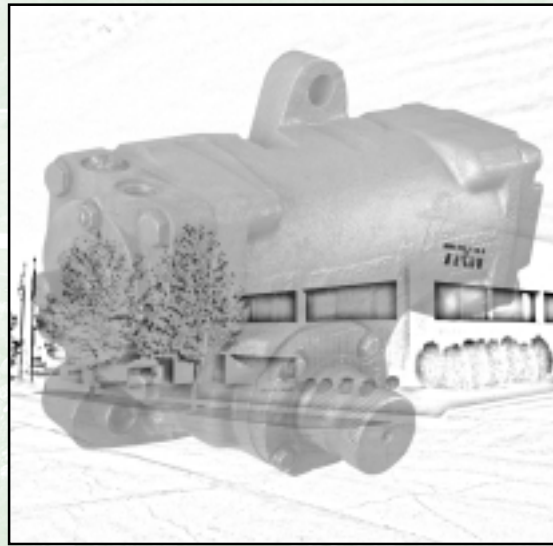


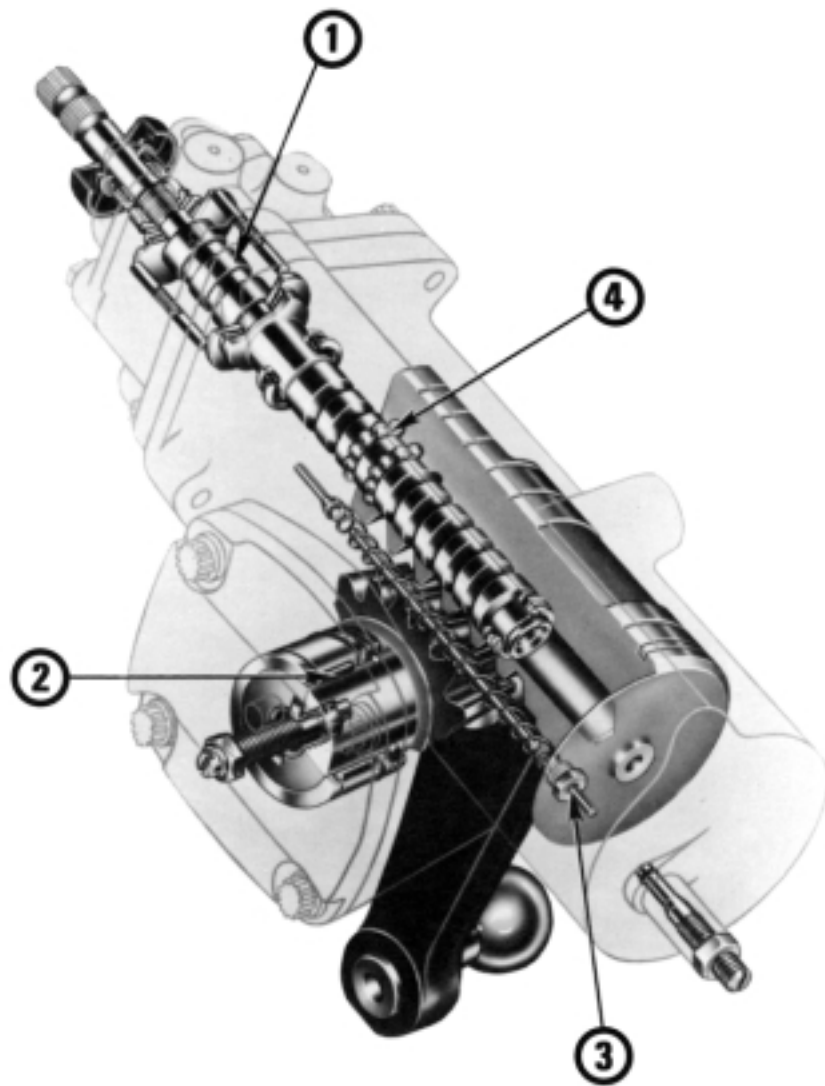
HF Steering Gear Service Manual

HF54 SERIES



HF54 Integral Hydraulic Power Steering Gear

This steering gear was specifically designed for motor trucks. Our design experience with previous models of hydraulic power steering gears have been incorporated into this product.



Design Features

1. **Preloaded Linear Spool 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
- **High Temperature Seals**—These specially developed seals may be operated intermittently at 250°F (121.1°C)
 - **Manual Steering Capability**—Provides for steering control in the event of hydraulic failure
 - **Auxiliary Porting Available**—For auxiliary cylinder control
 - **Seal Protectors**—Provide protection from harsh environment

Definitions

NOTE: A NOTE gives key information to make a procedure easier or quicker to follow.

CAUTION: A CAUTION refers to those procedures that must be followed to avoid damage to a steering component or the gear.

