Date 1-1-89

MC-9 MAINTENANCE MANUAL

SECTION 11
STEERING SYSTEM

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STEERING SYSTEM

The power steering system consists of the following components:

A. Vane-type Hydraulic Pump, Reservoir, Filter and Interconnecting Lines and Hoses
B. Steering Wheel and Column
C. HFB 70 Steering Gear
D. Steering Linkage consisting of a Pitman arm, drag link, steering arm and tie rod.

Steering action is transferred from the steering wheel and column directly to the HFB 70 steering gear. The Pitman arm on the steering gear moves the drag link to the axle steering arm in the proper direction. See figure 11-1.

Steering system and tire wear are affected by air suspension, brakes, wheel bearings, front suspension and front end alignment. These items are covered in their respective sections of this manual. Steering system specifications are given at the end of this section.

SYSTEM OPERATION

Power steering is accomplished by hydraulic pressure. Steering fluid is supplied by a vane-type hydraulic pump, mounted at the left rear of the engine. Hydraulic fluid lines (figure 11-2) are mounted from the power steering reservoir to the pump. Fluid displaced by the pump circulates through flexible lines to the power steering gear. A return line is connected from the steering gear back to the reservoir.

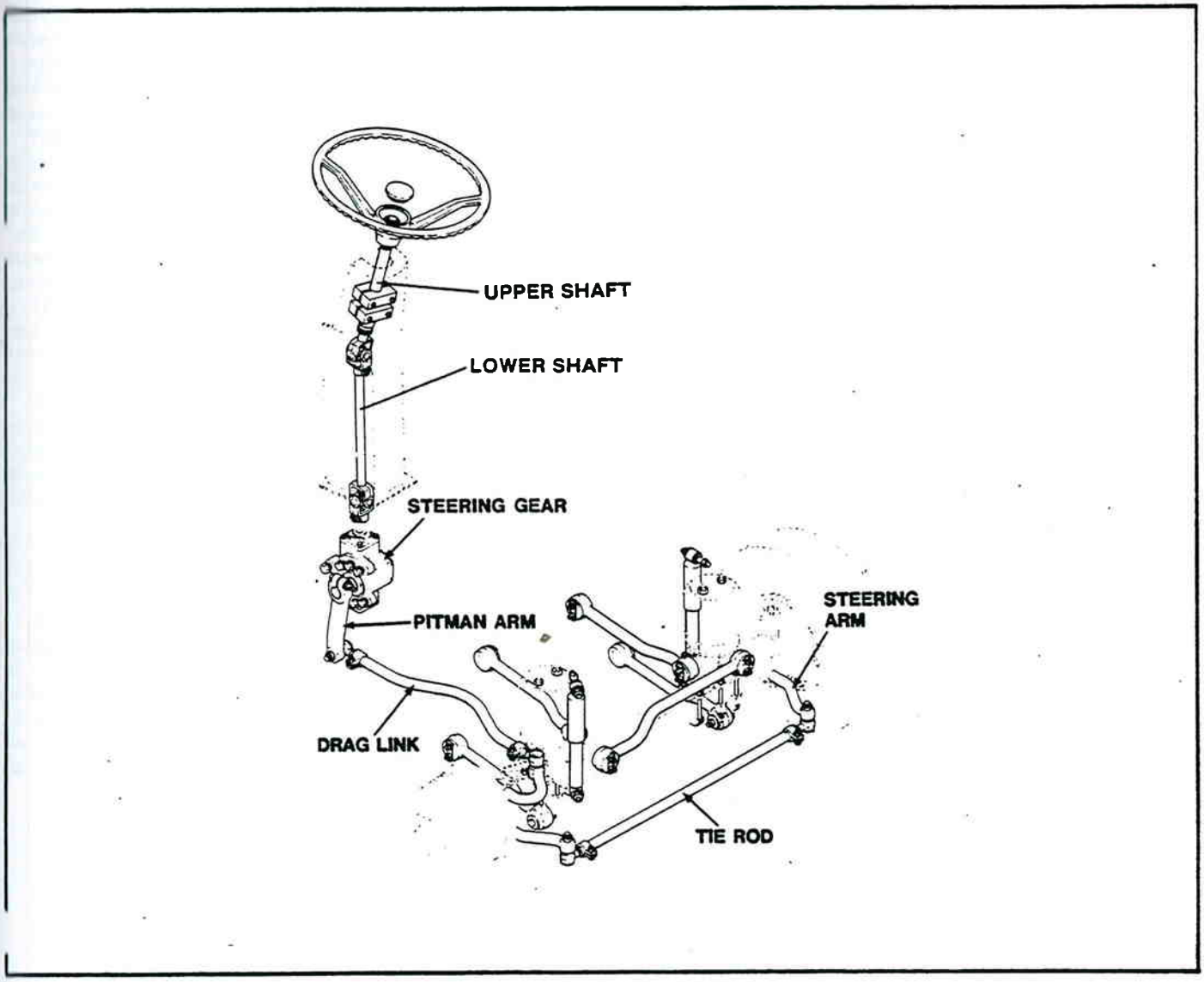

Figure 11-1 . Power Steering System.

