Steer Axle
REPAIR MANUAL

Ford Power Components

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PART 8
STEERING AND FRONT AXLE

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PART 8
STEERING AND FRONT AXLE

Chapter 1
STEERING

A. STEERING — DESCRIPTION AND OPERATION

DESCRIPTION

The Ford 550/555 steering system is a hydraulic power assisted hydrostatic system. The major components are shown in Figure 1. The components are serviced separately and consist of steering column shaft, a steering motor, a power steering pump, the cylinders, a front axle assembly, and the hoses and tubes required to connect the system.

The system is "closed" that is, the hydraulic oil is stored in the power steering oil reservoir, is pumped through the steering system, and returned to the reservoir. The reservoir and the power steering pump are an integral unit.

STEERING COLUMN SHAFT

The steering wheel is secured to the steering column shaft, Figure 2. The steering column shaft is protected by a steel outer tube. The lower end of the shaft is coupled to the power steering motor input shaft by a coupler and 2 pins.

Two retaining rings hold the pins in the coupler. The power steering motor and steering column assembly are bolted to the power steering motor support.

POWER STEERING PUMP AND RESERVOIR

The integral power steering pump and reservoir, Figure 3, are mounted on the engine front cover plate on the left side of the engine, Figure 3. The pump and reservoir are connected to the steering motor by two tubes.

The gear type pump is driven anti clock-wise by the camshaft gear. The pump driven gear is half the diameter of the camshaft drive gear thus the pump is driven at engine speed. Pump capacity is 2.74 U.S. Gal. per minute (2.28 Imp. Gal. per minute) (10.4 liters per minute at 1000 rev/min. Pump pressure is 1550-1650 lbf/in^2 (106.86-113.75 bar.)

STEERING MOTOR

The hydrostatic steering motor, Figure 4 utilizes a linear control valve to control the direction of the steered wheels and a metering unit to control the rate of turn. in the event of pump failure the wheels can be turned manually with the metering unit functioning as a hydraulic pump.

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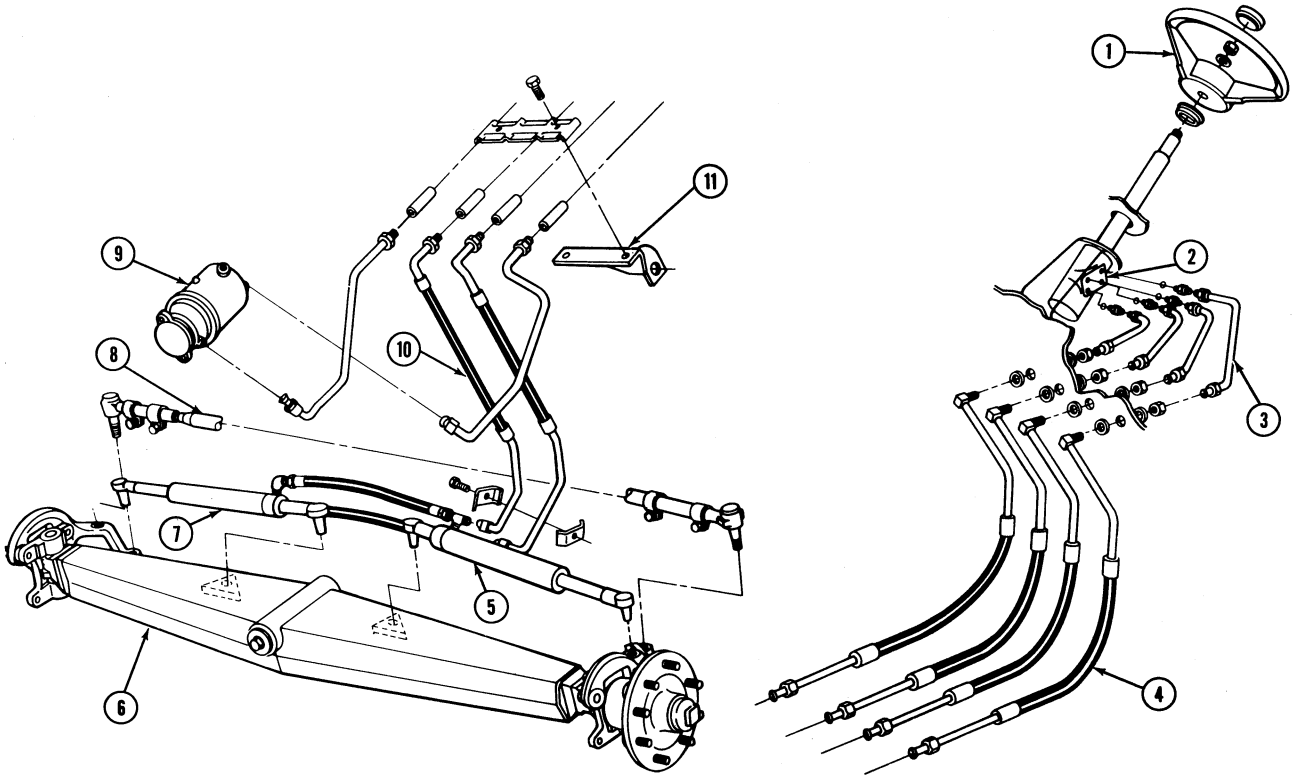

Figure 1
Steering System General Layout

1. Steering Wheel
2. Steering Motor
3. Steering Motor Tubes
4. Connecting Hoses
5. Left Hand Steering Cylinder
6. Front Axle
7. Right Hand Steering Cylinder
8. Connecting Rod
9. Pump Assembly
10. Cylinder Hoses
11. Clamp Assembly

CONTROL VALVE SECTION

The control valve section, Figure 5, directs the hydraulic oil to and from the metering unit, to and from the steering cylinders, and regulates the pressure of the oil flowing to the steering cylinders. The lower end of the input shaft is bored to receive the top of the torsion bar. The torsion bar is pinned to the input shaft, extends through the spool and is linked with the drive link in the metering system. The drive link is splined to and turns the rotor in the stator assembly. Thus, the torsion bar is the principal link between the input shaft and the metering system.

The lower end of the input shaft is splined to engage and drive the drive ring. The drive ring is externally splined to engage and drive the spool. The drive ring splines are wider than the input shaft splines allowing a pre-determined amount of free play. This provides a mechanical link between the shaft and spool for manual steering in event of pump failure, and limits the amount of twist on the torsion bar.

A helical groove is machined in the side of the input shaft. The actuating ball is held captive between the helical groove and a pocket inside the spool.

When the steering wheel is turned, the torsion bar is held stationary by the pressure of the oil. As the wheel is turned the torsion bar twists and the spool is moved up or down, uncovering oil ports leading to the metering system.

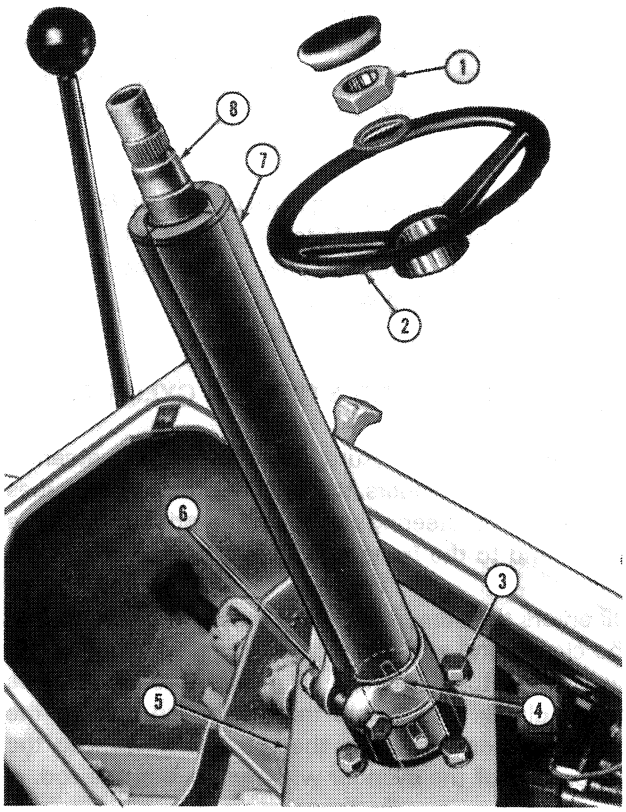

Figure 2
Steering Column Shaft

1. Steering Wheel Retaining Nut
2. Steering Wheel
3. Steering Motor Securing Bolts
4. Drive Pins
5. Steering Motor Support
6. Outer Tube Clamp
7. Outer Tube
8. Steering Column Shaft

METERING SYSTEM

The metering system, Figure 6, meters oil to the steering cylinders, thus maintaining the relationship between the steering wheel and the steered front wheels. In addition, the metering system acts as a manually operated hydraulic pump in the event the power steering pump fails.

As the spool moves up or down from the neutral, the pump supply flow to the return tube is restricted, causing the pump pressure to rise. At the same time the flow is directed to the metering rotor assembly through the manifold and commutator. From the metering rotor assembly the oil flows to one side of the steering cylinders. Return flow from the opposite side of the steering cylinders flows back to the return line.

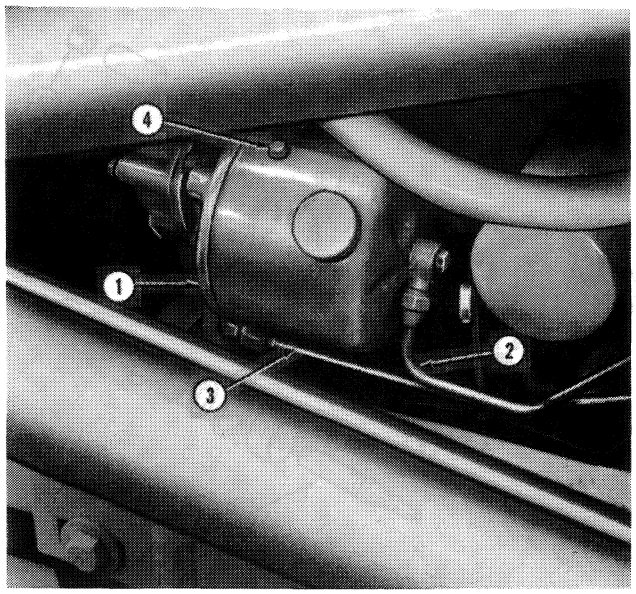

Figure 3
Steering Pump and Reservoir Installation

1. Reservoir
2. Inlet Tube — Low Pressure
3. Outlet Tube — Pressurized
4. Breather

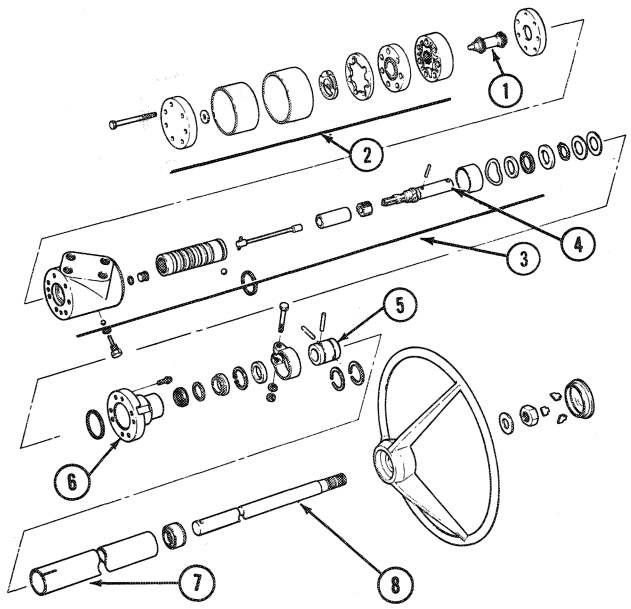

Figure 4
Steering Motor Assembly

1. Drive Link
2. Metering Valve
3. Linear Control Valve
4. Input Shaft
5. Coupling
6. Top Cover
7. Outer Tube
8. Steering Column Shaft

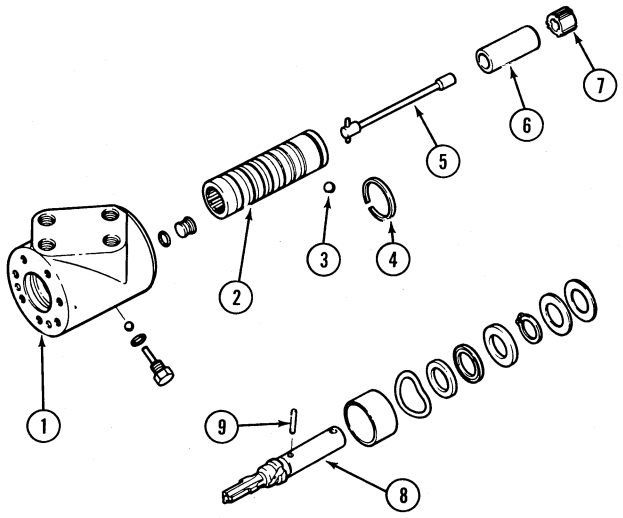

Figure 5
Steering Motor Control Valve Section

1. Steering Motor Housing
2. Spool
3. Actuating Ball
4. Retaining Ring
5. Torsion Bar
6. Spacer
7. Drive Ring
8. Input Shaft
9. Pin

