**Figure 25**

Position of Sealing Rings and Relationship  
of Bearings to Inlet Side of Body

A. Inlet

B. Outlet

1. Relieved Radius on Outlet Side of Pump
2. Pressure Loading Seal
3. Back Up Strip
4. Seal Back Up Ring
5. Pressure Loading Strip
6. Back Up Strip

- Coat the seal lip with grease
- If the pump is not to be re-used immediately, the ports should be capped.

## INSTALLATION

Installation of the transmission mounted gear type pumps follows the removal procedure in reverse.

**IMPORTANT:** *Prior to installation on the tractor, introduce hydraulic oil into the suction port and rotate the gears by hand.*



# PART 6

## POWER TAKE-OFF

### Chapter 2

### TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

Section	Page
A. TROUBLE SHOOTING	1
B. SPECIFICATIONS	2
C. SPECIAL TOOLS	3

#### A. TROUBLE SHOOTING

**IMPORTANT:** *Whenever effecting a repair the reason for the cause of the problem must be investigated and corrected to avoid repeat failures.*

The following table lists problems and their possible causes with recommended remedial action.

PROBLEM	POSSIBLE CAUSES	REMEDY
<b>P.T.O. will not engage with load or stop without load</b>	<ol style="list-style-type: none"> <li>1. Low rear axle oil level</li> <li>2. Selector lever linkage broken</li> <li>3. I.P.T.O. pump fails</li> <li>4. Fracture of clutch feed tube</li> <li>5. Broken I.P.T.O. control valve</li> <li>6. Pressure regulating valve broken</li> </ol>	<p>Check level and top-up Inspect and repair Pressure test pump Inspect and repair Check valve operation, renew components if necessary Check valve operation, renew components if necessary</p>
<b>P.T.O. will not engage with load but shaft stops without load</b>	<ol style="list-style-type: none"> <li>1. I.P.T.O. clutch to support sealing rings leak</li> <li>2. I.P.T.O. control valve piston stuck or spring broken</li> <li>3. I.P.T.O. clutch plates worn or teeth broken</li> <li>4. I.P.T.O. clutch piston seals leaking</li> <li>5. I.P.T.O. clutch piston or housing cracked</li> <li>6. Blocked I.P.T.O. oilways</li> </ol>	<p>Inspect and renew rings Inspect and renew components Inspect and renew plates Inspect and renew seals Inspect and renew components if necessary Inspect and repair</p>

PROBLEM	POSSIBLE CAUSES	REMEDY
<b>P.T.O. engages but will not disengage</b>	1. Selector lever linkage broken 2. I.P.T.O. control valve stuck 3. I.P.T.O. clutch return spring broken 4. Blocked I.P.T.O. oilways 5. Seized or warped plates	Inspect and repair Check valve operation, renew components if necessary Inspect and renew spring Inspect and repair Inspect lubrication circuit
<b>I.P.T.O. clutch Brake fails to operate, shaft rotates without load and with clutch disengaged</b>	1. Brake pad or band worn or broken, band incorrectly adjusted 2. Blocked I.P.T.O. oilways 3. Broken I.P.T.O. control valve 4. Brake piston seals leaking 5. Brake pressure oilways leaking	Inspect and repair Inspect and repair Check valve operation, renew components if necessary Inspect and renew Inspect and repair

### B. SPECIFICATIONS

#### P.T.O. SPEED

540 rev/min. @ 1850 engine rev/min.

#### SHIMS

LOCATION	SIZE AVAILABLE
I.P.T.O. Pressure Regulating Valve	0.050 in. (Nominal) (1.20 mm)
I.P.T.O. Control Valve	0.015 in. (0.381 mm) 0.030 in. (0.762 mm)
I.P.T.O. Drive Shaft – (Refer to Chart Below for Shimming Thickness)	0.030 in. (0.762 mm)

Gap Measurement	Shims to be Installed	Gap Measurement	Shims to be Installed
0.006 in. (0.14 mm) 0.035 in. (0.89 mm)	0	0.096 in. (2.42 mm) 0.124 in. (3.17 mm)	3
0.036 in. (0.90 mm) 0.065 in. (1.65 mm)	1	0.125 in. (3.18 mm) 0.155 in. (3.94 mm)	4
0.066 in. (1.66 mm) 0.095 in. (2.41 mm)	2	0.156 in. (3.95 mm) 0.185 in. (4.70 mm)	5



**I.P.T.O. SHAFT END PLAY**

I.P.T.O. Drive Shaft End Play – 0.000 – 0.025 in. (0.00 – 0.630 mm)

I.P.T.O. Output Shaft Turning  
Torque (Engine Stopped) –

0 – 2 lbf/ft (0 – 3 Nm, 0 – 0.3 Mkg)

**PRESSURE TESTING**

Oil Temperature 140 ± 6°F (60 ± 3°C)

I.P.T.O. Pressure Regulating Valve –  
(Clutch Disengaged)

At 2300 Engine rev/min. 220 – 230 lbf/in<sup>2</sup> (15.2 – 15.9 Bar 15.5 – 16.2  
(Oil Flow 1.5 gal/min. 1.8 U.S. kgf/cm<sup>2</sup>)  
gal/min. 6.8 litres/min.)

At 1000 – 2300 Engine rev/min. 200 – 230 lbf/in<sup>2</sup> (13.8 – 15.9 Bar 14.1 – 16.2 kgf/cm<sup>2</sup>)  
(Oil Flow 0.6 – 1.5 gal/min.  
0.75 – 1.80 U.S. gal/min.  
2.8 – 6.8 litres/min.)

I.P.T.O. Control Valve – (Clutch Engaged)

At 1300 Engine rev/min. 220 – 240 lbf/in<sup>2</sup> (15.2 – 16.5 Bar 15.5 – 16.9 kgf/cm<sup>2</sup>)  
(Oil Flow 0.8 gal/min. 1.0 U.S.  
gal/min. 3.8 litres/min.)

**TORQUE SPECIFICATIONS**

	lbf/ft	Nm	Mkg
Control Valve Spigot Bolt	33	45	4.6
Control Valve Retaining Bolt	33	45	4.6
Clutch Brake Plate Retaining Bolts	50	68	6.9
Tube Connections	9	12	1.2
Pump Port to Brake Pressure Regulating Valve Connector	25	35	3.6
I.P.T.O. Valve Dump Tube Clamp Bolt	6	8	0.8
Tube Adaptors in I.P.T.O. Clutch Support	10	14	1.4
Selector Lever Retaining Bolt	37	50	5.1
Rear Cover Retaining Bolts	50	68	6.9

**C. SPECIAL TOOLS**

<b>DESCRIPTION</b>	<b>CHURCHILL TOOL No.</b>	<b>NUDAY TOOL No.</b>
Ratchett	<b>P61</b>	<b>9162</b>
Step Plate Adaptors	<b>630S</b>	<b>9210</b>
Bushing Kit	<b>818</b>	<b>9514</b>
Adaptor	<b>924</b>	<b>9537</b>
Puller Legs	<b>930B</b>	<b>9521</b>
Puller Legs	<b>930E</b>	<b>9207</b>
Puller	<b>938</b>	<b>9506</b>
Puller	<b>943</b>	<b>9507</b>
Slide Hammer	<b>943S</b>	<b>9567</b>
Pulling Attachment	<b>951</b>	<b>9190</b>
Pulling Attachment	<b>952</b>	<b>9526</b>
Puller	<b>1002</b>	<b>9198</b>
Puller	<b>1003</b>	<b>9516</b>
Pressure Gauge	<b>FT.4096</b>	<b>7284</b>
Adaptor	<b>FT.4096-1</b>	<b>4646</b>
Test Pipe/Adaptor	<b>FT.4097</b>	<b>1221</b>
Pressure Gauge	<b>FT.4100</b>	<b>0074</b>
Pressure Pipe	<b>FT.4100-1</b>	<b>1552</b>
Adaptor	<b>FT.4100-2</b>	<b>4657</b>
Compressor	<b>FT.4101</b>	<b>1312</b>
Test Hose and Connector	<b>T.8503-4</b>	<b>-</b>
Consists of: Adaptor	<b>-</b>	<b>0835</b>
Adaptor	<b>-</b>	<b>1384</b>
Adaptor	<b>-</b>	<b>1389</b>
Hose	<b>-</b>	<b>1392</b>

# **PART 7**

## **STEERING AND FRONT AXLE**

### **Chapter 1**

#### **STEERING**

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### **Chapter 2**

#### **TWO WHEEL DRIVE FRONT AXLE**

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## Chapter 3

### FOUR WHEEL DRIVE FRONT AXLE ASSEMBLY

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### TRANSFER GEAR ASSEMBLY

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## Chapter 5

### TROUBLE SHOOTING SPECIFICATIONS AND SPECIAL TOOLS

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# PART 7

## STEERING AND FRONT AXLE

### Chapter 1

#### STEERING

Section	Page
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E. RESERVOIR FILTER AND HYDRAULIC TUBES	28
F. BLEEDING THE STEERING SYSTEM	29

#### A. STEERING – DESCRIPTION AND OPERATION

##### DESCRIPTION

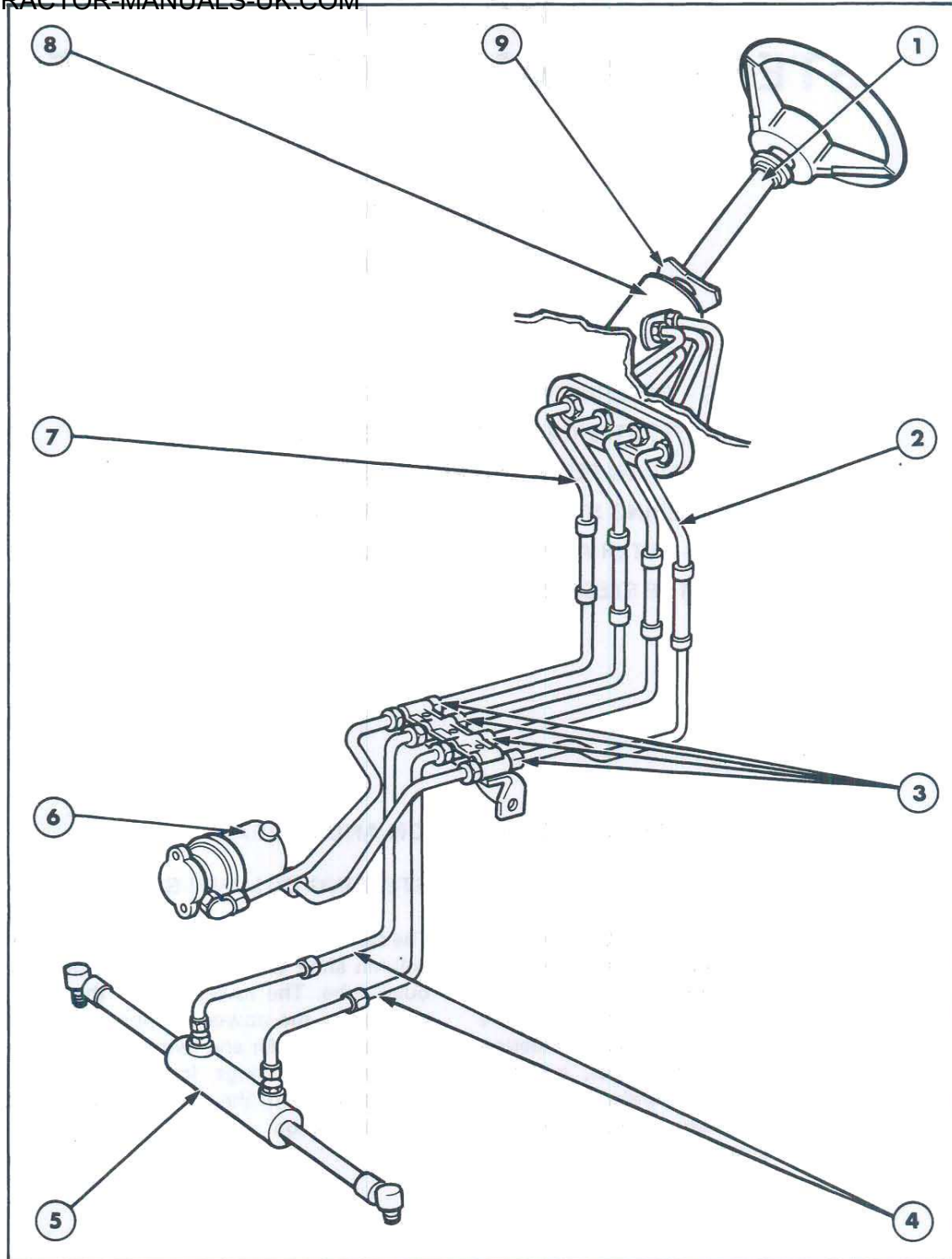
The Ford 455C, 555C and 655C steering system is a hydraulic power assisted hydrostatic system. The major components are shown in Figure 1. The Components are serviced separately and consist of steering column shaft, a steering motor, a power steering pump, steering cylinder, a front axle assembly, and 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

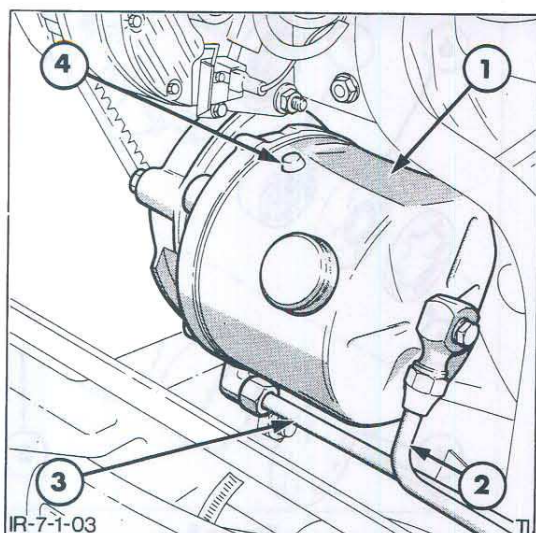
The steering wheel is secured to the steering column shaft which is protected by a steel outer tube. The lower end of the shaft is coupled to the power steering motor input shaft by a coupler and two pins. Two spring wire retaining rings located around the circumference of the shaft coupler hold the pins in position.

The power steering motor and steering column assembly are bolted to the power steering motor support by 4 bolts.



**Figure 1**  
Steering System General Layout

- |                                              |                                |
|----------------------------------------------|--------------------------------|
| 1. Steering Column                           | 6. Steering Pump and Reservoir |
| 2. Return to Reservoir Tube                  | 7. Supply Pressure Tube        |
| 3. Steering Tube Connections                 | 8. Steering Motor              |
| 4. Steering Cylinder Supply and Return Tubes | 9. Steering Motor Support      |
| 5. Steering Cylinder                         |                                |



**Figure 2**  
Steering Pump and Reservoir Installation

1. Reservoir
2. Inlet Tube - Low Pressure
3. Outlet Tube - Pressurised
4. Breather

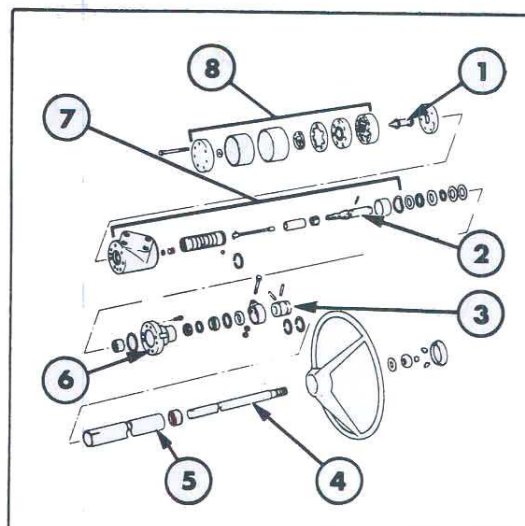
## POWER STEERING PUMP AND RESERVOIR

The integral power steering pump and reservoir, Figure 2 are mounted on the engine front cover plate on the left hand side of the engine. 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 output is 3.0 Imp. Gal. per minute (3.6 U.S. Gal. per minute) (13.65 litres per minute) at 1000 rev/min and a pump delivery pressure of 1525 lbf/in<sup>2</sup> (105 bar).

## STEERING MOTOR

The hydrostatic steering motor, Figure 3 utilises a linear control valve to control the direction of the steered wheels and a metering unit to control the rate of turn. In the



**Figure 3**  
Steering Motor Assembly

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

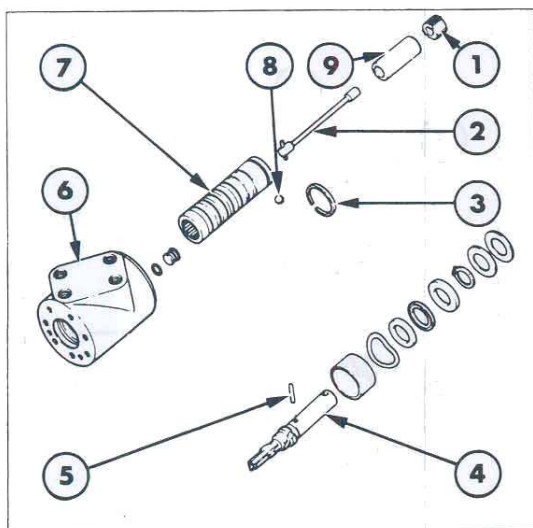
event of pump failure the wheels can be turned manually with the metering unit functioning as a hydraulic pump.

Port identification on the motor is cast in raised letters on the valve housing. The pressure port is identified 'IN' the return port 'OUT' the right turn port 'RT' and the left turn port 'LT'.

## CONTROL VALVE SECTION

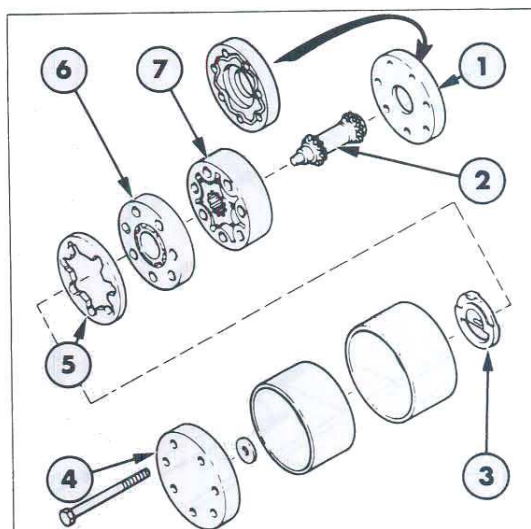
The control valve section, Figure 4, directs the hydraulic oil to and from the metering unit and steering cylinder, and regulates the pressure of the oil flowing to the steering cylinder. The lower end of the input shaft is bored to receive the top of the torsion bar. The torsion bar is pinned to the 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.





**Figure 4**  
Steering Motor Control Valve Section

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



**Figure 5**  
Steering Motor Metering Section

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

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 predetermined 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.

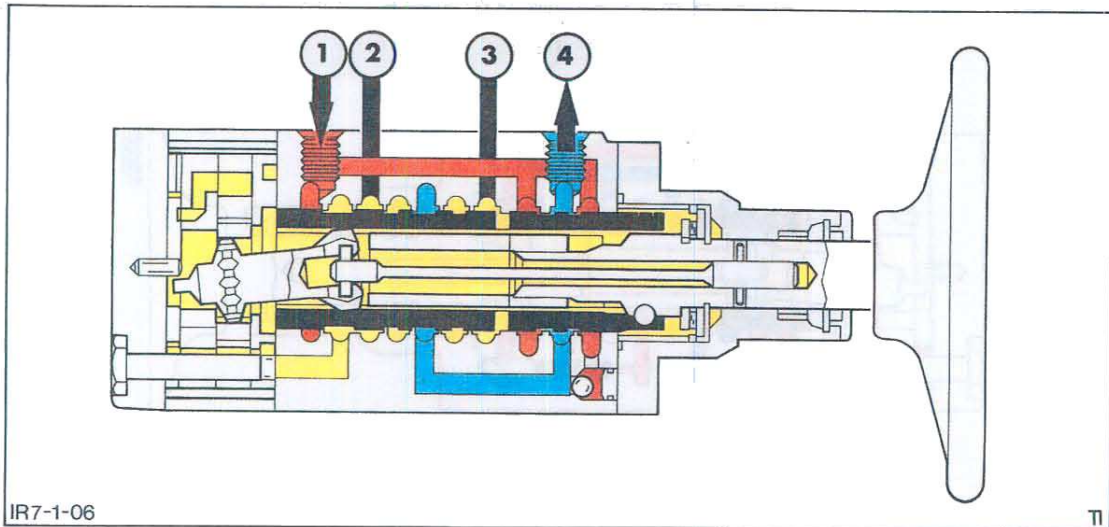
When the steering wheel is turned, the torsion bar twists and the spool is moved up or down, uncovering oil ports leading to the metering system.

## METERING SYSTEM

The metering system, Figure 5, 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 of power steering pump failure.

The metering element consists of an orbiting rotor and a fixed stator which are serviced as a matched set. The rotor has six lobes and the stator has seven cavities. When the rotor is moving, (driven by the drive link) oil is always flowing out of three cavities and flowing into three cavities. One cavity is inactive as it changes from one of discharging oil to one of admitting oil. The commutator rotates at orbit speed with the rotor, by means of the drive link and channels the oil to and from the metering element and the valve section.





**Figure 6**  
Steering Motor Oil Flow - Neutral

Supply Pressure (From Pump)  
 Static Oil

Return

1. Pump Feed
2. Cylinder Feed (Left Turn)

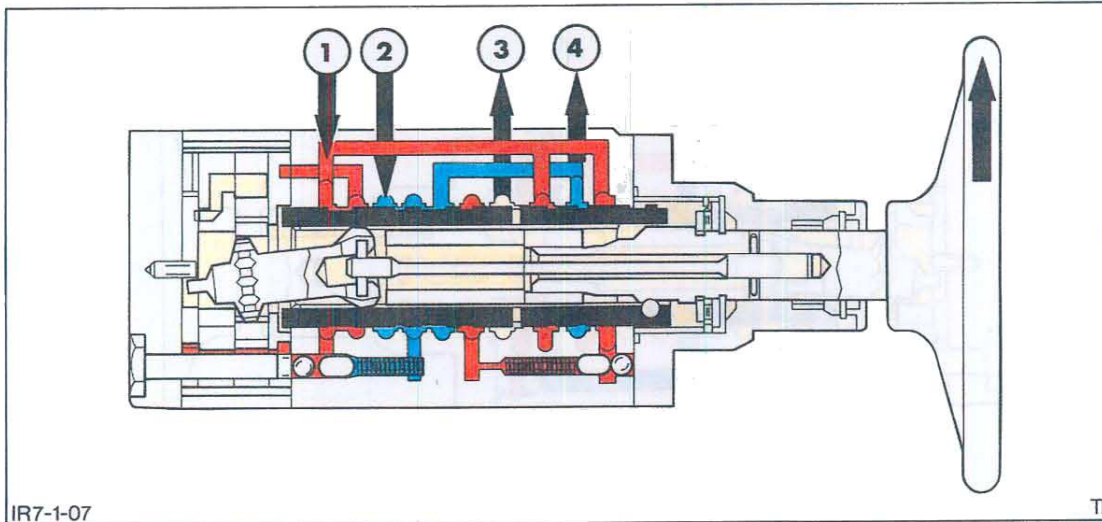
3. Cylinder Feed Right Turn
4. Return to Reservoir

In operation, when the steering wheel is turned, the turning force is transmitted through the input shaft, torsion bar and drive link to the metering element rotor. All of these components and the valve spool, tend to rotate together. However, static oil in the cylinder circuits tends to resist the movement of the rotor. As the input shaft is turned further, and with the rotor, drive link and spool held stationary by the static oil, the torsion bar is deflected. At the same time, the actuating ball, held between the spool and the helical groove in the input shaft, is forced to follow the groove and causes the spool to move axially.

When the spool is moved axially, fluid channels are selected to direct oil to and from the steering cylinders. Pressure oil flows from the valve section, through the metering section, back to the valve section and to the steering cylinder to be actuated.

Oil from the retracting cylinder flows into the valve section and is channelled to the return port and flows back to the hydraulic system reservoir.

When the desired turn is established, and there is no longer an input force at the steering wheel, the torsion bar returns to its original position, at the same time rotating the valve spool and causing the actuating ball to act against the helical groove in the input shaft and move the spool back to the neutral position closing the channels to the steering cylinders.



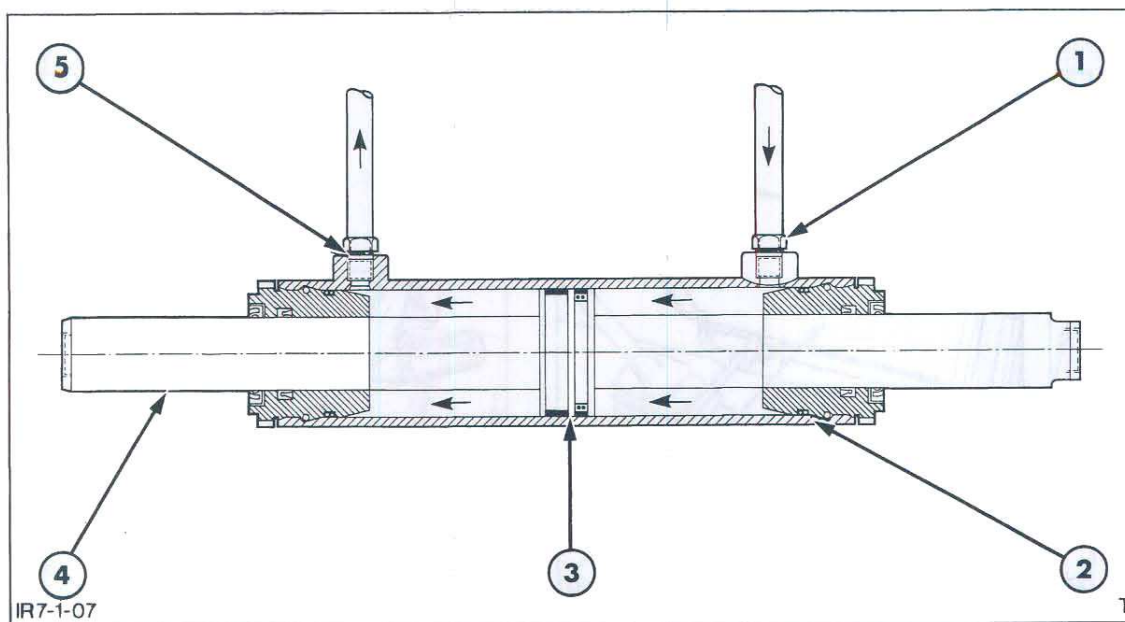
**Figure 7**  
Steering Motor Oil Flow - Right Turn

- |                                                                                                                                                     |                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <span style="display: inline-block; width: 15px; height: 10px; background-color: red; border: 1px solid black;"></span> Supply Pressure (From Pump) | <span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; border: 1px solid black;"></span> Metered Oil flow to cylinder |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black;"></span> Return to Reservoir        |                                                                                                                                                         |
| 1. Pump Feed                                                                                                                                        | 3. Cylinder Feed Right Turn                                                                                                                             |
| 2. Cylinder Feed (Left Turn)                                                                                                                        | 4. Return to Reservoir                                                                                                                                  |

In a right turn, Figure 7, the oil is directed to the metering section through two ports in the base of the valve housing. The oil enters a space between the retaining bolt and bolt holes where it flows to the commutator and is directed through ports in the manifold to the rotor in the metering element. The seven ports in the manifold index with the seven cavities in the metering stator. The commutator is so designed that as it rotates it is always channeling oil to the inlet side of the metering element and away from the outlet side. As the rotor turns and begins to mesh with the stator, the oil is forced out and through ports in the manifold and back to the commutator. The oil is now directed to the centre of the metering section then up past the drive link to the centre of the spool. Ports

in the spool are aligned with the right turn circuit in the valve housing and the oil flows to the right turn port and to the steering cylinder.

In a left turn the oil flows in the opposite direction. The metering element and the commutator now turn in the opposite direction and the inlet and outlet sides are reversed. The oil enters the centre of the spool through the ports and flows down past the drive link and rotor. The revolving rotor forces the measured amount of oil back down to the commutator, which itself has now moved. The commutator now directs the oil up the retaining bolt holes to the spool and from the spool to the steering cylinder.



**Figure 8**  
Steering Cylinder

1. Cylinder Port
2. Cylinder Barrel
3. Piston

4. Cylinder Rod
5. Cylinder Port

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 through the hoses and tubes to the steering cylinder.

Two types of steering cylinder are fitted dependant on whether a two or four wheel drive front axle has been installed.

On two wheel drive axles the cylinder is housed within the centre of the axle and on four wheel drive units the cylinder is anchored on the left hand side of the axle.

The principal of operation for both cylinders is the same as follows.

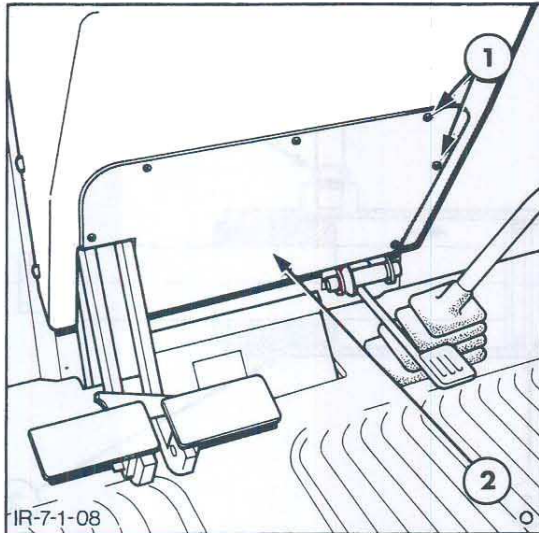
Metered Oil is directed from the steering motor outlet ports to either the right or left hand turn port on the steering cylinder.

The metered oil enters the cylinder and exerts pressure on the piston which, on two wheel drive Units, is centrally mounted on the cylinder rod, Figure 8. The exhaust oil on the opposite side of the piston returns to the steering motor allowing the piston to move in direct relationship to the degree of turn on the steering wheel.

For overhaul of the cylinders refer to the appropriate Chapters in this Part covering Two and Four Wheel Drive front Axle assemblies.

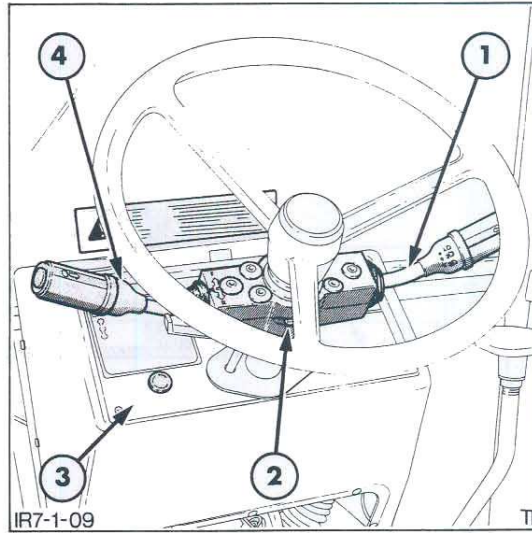


B. HYDROSTATIC STEERING MOTOR - OVERHAUL



**Figure 9**  
Lower Console

1. Attaching Screws
2. Lower Console



**Figure 10**  
Reversing Lever and Steering Console

1. Turn Signal Switch (where fitted)
2. Hexagon Socket Screw
3. Steering Console Panel
4. Power Reversing Lever

**REMOVAL**

1. Disconnect the battery ground cable at the battery.

2. Remove the lower console cover, Figure 9.

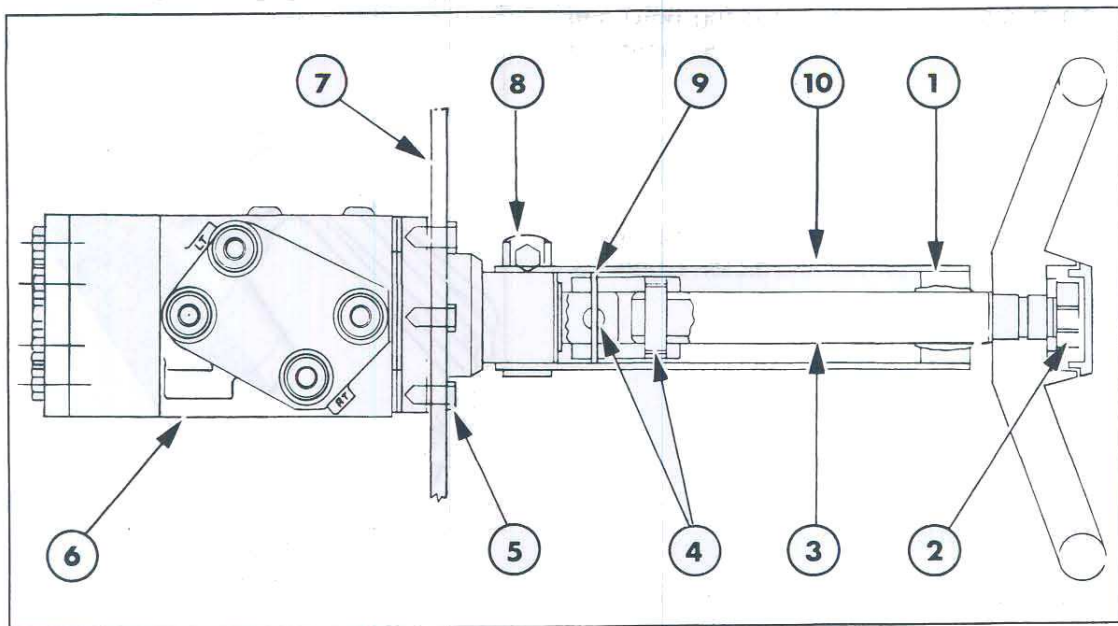
3. Remove the steering wheel cap and nut. Then lift the steering wheel from the steering column.

4. Remove the two hexagon socket screws securing the power reversing lever to the steering column. Figure 10. Ease the lever away from the column.

5. Remove the steering console panel screws and carefully slide the panel up the steering column. This will provide access to the power reversing and turn signal switch harness connectors. Disconnect the connectors, identify the location of the steering console indicator lights and remove the panel from the steering column.

6. Loosen the steering column shroud clamp, Figure 11 and slide the shroud up the steering column until the coupling is exposed.



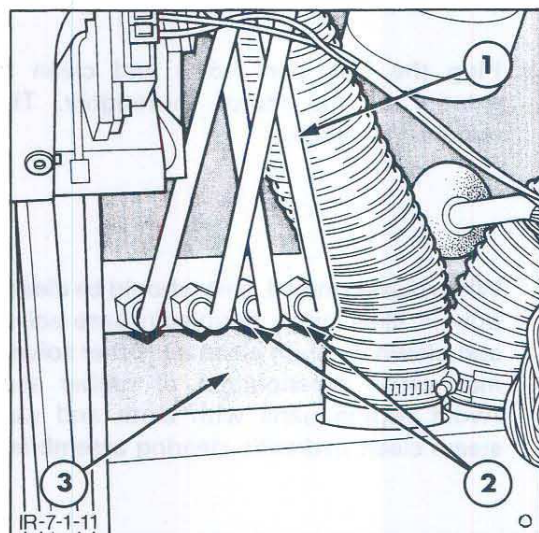


**Figure 11**  
Steering Column

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

7. Remove the pin retainer and pin, Figure 11, then remove the steering column from the steering motor.

8. Clean the steering tube connections, Figure 12.



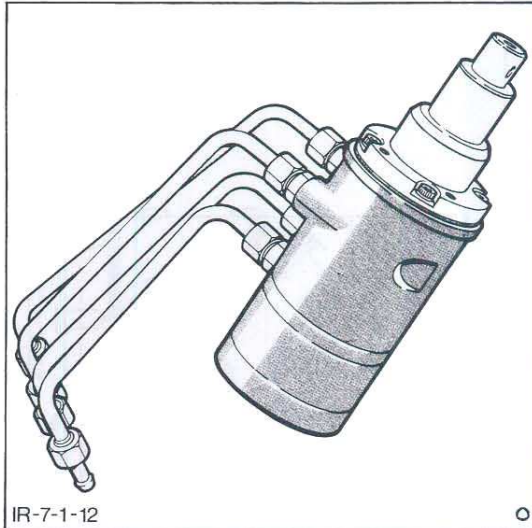
**Figure 12**  
Hydrostatic Steering Tubes

9. With a suitable container positioned to catch escaping steering oil, mark and separate the steering tubes at the point of entry through the cab fire wall. Cap and seal the tubes using suitable plugs.

