

# SHOP MANUAL

# CASE INTERNATIONAL

## (DAVID BROWN)

## MODELS

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## DUAL DIMENSIONS

This service manual provides specifications in both metric (SI) and U.S. customary systems of measurement. The first specification is given in the measuring system perceived by us to be the preferred system when servicing a particular component, while the second specification (given in parenthesis) is the converted measurement. For instance, a specification of "0.28 mm (0.011 inch)" would indicate that we feel the preferred measurement in this instance is the metric (SI) system of measurement and the U.S. customary equivalent of 0.28 mm is 0.011 inch.



## CONDENSED SERVICE DATA

	MODELS				
	1190	1290	1390	1490	1690
<b>GENERAL</b>					
Engine Make .....	Own				
No. of Cylinders .....	3	4	4	4	6
Bore .....	100 mm (3.939 in.)				
Stroke .....	114.3 mm (4.5 in.)	*	114.3 mm (4.5 in.)		
Displacement .....	2.7 liter (164 cu. in.)	*	3.6 liter (219 cu. in.)	3.6 liter (219 cu. in.)	5.4 liter (329 cu. in.)
Compression Ratio .....	17:1	17:1	17:1	16:1	16:1
Battery .....	12-Volt, Negative Ground				
No. of Forward Speeds .....	12				

\* 1290 models with independent pto clutch manufactured before P.I.N. 11052369, or 1290 models with continuous pto clutch manufactured before P.I.N. 11052410 use a 3.2 liter (195 cu. in.) engine which has a stroke of 101.6 mm (4.0 inches). All 1290 models manufactured after these used 3.6 liter (219 cu. in.) engines which have a 114.3 mm (4.5 inches) stroke. Service procedures are the same for either engine.

### TUNE-UP

Firing Order .....	1-2-3	1-2-4-3			1-5-3-6-2-4
Valve Clearance (Cold) .....	0.25 mm (0.010 in.)				
Injection Timing .....	16° BTDC	17° BTDC	17° BTDC	20° BTDC	25° BTDC
Engine Low Idle Rpm .....	750				
Engine High Idle (No-Load) Rpm .....	2350-2375				2450
Engine Rated Speed (Full Load) .....	2200				2300
Power Rating .....	37 kW (49 hp)	45 kW (60 hp)	52 kW (70 hp)	66 kW (88 hp)	82 kW (110 hp)

### SIZES AND CLEARANCES

Crankshaft Main Journal Diameter .....	63.474-63.487 mm (2.4990-2.4995 in.)		66.65-66.66 mm (2.6240-2.6245 in.)		69.84-69.85 mm (2.749-2.750 in.)
Crankpin Journal Diameter .....	60.27-60.29 mm (2.3730-2.3735 in.)		63.45-63.46 mm (2.4980-2.4985 in.)		60.27-60.28 mm (2.3728-2.3732 in.)
Main and Rod Bearing Running Clearance .....	0.05-0.10 mm (0.002-0.004 in.)				
Crankshaft End Play .....	0.05-0.25 mm (0.002-0.010 in.)				0.15-0.25 mm (0.006-0.010 in.)
Cylinder Bore .....	100.046-100.066 mm (3.9388-3.9396 in.)				
Piston Diameter .....	99.86-99.88 mm (3.9315-3.9323 in.)				
Valve Stem Diameter .....	9.454-9.479 mm (0.3722-0.3732 in.)				
Camshaft Journal Specifications, See Paragraph .....	97	98	98	98	99

### CAPACITIES

Cooling System .....	8.5 liters (9 qts.)	14.2 liters (15 qts.)			15.3 liters (16 qts.)
Crankcase (With Filter) .....	6.25 liters (6.6 qts.)	7.4 liters (7.8 qts.)			12.5 liters (13.2 qts.)
Transmission, Hydraulic and Differential Case .....	27.5 liters (29 U.S. qts.)			42 liters (44.5 U.S. qts.)	
Fluid Type .....	Case PTF Fluid or Hy-Tran Plus				

## CONDENSED SERVICE DATA CONT.

### MODELS

	1190	1290	1390	1490	1690
<b>CAPACITIES (Cont.)</b>					
Final Drive (Each) .....	2.3 liters (2.5 U.S. qts.)		6.8 liters (7 U.S. qts.)		7.5 liters (8 U.S. qts.)
Fluid Type .....	Case ET HB Fluid				
Power Steering .....	0.9 liters (1 U.S. qt.)	1.25 liters (1.5 U.S. qts.)			
Fluid Type .....	Case TCH Fluid				
Manual Steering Gear .....	1.2 liters (1.3 U.S. qts.)	....	....	....	....
Fluid Type .....	Case FDL SAE 140				
Front Drive Axle Differential—					
David Brown .....	....	8 liters (8.5 U.S. qts.)			....
Fluid Type .....	Case FDL SAE 90				
Carraro .....	....	....	....	4 liters (4.25 U.S. qts.)	
Fluid Type .....	Case FDL SAE 90				
Front Drive Axle Final					
Drive (Each)—					
David Brown .....	....	0.9 liters (1 U.S. qt.)			....
Fluid Type .....	Case FDL SAE 90				
Carraro .....	....	....	....	1.4 liters (1.5 U.S. qts.)	
Fluid Type .....	Case FDL SAE 90				

### MODELS

	1194	1294	1394	1494	1594
<b>GENERAL</b>					
Engine Make .....	Own				
No. of Cylinders .....	3	4	4	4	6
Bore .....	100 mm (3.937 in.)				
Stroke .....	114.3 mm (4.5 in.)				
Displacement .....	2.7 liter (164 cu. in.)	3.6 liter (219 cu. in.)			5.4 liter (329 cu. in.)
Compression Ratio .....	17:1	17:1	16:1		
Battery .....	12 volts, Negative Ground				
No. of Forward Speeds .....	12				
<b>TUNE-UP</b>					
Firing Order .....	1-2-3	1-2-4-3			1-5-3-6-2-4
Valve Clearance (Cold) .....	0.25 mm (0.010 in.)				
Injection Timing .....	16° BTDC	17° BTDC	17° BTDC	20° BTDC	25° BTDC
Engine Low Idle Rpm .....	750	600-650			
Engine High Idle (No-Load) Rpm .....	2350-2375				
Engine Full Load Rpm .....	2200				
Power Rating .....	35 kW (49 hp)	45 kW (62 hp)	53 kW (77 hp)	61 kW (85 hp)	72 kW (97 hp)



# CONDENSED SERVICE DATA CONT.

	MODELS				
	1194	1294	1394	1494	1594
<b>SIZES AND CLEARANCES</b>					
Crankshaft Main Journal Diameter .....	63.474-63.487 mm (2.4990-2.4995 in.)		66.65-66.66 mm (2.6240-2.6245 in.)		69.84-69.85 mm (2.749-2.750 in.)
Main and Rod Bearing Running Clearance .....	0.05-0.10 mm (0.002-0.004 in.)				
Crankshaft End Play .....	0.05-0.25 mm (0.002-0.010 in.)				0.15-0.25 mm (0.006-0.010 in.)
Cylinder Bore .....	100.46-100.66 mm (3.9388-3.9396 in.)				
Piston Diameter .....	99.86-99.88 mm (3.9315-3.9323 in.)				
Camshaft Journal Specifications, Refer to Paragraph .....	97	98	98	98	99
<b>CAPACITIES</b>					
Cooling System .....	8.5 liters (9 U.S. qts.)	14.2 liters (15 U.S. qts.)			15.3 liters (16 U.S. qts.)
Crankcase (with Filter) .....	6.25 liters (6.6 U.S. qts.)	7.4 liters (7.8 U.S. qts.)			12.5 liters (13.2 U.S. qts.)
Transmission, Hydraulic and Differential Case—Synchronesh .....	27.5 liters (29 U.S. qts.)	27.5 liters (29 U.S. qts.)	36.5 liters (38.5 U.S. qts.)	42 liters (44.5 U.S. qts.)	42 liters (44.5 U.S. qts.)
Power Shift .....	....	....	42 liters (44.5 U.S. qts.)	42 liters (44.5 U.S. qts.)	42 liters (44.5 U.S. qts.)
Fluid Type .....	Case PTF Fluid or Hy-Tran Plus				
Final Drive (Each) .....	2.3 liters (2.5 U.S. qts.)		6.8 liters (7 U.S. qts.)		7.5 liters (8 U.S. qts.)
Fluid Type .....	Case ETHB Fluid				
Power Steering .....	0.9 liters (1 U.S. qt.)	1.25 liters (1.5 U.S. qts.)			
Fluid Type .....	Case TCH Fluid				
Front Drive Axle Differential .....	....	6 liters (6.25 U.S. qts.)	NOTE 1	NOTE 2	NOTE 3
Fluid Type .....	Case FDL SAE 90				
Front Drive Axle Final Drive (Each) .....	....	1.4 liters (1.5 U.S. qts.)	NOTE 1	NOTE 2	NOTE 3
Fluid Type .....	Case FDL SAE 90				

**NOTE 1:** Prior to P.I.N. 11503001, differential capacity is 6 liters (6.25 U.S. qts.) and final drive capacity is 1.4 liters (1.5 U.S. qts.). P.I.N. 11503001 and after, differential capacity is 4 liters (4.25 U.S. qts.) and final drive capacity is 1 liter (1.06 U.S. qt.).

**NOTE 2:** Prior to P.I.N. 11518001, differential capacity is 6 liters (6.25 U.S. qts.) and final drive capacity is 1.4 liters (1.5 U.S. qts.). P.I.N. 11518001 and after, differential capacity is 4 liters (4.25 U.S. qts.) and final drive capacity is 1 liter (1.06 U.S. qt.).

**NOTE 3:** Prior to P.I.N. 11221501, differential capacity is 5 liters (5.25 U.S. qts.) and final drive capacity is 1.7 liters (1.75 U.S. qts.). P.I.N. 11221501 and after, differential capacity is 4 liters (4.25 U.S. qts.) and final drive capacity is 1 liter (1.06 U.S. qt.).

## FRONT AXLE (TWO-WHEEL DRIVE)

### FRONT WHEEL BEARINGS

#### All Models

1. A typical front wheel spindle, wheel hub and bearing assembly are shown in Fig. 1.

It is recommended that wheel bearings be lubricated with multipurpose lithium base grease using a pressure grease gun after every 50 hours of normal operation.

To adjust wheel bearings, tighten slotted nut (17—Fig. 1) to 95 N·m (70 ft.-lbs.) torque while turning the wheel. Loosen the nut, then retighten to 40 N·m (30 ft.-lbs.) torque while turning the wheel. Make certain wheel turns freely. Loosen nut, if necessary, to align hole for cotter pin, then install a new pin.