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

The product represented herein is protected by United States patent No. 3, 047, 087

Table of Contents

	Page
HF54 Design Features and Phantom View	Inside Front Cover
Definitions and Patents	1
Introduction	3
HF54 Hydraulic Fluid Flow Illustration	4
Valve Hydraulic Fluid Flow Illustration	5
HF54: General Design and Operation	6
Troubleshooting Information	7
Troubleshooting Guide	9
Repairs and Adjustments on Vehicle	12
–The Sector Shaft and Trunnion Cover Seal	12
–The Worm Shaft Seal	15
–Worm Shaft, Valve, Thrust Bearing Preload Adjustment	17
–Poppet Valve Adjustment	19
–Cross Shaft or Sector Shaft Adjustment	20
Torque Chart	21
Tools and Materials Required for Servicing	21
HF54 Exploded Assembly View-Typical	21A and 21B
Disassembly	22
Inspection	32
Assembly	35
Final Adjustments	49
Hydraulic Fluid	50
Filling and Air Bleeding the System	50
WARNINGS for Proper Steering Gear Operation	51
Steering System Maintenance Tips	52

WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

Introduction

Service Manual for Model HF54

This service manual has one purpose: to guide you in maintaining, troubleshooting and servicing the HF54 Hydrapower™ integral power steering gear.

Material in this manual is organized so you can work on the HF54 and get results without wasting time or being confused. To get these results, you should review the contents of this manual before you begin any work on the HF54.

The section of this manual on General Design and Operation, treats the major parts of the HF54 and explains how they function together. The knowledge you acquire from reviewing this section should assist you in solving your steering problem.

This manual also contains troubleshooting information and checklists. With them, you can diagnose a steering problem without removing the HF54 from the vehicle. If you must service the HF54, the checklists will help you to determine where the problem may be.

The three-column format of the Repairs, Adjustments, Disassembly, Inspection and Assembly sections will make it easier for you to service the HF54. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions and warnings.

A foldout page with the same typical HF54 exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly, assembly and other procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly, assembly and other procedures.

As you gain experience in servicing the HF54 you may find that some information in this manual could be clearer and more complete. If so, let us know about it. Don't try to second guess the manual; if you are stuck, contact us. Servicing the HF54 should be a safe and productive procedure.

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 12 and 15.
- Remove the supply and return lines from the gear, and immediately plug all port holes and fluid lines.

WARNING: THIS STEERING GEAR WEIGHS APPROXIMATELY 80 POUNDS, 36 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
and sector shaft

1. Position the steering gear firmly in a vise, clamping against the housing (55) mounting flange or boss, with the worm shaft (23) in a horizontal direction and components accessible for disassembly. SEE FIGURE 43.

CAUTION

CAUTION: Do not clamp against body of the housing as this could damage housing and cause disassembly, assembly difficulties. If housing mounting boss or flange is not accessible for clamping in vise, fabricate and attach a mounting plate to the housing mounting bosses for this purpose.

drain gear and
position
sector shaft

2. Prepare for fluid drainage and unplug hydraulic ports. Using appropriate 3/4 or 11/16 inch 12 point socket on the worm shaft serrations, rotate worm shaft (23) through gear travel a few times to purge hydraulic fluid from gear. Then rotate

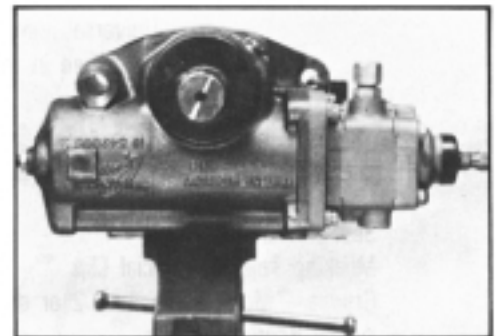


Figure 43

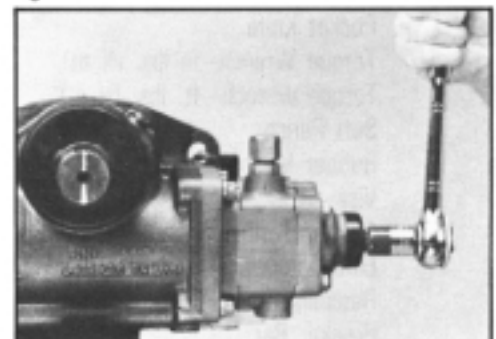


Figure 44

the worm shaft until the timing mark on the end of the sector shaft (51) is vertical to the worm shaft. This will position the gear for sector shaft removal. SEE FIGURE 44.