- |                              |
|------------------------------|
| 1. Steering Tubes            |
| 2. Steering Tube Connections |
| 3. Fire Wall                 |

10. Remove the motor mounting bolts and lower the motor from the mounting flange.

11. Identify and detach each of the power steering tubes from the motor, Figure 13.



**Figure 13**  
Steering Motor and Tubes

### DISASSEMBLY

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

Cleanliness in servicing the power steering system is imperative. If it is necessary to disassemble any of the units, ensure a clean work bench or table is used.

Plug the four port holes and clean the exterior of the motor thoroughly. Then remove the plugs.

When disassembled, parts should be cleaned only in clear-clean petroleum base solvent and blown dry with clean air. Other solvents may cause deterioration of rubber seals. Avoid wiping parts with cloth and never steam clean hydraulic steering assemblies.

**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.
- If the pin in the end cover or the end cover must be replaced, replace both the pin and end cover assembly.

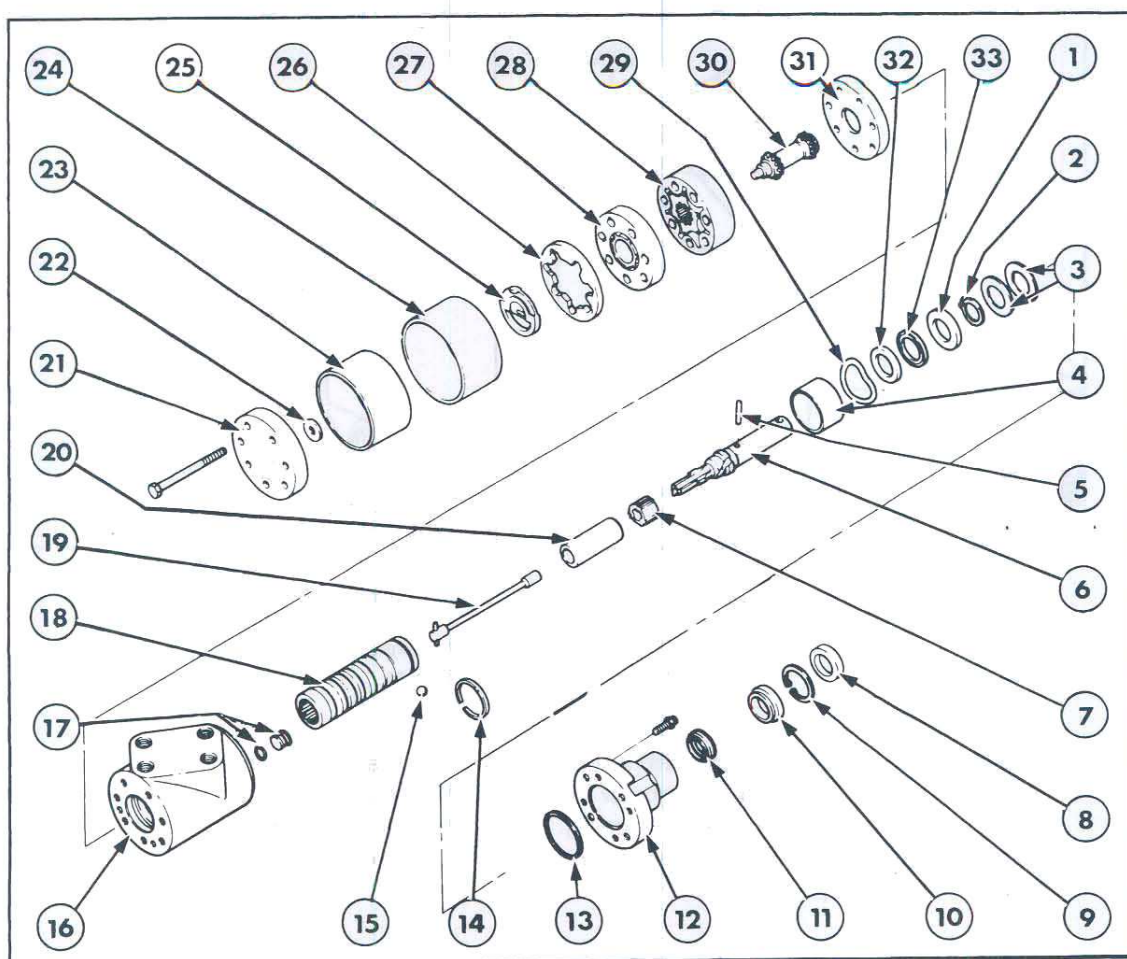
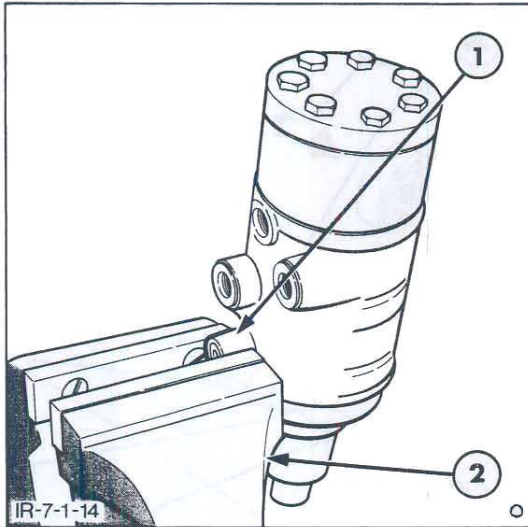


Figure 14  
Steering Motor

- |                               |                          |
|-------------------------------|--------------------------|
| 1. Thrust Washer              | 18. Valve Spool          |
| 2. Circlip                    | 19. Torsion Bar          |
| 3. Shims                      | 20. Spacer               |
| 4. Spacer                     | 21. End Cover            |
| 5. Pin                        | 22. Wear Washer          |
| 6. Input Shaft                | 23. Rotor Seal           |
| 7. Drive Ring                 | 24. Seal Retainer        |
| 8. Dust Seal                  | 25. Commutator           |
| 9. Circlip                    | 26. Commutator Ring      |
| 10. Stepped Washer            | 27. Manifold             |
| 11. Seal                      | 28. Metering Element     |
| 12. Upper Cover Assembly      | 29. Spring Washer        |
| 13. Seal                      | 30. Drive Link           |
| 14. Spool Spring              | 31. Spacer               |
| 15. Steel Ball                | 32. Thrust Washer        |
| 16. Housing                   | 33. Valve Thrust Bearing |
| 17. Plug and "O" Ring (2 off) |                          |





**Figure 15**  
Supporting Steering Motor

1. Fitting
2. Vice

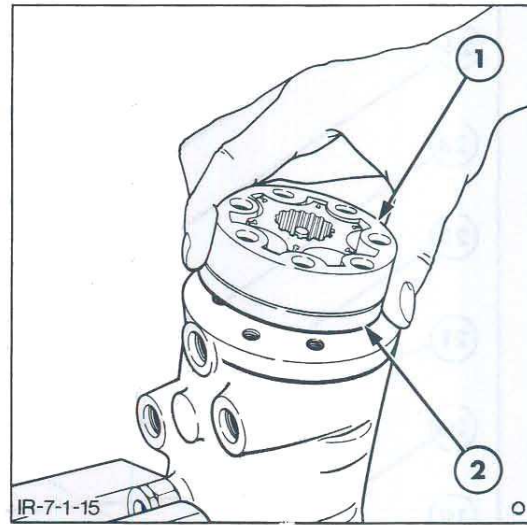
1. Insert an O-ring tube fitting, with a tube nut or fitting cap attached, into one of the four threaded ports in the housing. Clamp the fitting in a vice with the seven end cover bolts upright, Figure 15.

2. Withdraw the seven special bolts from the end cover.

**NOTE:** To ensure protection of the ground and lapped faces of the components, take care in the following steps to avoid scratching or nicking the finished surfaces.

3. Tap the end cover sideways with a soft headed hammer to loosen the seal and retainer. Lift the end cover from the unit.

**NOTE:** The wear washer and commutator may be stuck to the end cover by a film of oil. Do not attempt to remove the pin which is a press fit in the cover and is not serviceable.



**Figure 16**  
Steering Motor Metering Element

1. Metering Element
2. Spacer

4. Tap the seal retainer sideways with a soft headed hammer to remove the rotor seal retainer from the valve body. Discard the rotor seal.

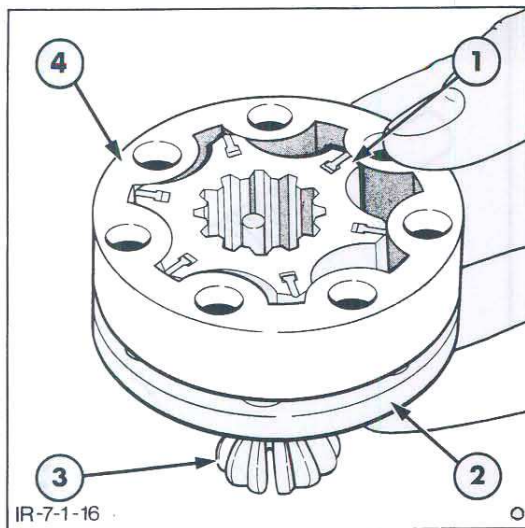
5. If they are not stuck to the end cover, lift the wear washer and commutator from the manifold.

6. Slide and lift the commutator ring from the manifold.

**NOTE:** Handle the fragile commutator ring with great care.

7. Slide and lift the manifold from the metering element.





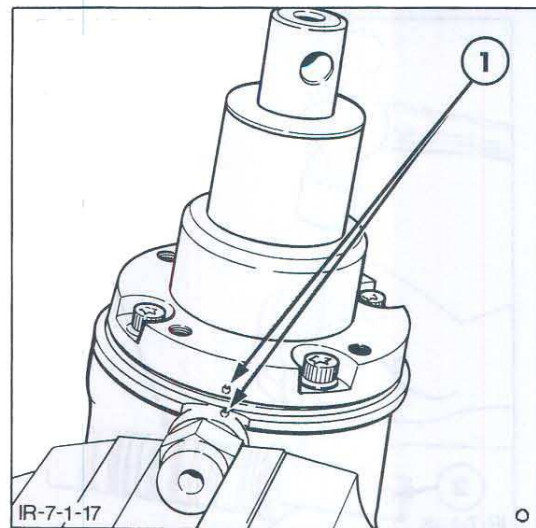
**Figure 17**  
Metering Element

- |           |               |
|-----------|---------------|
| 1. Rotor  | 3. Drive Link |
| 2. Spacer | 4. Stator     |

8. Grasp the spacer then slide and lift the metering element, spacer and drive link as an assembly, from the valve housing, Figure 16.

9. Separate the drive link by sliding the metering element on the spacer and 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 stop the vanes and springs from falling out. When handling the metering element, pressure should be applied to the rotor by gripping the metering element between the fingers and pressing the rotor into contact with the stator, Figure 17.

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



**Figure 18**  
Steering Motor Input Shaft

1. Alignment Marks

10. Reverse the unit in the vice with the input shaft in a vertical position. To facilitate re-assembly, use a centre punch to mark the upper cover assembly and the port face of the housing, Figure 18.

11. Remove the four special cap screws with a  $\frac{5}{16}$  inch 12-point socket.

12. Grasp the input shaft and, with a smooth upward motion, remove the input shaft, upper cover and spool assembly from the valve body.

**NOTE:** Do not apply side forces to the spool which will cause binding of the closely fitted assembly. Never use excessive force to remove the spool from the body.

13. Remove and discard the seal.

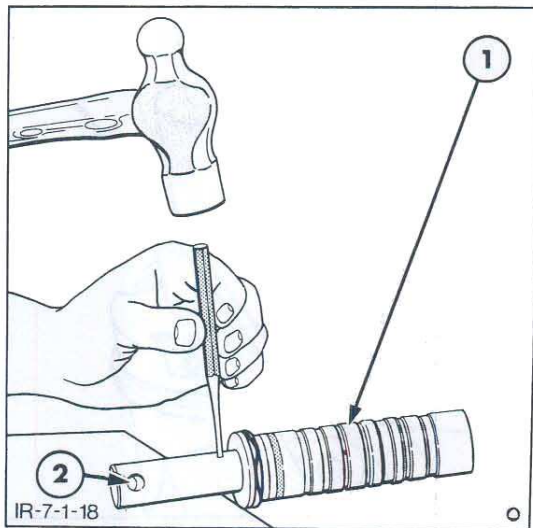


Figure 19

Steering Motor Input Shaft and Spool

- 1. Spool
- 2. Input Shaft

14. Remove the upper cover with the shaft seal intact.

15. Remove the shims from either the upper cover cavity or from the thrust washer face. To aid re-assembly, record the number of shims.

16. Remove the upper cover dirt seal. Extract the circlip and remove and discard the stepped washer and seal.

17. Remove the circlip, thrust washer, thrust bearing, thrust washer, spring washer and spacer from the input shaft.

18. Use a punch 0.12 in (3 mm) maximum diameter and 0.63 (16 mm) minimum length, to remove the torsion bar retaining pin. Place the input shaft on a block of wood and use light hammer blows to remove the pin, Figure 19.

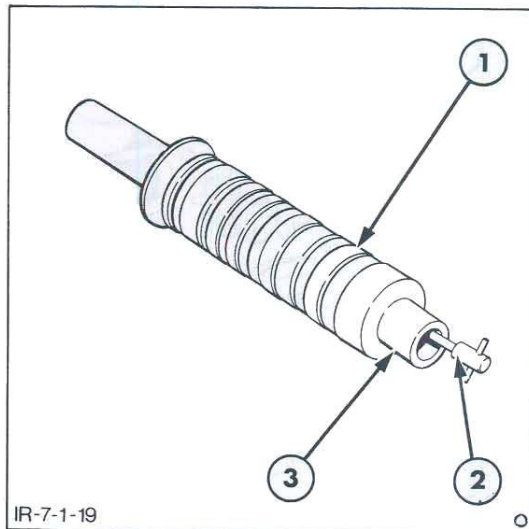


Figure 20

Torsion Bar and Spool

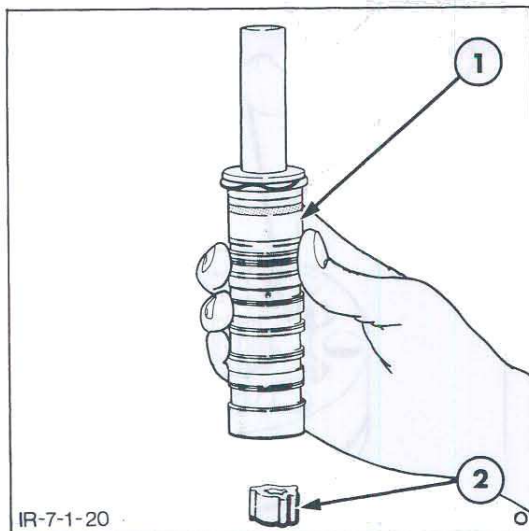
- 1. Spool
- 2. Torsion Bar
- 3. Spacer

19. Invert the spool assembly and allow the torsion bar and spacer to fall free Figure 20. Do not remove the pin from the end of the torsion bar.

20. Place the end of the spool on a flat surface and rotate the input shaft full left and full right until the drive ring falls free, Figure 21.

21. Keep the spool assembly in the same position and rotate the input shaft in a clockwise direction until the steel ball disengages from the helical groove in the input shaft. Lift out the input shaft.

**IMPORTANT:** Take care not to loose the steel ball which may fall free.



**Figure 21**  
Drive Ring Removal

1. Spool
2. Drive Ring

22. Do not remove the ball retainer spring unless replacement is required. If the spring has to be removed, grasp the flattened end with pliers and lift over the shoulder on the spool. Continue to pull and remove the retainer spring. A screwdriver may be used to pry the spring over the shoulder of the spool. Take care to avoid scratching or nicking the spool outside diameter edges.

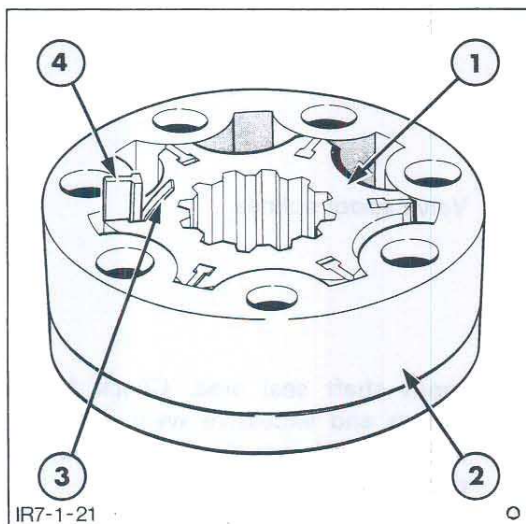
## INSPECTION AND REPAIR

1. Inspect and replace all damaged or worn parts. The following finished surfaces should be inspected for abnormal wear, scoring or damage.

- Housing bore and ends.
- Valve spool outside diameter. Some acceptable burnishing due to use may be observed.

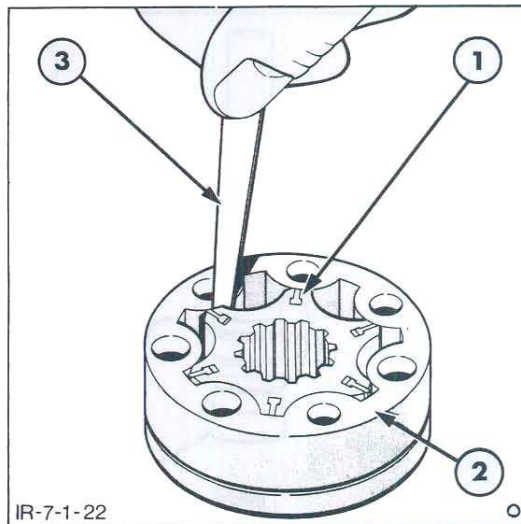
- Valve spool edges.
- Valve spool splines.
- Input shaft seal area. Check for rust, pitting and excessive wear. Acceptable light circumferential polishing due to seal contact may be observed.
- Input shaft helical groove. Note the contact pattern created by the actuator ball. The surface should be free from pits, chipping or surface breakdown.
- Thrust bearing and thrust washers. Inspect for pitting of the rollers and faces of the thrust washers.
- Drive link pin slot. The width of the slot must not vary more than 0.001 in (0.025 mm) along the entire length.
- Drive link teeth.
- Torsion bar and pin assembly. The diameter of the pin should not vary more than 0.001 in (0.025 mm).





**Figure 22**  
Metering Element

- |           |                |
|-----------|----------------|
| 1. Rotor  | 3. Vane Spring |
| 2. Stator | 4. Vane        |



**Figure 23**  
Rotor to Stator Check

- |           |                 |
|-----------|-----------------|
| 1. Rotor  | 3. Feeler Gauge |
| 2. Stator |                 |

2. 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.

- Spacer.
- Manifold.
- Rotor.
- End cover and pin assembly.
- Commutator.

**NOTE:** The difference in thickness between the commutator and the commutator ring must not exceed 0.0015 in (0.038 mm).

3. Handle the metering element with great care to avoid nicks and scratches. It is recommended that the rotor, stator vanes and springs be checked whilst assembled. To inspect the metering element, place the assembly face down on the lapped face of the end cover and check for freedom of rotor rotation within the stator. The action of the spring loaded vanes may be observed during rotation. The vanes should move freely in their slots without binding, Figure 22. Use a feeler gauge to check the rotor to stator clearance as shown in Figure 23. If the clearance is more than 0.006 in (0.15 mm) the metering element must be replaced.

4. Carefully separate the metering element components and measure the thickness of the rotor and the stator. The difference between the rotor and the stator must not exceed 0.002 in (0.05 mm).

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

## RE-ASSEMBLY

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

1. Re-clamp the valve body in the vice by means of the hose fitting.

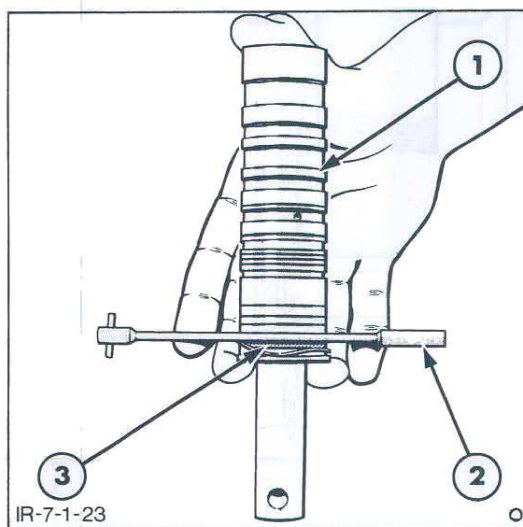
2. Assemble the small thrust washer, thrust bearing, large thrust washer and circlip on the input shaft.

3. If the actuating ball retaining spring has been removed, install a new retaining spring.

4. Hold the spool in a horizontal position and insert the steel ball into the ball seat located inside the spool.

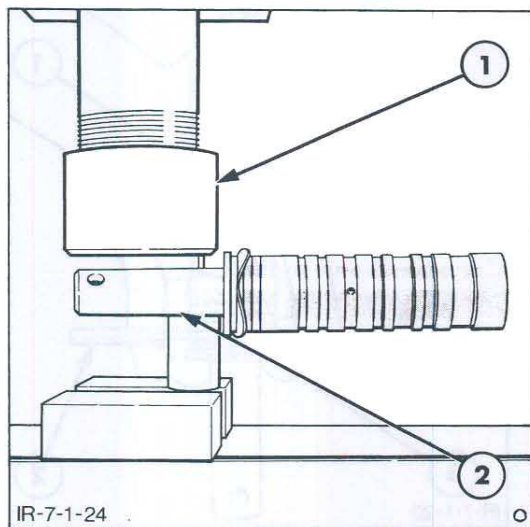
5. Assemble the spring washer over the thrust washer and thrust bearing. Insert the input shaft into the spool and engage the helix and ball with a counter clockwise motion.

6. Using the mid-section of the torsion bar as a gauge, insert the gauge between the spool end and the thrust washer, Figure 24.



**Figure 24**  
Using Torsion Bar as a Gauge

- |                |                  |
|----------------|------------------|
| 1. Spool       | 3. Thrust Washer |
| 2. Torsion Bar |                  |
7. Place the input shaft and spool assembly in a vertical position with the shaft end on a flat surface.
  8. Insert the drive ring into the spool end by aligning an internal space on the drive ring with a tooth on the input shaft spline and allow the drive ring to drop to the limit of 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.
  9. Install the spacer over the torsion bar and pin assembly and insert the assembly into the spool end.



**Figure 25**  
Pressing Pin Into Input Shaft

1. Press Arbor
2. Input Shaft

10. Align the cross-hole in the torsion bar with the cross-hole in the input shaft and insert the 0.12 in (3 mm) diameter pin punch to maintain alignment.

11. Insert the pin into the cross-hole in the input shaft and, whilst retracting the pin punch, engage the pin in the torsion bar cross-hole.

12. Press the pin flush with the outside diameter of the input shaft, Figure 25. With a few light taps on the 0.12 in (3 mm) diameter pin punch, drive the pin approximately 0.03 in (0.8 mm) below the input shaft outside diameter.

13. Slip the spacer over the spool ensuring that the stepped internal end of the spacer abuts the spring washer. Place the spool assembly into the motor housing.

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

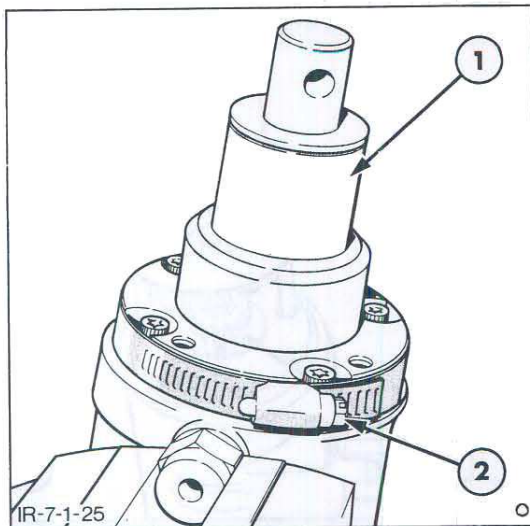
14. If neither the input shaft nor the upper cover are replaced, the original shims may be re-used. If the shims are damaged, replace with shims of the same thickness.

Place the shims on top of the thrust washer.

Coat the 'O' ring seal with clean grease and place in the upper cover counter-bore. Assemble the upper cover to the input shaft and rotate to align the punch marks previously made during disassembly.

**NOTE:** If a new upper cover is used then no angular alignment is required. However, the upper cover and housing must be aligned axially.





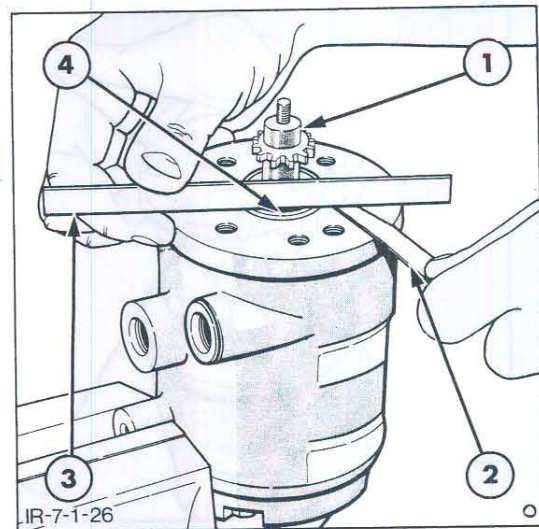
**Figure 26**  
Upper Cover Installation

1. Upper Cover
2. Hose Clamp

15. Install the upper cover screws finger tight. Use a pilot ring, or a worm drive type hose clamp tightened around the upper cover flange and the body pilot diameter, to achieve the required alignment, Figure 26. Tighten the screws to the correct torque, see 'Specifications' – Chapter 5.

**NOTE:** If either the input shaft or upper cover or both have been replaced, the following procedure for shimming must be used.

- (a) Reassemble as above, using the required new parts and shims of same thickness as previously removed.
- (b) Revolve the unit in the vice so the input shaft is pointing downwards.
- (c) Pull the input shaft down and prevent rotation then engage the drive link splines in the spool. Rotate the shaft until the spool is flush with the end of the housing.



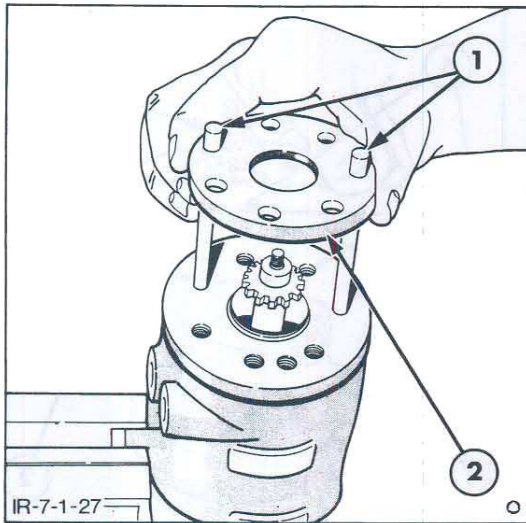
**Figure 27**  
Shimming on Final Assembly

1. Drive Link
2. Feeler Gauge
3. Straight Edge
4. Spool

(d) Remove the drive link then align the drive link slot to engage the torsion bar pin and fully insert the drive link.

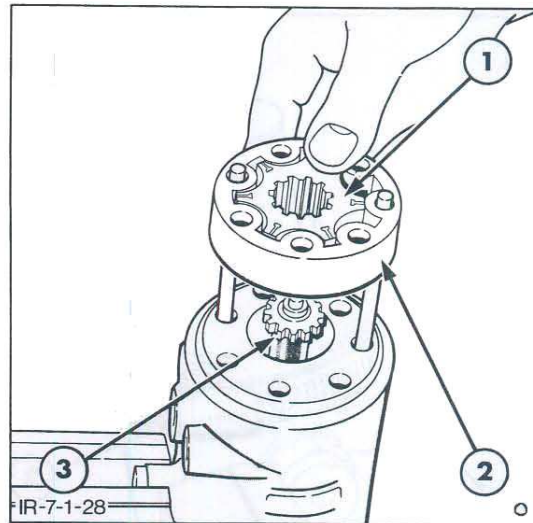
**NOTE:** To achieve engagement, the spool may have to turn slightly relative to the body.

- (e) Using a feeler gauge and straight edge measure the relationship of the spool end to the housing. The spool must be flush to no more than 0.0025 in. (0.064 mm), above the face of the housing Figure 27.
- (f) If the spool end is not within the specifications, add or remove shims in the upper cover according to the shim sizes available, see 'Specifications' – Chapter 5.



**Figure 28**  
Spacer Installation

1. Assembly Posts
2. Spacer



**Figure 29**  
Metering Element Installation

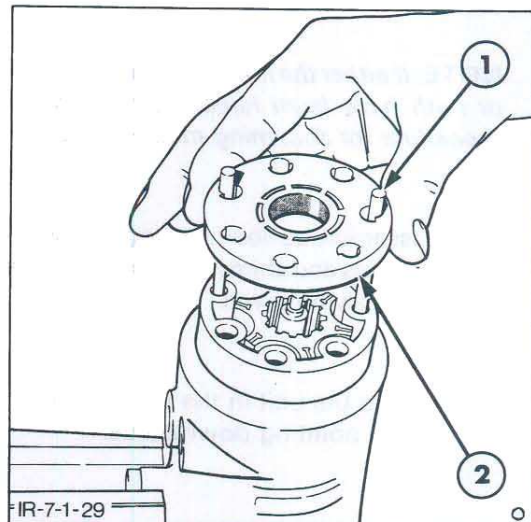
1. Rotor
2. Stator
3. Drive Link

16. With the drive link installed, assemble two assembly posts into the housing as shown in Figure 28. These assembly posts can be made by cutting the heads off two bolts similar to the special end cover bolts.

19. Install the manifold over the assembly posts and onto the metering element. Ensure the circular slot side of the manifold faces upwards, Figure 30.

17. Assemble the spacer plate over the assembly posts and onto the housing with the plain side up.

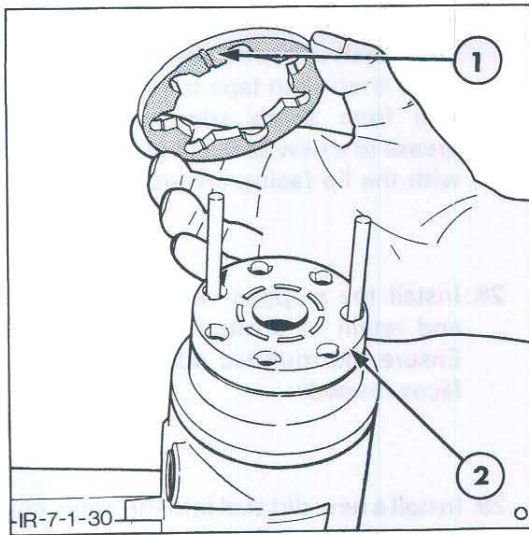
18. Install the geroter (metering element) over the assembly posts and drive link splines, Figure 29.



**Figure 30**  
Manifold Installation

1. Assembly Posts
2. Manifold

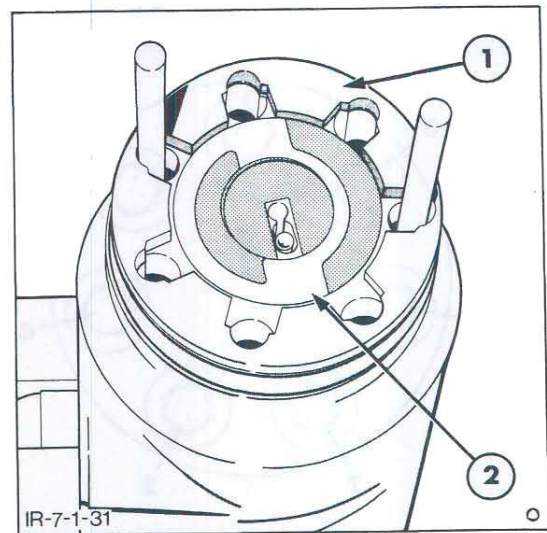
**IMPORTANT:** All vane springs must be down in their slots with no part of any spring protruding from either side of the metering element.



**Figure 31**  
Commutator Ring

1. Slot
2. Manifold

20. Install the commutator ring over the assembly posts and onto the manifold. Ensure the slot side of the ring faces the manifold, Figure 31.



**Figure 32**  
Commutator Installation

1. Commutator Ring
2. Commutator

23. Apply a few drops of hydraulic oil on the commutator and manifold.

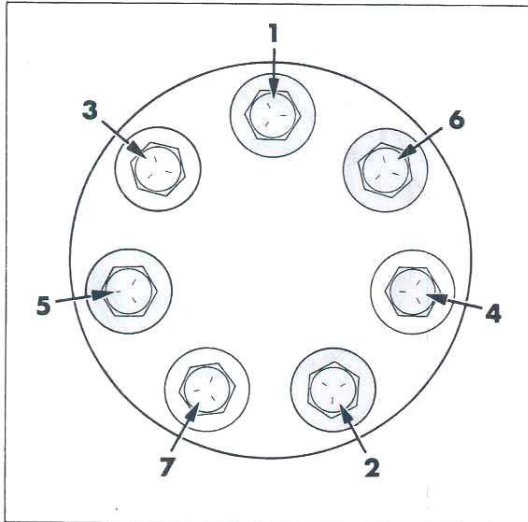
21. With the counterbore side of the commutator upwards, assemble the commutator into the commutator ring with the slotted hole in the commutator engaging the nose on the drive link. Align the commutator outside diameter concentric with the inside diameter of the commutator ring, Figure 32.

24. Apply a small amount of clean grease to the washer. Install the washer over the pin in the end cover. The grease should hold the washer to the end cover.

22. Install the rotor seal and seal retainer over the metering element allowing the seal and retainer to rest on the housing assembly.

25. Assemble the end cover, with the washer attached, over the assembly posts and onto the steering motor ensuring that the pin is engaged in the centre hole of the commutator.





**Figure 33**  
Steering Motor End Cover Bolt  
Tightening Sequence

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

**IMPORTANT:** *Finish tightening the seven special bolts according to the following procedure. Do not over-tighten as irreparable damage will occur.*

- (a) *Tighten all seven bolts to 2-3 lbf.ft (2.7 – 3.6 Nm) (0.3 – 0.4 Mkg) in the sequence shown in Figure 33.*
- (b) *Tighten all seven bolts to 17 lbf.ft (23 Nm) (2.3 Mkg), in the sequence shown in Figure 33.*
- (c) *Check that the unit will rotate when a torque of no more than 100 lbf.in (11 Nm) (1.2 Mkg) is applied to the input shaft.*

27. Re-locate the unit in the vice with the input shaft upwards. Cover the end of the input shaft with tape to protect the new seal from sharp edges. Apply clean grease to a new seal and gently assemble with the lip facing inwards.

28. Install the stepped washer flat side up and retain in position with the circlip. Ensure the rounded edge of the circlip faces inwards.

29. Install a new dirt seal into the upper cover counterbore.

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

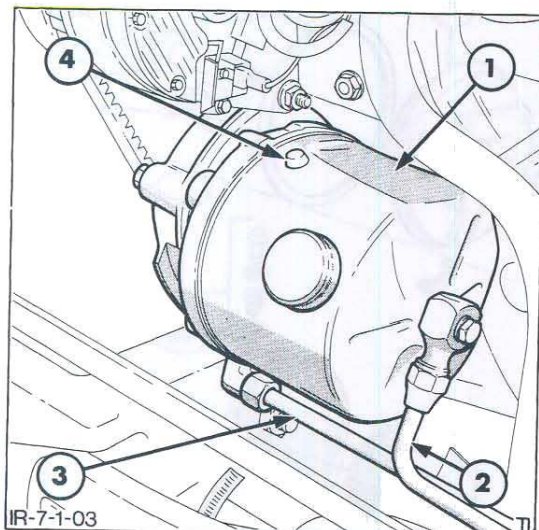
31. Plug the inlet and outlet port holes to prevent the entry of dirt.