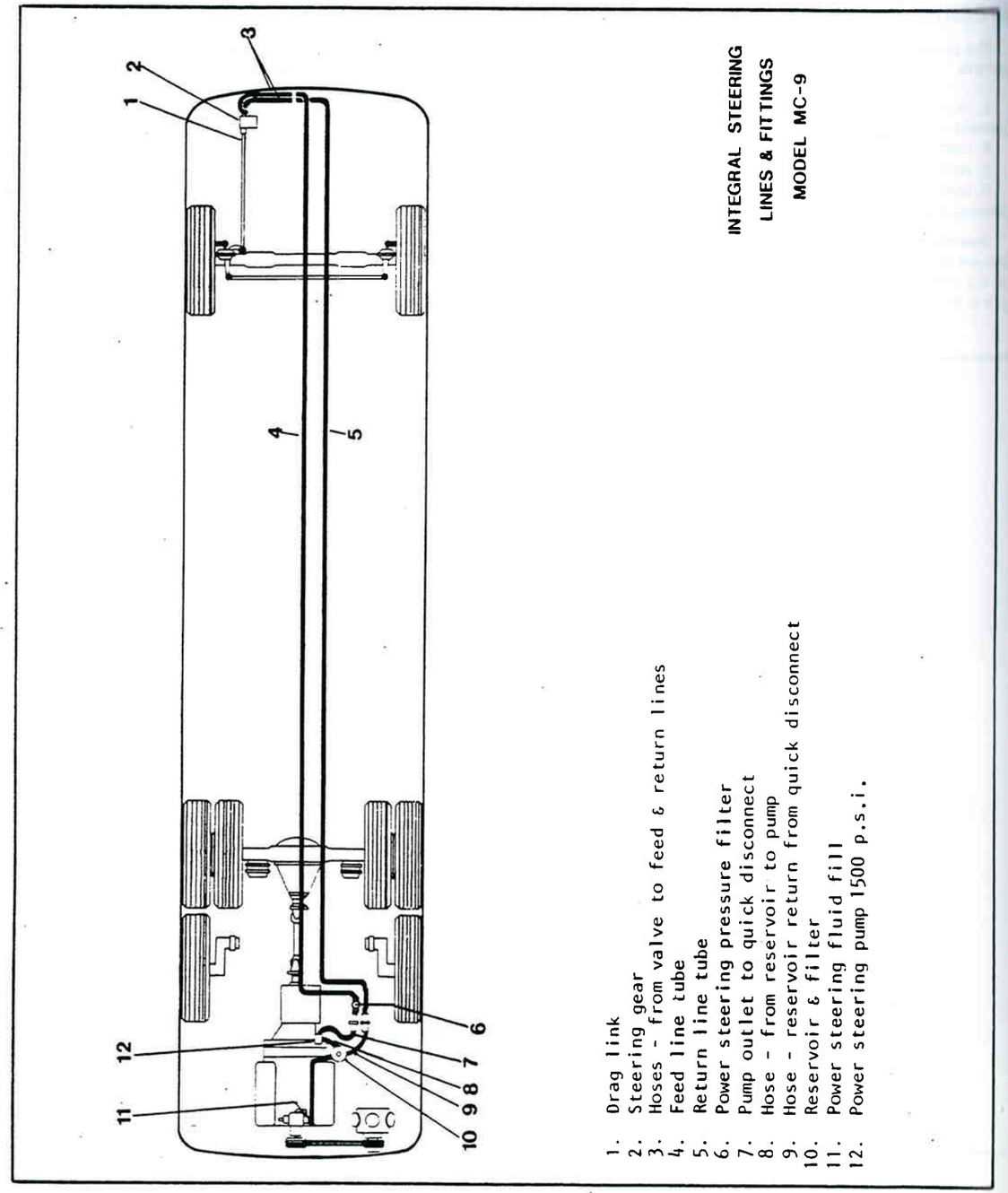

Figure 11-2. Steering Lines and Component Locations.

When the steering wheel is turned, the steering shaft turns the power steering gear actuating shaft. This motion, combined with hydraulic pressure supplied to the gear by the pump, provides the rotating action of the gear output shaft, which is connected to the Pitman arm.

The power steering hydraulic system has two filters to ensure that foreign matter does not enter the pump or the steering gear. A filter in the reservoir filters the steering fluid before it enters the pump and a supply line filter is used to filter the fluid before it enters the steering gear.

SYSTEM MAINTENANCE

The power steering system requires little maintenance. However, the system should be kept clean to ensure maximum operating performance and trouble free service. Periodic inspection should also be made to check for leaks.

At regular intervals, fluid level in the pump reservoir should be checked and fluid added when required. Refer to Power Steering Reservoir and Filter later in this section.

The fluid reservoir and filter assembly is mounted in the upper right corner of the engine compartment. When the slightest evidence of dirt, sludge or water is discovered in the system, disconnect fluid lines at the power steering gear. Drain, and refill the system with clean, recommended fluid. The power steering fluid reservoir filter should be serviced at regular lubrication intervals.