NOTE

NOTE: If the steering gear does not have a sector shaft timing mark, position sector shaft for removal by rotating worm shaft from end of travel one half of the total worm shaft rotations, counted when rotating worm shaft from one end of travel to the other.

**remove
protector seal**

3. Remove protector seal (61) from trunnion cover (59). SEE FIGURE 45.

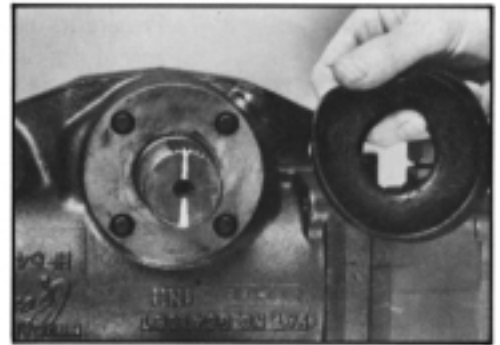


Figure 45

**clean sector
shaft**

4. Remove any paint or corrosion from the exposed area of sector shaft (51) with emery cloth. SEE FIGURE 46.

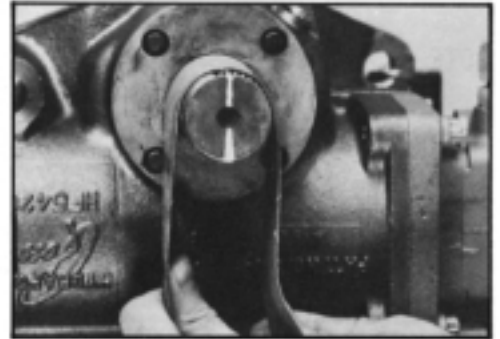


Figure 46

**remove trunnion
cover bolts**

5. Remove the four trunnion cover screws (60). A 5/16 inch 12 point thin wall socket required. SEE FIGURE 47.

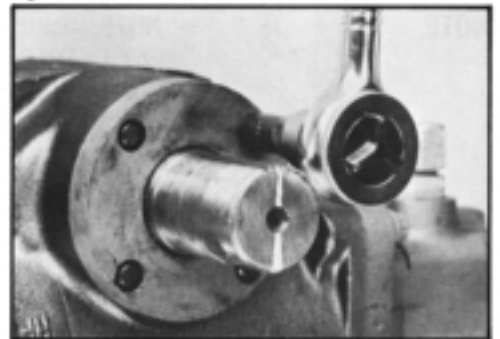


Figure 47

**remove trunnion
cover and
seal package**

6. Remove the trunnion cover (59). Remove and discard the seal ring (58), the two piece sector shaft seal (48) and the *Teflon backup washer (47) from the trunnion cover. SEE FIGURE 48.



Figure 48

**loosen sector
shaft adjusting
screw jam nut**

7. Loosen sector shaft adjusting screw jam nut (40). SEE FIGURE 49. 3/4 inch socket required.

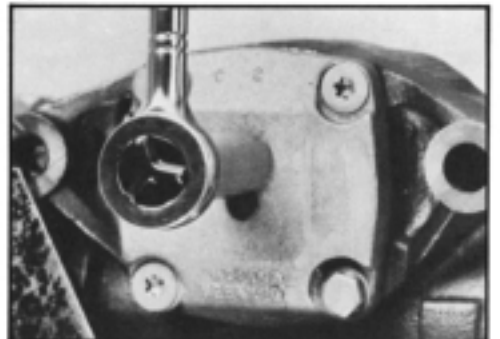


Figure 49

*Teflon is a registered trademark of DuPont Corporation.

remove side cover bolts

8. Prepare for fluid to drain and remove the four special bolts (42) and lockwashers (42A) from the side cover (43). A 5/8 inch socket required. SEE FIGURE 50. Tap lightly with a soft hammer on the end of sector shaft (51) to disengage seal and let drain.

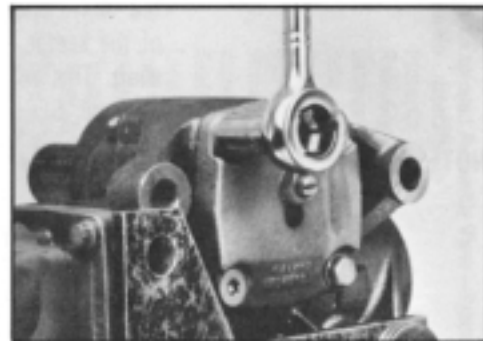


Figure 50

NOTE

NOTE: These bolts are special because they are equipped with either a ring or washer design on the underside of the head. SEE FIGURE 51. 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.