### SPINDLES

#### All Models

#### 2. REMOVE AND REINSTALL.

To remove spindle (9—Fig. 1), support front of tractor and remove wheel from

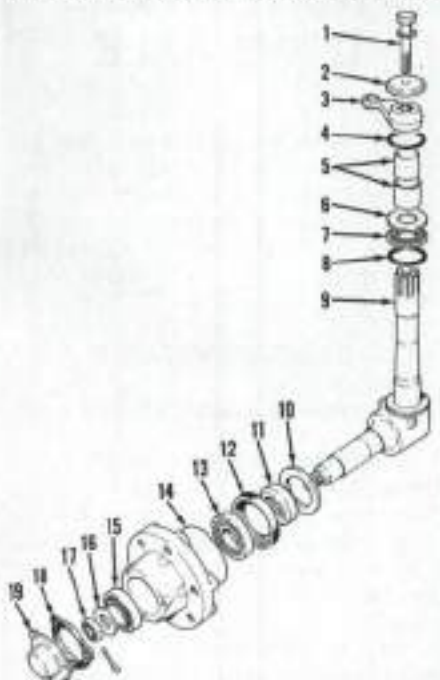


Fig. 1—Exploded view of typical front spindle assembly showing component parts and their relative positions.

- |                   |                          |
|-------------------|--------------------------|
| 1. Cap screw      | 11. Oil seal wear sleeve |
| 2. Special washer | 12. Oil seal             |
| 3. Steering lever | 13. Bearing              |
| 4. "O" ring       | 14. Hub                  |
| 5. Bushings       | 15. Bearing              |
| 6. Thrust washer  | 16. Washer               |
| 7. Thrust bearing | 17. Slotted nut          |
| 8. "O" ring       | 18. Gasket               |
| 9. Spindle        | 19. Hub cap              |
| 10. Dirt seal     |                          |

side to be serviced. Remove cap screw (1) and washer (2) which retains steering arm (3), and remove steering arm from spindle.

**NOTE:** If steering arm (3) is tight on spindle (9), reinstall cap screw (1) minus washer (2) and rap head of cap screw sharply to loosen steering arm. Care should be taken not to damage cap screw or threads in spindle.

Remove spindle and upper "O" ring (4—Fig. 1). Remove thrust washer (6) on all models and thrust bearing (7) on 1490, 1494, 1594 and 1690 models. On all models remove lower "O" ring (8).

With spindle removed, upper and lower spindle bushings (8 and 10—Fig. 2) can be removed from axle extension (9) using a suitable puller or drift punch. New bushings should be pressed into axle extension until flush with outer surface of axle extension. Bushings are presized and should not require reaming if carefully installed.

Reinstall by reversing removal procedure making certain thrust bearing (7—Fig. 1) and thrust washer (6) are in proper sequence on 1490, 1494, 1594 and 1690 models. On all models, tighten steering arm retaining cap screw (11) to 163 N·m (120 ft.-lbs.) torque.

### TIE RODS AND TOE-IN

#### All Models

3. Toe-in of front wheels should be 3

mm ( $\frac{1}{8}$  inch), measured between wheel rims at front and rear of wheels. Toe-in can be adjusted by lengthening or shortening threaded tie rod ends equally.

Tie rod ends are nonadjustable. If excessively worn, they must be renewed as complete units.

### AXLE MAIN MEMBER

#### All Models

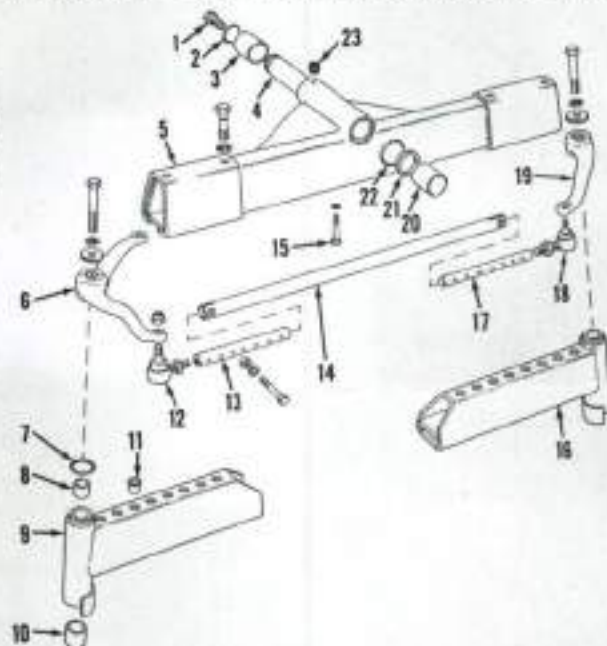
#### 4. REMOVE AND REINSTALL.

Refer to appropriate Fig. 2, 3 or 4 for an exploded view of front axle assembly. Disconnect drag link (manual steering), steering cylinder lines (power steering) or steering cylinder as necessary for model being serviced. Support front of tractor with suitable stand. Loosen trunion pin retaining bolt (15) about five turns, then rap head of bolt with a hammer to dislodge threaded insert (23). Remove bolt and insert. Remove expansion plug from trunion pin bore if so equipped. Screw slide hammer puller into trunion pin (4) and remove pin. Raise front of tractor until axle is clear. Remove thrust washer (21) and "O" rings (2 and 22). Drive bushings (3 and 20) out of bore noting placement if different in size or length. Models 1190 and 1194 have a blind hole at the rear, remove bushing with a chisel.

On all models, drive new bushings in until flush with housings. Bushings are presized and should not require reaming if carefully installed. Check trun-

Fig. 2—Exploded view of front axle used on Models 1190 and 1194. Front axle used on Model 1294 and early Model 1394 (before P.L.N. 1150d412) is similar.

- |                   |                         |
|-------------------|-------------------------|
| 1. Bolt adapter   | 15. Axle retaining bolt |
| 2. "O" ring       | 16. Axle extension      |
| 3. Bushing        | 17. Tie rod             |
| 4. Trunion pin    | 18. Tie rod end         |
| 5. Center beam    | 19. Steering lever      |
| 6. Steering lever | 20. Bushing             |
| 7. "O" ring       | 21. Thrust washer       |
| 8. Bushing        | 22. "O" ring            |
| 9. Axle extension | 23. Threaded insert     |
| 10. Bushing       |                         |
| 11. Plastic plug  |                         |
| 12. Tie rod end   |                         |
| 13. Tie rod       |                         |
| 14. Spacer tube   |                         |





## Paragraphs 5-8

nion pin for free fit and lubricate pin, bushings, thrust washer and "O" rings during assembly.

Check axle front to rear float on trunnion pin. Axle should pivot freely with a slight front to rear float. If end float is excessive, renew trunnion pin thrust washer.

### FRONT SUPPORT

#### Models 1190 and 1194

**5. REMOVE AND REINSTALL.** Front support for Models 1190 and 1194 is an integral part of the main frame casting. To renew front support, first split tractor as outlined in paragraph 217. Remove side covers and engine cover support framework. Drain engine oil. Remove radiator hoses and radiator. Remove battery and battery support. Remove all engine mounting bolts. Disconnect all necessary pipes, control rods and electrical wiring. Remove engine oil pan. Use a hoist and remove engine. Remove any remaining components from main frame and support with a suitable lifting device. Remove front axle as outlined in paragraph 4.

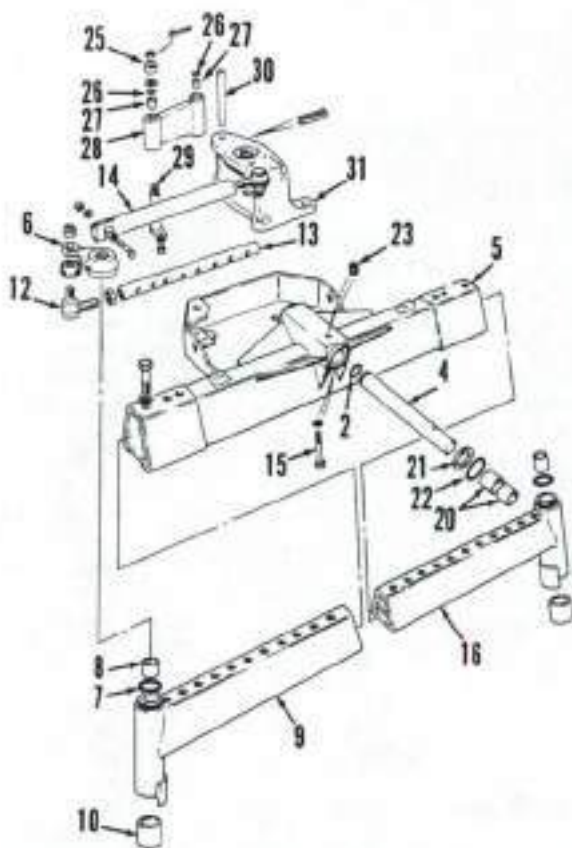
Reassemble by reversing disassembly procedure.

#### Models 1290-1294-1390-1394-1490-1494-1594-1690

**6. REMOVE AND REINSTALL.** Front support (main frame extension) bolts to main frame just forward of engine. To remove front support, first remove engine side covers, air cleaner assembly, battery and supports. Drain transmission and radiator. Remove oil

Fig. 4—Exploded view of typical front axle assembly used on 1490, 1494, 1594 and 1690 models.

2. "O" ring
4. Trunnion pin
5. Center beam
6. Steering lever
7. "O" ring
8. Bushing
9. Axle extension
10. Bushing
12. Tie rod end
13. Tie rod
14. Spacer tube
15. Axle retaining bolt
16. Axle extension
20. Bushings
21. Thrust washer
22. "O" ring
23. Threaded insert
25. Spacer
26. "O" ring
27. Bushing
28. Pivot link
29. Pivot pin
30. Pivot pin
31. Anchor fork



cooler and lines (if so equipped), hydraulic pumps, lines and drive shaft. Remove radiator and hoses. Raise front of tractor and remove front axle as outlined in paragraph 4 for two-wheel drive models, or paragraph 8 or 25 for models equipped with front drive axle. Attach a hoist to front support and remove retaining bolts. Remove front support.

Reassemble by reversing disassembly procedure.

## FRONT-WHEEL DRIVE AXLE

All models except 1190 and 1194 are available with front-wheel drive. Two different axles, David Brown and Carraro, are used. Carraro axles may be equipped with standard or limited slip differential.

### DAVID BROWN AXLE

#### All Models So Equipped

**7. TIE RODS AND TOE-IN.** Front wheel toe-in should be 0-1.5 mm (0-1/16 inch) measured from wheel rim to wheel rim at front and rear of wheels. Toe-in is adjusted by lengthening or shortening the threaded tie rod ends equally.

Tie rod ends that are excessively worn must be renewed as complete units.

**8. R&R AXLE.** Front drive axle final drives and differential may be serviced without removing entire axle and differential housing assembly. However, if housing or trunnion pin are to be serviced, it will be necessary to remove axle housing assembly.

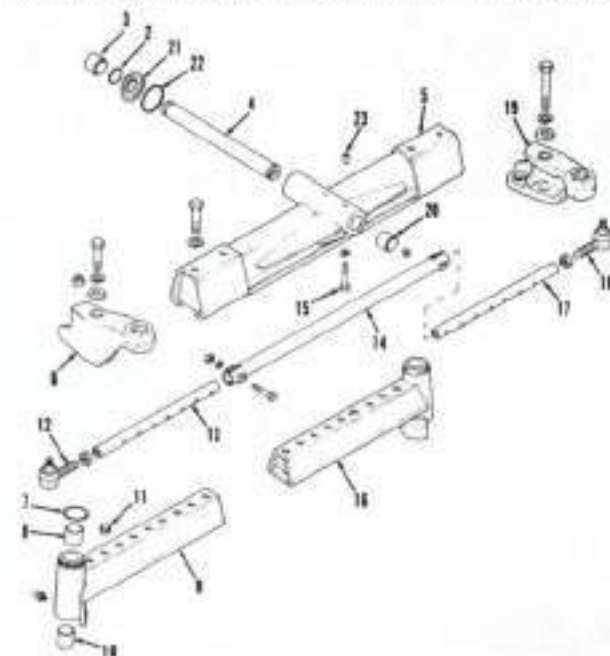


Fig. 3—Exploded view of front axle used on late Model 1394 (P.L.N. 11504412 and after). Refer to Fig. 2 for legend.