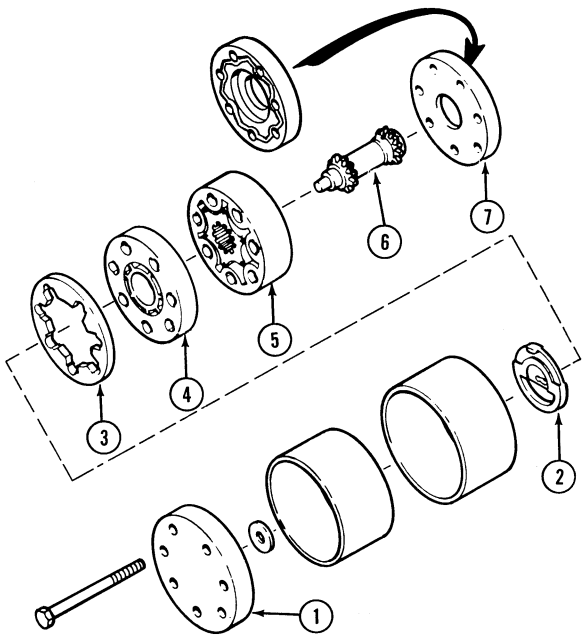

Figure 6
Steering Motor Metering Section

1. End Cover
2. Commutator
3. Commutator Ring
4. Manifold
5. Rotor and Stator Assembly
6. Drive Link
7. Spacer

Flow through the metering rotor assembly causes rotation of the rotor which is keyed to the spool by the drive link. Rotation of the spool causes the spool to react against a helix and thus move back toward neutral.

The rotation of the metering rotor provides a feed back that senses the amount of steering cylinder movement and matches it to the original displacement of the spool by the steering wheel.

HOSES, TUBES, AND STEERING CYLINDERS

Oil flows, under pressure, from the power steering motor to the cylinders through the hoses and tubes Figure 1. The steering cylinders are anchored at the piston end to the front wheel spindle arm.

Oil enters the steering cylinder outer tube Figure 7, at the closed end and is directed between the inner and outer tubes to the glands. Oil passes through notches in the glands and enters the piston rod area of the cylinder when retracting the rod. Oil flows into the piston end of the cylinder when extending the rod.

B. COMPONENT REMOVAL AND INSTALLATION

REMOVAL

1. Remove the brake pedals and the clutch pedal, Figure 8.
2. Remove the lower console cover, Figure 8.
3. On units equipped with power reversing transmissions loosen the reversing lever clamp lock bolt on the steering column, Figure 9.
4. Remove the instrument panel screws, Figure 9, and slide the panel up the steering column. This will provide access to the motor mounts and hydraulic fittings.
5. Remove the steering wheel hubcap, nut and washer (2), Figure 10. Then lift the steering wheel from the steering column.
6. Loosen the steering column shroud clamp (8), Figure 10 and slide the shroud up the steering column until the coupling (4) is exposed.

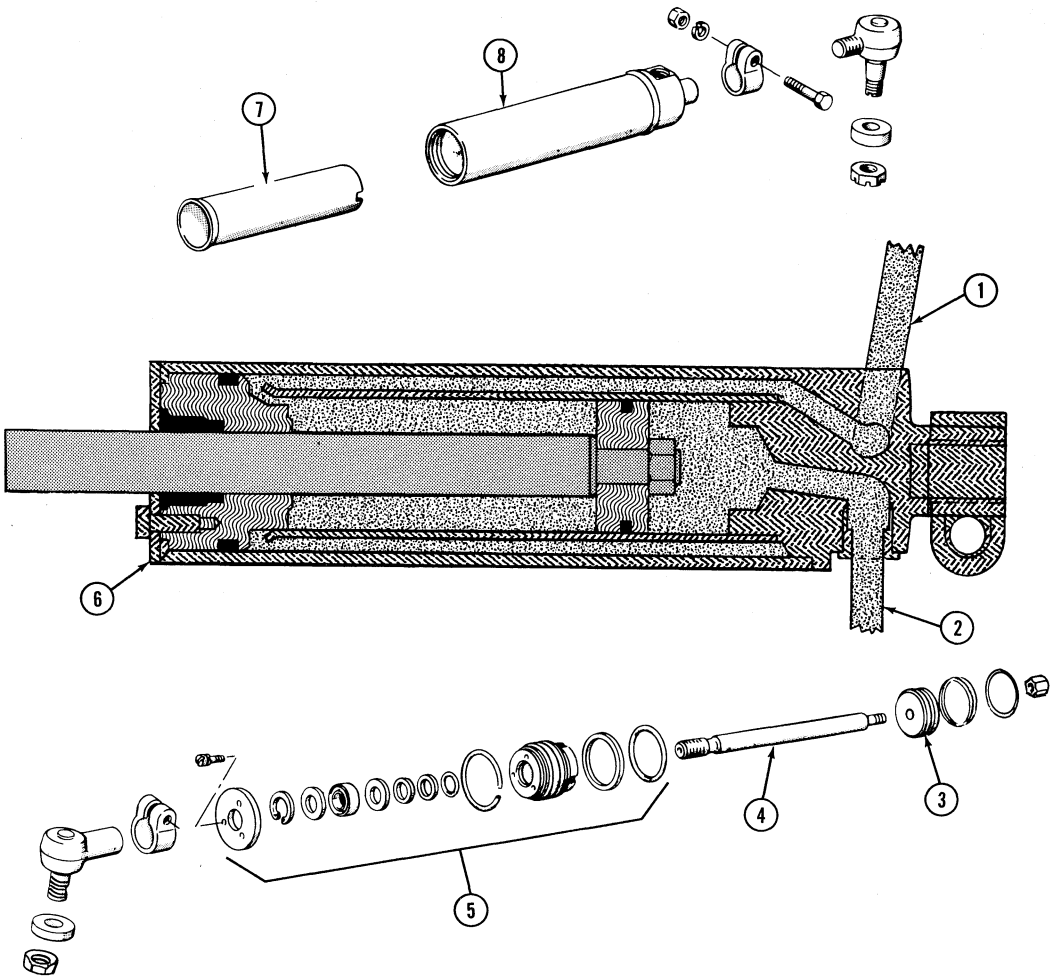

Figure 7
Steering Cylinder

1. Cylinder Rod End Port
2. Cylinder Piston End Port
3. Cylinder Piston
4. Cylinder Rod
5. Gland Assembly
6. Cylinder Cross Section
7. Cylinder Inner Tube
8. Cylinder Outer Tube

7. Remove the pin retainer and pin Figure 10, then remove the steering column from the steering motor.

8. Detach the hydraulic tube fittings, Figure 11, from the motor.

9. Remove the motor mounting bolts (5), Figure 10 and lower the motor from the mounting flange.

INSTALLATION

1. Position the motor in the mounting flange, Figure 10, and install the mounting bolts.

2. Attach the hydraulic fittings, Figure 11, to the motor.

3. Slide the steering column, Figure 10, and shroud into the reversing lever bracket where fitted until the coupling ring engages the motor shaft.

4. Replace the pin and pin retainer in the coupling ring, then position the shroud and tighten the shroud clamp.

5. Install the steering wheel, Figure 10, washer and nut. Torque the nut to the torque specified in Chapter 3. Press the hubcap into position.

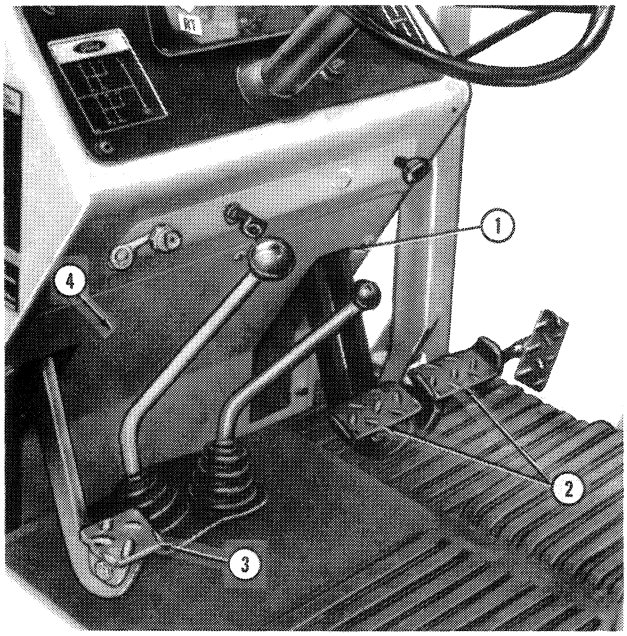

Figure 8
Lower Console
(Manual Reversing Transmission)

1. Lower Console Retaining Screw
2. Brake Pedals
3. Clutch Pedal
4. Lower Console Cover

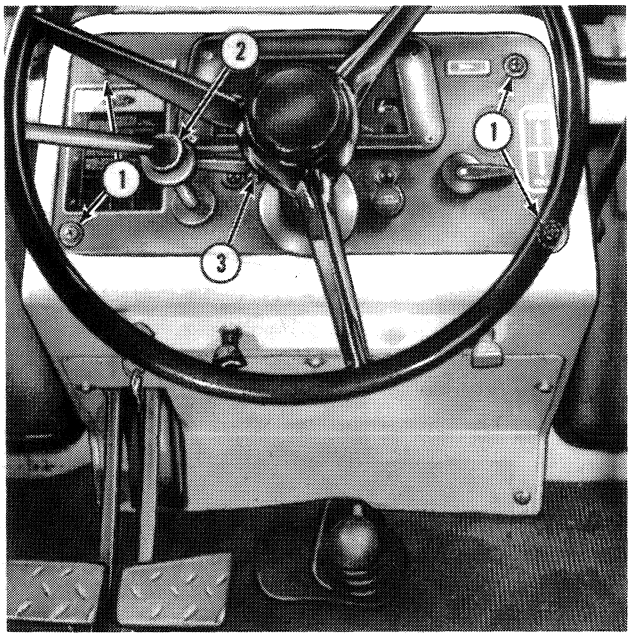

Figure 9
Reversing Lever Clamp and Instrument Panel Screws

1. Instrument Panel Screws
2. Reversing Lever
3. Reversing Lever Clamp Lock Bolt

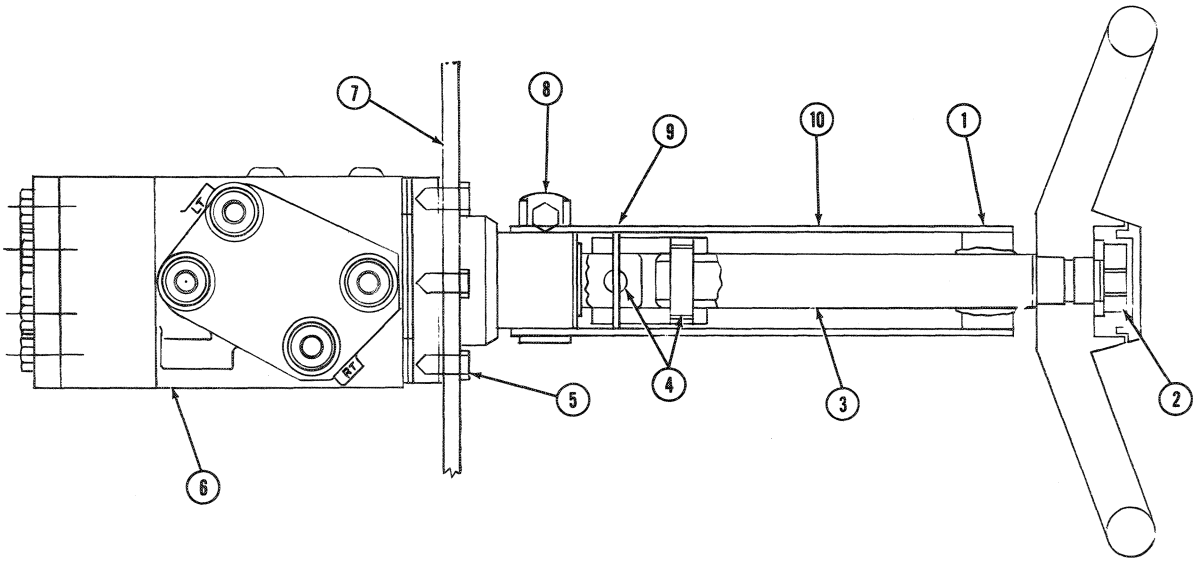

Figure 10
Steering Column

1. Steering Column Shroud Bushing
2. Steering Wheel Retaining Nut and Washer
3. Steering Column
4. Coupling Pins
5. Steering Motor Securing Bolt
6. Steering Motor
7. Steering Motor Support
8. Steering Column Shroud Clamp
9. Coupling Pin Retainer
10. Steering Column Shroud

6. Start the engine and cycle the steering from stop to stop several times to purge the system of air.

7. Stop the engine and check the steering system reservoir oil level and fill as necessary. Repeat step 6 above and recheck oil level.