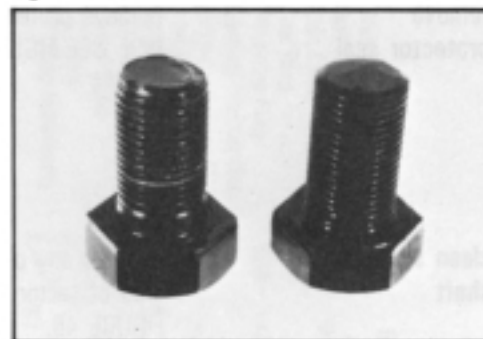


Figure 51

NOTE

NOTE: Some units have a flat head Torx drive bolt (42B) without a lockwasher as one or two of the side cover bolts. A T-50 Torx socket required.

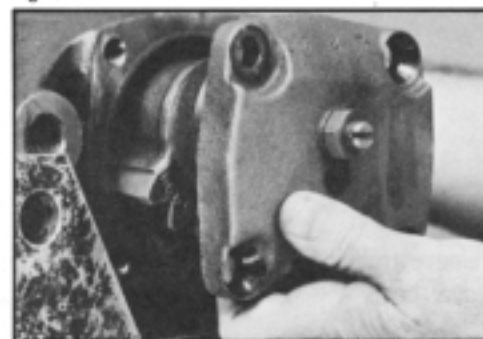


Figure 52

remove side cover and sector shaft assembly

9. Remove side cover (43) and shaft assembly (51) as a unit from gear assembly. SEE FIGURE 52. Remove and discard seal ring (43A).

NOTE

NOTE: If sector shaft hangs up on housing face during removal rotate worm shaft until sector shaft is positioned for removal.

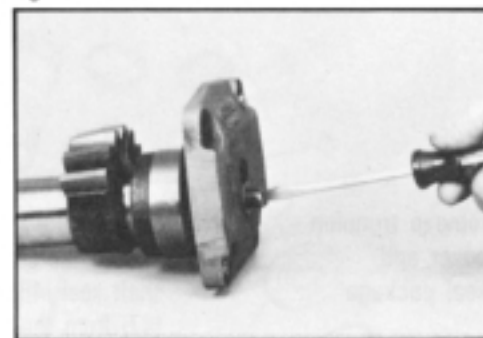


Figure 53

remove sector shaft from side cover

10. Remove jam nut (40) and screw sector shaft adjusting screw (50) out of side cover (43) and lift sector shaft (51) out of side cover. SEE FIGURE 53.

remove side seal retainer

11. Remove the side cover retaining ring (62) if there is one in the unit. SEE FIGURE 54.



Figure 54

remove seal package and vent plug

12. Remove the two piece seal (48), the Teflon backup washer (47) and steel backup washer (46) from side cover (43). Discard the two piece seal and Teflon washer. SEE FIGURE 55. Remove and discard vent plug (41).

NOTE

NOTE: Do not remove retaining ring (45) from side cover (43) unless it must be replaced.

remove retainer and adjusting screw

13. Only if replacement of retainer (49) and or adjusting screw (50) is required, (see inspection procedure #9, page 34.) place the sector shaft (51) firmly in a soft jawed vise and unstake retainer using a suitable chisel. Turn retainer out of sector shaft pocket and remove adjusting screw. Discard retainer. SEE FIGURE 56.

remove seal and clean worm shaft

14. Remove protector seal (1) from worm shaft (23). Clean exposed area of the worm shaft with a fine grade of emery paper. SEE FIGURE 57.

NOTE:

NOTE: Scribing or marking a line across the housing (55) adaptor (18) valve body (15A) and upper cover (7) before disassembly will facilitate correct alignment of these components when reassembled.