To remove assembly, first disconnect all steering lines and cap openings. Loosen locknuts (6—Fig. 5) on trunnion shaft cotter pins (31) until they are even with threaded ends. Using care to avoid damaging threads, drive cotter pins (31) through trunnion shaft. Remove locknuts and washers from cotter pins and remove pins (raise right end of axle for more clearance). Support axle and remove core plug (7) from trunnion shaft bore with punch and hammer. Use slide hammer to pull trunnion shaft (33). Raise front of tractor enough to clear axle and remove axle. Remove thrust washers (36) and "O" rings (35 and 37).

To reinstall, reverse removal procedure. Bleed steering system as outlined in paragraph 58.

**9. RENEW TRUNNION SHAFT BUSHINGS.** Remove axle assembly as outlined in paragraph 8. Remove the four trunnion shaft bushings (34—Fig. 5) using a suitable puller. Install bushings making certain grease hole in each bore is between the two bushings. Refer to Fig. 6 for correct bushing placement.

If trunnion shaft bracket (32—Fig. 5) is to be renewed, remove bracket from axle housing and remove dowel pins. Loosely bolt new bracket to housing and drive dowel pins in. Tighten bolts to 203-244 N·m (150-180 ft.-lbs.) torque.

Lubricate "O" rings and place in thrust washer grooves. When reinstalling thrust washers (36), "O" ring is toward front at front position and toward rear at rear position.

**10. FINAL DRIVE AND STUB AXLE.** Left and right final drive removal procedure is similar. To remove, raise and support side to be serviced and remove tire and wheel. Rotate hub so drain plug is at bottom and drain fluid. Remove end plate (12—Fig. 7) and use pry bars to pull sun gear (15) and shaft (1—Fig. 8) out approximately 5 mm ( $\frac{3}{16}$  inch).

**NOTE:** Axle shaft seals can be damaged if axle shaft is pulled out too far.

Hold axle shaft out and push sun gear in until split rings (14—Fig. 7) can be removed. Remove sun gear (15) and thrust washer (16).

**NOTE:** Do not push axle shaft into axle housing as oil seal damage could occur.

Bend tab washer (2—Fig. 7) away from locknut (1) and remove nut with special spanner wrench (CAS-1607). Remove tab washer (2), planetary ring gear (3) and bearing cup assembly (4).

Note number and thickness of shims (5) and remove. Remove spacer (6) and hub (7). Seal (10) in hub will be tight on axle and should stay on stub axle as hub is removed. Remove bearing (9) and seal (10).

Oil seal wear sleeve (11) should be renewed if damaged or worn. Use a

chisel to cut through wear sleeve being careful not to damage surface of stub axle. Install new sleeve on axle making sure side with inside chamfered edge goes onto axle first.

Remove steering lever (4—Fig. 8) and bolts retaining upper and lower bearing pins (6 and 10). Remove bearing pins

Fig. 5—Exploded view of David Brown front drive axle used on some models showing component parts and their relative positions.

1. Steering lever
2. Rubber cover
3. Tie rod end
4. Brawler
5. Steering link
6. Cotter pin nut
7. Core plug
8. Dowel pin
9. Gasket
10. Plug
11. Differential housing
12. Drain plug
13. Axle housing
14. Shield
15. Bearing
16. "O" rings
17. Sealing disc
18. Stub axle
19. Bearing pin
20. Shim
21. Bearing pin
22. Steering lever
23. Oil seal
24. Bushing
25. Shield
26. Bearing
27. "O" ring
28. Sealing disc
29. Brawler
30. Steering cylinder
31. Pin
32. Trunnion shaft bracket
33. Trunnion pin
34. Bushing
35. "O" ring
36. Thrust washer
37. "O" ring

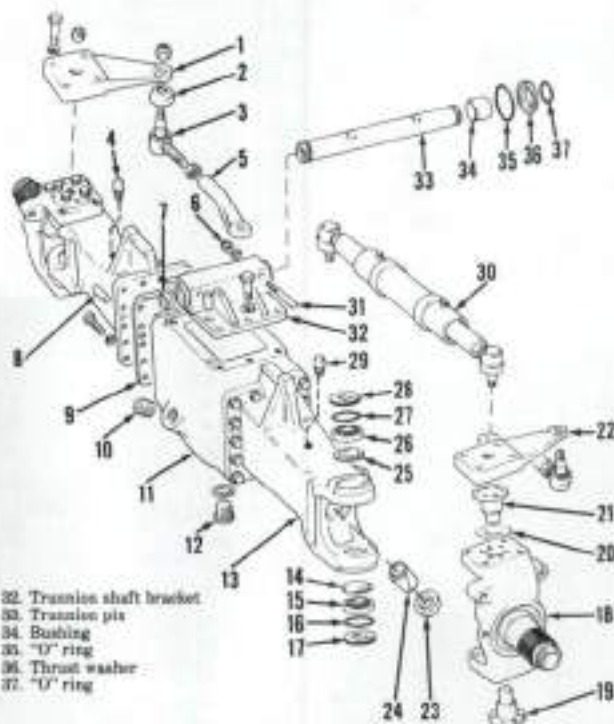


Fig. 6—Diagram showing correct dimensions for the placement of trunnion shaft bushings for models equipped with David Brown front drive axles.

1. 3 mm ( $\frac{1}{8}$  inch)
2. 15 mm ( $\frac{9}{16}$  inch)
3. 25 mm ( $2\frac{1}{8}$  inches)
4. 3 mm ( $\frac{1}{8}$  inch)

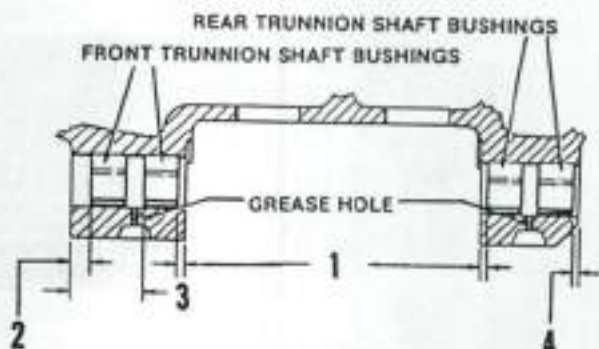
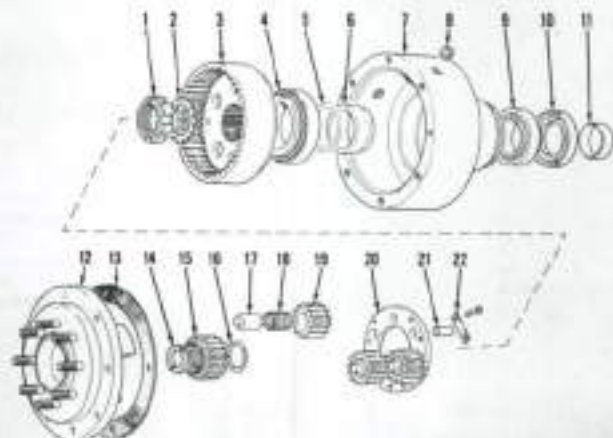


Fig. 7—Exploded view of David Brown front drive axle final drive showing relative position of its component parts.

1. Locknut
2. Tab washer
3. Planetary gear
4. Bearing
5. Shim
6. Spacer
7. Hub
8. Plug
9. Bearing
10. Oil seal
11. Seals
12. End plate
13. Gasket
14. Split ring
15. Sun gear
16. Thrust washer
17. Bearing pin
18. Bearing
19. Planet gear
20. Planet gear carrier
21. Dowel
22. Lockplate





## Paragraphs 11-14

## CASE INTERNATIONAL (DAVID BROWN)

using jack screws in threaded hole of bearing pins. Retain shims (7) for use in reassembly. Hold axle shaft in place while removing stub axle assembly to prevent damage to oil seals. Remove axle shaft from housing.

Remove upper and lower sealing discs (28 and 17—Fig. 5), "O" rings (27 and 16) and bearings (26 and 15) from axle housing (13). Use a suitable puller to remove upper and lower bearing cups from axle housing. Remove upper and lower shields (25 and 14).

Remove seal (2—Fig. 8) from inside stub axle (8). Using a suitable bushing driver, drive bushing (3) out oil seal end of stub axle. Install new bushing from seal end until it seats in stub axle. Install new oil seal with lip of seal entering bore first.

To reassemble, reverse disassembly procedure using care not to let axle shafts damage oil seals and noting preload must be set on bearing pin bearings and stub axle bearings.

To set bearing pin preload, reassemble unit minus shims (7—Fig. 8). Tighten lower bearing pin mounting bolts to 68 N·m (50 ft.-lbs.) torque and upper bearing pin mounting bolts to 20 N·m (15 ft.-lbs.) torque. Push stub axle up tight against bottom of axle housing and use a feeler gage to measure gap between upper bearing pin flange and stub axle. See Fig. 9. Remove upper bearing pin, then assemble shims so total thickness is 0.281 mm (0.011 inch) less than feeler gage measurement. This will correctly preload bearings to 0.10-0.15 mm (0.004-0.006 inch) when full load is on axle. Tighten upper bearing pin bolts to 68 N·m (50 ft.-lbs.) torque. Refer to paragraph 11 to set stub axle bearing preload.

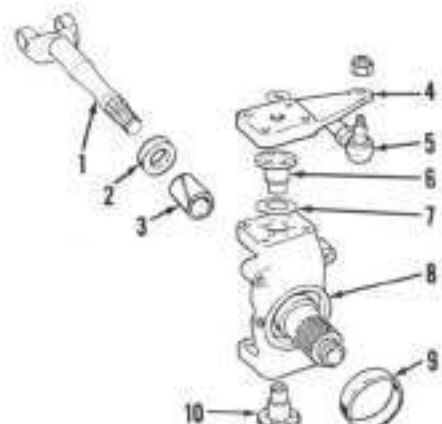


Fig. 8—Exploded view of David Brown front drive stub axle showing component parts and their relative positions.

- |                     |                 |
|---------------------|-----------------|
| 1. Axle drive shaft | 6. Bearing pin  |
| 2. Oil seal         | 7. Shim         |
| 3. Bushing          | 8. Stub axle    |
| 4. Steering lever   | 9. Wear sleeve  |
| 5. Tie rod end      | 10. Bearing pin |

**11. WHEEL HUB BEARING PRELOAD.** To set stub axle bearing preload, install shims (5—Fig. 7) having a total thickness of 2 mm (0.080 inch) next to spacer (6). Install planetary ring gear (3) and nut (1) minus tab washer (2). Using special spanner wrench (CAS-1607), tighten nut (1) to 203 N·m (150 ft.-lbs.) torque. Mount dial indicator so point of probe contacts outside face of hub. See Fig. 10. Measure and record amount of end play. Correct amount of bearing preload is 0.08-0.13 mm (0.003-0.005 inch). Subtract shims equal to measured end play plus 0.10 mm (0.004 inch) from previously installed shim pack to obtain correct bearing preload.