8. Check the hydraulic fittings at the steering motor for leaks, tighten as necessary and install the lower console cover, Figure 8.

9. Install the brake and clutch pedals, Figure 8.

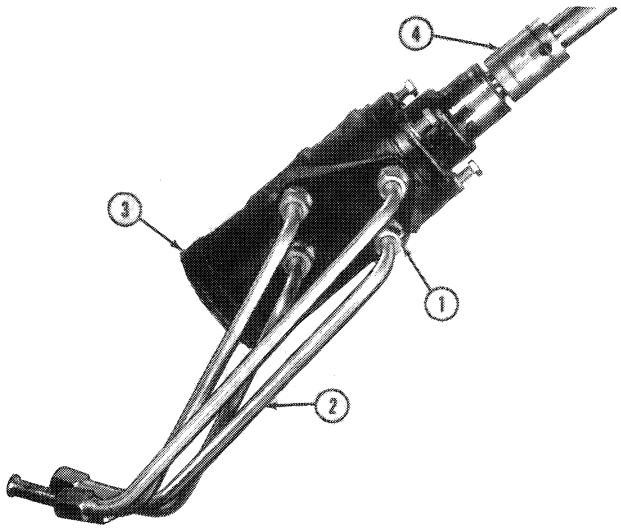

Figure 11
Steering Motor Tubes
1. Tube Connectors
2. Tubes
3. Steering Motor
4. Steering Column Shafts Coupling

POWER STEERING PUMP AND RESERVOIR

1. Disconnect the two hydraulic tubes at the pump and reservoir, Figure 12.

2. Remove the two attaching bolts (5) and lift the pump and reservoir assembly from the unit.

3. Remove the pump to engine O-ring seal.

INSTALLATION

1. Using a new O-ring seal, position the pump and reservoir assembly on the front cover and install the retaining bolts. Torque the bolts to the torque specified — see Chapter 3.

2. Attach the two hydraulic tubes to their respective ports.

3. Fill the reservoir with Ford M2C41-A oil. Start the engine and cycle the steering from lock to lock several times to purge the system of air.

4. Check the oil level. Refill as required.

5. Check the hydraulic fittings for leaks.

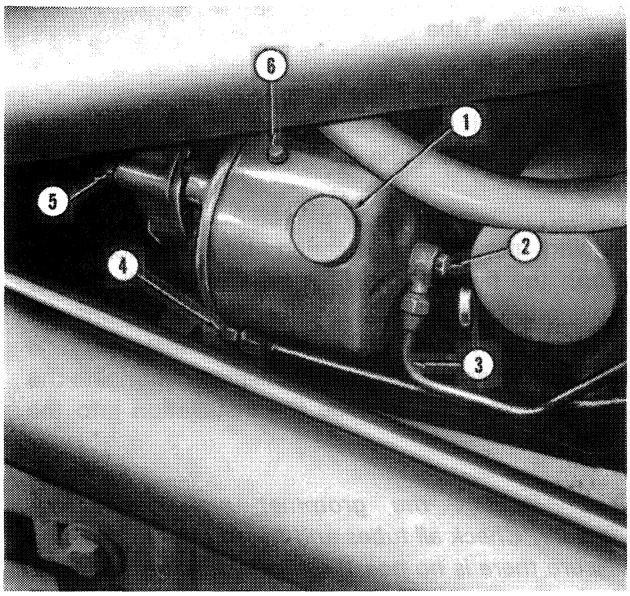

Figure 12
Steering Pump and Reservoir Installation
1. Reservoir Filler Cap
2. Reservoir Securing Bolt
3. Return Oil Tube
4. Pump Outlet Tube Connection
5. Pump Securing Bolts
6. Reservoir Breather

POWER STEERING TUBES AND HOSES

The power steering hoses and tubes are shown in Figure 13. Refer to Figure 13 for routing of hoses and tubes and location of clamps. Except for replacment of the tubes which pass through the firewall, no special procedures are required.

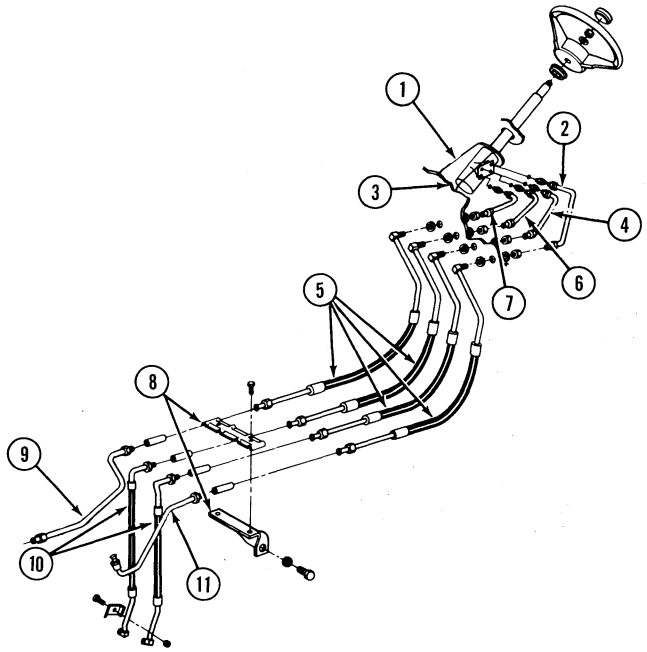

Figure 13
Power Steering System Tubes

1. Steering Motor Assembly
2. Return Tube
3. Front Panel
4. Left Turn Tube
5. Tube & Hose Assemblies
6. Right Turn Tube
7. Pressure Tube
8. Bracket Assembly
9. Pump Pressure Tube
10. Cylinder Hose & Tube Assemblies
11. Pump Return Tube

Servicing the power steering tubes which pass through the firewall can best be accomplished after removing the fuel tank as described in Part 10, Chapter 1, Engine Removal, while fuel tank installation is described in Part 10, Engine Installation. Lubricate the grommet with soap to ease the installation into the firewalls.

NOTE: *Inspect the grommet and replace as necessary. Check all tubes and hoses after installation to assure there is no possibility of chafing or rubbing.*

C. COMPONENT OVERHAUL

POWER STEERING MOTOR

Refer to Figure 14 for identification of parts during disassembly and assembly.

NOTE: *The spool and housing, the commutator and commutator ring, and the rotor and stator are selectively fitted and must be serviced as follows:*

- If the spool or housing must be replaced, replace the complete motor.
- If the commutator or commutator ring must be replaced, replace both as a matched set.
- If the rotor or stator must be replaced, replace the complete metering element.
- Replace the pin and end cover assembly if either the pin in the end cover or the end cover must be replaced.

DISASSEMBLY

Plug the four port holes and clean the exterior of the motor thoroughly. Then remove the plugs. Refer to Figure 14 for components.

1. To prevent distortion or damage to the unit if placed directly in a vise for disassembly, insert an O-ring tube fitting, with a tube nut or fitting cap attached into one of the four threaded ports in the housing. Clamp the fitting in a vise so the seven end cover bolts are upright, see Figure 15.

2. Unscrew the seven special bolts from the end cover, Figure 15.

   NOTE: *Use special care in the following steps to insure protection of the ground and lapped faces of the components. Avoid scratching or nicking the finished surfaces.*

3. Remove the end cover (2), Figure 14, by bumping it sideways with a soft hammer to loosen it from the seal and retainer, and lift it from the unit.

   NOTE: *The washer (3) and commutator (6), Figure 14, may be stuck to the end plate by an oil film, and may come off with the end plate. Do not attempt to remove the pin because it is a press fit in the plate and is not serviceable.*

4. Remove the rotor seal (4) and seal retainer (5), Figure 14, by bumping the retainer sideways with a soft hammer to loosen it from the valve body. Lift off the rotor seal and seal retainer. Discard the rotor seal.

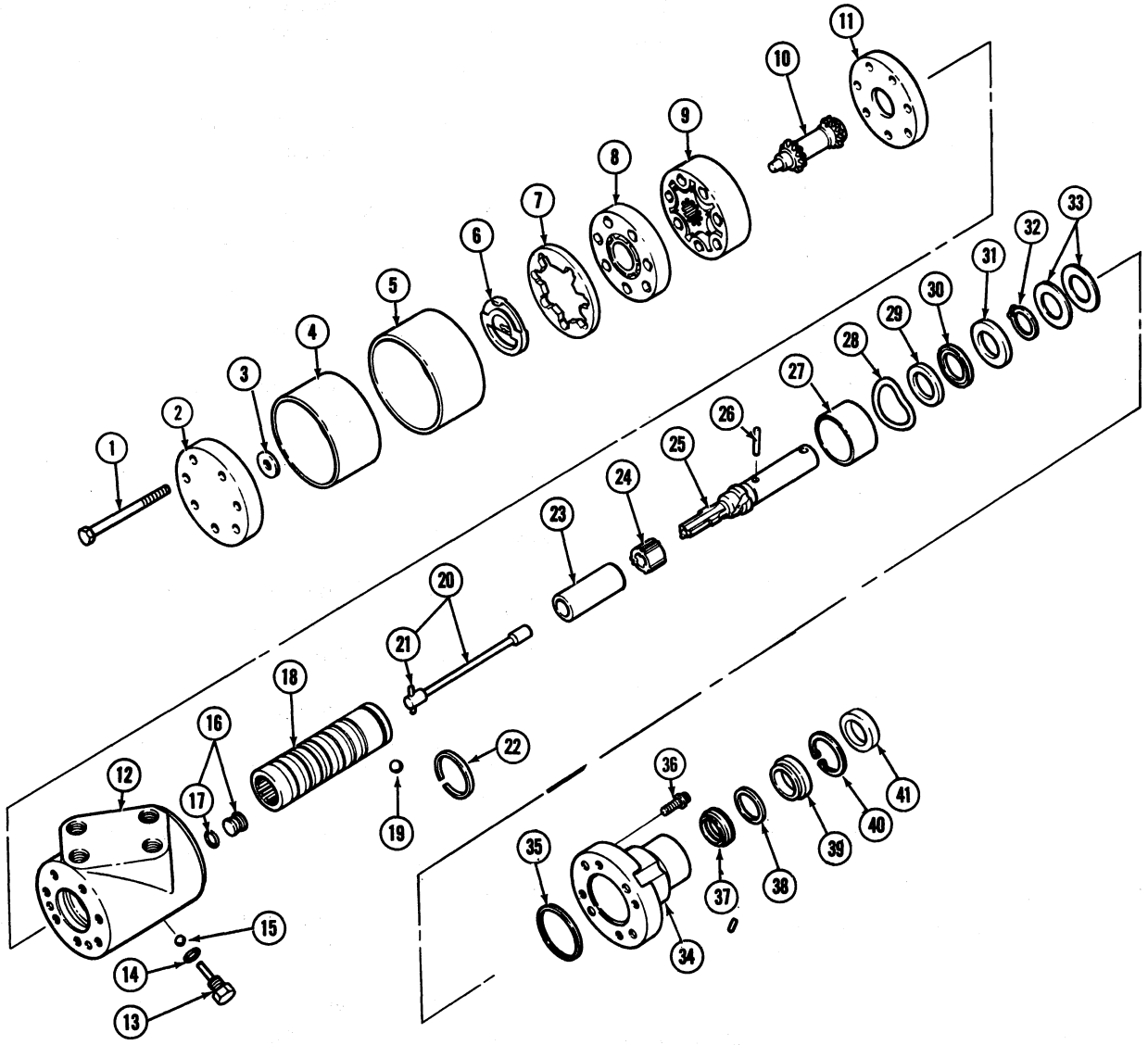

Figure 14
Steering Motor

1. Bolt
2. End Cover
3. Washer
4. Rotor Seal
5. Seal Retainer
6. Commutator
7. Commutator Ring
8. Manifold
9. Metering Element (Includes Stator, Rotor, Vanes and Vane Springs)
10. Drive Link
11. Spacer
12. Housing
13. Plug
14. O-Ring
15. Steel Ball
16. Plug and O-Ring
17. O-Ring
18. Valve Spool
19. Steel Ball
20. Torsion Bar
21. Pin
22. Spool (Ball Retainer) Spring
23. Spacer
24. Drive Ring
25. Input Shaft
26. Pin
27. Spacer
28. Spring Washer
29. Thrust Washer
30. Valve Thrust Bearing
31. Thrust Washer
32. Snap Ring
33. Shims
34. Upper Cover Assembly
35. Seal
36. Cover Screw
37. Packing Seal
38. Backup Washer
39. Seal Ring
40. Snap Ring
41. Dust Seal

5. Lift the washer (3) and commutator (6) from the end cover (2), Figure 14, if they are not stuck to the end plate.

6. Remove the commutator ring (7) from the manifold (8) with a sliding and lifting motion. Care should be used in the handling of this fragile component.