loosen upper cover bolts and adjusting nut

15. Loosen the four upper cover bolts (6) for later removal. A 9/16 inch socket required. SEE FIGURE 58.

remove adaptor bolts

16. Remove four adaptor bolts (17). A 7/16 inch 12 point socket required. SEE FIGURE 59.



Figure 55



Figure 56

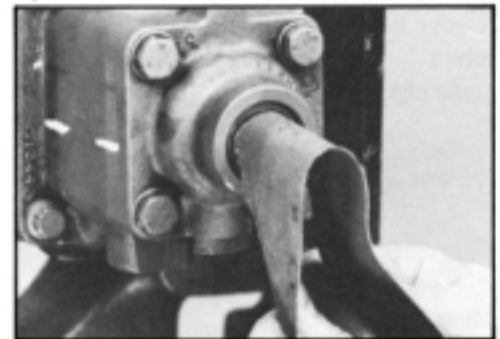


Figure 57

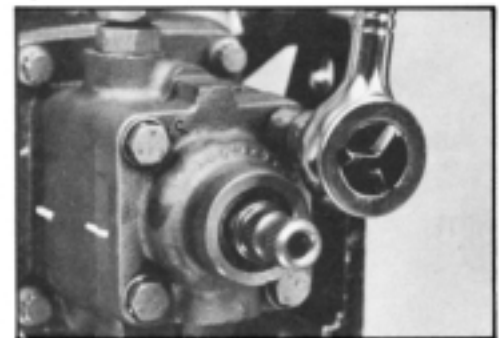


Figure 58

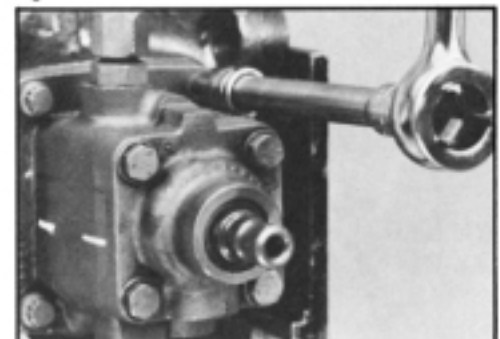


Figure 59

rotate worm shaft to loosen adaptor

17. Rotate worm shaft (23) until adaptor (18) moves away from housing (55), about 3/4 inch (19 mm) and let drain. SEE FIGURE 60.

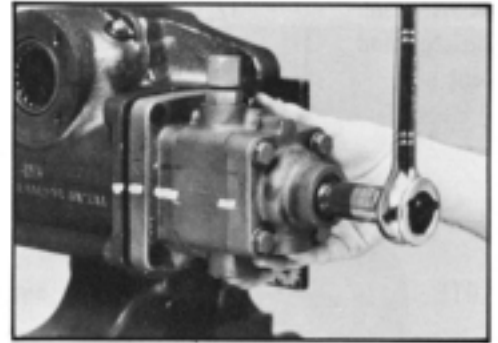


Figure 60

remove worm shaft subassembly

18. Remove worm shaft (23), upper cover (7) adaptor (18) rack piston (39) subassembly as a unit from housing (55) and place on a cloth covered work surface, with the ball return guides (35) up. SEE FIGURE 61. Remove and discard seal ring (19) and seal ring (16).

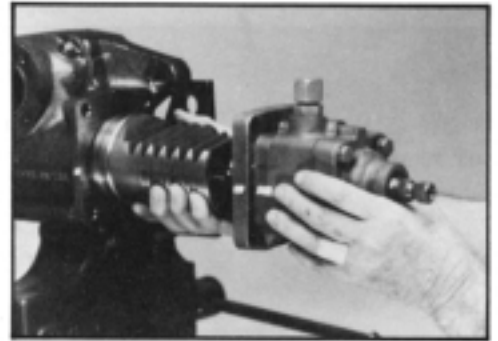


Figure 61

remove ball return guide clip

19. Bend the tangs down on the two locking tabs (37). SEE FIGURE 62. Remove the two hex bolts (38), locking tabs and ball return guide clip (36). 7/16 inch socket required. SEE FIGURE 63. Discard lock tabs.

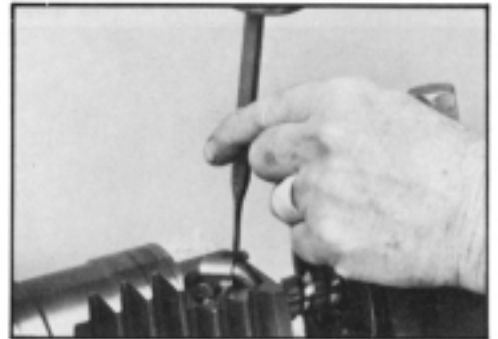


Figure 62

remove guides and balls

20. Remove the ball return guide halves (35) from the rack piston (39). With the rack piston ball guide holes tilting down, rotate worm shaft (23) to allow all balls (34A, 34B) to fall out. SEE FIGURE 64.



Figure 63

NOTE

NOTE: The ball return guide is closely fitted with the rack piston, and you may have to remove the halves by carefully inserting a screw driver between the rack and the guide.

CAUTION

CAUTION: The 22 steel balls are a matched set. Take care not to lose any of them. If you lose any of the balls, you must replace them with a complete, new set.

WARNING

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



Figure 64

remove rack piston from subassembly

21. Remove rack piston (39) from worm shaft (23) subassembly. SEE FIGURE 65.

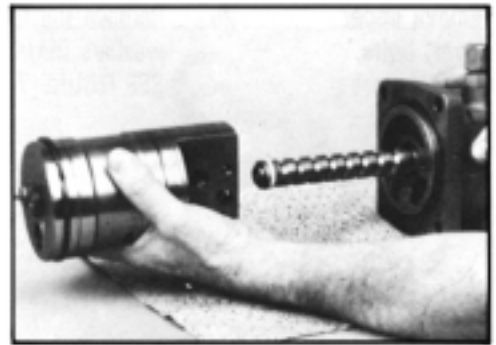


Figure 65

NOTE

NOTE: Do not remove rack piston ring (39A) or poppet (31) components from the rack piston unless replacement is necessary.