Reassemble unit installing tab washer (2—Fig. 7) and making sure flat side of nut (1) faces inward. Tighten nut to 203 N·m (150 ft.-lbs.) torque, then secure with tab washer. Fill each final drive with 0.9 L (1 quart) of Case FDL SAE 90 gear lubricant or equivalent.

**12. PLANETARY GEAR ASSEMBLIES.** Drain fluid, then remove end plate (12—Fig. 7). Remove lockplates (22) and bolts retaining planetary gear carrier (20) to end plate (12). Mark gear carrier, pins, gears and bearings prior to disassembly so they can be reassembled in their original positions. Remove carrier, gears and bearings.

Reassemble by reversing disassembly procedure making certain gears, bearings and pins are reinstalled in

their original positions. Install lockplates so they cover dowel pin holes and tighten bolts to 40 N·m (30 ft.-lbs.) torque. Reinstall end plate, tighten bolts to 100 N·m (75 ft.-lbs.) torque and fill hub to proper level with Case FDL SAE 90 gear lubricant or equivalent.

**13. AXLE HOUSINGS.** Axle shaft seal (23—Fig. 5) and bushings (24) can be renewed with axle housings in place.

If removal of housing is necessary, raise and support front of tractor and remove tire and wheel from side to be serviced. Drain oil from differential housing. Capacity is approximately 8 L (8.5 quarts). Attach hoist to axle housing so weight is equally balanced. Disconnect steering linkage and remove bolts retaining axle housing to differential housing, then remove axle housing. Remove final drive from axle housing if necessary.

To reinstall axle housing, reverse the removal procedure. Tighten housing mounting bolts to 110-130 N·m (80-95 ft.-lbs.) torque. Fill differential housing to correct level with Case FDL SAE 90 gear lubricant or equivalent.

**14. R&R DIFFERENTIAL ASSEMBLY.** Differential assembly may be removed with differential housing and axle housing installed on tractor. It is necessary, however, to first remove left and right stub axle assemblies as outlined in paragraph 10.

Fig. 9—To set bearing pin preload, use a feeler gage to measure gap between bearing pin flange and stub axle housing. Refer to text.

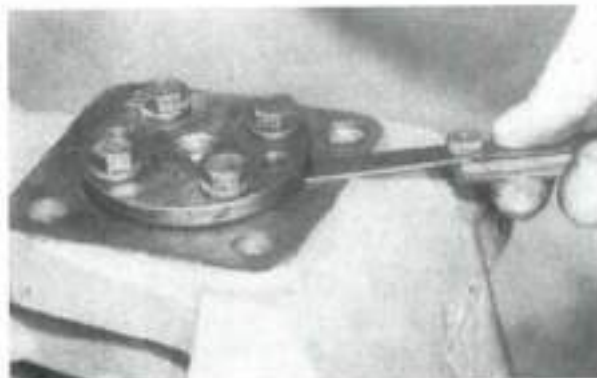
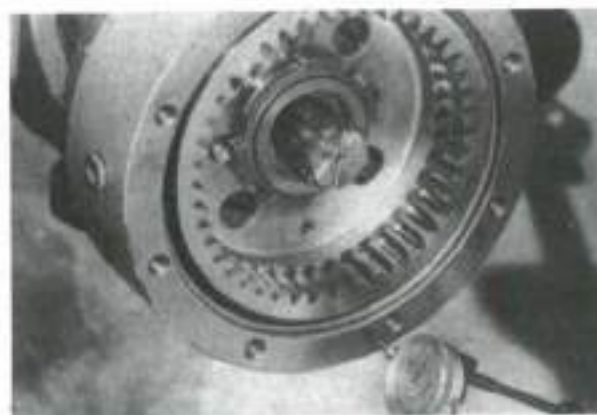


Fig. 10—To set stub axle bearing preload, mount a dial indicator so probe contacts face of wheel hub. Measure end play and refer to text.





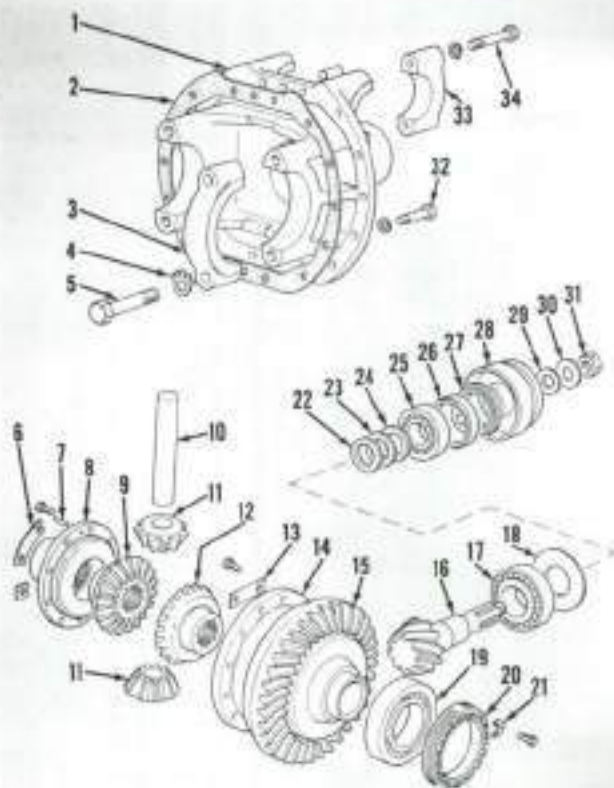


Fig. 11—Exploded view of David Brown differential assembly showing component parts and their relative positions.

1. Differential support bracket
2. Gasket
3. Bearing cap
4. Tab washer
5. Bearing cap bolt
6. Lockplate
7. Dowel pin
8. End plate
9. Side gear
10. Differential pin
11. Differential pinion gear
12. Side gear
13. Lockplate
14. Differential cage
15. Bevel gear
16. Pinion shaft
17. Bearing
18. Shim
19. Bearing
20. Adjuster wheel
21. Tab washer
22. Front spacer
23. Shim
24. Rear spacer
25. Bearing
26. Spacer
27. Seal
28. Flange
29. Sealing washer
30. Retaining washer
31. Locknut
32. Cap screw
33. Steering cylinder cap
34. Cap screw

With stub axle assemblies and axle drive shafts removed, remove main drive shaft and steering cylinder. Support differential unit on floor jack and remove retaining bolts. Carefully move differential assembly out of housing and lower to floor.

Reinstall by reversing removal procedure. Tighten differential assembly retaining bolts to 68 N·m (50 ft.-lbs.) torque and drive shaft bolts to 54 N·m (40 ft.-lbs.) torque. Fill differential to correct level with Case FDL SAE 90 gear lubricant or equivalent.

**15. OVERHAUL DIFFERENTIAL.** Remove differential assembly and place in a stand with flange end toward floor. Mark bearing caps so they

can be reinstalled in their original positions and remove. Remove adjuster rings. Remove differential bevel ring gear and cage as an assembly.

Remove pinion shaft locknut (31—Fig. 11), then drive pinion shaft through flange (28) and carrier (1). Front spacer (22), shims (23) and rear spacer (24) should remain on pinion shaft as it is removed. Remove remaining bearing cups and shims from carrier (1) as necessary. Inspect bearings and spacers on pinion shaft and renew as necessary.

Mark end plate (8), cage (14) and bevel ring gear (15) so they may be reassembled in their original positions. Remove carrier bearings and separate end plate (8) from cage (14). Remove axle

gears, pinion gears and pin (10). Separate bevel ring gear from cage as necessary.

Bevel ring gear and pinion shaft are serviced as matched sets only and must be installed as such.

If bevel ring gear and pinion shaft, pinion shaft bearings or carrier are renewed, pinion shaft protrusion must be set as outlined in paragraph 16. Reassemble by reversing disassembly procedure. Adjust carrier bearings and bevel gear backlash as outlined in paragraph 17.

**16. PINION SHAFT PROTRUSION AND BEARING PRELOAD.** Special tool (DB-8208) is required to set pinion shaft protrusion on David Brown axle, and all bearings, cups and spacers to be used in final assembly must be installed.

Assemble pinion shaft in carrier minus shims (18—Fig. 11), oil seal (27), spacer (26), sealing washer (29), front spacer (22), shims (23) or rear spacer (24). Install flange (28), retaining washer (30), and locknut (31) on pinion shaft (16) and tighten locknut until all end play of pinion shaft is just removed, then tighten locknut just a small amount more to slightly preload bearings. Install special tool in carrier bearing bores as shown in Fig. 12. Install shaft (CAS-1236-6), probe and spacer (CAS-1609) and locknut (CAS-1234-4) of special tool so probe point lightly contacts face of pinion shaft gear. Tighten locknut to lock probe in this position. Using a feeler gage, measure and record amount of gap between spacer and probe. See Fig. 13.

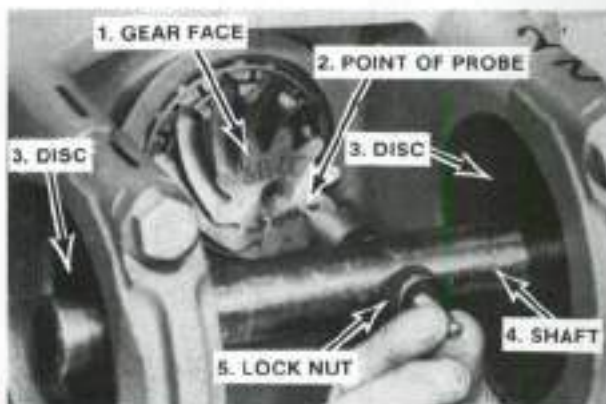
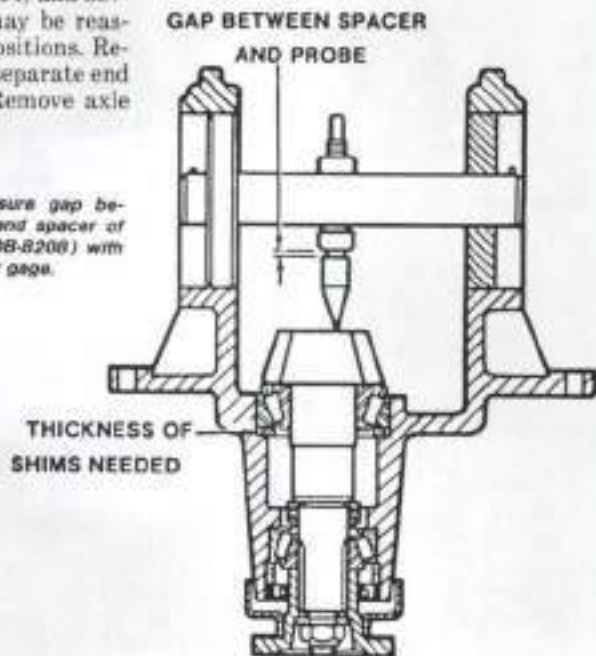


Fig. 12—To set pinion shaft protrusion, install special tool set (DB-8208) in carrier housing as shown. Refer to Fig. 13 and to text to determine thickness of shims required to correctly set shaft protrusion.