## INSTALLATION

Installation of the steering motor assembly follows the removal procedure in reverse. On installation observe the following requirements:

- Tighten all nuts, bolts and connections to the correct torques, see 'Specifications' – Chapter 5.
- Fill the power steering reservoir with the correct grade of oil, see 'specifications' – Chapter 5 and purge the air from the system as described in Section F "BLEEDING THE STEERING SYSTEM".

## C. POWER STEERING PUMP AND RESERVOIR – OVERHAUL



**Figure 34**  
Steering Pump and Reservoir Installation

1. Reservoir Filler Cap
2. Inlet Tube – Low Pressure
3. Outlet Tube – Pressurised
4. Breather

**REMOVAL**

1. Support a suitable container under the pump and reservoir assembly.
2. Disconnect the pump pressure and return tube and allow the oil to drain. Refer to Figure 34.
3. Plug the disconnected tubes and ports to prevent the entry of dirt.
4. Extract the bolts retaining the pump in the timing gear casing.
5. Remove the pump from the Unit and drain the remaining oil from the reservoir.

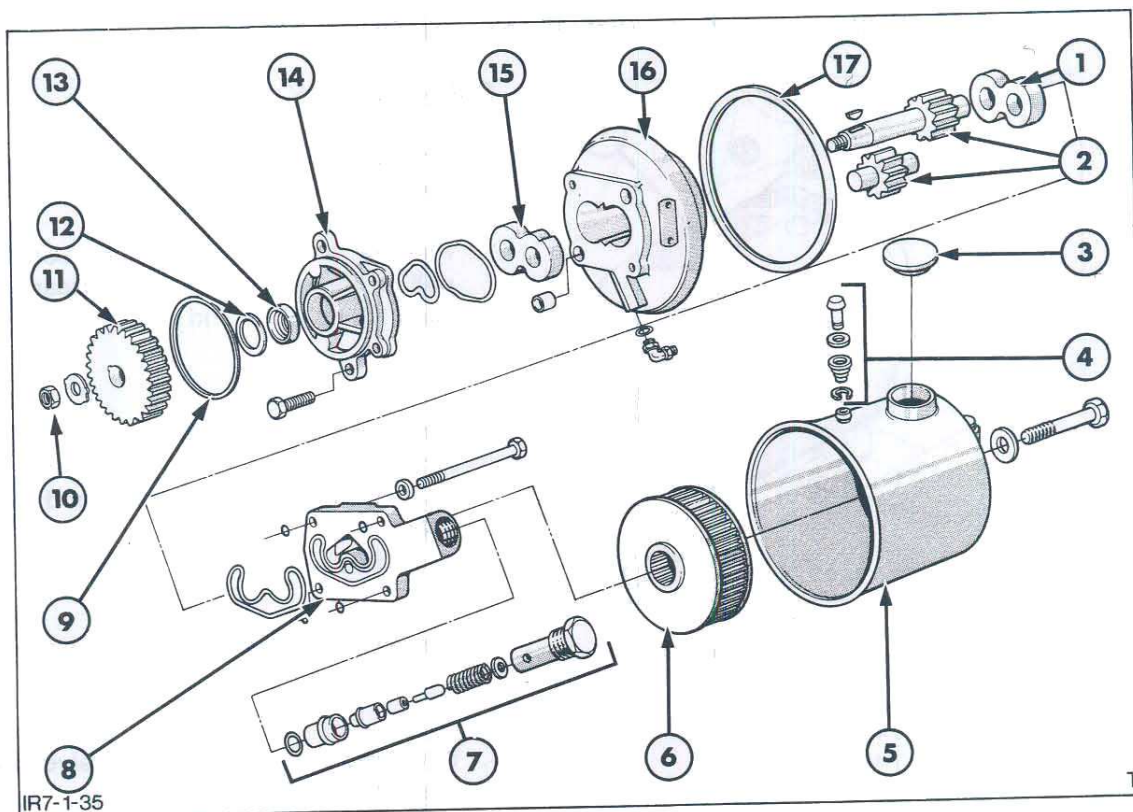
**DISASSEMBLY**

Refer to Figure 35 for Component Identity.

1. Remove the reservoir retaining bolt and pull off the reservoir casing. Discard the large 'O' ring seal and filter element.
2. Straighten the tab on the lockwasher locating the drive gear retaining nut. Remove the nut, lockwasher and drive gear.
3. Remove the key from the drive gear shaft.
4. Withdraw the pressure relief valve from the pump body.
5. Remove the four bolts and separate the pump end cover and pump flange from the pump body.
6. Noting their positions relative to the pump body for re-assembly, remove the bearing blocks and pump gears.
7. Remove the snap ring retaining the drive shaft oil seal in the pump flange and extract the oil seal.

**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.



**Figure 35**  
Steering Pump and Reservoir

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

- Examine the pump body and gears for wear or damage.

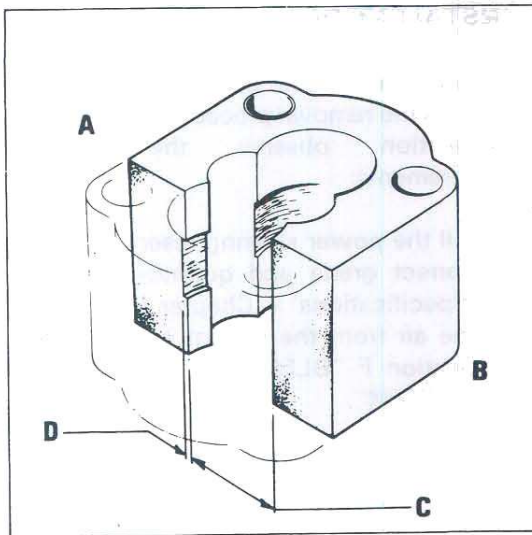
The wear track on the inlet side of the pump body interior should be free from scoring and no deeper than 0.0025 in. (0.064 mm) Figure 36.

The pump gears should not be scored or pitted. Run-out across the gear face to the tooth edge should not exceed

0.001 in. (0.025 mm). Shaft journals can be polished lightly with "O" grade emery paper and paraffin (kerosene) to remove wear marks. Gear faces may be polished by sandwiching the emery paper between the gear face and a scrap bearing block, then rotating the gear.

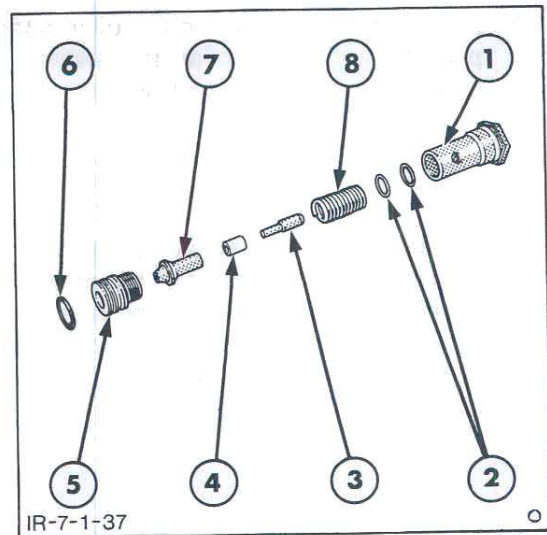
The pump body and gears are not supplied for service, if they are excessively worn a complete replacement pump must be installed.





**Figure 36**  
Gear Track in Body

- A. Inlet Side
- B. Outlet Side
- C. Bore Diameter
- D. Depth of Gear Track



**Figure 37**  
Steering Pump Pressure Relief Valve

- |               |               |
|---------------|---------------|
| 1. Valve Head | 5. Valve Seat |
| 2. Shims      | 6. 'O' Ring   |
| 3. Pins       | 7. Valve      |
| 4. Seal       | 8. Spring     |

3. Inspect the bearing blocks for signs of seizure or scoring. Light scoring on the sides can be removed by careful lapping on a surface plate using 'O' grade emery paper and paraffin (kerosene), ensure such parts are thoroughly washed and dried prior to re-assembly. Should the wear be excessive install new bearing blocks.
4. Use the soft jaws of a vice to grip the seat of the pump pressure relief valve then unscrew the head and body. Check the components for wear or swarf contamination, Figure 37.

### RE-ASSEMBLY

Re-assembly of the power steering pump follows the disassembly procedure in reverse. On re-assembly observe the following requirements:

- All rubber seals, 'O' rings and the drive shaft oil seal must be replaced.

- Apply grease to specification ESN M1C137-B to the drive shaft oil seal and the pump body bolt 'O' ring seals.

- Ensure correct installation of the bearing blocks and seals.

- Tighten the four through bolts evenly and to the correct torque, see 'Specifications' – Chapter 5.

- Install a new lockwasher under the pump drive gear retaining nut. Tighten the nut to the correct torque, see 'Specifications' – Chapter 5, and secure with the lockwasher tab.

- Pour a small quantity of clean oil into the pump for initial lubrication and ensure the pump drive can be turned by hand.
- Install a new oil filter element. Tighten the reservoir retaining bolt until the reservoir engages the reservoir 'O' ring seal then tighten the bolt to the specified torque which is usually achieved after one turn of the bolt.

## INSTALLATION

Installation of the power steering pump follows the removal procedure in reverse. On installation observe the following requirements:

- Fill the power steering reservoir with the correct grade and quantity of oil, see 'Specifications' – Chapter 5, and purge the air from the system as described in Section F "BLEEDING THE STEERING SYSTEM".

## D. POWER STEERING PUMP – PRESSURE TESTING

1. Turn the steering wheel until the wheels are on a full right hand lock.
2. **Two Wheel Drive Units**  
Raise and securely support the front of the Unit to enable the axle to oscillate.
3. Raise and securely support the left hand end of the axle to prevent any axle movement and allow easier access to the steering cylinder hose connections.
4. Disconnect the pressure 'IN' steering hose connection from the cylinder and using adaptors FT.8541, FT.8503-8 and Ford hose Part No. E1NN F493 AA connect pressure gauge FT.8503-A to the steering hose, Figures 38 and 39.
5. Start the engine and operate at 1100 rev/min.
6. Turn the steering wheel as for a right turn. Record the gauge reading then stop the engine.
7. Disconnect the pressure testing equipment and repeat the above installation and test procedure for the steering system performing a full left hand lock.
8. If the pressure readings on both locks are different it is an indication of concern within the steering motor and the steering motor should be overhauled as detailed in Chapter 1. If the pressure readings are similar but not to the Specified value, see "Specifications" – Chapter 5, remove the relief valve in the power steering pump and adjust the shims as follows:
  - (i) With a suitable container held under the pump assembly, disconnect the return pipe.
  - (ii) Remove the reservoir casing and carefully drain the oil.
  - (iii) Extract the pressure relief valve, Figure 40.

**IMPORTANT:** *Operate the engine just long enough to obtain an accurate reading. Prolonged operation will cause overheating and damage.*



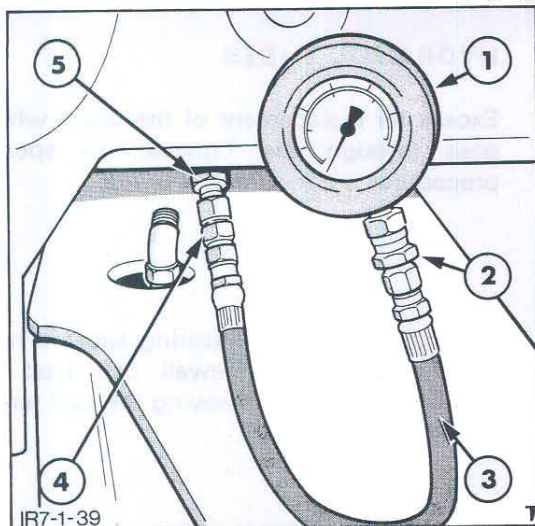


Figure 38

Pressure Test Gauge Installation  
Two Wheel Drive Units on Right Hand Lock

1. High Pressure Gauge; Tool No. FT.8503A
2. Adaptor; Tool No. FT.8503-8
3. Ford Hose; Part No. E1NN-F493AA
4. Adaptor; Tool No. FT.8541
5. Pressure 'IN' Steering Hose

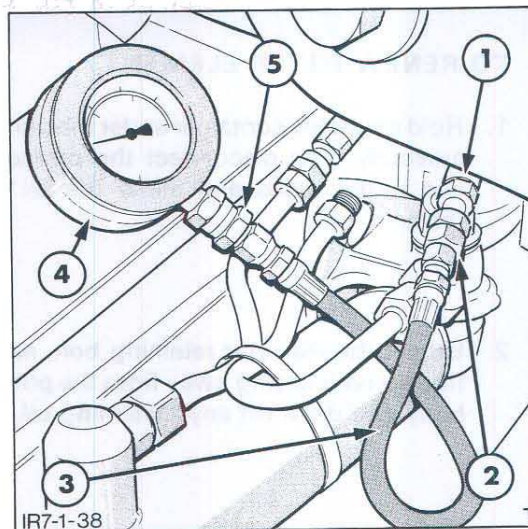


Figure 39

Pressure Test Gauge Installation  
Front Wheel Drive Units on Right Hand Lock

1. Pressure 'IN' Steering Hose
2. Adaptor; Tool No. FT.8541
3. Ford Hose; Part No. E1NN-F493AA
4. High Pressure Gauge; Tool No. FT.8503A
5. Adaptor; Tool No. FT.8503-8

(iv) Use the soft jaws of a vice to grip the seat of the pressure relief valve then unscrew the head and body.

(v) Carefully withdraw the pressure relief valve, pin, seal and spring, and add or subtract shims as required. Refer to Figure 37.

**NOTE:** For every 0.01 in. (0.25 mm) increase in shim thickness, the pressure relief valve setting is increased by 70 lbf/in<sup>2</sup> (4.8 bar, 4.9 kgf/cm<sup>2</sup>).

(vi) Reassemble the valve and install into the pump body. Tighten the valve to the correct torque, see "Specifications" – Chapter 5.

6. Reassemble the filter and reservoir, refill the reservoir and re-test the relief valve pressure setting.

7. Fill the power steering reservoir with the correct grade of oil, see "Specifications" – Chapter 5 and purge the air from the system as described in Section F "BLEEDING THE STEERING SYSTEM".

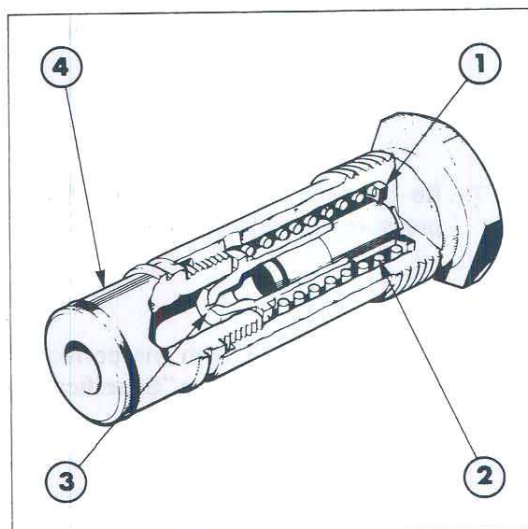


Figure 40

Pressure Relief Valve

- |           |               |
|-----------|---------------|
| 1. Shims  | 3. Valve      |
| 2. Spring | 4. Valve Seat |



## E. RESERVOIR FILTER AND HYDRAULIC TUBES

### TO RENEW FILTER ELEMENT

1. Hold a suitable container under the pump assembly then disconnect the pressure and return tubes and allow the oil to drain.
2. Extract the reservoir retaining bolt, ease the reservoir casing away from the pump body and drain off any remaining oil.
3. Discard the old filter element.
4. Clean the reservoir casing with a suitable solvent and dry with a lint-free cloth.
5. Inspect the large reservoir sealing ring and retaining bolt sealing washer for damage and replace if necessary.
6. Install a new filter element and replace the reservoir.
7. Re-connect the power steering pump pressure and return tubes.
8. Fill the reservoir with the correct grade and quantity of oil, see "Specifications" – Chapter 5.
9. Operate the steering from lock-to-lock several times with the engine running to expel any air from the system then re-check the oil level.

### HYDRAULIC TUBES

Except for replacement of the tubes which pass through the firewall, no special procedures are required.

Servicing the power steering tubes which pass through the firewall can best be accomplished after removing the fuel tank.

When replacing the power steering tube firewall grommet lubricate the grommet with soap to ease installation into the firewalls.

**NOTE:** Check all tubes and hoses after installation to assure there is no possibility of chafing or rubbing.

When examining the steering system check the tubes and hoses as follows:

1. Inspect the hydraulic tubes for leakage at connections. Replace oil seals (where fitted) and tighten loose connections.
2. Check the tubes for signs of fracture and renew if necessary.
3. Examine flexible hoses for cracks or chafing and renew if required.

**F. BLEEDING STEERING SYSTEM**

1. Fill the reservoir with the correct oil see "Specifications" – Chapter 5.
  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 piston 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.





# PART 7

## STEERING AND FRONT AXLE

### Chapter 2

#### TWO WHEEL DRIVE FRONT AXLE

Section	Page
A. FRONT AXLE – DESCRIPTION	1
B. TOE-IN – ADJUSTMENT	2
C. FRONT WHEEL HUB AND SPINDLE – OVERHAUL	4
D. STEERING CYLINDER AND TRACK CONTROL ROD – OVERHAUL	7
E. FRONT AXLE – OVERHAUL	12

#### A. FRONT AXLE – DESCRIPTION

The Two Wheel Drive Front Axle, Figure 1, is centrally mounted on the front support by two support caps. The support caps locate on the axle trunnion bushes and allow the axle to oscillate when traversing over rough terrain.

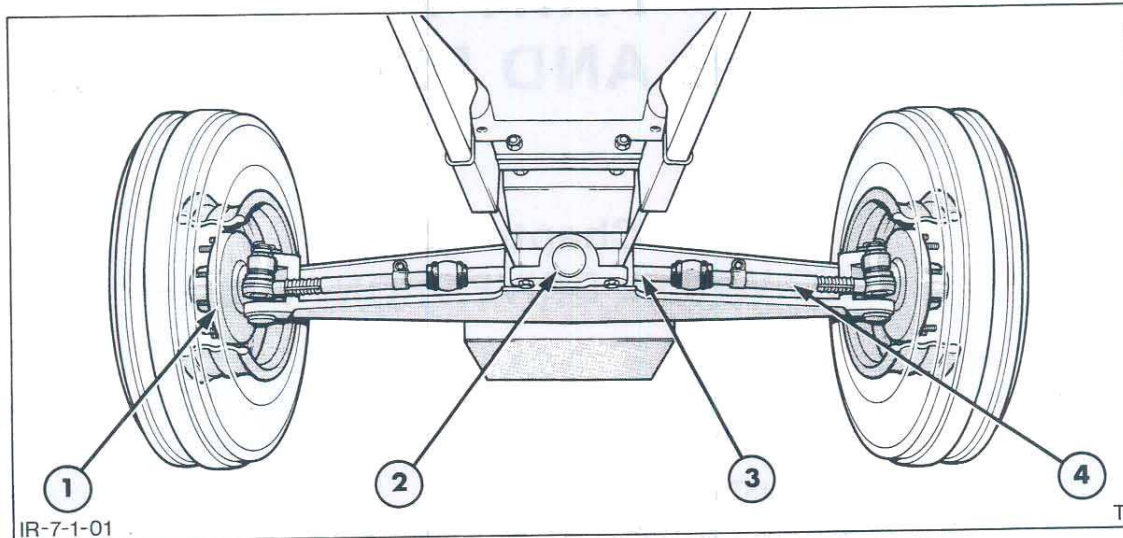
The hub and spindle assemblies are attached to the axle by spindle pins which pass through the spindle assembly and locate in machined castings welded on each end of the axle beam. The spindle pin is locked to the spindle by a locking pin but swivels in greasable bushings housed in the machined axle castings.

The vertical thrust of each spindle is supported by a thrust bearing located

between the top of the spindle and the axle casting.

The steering cylinder is clamped in the centre of the axle housing and retained in position by a locking plate and two studs. The track control rod assemblies are connected between the wheel spindle arms and the cylinder piston rod which protrudes through both ends of the cylinder.

The non adjustable front wheel track width is 62 inches (1575 mm) on 455C models and 70 inches (1778 mm) on 555C and 655C Units.



**Figure 1**  
Front Axle Assembly

- |                                    |                      |
|------------------------------------|----------------------|
| 1. Hub and Spindle Assembly        | 3. Steering Cylinder |
| 2. Oscillation Bearing Support Cap | 4. Track Control Rod |

## B. TOE-IN ADJUSTMENT

The toe-in for 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 as follows:

1. On flat level ground slowly drive the tractor in a straight line for at least 10 feet (2 metres). Stop the Unit and ensure the front wheels remain in the straight ahead position.
2. Mark the inboard rim of each front wheel towards the front at wheel centre height.
3. Measure and note the distance between the two marks, call this dimension A. Refer to Figure 2.
4. Maintain the straight ahead position and move the Unit forward so the wheels rotate through 180° and the marks on the wheels face the rear at wheel centre height.

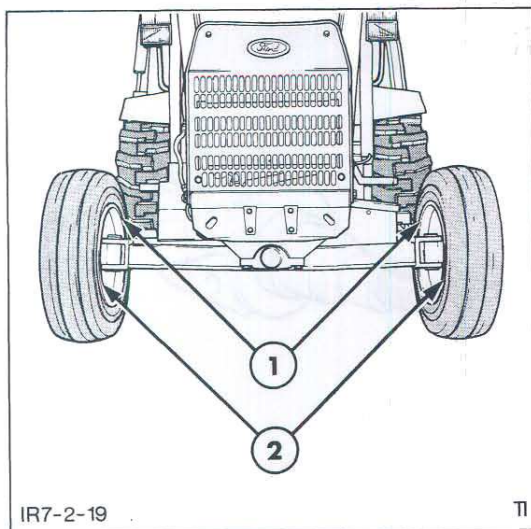


Figure 2

Front Wheel Toe-in Measurements

1. Rear Track Width (Dimension B)
2. Front Track Width (Dimension A)

5. Again measure and note the distance between the two marks, call this dimension B.

**NOTE:** If dimension A is larger, then  $A-B$  gives the toe-out. If dimension B is larger, then  $B-A$  gives the toe-in.

For specified toe-in see "Specifications" – Chapter 5.

To ensure accurate results it is recommended that the above procedure is completed three times with three different marks equally spaced around each wheel rim and the average dimension for toe-in calculated.

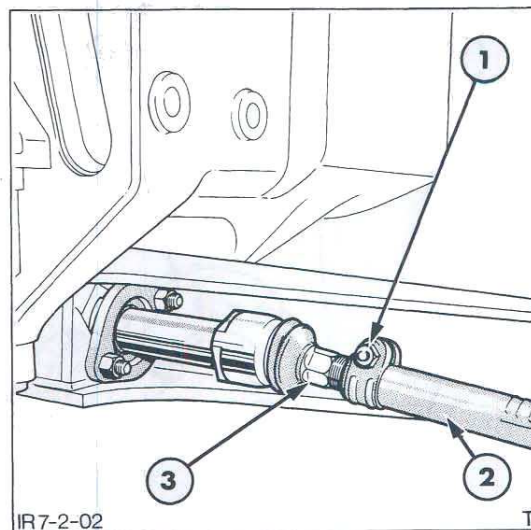


Figure 3

Track Control Rod Adjustment

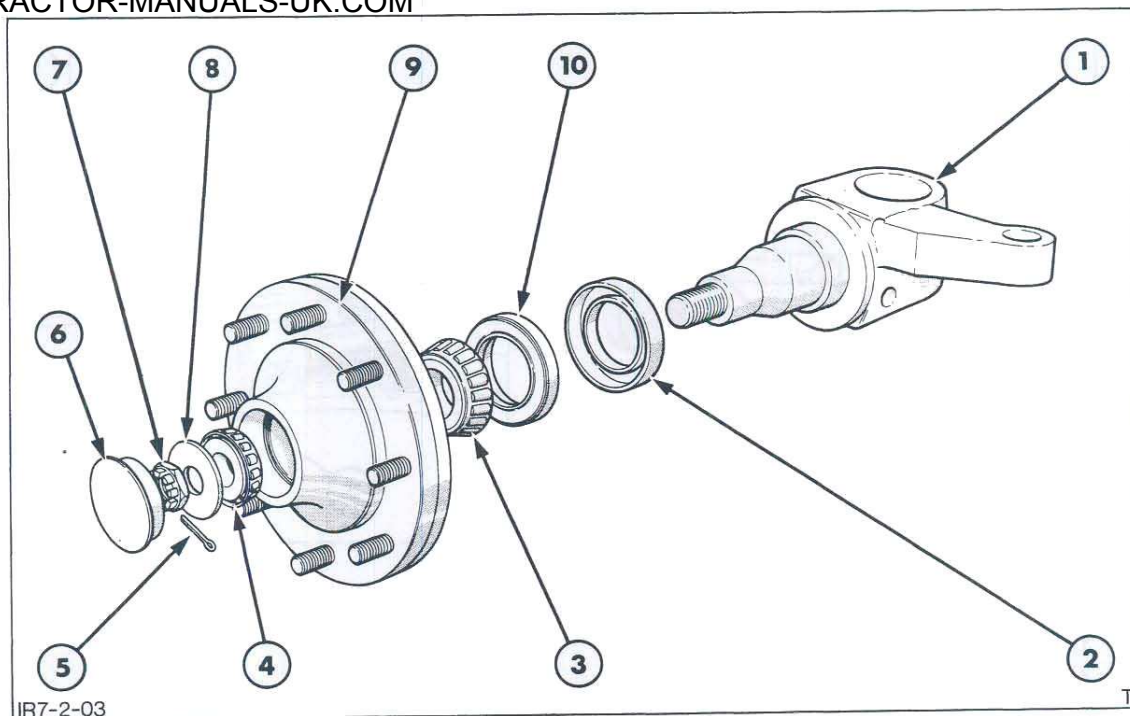
1. Clamp Bolt
2. Track Control Rod
3. Hexagon Adjuster

This method minimises any inaccuracy due to wheel rim run-out.

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

1. Loosen the clamp bolt on each track control rod, Figure 3.
2. Rotate the hexagon adjuster in order to achieve the specified toe-in. Ensure that this adjustment is carried out equally on both track rods.
3. After the correct toe-in is obtained, tighten the clamp nuts.
4. Re-check the toe-in as outlined above and readjust if necessary.





**Figure 4**  
Hub and Spindle Assembly

- |                  |                         |                     |
|------------------|-------------------------|---------------------|
| 1. Spindle       | 5. Cotter Pin           | 8. Washer           |
| 2. Mud Shield    | 6. Grease Retaining Cap | 9. Hub              |
| 3. Inner Bearing | 7. Castellated Nut      | 10. Grease Retainer |
| 4. Outer Bearing |                         |                     |

## C. FRONT WHEEL HUB AND SPINDLE – OVERHAUL

### REMOVAL

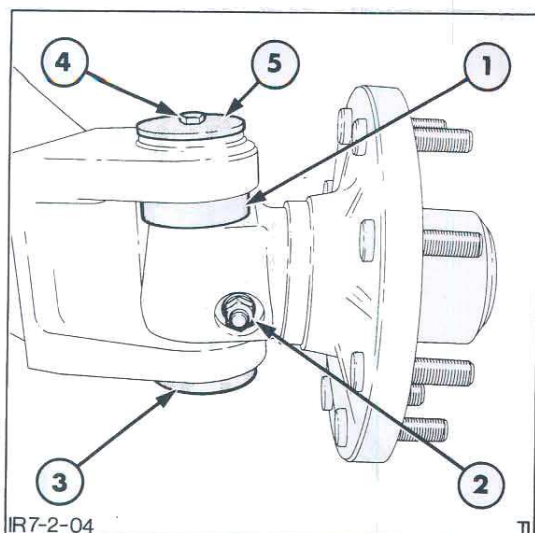
With reference to Figure 4

#### Hub and Bearing Removal

1. Using a suitable jack or hoist, support the front end of the unit.
2. Remove the front wheel.
3. Remove the front wheel hub grease retaining cap.
4. Remove the split pin and castellated nut.
5. Pull the hub assembly from the spindle and retrieve the washer and outer bearing.
6. Remove the inner bearing, grease retainer and mud shield from the spindle.

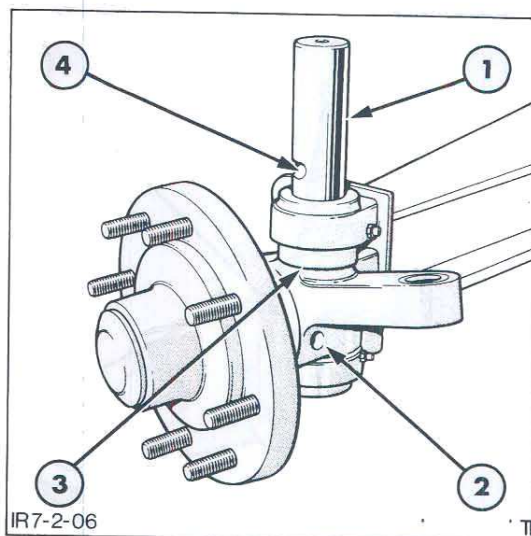
#### Spindle Removal

1. Disconnect the track control rod from the spindle arm.
2. Remove the bolts retaining the dust seals on each end of the spindle pin, Figure 5.
3. Remove the nut and lock washer from the spindle locking pin and drive out the pin.
4. Drive the spindle pin from the axle housing, refer to Figure 6.
5. Remove the spindle assembly and thrust bearing from the axle.
6. Remove and discard the seal located in the bottom of the spindle.



**Figure 5**  
Spindle Installation

- |                   |              |
|-------------------|--------------|
| 1. Thrust Bearing | 4. Bolt      |
| 2. Locking Pin    | 5. Dust Seal |
| 3. Dust Seal      |              |

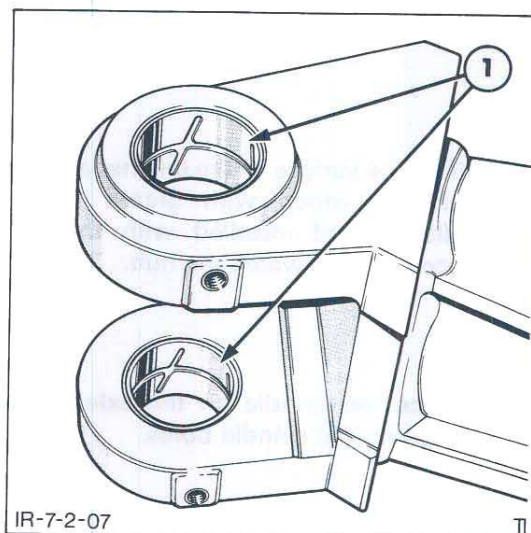


**Figure 6**  
Spindle Pin Removal

- |                     |                   |
|---------------------|-------------------|
| 1. Spindle Pin      | 3. Thrust Bearing |
| 2. Locking pin bore | 4. Notch          |

### INSPECTION AND REPAIR

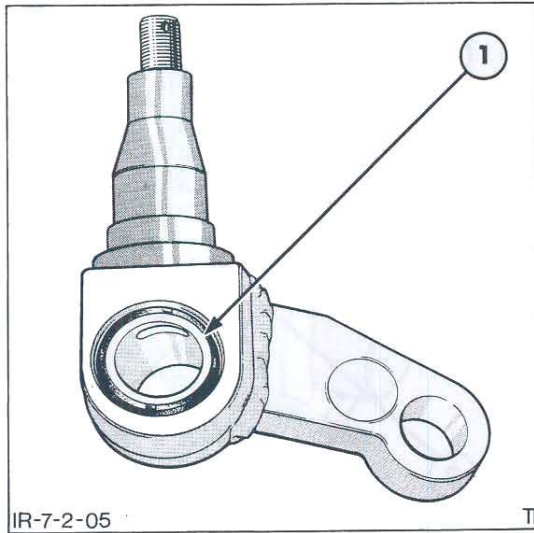
1. Clean all components with a suitable solvent and allow to dry.
2. Inspect the inner and outer bearings and cups for wear and damage. Install new parts as necessary. The bearings if worn should be replaced as an assembly and when installing bearing cups in the hub, ensure they are seated correctly against the shoulder in the bore.
3. Inspect the grease retainer bearing surface in the hub for scoring. If slight marking is evident, polish smooth with a fine abrasive. If scoring is excessive or damage is evident, install a new hub assembly.
4. Inspect the spindle pin bushes in the axle for wear, cracks or scoring, Figure 7. If the pin fit is poor or any side play was noticed before disassembly, install new bushings. The bushings can be removed and installed with bushing kit, Tool No. 818 or 9514.
5. Inspect the spindle pin for abnormal wear or scoring. Install a new pin if necessary.
6. If noisy thrust bearings were reported or the bearing race is scored or damaged, install a new bearing.



**Figure 7**  
Axle Spindle Pin Bushes

1. Bushes

**NOTE:** When installing new bushings the holes in the bushings must be aligned with the corresponding hole for the grease fitting.



**Figure 8**  
Spindle Oil Seal

1. Oil Seal

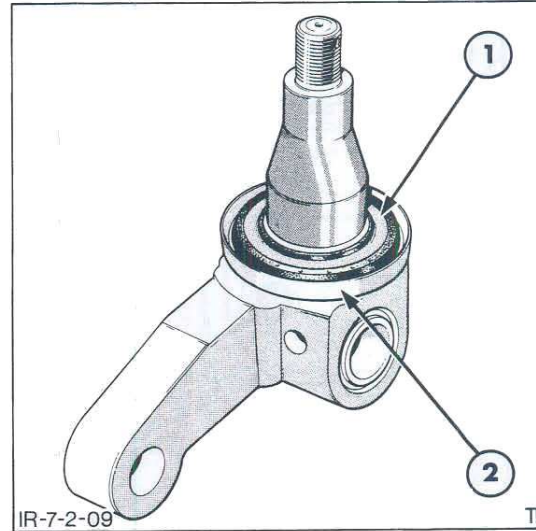
## INSTALLATION

1. Press a new seal into the base of the spindle, Figure 8.

2. Using a suitable sized sleeve install the mud shield and grease retainer on the wheel spindle. Refer to Figure 9.

**NOTE:** The surface of the retainer assembly should be wiped with grease prior to installation and installed with the metal surface facing towards the hub.

3. Place the spindle on the axle casting, aligning the spindle bores.
4. Apply grease to the thrust bearing and place the bearing between the axle and spindle pin bores.



**Figure 9**  
Mud Shield and Grease Retainer Installation

1. Grease Retainer
2. Mud Shield

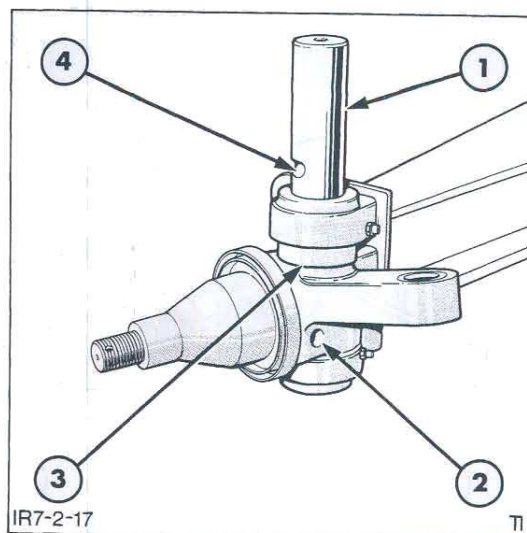
5. Install the spindle pin ensuring that the notch in the pin aligns with the locking pin bore in the spindle, Figure 10.

**NOTE:** The locking pin notch in the spindle pin is offset to one end. Ensure when installing the pin that the offset is positioned to the bottom of the spindle to align with the locking pin bore.

6. Drive the pin until it seats and secure with the lock washer and nut. Tighten the nut to the specified torque, see "Specifications" – Chapter 5.
7. Position new dust seals on each end of the pin and secure in position with the retaining bolts, tightening the bolts to the specified torque, see "Specifications" – Chapter 5.
8. Reconnect the track control rod to the spindle arm. Tighten the castellated nut to the specified torque then rotate the nut to the next slot to align with the hole in the ball joint stud. Install a new cotter pin to prevent movement of the nut.



