



Engineering Manual

HF 64

Hydraulic Power
Steering Gear



Ross 765
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ROSS HYDRAPOWER[®] STEERING GEAR

MODEL HF64

For over one half a century, Ross has anticipated and met the changing and increasing needs for better steering in the automotive, industrial and agriculture fields. This HYDRAPOWER[®] steering gear, incorporating the latest Ross Gear design, is further evidence of this fact.

It is a compact integral assembly, installed with the same type of mounting used with manual steering gears. A hydraulic cylinder is integral mounted to the steering gear to apply the power for steering.

This steering gear offers to the driver, that same quality of roadsense steering obtained with the conventional manually operated steering gear.

HYDRAPOWER[®] steering enables the driver to maintain better control in the event of tire blowouts, soft ground, sand or snow, or road obstructions. The hydraulic response is used either for power assistance or resisting shocks - -consequently, no tendency to over control.

TRW

ROSS GEAR DIVISION

LAFAYETTE, INDIANA 47902

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SECTION I

MODEL HF64

A. DESIGN

This Ross "Hydrapower" unit is a fully Integral Steering Gear incorporating a hydraulic control valve, a power cylinder, and a mechanical means of steering control. The power of the cylinder is transmitted to the steering gear output shaft by means of gear teeth on the piston mating with teeth on the shaft. The flow of oil from the engine-driven pump is directed to the power cylinder by means of the control valve. The valve is concentric with the input shaft and located on the upper end of the steering gear assembly.

B. OPERATION

The action of the steering gear is both manual and hydraulic in effect. When the input shaft is turned, by the driver's effort on the steering wheel, the piston is caused to move by the interaction of balls spaced between an external groove in the shaft and an internal groove in a nut rigidly fastened to the piston. Whenever the driver's effort at the steering wheel exceeds the force of the centering springs and the "hydraulic reaction" provided by the control valve, the valve is actuated and the power of the system is applied to provide the driver with power steering.

Power steering control valves generally utilize the hydraulic pressure in the steering system to urge the valve spool to its neutral position. This is called "hydraulic reaction." As the pressure in the hydraulic cylinder builds up, the hydraulic centering force increases. Thus, the driver's effort on the steering wheel, in turning a corner, is greater than for a straight-ahead road correction. Because the hydraulic pressure is low in the straight-ahead driving, it is necessary to add centering springs to assist the valves hydraulic reaction in giving the system "road feel." The feel and steering effort created by the centering springs is constant for any steering condition.

When the valve is in the center position, the oil pressure at its two cylinder ports is low and equal and produces ineffective forces in the cylinder. This results in no movement of the piston and no circulation of oil in the lines to the cylinder; however, oil is circulating from the pump through the control valve to the reservoir with sufficient pressure only to overcome friction of lines and fittings.

Whenever the driver's effort at the steering wheel overcomes the valve centering springs and hydraulic reaction, the valve spool is moved axially restricting one of the return passages to the outlet port, thus causing an immediate increase in pressure at one of the cylinder ports and in one end of the cylinder. At the same time, the other return passage is enlarged, allowing the oil from the discharging end of the cylinder free passage to the outlet port and return to the reservoir. The immediate effect is increased pressure in one end of the cylinder to actuate the piston, thereby applying

hydraulic power directly to the steering gear pitman arm. Full pressure is obtained with a valve spool travel of approximately thirty-five thousandths of an inch. However, the slightest movement of the valve spool from center position results in a pressure differential at the valve ports.

Whenever the effort at the steering wheel is released, the valve spool is returned to the center position.

If the steered wheels are subjected to shock loads, the pitman arm, acting through the inner parts of the gear, shifts the input shaft worm and control valve spool axially in the appropriate direction, thus directing the fluid to the proper side of the piston to resist the shock forces. This "blocking action" prevents kickbacks at the steering wheel.

NOTE: To assist in the elimination of pump heat and belt squeal problems, the power cylinder has an unloading (or poppet) valve incorporated so that at each end of the piston stroke the pressure may be reduced. An adjusting screw is provided to enable the pressure relieving point to be varied slightly.

C. INSTALLATION

This gear can be furnished for lefthand or righthand mounting position and with either trunnion mounting or side cover mounting.

D. PUMP

The oil flow of the engine-driven pump is usually expressed in Gallons Per Minute at a given engine speed, generally idle.

Flow required for use with this gear is 4 GPM (minimum).

This flow results in a steering speed in excess of 1.5 wheel turns per second. A flow control valve should be provided in the pump or pressure line to limit to recommended flow-NOTE: Excessive oil flow may cause an oil heating problem and produce other undesirable effects.

It is necessary to incorporate a pressure relief valve in the supply circuit. It is recommended that the maximum pressure not exceed 1750 PSI.

E. RESERVOIR

The oil reservoir must be of sufficient capacity to avoid heating and provide air space for oil rise and/or expansion. A "full Flow" 50 Micron Filter is recommended in the hydraulic system. The incorporation of a suitable breather and/or air filter may be as necessary as the oil filter.

NOTE: It is recommended that the pump and/or reservoir be placed in the "fan blast" or cool air stream.

SECTION I

F. OIL PORTS

The inlet port in the valve and the return port in the gear upper cover are tapped 3/4-16 for use with standard JIC-SAE fittings.