The power steering fluid line filter is in-line mounted. At regular lubrication intervals, the fluid filter element should be removed and replaced. Refer to Power Steering Filter later in this section for service instructions.

Air in the fluid system will cause spongy action and noisy operation. When any hose has been disconnected or when fluid has been lost for any reason, the system must be bled. Bleed the system as described under Bleeding Air From Power Steering System later in this section.

CAUTION: Do not operate the pump without fluid in the pump reservoir.

If the linkage between the steering gear and the front wheels is out of adjustment, bent, twisted or worn, the steering action of the coach will be seriously affected. Whenever any steering linkage parts are repaired, replaced or adjusted, steering geometry and front wheel alignment must be checked and necessary corrections made. Refer to Front Axle for front end alignment information (Section 1).

At regular lubrication intervals, the steering linkage should be thoroughly inspected for worn or loose components; Section 10, Lubrication.

After the coach has been operated continually, and high mileage figures have been reached, overhaul of the various steering units will be required.

General overhaul procedure normally requires removal and disassembly of the entire assembly, cleaning and inspection of all parts and final assembly. Careful inspection of all parts during overhaul is very important and must not be neglected.

REMOVAL OF STEERING COLUMN

1. Shut off the battery switch.

2. Remove steering wheel (refer to Removal of Steering Wheel). Replace the wheel nut on the shaft to avoid losing steering column components.

3. Disconnect the wire from the contact brush terminal located under the turn signal assembly on the left-hand side of the steering column.

4. Loosen the two allen head screws securing the turn signal assembly and remove it from the steering column.

5. Remove the four screws at both the lfloor and dashboard ends of the fiberglass cover.

6. Remove the six screws and the aluminum plate from the middle of the cover and remove the cover from the steering column.

7. Loosen the clamp connecting the steering column to the input shaft of the steering gear.

8. Remove the four bolts and the U-clamps that secure the steering column to the dashboard.

The steering column may now be lifted out of the coach as a complete unit.

INTEGRAL STEERING

DISASSEMBLY OF STEERING COLUMN

1. Remove the steering wheel nut (12).
2. Remove the spring (5), upper spacer (7), washer (8) and nylon bushing (9) from the top of the jacket tube (13).
3. Remove the contact brush (24) from the jacket tube. Slip the upper bearing (14) and jacket tube (13) off the upper wheel shaft. Ensure that the lower bearing remains on the wheel shaft.

1. Upper Shaft
2. Spacer Collar
3. Washer
4. Cup Washer
5. Spring
6. Lower Spacer
7. Upper Spacer
8. Spring Retainer Washer (2)
9. Nylon Bushing (2)
10. Contact Ring
11. Cable
12. Wheel Nut
13. Jacket Tube
14. Bearing (2)
15. Universal Joint Assembly
16. Universal Joint
17. Flexible Coupling
18. Lower Wheel Shaft
19. Button (2)
20. Pin
21. Bolt (2)
22. Lockwasher (2)
23. Rubber Seal
24. Clamp
25. Capscrew
26. Lockwasher
27. Nut
28. Nut
29. Lockwasher
30. Bolt
31. Screw (2)
32. Contact Brush
33. Fiberglass Cover
34. Lower Cover
35. Seal
36. Seal
37. Seal
38. U-Clamp (4)