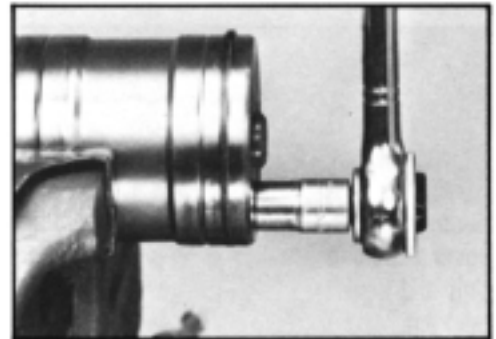


Figure 66

WARNING

WARNING: DURING STEP 22 YOU SHOULD WEAR EYE PROTECTION. AS THE SPRING LOADED POPPETS COULD EJECT, AND CAUSE EYE INJURY.

remove poppets

22. To remove poppets, place rack piston (39) in a soft jawed vise and turn poppet seats (30) out of both ends of rack piston. Remove two poppets (31), the nylon spacer rod (33) and spring (32). A 9/16 inch socket required. SEE FIGURES 66 and 67.

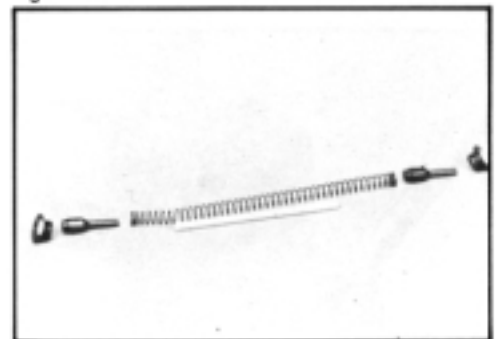


Figure 67

cut and remove worm shaft seal

23. Hold the seal cup (26) and seal (25) in place with pliers and cut, remove, and discard the seal cup and seal from end of worm shaft (23). SEE FIGURE 68.

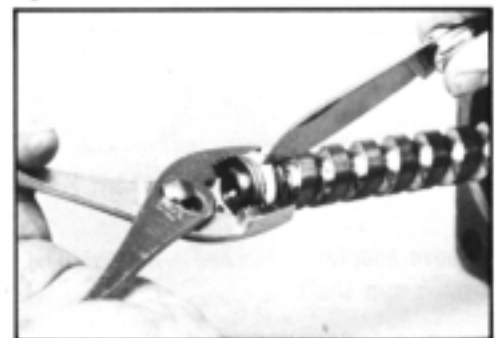


Figure 68

remove retainers and washers

24. Remove retaining ring (29) using needle nose pliers, then remove retaining washer (28) bronze backup washer (27) and steel washer (24) from end of worm shaft (23). SEE FIGURE 69.



Figure 69

remove upper cover, bolts, and washers

25. Remove the four loosened upper cover bolts (6), washers (6A) and the upper cover (7) assembly. SEE FIGURE 70. Discard seal ring (8).

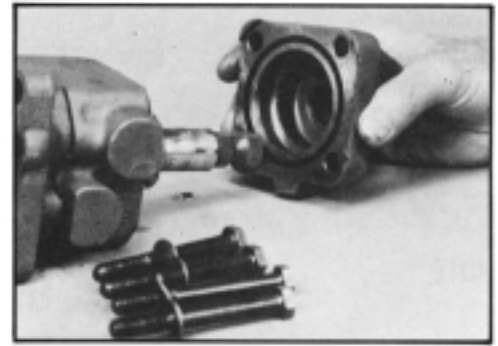


Figure 70

remove upper cover retaining ring and seal package

26. Remove retaining ring (2) from upper cover (7) with the appropriate retaining ring pliers or small screw driver. SEE FIGURE 71. Remove backup washer (3) and seal (4). SEE FIGURE 72. Discard seal.