G. GEAR DATA FOR HF64 SERIES

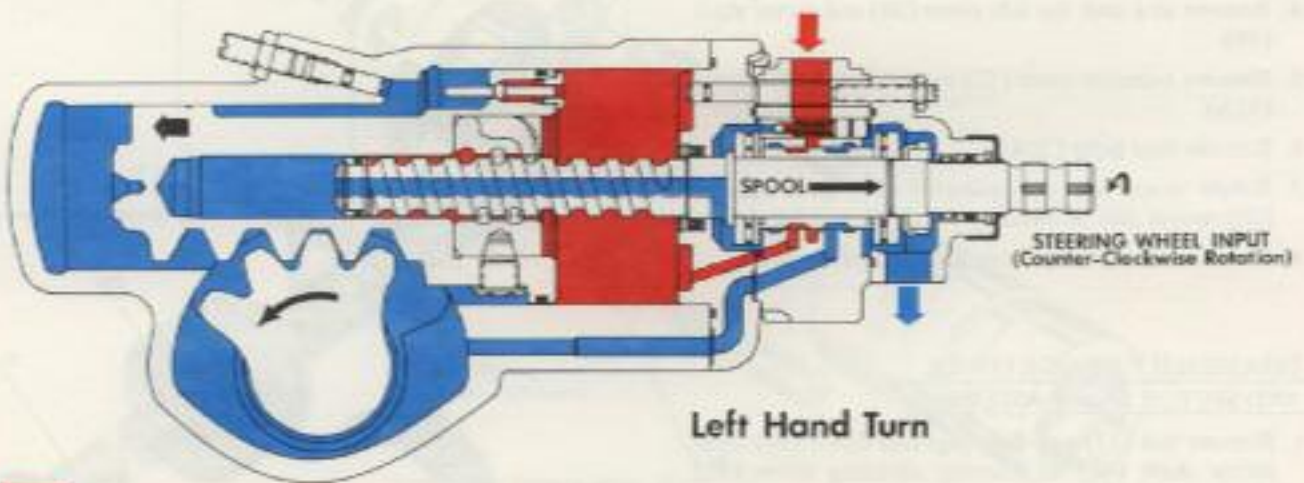
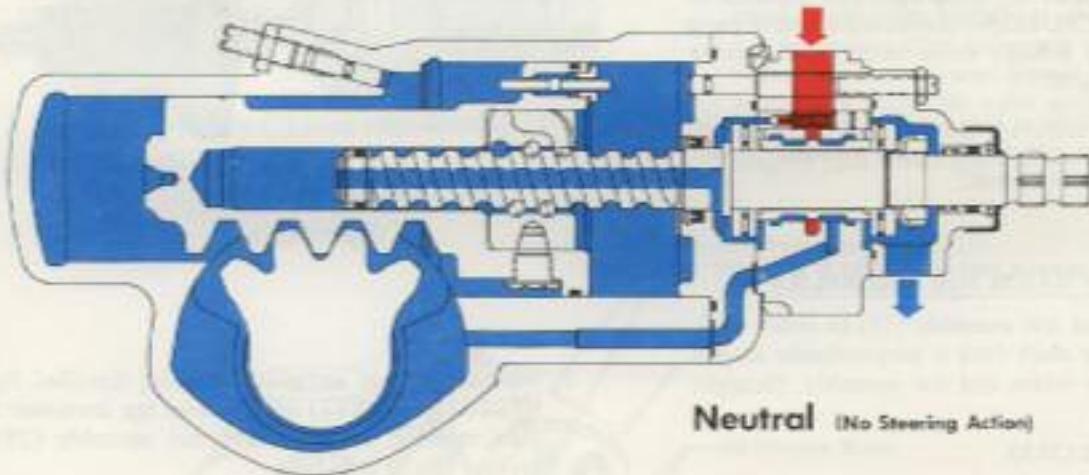
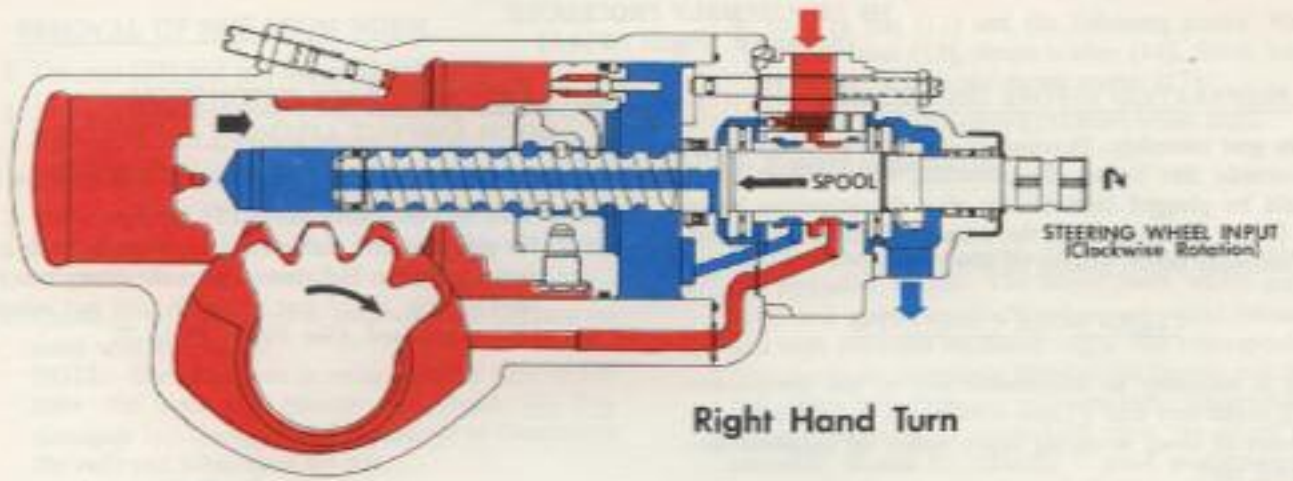
Angular Travel	95° guaranteed
	75° adjustable

Wheel turns	6.2 minimum (95°)
Output torque	21,000 inch pounds @ 1000 PSI 31,500 inch pounds @ 1500 PSI 36,750 inch pounds @ 1750 PSI
Ratio	23.4:1

H. HYDRAULIC OIL

The steering system should be kept filled with Automatic Transmission Fluid Type A - Suffix A or other approved fluids listed on Ross Service Bulletin #210.

HF64 OIL FLOW ILLUSTRATION



■ SUPPLY PRESSURE
■ RETURN OIL FLOW

Figure HF64-1

SECTION II

HF DISASSEMBLY PROCEDURE

(Reference: Figure HF64-6)

A. PREPARATION BEFORE DISASSEMBLY

Drain gear assembly. Thoroughly clean off around fittings all outside dirt before disconnecting hoses. (Port holes should be plugged immediately after disconnecting hoses and before removing from the vehicle). Finish cleaning and dry assembly before placing on work bench.

CLEAN WORK CONDITIONS

If it is necessary to disassemble any of the component parts, make sure that a clean work bench or table is used — (a piece of clean wrapping paper makes an excellent disposable top).

All internal parts should be cleaned in clear/clean solvent and blown dry with clean air. Keep each part separate to avoid nicks — burrs. CAUTION: Avoid wiping valve parts with cloth, as lint may actually cause binding and sticking of the closely fitted parts.

NOTE: Never steam clean or high pressure wash hydraulic steering assemblies. Do not force or abuse closely fitted parts, as damage usually will result.

B. DISASSEMBLY OF MAJOR SUB-ASSEMBLIES

1. Rotate worm and nut assembly (25) so index mark on end of sector shaft (46) is perpendicular to the centerline of the worm and nut assembly. (Straight ahead position).
2. Remove six bolts (38A).
3. Tap lightly with a soft-faced hammer on end of sector shaft (46) to disengage seal (39) and let drain.
4. Remove as a unit the side cover (38) and sector shaft (46).
5. Remove trunnion cover (52) by removing four screws (52A).
6. Remove four bolts (20A).
7. Rotate worm and nut assembly (25) until adaptor (20) moves out of housing for 3/4" and let drain.
8. Remove sub-assembly from housing and lay aside.

C. DISASSEMBLY OF SIDE COVER AND SECTOR SHAFT ASSEMBLY

1. Remove nut (37) and disengage side Cover (38) from sector shaft (46) by turning adjusting screw (45) clockwise.
2. Remove retaining ring (43A), shaft seal assembly (43), washer (41) and backup washer (42) from side cover (38). Check vent plug (38B). Vent plug should be flush with face of side cover (38).