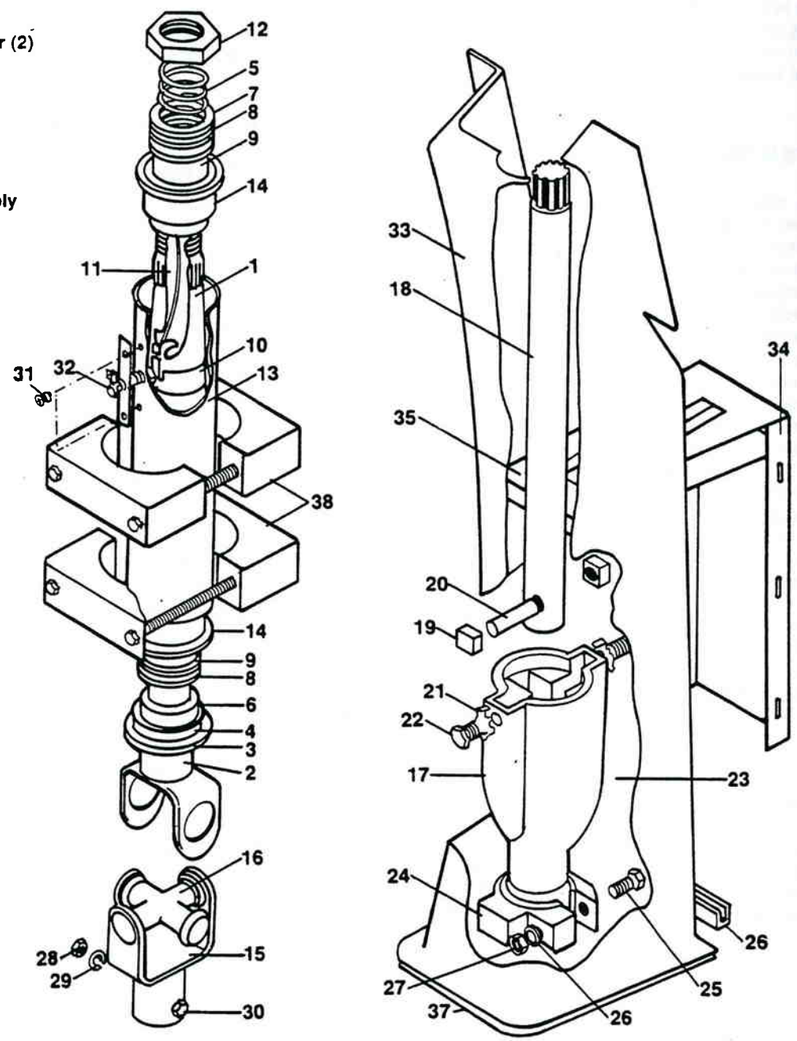

Figure 11-3. Steering Column Disassembled.

4. Unravel the tape on the contact ring (10). Disconnect the cable (11) from the contact ring and remove it from the wheel shaft.

5. Remove the nylon screw that secures the contact ring to the upper wheel shaft and remove the contact ring.

6. Remove the lower bearing (14), nylon bushing (9), washer (8), lower spacer (6), cup washer (4), flat washer (3), and spacer collar (2) from the wheel shaft.

7. Separate the upper wheel shaft (1) from the lower wheel shaft (18) by removing the nut (28), bolt (30), and lock washer (29) from the lower yoke of the universal joint (15).

8. Remove the two bolts (22) and lock washers (21) from the flexible coupling (17). The lower wheel shaft (18) may now be separated from the coupling, and the two buttons (19) and the pin (20) may be removed from the shaft.

This completes disassembly.

DISASSEMBLY OF BEARINGS

To disassemble the bearing remove the snap ring, retaining washer, and felt washer. Separate the bearing halves and remove the rolls.

CAUTION: The bearing contains 20 rolls. If any of the rolls are lost or damaged, the entire bearing must be replaced.

INSPECTION

Inspect the shaft splines, bearings, universal joint and all threads for unusual signs of wear or damage. Replace all parts not in good condition.

REASSEMBLY

Pack the bearings with clean grease and apply grease to the upper wheel shaft for the nylon bushings. Saturate the felt washers with No. 50 oil. Pack the bottom of the flexible coupling with 1 oz. (30 g) of heavy grease.

1. Insert the pin (20) into the hole on the lower wheel shaft (18) and attach one button (19) to either end of the pin.

2. Insert the shaft into the flexible coupling (17) and install lock washers (21) and bolts (22) onto the coupling. If new lock washers are used bend the large tang over the edge of the flexible coupling.

3. Assemble the upper wheel shaft (1) U-joint assembly onto the lower wheel shaft. Ensure ithat the cross in the lower yoke of the universal joint is parallel to the pin in the lower wheel shaft.

4. Tighten the bolt (30), lock washer (29) and nut (28) on the U-joint to 35 ft lbs. (47 Nm).

5. Assemble onto the upper wheel shaft the spacer collar (2), flat washer (3), cup washer (4), lower spacer (6), washer (8), nylon bushing (9) and lower bearing (14).

6. Install the contact ring (10) and connect the cable (11). Secure the cable to the contact ring with tape.

7. Slide the jacket tube (13) onto the wheel shaft (1) and install the contact brush (32).

8. Install the upper bearing (14), nylon bushing (9), washer (8), upper spacer (7) and spring (5) onto the jacket tube.

NOTE: When assembling bearings onto the jacket tube it may be necesasry to tap the top of the jacket with a rubber mallet.

INSTALLATION

1. Remove the two screws that secure the instrument panel and partially remove the panel to gain access to the U-clamp tapping plate.

2. Position the U-clamps around the jacket tube and align the tapping plate holes with the U-clamps. Thread the bolts into the tapping plate but do not tighten.

3. Lift the rubber cover off the flexible coupling and locate the hole beneath the bolt and lock washer. Insert a ¼" (6.35 mm) pin, or drill shank into the hole and lift up on the column assembly until it stops against the pin. Using vise grip pliers, clamp the lower shaft at the flexible coupling to hold the shaft in position against the pin.

4. Align and tighten the bolts on the U-clamps.

5. Slide the turn signal assembly over the steering column but do not secure.

6. Clean, degrease and apply "Locquic Primer T" to the column shaft threads and nut. Apply a film of "Loctite Stud Lock" to the shaft and nut. Mount the steering wheel in a straight ahead position and install the wheel nut using 50 ft. lbs. (68 Nm) of torque.

7. Remove vise grip pliers and pin.

8. Adjust and secure the turn signal assembly ensuring that it functions properly.

9. Install the contact brush wire on the left side of the steering column and connect the horn wires. Mount the steering wheel medallion ensuring that the logo is parallel and centered in the steering wheel cross member.