9. Install the inner bearing assembly onto the spindle. Where necessary a suitable sleeve may also be used to install the bearing.
10. Apply the specified grease to the bearing and position the hub onto the spindle.
11. Apply grease to the outer bearing and locate the bearing in the hub. Install the retaining washer and castellated nut. Tighten the nut to a torque of 50 lbf.ft (6.92 kgm), then slacken off two to three slots to give an end float of 0.002 to 0.010 inch (0.050 to 0.254 mm). Insert a new cotter pin to locate the nut. Pack the hub grease retaining cap with the specified grease, see "Specifications" – Chapter 5 and install the cap.
12. Install the wheel and lower the tractor to the ground.



**Figure 10**  
Installing Spindle Pin

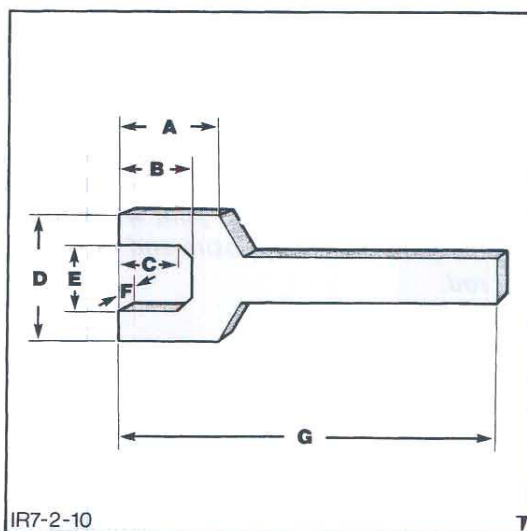
1. Spindle Pin
2. Locking Pin Bore
3. Thrust Bearing
4. Notch

## D. STEERING CYLINDER AND TRACK CONTROL ROD OVERHAUL

### REMOVAL

In order to remove the steering cylinder it is necessary to use a suitable 55 mm open ended spanner or to manufacture a ball joint locking spanner which will be used when releasing the track control rod ball joint from the steering cylinder piston rod.

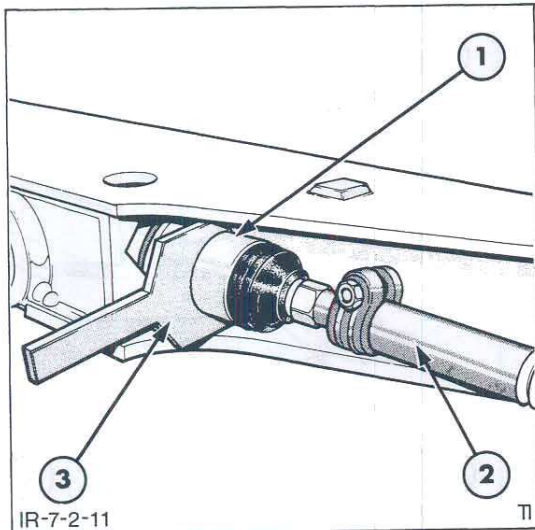
If a locking spanner is to be manufactured it should be made from high carbon steel to the dimensions shown in Figure 11 and hardened after machining.



**Figure 11**  
Locking Spanner

1. Stand the Unit on a hard level surface and position the front wheels as for a right hand turn.

A	80 mm	E	55 mm
B	60 mm	F	10 mm
C	50 mm	G	250 mm
D	90 mm		



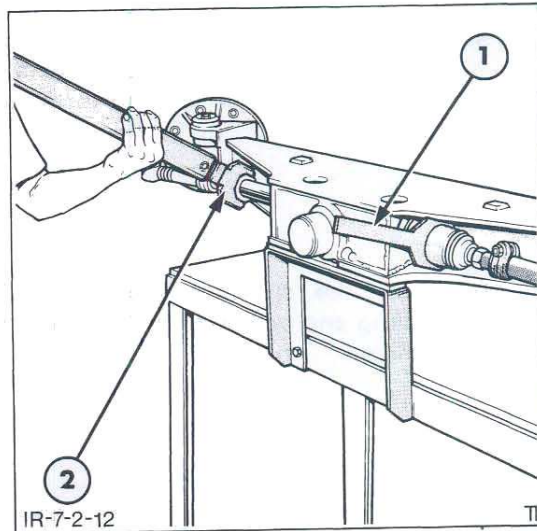
**Figure 12**  
Locking Spanner Installed

1. Ball Joint
2. Track Control Rod
3. Locking Spanner

1. Fit the locking spanner over the flats on the right hand track control rod ball joint, Figure 12.

**NOTE:** The outer edge of the spanner fingers will locate in the channel in the axle and prevent rotation of the joint when releasing the joint on the opposite end of the piston rod.

2. Position a good quality heavy duty open ended spanner with leverage capable of withstanding a torque in excess of 340 lbf.ft (465 Nm) onto the ball joint at the opposite end of the piston rod. Refer to Figure 13. Apply leverage to the spanner to unscrew the ball joint.



**Figure 13**  
Releasing Track Control Rod Ball Joints  
(Shown With Axle Removed From Vehicle For Clarity)

1. Locking Spanner
2. Heavy Duty Open Ended Spanner

**NOTE:** The weakest joint will unscrew and to remove the cylinder from the axle it is necessary to release the left hand joint. If the right hand joint is released, position the locking spanner on the left hand track control rod ball joint and use a suitable spanner located on the flats machined on the left hand end of the piston rod to release the joint.

3. Raise and securely support the front of the Unit to enable the axle to oscillate.

4. Raise one end of the axle and support the raised end with an axle stand to prevent axle movement. For additional safety insert a wooden wedge between the axle and front support on the lowered side of the axle, then disconnect the steering cylinder hose connection elbow at the steering cylinder, Figure 14. Remove the wedge and repeat this procedure to disconnect the elbow on the opposite end of the cylinder.

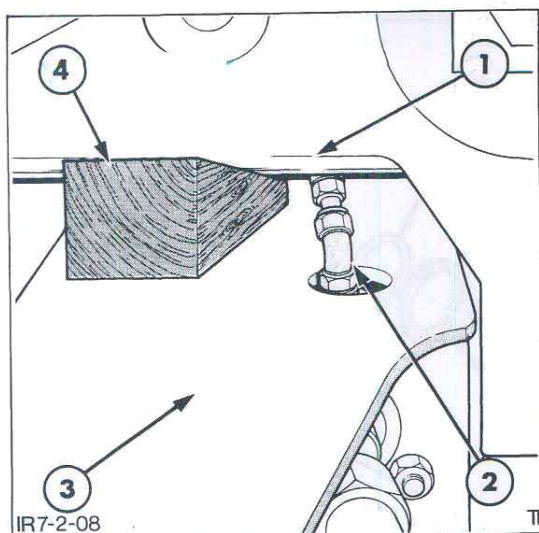


Figure 14

Steering Cylinder Hose Connections

1. Front Support
2. Steering Hose Elbow
3. Front Axle
4. Wedge

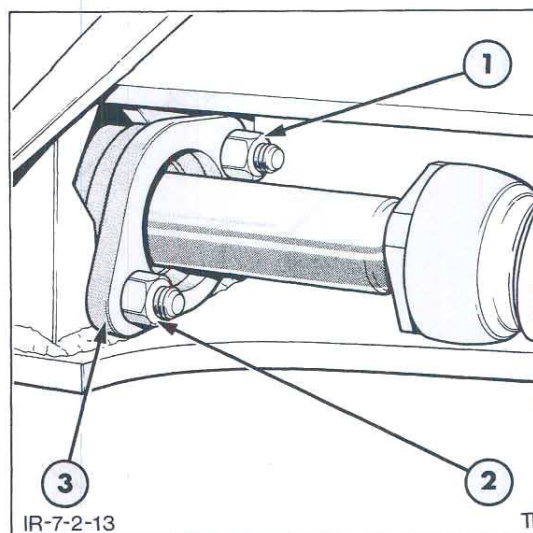


Figure 15

Steering Cylinder Locking Plate

1. Stud
2. Stud
3. Locking Plate

5. Disconnect and remove the track control rods from the spindle arms.
6. Remove the two studs which clamp the locking plate to the cylinder and remove the plate, Figure 15.
7. Withdraw the cylinder assembly from the right hand side of the axle.

clamped by the jaws of a vice without gripping on the cylinder barrel.

**IMPORTANT:** Do NOT clamp directly around the cylinder barrel as distortion and damage to the barrel will occur.

## DISASSEMBLY

With reference to Figure 15.

1. Thoroughly drain the cylinder of all oil from both ports. Recap the ports and thoroughly clean the exterior so that the internal parts will not be contaminated.
2. Install suitable fittings into the cylinder ports so that the cylinder may be
3. Using Special 'C' spanner FT. 8554 and while pulling the exposed tang of the locking wire, rotate each gland anti-clockwise and remove the wire.
4. Pull on the cylinder rod and knock the gland from the end of the cylinder barrel. If necessary, continue to rotate the gland during this operation.
5. Insert the rod back into the cylinder and similarly remove the gland at the opposite end of the barrel.



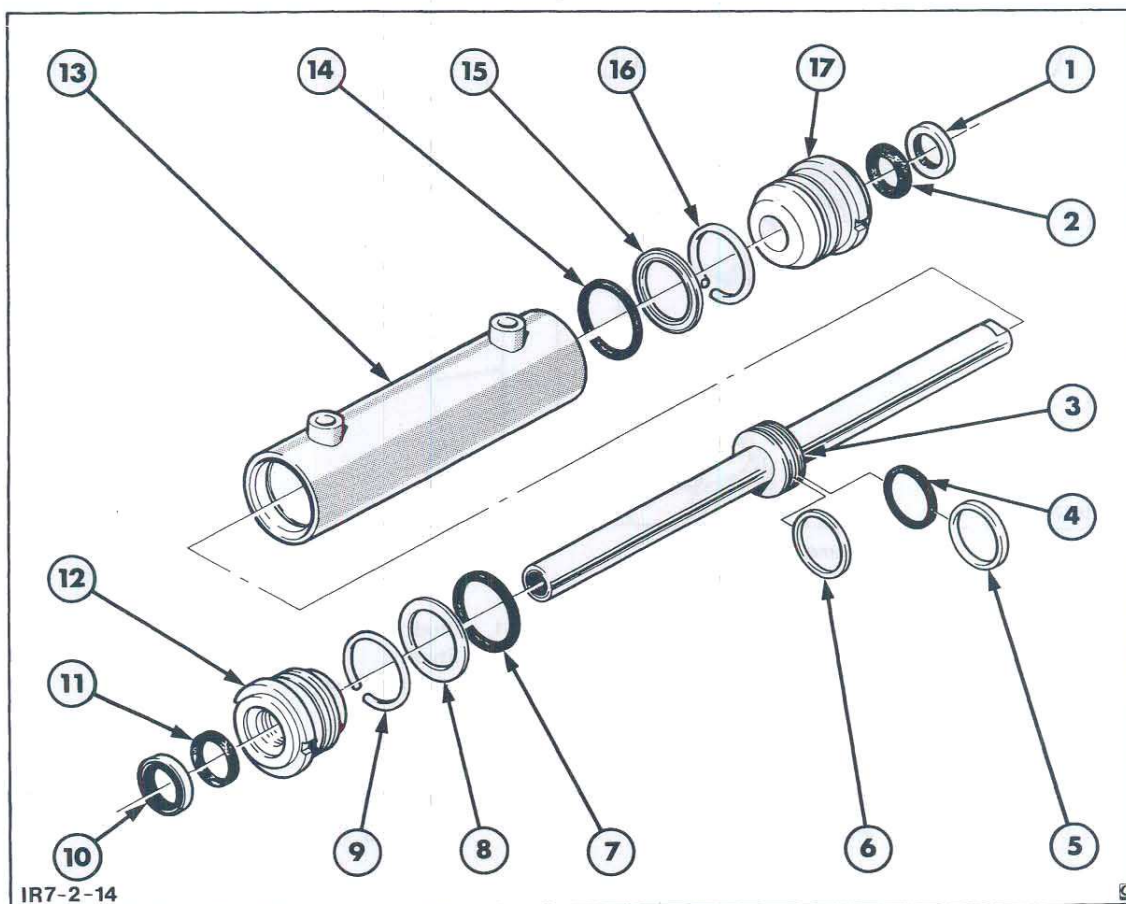


Figure 16  
Steering Cylinder – Exploded View

- |                            |                   |                     |
|----------------------------|-------------------|---------------------|
| 1. Wiper Seal              | 7. 'O' Ring       | 13. Cylinder Barrel |
| 2. Oil Seal                | 8. Back Up Washer | 14. 'O' Ring        |
| 3. Piston and Rod Assembly | 9. Locking Wire   | 15. Back Up Washer  |
| 4. 'O' Ring                | 10. Wiper Seal    | 16. Locking Wire    |
| 5. Piston Seal             | 11. Oil Seal      | 17. Gland           |
| 6. Wear Ring               | 12. Gland         |                     |

- Remove the wear ring, piston seal and 'O' ring from the piston.

## INSPECTION

- Wash the cylinder components in a suitable solvent and allow to air dry.
  - Inspect the cylinder rod for damage. Any minor nicks or burrs may be relieved using an abrasive stone.
  - Inspect the inside of the cylinder barrel for damage.
- Remove the 'O' ring, back up washer, oil seal and wiper seal from each of the glands.

4. Inspect the track control rod ball joints for looseness. If any wear is evident renew the joint.

### RE-ASSEMBLY

With reference to Figure 16

1. Install new piston seal expander ('O' ring), piston seal and wear ring on the piston.
2. Install a new rod seal in the groove in the gland. Ensure the sealing lip faces towards pressure.
3. Install a new cylinder rod wiper seal into the gland.
4. Install a new 'O' ring and back-up seal onto the outer diameter of the gland. Ensure that the concave face of the back-up ring abuts the 'O' ring and that the 'O' ring is positioned towards the barrel.

**NOTE:** *Installation of the piston seal on top of the 'O' ring requires special care. Allow the seal to contract naturally before attempting to install the piston and rod assembly into the cylinder.*

5. Lubricate all seals and slide a gland assembly onto the piston rod.
6. Place the cylinder barrel in a vertical position and insert the piston and rod assembly.
7. Lightly coat the outer surface of the gland and lead in area of the cylinder barrel with a lithium base high melting point type grease. Gently tap the gland into the barrel until fully seated. Slowly rotate the gland until the small hole in the locking wire groove aligns with the hole in the side of the barrel.

8. Push the short right angled bend on the locking wire into the entry hole in the barrel and using the special 'C' spanner FT. 8554 rotate the gland clockwise (as if it were threaded) and feed in the wire. The rotation of the gland will become tight when the wire has completely rotated around the barrel. Ensure at least 0.375 in. (8 mm) of wire is left exposed for future disassembly. Seal the wire entry hole with a proprietary non solidifying sealant.

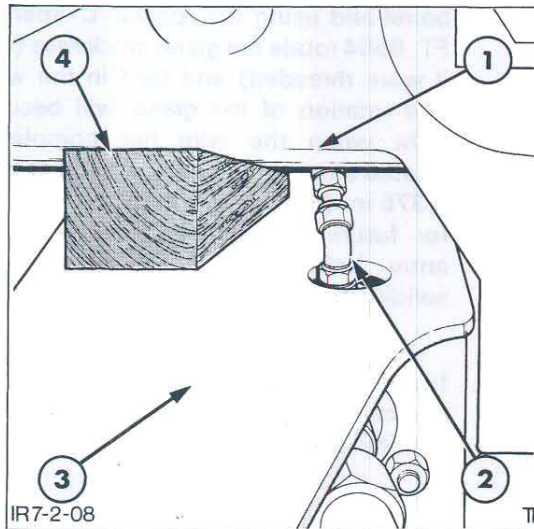
9. Install the gland on the opposite end of the barrel using the same procedure as detailed above.

### INSTALLATION

1. Installation of the steering cylinder and track control rods follows the removal procedure in reverse.
2. Ensure all steering joints and ball joints are tightened to the specified torque, see "Specifications" – Chapter 5. When tightening the track control rod ball joints to the steering cylinder rod locate the locking spanner on the flats of the right hand joint and position a suitable good quality torque wrench onto the flats of the left hand joint. Apply effort to the torque wrench until the specified torque is applied. When this torque is achieved both joints will have been tightened to the specified value.
3. Fill the steering reservoir with oil to the specified type and grade, see "Specifications" – Chapter 5, and purge the air from the system as described in Chapter 1 Section F "BLEEDING THE STEERING SYSTEM".
4. Adjust and set the front wheel toe-in as detailed in Section B of this Chapter.

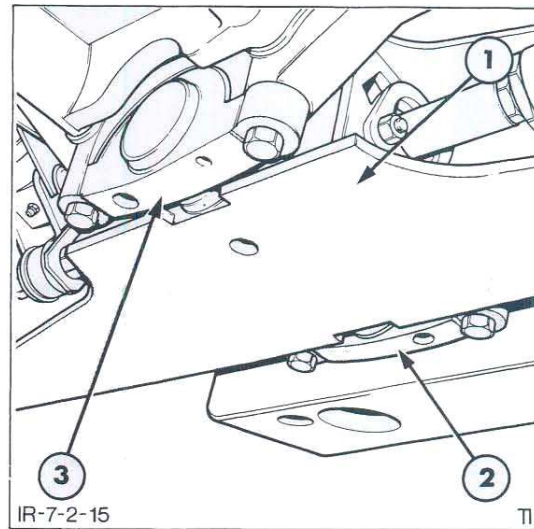


**D. FRONT AXLE OVERHAUL**



**Figure 17**  
Steering Cylinder Hose Connections

1. Front Support
2. Hose Connection
3. Axle
4. Wooden wedge



**Figure 18**  
Axle Bearing Caps

1. Axle
2. Front Oscillation Bearing Cap
3. Rear Oscillation Bearing Cap

For overhaul of the hub and spindle assembly refer to Section C of this Chapter.

repeat this procedure to disconnect the hose on the opposite end of the cylinder.

**REMOVAL**

1. Using suitable lifting equipment raise the front of the unit and place a support in a position clear of the front axle and wheels.
2. Remove the front wheel and tyre assemblies.
3. Raise one end of the axle and support the raised end with an axle stand to prevent axle movement. For additional safety insert a wooden wedge between the axle and front support on the lowered side of the axle, then disconnect the steering cylinder hose connection at the cylinder, Figure 17. Remove the wedge and

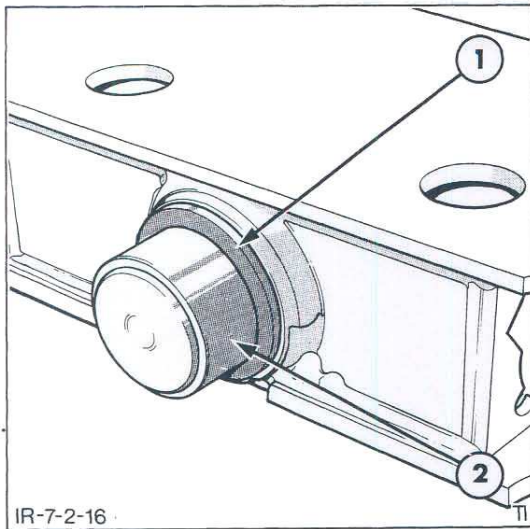
4. Support the front axle with suitable lifting equipment and remove the bolts securing the front and rear oscillation bearing caps, refer to Figure 18.

5. Carefully lower the axle from the vehicle and position it on a suitable stand.

**INSPECTION AND REPAIR**

1. Inspect the bushes on the axle trunnions, Figure 19, for excessive wear or distortion and replace if necessary. Similarly inspect the bushes in the oscillation bearing caps and replace if worn.
2. Inspect the thrust washers for wear and replace if excessively worn. The thickness of the washers when new are 3.85-4.00 mm (0.151-0.157 inch).



**Figure 19**

Trunnion Bush and Thrust Washer

1. Thrust Washer
2. Bush

3. Examine the oscillation bearing cap locating dowells for damage. During axle removal the dowells may remain in either the bearing cap or front support.
4. Inspect the front axle body for cracks or damage. If the axle structure is damaged it is necessary to install a new axle.

## INSTALLATION

1. Position the thrust washers on both axle trunnions.
2. Locate the dowells in the front support.
3. Position the oscillation bearing caps onto the axle trunnions and using suitable lifting equipment locate the axle beneath the vehicle. Position the bearing caps onto the locating dowells in the front support and install the retaining bolts. Tighten the bolts to the correct torque, see "Specifications" – Chapter 5.
4. Reconnect the steering hoses using the removal procedure in reverse and tighten the joints to the correct torque.
5. Attach the wheel and tyre assemblies to the wheel spindles and tighten the nuts to the correct torque, see "Specifications" – Chapter 5.
6. Fill the power steering reservoir with the correct grade of oil, see "Specifications" – Chapter 5, and purge the air from the steering system as described in Chapter 1 Section F "BLEEDING THE STEERING SYSTEM".



# PART 7

## STEERING AND FRONT AXLE

### Chapter 3

#### FOUR WHEEL DRIVE FRONT AXLE ASSEMBLY

Section	Page
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C. AXLE SHAFT — OVERHAUL	10
D. STEERING SWIVEL PIN BEARINGS — OVERHAUL	14
E. STEERING CYLINDER AND TRACK RODS — OVERHAUL	19
F. FRONT AXLE — REMOVAL AND INSTALLATION	23
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H. DRIVE SHAFT — OVERHAUL	36

#### A. FOUR WHEEL DRIVE FRONT AXLE — DESCRIPTION AND OPERATION

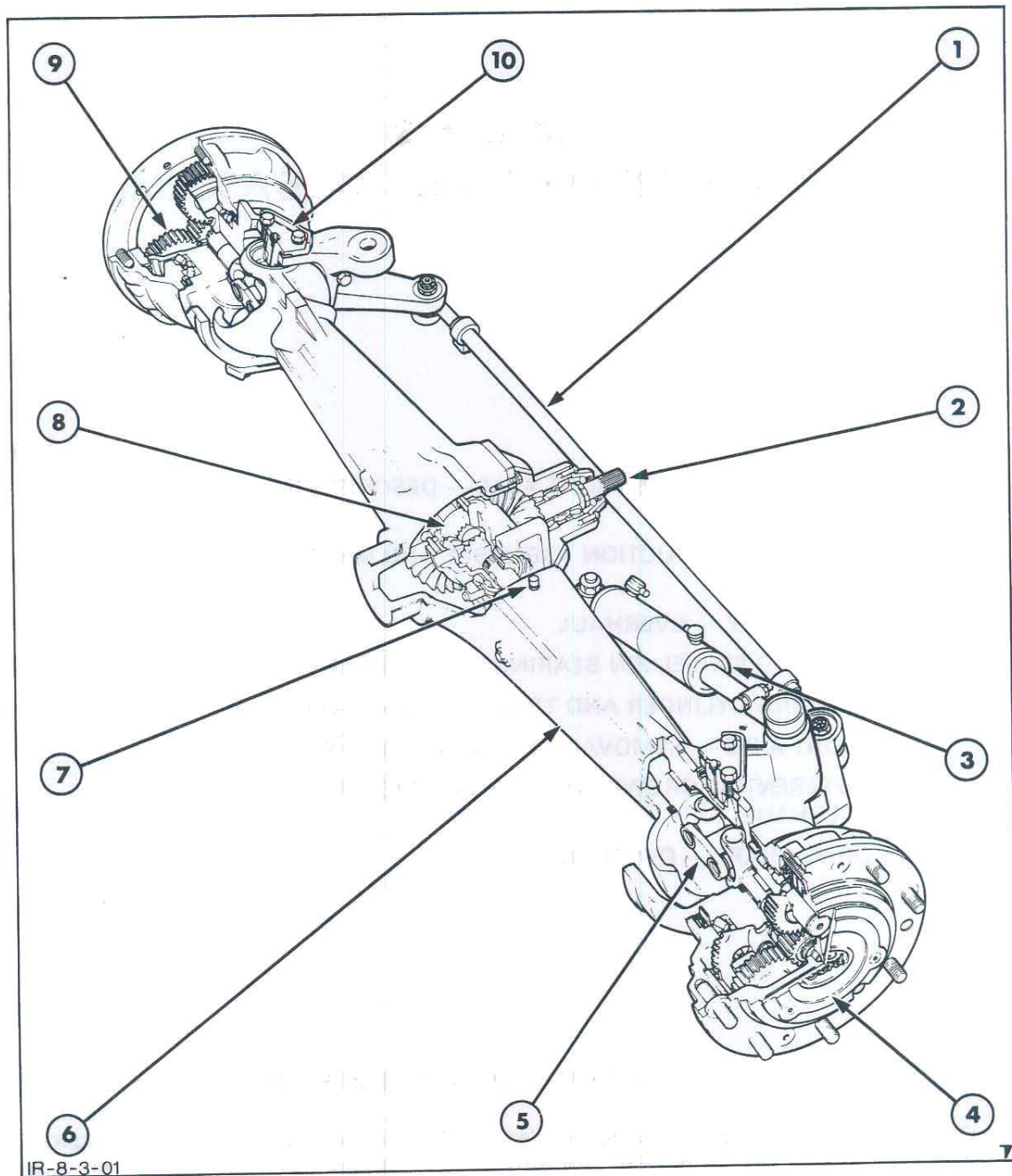
The 'Carraro' 710-19 type front axle installed on Ford 455C, 555C and 655C backhoe loaders can be readily identified by the data plate attached to the right hand side of the axle casing.

The data plate details the axle type, serial number, total gear ratio, reference number, oil capacity and type and grease type.

When ordering spare parts, always quote the type, reference and serial numbers. Refer to Chapter 5 for Ford oil and grease specifications.

The axle has a track width measuring 1884 mm (74.2 in) and is measured at the wheel mounting flange. Wheel track adjustment is achieved by using separate wheel rim and disc assemblies.





**Figure 1**  
Front Axle – Cutaway View

- |                                               |                                          |
|-----------------------------------------------|------------------------------------------|
| 1. Track Rod                                  | 6. Axle Centre Casing                    |
| 2. Pinion                                     | 7. Centre Casing Breather                |
| 3. Steering Cylinder                          | 8. Crown Wheel and Differential Assembly |
| 4. Hub and Planetary Reduction Gear Assembly  | 9. Planetary Reduction Gear              |
| 5. Axle Shaft Double Universal Joint Assembly | 10. Swivel Pin Assembly                  |

The axle, Figure 1, is pivoted at the centre to allow oscillation when traversing rough ground and the drive pinion actually passes through the hollow centre of the rear oscillation bushing. This arrangement keeps the driveshaft, connecting the front axle with the transfer case assembly, in a straight plane through all degrees of oscillation. The drive shaft runs in a single row ball bearing and is connected to the axle pinion and transfer case through sliding splined connections.

Final reduction is achieved using three pinion epicyclic gearing housed in a removable hub with a separate oil housing. The reduction hubs are attached to the central housing by swivel pins top and bottom, turning in cone and cup type bearings which are serviceable and greaseable to ensure long life.

This axle type features a centrally mounted differential supported in the axle casing by a separate removable carrier.

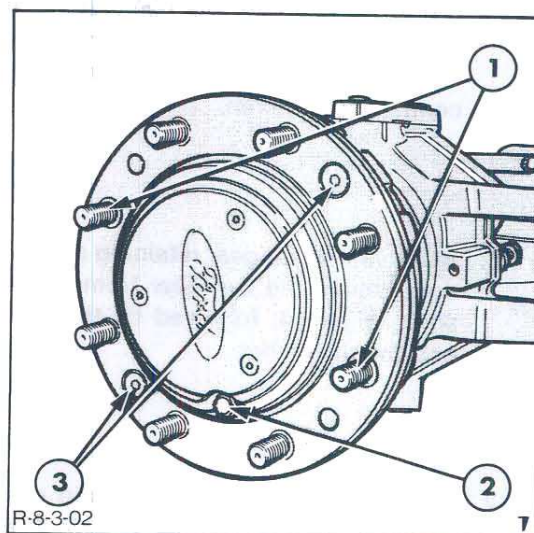
Axle shafts are double universally jointed for constant running and each joint is serviceable.

With the exception of the differential unit, the axle reduction hubs, wheel hub bearings, axle shafts and steering cylinder can all be removed and overhauled without removing the axle from the unit.

## B. PLANETARY REDUCTION ASSEMBLY AND WHEEL HUBS — OVERHAUL

### REMOVAL

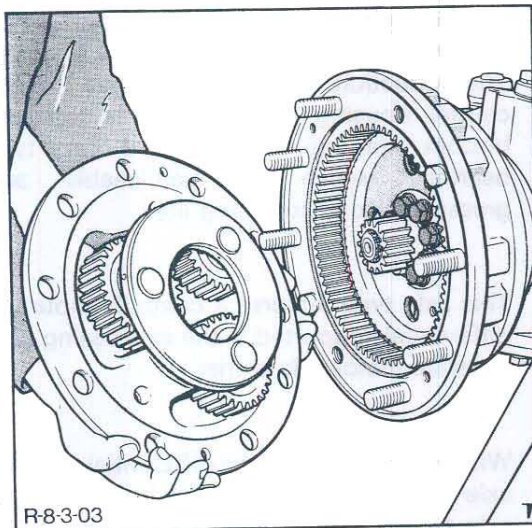
1. Position the unit on a hard level surface, lower the loader arms, apply the parking brake and block the rear wheels. Disconnect the battery.
2. Jack up the front axle and securely support the front of the unit. Remove the front wheel.
3. Turn the hub so that the filler/drain plug is at its lowest point and drain the hub oil.
4. Remove the two 8 mm socket screws and the two shouldered wheel studs, Figure 2, securing the planetary carrier assembly to the hub assembly.



**Figure 2**  
Planetary Carrier Retainers

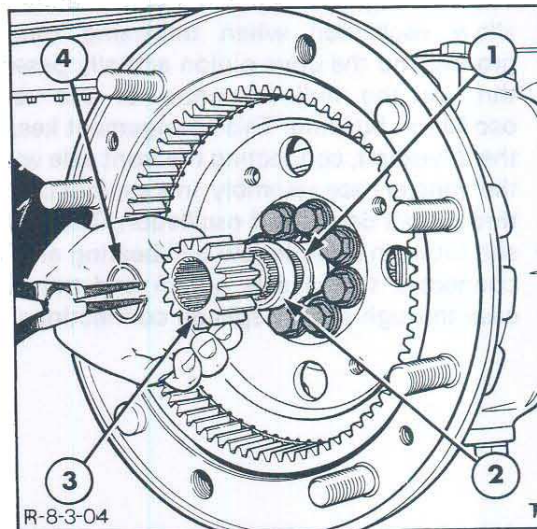
1. Shouldered Wheel Studs
2. Filler/Drain Plug
3. Socket Screws





**Figure 3**

Withdrawing Planetary Carrier from Hub Assembly



**Figure 4**

Removing Sun Gear Components

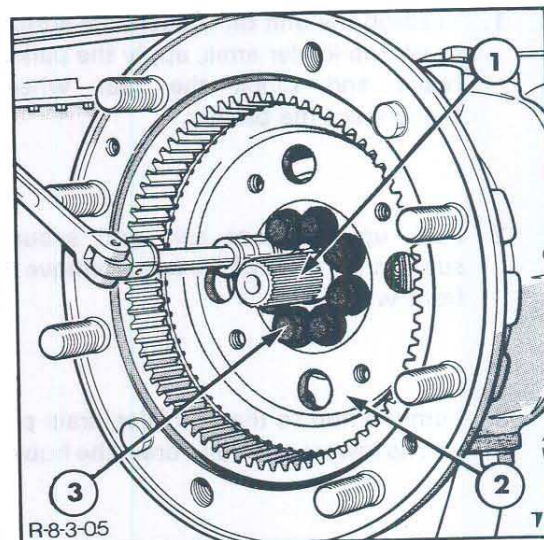
- |                  |              |
|------------------|--------------|
| 1. Thrust Washer | 3. Sun Gear  |
| 2. Spacer        | 4. Snap Ring |

5. Gently tap the planetary carrier with a soft face mallet and using the slots provided, lever the carrier from the hub.

8. Carefully pull off the hub assembly, if necessary tap the hub using a soft faced mallet on the rear face at equal spaces around periphery, Figure 7.

Carefully withdraw the planetary carrier assembly, Figure 3. Take care not to misplace the thrust pad positioned in the centre of the carrier.

6. Remove the sun gear retaining snap ring and remove the sun gear from the axle shaft, Figure 4, followed by the spacer and thrust washer.
7. Remove the eight ring gear and carrier assembly retaining bolts, Figure 5, and remove the assembly by installing 4 of the bolts into the threaded jacking holes in the ring gear. Tighten the bolts evenly to draw off the planetary ring gear, Figure 6.