D. REMOVAL OF RACK PISTON FROM WORM AND NUT ASSEMBLY

1. Unstake washer (36A) and remove locking screw (36) from rack piston (35).
2. Pre-position rack piston (35) so the rack teeth are in down position and disengage rack slowly until approximately 1" of nut on worm and nut assembly (25) is exposed. (See Figure HF64-2).



Figure HF64-2

3. Wipe dry surface and place retaining clip (Ref. figure HF64-3, item (25T1) or tape over the cross-over ball tube opening in worm and nut assembly (25) to prevent loss of steel balls.
4. Remove rack piston (35).



Figure HF64-3

E. REMOVAL OF NUT FROM WORM

1. Cut seal (27) and seal cup (28) and remove.
2. Remove retaining ring (31), retaining washer (30), back-up washer (29) and washer (26) and lay aside in same order and position. (See Figure HF64-5).
3. Place mandrel (TL1913, Detail 69) in hole at the bottom end of worm and nut assembly (25) and unscrew nut over mandrel. (See Figure HF64-3).
4. Carefully remove mandrel with nut attached and set aside with nut up.

NOTE: Use extra care in order that the tape or ball tube clip does not become disengaged. Do Not disengage nut from mandrel or attempt to disassemble the balls and tubes from the nut.

F. DISASSEMBLY OF VALVE ASSEMBLY AND ADAPTOR

1. Remove seal (1) and the four bolts (7A) from the upper cover (7).
2. Remove upper cover (7) from valve assembly (18).
3. Unstake washer (12).

4. Remove nut (11) and the following pieces: Washer (12), washer (13), thrust washer (14), thrust bearing (15), washer (16) and thrust washer (17).
5. Remove valve assembly (18) from worm shaft.
6. Remove adaptor (20).

NOTE: The valve assembly (18) 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 be removed from valve body, the valve spool should be assembled with the end, having the internal groove, toward the adaptor (20). (See Figure HF64-4).

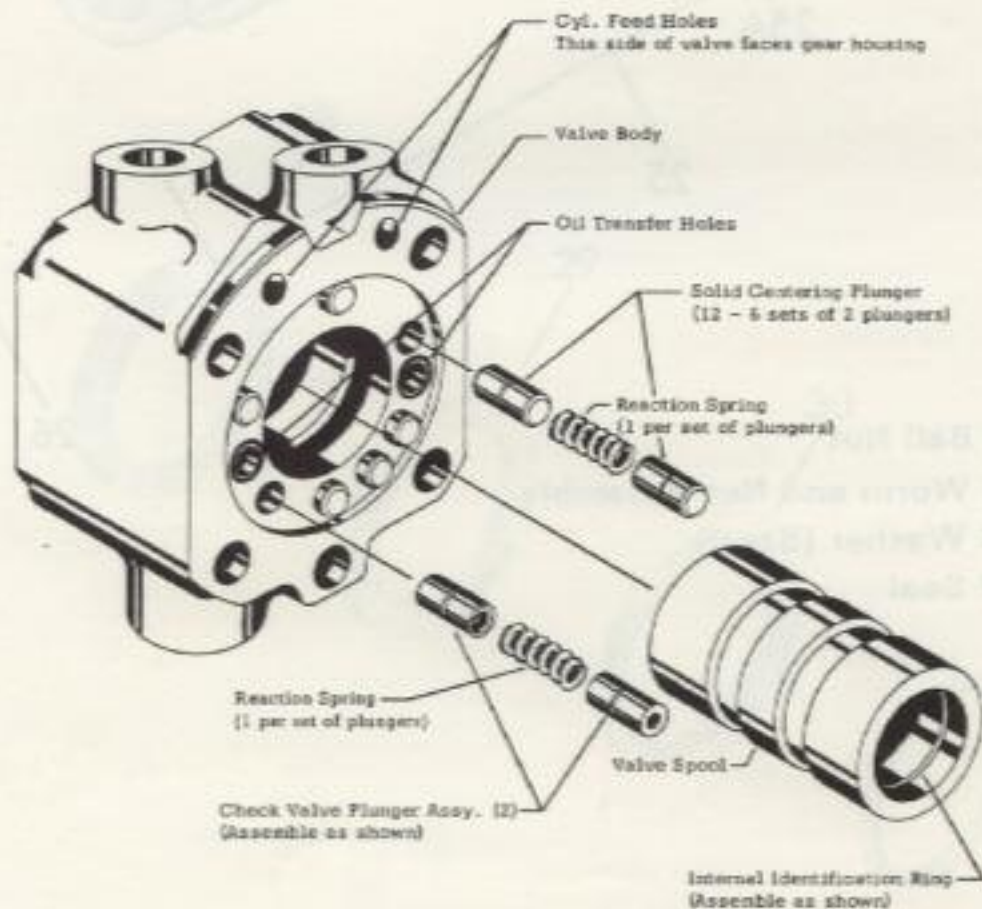
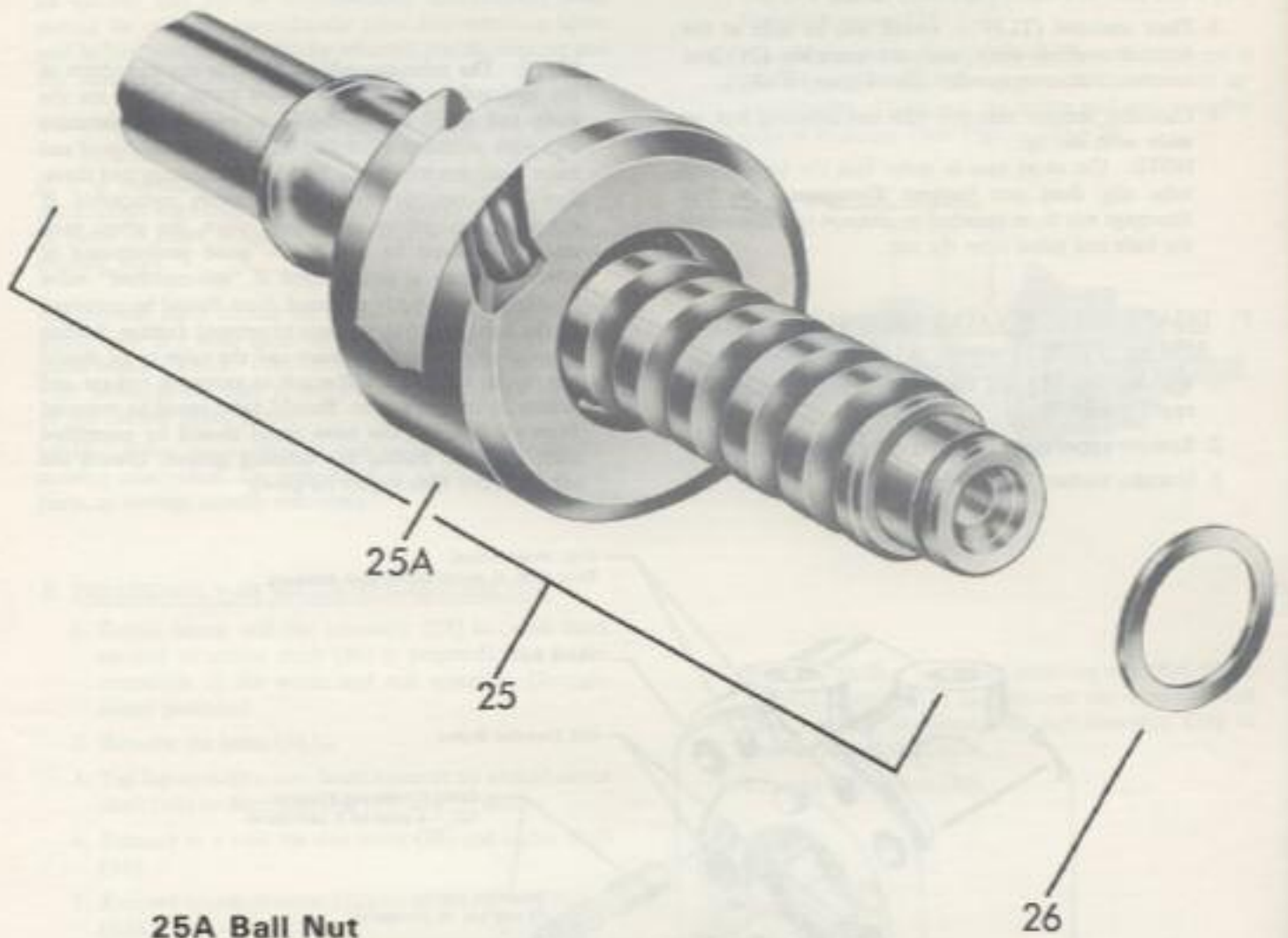