7. Remove the manifold (8) from the metering element (9) with a sliding and lifting motion.

8. Remove the metering element (1), Figure 16, spacer (2) and drive link (3) as an assembly by grasping the spacer and removing the assembly with a sliding and lifting motion.

9. Separate the drive link (3), Figure 16, by sliding the metering element (1) on the spacer (2), allowing the drive link teeth to clear the spacer hole. Remove the drive link and separate the metering element from the spacer. Use extreme caution to keep vanes and springs from falling out. When handling the metering component, pressure should be applied to the rotor by gripping the metering element between the fingers and pressing the rotor into contact with the stator, see Figure 17.

   NOTE: *The rotor and the stator must be kept in a matched set. Protect against damage to the side faces.*

10. Reverse the unit in the vise to place the input shaft in a vertical position. Using a center punch, mark the upper cover assembly and the port face of the housing (1) to facilitate reassembly, see Figure 18.

11. Remove the four special cap screws (36), Figure 14 with a 5/16" — 12 point socket.

12. Grasp the input shaft (25) and with a smooth upward motion, remove the input shaft, upper cover (34) and spool (18) assembly from the valve body (12), Figure 14.

    NOTE: *Avoid applying side forces to the spool which would cause binding of the closely fitted assembly. Never use excessive force to remove the spool from the body.*

13. Remove and discard the seal (35), Figure 14.

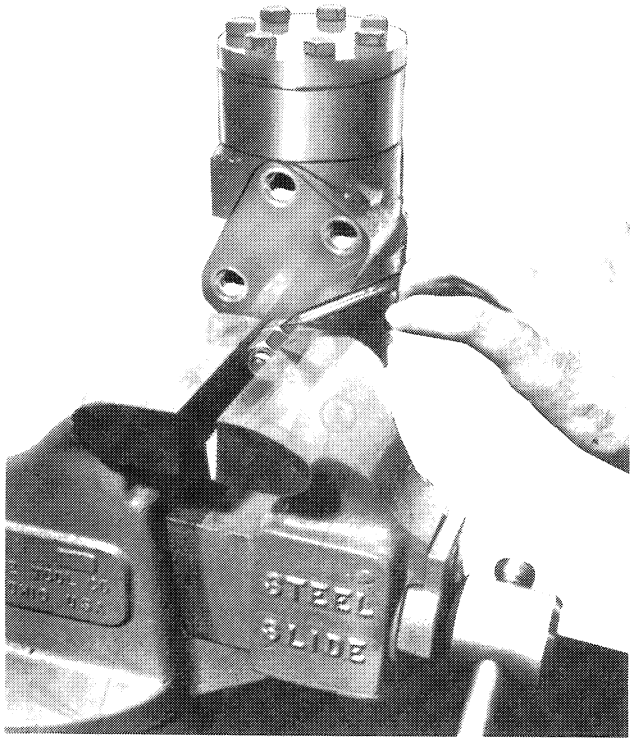

Figure 15
Power Steering Motor

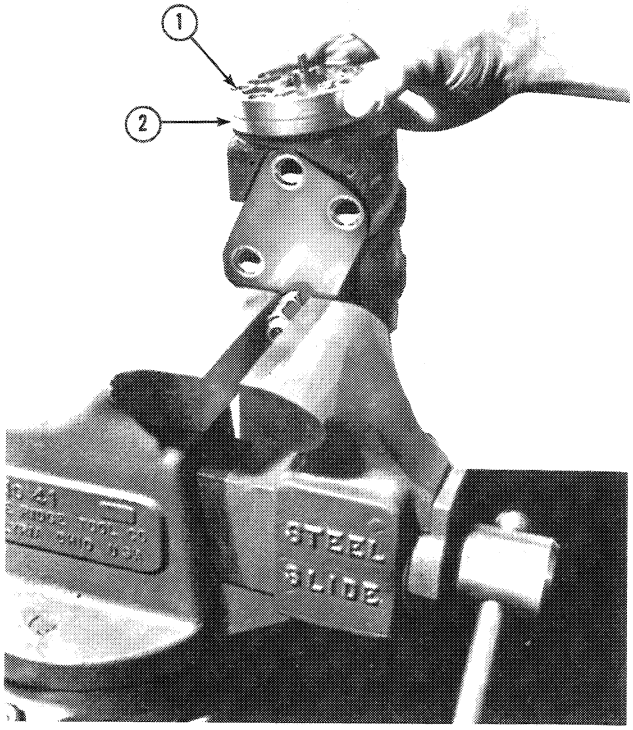

Figure 16
Power Steering Motor
1. Metering Element
2. Spacer

14. Remove the upper cover (34) with the shaft seal package (items 37 thru 40) intact. Remove the spacer (27), Figure 14.

15. Remove the shims (33) from either the upper cover (34) cavity or from the face of thrust washer (31), Figure 14. Count and record the number of shims to aid in reassembly of the unit.

16. Remove the snap ring (40), using snap ring pliers. Remove and discard the brass washer (38), and seal (37). Remove and retain the seal ring (39) and the snap ring (40) for later use.

17. Remove the snap ring (32), thrust washer (31), thrust bearing (30), thrust washer (29), and spring washer (28) from the input shaft (25), Figure 14.

18. Remove the pin (4), Figure 19, by using a 0.120 in. (3.00 mm) maximum diameter punch that is a minimum 0.625 in. (15.86 mm) long. The input shaft (5) should be placed on a block of wood (to avoid shaft damage) and the pin removed by impact, using light hammer blows.

19. Remove the torsion bar (2) and spacer (3), Figure 20, by inverting the spool assembly and allowing the parts to fall free. Do not remove the pin from the torsion bar.

20. Remove the drive ring (2), Figure 21, by placing the end of the spool (1) on a flat surface and rotate the input shaft full left and full right until the drive ring falls free.

21. With the spool assembly in the same position as in the step above, rotate the input shaft (25), Figure 14, in a clockwise direction until the steel ball (19), disengages from the helical groove in the input shaft. Lift out the input shaft.

    NOTE: *The steel ball may fall free; be careful not to lose it.*

22. Do not remove the ball retainer spring (22) unless replacement is required. If necessary to remove this spring, grasp the flattened end of the retainer spring with pliers and lift the flattened end over the shoulder on spool (18). Continue with a pulling motion to remove the retainer spring. A screw driver may be used to pry the spring over the shoulder of the spool. Use care to avoid scratching or nicking the spool outside diameter edges.

Figure 17
Metering Element

1. Metering Element

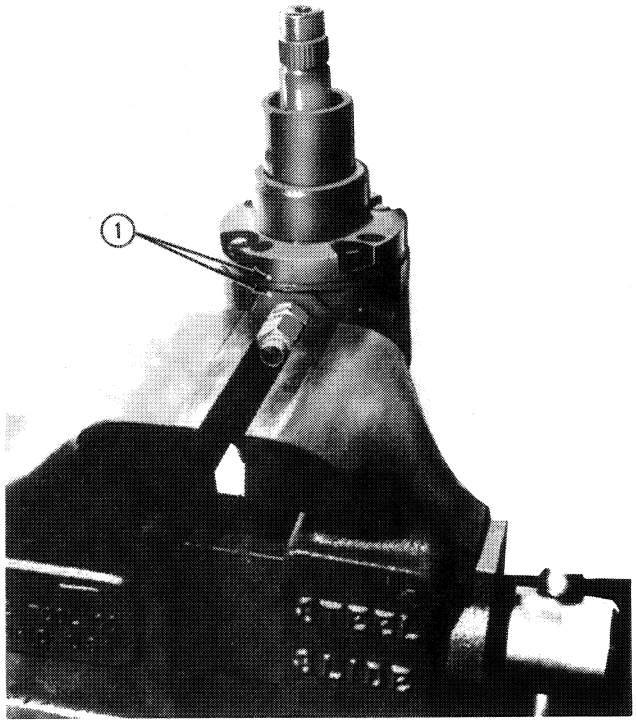

Figure 18
Steering Motor Input Shaft

1. Marks

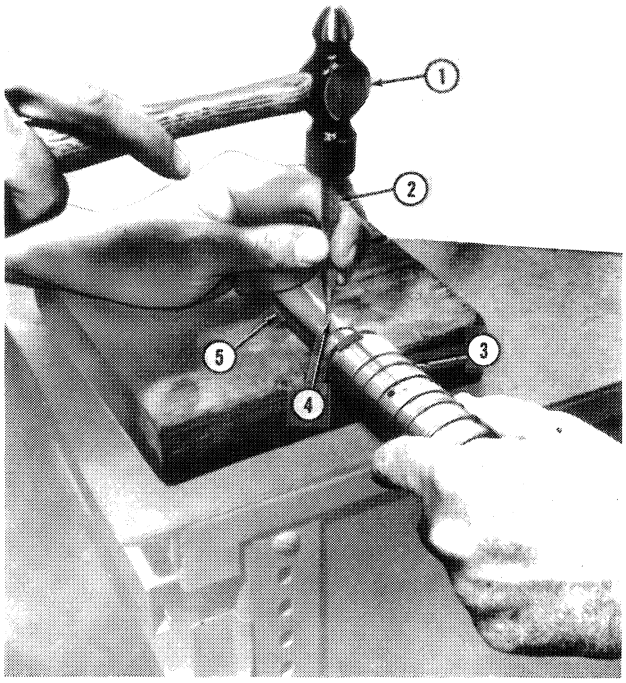

Figure 19
Steering Motor Input Shaft and Spool

1. Hammer
2. Punch
3. Spool
4. Pin
5. Input Shaft

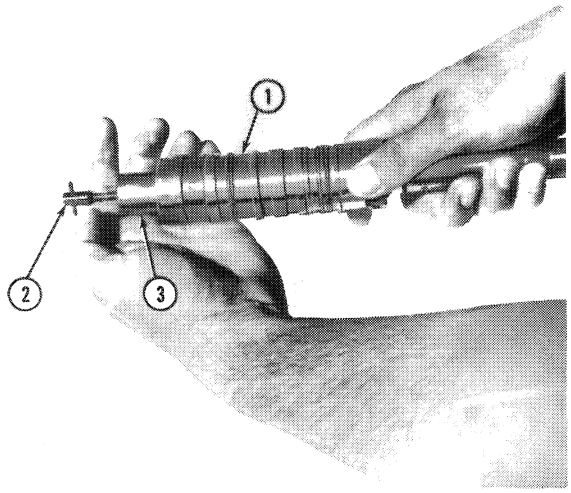

Figure 20
Torsion Bar and Spool

1. Spool
2. Torsion Bar
3. Spacer

23. Return to the housing (12), which is mounted in the vise, and remove the plug and roll pin assembly (13). A steel ball (15) is held in place by the plug and roll pin assembly and care must be used to avoid losing the ball. Remove the housing from the vise and shake the housing until the ball drops out. Discard the O-ring (14).

INSPECTION AND REPLACEMENT

Visually inspect all parts and replace those parts that are not in good condition. The following finished surfaces should be inspected for abnormal wear, scoring or damage, refer to Figure 14.

1. Housing (12) bore and ends.
2. Valve spool (18) outside diameter. Some acceptable burnishing due to use may be observed.
3. Valve spool (18) edges.
4. Valve spool (18) splines.
5. Input shaft (25) seal area. Check for rust, pitting and excessive wear. Acceptable light circumferential polishing due to seal contact may be observed.
6. Input shaft (25) helical groove. Note the contact pattern created by the actuator ball (19). Surface should be free from pits, chipping or surface breakdown.
7. Thrust bearing (30) and thrust washers (31) and (29). Inspect for pitting of rolls and faces of thrust washers.
8. Drive link (10) pin slot. Width of the slot must not vary over .001 in. (.0254 mm) at any point in its length.
9. Drive link teeth should not be excessively worn.
10. Torsion bar and pin assembly (20) and (21) difference in diameter of pin should not exceed .001 in. (.0254 mm).