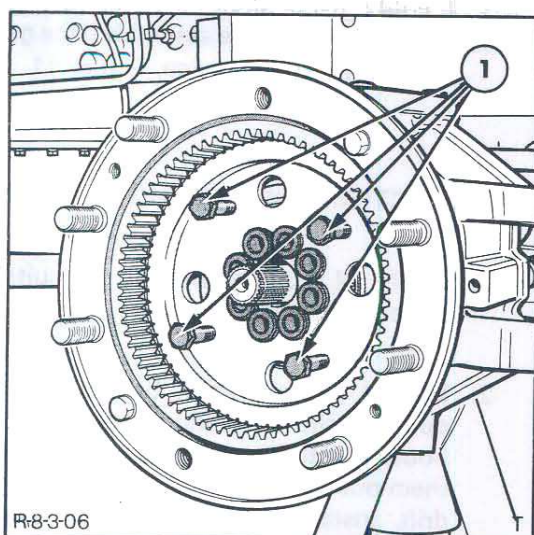


**Figure 5**

Ring Gear and Carrier Retaining Bolts

- |                          |                    |
|--------------------------|--------------------|
| 1. Axle Shaft            | 3. Retaining Bolts |
| 2. Ring Gear and Carrier |                    |



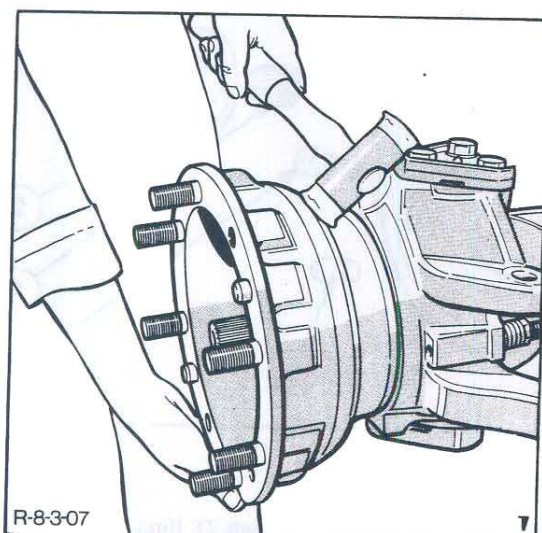
**Figure 6**

Using Jack Bolts to Withdraw Ring Gear and Carrier Assembly

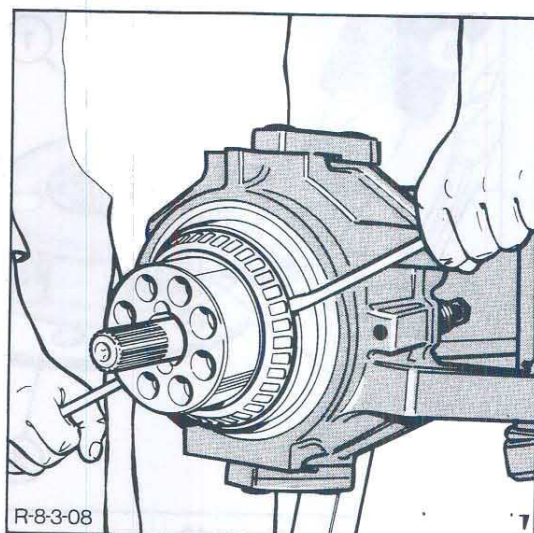
1. Jack Bolts

9. Lever off the inner bearing inner track from the swivel casing, Figure 8.

10. Remove the oil seal from the inner side of the hub.

**Figure 7**

Removing Hub Assembly

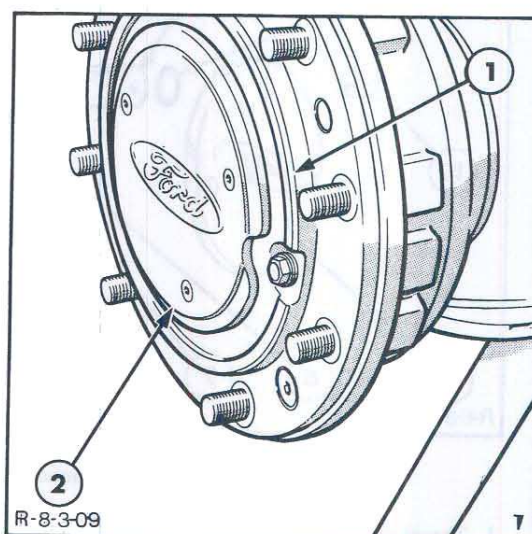
**Figure 8**

Levering Off Hub Inner Bearing

## DISASSEMBLY

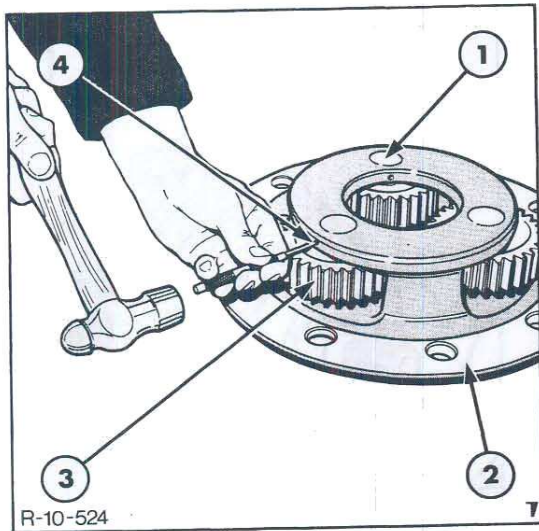
### Planetary Carrier Assembly

1. Remove the planetary carrier outer cover plate screws and remove the cover plate, Figure 9.

**Figure 9**

Carrier Housing Cover Plate

1. Carrier Housing      2. Cover Plate



**Figure 10**  
Removing Shaft Roll Pins

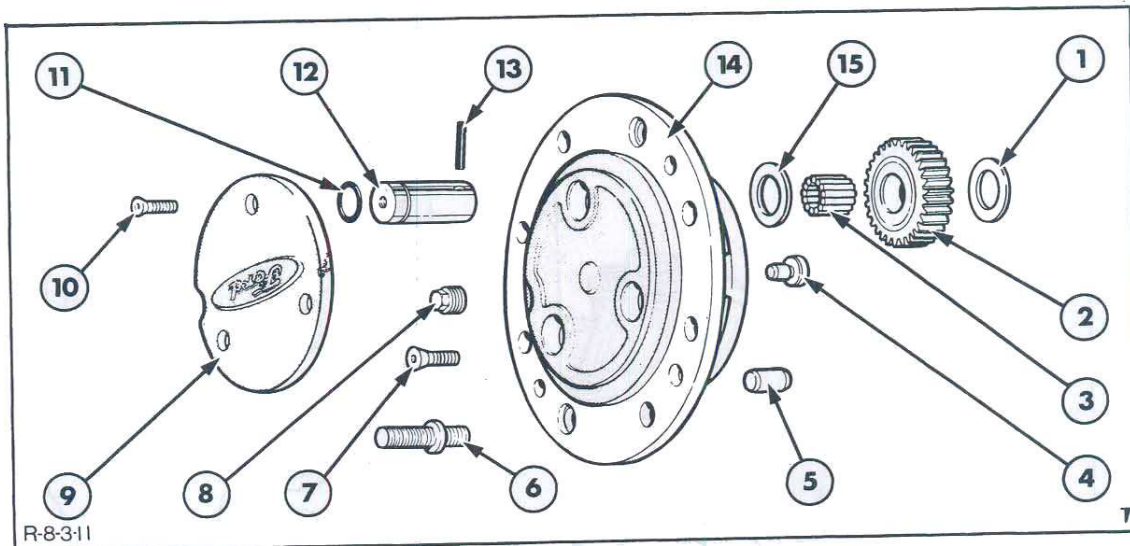
- |            |                |
|------------|----------------|
| 1. Shaft   | 3. Planet Gear |
| 2. Housing | 4. Roll Pin    |

2. Drive out the three roll pins, Figure 10, securing each shaft to the carrier. Push each shaft outward, out of the carrier collecting from each shaft two thrust washers, the planetary gear and the thirty bearing rollers.

3. Identify each shaft and its gear and bearings to facilitate assembly if the gears are fit for further service, Figure 11.

### INSPECTION AND REPAIR

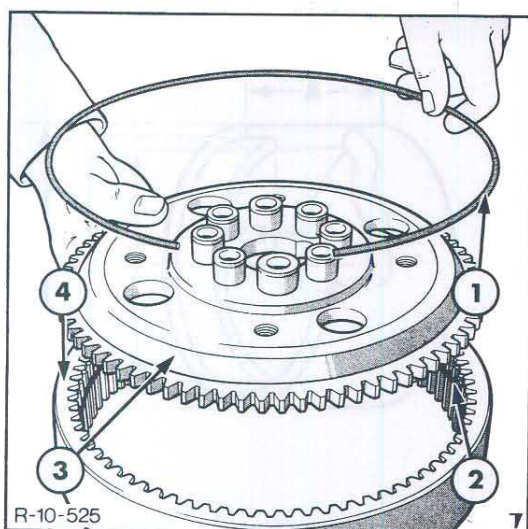
1. Wash all components in a suitable solvent and allow to air dry.
2. Inspect the hub main bearings — the outer tracks will still be in the hub housing. If these are worn, carefully drive them out of the housing using a suitable drift. Install new bearing outer tracks, carefully pressing in the tracks until they are fully seated.
3. Examine the planet gear bearing rollers and shafts. If wear is found renew the complete planet gear shaft and bearing set. A worn bearing roller or one which has picked up will undoubtedly signify similar wear or damage to the bearing path inside the planet gear and to the planet gear shafts.



**Figure 11**  
Planetary Carrier — Exploded View

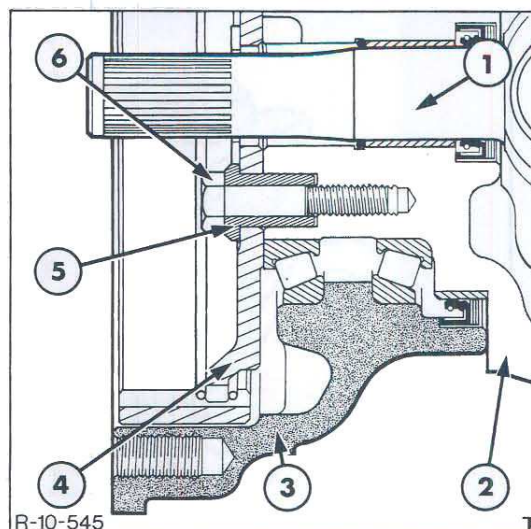
- |                           |                          |                         |
|---------------------------|--------------------------|-------------------------|
| 1. Thrust Washer          | 6. Shouldered Wheel Stud | 11. Shaft 'O' Ring Seal |
| 2. Planet Gear            | 7. Carrier to Hub Screw  | 12. Shaft               |
| 3. Needle Roller Bearings | 8. Drain/Filler Plug     | 13. Roll Pin            |
| 4. Thrust Pad             | 9. Cover Plate           | 14. Carrier Housing     |
| 5. Locating Dowel         | 10. Retaining Screw      | 15. Thrust Washer       |





**Figure 12**  
Ring Gear and Carrier

- |                   |              |
|-------------------|--------------|
| 1. Retaining Ring | 3. Carrier   |
| 2. Retaining Ring | 4. Ring Gear |



**Figure 13**  
Ring Gear and Carrier Retention – Section View

- |                  |                                                |
|------------------|------------------------------------------------|
| 1. Axle Shaft    | 5. Locating Bushing<br>(7 × 20 mm + 1 × 24 mm) |
| 2. Swivel Casing | 6. Carrier Retaining Bolt                      |
| 3. Hub           |                                                |
| 4. Carrier       |                                                |

4. Remove the carrier to ring gear retaining ring and separate the two components, Figure 12. Carefully inspect the ring gear teeth for wear.

5. Examine the ring gear carrier to swivel hub locating bushings, Figure 13.

Examine these bushes for any damage caused by fretting, particularly if it was noticed that the bolts were below torque during disassembly.

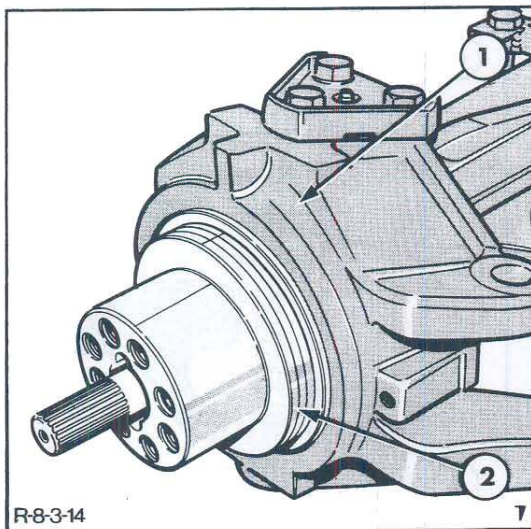
**NOTE:** On each hub there are two types: seven bushes have a diameter of 20 mm and one has a diameter of 24 mm. The larger one serves as a master locator ensuring that the carrier can only be refitted in one position.

6. Examine the sun gear and planet gear teeth for wear or damage.

7. Examine the sun gear and planet gear thrust washers and spacers and the thrust pad located on the inner face of the planet carrier housing. Renew any worn or defaced item.

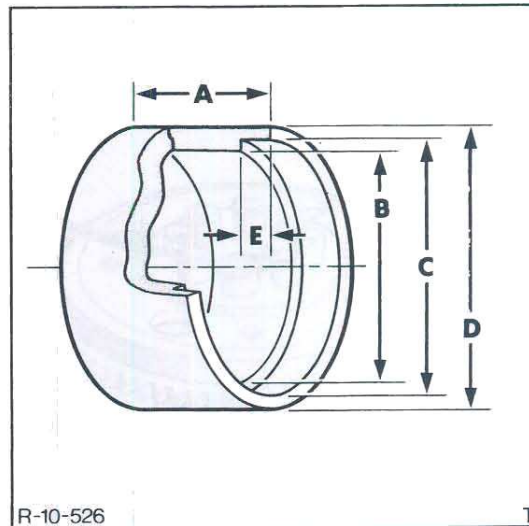
8. Renew the planet gear shaft 'O' ring seals.





**Figure 14**  
Hub Oil Seal Wear Journal

1. Swivel Casing
2. Wear Journal



**Figure 15**  
Oil Seal Journal Installation Tool

- |                                              |                       |
|----------------------------------------------|-----------------------|
| A. 90 mm (3.543 in)                          | D. 175 mm (7.0 in)    |
| B. 140 mm (5.512 in)                         | E. 18.5 mm (0.728 in) |
| C. 155.2 mm (6.110 in) Material:- Mild Steel |                       |

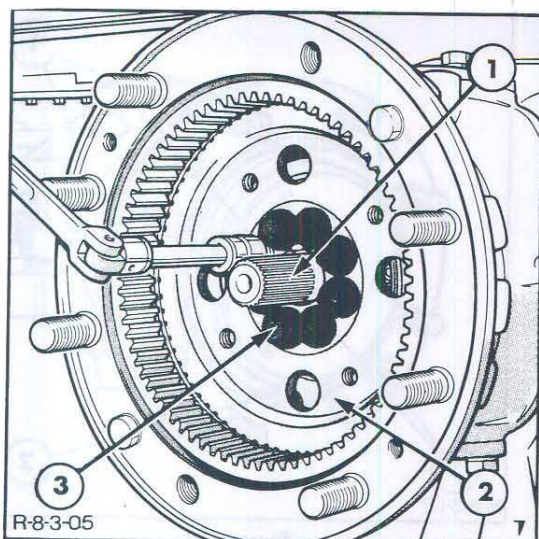
9. On the swivel hub assembly there is a removable oil seal journal, Figure 14. Inspect this journal for damage. If necessary, carefully cut off the journal, thoroughly clean the swivel hub surface and press on a new journal using the 'fixing agent' as specified in 'Specifications' – Chapter 5. Ensure the journal is correctly seated and that the continuous bead of fixing agent is applied to the mating surfaces to prevent oil leakage. A locally fabricated tool made to fully enclose the journal during the pressing operation will ease assembly, Figure 15.

## RE-ASSEMBLY

1. Reassemble the planetary carrier following the disassembly procedure in reverse. Ensure thirty bearing rollers are placed in each planet gear and new roll pins are used to secure the shafts to the housing.
2. Note sealant is not specified for the outer planet shaft cover. Sealing is effected by the shaft 'O' rings. Apply sealant to the chamfered heads only of the three cover attaching bolts as specified in 'Specifications' – Chapter 5.

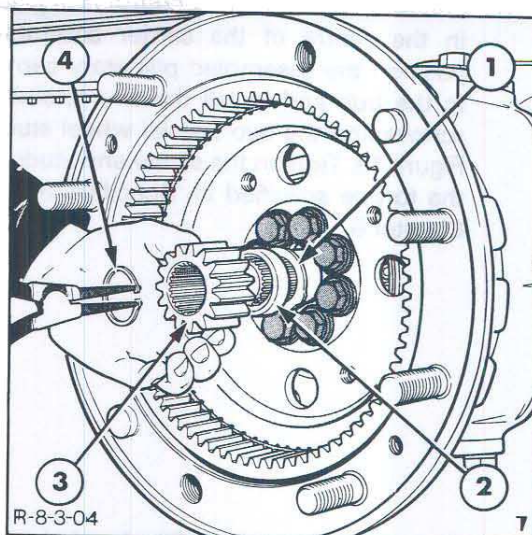
## INSTALLATION

10. Carefully inspect the planet shaft cover to planet carrier mating surfaces and the planet carrier to hub mating surfaces. Minor nicks or burrs to these surfaces should be relieved, using an abrasive stone.
1. Assemble the hub inner bearing onto the swivel casing. Carefully install a new oil seal into the hub. Ensure the seal is fully seated and concentric within the hub. Special tooling is not required for this operation.

**Figure 16**

Tightening Ring Gear and Carrier Assembly Retaining Bolts

- 1. Axle Shaft
- 2. Ring Gear and Carrier
- 3. Retaining Bolts

**Figure 17**

Installing Sun Gear Components

- 1. Thrust Washer
- 2. Spacer
- 3. Sun Gear
- 4. Snap Ring

2. Lubricate the oil seal journal area with grease, as specified in 'Specifications' – Chapter 5 and carefully assemble the hub to the swivel assembly.

3. Supporting the hub, slide in the outer bearing, maintain the hub in this position whilst fitting the ring gear and carrier.

**NOTE:** *The hub bearings and the machining of the hub housing and swivel stub are held to fine limits and bearing pre-load/rolling resistance adjustment is not necessary.*

4. Assemble the ring gear carrier to the ring gear with the wire type locking rings. Ensure that the rings have not been deformed or damaged during disassembly.

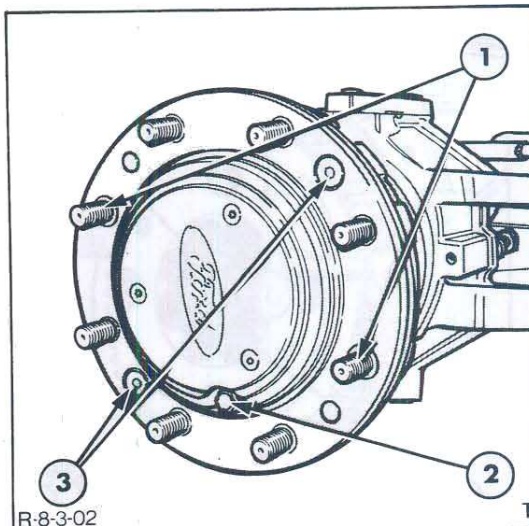
5. Bolt the ring gear and carrier assembly to the swivel casing, ensuring that the single large bushing is correctly positioned, Figure 16. Tighten the bolts, as specified, evenly in three stages, see 'Specifications' – Chapter 5.

6. Install the sun gear/axle shaft thrust washer, spacer and sun gear, Figure 17. Lock the sun gear to the axle shaft using a new snap ring.

7. Coat the mating surfaces of the planetary carrier and the hub with sealant as specified in 'Specifications' – Chapter 5.



8. Ensuring that the thrust button is in place in the centre of the carrier assembly, position the assembled planetary carrier to the hub and install the two retaining screws and the two special wheel studs, Figure 18. Tighten the screw and studs to the torque specified in 'Specifications' – Chapter 5.



**Figure 18**  
Installing Planetary Carrier Retainers

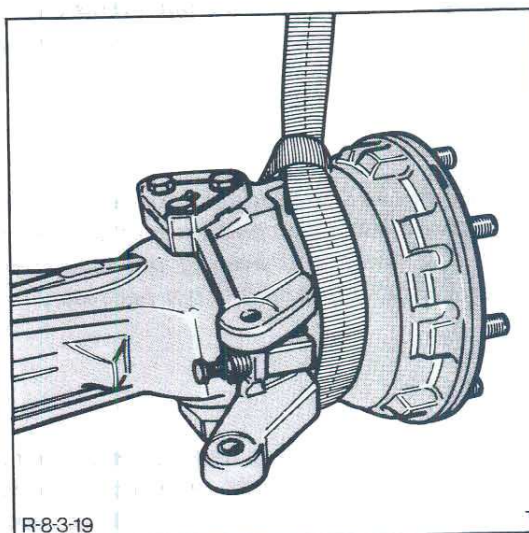
- |                      |                  |
|----------------------|------------------|
| 1. Shouldered Studs  | 3. Socket Screws |
| 2. Filler/Level Plug |                  |

9. Position the combined filler/level plug on the horizontal plane and refill the hub with oil, as specified in 'Specifications' – Chapter 5.

## C. AXLE SHAFTS — OVERHAUL

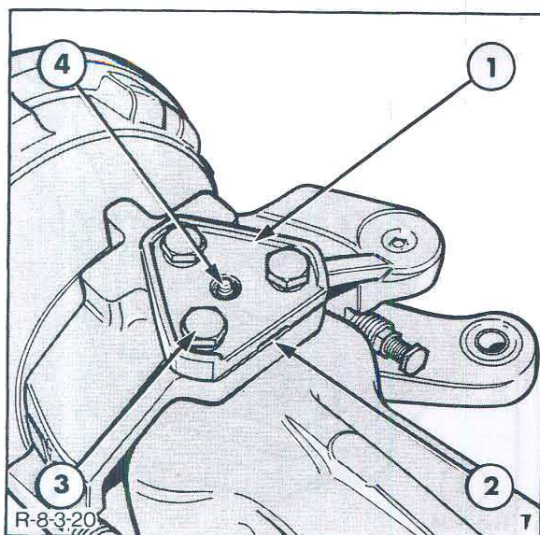
### REMOVAL

1. Remove the planetary gear carrier assembly, sun gear, spacer and thrust washer as previously described under Section B "PLANETARY REDUCTION ASSEMBLY AND WHEEL HUBS" — OVERHAUL.
2. Position a suitable sling around the hub and swivel casing, Figure 19.
3. Disconnect the track rod and steering cylinder, where necessary, from the steering control arm.



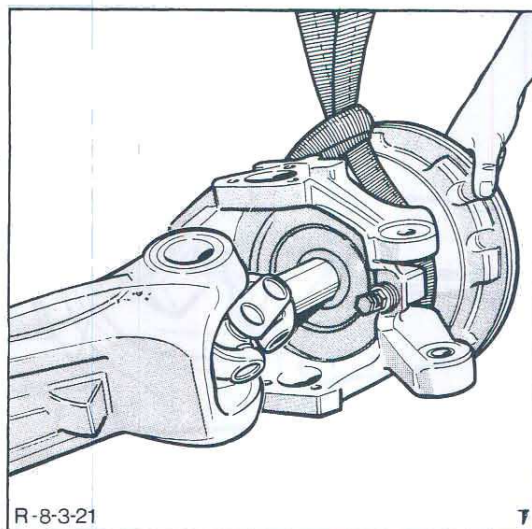
**Figure 19**  
Hub and Swivel Assembly Supported by Sling



**Figure 20**

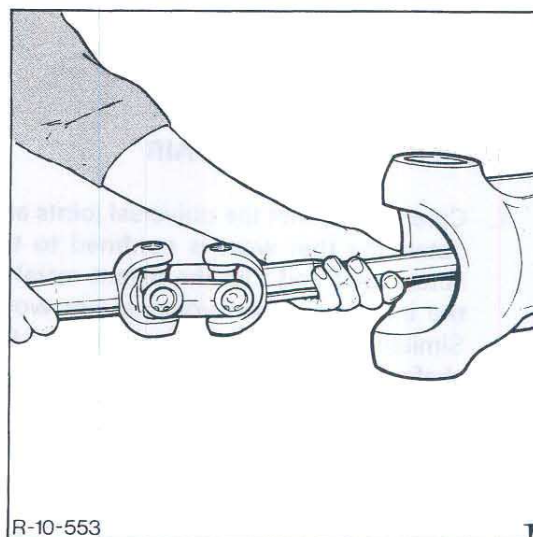
Upper Swivel Pin and Retaining Bolts

- |               |                    |
|---------------|--------------------|
| 1. Swivel Pin | 3. Retaining Bolts |
| 2. Lever Slot | 4. Greaser         |

**Figure 21**

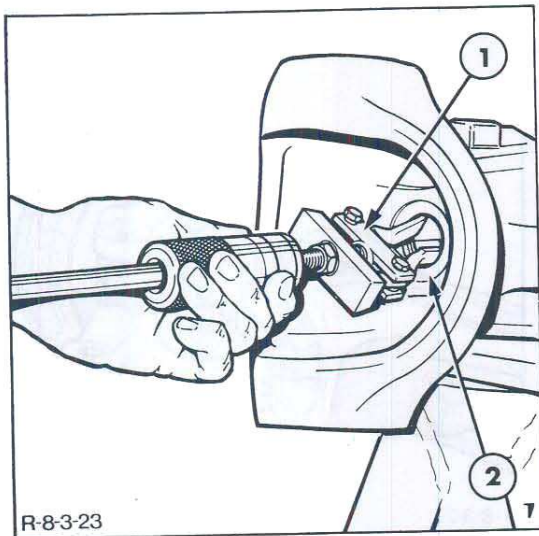
Removing Swivel Casing and Hub Assembly

4. Remove the upper and lower swivel pin retaining bolts, Figure 20, and carefully lever the swivel pins and shims from the casing, noting the position of the shims. Identify the top pin and shims to aid re-assembly.
5. Carefully ease the hub and swivel assembly from the axle centre casing, Figure 21, — do not allow the axle shaft to be pulled from the centre casing. As the hub and swivel casing assembly is moved away from the centre casing, support the short outer end of the axle shaft as it passes through the seal.
6. Very carefully pull the axle shaft from the axle casing, guiding it through the outer oil seal, Figure 22.

**Figure 22**

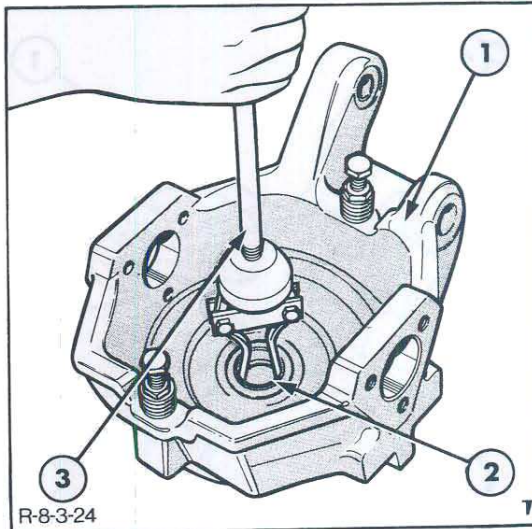
Withdrawing Axle Shaft from Axle Casing

5. Carefully ease the hub and swivel assembly from the axle centre casing, Figure 21, — do not allow the axle shaft to be pulled from the centre casing. As the hub and swivel casing assembly is moved away from the centre casing, support the short outer end of the axle shaft as it passes through the seal.



**Figure 23**  
Removing Axle Shaft Oil Seal  
from Axle Casing

1. Puller Tool No. 954C or 9508
2. Oil Seal



**Figure 24**  
Removing Oil Seal from Swivel Casing

1. Swivel Casing
2. Oil Seal
3. Puller Tool No. 954C or 9508

## DISASSEMBLY

1. Disassembly of the double universally jointed axle shaft follows conventional practice and requires no special instruction. Before disassembly, read the following "INSPECTION AND REPAIR" section.

3. If yoke parent metal and journals are undamaged and fit for further service, disassemble the universal joints as necessary. If damage is present, consider replacement of the complete axle shaft.

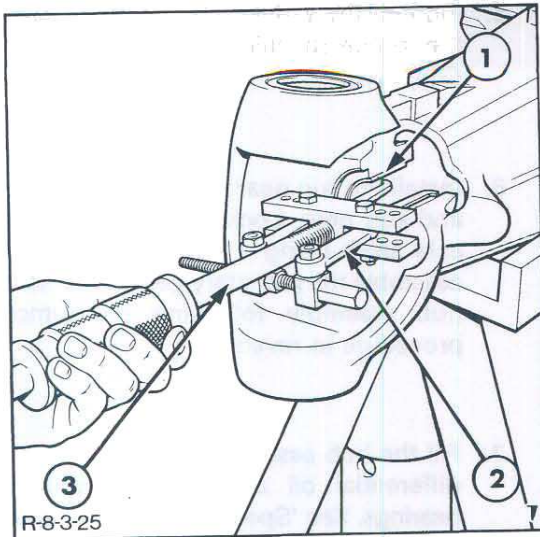
## INSPECTION AND REPAIR

1. Carefully inspect the universal joints and determine that wear is confined to the actual joint and that the parent metal of the inner and outer yokes is not worn. Similarly, inspect the splined ends of the shafts for fretting or wear.
2. Inspect the bearing and seal journal areas for wear or damage.

4. Remove the axle shaft oil seals from the axle centre casing, Figure 23, and the swivel casing assembly, Figure 24.

5. Inspect the axle shaft bushings in the swivel casing and the axle centre casing. If these bushings are worn or damaged, extract them using Tool No. 943 and 943S (9507 and 9567) or Tool No. 954C (9508), Figure 25.

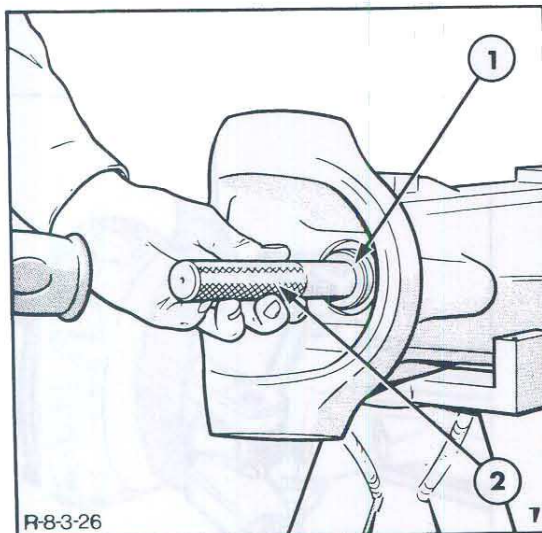


**Figure 25**

Removing Axle Shaft Bushing from Axle Casing

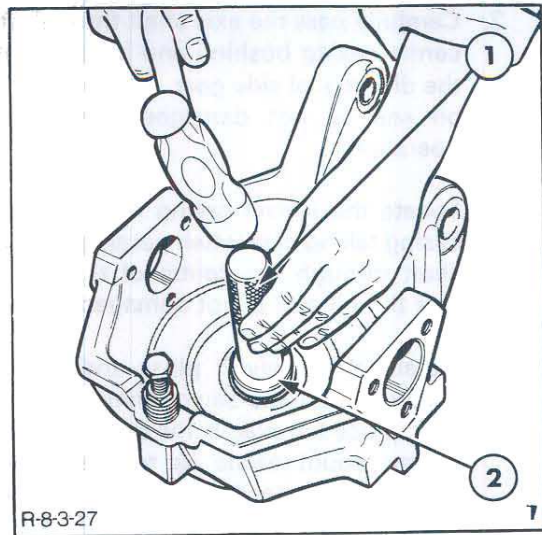
1. Bushing
2. Puller Tool No. 943 or 9507
3. Slide Hammer Tool No. 943S or 9567

6. Where necessary, drive in new bushings, Figure 26, using the following tools with driver handle No. 550:  
Swivel Hubs – FT. 3164 (307974)  
Axle Centre Casing – FT. 3165 (307975)  
Ensure the bushings are fully seated.

**Figure 26**

Installing Axle Shaft Bushing in Swivel Casing

1. Bushing Installer FT. 3164 or 307974
2. Driver Handle Tool No. 550

**Figure 27**

Installing Oil Seal in Swivel Casing

1. Driver Handle Tool No. 550
2. Oil Seal Installer Tool No. FT. 3162 or 307972

7. Install new oil seals to the swivel casing and axle centre casing using driver handle No. 550 and FT. 3162 (307972), Figure 27.

Ensure the seals are positioned squarely.

**RE-ASSEMBLY**

1. Re-assemble the axle shaft universal joints following established techniques. Take great care that each bearing cup is installed without disturbing the bearing rollers and that the new snap rings can be installed positively in their grooves.

**INSTALLATION**

1. Lubricate the bushing and oil seal in the axle casing and swivel casing using a good quality grease, see 'Specifications' – Chapter 5.



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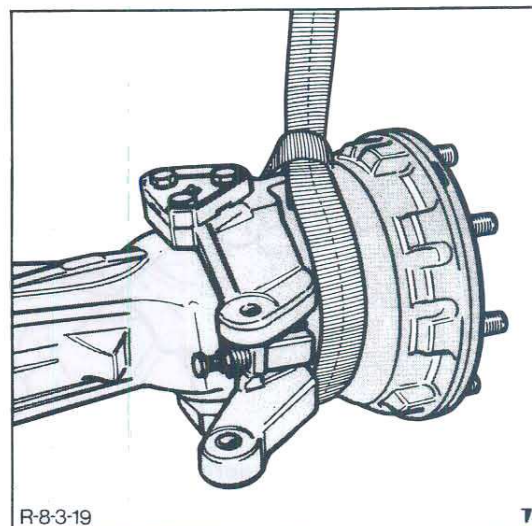
2. Carefully pass the axle shaft through the centre casing bushing and locate it into the differential side gear. Ensure that the oil seal is not damaged during this operation.
3. Locate the swivel casing onto the axle casing taking care when passing the axle shaft through the centre of the casing that the oil seal is not damaged.
4. Install the swivel pins and shims, ensuring that the same shims removed are replaced in exactly the same location. If any doubt exists as to the correct position, refer to the following heading covering "STEERING SWIVEL PIN BEARINGS — OVERHAUL".
5. Tighten the swivel pin retaining bolts to the torque specified in 'Specifications' — Chapter 5.
6. Install the sun gear thrust washer, spacer and sun gear. Lock the sun gear to the axle shaft using a new snap ring. Re-assemble the planetary gear carrier to the hub assembly following the removal procedure in reverse.
7. Fill the hub assembly with oil, check the differential oil and grease the swivel bearings. See 'Specifications' — Chapter 5 for Lubricant detail.

#### D. STEERING SWIVEL PIN BEARINGS — OVERHAUL

##### REMOVAL

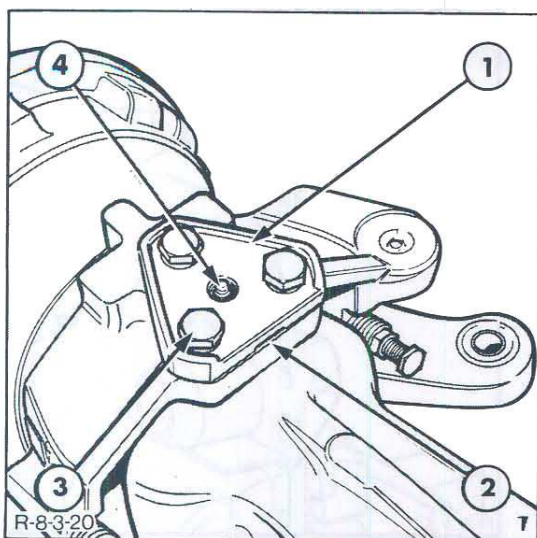
1. Position the unit on a hard level surface lower the loader arms and raise the front wheel. Securely support the unit in this position and remove the front wheel.
2. Remove the planetary gear carrier assembly, sun gear, spacer and thrust washer as previously described under the heading "PLANETARY REDUCTION ASSEMBLY AND WHEEL HUBS — OVERHAUL".
3. Disconnect the steering track rod and steering cylinder where applicable, from the steering arm.

4. Support the hub and planetary carrier assembly using a crane and sling, Figure 28.



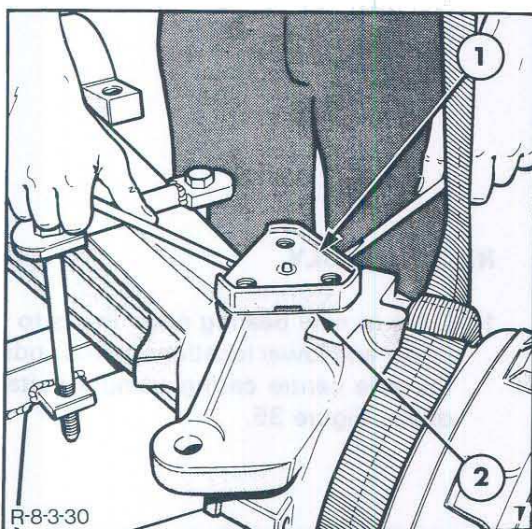
**Figure 28**

Hub and Swivel Assembly Supported by Sling

**Figure 29**

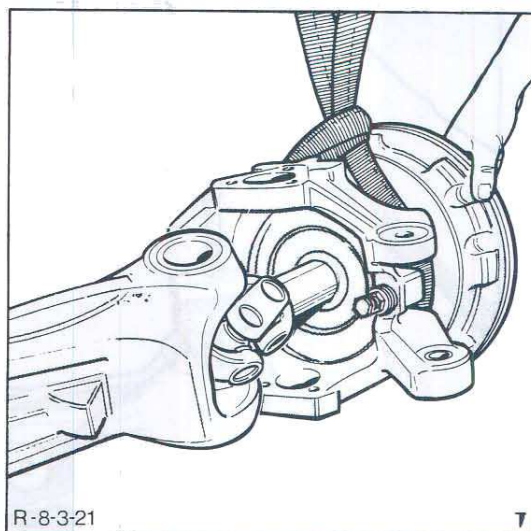
Upper Swivel Pin and Retaining Bolts

1. Swivel Pin
  2. Lever Slot
  3. Retaining Bolts
  4. Greaser
5. Remove the upper and lower swivel pin retaining bolts, Figure 29, and carefully level the swivel pins from the casing, noting the position of the shims. Identify the top pin and shims and the bottom pin and shims, Figure 30.
  6. Carefully ease the hub and swivel casing assembly from the axle centre casing, Figure 31, do not allow the axle shaft to be pulled from the centre casing.

**Figure 30**

Removing Upper Swivel Pin

1. Swivel Pin
2. Shim

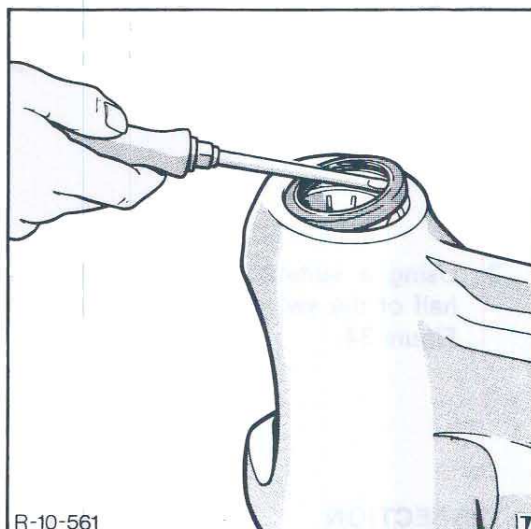
**Figure 31**

Removing Swivel Casing and Hub Assembly

As the hub and swivel casing assembly is moved away from the centre casing, support the short outer end of the axle shaft as it passes through the seal.