10. Install the instrument panel and lower steering column cover.

LUBRICATION

Grease the steering column U-joints at 5000 mile intervals using molybdenum disulphide grease. Remove steering column cover for access to grease fitting.

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HFB 70 INTEGRAL STEERING GEAR

The integral power steering gear incorporates a manual steering mechanism, a hydraulic control valve, and a hydraulic power cylinder. The control valve is a rotary type which directs oil flow from the engine driven power steering pump to either one of the cylinder cavities. The flow directed to a cylinder cavity is dependent upon the speed at which the steering wheel is turned. See figure 11-6.

Force on the steering wheel is transmitted to the steering gear input shaft. The input is connected to the worm shaft by means of a torsion bar. The torsion bar turns with the input shaft, exerting a rotational force on the worm shaft. The worm shaft in turn transmits the force through a ball nut mechanism to axial force on the rack piston. The rack piston resists this force due to its engagement to the sector shaft. With this resistance, the torsion bar is twisted by the input shaft. Pressurized fluid moves the rack piston axially through the cylinder bore and the rack piston then turns the sector shaft and steers the coach.

If the wheels receive a shock load, the shock force is transmitted through the sector shaft to the rack piston and on to the worm shaft. This force causes the control valve to send high pressure fluid to the proper cavity to resist the shock force. By hydraulically absorbing the shock, the steering gear prevents kickback at the steering wheel.

The steering gear is equipped with two unloading valves (poppets) at either end of the housing. As the steered wheels approach the axle stop, the corresponding poppet is opened. This reduces pressure in the gear and helps to reduce heat generated by the pump. The tripped poppet also reduces the load force on the steering linkage. These poppets may be adjusted by the adjusting screws on either end of the steering gear.

CENTERING STEERING

1. Center the steering gearbox by aligning the sector shaft timing mark (scribed line) at a 90 degree angle to the input shaft.

NOTE: The Pitman arm is installed on the sector shafts so the timing marks on the arm and shaft are aligned.

2. Adjust the drag link so that the wheels are straight ahead.
3. If necessary, remove the steering wheel and install it so that the cross pieces are at the 3 and 9 o'clock positions.

AXLE STOP ADJUSTMENT

1. Turn the wheels to the left until there is a minimum 1/16" (1.59 mm) clearance between the left steering arm and any possible contact surfaces.

2. Adjust axle stop screw to provide this clearance.

3. Turn the wheels to the right until there is a minimum 1/16" (1.59 mm) clearance between the right steering arm and any possible contact surfaces.

4. Adjust axle stop screw to provide this clearance.

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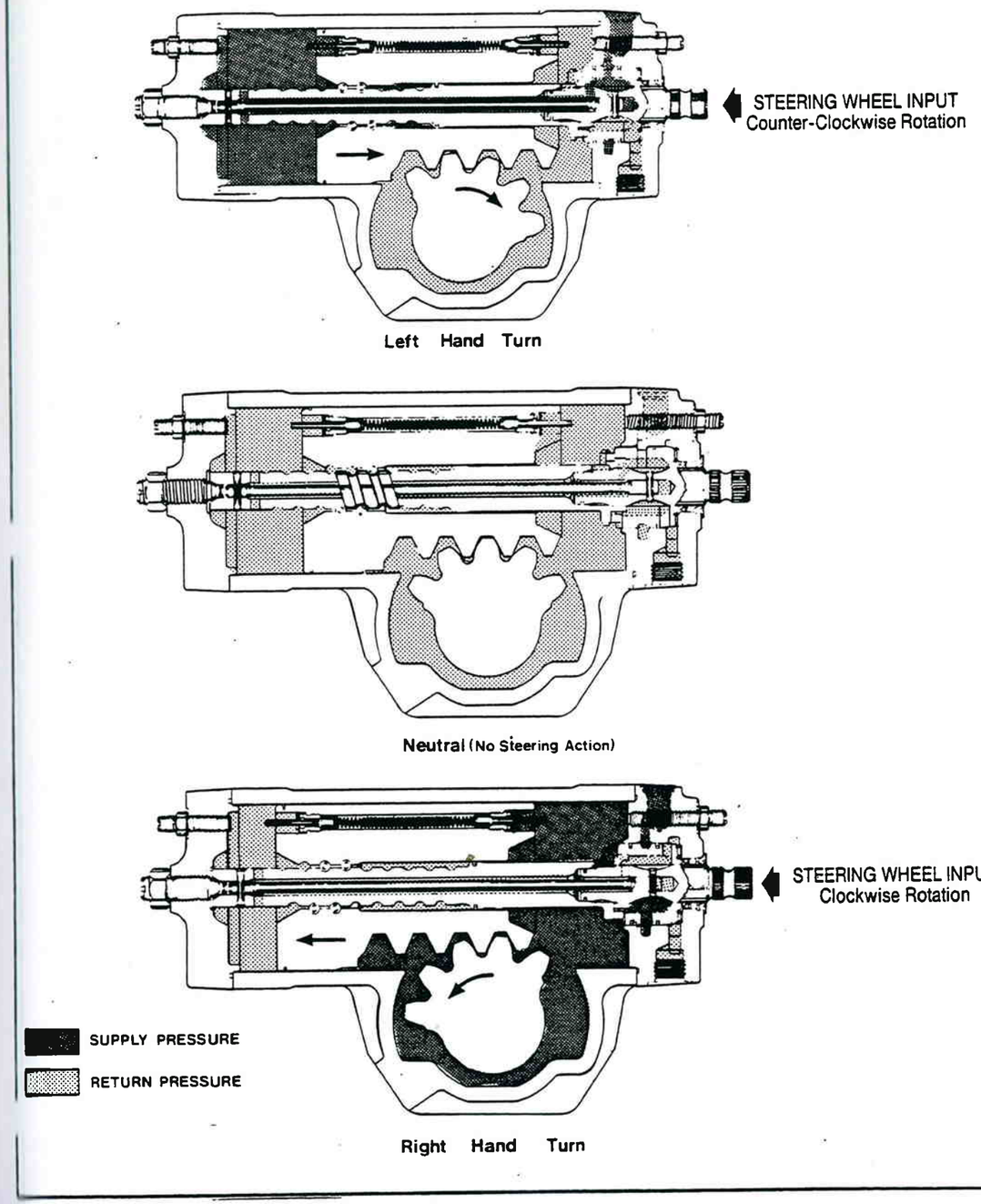