    The following parts may show a normal polish pattern due to the rotor action and the circular motion of the commutator. The sides of these components are ground and lapped and should be free from nicks, burrs and scoring, refer to Figure 14.

1. Spacer (11).
2. Manifold (8).
3. Rotor (9).
4. Commutator (6).

   NOTE: *Thickness difference between commutator and commutator ring (7) must not exceed .0015 in. (.038 mm).*

5. End cover and pin assembly (2).

   The metering element requires special care while handling to avoid nicks and scratches. It is recommended that the rotor, stator, vanes and springs be checked while assembled. To inspect the metering element, place the assembly face down on the lapped face of the end cover (2) and check for freedom of rotor rotation within the stator, Figure 22. The action of the spring loaded vanes may be observed during rotation. The vanes should move freely in their slots without binding. Using a tapered blade feeler gauge (1), check the rotor (2) to stator (3) clearance as shown in Figure 23. If there is more than .006 in. (.15 mm) clearance, the metering element assembly must be replaced.

   Carefully lift the metering element assembly from the end cover and measure the thickness of the rotor and stator. Thickness difference between the rotor and stator must not exceed .002 in. (.05 mm).

   The internal splines in the rotor should not show abnormal wear or damage.

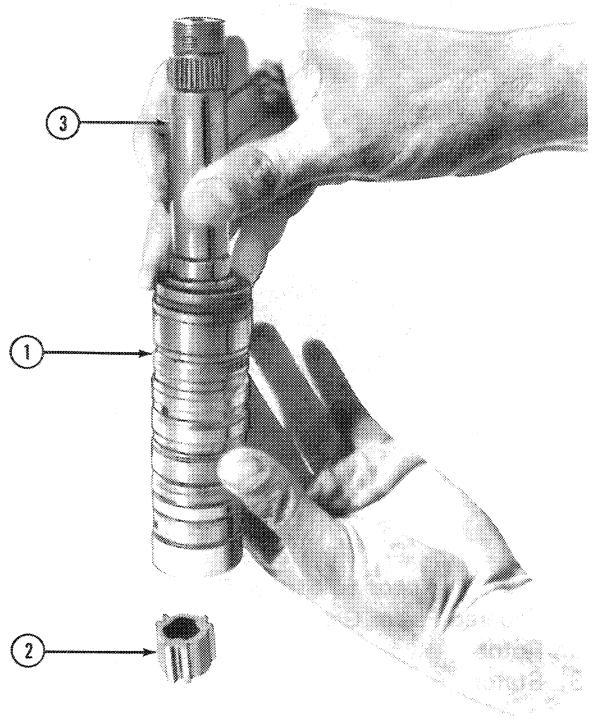

Figure 21
Removing Drive Ring From Spool
1. Spool
2. Drive Ring
3. Input Shaft

ASSEMBLY

IMPORTANT: *Before starting assembly, clean all parts with a petroleum base solvent and air dry. Do not wipe dry with rags. Unless otherwise stated, DO NOT oil parts before assembly.*

NOTE: *From 1980 on a heavier and wider spool ring was used on the hydrostatic valve spool.*

The new ring is not interchangeable with the old ring and can only be used with the new valve spool which has a 3/8" (9.53 mm) wide groove as shown in Figure 24.

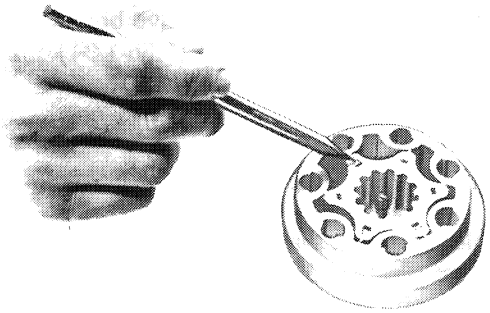

Figure 22
Metering Element

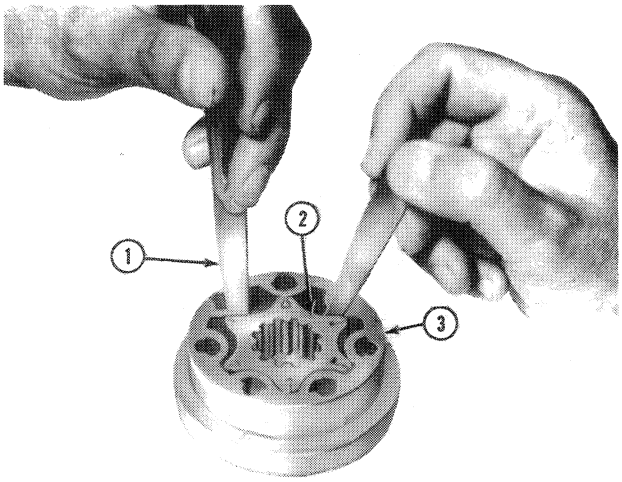

Figure 23
Rotor to Stator Check

1. Tapered Feeler Gauge
2. Rotor
3. Stator

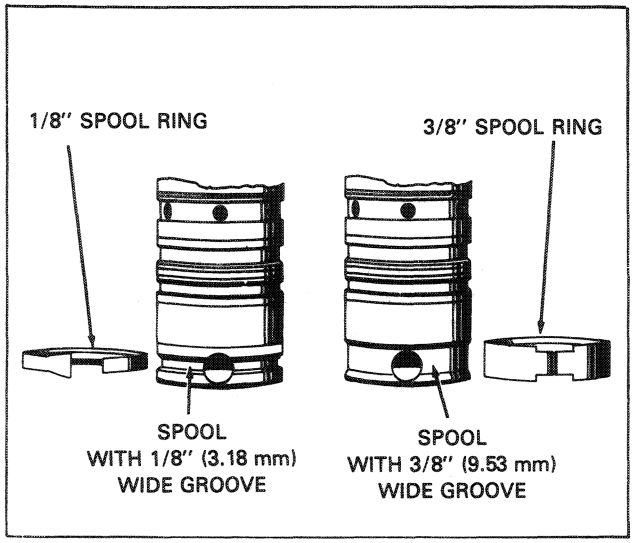

Figure 24
Spool Ring Identification

The new ring should be installed with the ends placed in the ball retaining hole as shown in Figure 25.

The old ring is retained for service on those motors which have a spool with a 1/8" (3.18 mm) wide groove.

1. Insert the ball (15) into its cavity in the housing (12), Figure 14.

2. Install a new O-Ring (14) on the plug and roll-pin assembly (13) and install in the valve body (12). Tighten the plug to 10-14 lbs. ft. (1.66-1.94 kgm) torque.

3. Reclamp the valve body in the vise as shown in Figure 15.

4. Assemble the thrust washer (29), thrust bearing (30), thrust washer (31), and snap ring (32) on the input shaft (25), Figure 14.

5. If the steel ball retaining spring (22) has been removed, install a new retaining spring.

6. Insert the steel ball (19) into the ball seat located inside the valve spool (18).

7. Assemble the spring washer (28) over the thrust washer (29) and thrust bearing (30). Insert the input shaft (25) into the spool, engaging the helix and ball with a counter-clockwise motion. This operation is best done while holding the spool in a horizontal position.

8. Using the mid-section of the torsion bar (3), Figure 26, as a gauge, insert the gauge between the spool end and the thrust washer (1).

9. Place the input shaft (25), Figure 14, and spool assembly (18), in a vertical position with the shaft end on a flat surface.

10. Insert the drive ring (24) into the spool (18) end by visually aligning an internal space on the drive ring with a tooth on the input shaft (25) spline, and allow the drive ring to drop to the limit of its travel. If the drive ring does not engage the input shaft spline, a slight rotation of the input shaft will allow the drive ring to become fully engaged. Remove the torsion bar.

11. Install the spacer (23) over the torsion bar and pin assembly (20) and insert the assembly into the spool end (18), Figure 14.

12. Align the cross-hole in the torsion bar (20) with the cross-hole in the input shaft (25) and insert the .120 in. (3.05 mm) diameter pin punch to maintain alignment.

13. Insert the pin (26) into the cross-hole in the input shaft (25); and while retracting the pin punch, engage the pin in the torsion bar (20) cross-hole.

14. Press pin (26) into the torsion bar (20), Figure 14 with a few light taps. Press the pin flush with the outside diameter of the input shaft using an 11/16 in. socket with 1/2 in. drive (1), Figure 27, to support the input shaft. With a few light taps on .120 in (2.94 mm) diameter pin punch, drive the pin approximately 1/32 in. (.81 mm) below the input shaft O.D.

15. Slip the spacer (27), Figure 14, over the spool and place the spool assembly into the body.

    NOTE: *Avoid applying side forces to the spool which would cause binding of the closely fitted assembly.*

16. **NOTE:** *If neither the input shaft (25) nor the upper cover are replaced, the original shims (33), Figure 14, may be reused. If the shims are damaged, replace with shims of the same thickness.*

    Place the shims on top of the thrust washer (31), Figure 14. Coat the seal (35) with clean grease and place in the upper cover (34) counterbore. Assemble the upper cover to the input shaft (25) and rotate to align the punch marks previously made during disassembly.

    - If a new upper cover is used, no angular orientation is required. However, it is necessary to align the upper cover and housing (12). Replace the screws finger tight and then use a pilot ring on a worm drive type hose clamp tightened around the upper cover flange and the body pilot diameter to achieve the required alignment, Figure 28. Tighten screws to 18-22 lbs. ft. (2.48-3.04 kgm) torque.

    - If either the input shaft (25) or upper cover (34), Figure 14, or both have been replaced, the following procedure for shimming between the housing and cover must be used to relocate the neutral position of the spool.

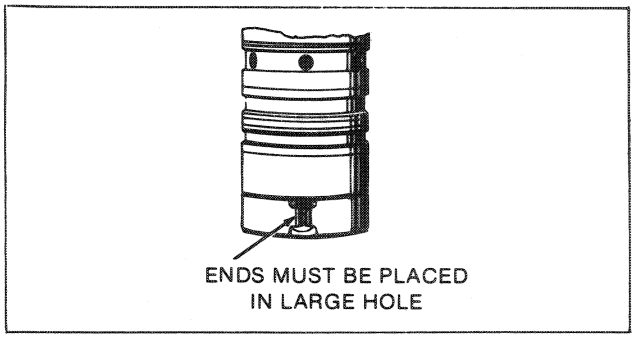

Figure 25
Spool Ring Identification

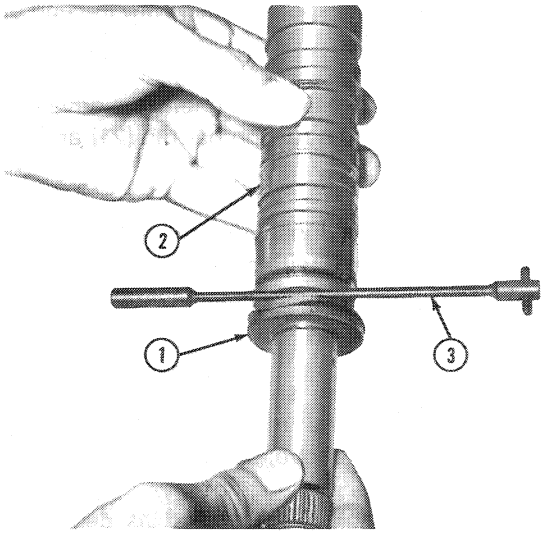

Figure 26
Using Torsion Bar As A Gauge

1. Thrust Washer
2. Spool
3. Torsion Bar

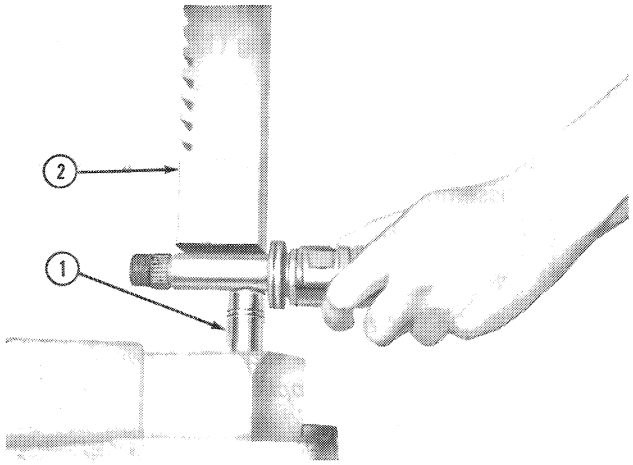

Figure 27
Pressing Pin Into Input Shaft

1. 1/2 in. Drive Socket
2. Press

a. Reassemble as above, using the required new parts.

b. After torquing the four screws (36), revolve the unit in the vise so the input shaft is pointing down.

c. To determine that the unit is shimmed correctly, the drive link (10) must be in its proper position. To do this, grasp the input shaft (25), pull down, and prevent rotation.

d. Engage the drive link splines in the spool (18) and rotate so the spool is flush with the end of the housing (12).

e. Remove the drive link and orient the drive link slot to engage the torsion bar pin (21) and insert the drive link.

f. Observe the relationship of the spool end to the body, if this is within .0025 in. (.0625 mm) of being flush, no additional shimming is required.

g. Add or remove shims (33) until these specifications are met, then repeat the assembly steps above, see Figure 29.