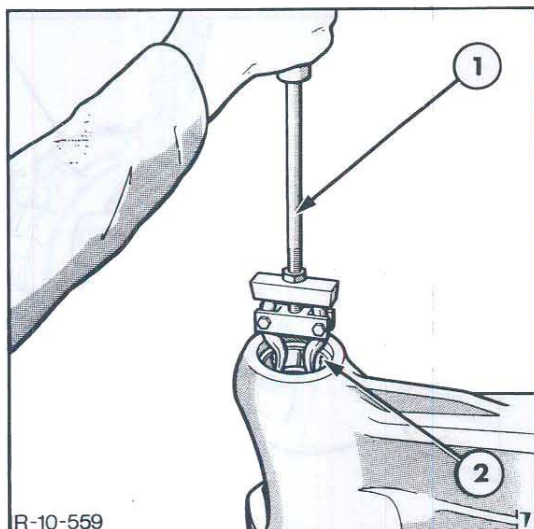
### DISASSEMBLY

1. Remove the seals from the upper and lower locations in the axle centre casing, Figure 32.

**Figure 32**

Removing Swivel Pin Grease Seal





**Figure 33**

Removing Swivel Pin Bearing Outer Cup

1. Slide Hammer Tool No. 9435 or 9567
2. Outer Track

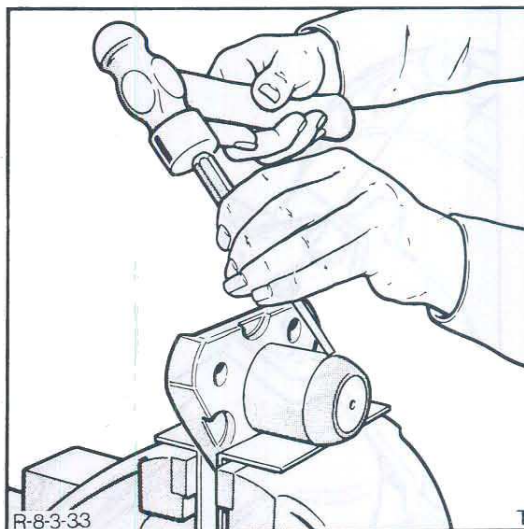
2. Using Tool No. 943 and 943S (9507 and 9567), or 954C (9508) extract the outer bearing track from the axle centre casing, Figure 33.

**NOTE:** It may be necessary to heat the axle casing or apply a bead of weld to the inner surface of the bearing causing the bearing to contract to ease removal.

3. Using a suitable drift, drive the cone half of the swivel bearing off each pin, Figure 34.

### INSPECTION

1. Thoroughly clean all parts including the ends of the axle centre casing.



**Figure 34**

Removing Swivel Pin Bearing Cone

2. Inspect the axle shaft oil seal in the swivel casing. If this was damaged during disassembly or is worn, renew the seal, as described under the heading AXLE SHAFTS — INSPECTION AND REPAIR.

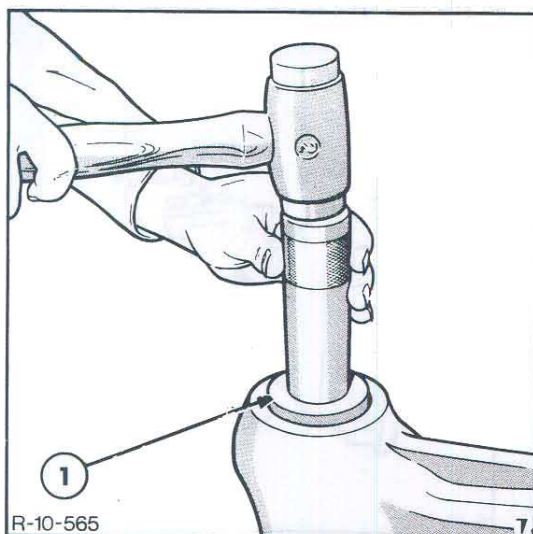
3. Ensure the greasers are in good condition and that the grease channels are not blocked.

### RE-ASSEMBLY

1. Drive in new bearing outer tracks to the upper and lower locations on the ends of the axle centre casing using a suitable driver, Figure 35.

**NOTE:** It may be necessary to heat the axle casing and chill the bearing to aid installation.

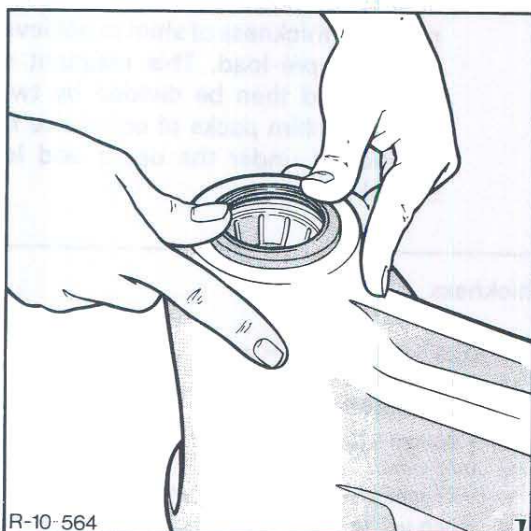


**Figure 35**

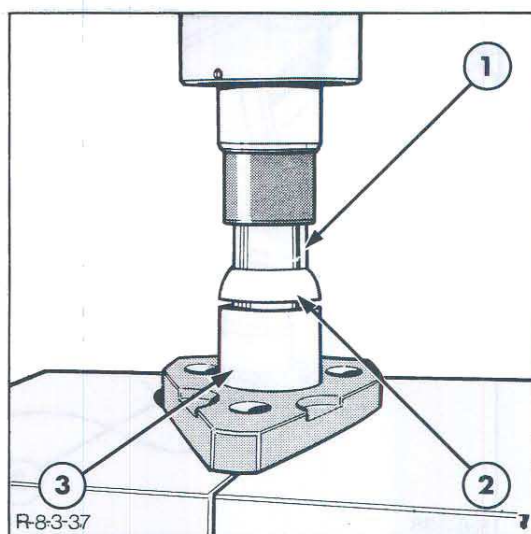
Installing Swivel Pin Bearing Outer Track

1. Suitable Driver Tool

2. Install new grease seals adjacent to each bearing cup. The seals are a light press fit and are easily pushed into their locations, Figure 36.

**Figure 36**

Installing Swivel Pin Grease Seal

**Figure 37**

Pressing Swivel Pin Bearing Cone onto Pin

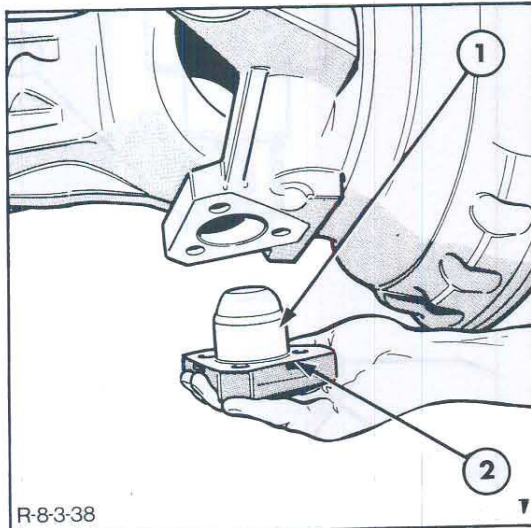
1. Spacer Block
2. Bearing Cone
3. Swivel Pin

3. Press on new cone halves to the swivel pins, ensuring that they are fully seated, Figure 37.

## INSTALLATION

1. Carefully reposition the hub and swivel casing onto the axle shaft and to its location on the axle centre casing. Ensure that the axle shaft does not damage the seal as it passes through the swivel casing and that the upper and lower swivel pin seals are not damaged.

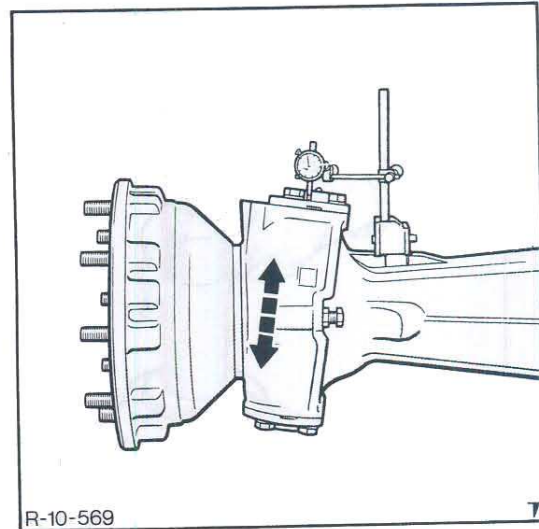
**NOTE:** The swivel pin bearings are pre-loaded by 0.20 mm — 0.40 mm (0.008 — 0.016 in). When installing new bearings, a new swivel casing or axle centre casing, the pre-load must be adjusted. It is recommended that when new bearings are installed, the pre-load is set at the upper limit, when resetting old bearings, set the pre-load to the lower limit.



**Figure 38**

Lower Swivel Pin and Shim Installation

1. Swivel Pin                      2. Shim (1 mm)



**Figure 39**

Dial Gauge Mounted to Record Swivel Pin Bearing Clearance

2. Select a shim value of 1.00 mm (0.040 in) and assemble the lower swivel pin assembly with the 1.00 mm (0.040 in) shim installed under the head of the pin, Figure 38.
3. Without any shims, install the upper swivel bearing assembly. Tighten the upper and lower swivel bearings to the specified torque, see 'Specifications' — Chapter 5.
4. Mount a dial gauge with its stylus mounted on the top of the upper swivel pin and the body clamped to the axle housing, Figure 39.
5. Zero the gauge and lever the swivel casing upwards. The placement of the 1.00 mm (0.40 in) shim on the lower pin will ensure a free play. Record the amount of free play.
6. Add the specified pre-load to the recorded measurement and subtract the total from the 1.00 mm (0.40 in) shim already in position. This will give the resultant thickness of shim to achieve the specified pre-load. This resultant shim size should then be divided by two to give two shim packs of equal size to be positioned under the upper and lower swivel pins.

#### Example for Calculating Required Shim Thickness

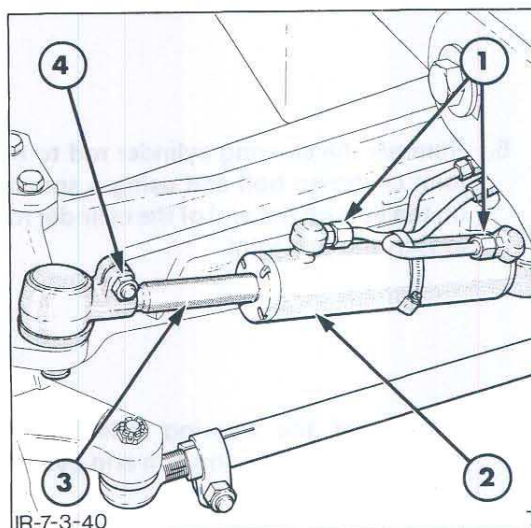
Recorded movement	= 0.20 mm (0.008 in) = a
Specified pre-load (new bearings)	= 0.40 mm (0.016 in) = b
Shim pack already positioned	= 1.00 mm (0.040 in) = c
Shim Calculation = $c - (a + b)$ mm	= 1.00 mm - (0.20 mm + 0.40 mm)
	= 0.40 mm
0.40 mm divided by two	= 0.20 mm shims required per swivel pin
Shim Calculation = $c - (a + b)$ in	= 0.040 in - (0.008 in + 0.016 in)
	= 0.016 in
0.016 in divided by two	= 0.008 in shims required per swivel pin

7. Remove the swivel pins and the 1.00 mm (0.040 in) shim from the lower pin and install the calculated shim value to each swivel pin. Re-tighten to the specified torque, see 'Specifications' — Chapter 5.
8. Grease the swivel pins with grease as specified in 'Specifications' — Chapter 5.
9. Re-install the axle shaft thrust washer spacer and sun gear. Lock the sun gear to the axle shaft using a new snap ring and re-assemble the planetary gear carriage to the hub assembly following the removal procedure in reverse.
10. Fill the hub with the specified oil as detailed under the heading — "PLANETARY REDUCTION ASSEMBLY AND WHEEL HUBS".
11. Reconnect the track rod end to the steering arm and tighten the retaining bolt to the specified torque, see 'Specifications' — Chapter 5.

### E. STEERING CYLINDER AND TRACK CONTROL ROD OVERHAUL

#### REMOVAL

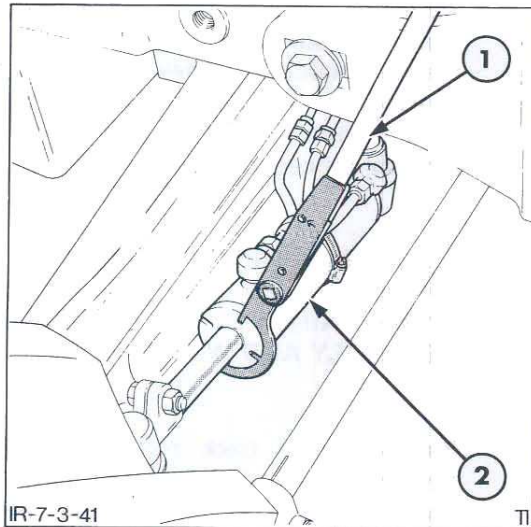
1. Position the unit on a hard level surface.
2. Thoroughly clean the area around the cylinder to prevent contamination of the steering system during removal.
3. Disconnect the hydraulic steering connections to the cylinder, Figure 40 and cap the open ends of the connections. Remove the hose clip securing the tubes to the cylinder.



**Figure 40**  
Steering Cylinder Installation

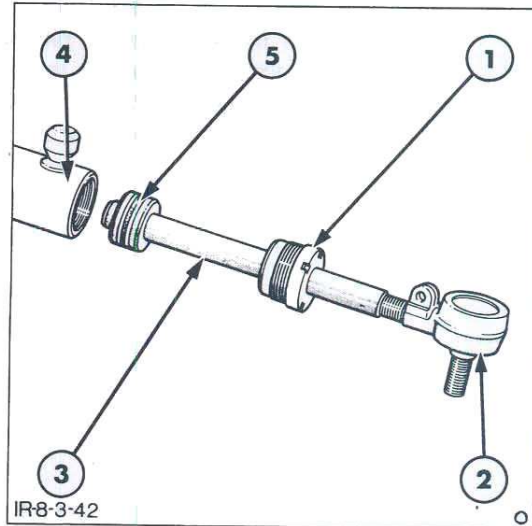
1. Hydraulic Steering Connections
2. Steering Cylinder
3. Cylinder Rod
4. Ball Joint Clamp Bolt





**Figure 41**  
Releasing Steering Cylinder Gland

1. Wrench
2. 'C' Spanner Tool No. FT 3171
3. Gland



**Figure 42**  
Cylinder Rod and Piston Assembly

1. Ball Joint
2. Gland
3. Cylinder Rod
4. Cylinder
5. Piston

4. To aid disassembly of the cylinder after removal from the unit, use 'C' spanner Special Tool No. FT 3171 and a suitable wrench to release the gland from the cylinder, Figure 41.

8. Where overhaul of the ball joints on either end of the track control rod connecting the axle swivel hubs are required the ball joints are disconnected and removed using established overhaul procedures.

5. Remove the steering cylinder rod to ball joint clamping bolt and using a spanner on the flats on the end of the cylinder rod, loosen the ball joint.

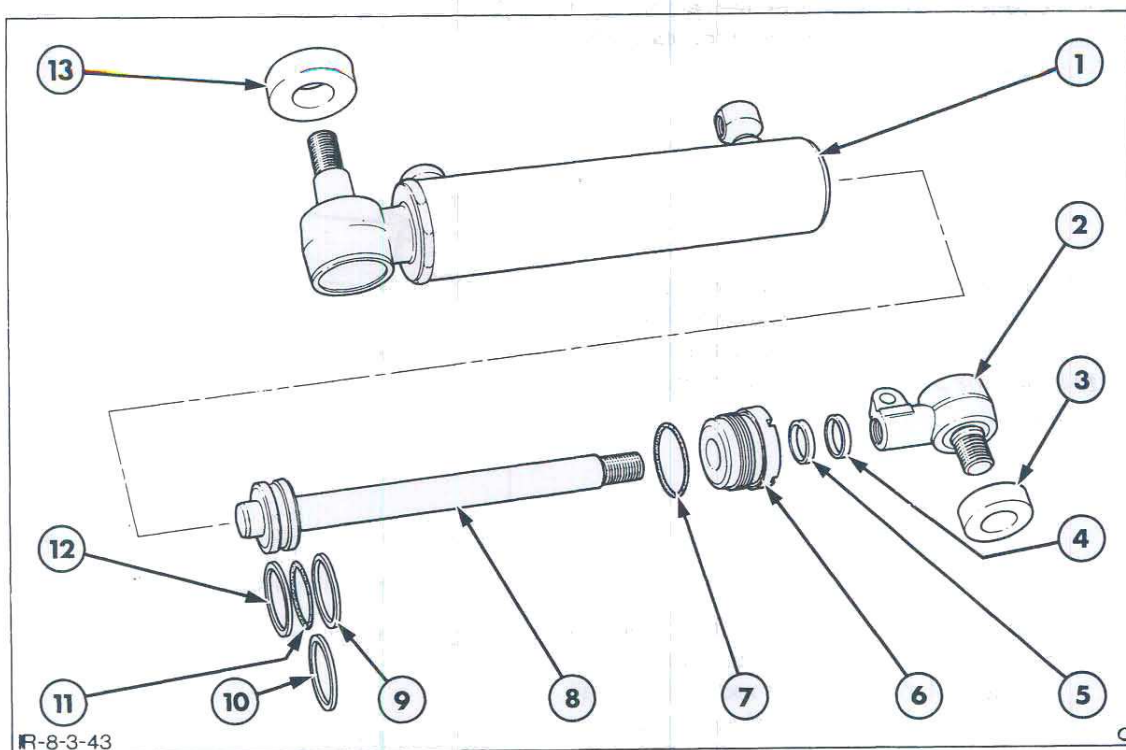
## DISASSEMBLY

6. Disconnect the steering cylinder ball joints from the steering arm and cylinder anchor.
7. Withdraw the steering cylinder assembly from the axle.

1. Unscrew the gland from the cylinder and withdraw the cylinder rod and piston assembly, Figure 42.

2. Unscrew the ball joint from the cylinder rod and withdraw the gland.

3. Remove the wear rings, piston seal and 'O' ring from the piston and the 'O' ring, oil seal and wiper seal from the gland, Figure 43.



**Figure 43**  
Steering Cylinder — Exploded View

- |                    |                 |                          |                |
|--------------------|-----------------|--------------------------|----------------|
| 1. Cylinder Barrel | 5. Rod Seal     | 9. Wear Ring             | 12. Wear Ring  |
| 2. Ball Joint      | 6. Gland        | 10. Seal                 | 13. Dust Cover |
| 3. Dust Cover      | 7. 'O' Ring     | 11. Piston Seal Expander |                |
| 4. Wiper           | 8. Cylinder Rod |                          |                |

### INSPECTION

1. Wash the cylinder components in a suitable solvent and allow to air dry.
2. Inspect the cylinder rod for damage. Any minor nicks or burrs may be relieved using an abrasive stone.
3. Inspect the inside of the cylinder barrel for damage.
4. Inspect the cylinder rod ball joint for looseness. If any wear is evident renew the joint.

### RE-ASSEMBLY

With reference to Figure 43

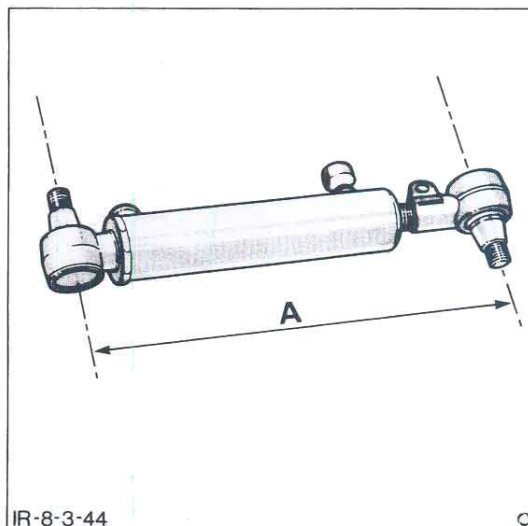
1. Install new piston seal expander ('O' ring), piston seal and wear rings on the piston.
2. Install a new rod seal in the groove in the gland. Ensure the sealing lip faces towards pressure.
3. Install a new cylinder rod wiper seal and 'O' ring barrel seal into their respective locations on the gland.

**NOTE:** The cylinder rod and barrel are not serviced as individual components. If either of these parts is damaged, the complete cylinder assembly must be renewed.

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4. Lubricate all seals and the piston and re-assemble the piston and rod assembly into the cylinder barrel.

**NOTE:** *Installation of the piston seal on top of the 'O' ring requires special care. Allow the seal to contract naturally before attempting to install the piston and rod assembly into the cylinder.*



**Figure 44**  
Steering Cylinder Ball Joint Adjustment

A 403 mm (15.875 in)

5. To protect the gland seals during reassembly apply masking tape to the threads of the cylinder rod then install the gland and tighten using 'C' spanner Tool No. FT 3171 and a suitable torque wrench to the specified torque, see 'Specifications' — Chapter 5.

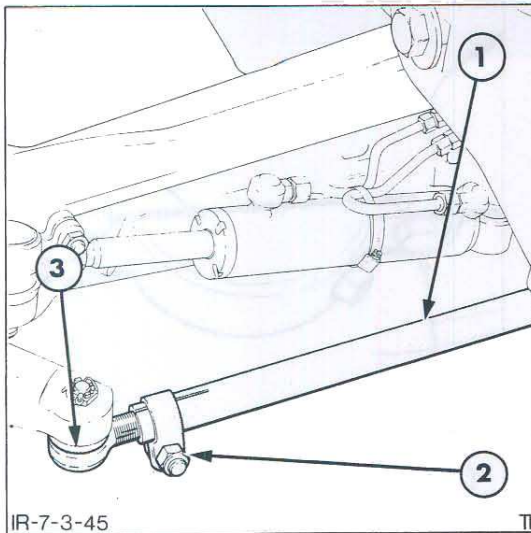
**NOTE:** *Do not clamp the cylinder barrel when tightening the gland as this will cause distortion. Instead clamp the ball joint or alternatively tighten the gland after installation of cylinder onto the axle.*

6. Remove the masking tape and loosely install the ball joint to the cylinder rod. Push the cylinder rod into the barrel until fully retracted and adjust the position of the ball joint until the specified distance between the centres of the ball joint studs on either end of the cylinder is achieved, Figure 44. Tighten the ball joint retaining bolt to the specified torque, see 'Specifications' — Chapter 5.

## INSTALLATION

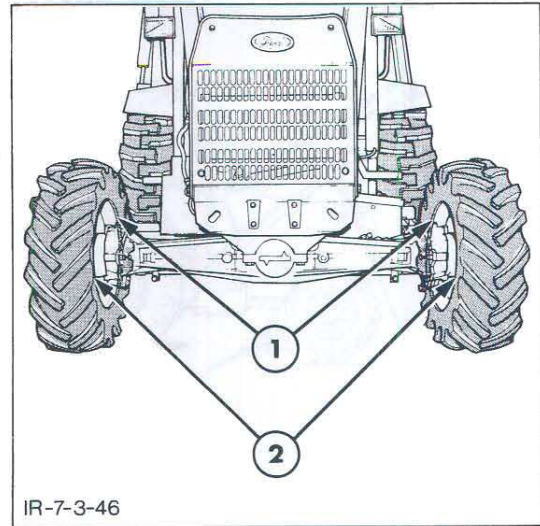
1. Installation of the steering cylinder follows the removal procedure in reverse.
2. Ensure all steering joints and ball joints are tightened to the specified torque, see 'Specifications' Chapter 5.
3. Secure the steering cylinder tubes to the cylinder using a hose clip.
4. Fill the steering reservoir with oil to the specified type and grade, see 'Specifications' — Chapter 5.





**Figure 45**  
Track Rod Adjustment

1. Track Rod
2. Clamp Bolt
3. Ball Joint



**Figure 46**  
Toe-in Measurement

1. Rear Measurement
2. Front Measurement

5. Adjust and set the front wheel toe-in as specified in 'Specifications' — Chapter 5, by adjusting the length of the track control rod. To adjust length of track rod release clamp bolts on either end of rod, Figure 45 and turn rod as necessary.

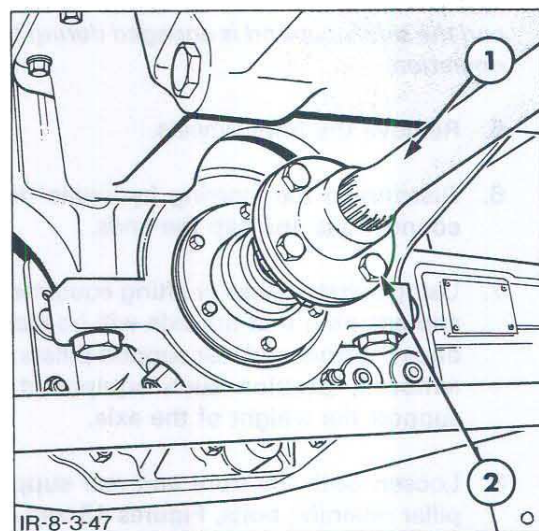
After adjustment tighten clamp bolts to specified torque, see 'Specifications' — Chapter 5.

Ensure toe-in measurement is made at the inside of each wheel rim and at hub height, Figure 46.

## F. FRONT AXLE — REMOVAL AND INSTALLATION

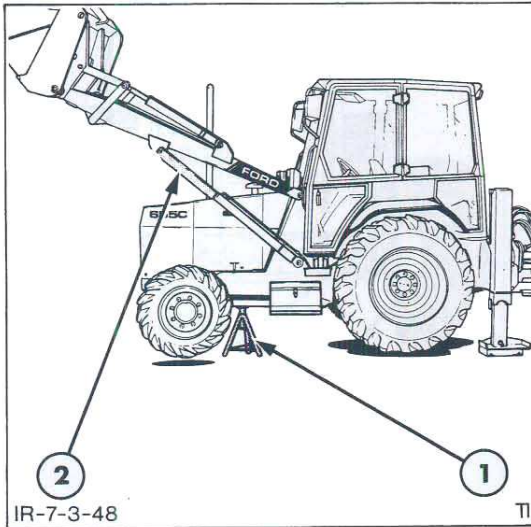
### REMOVAL

1. Position the unit on a hard level surface, apply the parking brake and block the rear wheels.
2. Remove the drive shaft guard retaining bolts and remove the guard.
3. Disconnect the drive shaft to axle pinion flange bolts. Figure 47.



**Figure 47**  
Drive Shaft to Axle Pinion Flange

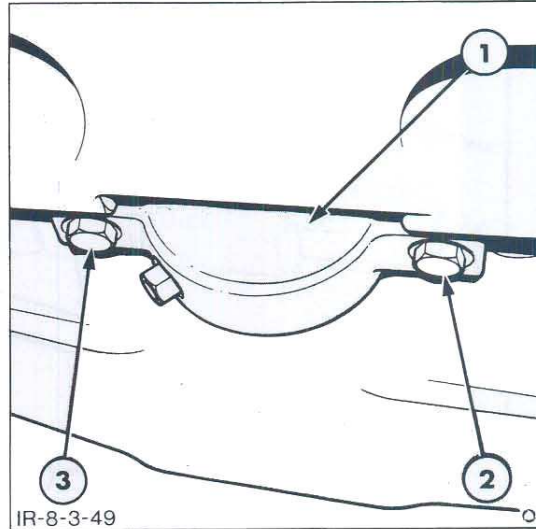
1. Drive Shaft
2. Drive Flange Bolt



**Figure 48**

Front of Vehicle Supported Prior to Axle Removal

1. Axle Stands
2. Safety Support



**Figure 49**

Front Support Pillar Retaining Bolts

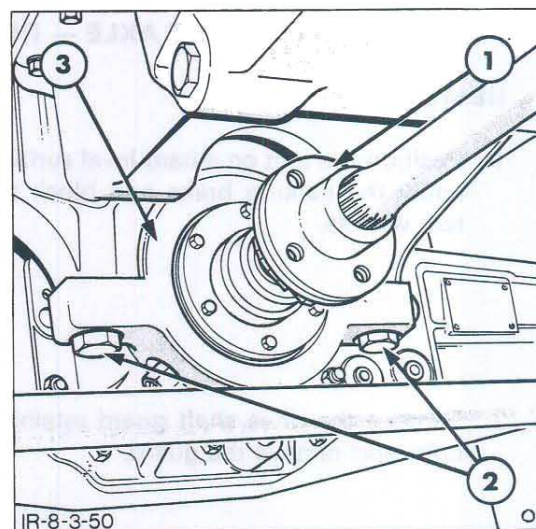
1. Support Pillar
2. Retaining Bolt
3. Retaining Bolt

4. Raise the front of the tractor so that both front wheels are clear of the ground and securely support the tractor on the loader subframe in a position clear of the front axle and wheels, Figure 48. Ensure the method of blocking and supporting the tractor is secure.

**IMPORTANT:** Ensure the loader is raised and the safety support is engaged during this operation.

5. Remove the front wheels.
6. Disconnect the steering hydraulic hose connections and cap the ends.
7. Using suitable jacks or lifting equipment, and ensuring that the axle will be stable once the front and rear support pillars are removed, position such equipment to support the weight of the axle.
8. Loosen both the front and rear support pillar retaining bolts, Figures 49 and 50, equally and gradually lower the jacks or lifting equipment, checking that the axle is stable and secure.

9. Fully remove the front and rear support retaining bolts and lower the axle to the ground.

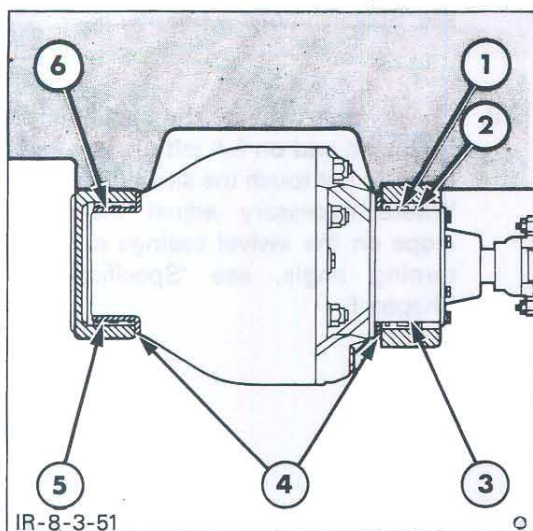


**Figure 50**

Rear Support Pillar Retaining Bolts

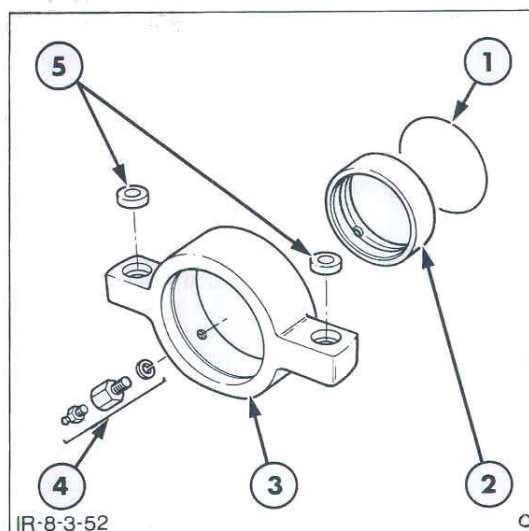
1. Pinion Drive Flange
2. Retaining Bolts
3. Support Pillar



**Figure 51**

Front and Rear Support Pillar Installation

1. Rear Support Bushing
2. 'O' Ring Seal
3. Rear Support Bearing Surface
4. Thrust Washers
5. Front Support Bushing
6. Front Trunnion Bushing

**Figure 52**

Rear Support Pillar Bushing and 'O' Ring Seal

1. 'O' Ring Seal
2. Bushing
3. Rear Support Pillar
4. Bushing Locator and Greaser
5. Locators (Dowels)

## INSPECTION

1. Remove the front and rear support pillars from the axle trunnions. Inspect the bush on the front trunnion and the rear support bearing surface on the differential housing trunnion. Figure 51.
2. Remove the 'O' ring seal from the bushing inside the rear support pillar, Figure 52. Clean all mating surfaces of the bushings and offer the front and rear supports back on to the front and rear trunnions. Assess the degree of wear by rocking the supports from side to side. If wear is excessive bushings should be replaced.
3. To remove the bushings from the supports, first remove the locating bolt and greaser assembly then remove the rear support bushing using a press. The front support bushing may require cutting to ease removal. Install new bushings, ensuring that the grease holes align with the drilling in each support and insert the special locating bolt and greaser assemblies.

4. Where necessary draw off the bush on the front axle trunnion. If necessary cut the bush longitudinally to ease removal. Install a new thrust washer and bush by carefully driving the bush onto the trunnion until it abuts the thrust washer.

## INSTALLATION

1. Installation of the axle follows the removal procedure in reverse.
2. Apply thread locking sealant to the front and rear support pillar retaining bolts and tighten to the specified torque, see 'Specifications' — Chapter 5.
3. Lubricate the support pillar bushings with grease as specified in 'Specifications' — Chapter 5.



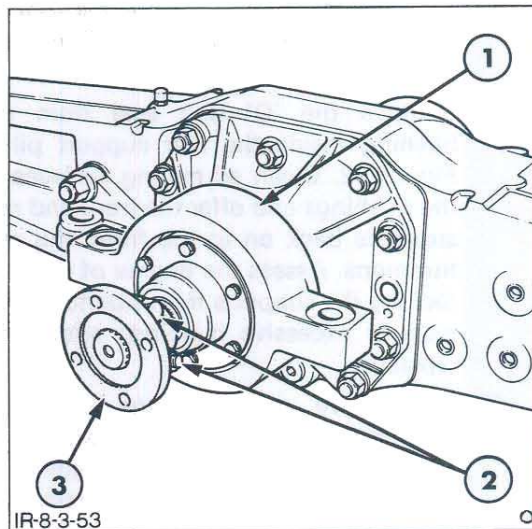
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4. Tighten the drive shaft to axle pinion flange bolts to the specified torque, see 'Specifications' – Chapter 5.
5. Fill the steering reservoir with the correct type and grade of oil, see 'Specifications' – Chapter 5.
6. Cycle the steering from lock to lock to purge any air from the circuit. Re-check the reservoir level.
7. Check and adjust the front wheel toe-in, see 'Specifications' – Chapter 5.
8. Check that when the axle is fully oscillated and on full left or right lock the tyres do not touch the sides of the tractor. Where necessary adjust the steering stops on the swivel casings to limit the turning angle, see 'Specifications' – Chapter 5.

**G. DIFFERENTIAL, CROWN WHEEL AND PINION ASSEMBLY – OVERHAUL**

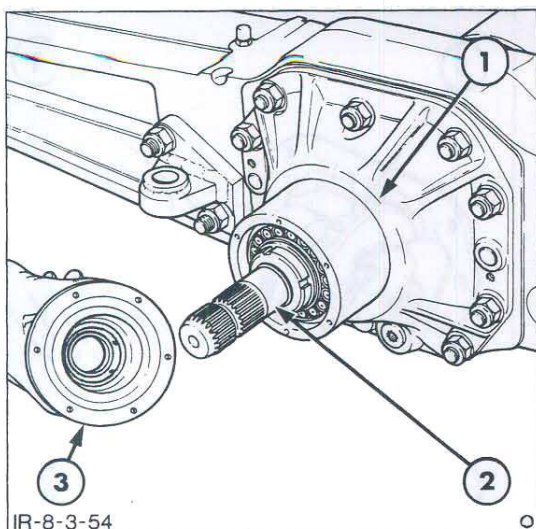
**REMOVAL**

1. Remove the axle assembly as described in the relevant section of this Chapter and mount on a suitable stand to enable the differential assembly to be removed.
2. Drain the oil from the differential housing.
3. Disconnect and remove the track rod and steering cylinder.
4. Remove the two bolts securing the drive shaft coupler to the pinion shaft, Figure 53, and withdraw the coupler from the shaft.
5. Remove the rear support pillar from the trunnion on the differential support housing.
6. Remove the pinion oil seal housing retaining bolts and withdraw the housing from the pinion shaft. Figure 54. Removal of oil seal housing at this stage improves handling of differential support housing during removal from axle.
7. Remove the swivel casings and axle shafts following the procedure described in this Chapter.