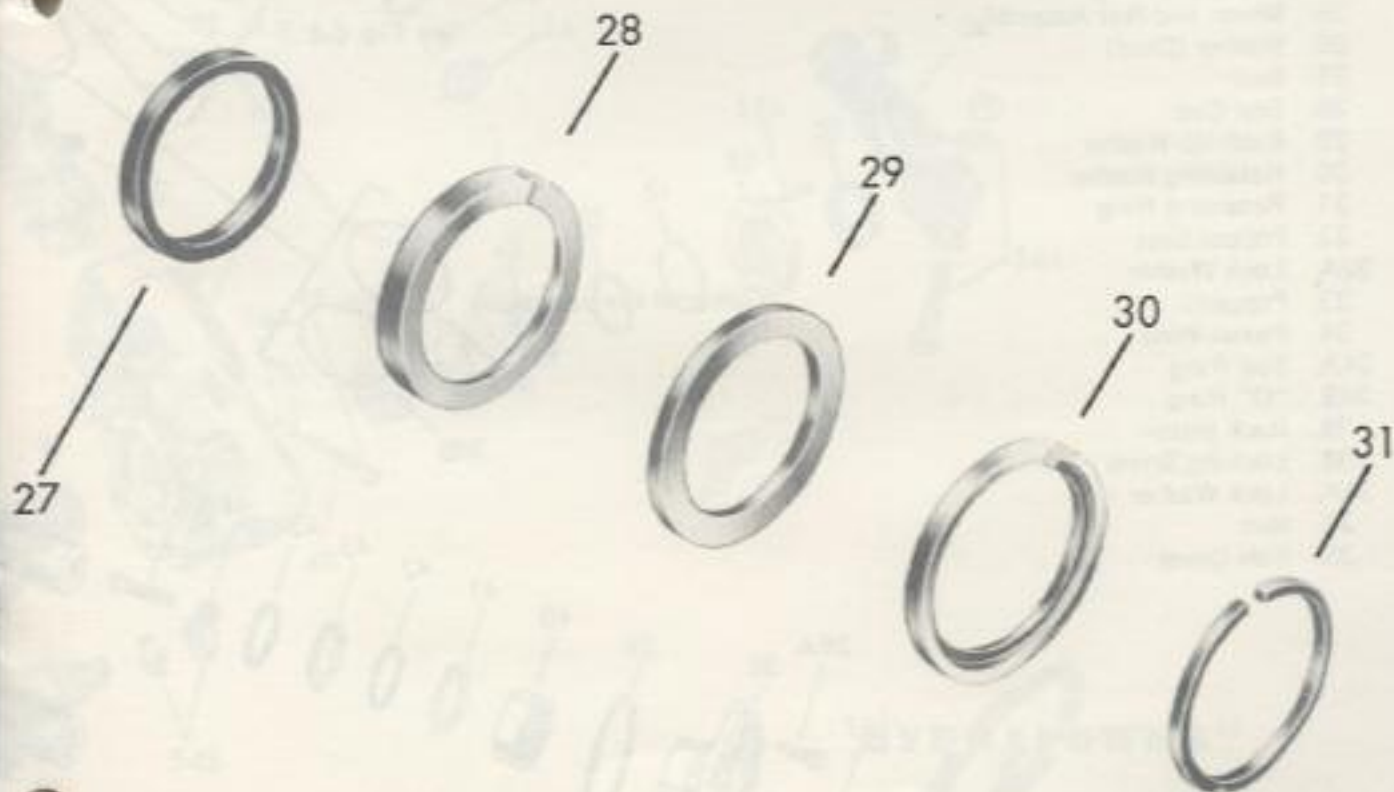
Figure HF64-4



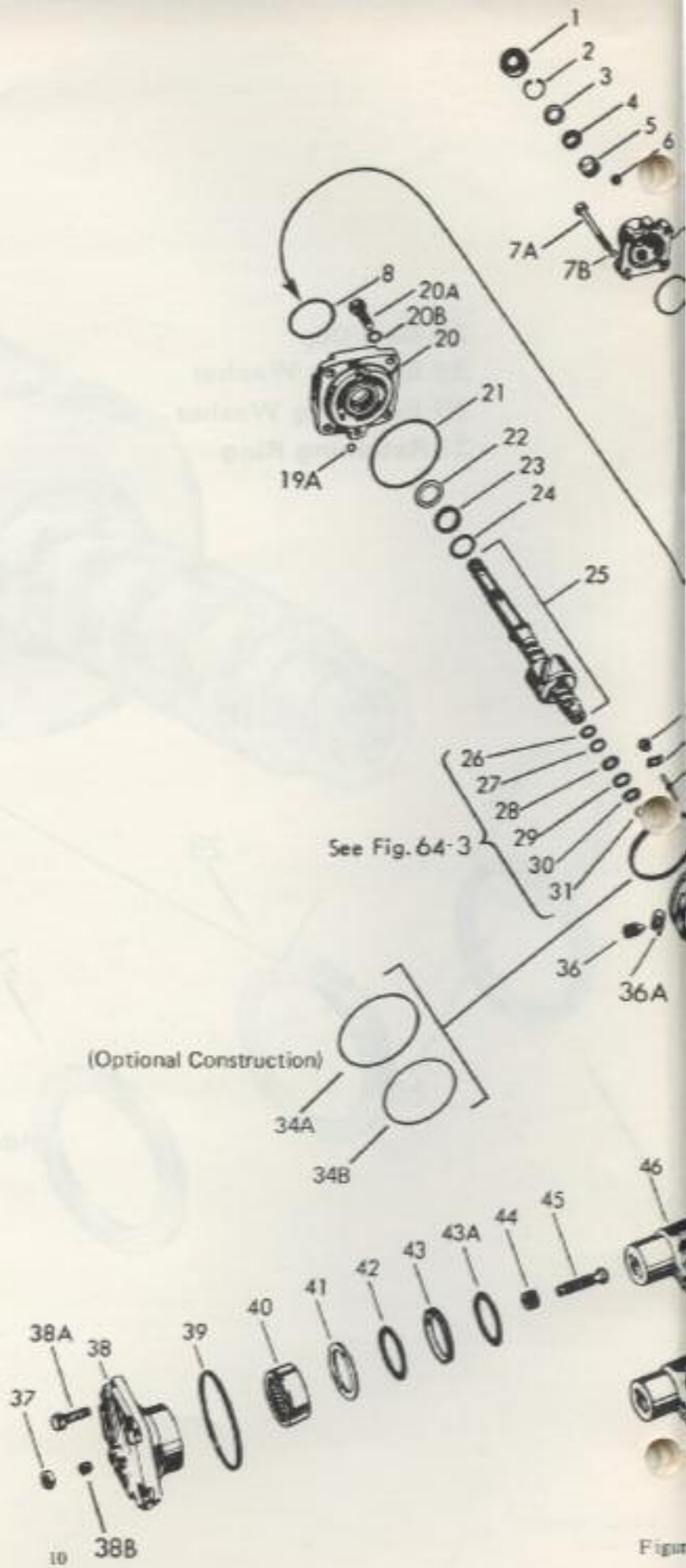
- 25A Ball Nut**
- 25 Worm and Nut Assembly**
- 26 Washer (Steel)**
- 27 Seal**

Figure HP64-

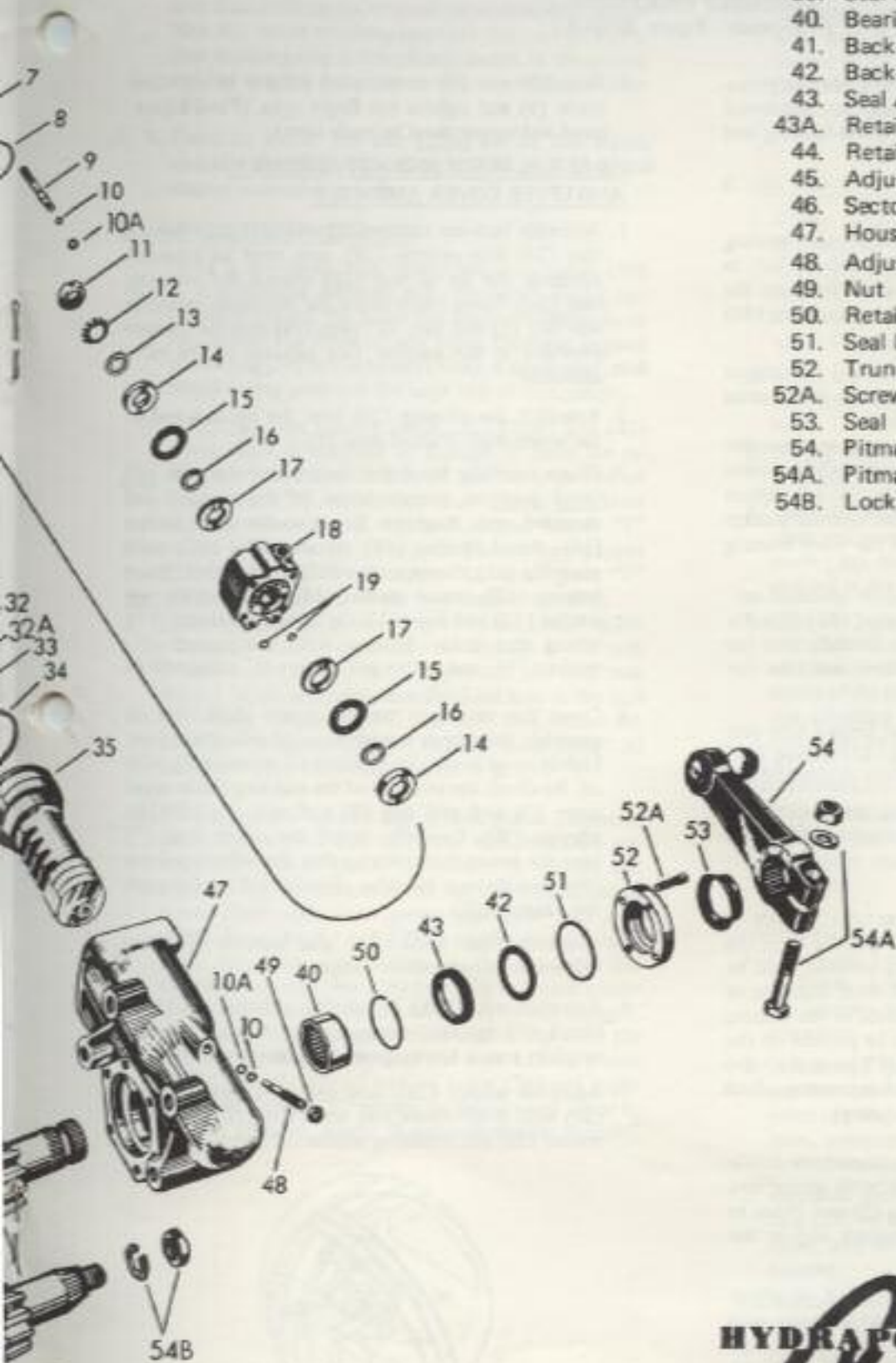
- 28 Seal Cup
- 29 Back-up Washer
- 30 Retaining Washer
- 31 Retaining Ring



1. Seal
2. Retaining Ring
3. Spacer
4. Seal
5. Bearing
6. Nut
7. Upper cover
- 7A. Bolt (4) (3/8-16 x 3-1/4")
- 7B. Washer
8. Seal Ring (2)
9. Adjusting Screw
10. Back-Up Washer
- 10A. "O" Ring
11. Nut
12. Washer
13. Washer
14. Thrust Washer (2)
15. Thrust Bearing (2)
16. Washer (2)
17. Thrust Washer (2)
18. Valve Assembly
19. "O" Ring (2)
- 19A. Seal Ring
20. Adaptor
- 20A. Bolt (4) (1/2-13 x 1-1/2")
- 20B. Washer (4)
21. Seal Ring
22. Back-Up Washer
23. Seal
24. Retaining Ring
25. Worm and Nut Assembly
26. Washer (Steel)
27. Seal
28. Seal Cup
29. Back-Up Washer
30. Retaining Washer
31. Retaining Ring
32. Poppet Seat
- 32A. Lock Washer
33. Poppet
34. Piston Ring
- 34A. Seal Ring
- 34B. "O" Ring
35. Rack piston
36. Locking Screw
- 36A. Lock Washer
37. Nut
38. Side Cover