17. With the drive link (10) installed as described above, assemble two assembly posts into the housing (12) as shown in Figure 30. These assembly posts can be made by cutting the heads off two bolts similar to the special end cover bolts (1).

18. Assemble spacer plate (11) over the assembly posts and onto the housing (12) with plain side up, see Figure 30.

19. Install the metering element (9), Figure 14, over the assembly posts and onto the spacer plate (11).

NOTE: *One of the seven holes in the metering element may be smaller than the other six holes. Position this hole, if applicable, over one of the assembly posts, see Figure 31.*

IMPORTANT: *All vane springs must be down in their slots with no part of spring protruding out either side of metering element.*

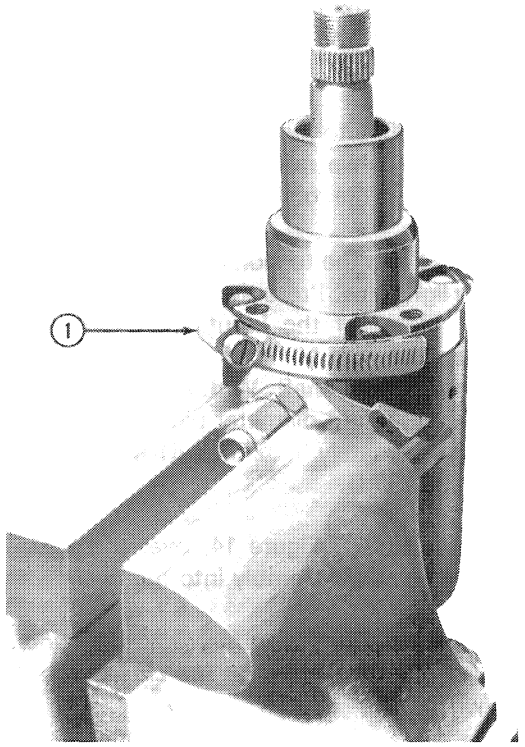

Figure 28
Steering Motor

1. Hose Clamp

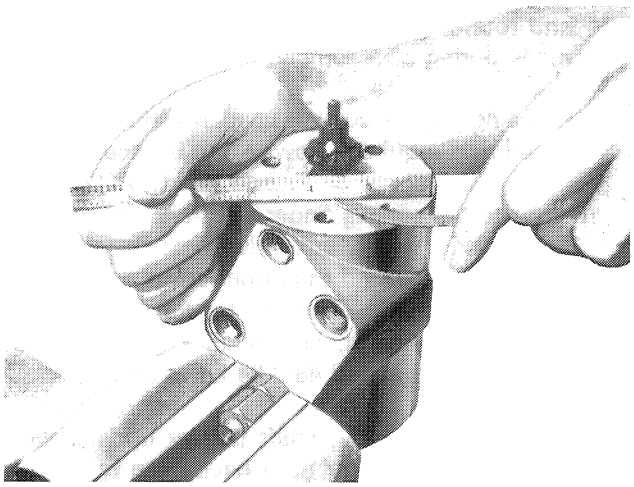

Figure 29
Shimming Final Assembly

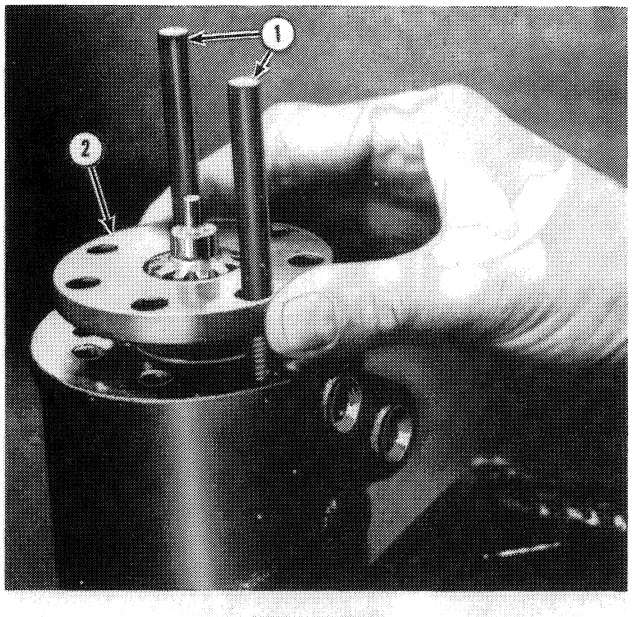

Figure 30
Plate Installation

1. Posts
2. Plate

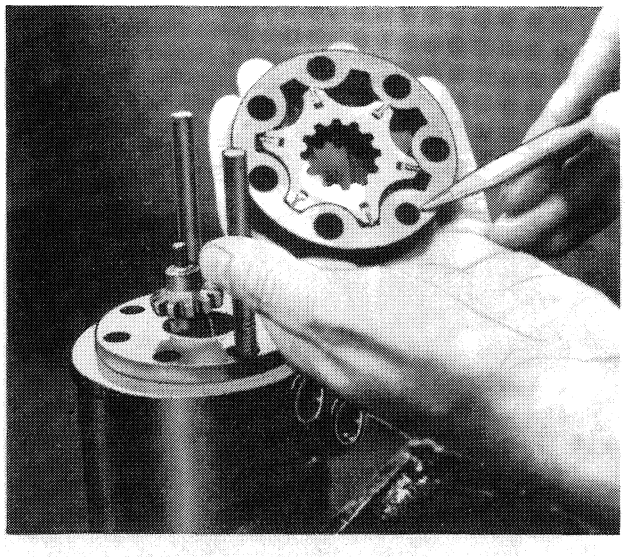

Figure 31
Metering Element

20. Install the manifold (1), Figure 32, over the assembly posts and onto the metering element, making sure the circular slot side of the manifold is up.

21. Install commutator ring (1) over the assembly posts and onto the manifold (2), making sure the slot side is down, see Figure 33.

22. Install the rotor seal (4), Figure 14, and seal retainer (5) over the metering element (9) and down against the housing (12).

    NOTE: *New longer seals (1.766-1.786", 44.86-45.36 mm) were released effective with unit code 6H02 to provide more positive sealing.*

23. With the counterbore side of the commutator (2), Figure 34, up, assemble the commutator into the commutator ring (1) with the slotted hole in the commutator engaging the nose on the drive link. Align the commutator outside diameter concentric with the inside diameter of the commutator ring.

24. Apply a small amount of clean grease to the washer (3) and install it over the pin in the end plate assembly (2), Figure 14. The grease should hold the washer to the end plate assembly.

25. Assemble the end plate assembly with the washer attached, over the assembly posts and onto the steering motor.

26. Install five of the special bolts (1) finger tight. Remove the two assembly posts and assemble the other two special bolts finger tight.

    IMPORTANT: Finish tightening the seven special bolts as follows, and do not over torque as it will cause unrepairable damage.

    a. Torque all seven special bolts in 2-3 lbs. ft. (0.28-0.41 kgm) increments in sequence as shown in Figure 35.

    b. Torque all seven special bolts to 15-19 lbs. ft. (2.07-2.63 kgm) in sequence as shown in Figure 35.

27. Relocate the unit in the vise with the input shaft up. With clean grease on a new seal, gently assemble with the lip in.

28. Assemble a new seal (37), Figure 14, a new brass washer (38), and stepped washer seal ring (39) flat side up. Then secure with the retaining ring (40). Be sure the rounded edge of the retaining ring is face inward.

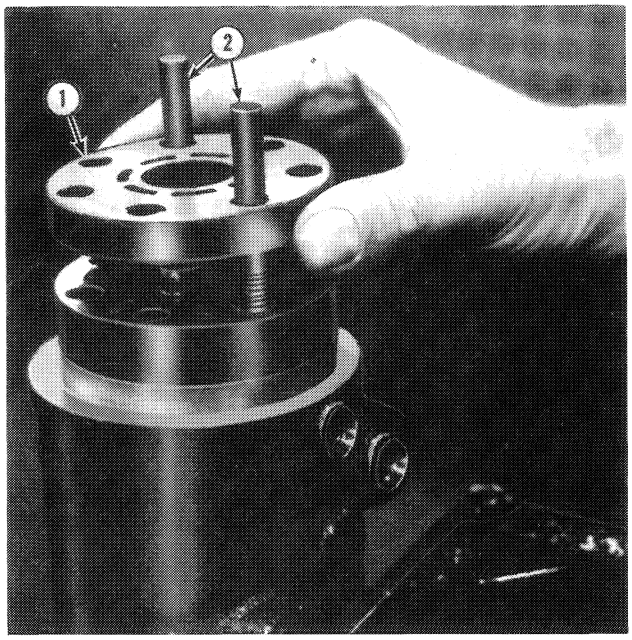

Figure 32
Manifold Installation
1. Manifold
2. Assembly Posts

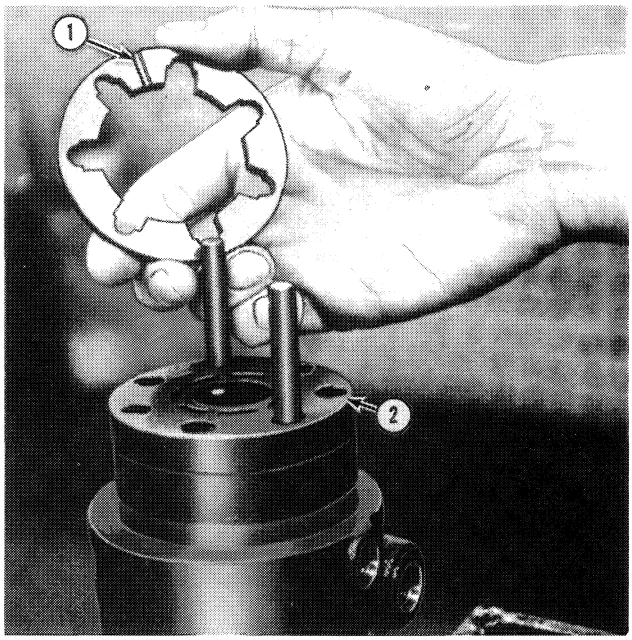

Figure 33
Commutator Ring
1. Slot
2. Manifold

29. If the unit is to be stored, plug the cylinder ports and fill the inlet port with clean oil. Rotate the coupling shaft until oil appears at the outlet port.

30. Plug the inlet and outlet port holes to prevent the entrance of dirt.

FILLING AND AIR BLEEDING THE SYSTEM WHEN DRAINED OF OIL

1. Fill the reservoir nearly full.

2. Start the engine and let it idle.

3. Add oil to the reservoir as required. Do not let the oil level drop below the pump outlet.

4. With one finger on a spoke of the steering wheel, spin the wheel rapidly to bleed the air in the steering cylinders and lines.

5. As soon as the steering motor valve spool is actuated, oil must be added to the reservoir to replenish the oil flowing into the circuit.

6. Rotate the steering wheel to keep the valve spool actuated. Do this until the front wheels have reached the stop in one direction, then quickly reverse the steering wheel rotation to actuate the valve spool in the opposite direction.

7. Keep rotating the steering wheel left and right (from stop to stop) to bleed out the air, replenishing the oil as necessary.

8. The air will bleed out only at the reservoir, therefore, the oil must be circulated in both directions repeatedly until the air has bled out. (The oil in the lines to the power cylinder reaches a "dead end" at the piston. The oil in the cylinder does not flow in a circuit. As the position moves back and forth, the oil moves back and forth in the lines. Therefore, air in these lines and the cylinder may be slow in moving into the steering motor control valve and to the reservoir.)