Fig. 13—Measure gap between probe and spacer of special tool (DB-8208) with a feeler gage.





Note protrusion correction mark etched on end of pinion shaft gear. This will be "0" or a plus (+) or minus (-) dimension. Note that dimension is given in thousandths of an inch.

Noting that special tool has a built in dimension of 0.030 inch (0.76 mm), substitute actual gap measurement and shaft correction number for figures shown in the following example to determine thickness of shims (18—Fig. 11) needed to correctly set pinion shaft protrusion.

Tool built in dimension . . . . .	0.030 in. (0.76 mm)
Add or subtract dimension etched on pinion shaft . . . . .	-0.005 in. (0.13 mm)
Result is setting dimension "A" . . . . .	0.025 in. (0.63 mm)
Measured gap . . . . .	0.055 in. (1.40 mm)
Minus setting dimension "A" determined above . . . . .	-0.025 in. (0.63 mm)
Result is thickness of shims required . . . . .	0.030 in. (0.77 mm)

Remove special tool, pinion shaft and inner bearing cup. Assemble correct thickness of shims into housing bore, then reinstall inner bearing cup. Be

sure cup seats against shims and housing counterbore.

Reassemble pin shaft with spacers (22 and 24—Fig. 11) using 1.27 mm (0.050 inch) thick shims (23), but without spacer (25), oil seal (27) and sealing washer (29). Install flange (28), washer (30) and nut (31) on pinion shaft and tighten nut to 190 N·m (140 ft.-lbs.) torque. Turn shaft in both directions to seat bearings, then mount a dial indicator on carrier so probe contacts end of pinion gear as shown in Fig. 14 and measure shaft end play. Remove pinion shaft and reduce thickness of shims (23—Fig. 11) an amount equal to measured end play. This procedure will provide zero end play and zero preload. However, a tolerance of plus or minus 0.05 mm (0.002 inch) is acceptable.

Reinstall pinion shaft with all spacers and seals. Tighten retaining nut to 190 N·m (140 ft.-lbs.) torque.

**17. DIFFERENTIAL CARRIER BEARINGS AND BEVEL GEAR BACKLASH.** On all models, adjustment of differential carrier bearings to provide proper bevel gear backlash and bearing adjustment is correlated with pinion shaft protrusion adjustment as outlined in paragraph 16.

Install differential assembly, but do not securely tighten carrier bearing caps. Install adjuster rings and turn in

until end play of differential in carrier is less than 0.05 mm (0.002 inch) without preloading bearings. Mount dial indicator as shown in Fig. 15, then move carrier assembly sideways as required to obtain correct bevel gear backlash of 0.18-0.23 mm (0.007-0.009 inch) by loosening one adjuster ring one notch at a time and tightening opposite adjuster ring the same amount each time. When bevel gear backlash and differential carrier bearings are properly adjusted, install adjuster ring locks and tighten carrier bearing cap bolts to 163 N·m (120 ft.-lbs.) torque.

**18. MAIN DRIVE SHAFT.** Main drive shaft consists of a sliding yoke, drive shaft tube and two universal joints. To remove sliding yoke, mark its position for reassembly on correct splines, unscrew threaded cap and slide slip yoke off splines. Use conventional procedure to renew universal joints.

Install drive shaft with slip yoke at differential end and tighten bolts to 54 N·m (40 ft.-lbs.) torque.

**19. R&R TRANSFER GEARBOX.** Drain oil from transfer case and transmission. Capacity is approximately 42 L (44 quarts). Remove front drive shaft. Engage front-wheel drive, then remove output shaft flange retaining nut (20—Fig. 16). Remove platform or cab, if equipped, as outlined in paragraph 348 or 349. Remove fuel tanks. Disconnect selector cable from selector shaft (4). Remove left and right shift lever housings from transmission top cover. Remove bolts from transmission top cover, remove wedge and shims between top cover and clutch housing, and remove top cover using a suitable hoist. Remove bolt (37) and locknut (39), then slide coupler (38) connecting transfer gearbox input shaft to transmission bevel pinion shaft rearward. Remove selector cable bracket (44) and hydraulic pump inlet pipe connector. Support transfer gearbox with a hydraulic jack, then remove gearbox mounting bolts and lower gearbox from transmission housing.

When reinstalling, laminated gasket (1—Fig. 16) must be the same thickness as original gasket, or layers peeled off to allow coupler (38) to slide freely onto input shaft (12) and bevel pinion shaft. Tighten transfer gearbox mounting bolts to 165 N·m (120 ft.-lbs.) torque. Tighten output shaft flange nut (20) to a torque of 190 N·m (140 ft.-lbs.). Install transmission top cover with wedge and same thickness of shims that were removed. Tighten three middle 3/4 inch bolts securing rear axle housing to top cover to 205-245 N·m (150-180 ft.-lbs.) torque. Tighten re-



Fig. 14—View showing proper dial indicator position for setting pinion shaft bearing preload.



Fig. 15—View showing proper placement of dial indicator for setting backlash in front drive differentials.



mainder of top cover mounting bolts to 110-130 N·m (80-95 ft.-lbs.) torque. Tighten drive shaft flange bolts to 54 N·m (40 ft.-lbs.) torque. Complete installation by reversing removal procedure.

**20. OVERHAUL TRANSFER GEARBOX.** With transfer gearbox removed, disassemble as follows: Remove end plates (3 and 46—Fig. 16) and shims (36). Note position and thickness of shims (36). Drive input shaft (12) and idler shaft (34) out of housing (2). Remove input gear (13). Remove front bearing and cup (16). Remove output flange (23), cork seal (22) and washer (21). Remove oil seal housing (26) and output shaft end cover (43). Note thickness of shims (33). Drive output shaft (19) out of housing (2), remove the six bearing pads (18) and bearing and cup (27). Remove bottom cover (9) and drive roll pin (7) out of selector fork (6) and remove selector shaft (4). Remove selector fork, fixed gear (30) and sliding gear (29). Remove output gear (17) and idler gear (15). Remove selector shaft oil seal (5) and core plug (41).

Clean and inspect all parts for excessive wear or damage. Lubricate all parts during reassembly.

**21.** Install idler gear (15—Fig. 16) into bottom of transfer gearbox housing (2). Install output gear (17) into housing with hub for sliding gear engagement towards front of housing. Place fixed gear (30) inside sliding gear (29) and install output shaft (19) into rearward side of bottom hole in housing, pushing it through output gear (17) and partially through fixed gear (30). Oil slots on side of fixed gear (30) go against output gear (17). Spacer (31) and bearing (32) must already be assembled on output shaft (19). Install six bearing pads in output shaft, concave side against shaft, as it is pushed through output gear (17) and fixed gear (30). Install rear bearing cup (32), gasket (42), rear cover (43) and cable bracket (44) minus shims (33). Tighten bolts to 27 N·m (20 ft.-lbs.) torque. Install front bearing (27) and bushing (28) on output shaft and drive front bearing cup (27) into housing (2). Install oil seal (25) in oil seal housing (26) and install oil seal housing on transfer gearbox housing. Tighten bolts to 27 N·m (20 ft.-lbs.) torque. Hit end of output shaft (19) with a plastic hammer to seat bearings and cups.

Mount dial indicator on transfer gearbox housing (2) so probe end contacts end of output shaft (19). Measure and record end play of output shaft. End play tolerance is 0-0.05 mm (0-0.002 inch) for new bearings and 0.05-0.10

mm (0.002-0.004 inch) for used bearings.

To determine proper shim (33—Fig. 16) thickness, subtract 0.025 mm (0.001 inch) from dial indicator measurement if new bearings were installed, or subtract 0.076 mm (0.003 inch) from dial indicator measurement if original bearings are reused. The result is the required shim thickness to provide recommended end play.

Remove rear bearing cover (43) and install correct thickness of shims (33). Reinstall cover and tighten bolts to 27 N·m (20 ft.-lbs.) torque. Recheck end play and adjust shim thickness, if necessary, if not within tolerance.

Install oil seal (5—Fig. 16) into housing (2) and place trunnion pins (40) in selector fork (6). Install selector fork in housing, making certain trunnion pins engage slot in sliding gear (29). Install selector shaft (4) through oil seal (5) and selector fork. Align roll pin holes in selector fork and shaft and install roll pin (7). Install core plug (41), bottom cover gasket (8) and bottom cover (9). Install flange (23), cork washer (22), washer (21) and locknut (20). Tighten locknut to 190 N·m (140 ft.-lbs.) torque.

**22.** Install idler shaft (34—Fig. 16) and bearing assembly through rear of housing and drive it through idler gear (15). Install rear bearing cup (35) and end plate (46). Tighten bolts to 27 N·m (20 ft.-lbs.) torque. Drive front bearing (16) onto idler shaft (34) until seated. Install bearing cup (16) and end plate (3). Tighten bolts to 27 N·m (20 ft.-lbs.) torque and hit idler shaft (34) to seat bearings.

Mount dial indicator so end of probe contacts end of idler shaft (34—Fig. 16). Measure and record amount of end play. End play tolerance is 0-0.05 mm (0-0.002 inch) for new bearings and 0.05-0.10 mm (0.002-0.004 inch) for used bearings.

To determine correct shim (36—Fig. 16) thickness, subtract 0.025 mm (0.001 inch) from dial indicator measurement if new bearings are used, or subtract 0.076 mm (0.003 inch) from dial indicator measurement if original bearings are reused. The result is the required thickness of shims needed to obtain desired end play.

Remove rear end plate (46—Fig. 16) and install correct shim (36) thickness. Reinstall end plate (46) and tighten bolts to 27 N·m (20 ft.-lbs.) torque. Recheck end play and adjust shim thickness, if necessary, if not within required tolerance.

**23.** Install input shaft (12—Fig. 16) and bearing assembly through front of

housing (2) and input gear (13). Install bearing cup (14) and end plate (3). Tighten bolts to 27 N·m (10 ft.-lbs.) torque. Drive rear bearing (11) onto input shaft (12) until seated. Install bearing cup (11) and end plate (46). Tighten bolts to 27 N·m (20 ft.-lbs.) torque. Set end play in the same manner as outlined in paragraph 22.

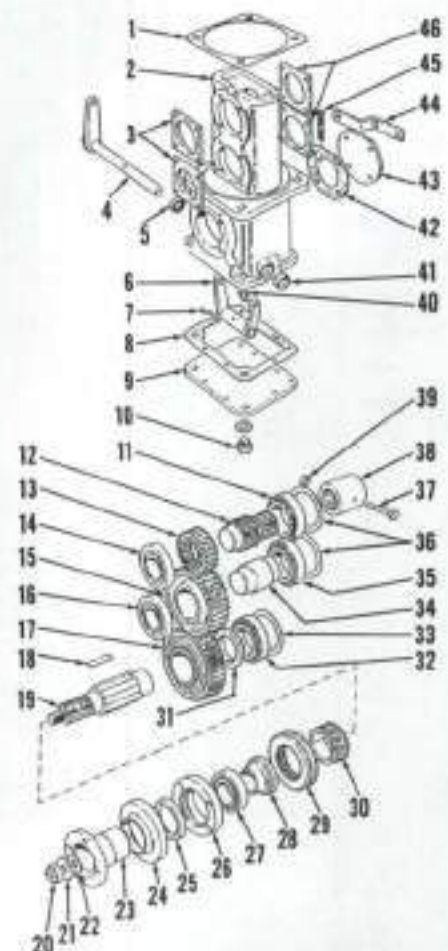


Fig. 16—Exploded view of transfer gearbox used with David Brown front drive axle showing component parts and their relative positions.