Figure



- 38A. Special Bolt (6) (9/16-18 x 1")
- 38B. Vent Plug
- 39. Seal Ring
- 40. Bearing
- 41. Back-up Washer (Steel)
- 42. Back-up Washer
- 43. Seal Assembly
- 43A. Retaining Ring
- 44. Retainer
- 45. Adjusting Screw
- 46. Sector Shaft
- 47. Housing
- 48. Adjusting Screw
- 49. Nut
- 50. Retaining Ring
- 51. Seal Ring
- 52. Trunnion Cover
- 52A. Screw (4) (5/16-18 x 1")
- 53. Seal
- 54. Pitman Arm
- 54A. Pitman Arm Bolt Assembly (Straight Serration)
- 54B. Lock Washer and Nut (Taper Serration)

HYDRAPOWER®
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SECTION III

ASSEMBLY PROCEDURE (Reference: Figure HF64-6)

Before assembly, all parts should be cleaned in clean petroleum base solvent and blown dry with clean, dry air. Avoid wiping parts with cloth, since lint may cause binding and sticking of closely fitted components.

A. HOUSING ASSEMBLY

1. Assemble retaining ring (50) in groove of roller bearing (40). Place the housing (47) on a wooden block to protect the side cover face and carefully press the roller bearing into the housing until retaining ring (50) contacts housing.
2. Carefully clamp the housing (47) into a convenient assembly position and inspect the large rack piston bore for excessive scratches or damage.
Note: Do not rate in the same manner as a gasoline engine cylinder wall; the housing may exhibit severe scratches and still function properly. Do not replace the housing unless there is excessive internal leakage and it can be proven to be due to the worm housing bore.
3. Assemble back-up washer (10), when specified on adjusting screw (48). Coat "O" ring (10A) liberally with clean grease or oil and urge it carefully over the non-threaded end of adjusting screw and into the groove provided.
4. Insert the above assembly into the tapped hole provided and thread into the housing (47) leaving 7/8" exposed thread.
5. Assemble nut (49) onto adjusting screw (48) and tighten nut finger tight. (Final adjustment and torque must be made later).

B. UPPER COVER ASSEMBLY

1. If the needle bearing (5) has been removed from the upper cover (7), a suitable pressing mandrel must be fabricated which will pilot on the inner diameter of the needle bearing and have clearance in the bearing bore. The needle bearing (5) must be pressed on the numbered end and positioned 1 1/8" from the valve face side of the upper cover (7). (After pressing, check for freedom of the needles in the bearing).
2. Assemble seal (4) with the seal lip toward the needle bearing (5). Coat the spacer (3) with grease and assemble. Install the retaining ring (2) and check to insure proper seating of the retaining ring in the groove. Assemble seal (1).
3. Assemble back-up ring (10), when specified, on adjusting screw (9). Coat "O" ring (10A) liberally with clean grease or oil and urge it carefully over the non-threaded end of adjusting screw (9). Thread the adjusting screw (9) through the upper cover (7) until 9/16" of the thread is exposed beyond the boss.

4. Assemble nut (6) on threaded portion of adjusting screw (9) and tighten nut finger tight. (Final adjustment and torque must be made later).

C. ADAPTOR, WORM AND NUT ASSEMBLY AND UPPER COVER ASSEMBLY

1. Assemble back-up washer (22), seal (23) and retaining ring (24) into adaptor (20), care must be taken to assemble the lip of seal (23) toward the retaining ring (24). Using clean grease for retention, assemble seal ring (8) and two "O" rings (19) into the recesses provided in the adaptor face adjacent to the valve assembly.
2. Assemble the adaptor (20) over the bottom end of the worm shaft (Part of item 25).
3. Clamp carefully the worm shaft into a vise with soft faced jaws to permit access to the serrated and threaded end. Assemble thrust washer (14), washer (16), thrust bearing (15), thrust washer (17), valve assembly (18), thrust washer (17), washer (16), thrust bearing (15), thrust washer (14), washer (13), new washer (12) and nut (11). Carefully tighten nut (11), noting that thrust bearings (15) are located over washers (16) and adjust per section IV, paragraph B.
4. Cover the serrations on the worm shaft with an assembly thimble or a single layer of cellophane tape. Lightly coat remaining portion of worm shaft with oil. Re-check the position of the seal ring (8) in upper cover (7) and seal ring (8) and seal ring (19A) in adaptor (20). Carefully install the upper cover (7) over the worm shaft, noting that the adjusting screw (9) passes through the valve assembly (18) and engages the adaptor (20).
5. Assemble four bolts (7A) and washers (7B) and tighten bolts to specified torque.
6. Assemble nut (25A) by placing mandrel (TL1913, Detail 69) against bottom end of worm shaft and carefully rotate to engage worm groove on shaft.
7. Assemble washer (26), new seal (27), new seal cup (28) with counterbore side toward seal (27), back-up washer (29) and retaining washer (30) on worm shaft.



Figure HF64-7

(See Figure HF64-5) Compress parts previously assembled and install retaining ring (31). Use care to insure that retaining ring is completely seated in the groove and has entered the recessed area of retaining washer (30).

- Carefully rotate the nut (25A) for its full travel, checking for bind and insuring that all balls are in the correct recirculating path.

D. RACK PISTON ASSEMBLY

- Using a soft-faced vise, clamp the rack piston (35) in a horizontal position with the teeth facing up. Carefully inspect the bores and outer ground surfaces for damage and stone off any burrs. Carefully expand piston ring (34) or (34A) and (34B), if applicable, and install in ring groove at the large end of rack piston.
- Note: Do not remove items (32), (32A) and (33) unless there is evidence of damage. If parts are removed, clean threaded hole in face of large end of rack piston (35) with clear, clean solvent and blow dry with clean dry air. Apply "Loquic" Grade "T" primer (allow to dry 10 minutes) insert new poppet (33) in the threaded hole. Apply "Loquic" grade "T" primer to the threads of the new poppet seat (32). (Allow to dry 10 minutes) apply "Stud Lock" to the new poppet seat threads and the threads of the rack piston. Assemble the new poppet seat and new lock washer (32A) and screw into threaded hole in the rack piston and torque to 20 ft. lbs. Bend lock washer tab as shown in figure HF64-7. (Allow "Stud Lock" 20 minutes to dry before adding oil to gear).
- Clean threaded hole on top of rack piston (35) with clear-clean solvent and blow dry with clean dry air. Apply "Loquic" grade "T" primer to threads and allow to dry 10 minutes. Coat seal cup (28) at end of worm shaft with clean grease and enter into rack piston bore. As the nut (25A) approaches the large bore, align the conical hole in the nut with the threaded locking screw (36) hole, slip into rack piston bore until about 1" of the nut (25A) is not engaged. (See figure HF64-2) remove the tape or clip from the ball nut (25A) and slip into the bore of rack piston (35). Clean threads of locking screw (36) and apply "Loquic" grade "T" primer to threads and allow to dry ten minutes. Apply "Loctite Hydraulic Sealant"



Figure HF64-8

to threads of locking screw. Assemble locking screw with new lock washer (36A) into rack piston and torque to 30-35 ft. lbs. Bend lock washer against one flat of hex. head on locking screw (See Figure HF64-8). Allow "Loctite Hydraulic sealant" 20 minutes to dry before adding oil to gear.