Figure 11-4. Steering Gear Oil Flow.

POPPET VALVE ADJUSTMENT

1. Before adjusting the poppet valves make sure the axle stops are properly set, and the front wheels are on the floor.

2. Back off the adjusting screw jam nuts and turn the screws all the way into the gearbox.

3. Start the engine and let it idle.

CAUTION: When relief pressure is reached, the gear will produce a hissing sound. This is normal. However, do not hold the gear in this position for longer than five seconds. To do so will damage the pump.

4. Back out the bottom adjusting screw until the gearbox allows the axle to turn to within ⅛" (3.175 mm) of the right hand axle stop.

5. Tighten the jam nut to 12-18 ft. lbs. (16.3-24.4 Nm) torque.

6. Repeat this procedure for the left hand turn using the adjusting screw at the top of the gearbox.

NOTE: While tightening the jam nut, make sure that the adjusting screw does not move.

7. Check the clearance at the right hand stop to ensure that it has not changed. If it has, readjust the poppet.

REMOVAL OF STEERING GEAR (96A3/102A3/102C3)

1. Remove the steering column. (Refer to Removal of Steering Column.)

2. Remove the pinch bolt on the Pitman arm.

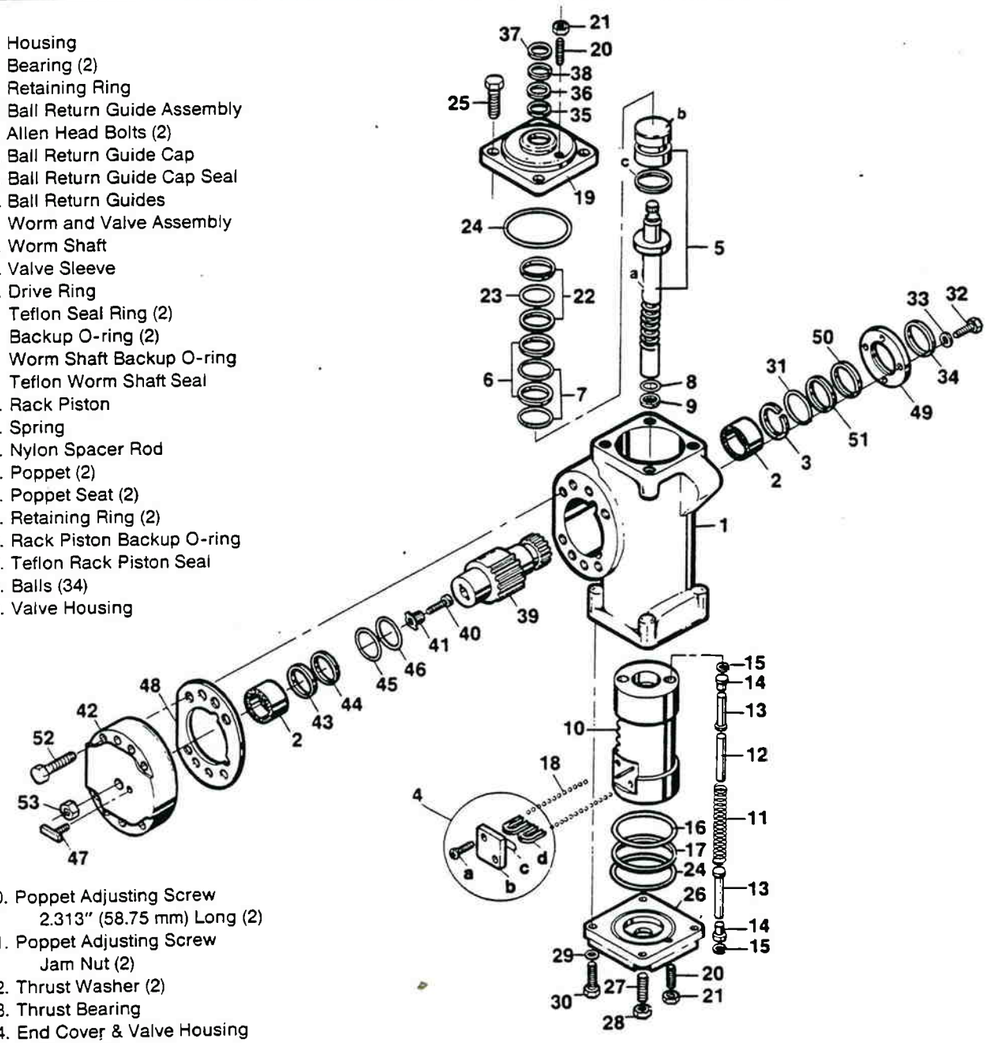
3. Drive a wedge into the groove at the top of the arm to loosen it from the sector shaft. Slide the Pitman arm off the shaft.