**Figure 53**  
Pinion Drive Shaft Coupler

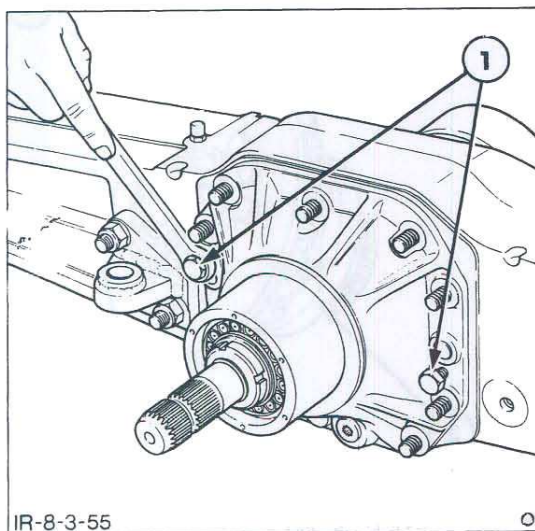
1. Rear Support Pillar
2. Coupler Retaining Bolts
3. Drive Shaft Coupler



**Figure 54**  
Removing Pinion Oil Seal Housing

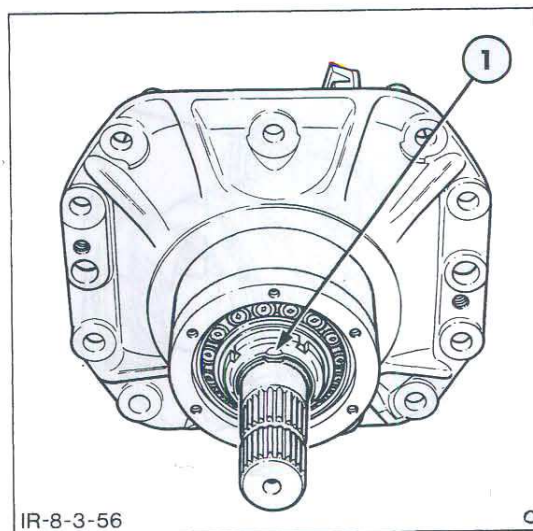
1. Differential Support Housing
2. Pinion Shaft
3. Pinion Oil Seal Housing

8. Remove the differential support to axle casing retaining bolts.
9. Install 2 off M10×1.5×50 mm bolts in the threaded jacking holes in the differential support. Tighten the bolts evenly to draw off the differential support assembly, Figure 55. Remove the differential support from the axle casing.



**Figure 55**  
Removing Differential Support

1. Jacking Bolts



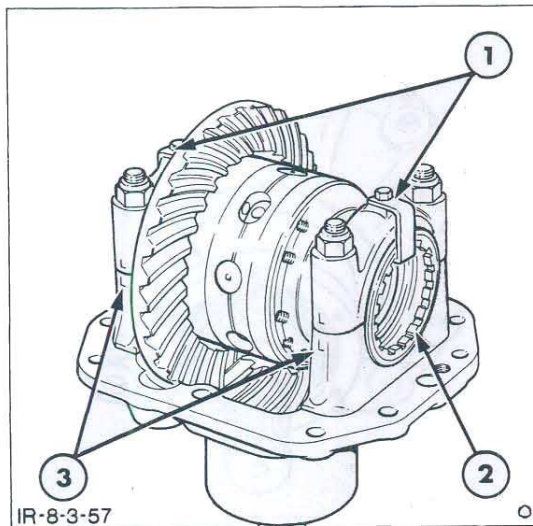
**Figure 56**  
Pinion and Bearing Retaining Nut

1. Retaining Nut Deformation

## DISASSEMBLY

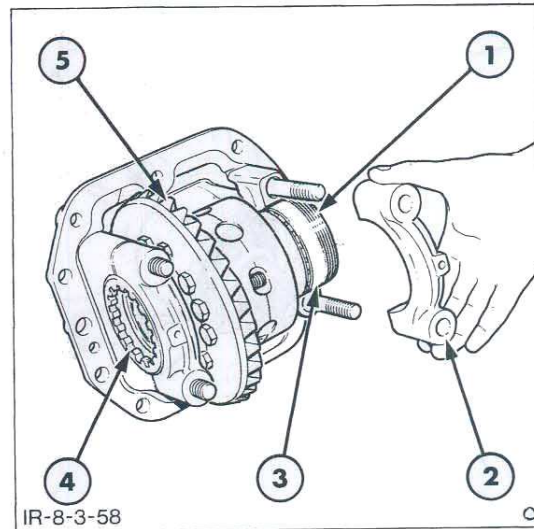
1. Relieve the deformation on the edge of the pinion and bearing retaining nut which locks the nut to the pinion shaft. Figure 56.
2. Position a suitable piece of hard wood in mesh with the crown wheel and pinion to effectively lock the two gears to facilitate removal of the pinion and bearing retaining nut.
3. Using Tool No. FT.3168 (307978) remove the retaining nut and tabbed washer.
4. Carefully mark the bearing adjuster ring nuts relative to their respective bores and to the position of each within its bore. This marking will assist re-assembly if new components affecting bearing pre-load or crown wheel and pinion matching are not required.





**Figure 57**  
Differential Support Assembly

1. Locking Plates
2. Bearing Adjuster Ring Nut
3. Bearing Cap Identification Marks



**Figure 58**  
Removing Differential Bearing Caps

1. Bearing Adjuster Ring Nut
2. Bearing Cap
3. Bearing Outer Track
4. Bearing Adjuster Ring Nut
5. Crown Wheel

5. Mark each bearing end cap in relation to the housing to ensure these are not interchanged during re-assembly, Figure 57.

6. Remove the differential unit bearing adjuster ring nut locking plates.

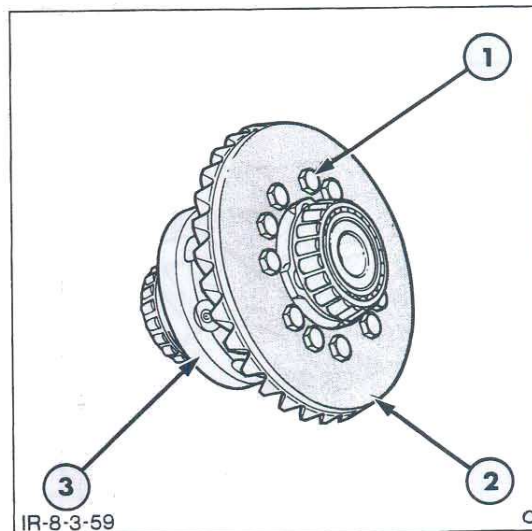
7. Remove the bearing cap retaining nuts and caps. Figure 58.

8. Lift out the differential and crown wheel assembly, Figure 59 from the support housing. Collect the bearing outer tracks and adjuster ring nuts. Identify each bearing track to its respective bearing.

9. Mark the two halves of the differential housing to ensure correct alignment on re-assembly.

10. Support the differential and remove the crown wheel retaining bolts.

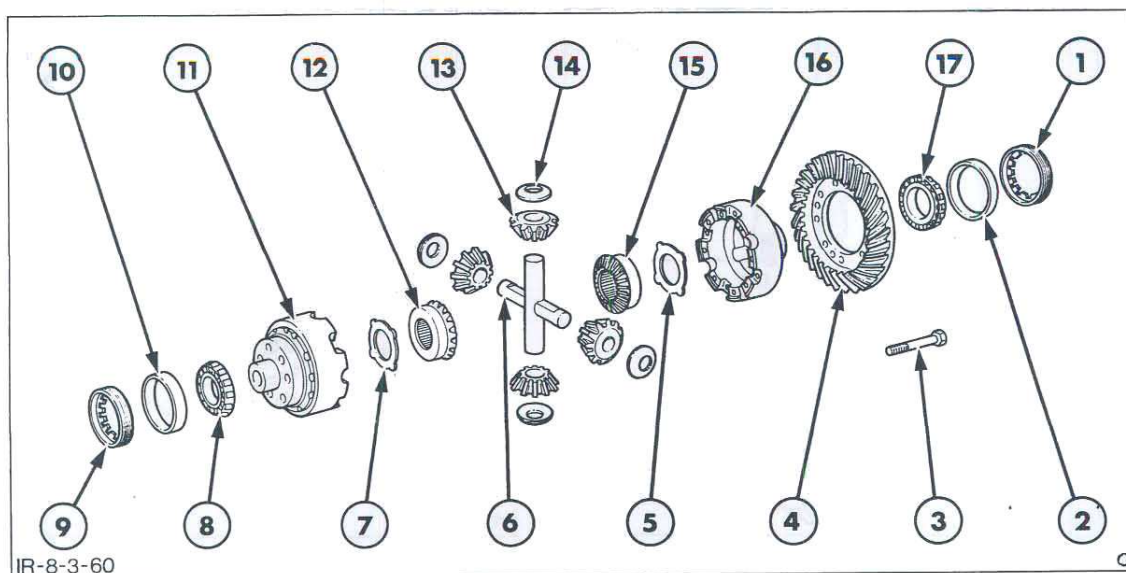
11. Remove the crown wheel and separate the two halves of the differential housing. Refer to Figure 60.



**Figure 59**  
Differential and Crown Wheel Assembly

1. Crown Wheel Retaining Bolts
2. Crown Wheel
3. Differential Housing





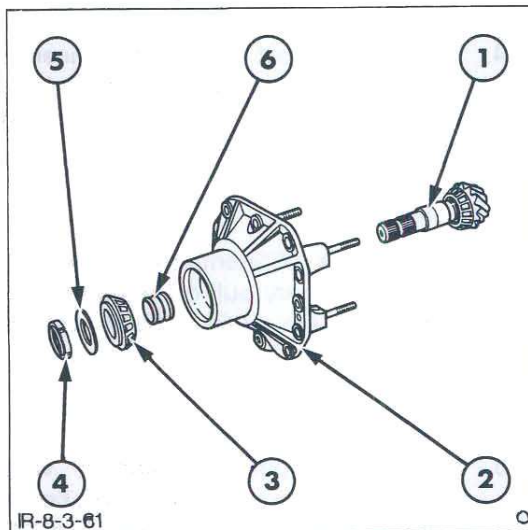
**Figure 60**  
Differential and Crown Wheel Assembly — Exploded View

- |                  |                  |                          |                          |
|------------------|------------------|--------------------------|--------------------------|
| 1. Adjuster Ring | 6. Shaft         | 10. Bearing Track        | 14. Thrust Washer        |
| 2. Bearing Track | 7. Thrust Washer | 11. Differential Housing | 15. Side Gear            |
| 3. Bolt          | 8. Bearing       | 12. Side Gear            | 16. Differential Housing |
| 4. Crown Wheel   | 9. Adjuster Ring | 13. Bevel Gear           | 17. Bearing              |
| 5. Thrust Washer |                  |                          |                          |

12. Prise the bevel gear shafts from the separated differential housing and collect the four bevel gears and thrust washers and two side gears and thrust washers.

2. Clean the differential support housing mounting face and the mating face of the axle casing, remove all traces of sealant.

13. Drive the pinion from the differential support housing and collect the collapsible spacer and outer bearing inner race Figure 61.

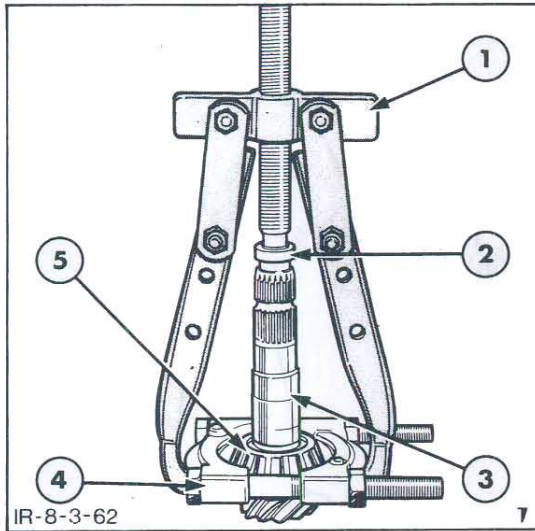


**Figure 61**  
Drive Pinion Removed from Differential Support Housing

- |                       |                       |
|-----------------------|-----------------------|
| 1. Pinion and Bearing | 4. Retaining Nut      |
| 2. Support Housing    | 5. Tabbed Washer      |
| 3. Outer Bearing      | 6. Collapsible Spacer |

## INSPECTION AND REPAIR

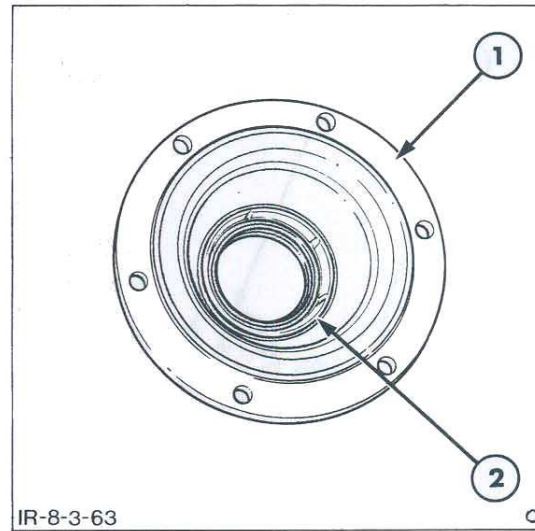
1. Clean all the components in a suitable solvent and allow to air dry.



**Figure 62**

Removing Pinion Inner Bearing Race

1. Puller Tool No. 1003 or 9516
2. Shaft Protector
3. Pinion
4. Pulling Attachment Tool No. 951 or 9190
5. Bearing Inner Race



**Figure 63**

Pinion Oil Seal Housing

1. Housing
2. Oil Seal

3. Clean all traces of locking compound from the crown wheel securing bolts and any locating dowels.
4. Carefully inspect the crown wheel and pinion teeth. If worn or damaged both gears must be replaced. They are only serviced as a matched pair.
5. Inspect the differential side bearings; where necessary pull off the inner races using Tool No. 1003 (9516) and Tool No. 951 (9190).
6. Inspect the pinion bearings; where necessary draw off the inner bearing inner race using Tool Nos. 951 and 1003 (9190 and 9516), Figure 62. Note that there is a shim positioned between the pinion inner bearing and the head of the pinion. Drive out the outer tracks from the differential support housing.
7. Inspect the differential gears, thrust washers and shafts for wear, renew any worn or damaged items.
8. Inspect the side gears and the splines within each gear for damage.
9. Examine the thrust washer placed under the head of each side gear for wear and damage and replace if necessary.
10. Visually check the condition of the axle housing, the differential support housing and the differential gear housing.
11. Remove and replace the oil seal in the pinion oil seal housing, Figure 63.

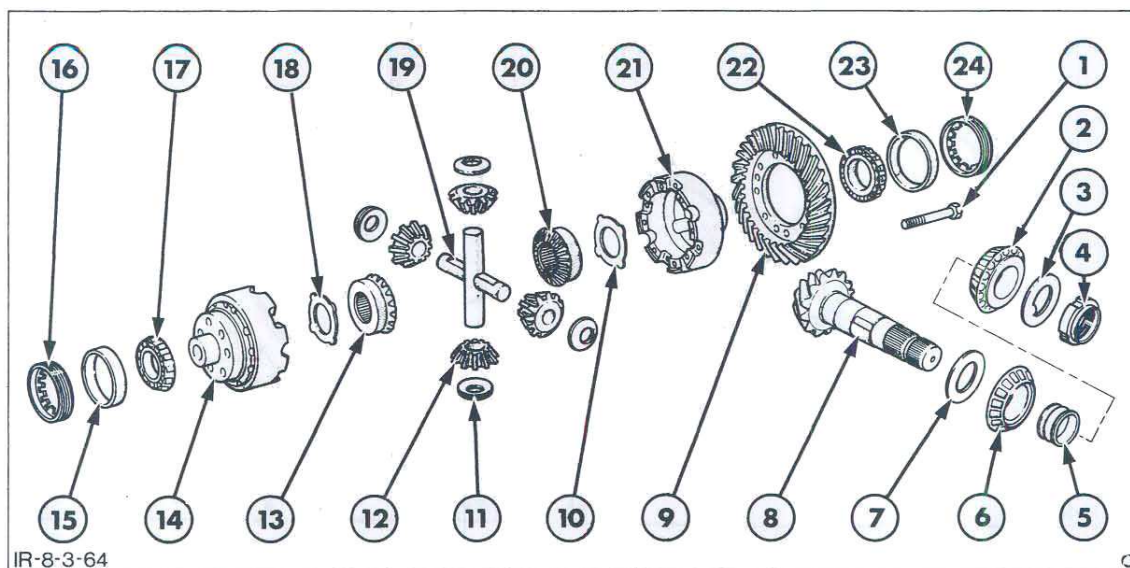


Figure 64

Differential, Crown Wheel and Pinion Assembly — Exploded View

- |                       |                   |                          |                          |
|-----------------------|-------------------|--------------------------|--------------------------|
| 1. Bolt               | 7. Shim           | 23. Side Gear            | 19. Shaft                |
| 2. Bearing            | 8. Pinion         | 14. Differential Housing | 20. Side Gear            |
| 3. Tabbed Washer      | 9. Crown Wheel    | 15. Bearing Track        | 21. Differential Housing |
| 4. Retaining Nut      | 10. Thrust Washer | 16. Adjuster Ring        | 22. Bearing              |
| 5. Collapsible Spacer | 11. Thrust Washer | 17. Bearing              | 23. Bearing Track        |
| 6. Bearing            | 12. Bevel Gear    | 18. Thrust Washer        | 24. Adjuster Ring        |

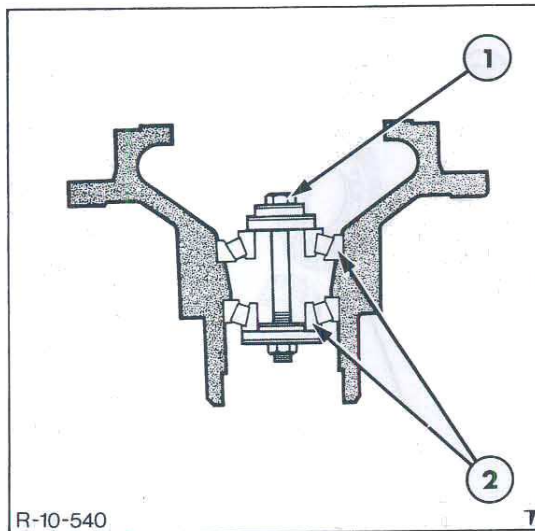
**RE-ASSEMBLY**

With reference to Figure 64.

Calculate the shim thickness as follows:—

1. If the crown wheel and pinion assembly or pinion bearings have been renewed or the differential support housing has been changed, it will be necessary to recalculate the thickness of shim placed behind the head of the drive pinion on the pinion shaft (the bevel distance). If all these components are re-usable then the drive pinion may be re-installed in the differential support housing using the same shim value as originally fitted.
  - (i) Install the pinion bearings in the differential support housing as shown in Figure 65 and lightly clamp the bearings using part of Tool No. FT. 3135 (or 4775). Ensure the disc part of the tool with the cut-away side is uppermost. Tighten the clamp so that the bearing cones can just be turned by hand — do not overtighten.

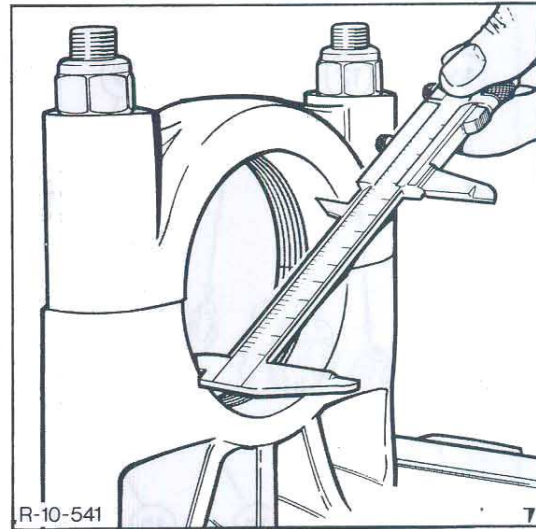




**Figure 65**

Pinion Bearings Clamped in Housing

1. Part of Pinion Setting Gauge Tool No. FT.3135 or 4775
2. Pinion Bearing Assemblies



**Figure 66**

Measuring Diameter of Differential Support Housing Bearing Bores

- (ii) Install the differential support housing bearing caps (not the bearing tracks) and tighten the cap retaining nuts to the specified torque. See 'Specifications' — Chapter 5.
- (iii) Using an internal micrometer or vernier gauge, measure the side bearing bore dimension 'A' shown in Figure 66.

- (iv) Locate the circular bar of Tool No. FT.3135 (4775) across the two bearing bores in the support housing Figure 67, and using a depth gauge, measure the dimension B.

- (v) Determine the required thickness of shim using the following calculation:

$$a) C = B - 25.0 \text{ mm (dia. of bar)} + \frac{1}{2}A$$

The actual shim thickness will be the difference between calculation C and the dimension etched on the head of the pinion.

Example:

$$C = 90.8 - 25 + \frac{1}{2}(90) = 110.8$$

Etched on head of pinion is 107,7.

$110.8 - 107.7 = 3.1$  shim thickness required in millimeters.

Select the calculated shim thickness from the range available, see 'Specifications' — Chapter 5, and install on the pinion shaft with the chamfer adjacent to the pinion gear.

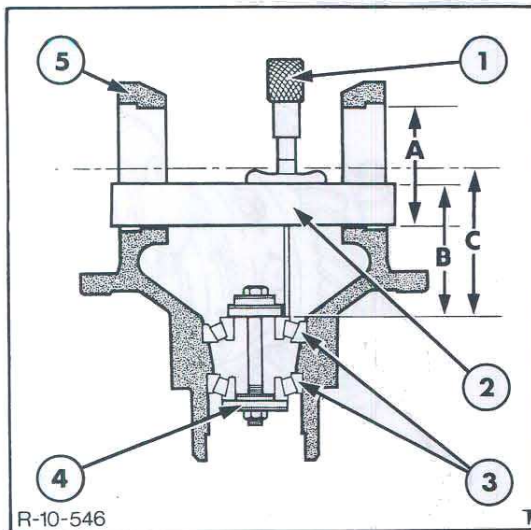


Figure 67

Measuring Dimension 'B'

1. Depth Gauge
2. Bar Gauge — Part of Tool No. FT.3135 or 4775
3. Pinion Shaft Bearings
4. Pinion Setting Gauge Tool No. FT.3135 or 4775
5. Differential Support Housing

2. Press the inner bearing onto the pinion shaft, ensuring that it is fully seated, Figure 68.

**IMPORTANT:** Place a new collapsible spacer on the pinion shaft. **DO NOT** use the old item.

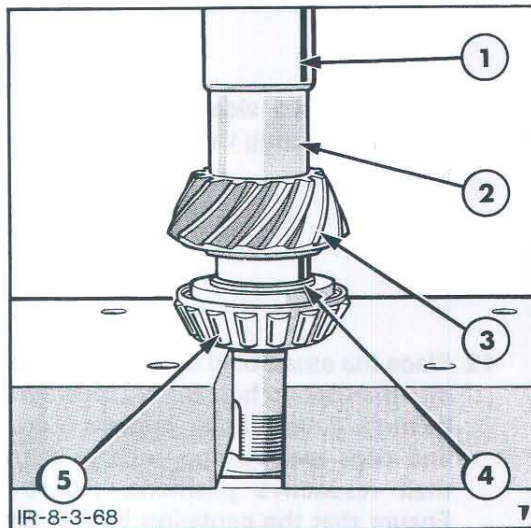


Figure 68

Pressing Inner Bearing onto Pinion

- |                    |                  |
|--------------------|------------------|
| 1. Press           | 4. Shim          |
| 2. Shaft Protector | 5. Inner Bearing |
| 3. Pinion          |                  |

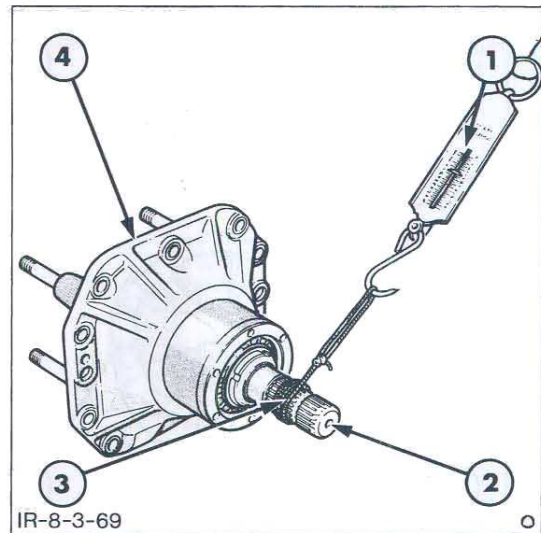


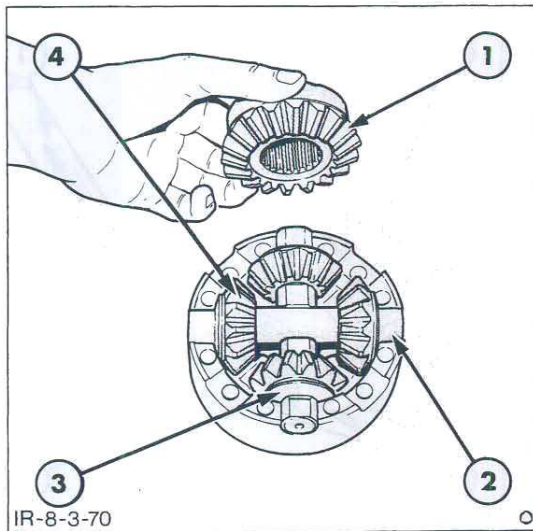
Figure 69

Checking Pinion Shaft Bearing Rolling Resistance

1. Spring Balance
  2. Pinion Shaft
  3. String
  4. Differential Support Housing
3. Assemble the pinion bearing and spacer assembly into the support housing and install the outer bearing, tabbed washer and retaining nut. Ensure the retaining nut is in good condition and, using Tool No. FT.3168 (307978) tighten the nut until the bearings are just supported (no free play exists).
  4. Wrap a length of string evenly and without over lapping around the exposed input spline and using a pull scale, measure the force required to rotate the pinion shaft in its bearings, Figure 69. The scale should be read during rotation of the pinion. Do not read the scale at the point where rotation starts.
  5. Progressively tighten the retaining nut until a rotational pull, as specified in 'Specifications' — Chapter 5, is achieved.

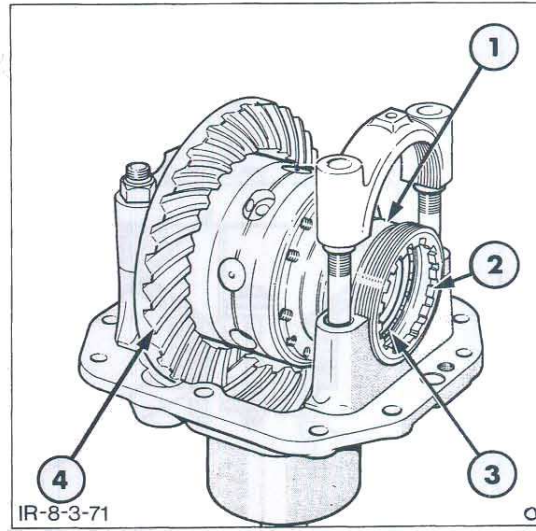
It may be necessary to temporarily replace the differential and crown wheel to prevent rotation of the pinion during tightening of the bearing retaining nut.





**Figure 70**  
Re-assembling Differential

- |              |                  |
|--------------|------------------|
| 1. Side Gear | 3. Thrust Washer |
| 2. Shaft     | 4. Bevel Gear    |



**Figure 71**  
Re-assembling Differential and Support Housing

- |                  |                |
|------------------|----------------|
| 1. Bearing Track | 3. Bearing     |
| 2. Adjuster Ring | 4. Crown Wheel |

6. When the specified pull scale reading is achieved, lock the retaining nut to the shaft by forming the locking sleeve part of the nut into the slot machined on the pinion shaft. Record the reading obtained.

7. Position a tabbed thrust washer and side gear into one half of the differential housing.

8. Locate the bevel gears and thrust washers onto the shafts and position the shafts into the differential housing, Figure 70. It will be necessary to lightly tap each shaft to ensure they are fully seated in the housing.

9. Position the remaining tabbed thrust washer and side gear into the second half of the differential housing and assemble the two halves of the housing ensuring that they align with marks scribed during disassembly.

10. Install the crown wheel on the housing. Coat the threads of the retaining bolts with sealant as specified in 'Specifications' — Chapter 5 and tighten to the specified torque.

11. Press the two side bearings onto the housing ensuring that they are both fully seated.

12. Place the assembled differential housing into the support housing and position the bearing outer tracks, support housing end caps and bearing adjuster rings in their respective positions, Figure 71. Ensure that the centering bushes are in position and that the relationship between the crown wheel and pinion is correct. The crown wheel should always be to the right of the pinion when viewed from the input side.



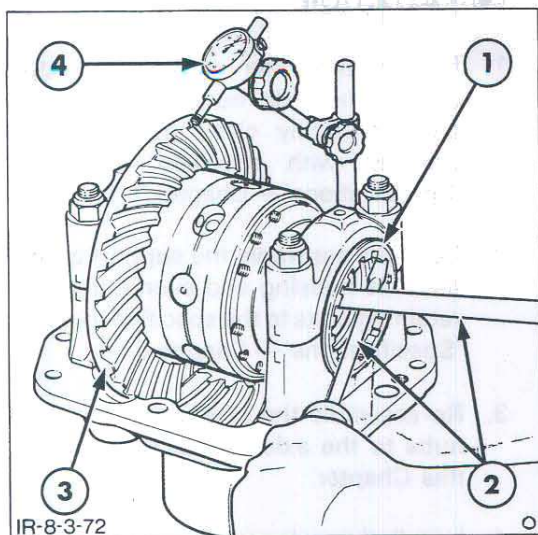


Figure 72

Measuring Crown Wheel to Pinion Back Lash

- |                  |                   |
|------------------|-------------------|
| 1. Adjuster Ring | 3. Crown Wheel    |
| 2. Pry Bars      | 4. Dial Indicator |

13. Assemble the bearing cap retaining nuts so that the caps are just pinched and at the same time carefully adjust the adjuster rings to ensure that the crown wheel is not forced into mesh with the pinion. Take care during this procedure. Tightening the cap nuts and forcing the crown wheel against the pinion could seriously damage the gear set.
14. With the bearing cap retaining nuts fully supporting the caps, but not fully tightened, adjust the adjuster rings to remove all free play. Do this by first tightening the crown wheel side locking ring, moving the crown wheel against the pinion and then tightening the other adjuster until it becomes difficult to move. **DO NOT** force the adjuster.
15. Measure the backlash between the crown and pinion by placing a dial indicator with its stylus placed at 90° to the crown wheel teeth, Figure 72.
16. Adjust the adjuster rings by equal amounts moving the crown wheel towards or away from the pinion to achieve the specified backlash. See 'Specifications' — Chapter 5. During this operation, gently tap each bearing cap with a soft faced hammer to ensure the cap and bearings remain correctly seated. Repeat the backlash measurement on two more teeth equidistant around the crown wheel and re-adjust as necessary.
17. To set the pre-load on the differential side bearings tighten each adjuster ring by ½ to 1 notch and perform the following test to ensure correct adjustment has been achieved:
  - (i) With the crown wheel in mesh with the pinion and the backlash correctly set, rotate the pinion using the string and pull scale and record the effort required to rotate the pinion and the crown wheel/differential unit.
  - (ii) From this result, subtract the previously recorded pinion only bearing rolling resistance, refer to Steps 5 and 6.

## Example:

Effort to rotate crown wheel and pinion  
 = 15 daN (15.3 kgf, 34 lbf)  
 Effort to rotate pinion only  
 = 11 daN (11.2 kgf, 25 lbf)  
 Differential Bearing rolling resistance  
 = 15 - 11  
 = 4 daN (4.1 kgf, 9 lbf)

- (iii) Adjust where necessary each differential side bearing adjuster ring by equal amounts, to preserve the backlash adjustment, until the rolling resistance achieved is within the lower band of the specified figure see 'Specifications' — Chapter 5.

18. Fully tighten the bearing cap nuts to the torque specified in 'Specifications' — Chapter 5.

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19. Recheck the backlash and then install the adjuster ring lock tabs. Where necessary tighten the adjuster rings to align the tab with the slot. Recheck the bearing rolling resistance.
20. Install a new oil seal in the pinion oil seal housing using driver handle No. 550 and seal installer FT.3162 (307972).
21. Coat the mating surfaces of the pinion oil seal housing and the differential support casing with specified sealant, see 'Specifications' — Chapter 5.
22. Carefully slide the housing over the pinion and install the retaining bolts. Tighten the bolts to the specified torque, see 'Specifications' — Chapter 5.

INSTALLATION

1. Ensure that the differential support casing and axle housing mating faces are thoroughly clean then coat these surfaces with specified sealant, see 'Specifications' — Chapter 5.
2. Carefully assemble the support casing to the axle housing and evenly tighten the retaining bolts to the specified torque, see 'Specifications' — Chapter 5.
3. Re-assemble the axle shafts and swivel hubs to the axle as described earlier in this Chapter.
4. Install the axle on the tractor as previously described in Section F of this Chapter.
5. Fill the axle centre casing and the hubs with the specified type, grade and quantity of oil, see 'Specifications' — Chapter 5.

H. DRIVE SHAFT — OVERHAUL

REMOVAL

1. Position the unit on a hard level surface, apply the parking brake and block the wheels.
2. Remove the drive shaft guard.
3. Support the drive shaft and remove the bolts securing the drive shaft to the axle pinion drive flange, Figure 73.

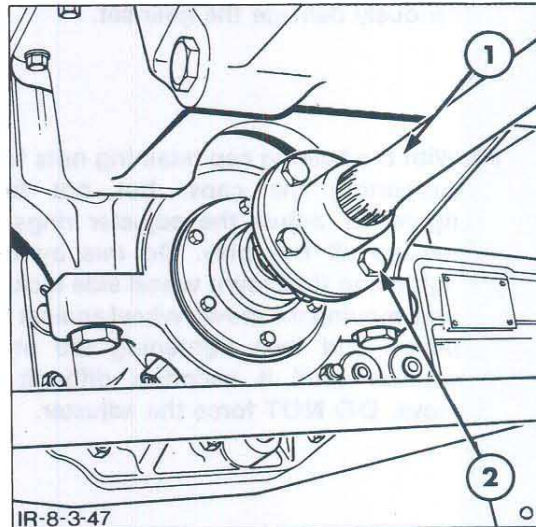
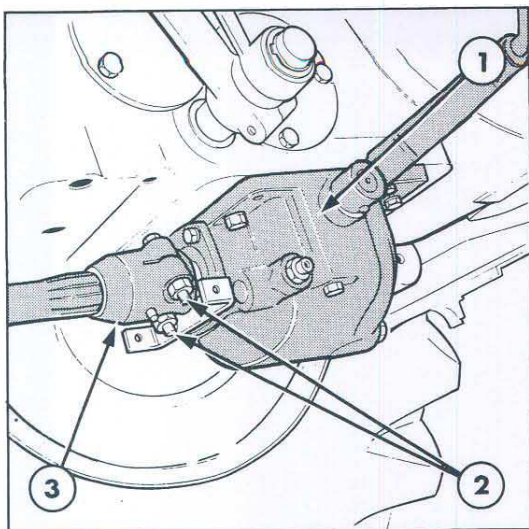


Figure 73  
Drive Shaft to Axle Pinion Flange

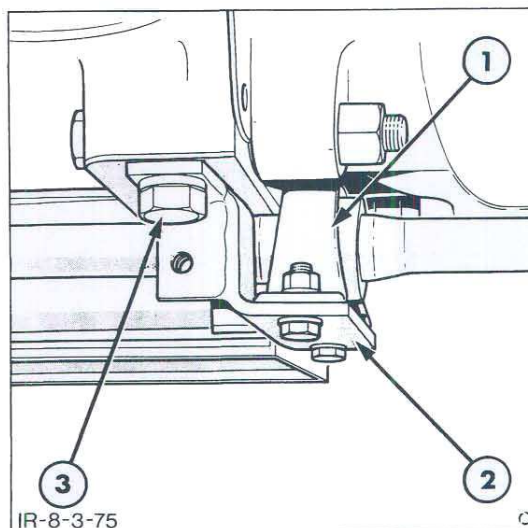
1. Drive Shaft
2. Bolt



**Figure 74**

Drive Shaft to Transfer Case Coupling

1. Transfer Case
2. Connecting Bolts
3. Coupling

**Figure 75**

Drive Shaft Support Bearing

1. Bearing
2. Support Bracket
3. Support Retaining Bolt

4. Remove the clamping bolts on the sliding coupling connecting the drive shaft to the transfer case output shaft and disconnect the coupler, Figure 74.
5. Remove the bolts securing the bearing support bracket and withdraw the drive shaft from beneath the unit, Figure 75.