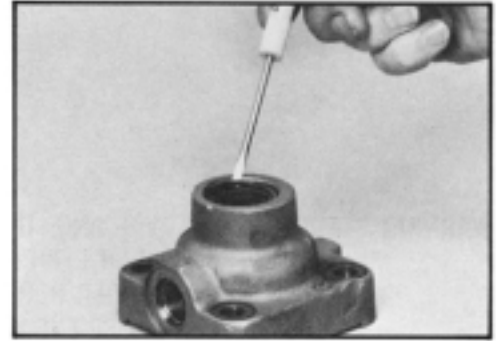


Figure 71



Figure 72

remove adaptor from worm shaft

27. Remove adaptor (18) from worm shaft (23). SEE FIGURE 73. Remove and discard seal ring (8) and two seal rings (16).

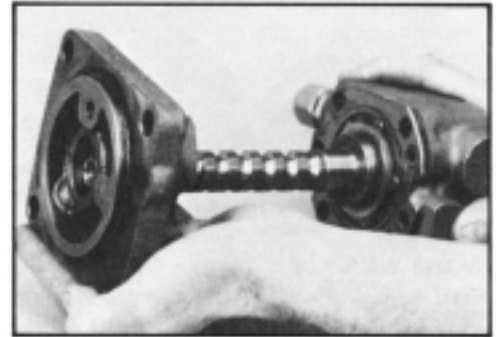


Figure 73

remove retaining ring, seal and backup washer

28. Remove retaining ring (22) from adaptor (18). SEE FIGURE 74. Remove and discard seal (21) and backup washer (20). SEE FIGURE 75.



Figure 74

unstake locking washer from nut

29. Unstake the tang on bearing lockwasher (10) that is staked in a slot of bearing (spanner) lock nut (9) on the worm shaft, valve subassembly. SEE FIGURE 76.



Figure 75

remove bearing lock nut

30. Use a breaker bar and the appropriate 3/4 or 11/16 inch 12 point socket on the serrations to hold worm shaft (23) from rotating or clamp worm shaft carefully in a soft jawed vise. Turn off the bearing lock nut (9) from the worm shaft with a hook type spanner wrench or self gripping (groove joint) pliers. SEE FIGURE 77.



Figure 76

NOTE

NOTE: The 12 point socket must have sharp points to effectively fit the serrations and hold or rotate the worm shaft.

remove washer and thrust bearing package

31. Remove and discard bearing lock washer (10) and remove washer (11), thrust washer (12), thrust bearing (13) and thrust washer (14). SEE FIGURE 78.

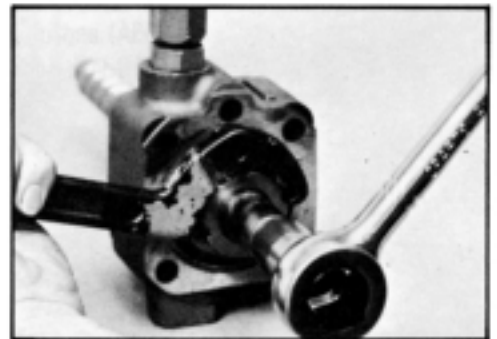


Figure 77

remove valve assembly

32. Carefully remove valve assembly (15) intact from worm shaft (23) and set aside for inspection and assembly procedures. SEE FIGURE 79.

CAUTION

CAUTION: The valve assembly (15) is the control center of the hydraulic system. The major parts, which are the body and spool, are machined to very close tolerances and with precision machined edges. The valve spool and valve body are selectively fitted at the factory and therefore these two parts are not separately replaceable. If either is damaged or excessively worn, the whole valve assembly should be replaced - good performance of power steering is not assured if "mis-matched" valve spool and valve body are used. Care should be exercised in the handling of these parts to prevent damage. Sealing edges of the valve body bore and the valve spool should not be broken. This will result in excessive leakage and reduce hydraulic power. Should valve spool (15B) or other valve components become disassembled follow the assembly procedures with care.

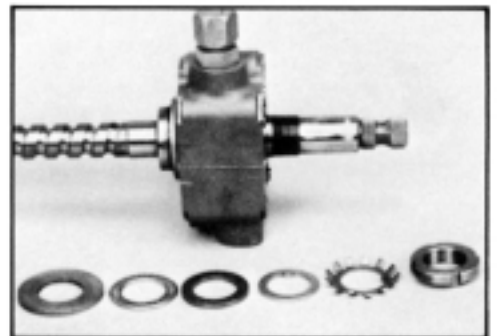


Figure 78

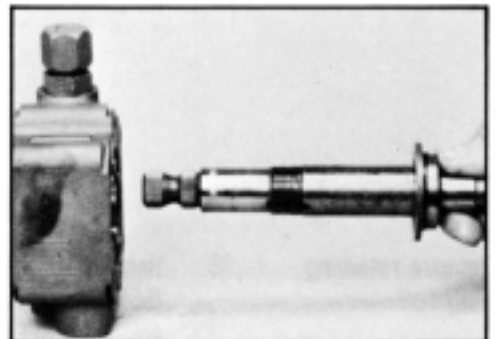


Figure 79

remove second thrust bearing package

33. Remove the second thrust washer (14) and thrust bearing (15) from worm shaft (23). SEE FIGURE 80.

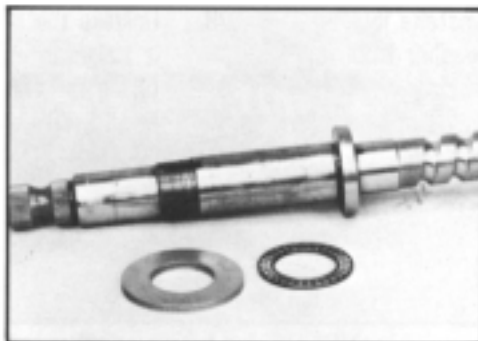


Figure 80

NOTE

NOTE: HF54 steering gears may be equipped with one of three alternate types of poppet screws as shown on the exploded assembly view on pages 21A and 21B.