- |                     |                        |
|---------------------|------------------------|
| 1. Gasket           | 24. Flange dust shield |
| 2. Housing          | 25. Oil seal           |
| 3. Front end plates | 26. Oil seal housing   |
| 4. Selector shaft   | 27. Front bearing      |
| 5. Oil seal         | 28. Bushing            |
| 6. Selector fork    | 29. Sliding gear       |
| 7. Roll pin         | 30. Fixed gear         |
| 8. Gasket           | 31. Spacer             |
| 9. Bottom cover     | 32. Rear bearing       |
| 10. Drain plug      | 33. Shims              |
| 11. Rear bearing    | 34. Idler shaft        |
| 12. Input shaft     | 35. Rear bearing       |
| 13. Input gear      | 36. Shims              |
| 14. Front bearing   | 37. Bolt               |
| 15. Idler gear      | 38. Coupler            |
| 16. Front bearing   | 39. Locknut            |
| 17. Output gear     | 40. Trunnion pin       |
| 18. Bearing pads    | 41. Core plug          |
| 19. Output shaft    | 42. Gasket             |
| 20. Locknut         | 43. Rear cover         |
| 21. Washer          | 44. Cable bracket      |
| 22. Cork seal       | 45. Stud               |
| 23. Flange          | 46. Rear end plates    |

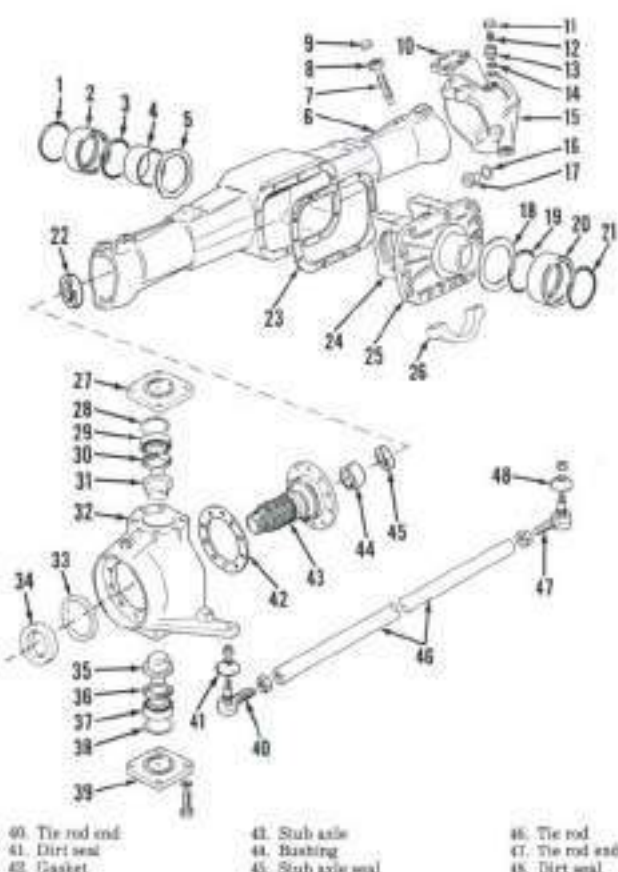


## Paragraphs 24-27

## CASE INTERNATIONAL (DAVID BROWN)

Fig. 17—Exploded view of Carraro front drive axle typical of AE1, AE2 and AE3 type axles showing component parts and their relative positions.

1. "O" ring
2. Bushing
3. "O" ring
4. Sleeve
5. Thrust washer
6. Axle case
7. Locating screw
8. Locknut
9. Dust cover
10. Steering lever
11. Cover
12. Beasher
13. Retainer
14. Washer
15. Stub axle housing
16. Shim
17. Stop
18. Thrust washer
19. "O" ring
20. Bushing
21. "O" ring
22. Seal
23. Gasket
24. Differential carrier bearing cap
25. Differential carrier housing
26. Bushing cap
27. Bearing pin cover
28. Shim
29. Bearing
30. Seal
31. Bearing pin
32. Stub axle housing
33. Seal
34. Seal
35. Bearing pin
36. Seal
37. Bearing
38. Shim
39. Bearing pin cover
40. Tie rod end
41. Dirt seal
42. Gasket
43. Stub axle
44. Bushing
45. Stub axle seal
46. Tie rod
47. Tie rod end
48. Dirt seal



### CARRARO AXLE

On tractors so equipped, a Carraro Type 790/19 mechanical front drive axle is used on Model 1394 with product identification number (P.I.N.) 11503001 and after, Model 1494 with P.I.N. 11518001 and after and Model 1594 with P.I.N. 11221501 and after. A Carraro AE3 front drive axle is used on Model 1594 prior to P.I.N. 11221501 and all 1690 tractors so equipped. On all other models equipped with a Carraro mechanical front drive axle, either an AE1 or an AE2 axle is used. Service procedures for AE1, AE2 and AE3 axles are the same.

### All Models So Equipped

**24. TIE RODS AND TOE-IN.** Front wheel toe-in is measured from wheel rim to wheel rim at front and rear of wheels. Toe-in should be 0-5 mm (0-3/16 inch) on tractors with Type 709/19 axle. On all other tractors, toe-in should be 0-1.5 mm (0-1/16 inch). Toe-in is adjusted by lengthening or shortening the threaded tie rod ends equally.

Tie rod ends that are excessively worn must be renewed as complete units.

**25. R&R AXLE ASSEMBLY.** To remove front drive axle assembly, raise

and support front of tractor. Remove drive shaft and disconnect all steering lines and cap openings. Mark positions of bushing caps (26—Fig. 17). Support axle assembly on floor jack and remove bushing caps. Raise front of tractor and remove axle assembly.

To reinstall, reverse removal procedure making certain bushing caps are reinstalled in their original positions. Tighten mounting bolts to 210 N·m (155 ft.-lbs.) torque. Bleed steering system as outlined in paragraph 59.

**26. PIVOT BUSHINGS.** To renew axle pivot bushings (2 and 20—Fig. 17), first remove axle as outlined in para-

graph 25. On AE1, AE2 and AE3 axles, put marks (B—Fig. 18) on oil seal carrier and differential carrier so seal carrier can be reinstalled in original position. On all axles, put mark (A) on differential carrier and axle housing in line with hole in bushings prior to removing bushings. Remove oil seal carrier, then pry bushings from housings. Remove sleeve (4—Fig. 17) and thrust washers (5 and 18) as necessary.

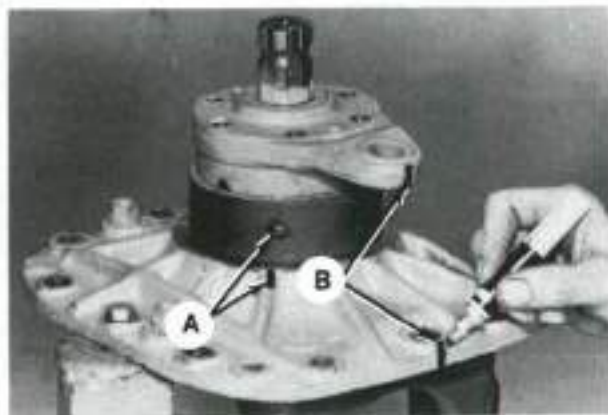
Install new "O" rings in pivot bushings and lubricate with grease before reinstalling bushings. Make certain holes in bushings are aligned with marks made previously on case and carrier housing (Fig. 18). Install oil seal carrier aligning mark on carrier with mark on differential carrier.

### Models With AE1, AE2 or AE3 Carraro Axle

**27. FINAL DRIVE AND STUB AXLE.** Raise and support front of tractor, then remove tire and wheel. Rotate hub (4—Fig. 19) until drain plug (18) is at bottom, then drain oil from housing. Remove bolts retaining end plate (19) to hub (4) and install two guide studs opposite each other in hub. Remove end plate (19) with planetary gears. Remove snap ring (15) and sun gear (22). Support hub with a chain hoist. Remove locknut (23) and spacer (24). On Model 1690 and early Model 1594, remove and retain shims (25—Fig. 20). On all models, remove planetary ring gear and hub assembly.

To remove stub axle (43—Fig. 17) and pivot housing (32), remove felt seal (34) and oil seal (33). Loosen nuts securing stub axle to housing. Disconnect tie rod ends (40 and 47). Disconnect steering cylinder from right-hand steering arm. Remove bearing pin covers (27 and 39) and shims (28 and 38). Use special puller (CAS-1652) to remove bearing pins (31 and 35). Remove stub axle and housing assembly.

Fig. 18—Before disassembling differential carrier, place alignment marks (A and B) as shown for repositioning of bushings and oil seal carrier. On Type 709/19 axles, oil seal carrier (B) alignment is not required.





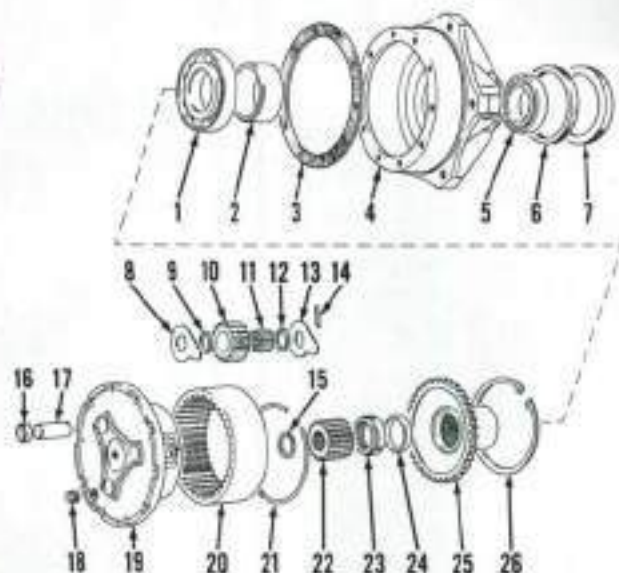


Fig. 19—Exploded view of Carraro front drive axle final drive assembly used on 1290, 1294, 1390 and 1490 models and early 1394, 1494 and 1594 models showing component parts and their relative positions

1. Bearing
2. Spacer
3. Gasket
4. Hub
5. Bearing
6. Seal
7. Seal
8. Bearing retainer
9. Washer
10. Flange gear
11. Bearings
12. Washer
13. Bearing retainer
14. Roll pin
15. Snap ring
16. Core plug
17. Planetary gear pin
18. Drain plug
19. Cover
20. Gear
21. Support gear
22. Gear
23. Locknut
24. Spacer
25. Support gear
26. Snap ring

Remove stub axle mounting nuts and separate axle from pivot housing. Remove bearing, thrust spacer, bushing (44) and oil seal (45) as necessary.

When reassembling, be sure lip of oil seal is towards inside of stub axle and chamfered side of thrust spacer faces away from bearing. Heat bearings to 120°C (250°F) maximum prior to installation.

To reinstall, reverse removal procedure while noting that slot in stub axle

mounting flange must be installed over breather hole in swivel housing as shown in Fig. 21.