E. SECTOR SHAFT AND SIDE COVER ASSEMBLY

- Clamp the sector shaft (46) into a soft-faced vise by gripping the serrated end. Coat the expanded end of adjusting screw (45) with wheel bearing grease and insert into recess in end of sector shaft. Thread new retainer (44) into the sector shaft until adjusting screw (45) has no perceptible end play.
- Stake the retainer (44) into the two slots provided and again check freedom of adjusting screw movement.
- If vent plug (38B) is to be replaced, press in new vent plug flush.
- Assemble back-up washer (41), back-up washer (42), shaft seal assembly (43) and snap ring (43A) into side cover (38). Note: Shaft seal assembly has "oil side" molded in the face and must be visible after assembly.
- Coat the end of the gear shaft (46) with clean grease and insert the gear shaft in the side cover to the point of contact of the adjusting screw (45) and the inner cavity of the side cover (38). Using a screw driver, turn the adjusting screw (45) to engage the threads and rotate the screw until a firm stop is reached.

F. TRUNNION COVER ASSEMBLY

- Inspect trunnion cover (52) for damage and assemble back-up washer (42) and position shaft seal assembly (43) with the words "oil side" to be visible after assembly.

G. FINAL ASSEMBLY

- Clamp the housing (47) as before, to permit access to all bores. Assemble seal (21) and seal ring (19A) in the recesses provided in adaptor (20) using grease for retention.
- Insert rack piston (35) into the housing (47) and position teeth to be visible through the housing side cover opening. As the rack piston enters the lubricated bore, compress piston ring (34) or (34A) and urge into assembled position.
- Re-check the position of seal ring (19A) and seal ring (21) in the adaptor (20), align the oil transfer holes, and move the adaptor into contact with the housing.
- Assemble four bolts (20A) with washers (20B) thru adaptor (20) and tighten to specified torque.
- Coat seal ring (39) with clean grease and assemble into recessed groove provided in side cover (38).
- By observation thru the housing (47) side cover side opening, align the rack piston (identification mark on

SECTION III

centerline) and assemble side cover (38) and sector (46) into housing (47). Note the center of the sector shaft (46) must engage the center of the rack piston (35).

7. Assemble six bolts (38) and tighten to specified torque.
8. Adjust adjusting screw (45) in side cover (38) per section IV, paragraph C.
9. Cover the serrations on the sector shaft (46) with an assembly thimble or a single layer of cellophane tape. Coat the seal (51) with clean grease and place over retaining ring (50). Assemble the trunnion cover (52) over the lightly greased sector shaft (46). Care must be taken to insure that seal (51) is properly positioned over retaining ring (50).
10. Assemble four screws (52A) thru trunnion cover (52)

and tighten to specified torque. Before assembly of pitman arm (54), pack seal (53) with wheel bearing grease to inhibit water and install over trunnion cover (52).

H. FINAL CHECKS

1. After rotating the worm shaft thru its full travel for a minimum of five cycles, re-check the sector shaft adjustment. No rotational lash or bind of the sector shaft (46) in center position is permissible. (Reference Section IV, Paragraph C)
2. If the steering gear is properly assembled and adjusted, the input torque should not exceed 15 in. lbs. over full travel of 95° at the sector shaft.
3. Reverse torque applied to the gear shaft for full steering gear travel should not exceed 50 ft. lbs.

SECTION IV

WRENCH TORQUES AND ADJUSTMENT PROCEDURE
(Reference: Figure HF64-6)

A. WRENCH TORQUES

PART NAME	ITEM NO.	TORQUE
Nut (5/16 - 24)	6	15-20 Ft. Lbs.
Nut (1/2 - 20)	37	20-25 Ft. Lbs.
Nut (7/16 - 20)	49	20-25 Ft. Lbs.
Poppet Seat	32	25-30 Ft. Lbs.
Locking Screw	36	30-35 Ft. Lbs.
Screw (5/16 - 18 x 1")	52A	13-23 Ft. Lbs.
Bolt (9/16 - 18 x 1")	38A	45-55 Ft. Lbs. 150-170 Ft. Lbs.
Bolt (3/8 - 16 x 3 1/4)	7A	25-35 Ft. Lbs.
Pitman Arm Bolt Assembly	54A	{ Lubricated or Plated Bolts 300-320 Ft. Lbs. { Dry Unplated Bolts 380-420 Ft. Lbs.
Lock Washer and Nut	54B	475-500 Ft. Lbs.
Screw (1/2 - 13 x 1 1/2)	20A	70-80 Ft. Lbs.

B. ADJUSTMENT OF THRUST BEARINGS

(Reference Figure HF64-6)

1. Assemble per section III, paragraph C.
2. Tighten nut (11), noting that the thrust bearings (15) are located over the washers (16), until all components are "snug" and at a solid height. (Torque not to exceed 20 ft. lbs.) Back off the nut approximately 20° and bend one tang of washer (12) into a matching slot in nut (11).
3. Check for free rotation of valve assembly (18) on worm shaft assembly (25) and for perceptible end play. Note: The above assembly should rotate at 3 to 5 inch pounds.

C. ADJUSTMENT OF SECTOR SHAFT

(Steering Gear in Center of Travel)

(Reference Figure HF64-6)

1. Adjust adjusting screw (45) in side cover (38) to provide a 15-20 in. lbs. torque at the worm shaft as the steering gear is moved 90° each side of center. Back out the adjusting screw one turn and note torque required to move through 90° each side of center. Move adjusting screw in to provide a rise in torque of 2 to 4 in. lbs. at a point within 45° each side of center after nut (37) is locked to specified torque. Note: Input torque, of the completely assembled gear, minus hydraulic oil, should not exceed 15 inch pounds over full travel of 95° at the sector shaft.