   NOTE: *Do not operate the vehicle until all the air is bled from the hydraulic steering system.*

9. When the oil in the reservoir is clear (not cloudy or creamy), the system is free of air.

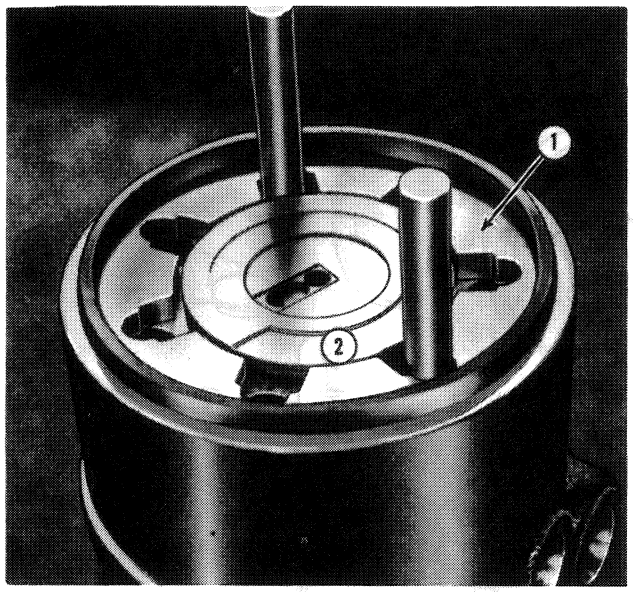

Figure 34
Commutator Installation
1. Commutator Rings
2. Commutator

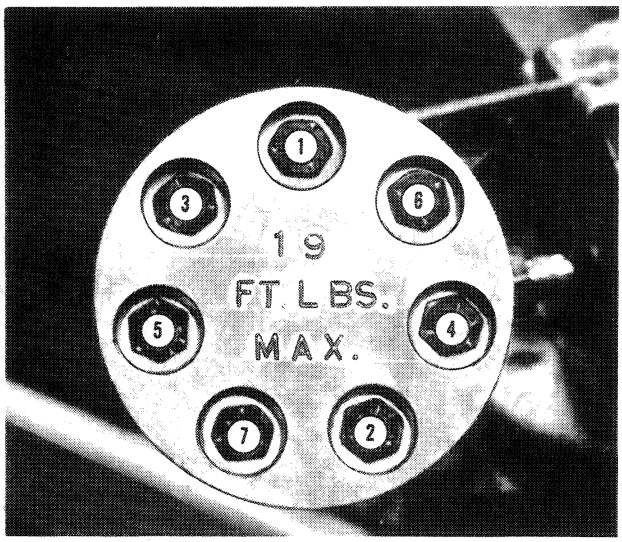

Figure 35
Bolt Torque Sequence

10. Adjust the oil to the recommended level in the reservoir and assemble the reservoir cover.

11. Always fill the reservoir to the recommended level.

POWER STEERING PUMP AND RESERVOIR

DISASSEMBLY — Refer to Figure 36 for Component Identity.

1. Remove reservoir bolt, reservoir, filter and O-Ring.

2. Turn the pump around and straighten the tab on the drive gear lock washer. Remove the nut, lockwasher and drive gear.

3. Remove the 4 thrubolts and the pump cover.

4. Remove the Woodruff key from the drive shaft and remove the pump flange, (13).

5. Remove the bearing and bushing assemblies (1) & (14) and the gear set, (2) from the pump body as an assembly.

6. Remove the pressure relief valve, (7).

7. Remove the drive gear seal snap ring and the drive gear seal, (12) from the pump flange.

CLEANING, INSPECTION AND REPAIR

1. Clean all parts in a suitable solvent and air dry. Lightly oil machine surfaces. Keep disassembled parts in position to facilitate assembly.

2. Inspect the bearing and bushing assemblies for signs of seizure or scoring on the face of the bushings. Remove light scoring marks on the journals by lapping with fine emery paper and paraffin.

3. Examine the gear track in the pump body for wear. If the track is deeper than .0025 in. (.0635 mm) on the inlet side, replace the pump body.

4. Examine the gear set for excessive wear or damage to journals, gear faces and teeth. Run-out across the gear face to the tooth edge should not exceed .001 in. (.025 mm). Shaft journals can be polished lightly with fine grade emery paper to remove wear marks. Gear faces may be polished by sandwiching the emery paper between the gear face and a surface plate, then

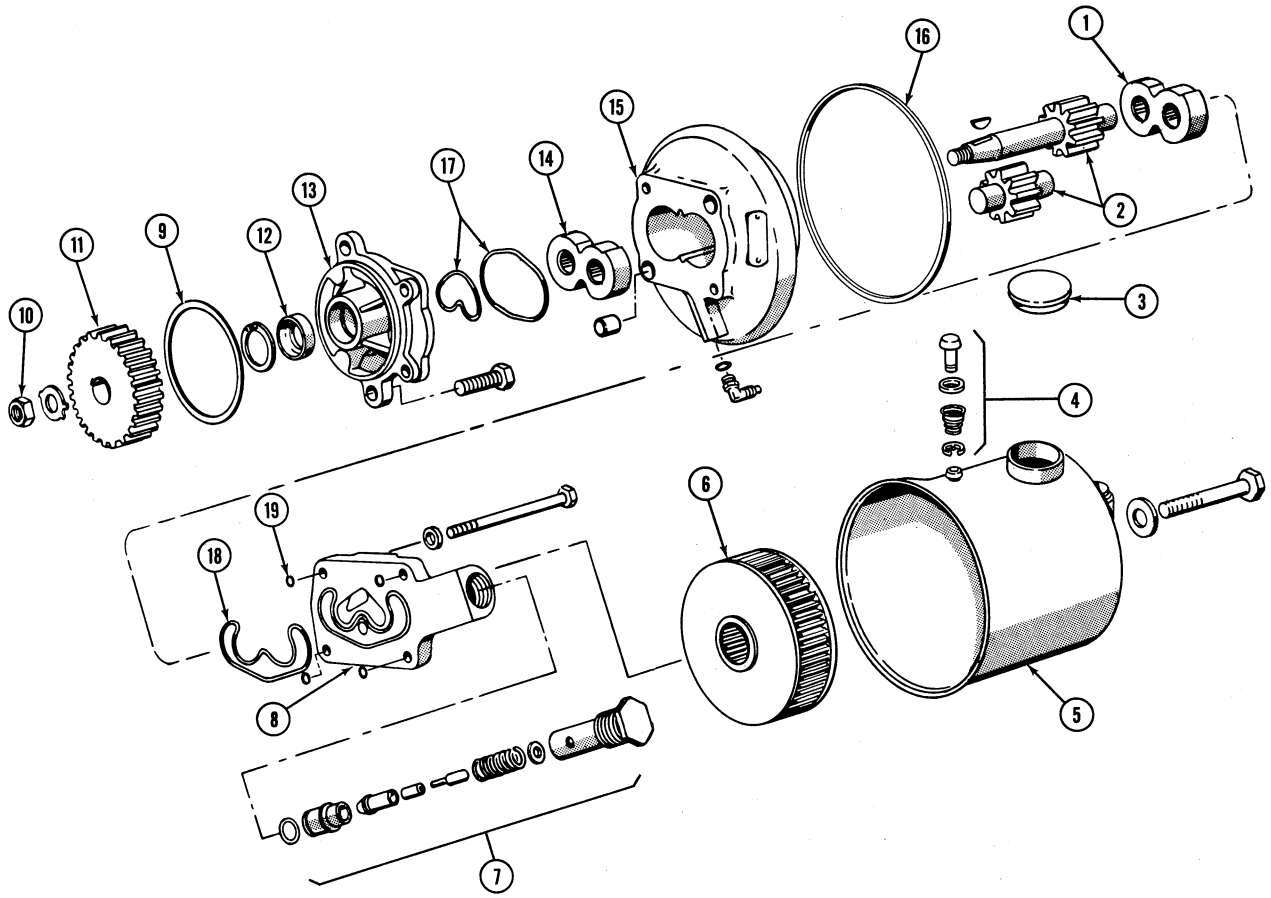

Figure 36
Steering Pump and Reservoir

1. Bearing Block
2. Pump Gear Set
3. Reservoir Filler Cap
4. Breather Assembly
5. Reservoir
6. Filter
7. Relief Valve Assembly
8. Pump End Cover
9. 'O' Ring Seal
10. Drive Gear Retaining Nut
11. Pump Drive Gear
12. Drive Gear Seal
13. Pump Flange
14. Bearing Block
15. Pump Body
16. Reservoir 'O' Ring Seal
17. O-Ring Seals
18. O-Ring Seal
19. O-Rings

rotating the gear. When new gears are fitted, the journals on both sides of each gear must be within .001 in. (.025 mm) in diameter. The gears are supplied in matched sets.

5. Replace all seals and 'O' Ring seals when servicing the pump.

ASSEMBLY

1. Insert a new drive shaft seal in the pump flange and replace the snap ring.

2. Install the pressure relief valve, (7), Figure 36. Torque to the specified value — see Chapter 3.

3. Assemble the gear set and the bearing assemblies and insert them in the pump body.

4. Replace the pump flange seals, (17), Figure 36. Assemble the pump flange on the drive shaft and replace the Woodruff key.

5. Replace the pump cover seals (18) and (19), Figure 36, and install the pump cover with the four thrubolts. Torque the thrubolts to the specified value — Chapter 3.

6. At the drive end, install the drive gear, tab washer and nut. Torque the nut to the specified value — Chapter 3.

7. Bend the tab on the lockwasher to lock the nut.

8. Install the filter 'O' Ring Seal reservoir, washer and reservoir bolt. Tighten the bolt until it engages the washer, then turn it an additional 3/4 to 1 turn.

POWER STEERING PUMP PRESSURE TESTING

1. Disconnect the hydraulic hose from the power steering cylinder.

2. Connect tee fitting D-31 (Universal Hydraulic Pressure Testing Kit), 9/16 in.-181 JIC x 7/16 in. - 20 m JIC.

3. Attach the 18 in. swivel hose and 5000 psi gauge to the tee fitting.

4. With the engine running at 800 rpm, turn the front wheels full left to the stop and read the gauge. Pump pressure should be between 1550 and 1650 psi (106.86 and 113.75 bar).

   IMPORTANT: *Keep the wheels turned full left to the stop just long enough to obtain a pressure reading, then release the wheels. Prolonged operation at full left stop will overheat and may damage the pump.*

5. If the pressure is incorrect, remove and adjust the pressure relief valve. See below.

6. After adjusting the pressure relief valve correctly, remove the test equipment and connect the hydraulic hose to the cylinder.

ADJUSTING THE PRESSURE RELIEF VALVE.

1. Remove the pump assembly from the engine, and drain the reservoir.

2. Remove the reservoir and filter from the pump.

3. Remove the pressure relief valve (7), Figure 36, from the pump body.

4. Place the valve in a soft jawed vice and remove the head from the valve body. Remove the valve and spring.

5. The pressure adjusting shims are now accessible. Add or remove shims until the correct pressure reading is obtained. The following shims are available. Each shim will increase or decrease the pressure as indicated.

Shim Thickness	Pressure Change
.010 in. (.25 mm)	66-74 psi (4.55-5.10 bar)
.015 in. (.38 mm)	99-110 psi (6.83-7.58 bar)
.060 in. (1.52 mm)	396-440 psi (27.30-30.53 bar)

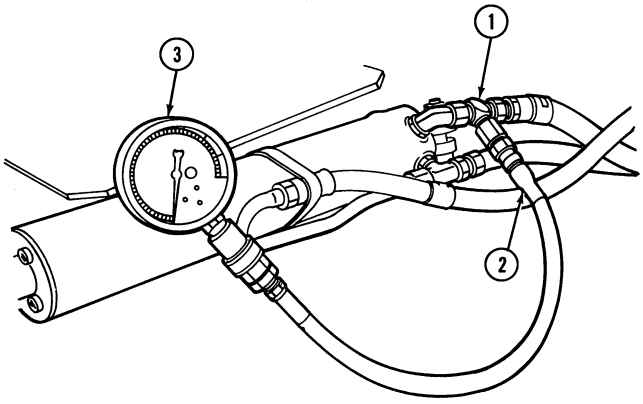

Figure 37
Power Steering Pressure Test
1. Tee Fitting — Tool No. 0003
2. Hose Tool No. 7099
3. Gauge Tool No. 2028