4. Clean the area around the fittings.

5. Disconnect the hoses and plug the holes to prevent contamination.

WARNING: The steering gear weighs approximately 110 lbs. (50 kg) dry. Before continuing with the removal procedure, support the gear to prevent it from falling from the frame after the mounting bolts have been removed.

6. Take out the bolts that mount the gear to the frame and carefully remove the gear.



1. Housing
2. Bearing (2)
3. Retaining Ring
4. Ball Return Guide Assembly
4a. Allen Head Bolts (2)
4b. Ball Return Guide Cap
4c. Ball Return Guide Cap Seal
4d. Ball Return Guides
5. Worm and Valve Assembly
5a. Worm Shaft
5b. Valve Sleeve
5c. Drive Ring
6. Teflon Seal Ring (2)
7. Backup O-ring (2)
8. Worm Shaft Backup O-ring
9. Teflon Worm Shaft Seal
10. Rack Piston
11. Spring
12. Nylon Spacer Rod
13. Poppet (2)
14. Poppet Seat (2)
15. Retaining Ring (2)
16. Rack Piston Backup O-ring
17. Teflon Rack Piston Seal
18. Balls (34)
19. Valve Housing
20. Poppet Adjusting Screw 2.313" (58.75 mm) Long (2)
21. Poppet Adjusting Screw Jam Nut (2)
22. Thrust Washer (2)
23. Thrust Bearing
24. End Cover & Valve Housing O-ring (2)
25. Valve Housing Bolts 2.125" (53.98 mm) Long (4)
26. End Cover
27. Worm Shaft Preload Adjusting Screw
28. Worm Shaft Preload Adjusting Screw Jam Nut
29. End Cover Washer (4)
30. End Cover Bolts 1.625" (41.275 mm) Long (4)
31. Trunnion Cover O-ring
32. Trunnion Cover Bolts (4)
33. Trunnion Cover Washers (4)
34. Dirt & Water Seal
35. Input Shaft Seal
36. Steel Backup Washer
37. Retaining Ring
38. Dirt & Water Seal
39. Sector Shaft
40. Sector Shaft Adjusting Screw
41. Retainer
42. Side Cover
43. Steel Backup Washer
44. Teflon Backup Washer
45. Side Cover Seal (Two Piece)
46. Retaining Ring
47. Vent Plug
48. Side Cover Gasket
49. Trunnion Cover
50. Teflon Backup Washer
51. Sector Shaft Seal (Two Piece)
52. Side Cover Bolts (8)
53. Sector Shaft Adjusting Screw Jam Nut

Figure 11-5. Steering Gear.

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DISASSEMBLY OF STEERING GEAR

Throughout the disassembly and assembly instructions, key numbers are called out to aid in parts identification. These numbers refer to the exploded view of the steering gear (figure 11-5).

1. Drain steering gear and clean the outer surface.

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

2. Position the steering gear in a vise with the worm shaft (5a) in a horizontal position.
3. Rotate the worm shaft to the end of the sector shaft (39) travel.
4. Position the timing mark on the sector shaft in a vertical direction (halfway between two capscrews). The steering gear is now in its center of travel.
5. Clean the serrated end of the sector shaft and loosen the jam nut (53) on the sector shaft adjusting screw (49) (figure 11-6).
6. Remove and discard the dirt and water seal (34) from the trunnion cover (49) (figure 11-7).

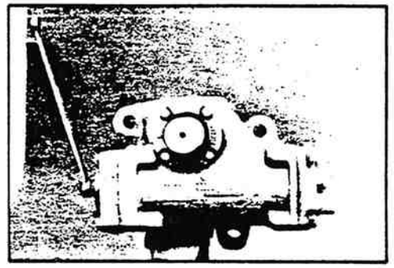

Figure 11-6. Loosening Sector Shaft From Nut.

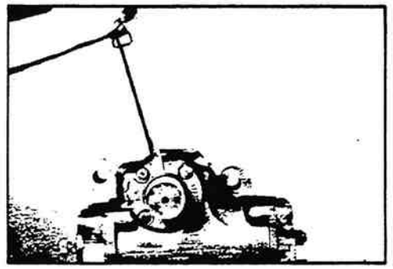

Figure 11-7. Removing Seal.