D. ADJUSTMENT OF PRESSURE RELIEF**ADJUSTING SCREWS**

(Reference Figure HF64-6)

1. Assemble adjusting screw (48) per section III, paragraph A.

2. Assemble adjusting screw (9) per section III, paragraph B.

3. Adjustment on Vehicle:

- 3.1 The purpose of this procedure is to set the poppet adjusting screws so that the poppet contacts the screw just before full wheel cut is attained. Then at full wheel cut (when steering against axle stops) the poppet should be fully tripped and pressure shown by a gage in the supply line should be between 350 and 900 PSI.
- 3.2 Adjustment procedure. Steer vehicle against axle stops in one direction of turn and note pressure on gage in supply line as wheel contacts axle stop. If this pressure reading is less than system relief pressure, back poppet adjusting screw out until the system is operating at relief pressure while steering against axle stops. Screw adjusting screw in until pressure on gage reads less than 900 PSI steering against axle stops. Lock adjusting screw in this position by tightening jam nut to specified torque. Repeat procedure for other direction of turn.
- 3.3 Caution: During the above procedure care must be taken not to operate the system at relief pressure for more than a few seconds at a time or damage to the system may result due to excessive heat generation.
- 3.4 The 900 PSI figure used above is valid only for recommended automatic transmission fluid at 130° F. and a flow rate of 4.5 GPM. Consult Ross Engineering if other conditions exist.

MAINTENANCE DATA

TROUBLE SHOOTING

Normal Noise

1. A "hissing" noise may be heard from the valve assembly when it is actuated during a steering maneuver.
2. Fluid being bypassed thru the poppets at full turn may cause noise.
3. Noise may be heard from the system relief valve when it is required to actuate.
4. Pump "growl" may be heard from some types of power steering pumps.

Abnormal Noise

1. If the power steering pump is belt driven, a "squealing" noise during steering may indicate that the belt(s) should be tightened or replaced.
2. A "clicking" noise heard when initiating a steering maneuver or when changing directions of turn may indicate that some component is loose and is shifting under load.
3. A change in the normal noise from the power steering pump may indicate that an excessive amount of air has been trapped in the fluid or that the fluid level is low.
4. Excess noise from the power steering pump may indicate that the hydraulic system has dirt, sludge or other impurities trapped or that the power steering pump is worn and defective.

Road Wander

1. Components in steering linkage such as ball sockets on drag link or axle arm loose or worn.
2. Tire pressure incorrect or unequal left to right.
3. Wheel bearings improperly adjusted or worn.
4. Steering gear mounting bolts loose on frame.
5. Front end alignment out of specification.
6. Steering gear center adjustment improperly adjusted (See page 16 for adjustment procedure).
7. Dry fifth wheel or poor finish on fifth wheel or trailer plate.

8. Steering geometry incorrect (pitman arm and/or axle arm ball position).
9. Sap joint in upper-column sticking or binding.
10. Thrust bearing adjustment nut (11) improperly adjusted.

No Recovery

1. Front end alignment incorrect.
2. Front end components binding.
3. Pump flow insufficient.
4. Tire pressure low.
5. Fifth wheel dry.
6. Control valve spool sticking.
7. Tight front axle spindles.
8. Steering column binding.

Shimmy

1. Front end alignment incorrect.
2. Air in hydraulic system.
3. Wheels out of balance.
4. Components in steering linkage such as ball sockets on drag link or axle arm loose or worn.
5. Badly worn or unevenly worn tires.
6. Wheel bearings improperly adjusted or worn.

External Oil Leakage

1. No external leakage is acceptable at steering gear.
2. Vent plug (38B) leaking at side cover indicates failure of shaft seal assembly (43) in side cover.
3. Finding location of leak may be difficult since oil may "run" away from leak and drip from a low point on the gear or chassis.

TROUBLE SHOOTING

Oversteer or Darting

1. Front end components binding.
2. Sector shaft adjustment too tight. (See page 16 for adjustment procedure.)
3. Valve assembly spool sticking.
4. Steering geometry incorrect (pitman arm and/or axle arm ball position).
5. Steering column binding.

High Steering Effort in One Direction

1. Vehicle overloaded.
2. Lower worm shaft seal (27) failure.
3. Auxiliary cylinder lines crossed.
4. Inadequate flow.
5. Inadequate pressure.
6. Steering column slip joint binding, allowing the control valve to shift in only one direction.
7. Thrust bearing adjustment nut (11) loose.
8. Hydraulic valve assembly adaptor seal (23) failure.

High Steering Effort in Both Directions

1. Vehicle overloaded.
2. Low flow or pressure from pump, may be due to loose drive belt(s), sticky flow control or relief valve, or high internal leakage in pump.
3. Components of steering system binding. High back pressure caused by clogged return line filter.
4. Restriction in return line, or too small return line.
5. Excessive internal leakage in steering gear.
6. Low hydraulic fluid level.

7. Valve assembly spool sticking.
8. Low tire pressure.
9. Restriction in supply line or supply line too small.
10. Slip joint in upper column sticking or binding.

Lost Motion at Steering Wheel

1. Loose ball socket connections or other linkage connections.
2. Loose steering gear adjustments – Side cover adjustment and/or worm adjustment.
3. Steering wheel loose on shaft.
4. Pitman arm loose on sector shaft.
5. Steering gear loose on frame.
6. Loose connections between steering column and steering gear.

Excessive Heat

1. An undersize replacement hose or line can cause excessive heat.
2. A restricted hose or line due to a kink or severe bend can cause excessive heat.
3. If poppets have not been adjusted properly to relieve pressure at ends of steering gear travel excessive heat may result.
4. If the hydraulic system fluid becomes overheated it can cause the seals in the steering gear to dry out and lose their sealing ability.
5. If the hydraulic system fluid has been overheated it will have a rancid odor.
6. The internal parts of the steering gear may show some discoloration if the hydraulic system fluid has been highly overheated.

"TIPS" FOR MAINTENANCE OF STEERING GEAR SYSTEMS

1. Always check for wear in steering linkage and other system components first, before making adjustments to steering gear assembly.
2. Prevent internal bottoming of steering gear . . . Carefully check axle stops.
3. Make periodic checks of lube level for steering gear and components to prevent malfunction due to inadequate lubrication.
4. Make routine and/or periodic checks for proper front end alignment.
5. Maintain correctly inflated tires.
6. Always use a "puller", never use a torch or hammer to remove steering arms.
7. Always carefully examine all steering parts which have been subject to "impact" and replace any that are questionable.
8. Investigate immediately, and correct cause of any play, rattle, or shimmy in any part of the linkage or steering mechanism.
9. Remove cause of steering column misalignment, and if necessary elongate support bracket holes at dash.
10. Encourage all drivers to report any malfunction or accident that could have damaged the steering mechanism.
11. Do not attempt to weld any broken steering component. (Replace only with original equipment.)
12. Do not attempt to severely cold straighten any steering system part.
13. Do not attempt to hot straighten or bend any steering system part.
14. Always use new seals and "O" rings during repairs and overhauls.
15. Replacement of single bearing assemblies, or balls, if one or more make a "set" is not recommended.
16. Excessive heat will develop if any power steering gear is held in an extreme right or left turn longer than a few seconds. (Heat developed can damage seals and/or pump.)
17. Prevent dirt or foreign particles from entering hydraulic steering systems. (Always clean off around filler caps, before removing, to check oil supply.)
18. Use care to prevent even minor hydraulic leaks to continue.

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