**NOTE:** If stub shaft bearing is renewed on Model 1690 and early Model 1594, bearing preload must be set as outlined in paragraph 29 before installing oil seal (33—Fig. 17) and felt seal (34).

Install stub axle and swivel housing onto axle housing, then install upper and lower bearing pins (31 and 35—Fig. 17) with bearings. Be sure flange of bearing pins seats against the housing. Adjust swivel bearing preload as outlined in paragraph 28. Complete reassembly by reversing disassembly procedure. Tighten ring gear retaining nut to 1200 N·m (885 ft.-lbs.). Lubricate swivel bearings with multipurpose lithium base grease. Fill hubs with correct amount of Case FDL SAE 90 gear lubricant or equivalent.

**28. SWIVEL BEARING PRELOAD.** Shims (28 and 38—Fig. 17) are used between swivel bearing cups and

bearing covers (27 and 39) to adjust bearing preload. Correct setting is 0.40 mm (0.016 inch) preload on each bearing. To set bearing preload, install lower bearing cover without shims and tighten mounting bolts to 280 N·m (205 ft.-lbs.) torque. Install all shims which were removed from upper and lower pins, plus an additional 0.5 mm (0.020 inch) shim, on the upper bearing cup. Install upper bearing cover and tighten mounting bolts evenly in sequence shown (Fig. 22) until all up and down movement of swivel housing is eliminated. Tap bearing pin cover and turn swivel housing from side to side to assure bearings are seated. Continue to tighten upper cover bolts, if necessary, until all up and down movement is just removed, then measure gap between upper bearing cover and axle housing using a feeler gage. Remove upper and lower bearing covers and all shims. Remove thickness of shims equal to measured gap, then divide remaining shims equally between upper and lower bearing covers. Install an additional 0.20 mm (0.008 inch) shim under each bearing cover to provide specified 0.40 mm (0.016 inch) bearing preload, then tighten cover bolts to 280 N·m (205 ft.-lbs.) torque. Tighten stub axle mounting nuts to 130 N·m (95 ft.-lbs.) torque.

**29. WHEEL HUB BEARING PRELOAD.** Model 1690 and early Model 1594 equipped with Carraro AE3 axles are equipped with taper roller bearings and bearing preload is set by adjusting thickness of shims (25—Fig. 20). On all other models, axles are equipped with ball bearings and preload is controlled by spacers (2 and 24—Fig. 19). Preload is not adjustable on these models.

**NOTE:** Bearing preload must be set before installing oil seal (33—Fig. 17) and felt seal (34).

To set preload, install ring (26—Fig. 20) and original amount of shims (25)

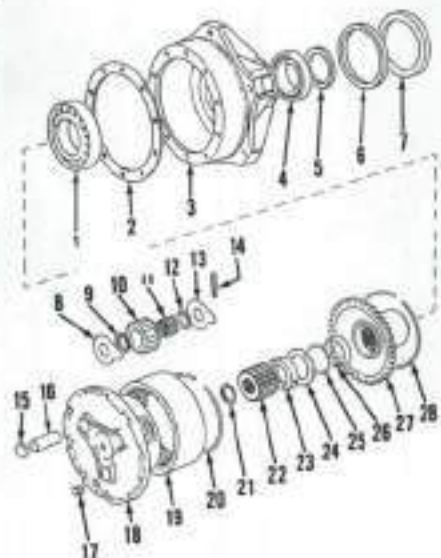


Fig. 20—Exploded view of AE3 Carraro front drive axle final drive unit used on 1690 and early 1594 tractors showing component parts and their relative positions.

1. Bearing
2. Gasket
3. Hub
4. Bearing
5. Washer
6. Seal
7. Seal
8. Bearing retainer
9. Washer
10. Flange gear
11. Bearings
12. Washer
13. Bearing retainer
14. Roll pin
15. Core plug
16. Planetary gear pin
17. Drain plug
18. Hub cover
19. Planetary ring gear
20. Snap ring
21. Snap ring
22. Sun gear
23. Locknut
24. Washer
25. Shim
26. Spacer
27. Support gear
28. Snap ring

Fig. 21—View showing location of slot on stub axle which must cover breather hole of stub axle housing on Carraro front drive axles.

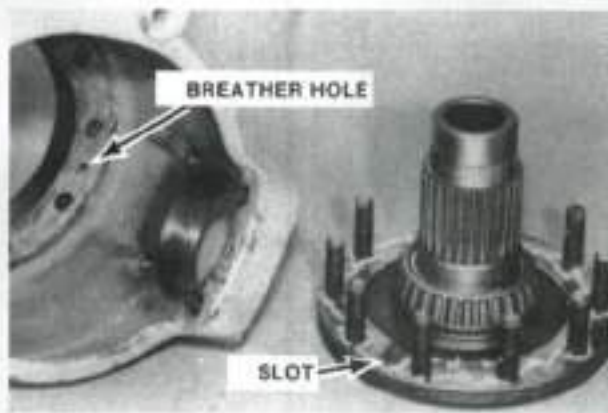






Fig. 22—Proper tightening sequence used to install bearing pin cover prior to setting bearing pin preload.

removed during disassembly. Install washer (24) and locknut (23). Use special socket (CAS-1645) to tighten locknut to 1200 N·m (885 ft.-lbs.) torque. Install special fixture as shown in Fig. 23 on wheel hub, then use a torque wrench to measure amount of torque needed to turn wheel hub.

Correct bearing preload requires 23 N·m (20 in.-lbs.) torque to turn hub. Add or subtract from shim thickness (25—Fig. 20) until correct preload is obtained.

After preload is correctly adjusted, remove ring gear assembly and install oil seal and felt seal in hub. Reinstall ring gear with correct amount of shims and tighten locknut to 1200 N·m (885 ft.-lbs.) torque.

**30. PLANETARY GEARS.** Drain oil from hub, then remove planetary gear carrier (19—Fig. 19 or 18—Fig. 20). Mark location of planetary gear pins and gears in the carrier so they can be reassembled in their original positions. Remove roll pins (14), then drive planetary gear pins outward from gear carrier. Cup plugs (16—Fig. 19 or 15—Fig. 20) will be driven out with pins. Remove gears, thrust washers, spacers and bearing rollers. Keep these parts with their respective gear pins.

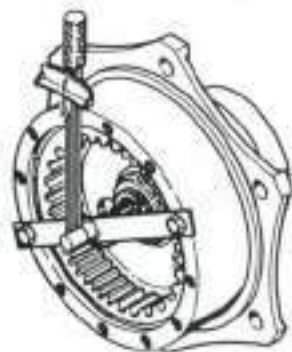


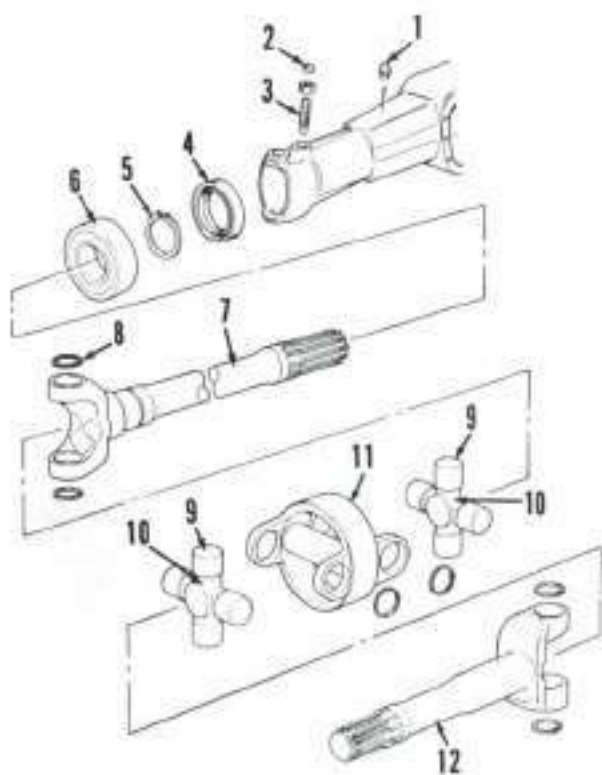
Fig. 23—When setting wheel hub bearing preload on Models 1594 and 1690, use special fixture and a torque wrench to check torque required to turn wheel hub.

Reassemble by reversing disassembly procedure. Apply sealant to cup plugs before installation. Make certain that notch in carrier gasket and drain hole in carrier is aligned with notch in wheel hub. Tighten retaining bolts to 80 N·m (60 ft.-lbs.) torque. Fill hub to correct level with Case FDL SAE 90 gear lubricant or equivalent.

**31. AXLE SHAFTS.** Axle halfshafts (7 and 12—Fig. 24), bearing (6) and oil seal (4) can be renewed with axle housing in place. Refer to paragraph 27 for removal of final drive, swivel housing and stub axle. Loosen bearing lock screws (3), then pull axle shaft from housing using a suitable slide hammer puller. Use a puller to remove oil seal from housing.

Fig. 24—Exploded view of typical front axle shafts used AE1, AE2 and AE3 Carraro axles.

1. Breather
2. Dust plug
3. Bearing lock screw
4. Oil seal
5. Snap ring
6. Bearing
7. Long shaft
8. Snap ring
9. Bearing cap
10. Cross
11. Housing
12. Short shaft



Install new oil seal with lip facing inward. Lubricate seal lip before installing axle shaft. Be sure bearing is seated in housing bore, then tighten upper and lower bearing lock screws (3) to secure bearing.

**32. R&R DIFFERENTIAL.** To remove front drive differential assembly, it is first necessary to remove final drives and stub shafts as outlined in paragraph 27. Remove axle shafts as outlined in paragraph 31. Remove axle housing as outlined in paragraph 25. Remove differential carrier mounting bolts and remove differential assembly from housing.

To reinstall differential, reverse the removal procedure. Tighten differential carrier retaining bolts to 87 N·m (65 ft.-lbs.) torque. Fill axle housing to correct level with Case FDL SAE 90 gear lubricant or equivalent.

**33. OVERHAUL DIFFERENTIAL.** Place differential unit in a stand with pinion shaft pointing downward. Mark bearing caps and carrier housing so caps can be reinstalled in their original positions. Remove bearing caps and bearing adjuster rings (8 and 35—Fig. 25). Remove bevel ring gear and differential assembly from carrier housing.

Mark position of oil seal carrier as shown in Fig. 18, then remove carrier. Using special spanner wrench (CAS-1597), remove pinion shaft locknut



(16—Fig. 25). Use a soft hammer to drive pinion shaft out of bearings and carrier. Remove bearings, shims and bushing from pinion shaft and carrier as necessary.

Mark end plate (37), bevel ring gear (3) and cage (4) so they can be reassembled in their original positions. Remove carrier bearings (6 and 36) as necessary. Separate end plate from cage and remove side gear (20) and friction plates. To remove cross-shaft retaining pins (25 and 30), remove the cage stud (38) that is aligned with one of the pins. The remaining two pins are aligned with end plate locating dowels (33). Use a punch to drive the two retaining pins and dowel pins out of cage. Drive long cross-shaft (21) out of cage, then remove the two pinion gears (22 and 28) and thrust washers. Drive short cross-shafts (24 and 31) out of cage, then remove cross-shaft block (26) and remaining two pinion gears and thrust washers. Remove side gear (27) and friction plates. Remove bevel ring gear (3) as necessary.