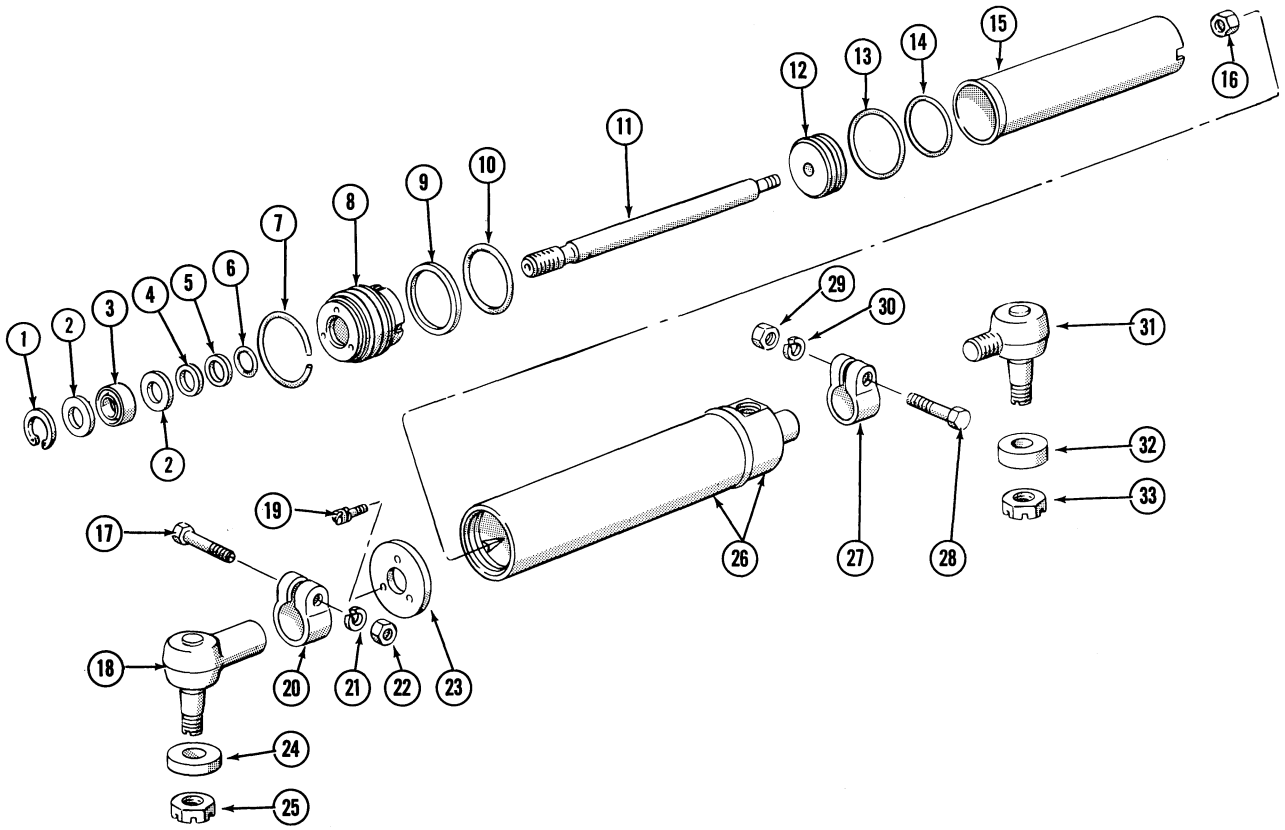

Figure 38
Steering Cylinder

1. Ring, Piston Rod Seal Retainer
2. Washer, Piston Rod Seal Retainer
3. Seal, Piston Rod Outer
4. Washer, Piston Rod O-Ring Retainer
5. Ring, Piston Rod O-Ring Backup
6. O-Ring, Piston Rod Inner
7. Gland Lock Ring
8. Gland and Seal Kit
9. Ring Gland, O-Ring Backup
10. Gland O-Ring
11. Cylinder Piston Rod
12. Cylinder Piston
13. Cylinder Piston Outside Ring
14. Cylinder Piston Inside Ring
15. Cylinder Inner Tube
16. Piston-to-Rod Nut
17. Clamp Bolt
18. Cylinder End Assembly, Front
19. Plate-to-Gland Screw
20. Cylinder End Clamp
21. Lock Washer
22. Nut
23. Cylinder End Plate
24. End Assembly Dust Cover
25. Nut End Assembly
26. Cylinder Head & Tube Assembly
27. Cylinder End Clamp
28. Bolt
29. Nut
30. Lockwasher
31. Cylinder End Assembly, Rear
32. End Assembly Dust Cover
33. End Assembly Nut

6. Reassemble the valve, spring and head in the valve body. Do not overtighten the valve head. Torque to 8 lbs. ft. (1.11 kgm).

7. Install the pressure relief valve in the pump, replace the filter and reservoir, and install the assembly.

8. Refill the reservoir with the specified oil. Run the engine and turn the steering gear from stop to stop to bleed the air from the system. Add oil as required to maintain the proper oil level.

STEERING CYLINDERS

DISASSEMBLY

Refer to Figure 38 for Component Identification

1. Remove the cylinder from the unit.

2. Remove the clamp bolts, nuts and lockwashers and remove the two cylinder end assemblies from the piston rod. Remove the clamps.

3. Remove the end plate securing screws and the cylinder end plate.

4. Depress the cylinder gland and insert a punch through the hole in the side of the cylinder to depress the gland lock ring. Remove the lock ring.

5. Slide the piston rod and related parts out of the cylinder assembly.

6. Remove the snap ring, washer, rod outer seal, retainer, backup 'O' Ring seal and inner 'O' Ring seal.

7. Remove the piston securing nut and remove the cylinder Piston from the piston rod.

8. Remove the cylinder piston outside ring and inside ring.

CLEANING, INSPECTION AND REPAIR

1. Clean all metal components in a suitable cleaning solvent and dry with compressed air, if available.

2. Inspect the piston assembly for defects and evidence of leakage. Install a new piston assembly if necessary.

3. Inspect the cylinder assembly and inner tube for damage. Install new parts as required.

4. Inspect the cylinder gland. If damage is visible or if the gland has been leaking, install a new gland.

   NOTE: *Install a new cylinder seal kit whenever the cylinder is disassembled. Two seal kits are available. One includes items 1 to 10; the other includes items 1 to 7, and items 9 and 10.*

5. Inspect the end assemblies for damage or worn threads. Replace as required.

ASSEMBLY

1. Install the piston inside ring and the piston outside ring. Install the piston on the piston rod and secure with the lock nut. Tighten the nut to the torque specified — Chapter 3.

2. Use a new seal kit and if necessary a new cylinder gland. Install the gland components on the piston rod in the order shown — Figure 38.

3. Insert the assembled parts into the cylinder assembly.

4. Depress the cylinder gland and install the retaining ring in its groove.

5. Place the cylinder end plate against the gland and secure the plate with the three screws and lock washers. Tighten securely.

6. Install the front and rear clamps and end assemblies. Secure with bolts, lock washers and nuts. Tighten securely.

PART 8
STEERING AND FRONT AXLE

Chapter 2
FRONT AXLE

A. FRONT AXLE — DESCRIPTION AND OPERATION

The Front axle, Figure 39 is tapered from the center to the ends and is slightly swept back. It is centrally mounted by two tapered pins through one long pin bore. The pins are inserted from the front.

The dual pin through one long bore gives strength and lateral rigidity to the axle and limits the axle end movement to a radial pivot around the pin axis.

Castings, machined to receive the wheel spindle pins, are welded to the ends of the axle. The wheel spindle assemblies are located on the spindle pins by means of bushings at the upper and lower ends.

A thrust bearing is located at the lower end of each spindle pin to support vertical thrust. The spindle pins and wheel spindle assemblies are held in place by a tapered locking pin through the axle castings and the spindle pins.

The steering arms are bolted to the outer surfaces of the wheel spindle assemblies. The steering arms are connected by means of a connecting rod. Steering cylinder rods are pivoted on the steering arms and the rear of the axle.

The front wheel track is 68 inches (1.727 m) and is not adjustable.

B. TOE-IN ADJUSTMENT

The toe-in of the front wheels is set at the factory. Normally, the front wheels maintain their toe-in adjustment; however, an occasional check of the toe-in should be made after any front axle component overhaul.

Check for correct toe-in as follows:

1. Place the front wheels in the straight-ahead position. Determine the straight-ahead position by turning the steering wheel from lock-to-lock and then halfway back, or drive the tractor forward several feet and backward several feet in a straight line.
2. Measure and record the distance from the inside front rim of one wheel (not the tire) at hub height, to the inside front rim of the other wheel at hub height.
3. Measure and record the distance between the rear of the wheel rims at hub height.

The measurement taken at the rear of the wheels should be between 0.0 in. and 0.5 in. (0.0-12.7 mm) greater than the measurement taken at the front.

If the toe-in is not correct, make the adjustments outlined as follows:

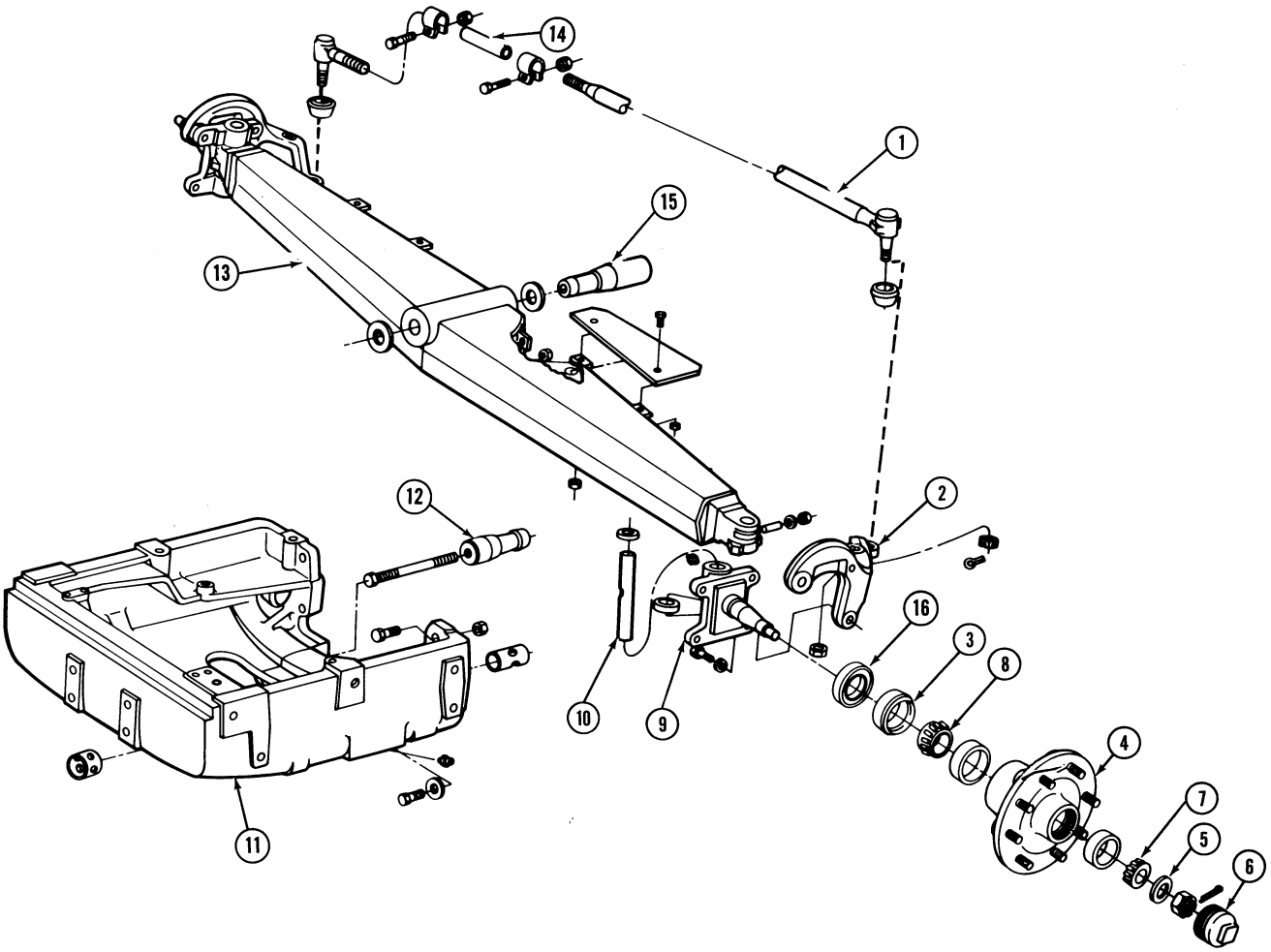

Figure 39
Front Axle Assembly

1. Connecting Rod
2. Steering Arm
3. Grease Retainer
4. Hub
5. Retainer Washer
6. Hub Cap
7. Outer Bearing Assembly
8. Inner Bearing Assembly
9. Spindle
10. Spindle Pin
11. Front Support
12. Front Pivot Pin
13. Front Axle
14. Toe-in Adjuster
15. Rear Pivot Pin
16. Mud Shield

1. Loosen the clamp bolts, Figure 40.

2. Rotate the connecting rod in the required direction until the rear of the rims, measured at hub height, are 0.0-0.5 in. (0-12.7 mm) further apart than the front of the rims.

3. After the correct toe-in is obtained, tighten the clamp nuts.

4. Recheck the toe-in as outlined above and readjust if necessary.