### INSPECTION AND REPAIR

1. Remove the bolts securing the bearing to the support and slide the bearing from the drive shaft.
2. Inspect the drive shaft bearing for wear or damage and replace if necessary.

3. Examine the drive shaft for straightness. The drive shaft and bearing must be replaced if the shaft is damaged.

### INSTALLATION

Installation follows the removal procedure in reverse. On installation observe the following requirements:-

- Tighten all nuts and bolts to the specified torque. See 'Specifications' — Chapter 5.
- Grease the bearing and couplings with the correct grade of Ford grease, see 'Specifications' — Chapter 5.





# PART 7

## STEERING AND FRONT AXLE

### Chapter 4

#### TRANSFER GEAR ASSEMBLY

Section	Page
A. TRANSFER GEAR ASSEMBLY — DESCRIPTION AND OPERATION	1
B. TRANSFER GEAR ASSEMBLY — OVERHAUL	3
C. TRANSFER GEAR OPERATING CABLE — ADJUSTMENTS	15

#### A. TRANSFER GEAR ASSEMBLY — DESCRIPTION AND OPERATION

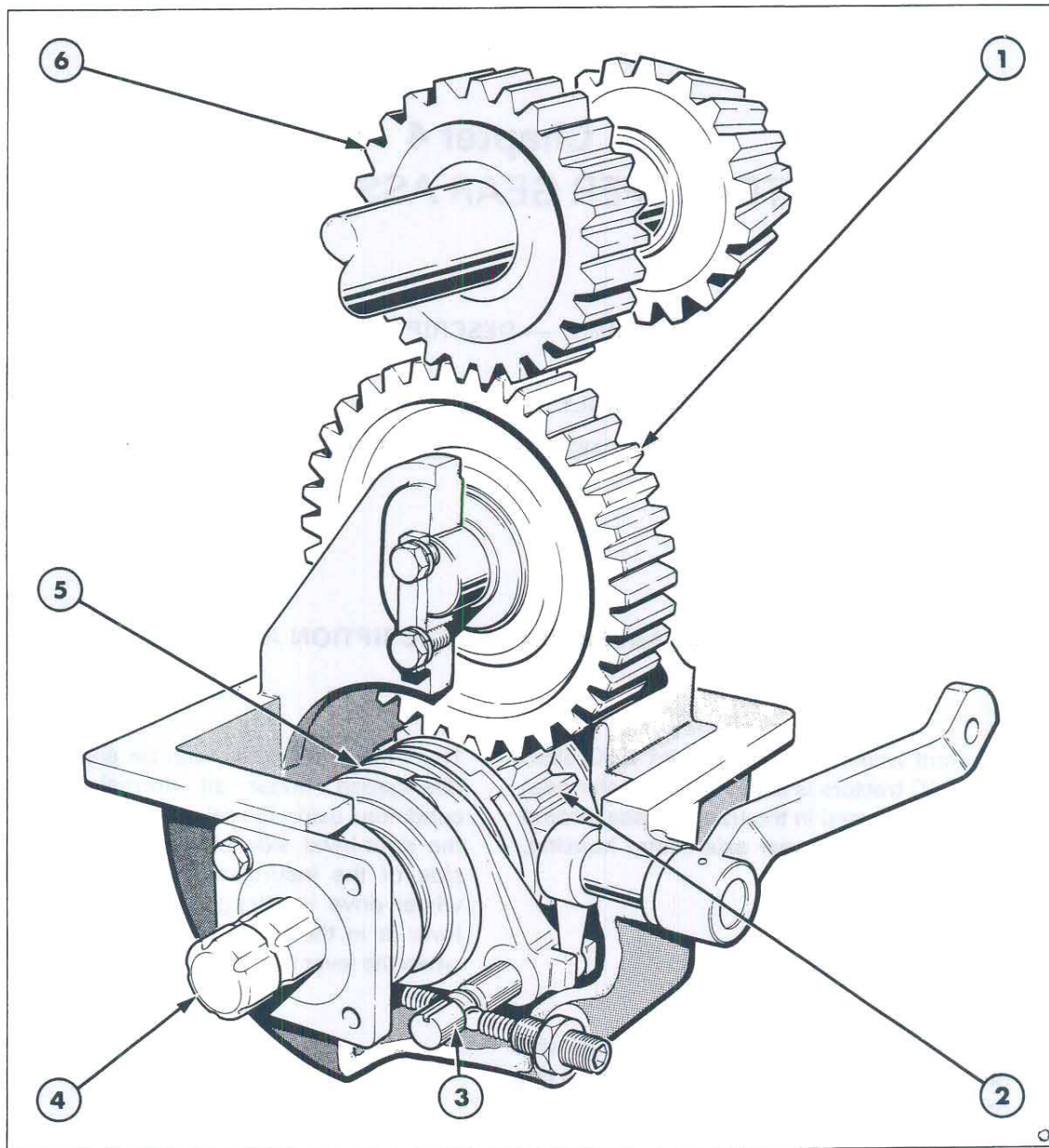
The front wheel drive on the Ford 455C, 555C and 655C tractors is taken via a transfer gear assembly housed in the transfer case located at the base of the rear axle centre housing, Figure 1.

The front wheel drive can be engaged and disengaged under all normal operating conditions using the selector lever located on the right-hand side of the operator on the side of the instrument console. The front wheel drive is engaged when the selector lever is in the up position and disengages when the lever is in the down position.

The transfer gear assembly transmits the drive from the rear axle centre housing to the drive shaft which is located under the tractor and protected by a guard. The drive shaft connects directly to the pinion in the front axle.

A gear on the rear axle pinion drives the train of two gears inside the transfer case. The second gear in the train is connected to the transfer gear output shaft via a sliding dog clutch assembly, actuated by the spring loader selector lever mechanism.

Moving the selector lever to engaged position (up) moves the selector fork operating the sliding coupling/dog clutch rearwards. Should a tooth to tooth situation occur on the dog clutch the rear springs in the sliding coupling will be loaded trying to force the shift gear half of the clutch rearwards. As the driving gear rotates the dog clutch teeth will move relative to one another and the springs will ensure full engagement takes place.



**Figure 1**  
**Front Wheel Drive Transfer Gear Assembly**

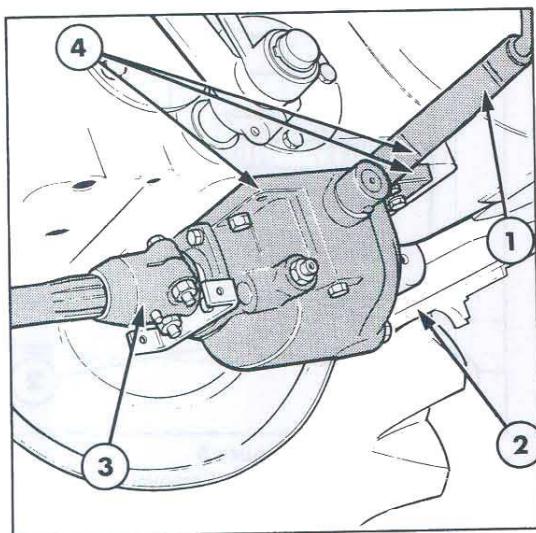
- |                     |                              |
|---------------------|------------------------------|
| 1. Idler Gear       | 4. Output Shaft              |
| 2. Driven Gear      | 5. Sliding Coupling Assembly |
| 3. Detent Mechanism | 6. Pinion Drive Gear         |

Moving the selector lever to the disengaged position (down) moves the fork forwards. If there is a large torque difference between the shift gear and driving gear, the dog clutch teeth will not separate.

In this situation, the front springs of the sliding coupling will be loaded, trying to force the shift gear forwards. When the torque equalises, the dog clutch teeth will part due to the springs and disengage the drive.

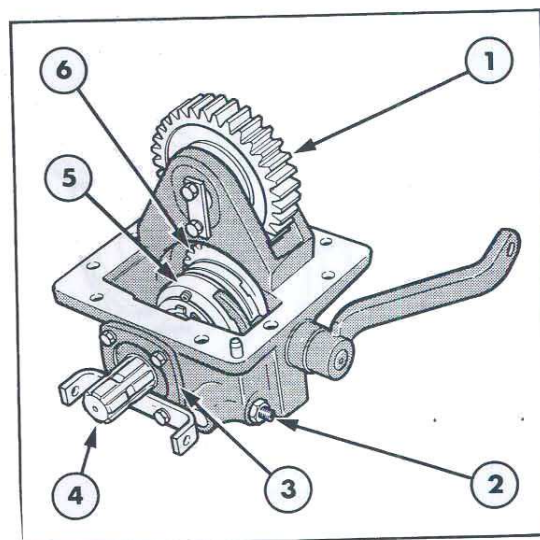


## B. TRANSFER GEAR ASSEMBLY — OVERHAUL



**Figure 2**  
Transfer Case Installation

1. Actuating lever
2. Drain Plug
3. Drive Shaft Coupling
4. Transfer Case Securing Bolts



**Figure 3**  
Transfer Gear Assembly

- |                    |                              |
|--------------------|------------------------------|
| 1. Idler Gear      | 5. Sliding Coupling Assembly |
| 2. Detent Adjuster | 6. Driven Gear               |
| 3. End Cap         |                              |
| 4. Output Shaft    |                              |

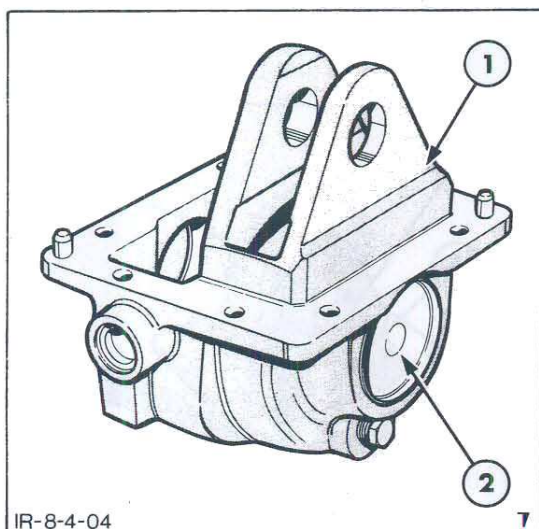
**REMOVAL**

1. Park the unit on a hard level surface and block the wheels.
2. Remove the drive shaft guard.
3. Remove the transfer case/rear axle drain plug, Figure 2, and allow the oil to drain into a suitable container. Replace the drain plug.
4. Disengage the front wheel drive and disconnect the selector lever linkage from the actuating lever at the transfer case.
5. Disconnect the drive shaft coupling from the transfer gear output shaft.

6. Support the weight of the transfer case on a trolley jack and remove the transfer case to centre housing securing bolts. Carefully withdraw the transfer case assembly.

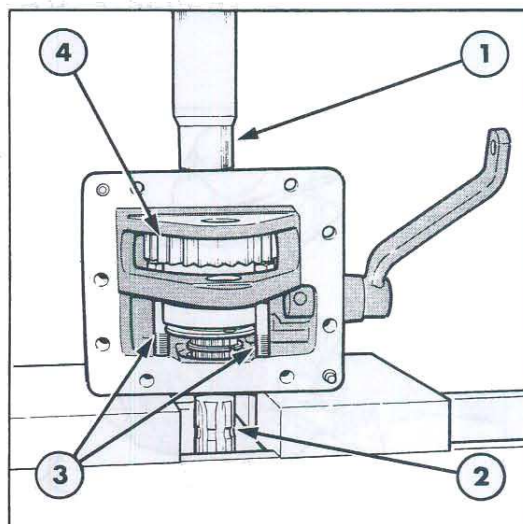
**DISASSEMBLY**

1. Withdraw the idler gear shaft retainer bolts, Figure 3, and remove the retainer.
2. Using a suitable press remove the idler gear shaft and withdraw the idler gear and bearing assembly.
3. Remove the output shaft end cap retaining bolts and withdraw the end cap and drive shaft guard retaining bracket.



**Figure 4**  
Transfer Case

- 1. Transfer Case
- 2. Blanking Plug



**Figure 5**  
Output Shaft Removal

- 1. Press
- 2. Output Shaft
- 3. 80 mm Bolts
- 4. Driven Gear

4. Remove the detent adjusting bolt and withdraw the spring and ball.

5. Remove the blanking plug in the rear of the transfer case, Figure 4.

**NOTE:** Where the driven gear is of similar diameter to the sliding coupling it is necessary to reduce the thickness of the bolt heads in order that they can be positioned between the coupling and driven gear to enable shaft removal.

**NOTE:** The end of the output shaft is situated very close to the face of the blanking plug and care must be taken if drilling a hole in the plug to assist in applying leverage to remove the plug.

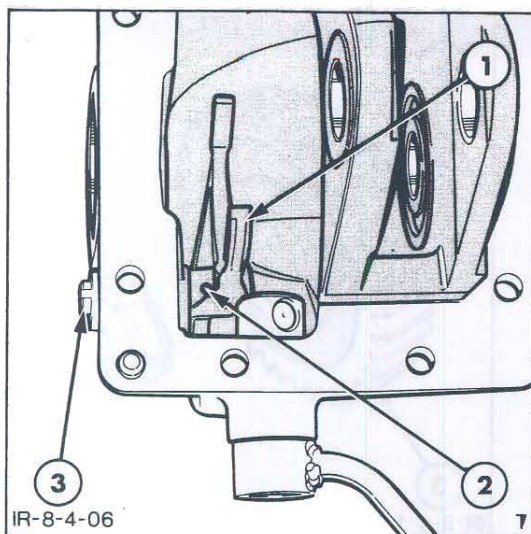
6. Position the transfer case assembly on a suitable press and insert two 80 mm long bolts between the driven gear and transfer casing, Figure 5. Press the shaft from the transfer case.

7. Using the transfer gear actuating lever position the fork to the front of the casing then remove the sliding coupling assembly and thrust washer. Moving the fork fully forwards will also press the detent shaft plug from the casing, retrieve the plug.

**NOTE:** The two 80 mm (3 in) bolts will ensure that the rear bearing remains seated in the casing. Failure to achieve this will make shaft removal difficult.

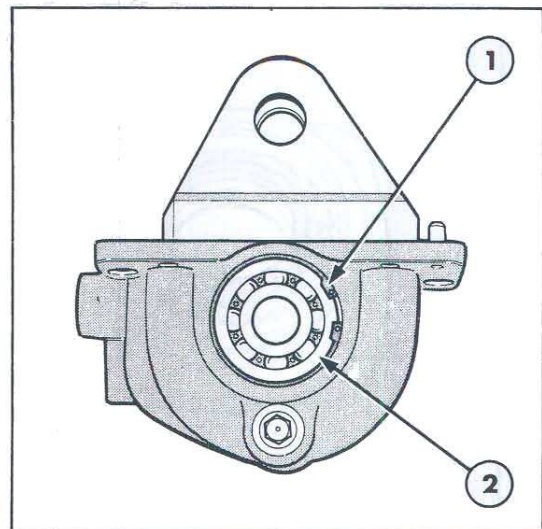
8. Remove the driven gear and thrust washer from the casing. To aid removal twist the gear through 180° so that the dog clutch teeth are facing rearwards.





**Figure 6**  
Shaft and Fork Installation

- |         |                 |
|---------|-----------------|
| 1. Fork | 3. Detent Shaft |
| 2. Pin  |                 |

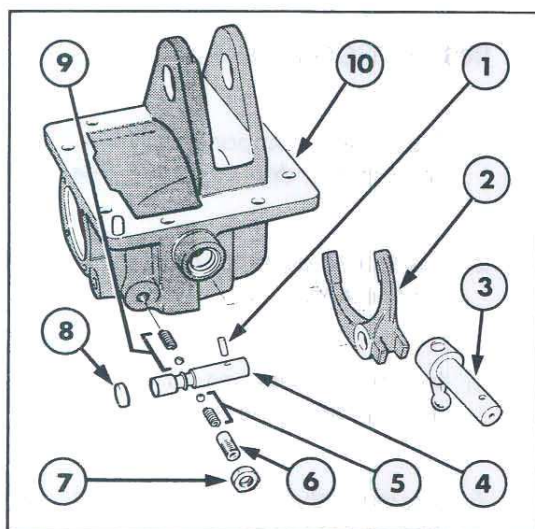


**Figure 8**  
Output Shaft Rear Bearing

- |              |
|--------------|
| 1. Snap Ring |
| 2. Bearing   |

9. Using a pin punch knock the pin securing the fork on the detent shaft into the "centre" of the shaft, Figure 6.

**NOTE:** Do not attempt to knock the pin through the shaft as this will prevent removal of shaft.



**Figure 7**  
Fork and Detent Shaft Assembly

- |                    |                    |
|--------------------|--------------------|
| 1. Pin             | 6. Detent Adjuster |
| 2. Fork            | 7. Lock Nut        |
| 3. Actuating Shaft | 8. Plug            |
| 4. Detent Shaft    | 9. Ball and Spring |
| 5. Ball and Spring | 10. Transfer Case  |

10. Push the detent shaft toward rear of housing and remove fork.

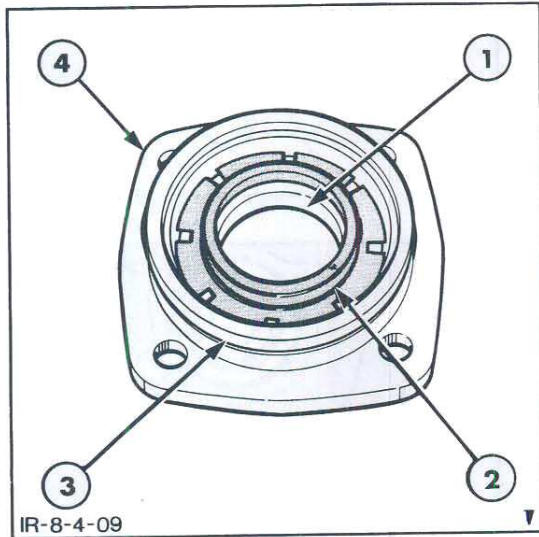
11. Remove detent shaft from casing and "knock" the pin from the shaft. Retrieve the remaining detent ball and spring. Refer to Figure 7.

12. Using a pin punch drive the lever assembly retaining pin from the actuating lever shaft. Remove the lever and shaft from the casing.

13. Remove the rear bearing snap ring, Figure 8 and using a suitable press and step plate adaptors Tool Nos. 630T/14 and 15 or 9211, remove bearing.

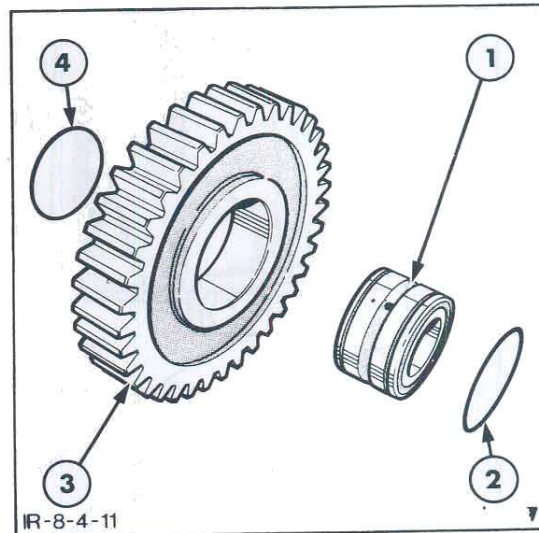
14. Using a suitable press and step plate adaptor Tool No. 630T or 9211, remove the dust and oil seal from the output shaft end cap, Figure 9.





**Figure 9**  
End Cap Assembly

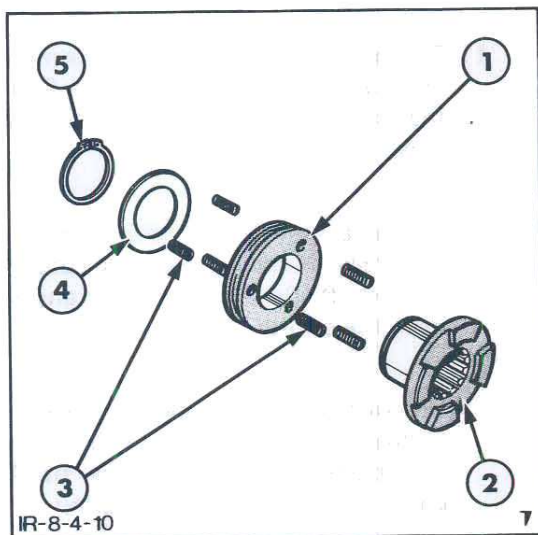
- |              |                 |
|--------------|-----------------|
| 1. Dust Seal | 3. Sealing Ring |
| 2. Oil Seal  | 4. End Cap      |



**Figure 11**  
Idler Gear Assembly

- |                   |                   |
|-------------------|-------------------|
| 1. Bearing        | 3. Idler Gear     |
| 2. Retaining Ring | 4. Retaining Ring |

15. Remove the actuating lever oil seal from the transfer case.
16. Remove the snap ring from the sliding coupling assembly and separate the components, Figure 10.



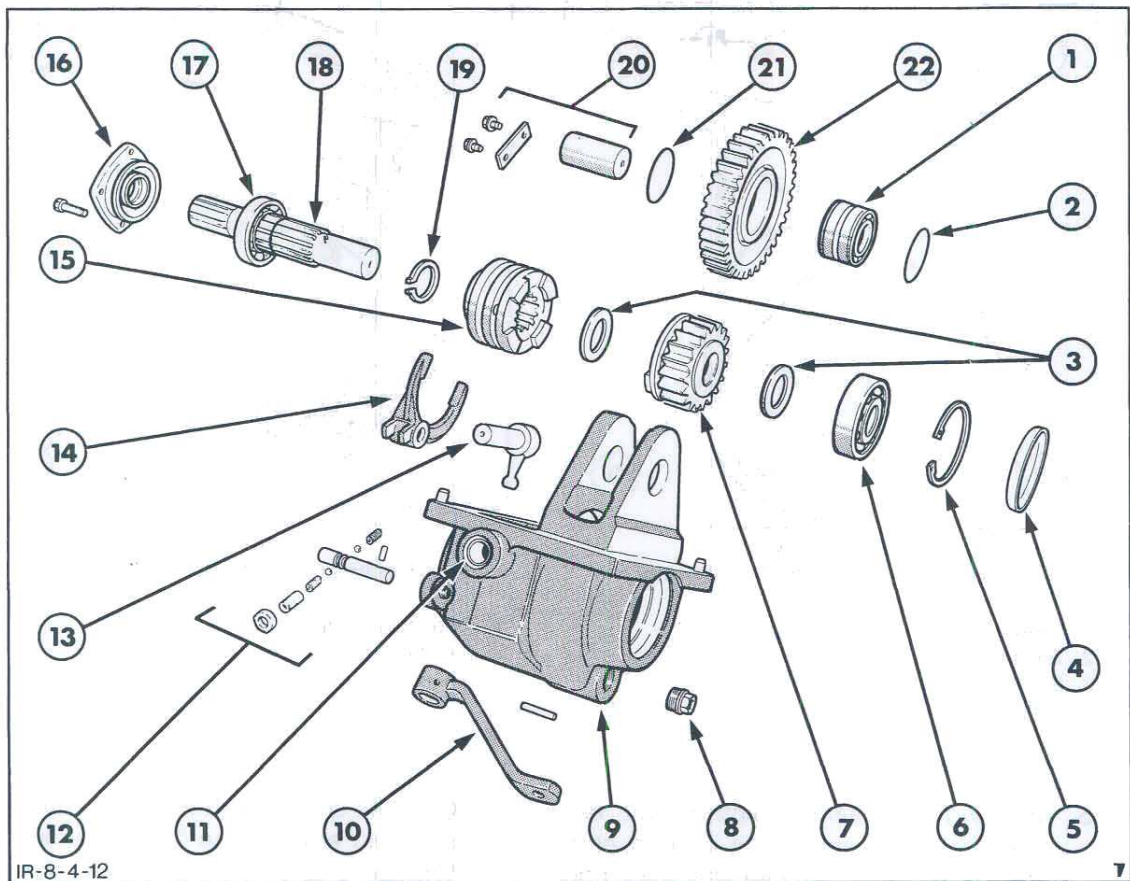
**Figure 10**  
Sliding Coupling Assembly

- |               |                   |
|---------------|-------------------|
| 1. Collar     | 4. Retaining Ring |
| 2. Shift Gear | 5. Snap Ring      |
| 3. Springs    |                   |

17. Remove the retaining ring from the idler gear and bearing assembly and separate the components, Figure 11.

## INSPECTION AND REPAIR

1. Clean all components in a suitable solvent and dry with a lint free cloth.
2. Inspect all gears for damage and replace if necessary.
3. Inspect all bearings for wear or damage and replace if necessary.
4. Examine the transfer casing for cracks and replace if necessary.
5. Replace the dust seal, oil seal and sealing ring in the end cap.
6. Replace the actuating lever oil seal.



**Figure 12**  
Transfer Gear Assembly — Exploded View

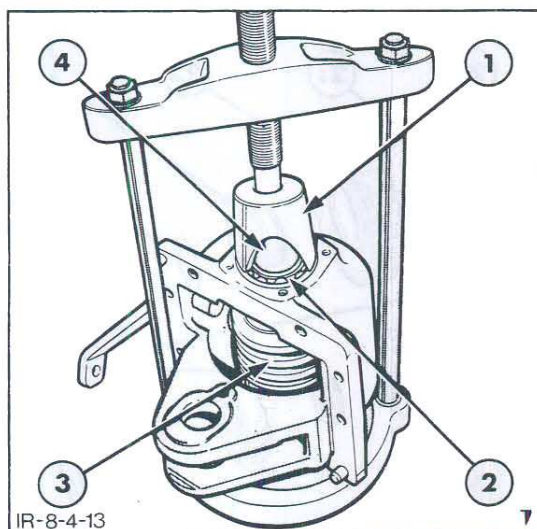
- |                       |                             |                               |
|-----------------------|-----------------------------|-------------------------------|
| 1. Idler Gear Bearing | 8. Drain Plug               | 15. Sliding Coupling Assembly |
| 2. Bearing Retainer   | 9. Transfer Case            | 16. End Cap Assembly          |
| 3. Thrust Washers     | 10. Actuating Lever         | 17. Front Bearing             |
| 4. Blanking Plug      | 11. Oil Seal                | 18. Output Shaft              |
| 5. Snap Ring          | 12. Detent Shaft Components | 19. Snap Ring                 |
| 6. Rear Bearing       | 13. Actuating Lever Shaft   | 20. Shaft and Retainer        |
| 7. Driven Gear        | 14. Fork                    | 21. Bearing Retainer          |
|                       |                             | 22. Idler Gear                |

### RE-ASSEMBLY

With reference to Figure 12.

1. Assemble the actuating lever and shaft to the transfer case.
2. Insert the detent spring and ball into transfer case drilling and install shaft. To ease installation locate the ball in the machined slot in the shaft, push shaft forward and then rotate shaft to seat ball.
3. Locate the actuating lever in the gate on the fork and position the fork on detent shaft. Retain fork on shaft with roll pin.
4. Re-assemble the sliding coupling assembly.

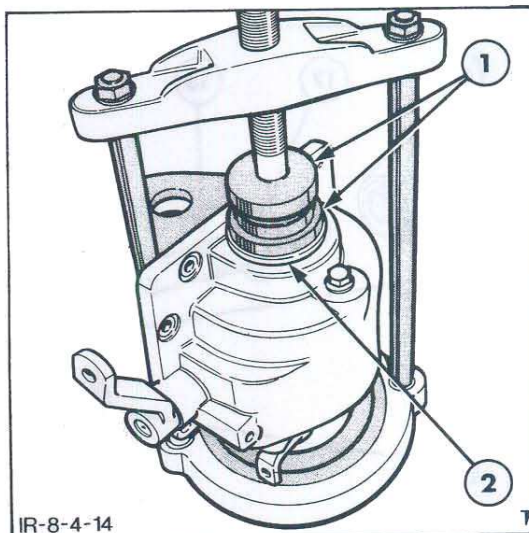




**Figure 13**

Installing Output Shaft Front Bearing

1. Sleeve
2. Bearing
3. Sliding Coupling Assembly
4. Output Shaft



**Figure 14**

Installing Output Shaft Rear Bearing

1. Step Plate Adaptors
2. Bearing

5. Where front bearing replacement has been necessary install the bearing onto the output shaft. Ensure the snap ring which limits travel of the sliding coupling is also correctly located on the shaft.
6. Position the driven gear in transfer case. To ease installation install gear with dog clutch teeth facing rearwards and then turn gear through 180° to position teeth forwards.
7. Position the sliding coupling on the actuating fork. Pass the output shaft through the front of the transfer casing, through the coupling and driven gear while at the same time positioning the thrust washer to the front of the gear.
8. Using a suitable press and sleeve, press the output shaft and front bearing into the casing, Figure 13.
9. Coat the detent shaft blanking plug with specified sealant, see 'Specifications' — Chapter 5 and press plug into bore in housing.
10. Install the end cap assembly and drive shaft guard retaining bracket, tighten the retaining bolts to the specified torque, see 'Specifications' — Chapter 5.
11. Position the driven gear thrust washer over the output shaft and using a suitable press and step plate adaptors Tool No. 630T or 9211, install the rear bearing, figure 14. The bearing must only be pressed into the bore sufficiently to allow the locating snap ring to be installed. Install the snap ring.



12. Re-assemble the idler gear and bearing assembly and install in the casing. Retain the idler gear shaft in position with the retainer, tightening the bolts to the specified torque, see 'Specifications' — Chapter 5.

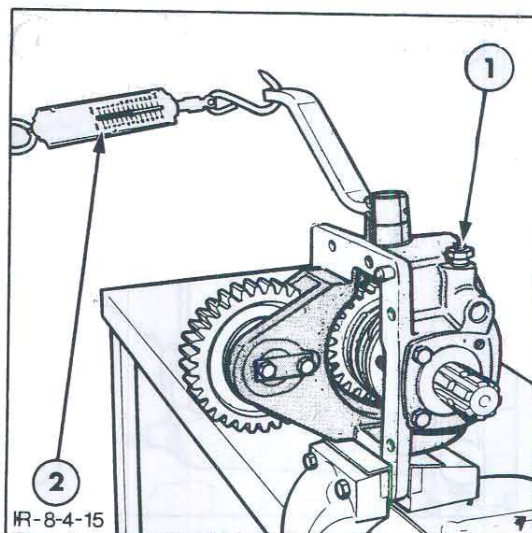
13. Ensure the output shaft rotates freely and install a new blanking plug into the rear of the casing.

14. Install the drain plug.

15. Install the activating lever onto the shaft and retain with roll pin.

16. Install detent outer ball and spring. Coat threads of adjusting stud with sealant, see 'Specifications' — Chapter 5 and adjust detent pressure until a 12 Kgf is required on the operating lever to activate detent, Figure 15.

17. Lock detent adjusting stud in position using lock nut tightened to specified torque, see 'Specifications' — Chapter 5.



**Figure 15**  
Detent Adjuster

- 1. Detent Adjuster
- 2. Spring Balance

## INSTALLATION

Installation of the transfer case follows the removal procedure in reverse. On installation, observe the following requirements:—

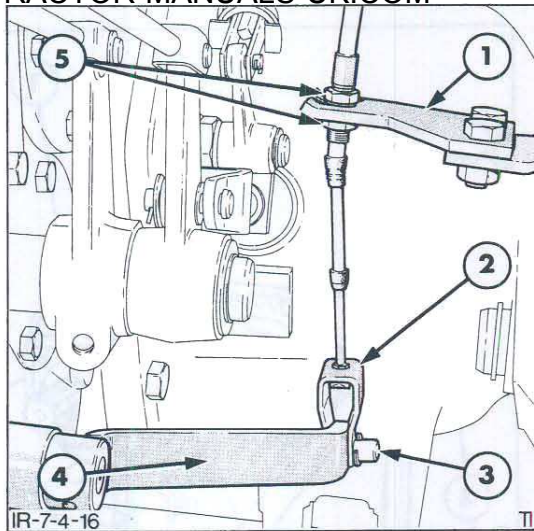
- Install a new mounting face gasket.
- Tighten all bolts to the specified torque, see 'Specifications' — Chapter 5.
- With the Unit on level ground, refill the rear axle with the correct grade and quantity of new oil, see 'Specifications' — Chapter 5.

## C. TRANSFER GEAR OPERATING CABLE – ADJUSTMENTS

### REMOVAL

1. Disengage the front wheel drive and disconnect the selector lever linkage from the actuating lever at the transfer case, Figure 16.
2. Loosen the cable adjusting nuts at the bracket attached to the loader sub-frame, Figure 16.
3. Pull the cable from the bracket.

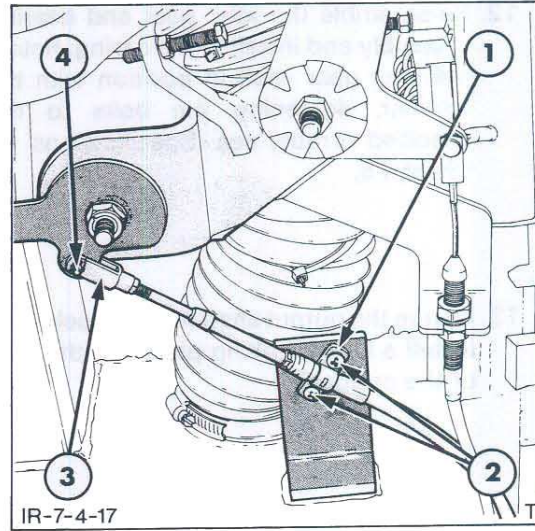
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**Figure 16**

Transfer Gear Operating Cable at  
Transfer Case

1. Retaining Bracket
2. Cable Clevis
3. Clevis Pin
4. Actuating Lever
5. Cable Locknuts



**Figure 17**

Transfer Gear Operating Cable at  
Side Console

1. Retaining Bracket
2. Clamp Retaining Screw
3. Cable Clevis
4. Clevis Pin

4. Remove the side console lower panel retaining screws.
5. Remove the front wheel drive selector lever knob and remove the panel
6. Disconnect the cable at the selector lever, Figure 17, loosen the cable clamp retaining screws and pull the cable through the clamp.
7. Pull the cable from the tractor from underneath the cab.
2. Connect the cable to the selector lever and retain with the clevis pin and split pin, Figure 17.
3. Attach the cable to the transfer case actuating lever and retain with the clevis pin, Figure 16.
4. Position the cable into the retaining bracket, Figure 16, and hand tighten the locking nuts.

## INSTALLATION

1. Route the cable up into the cab and through the cable clamp. Secure the clamp retaining screws, Figure 17.
5. Install the side console lever panel and tighten the retaining screws. Install the selector lever knob and tighten the retaining screw.