7. Remove the four bolts (32) from the trunnion cover with a ½ inch socket (figure 11-8).
8. Remove the trunnion cover (figure 11-10).
9. Turn the serrations and bolt groove of the sector shaft (figure 11-11).

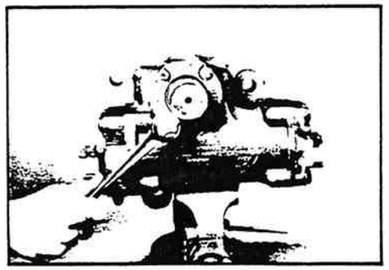

Figure 11-8. Bolt Removal.

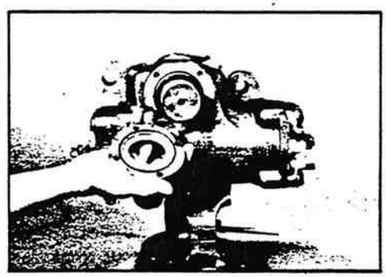

Figure 11-10. Trunnion Cover Removal.

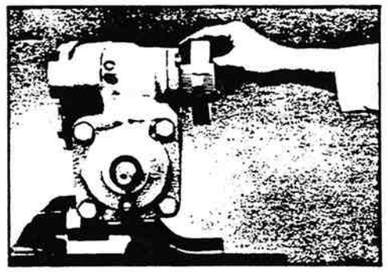

Figure 11-11. Applying Tape to Sector Shaft.

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10. Remove the eight special ring head bolts (52) from the side cover (42) with a 13/16 inch socket (figures 11-11 and 11-12). There will be some draining of fluid at this point.

NOTE: These eight bolts have a special sealing ring located on the underside of the bolt head. If it is necessary to replace any of these bolts, use only the same special type and length of bolts.

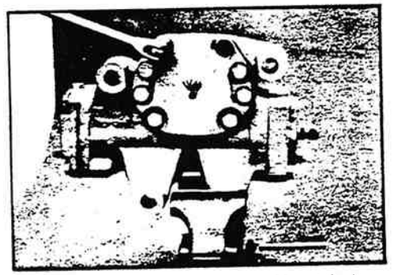

Figure 11-11. Removing Ring Head Bolts.

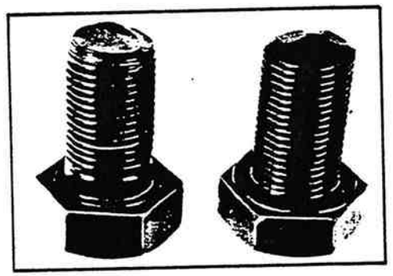

Figure 11-12. Ring Head Bolts.

11. Begin to remove the side cover (42) and sector shaft (39) assembly (figure 11-13) and stop when the bearing rollers are half exposed. A soft hammer may be needed to start the removal of the side cover sector shaft assembly.

NOTE: Exercise care in removing this assembly slowly. If the assembly is removed too quickly, it will be difficult to retain the bearing rollers in the race.

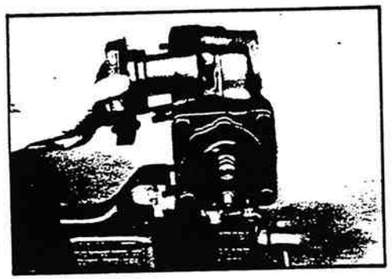

Figure 11-13. Sector Shaft Partial Removal.

12. When the rollers are half exposed, apply enough grease to retain them in the housing bearing (2) (figure 11-14).

CAUTION: If one or more of the bearing rollers is lost, it is necessary to replace the entire bearing.

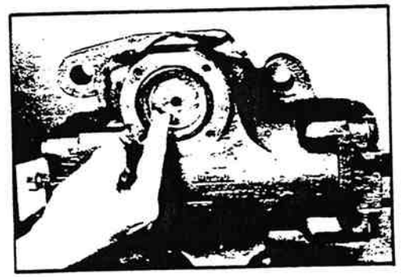

Figure 11-14. Apply Grease to Retain Bearing Rollers.

13. Complete removal of the side cover sector shaft assembly.

If the bearing is damaged, or it becomes necessary to replace the housing bearing (2), remove the bearing in the following manner: Using bearing mandrel J26743, apply pressure from the side cover opening and press the bearing out through the trunnion cover opening (figure 11-15). Care must be taken to maintain a good, square contact between the housing and press base to avoid damaging the bearing bore. If the bearing is cocked during removal, it may burnish the bore, causing it to become oversized and to require replacement of the steering gear housing.

CAUTION: The bearing may contain either 41 or 42 rollers, depending upon the type of bearing used. Bearing BR-970 has 41 rolls. Bearing BR-970-1 has 42 rolls. The bearing identification number is on the outside edge of bearing rollers inside the side cover with either 41 or 42 rollers. The quantity may not be the same as in the housing bearing. In any case, do not mix these rollers.

Figure 11-15. Removing Bearing.