remove and disassemble poppet screw assembly

34. Remove poppet screw assembly or poppet screw and nut assembly from housing (55) as follows:
Remove nut (54), poppet adjusting screw (53) and o-ring (52). Discard o-ring. 11/16 inch socket required. SEE FIGURE 81.

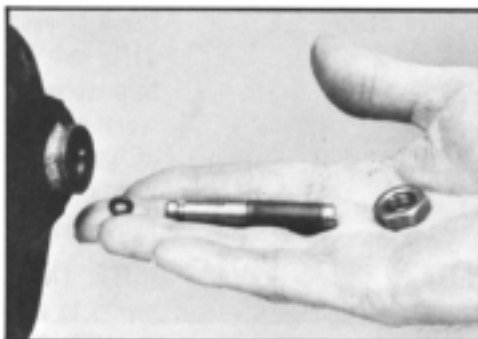


Figure 81

Or remove sealing nut (54A) and adjusting screw (53). Discard sealing nut. 3/4 and 5/16 inch socket required. SEE FIGURE 82.

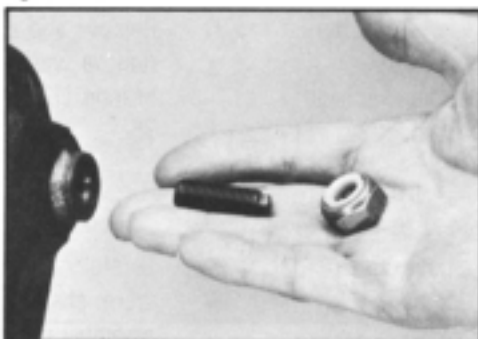


Figure 82

Or remove non adjusting hex head poppet screw (53A) and o-ring (52A). Discard o-ring. 1/2 or 9/16 inch socket required. SEE FIGURE 83.

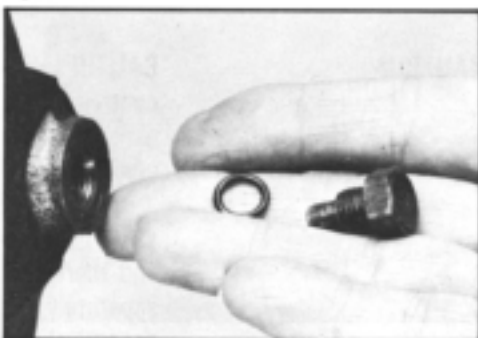


Figure 83

remove retaining ring

35. Remove spacer ring (55A) from bottom of housing (55) rack piston bore if the housing is so equipped. SEE FIGURE 84.



Figure 84

remove bleed screw

36. Remove bleed screw (55B) if the housing is so equipped. 5/16 inch socket required. SEE FIGURE 85.

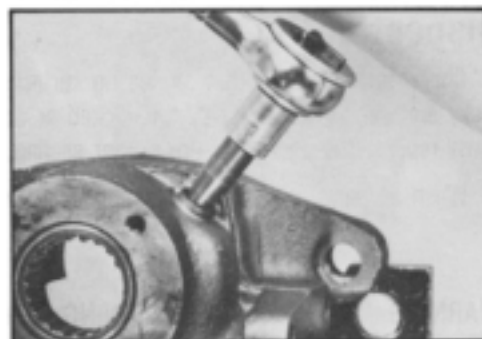


Figure 85

remove housing bearing if necessary

37. The housing bearing assembly (57) should only be removed if you determine that only the bearing must be replaced after following housing inspection procedures 6, 7, and 8. Place a suitable bearing mandrel that will clear the retaining ring (56) inside diameter to apply pressure from the side cover opening and press the bearing assembly out through the trunnion cover opening. SEE FIGURE 86. Maintain a good square contact between housing and press base to avoid damaging the housing bearing bore. Discard bearing. Do not remove retaining ring (56) unless it must be replaced.



Figure 86

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.

press out upper cover bearing

38. Press bearing (5) out of upper cover (7) with a bearing mandrel against seal end of bearing and only if it is to be replaced. Discard bearing. SEE FIGURE 87.



Figure 87

This completes the disassembly of HF54 steering gear.



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