Bevel ring gear and pinion shaft are serviced as a matched set only. If bevel ring gear and pinion shaft, pinion shaft bearings or carrier are renewed, pinion shaft protrusion must be set as outlined in paragraph 35.

Reassemble by reversing the disassembly procedure while noting the following special instructions: Be sure tabs of friction plates (9 and 34—Fig. 25) engage the grooves in differential cage (4) and end plate (37). Tighten end plate nuts to 48 N·m (35 ft.-lbs.) torque. When renewing carrier bearings (6 and 36), heat bearings to 120°C (250°F) maximum before installing. Heat ring gear before installing on differential cage. Tighten retaining bolts to 90 N·m (65 ft.-lbs.) torque.

Check and set friction plate end play as outlined in paragraph 34. Set pinion shaft protrusion as outlined in paragraph 35. Adjust differential carrier bearings and bevel gear backlash as outlined in paragraph 36.

**34. DIFFERENTIAL FRICTION PLATE END PLAY.** To check end play of friction plates, mount a dial indicator so probe extends through axle shaft opening and contacts end of one of the side gears. Insert a screwdriver or other suitable tool through opening in side of differential cage, pry side gear upward and measure end play.

Correct end play is 0.03-0.20 mm (0.001-0.008 inch). End play can be adjusted by replacing 2.8 mm spacer with a 2.9 mm spacer (1 and 40—Fig. 25). Renew friction plates if end play is still excessive.

Fig. 25—Exploded view of Carraro Type AE1, AE2 and AE3 limited slip front drive axle differential showing component parts and their relative positions.

1. Spacer
2. Friction plate, inner
3. Differential bevel gear
4. Differential cage
5. Lockplate
6. Bearing
7. Roll pin
8. Adjusting wheel
9. Friction plate, outer
10. Pinion gear shaft
11. Shim
12. Bearing
13. Spacer
14. Shim
15. Bearing
16. Locknut
17. Oil seal
18. Gasket
19. Oil seal carrier
20. Side gear
21. Long cross-shaft
22. Pinion gear
23. Thrust washer
24. Cross-shaft
25. Retaining pin
26. Cross-shaft block
27. Side gear
28. Pinion gear
29. Thrust washer
30. Retaining pin
31. Cross-shaft

32. Roll pin
33. Dowel pin
34. Friction plate, outer

35. Adjusting ring
36. Bearing
37. End plate

38. Steel
39. Friction plate, inner
40. Spacer

Repeat procedure for friction plates and side gear on opposite side.

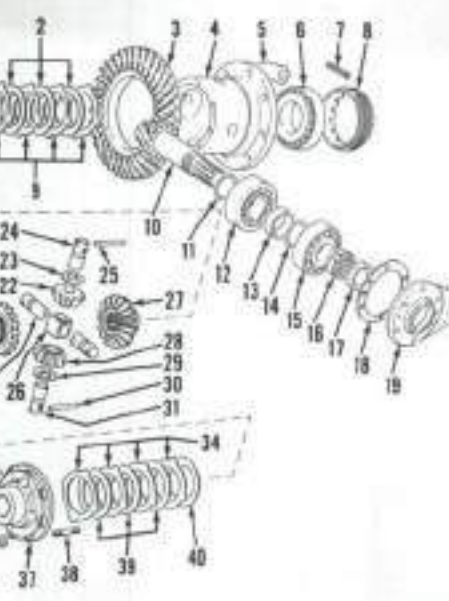
### 35. PINION SHAFT PROTRUSION AND BEARING PRELOAD.

To set pinion shaft protrusion, install bearing cups and cones in carrier housing. Use a bolt, washers and nut as shown in Fig. 27 to hold bearing cones in place. Tighten bolt and nut until bearing cones are difficult to turn.

Install carrier bearing caps (1—Fig. 27) on carrier housing and tighten nuts to 205 N·m (150 ft.-lbs.) torque. Measure and record diameter of bearing bore (A). Place a shaft (3), having a diameter of at least 25 mm (1 inch) and having a cross hole drilled through it, across bearing bores as shown in Fig. 27. Measure and record diameter (B) of shaft. Using a depth gage measure from top of shaft to face of inner bearing cone (Fig. 28) and record measurement (C—Fig. 27).

To determine correct thickness of shims (11—Fig. 25) required to obtain desired shaft protrusion, use the following calculations: Subtract diameter of shaft (B—Fig. 27) from depth gage measurement (C). Add this figure to one-half the diameter of carrier bearing bore (A). The result is dimension (E). Then subtract dimension etched on pinion shaft gear face (dimension is in millimeters) from dimension (E). The resulting dimension will be correct shim (11—Fig. 25) thickness to install to properly set pinion shaft protrusion.

Install correct thickness shim (11—Fig. 25) on pinion shaft with chamfered side towards gear end of shaft. Press inner bearing onto shaft until seated against shim.



To set pinion shaft bearing preload, assemble pinion shaft in carrier minus seal (17—Fig. 25) and seal carrier (19). Install spacer (13) and a shim (14) that is 0.5 mm (0.020 inch) thicker than original shim removed during disassembly. Install outer bearing cone and old locknut (16). Tighten locknut to 450 N·m (330 ft.-lbs.) torque. Rotate pinion shaft to seat bearings, then mount a dial indicator so probe contacts end of pinion shaft. Move pinion shaft and record end play. Disassemble pinion shaft and reduce shim (14—Fig. 25) thickness an amount equal to measured end play plus 0.5 mm (0.020 inch) to

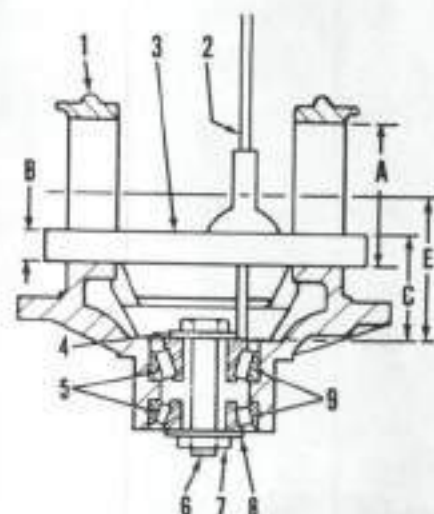


Fig. 27—Diagram showing method of securing pinion bearings in support housing to allow depth gage measurement to be taken.

1. Bearing cap
2. Depth gage
3. Pilot shaft
4. Washer
5. Bearing cones

6. Bolt
7. Nut
8. Washer
9. Bearing caps



## Paragraphs 36-38

obtain desired preload of 0.5 mm (0.020 inch) on pinion shaft bearings.

After correct shim thickness is determined, reinstall pinion shaft assembly using a new locknut. Tighten locknut to 450 N·m (330 ft.-lbs.) torque. Stake nut to groove in shaft to prevent loosening of nut.

**36. DIFFERENTIAL CARRIER BEARINGS AND BEVEL GEAR BACKLASH.** Pinion shaft protrusion and bearing preload must be properly set before adjusting differential carrier bearings. Install differential unit in carrier housing making certain ring gear is aligned with drain hole in carrier as shown in Fig. 29. Install bearing support caps, but do not tighten retaining nuts securely at this time. Install bearing adjuster rings and turn adjuster ring on ring gear side of differential until ring gear contacts pinion gear. Then turn adjuster ring on side opposite ring gear until all bearing end clearance is removed, but do not preload bearings. Mount dial indicator as shown in Fig. 30, then hold pinion shaft and move ring gear to check backlash. Turn adjuster rings as needed to move ring gear sideways to obtain recommended backlash of 0.15-0.25 mm (0.006-0.010 inch). Loosen adjuster ring one notch at a time and tighten opposite adjuster ring the same amount when setting backlash.



Fig. 29—View showing proper depth gage and pilot shaft placement used in determining pinion shaft protrusion.



Fig. 29—When installing differential unit in carrier, make sure ring gear is on same side as drain hole in carrier.

## CASE INTERNATIONAL (DAVID BROWN)

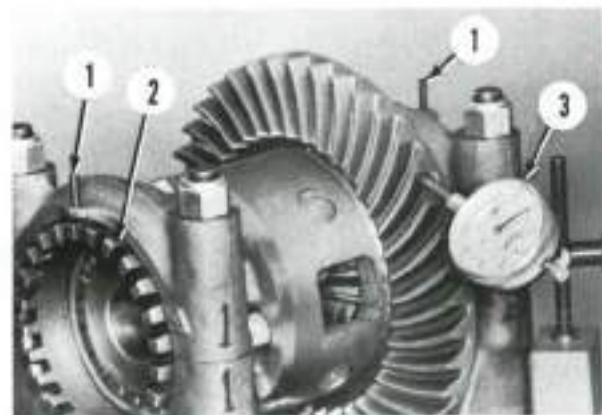


Fig. 30—Dial indicator probe should be against outer tip of ring gear tooth when measuring backlash.

1. Roll pin
2. Adjuster ring
3. Dial indicator

After bevel gear backlash is properly adjusted, turn adjuster ring on each side of differential clockwise two notches to provide recommended bearing preload. Tighten bearing cap mounting nuts to 210 N·m (155 ft.-lbs.) torque, then recheck for correct backlash. Drive roll pin (1—Fig. 30) into notch of each adjuster ring to secure adjustment.

### Models With Type 709/19 Carraro Axle

**37. FINAL DRIVE.** Left and right final drive removal procedure is similar. Raise and support front of tractor, then remove tire and wheel. Remove

drain plug from end plate and drain oil. Remove the two screws securing hub cover (22—Fig. 31) to hub housing (5). Pry cover loose and remove cover and planetary gears. Remove snap ring, sun gear (19), spacer (18) and washer (17). Remove bolts retaining planetary ring gear hub (8), then install four of the bolts into threaded holes in ring gear hub to remove ring gear. Remove outer bearing (6), then tap hub assembly (5) off swivel housing.

To remove swivel housing (1—Fig. 32), disconnect steering cylinder from left-hand steering arm. Disconnect tie rod end from swivel housing arm. Remove upper and lower swivel pins (9) and shims (10). Withdraw swivel housing from axle housing.

Inspect bashings, bearings and oil seals and renew if necessary.

To reinstall, reverse the removal procedure while noting the following items: Refer to paragraph 38 to set swivel bearing preload. Lubricate lip of oil seals prior to reassembly. Tighten planetary ring gear bolts evenly in steps to a final torque of 88 N·m (65 ft.-lbs.).

Lubricate swivel bearings with multipurpose lithium base grease. Fill hubs to correct level with Case FDL SAE 90 gear lubricant or equivalent.

**38. SWIVEL BEARING PRELOAD.** Shims (10—Fig. 32) are used between swivel pin (9) and housing (1) to adjust bearing preload. Correct preload setting is 0.2 mm (0.008 inch). To adjust, install bottom pin without shims and tighten bolts to 83 N·m (60 ft.-lbs.) torque. Support the weight of the axle with a jack under bottom pin. Install top pin without shims or bolts making sure bearing cone is fully seated in cup. Measure the gap between flange of swivel pin and swivel housing (Fig. 33). Select shim pack which is 0.1-0.2 mm (0.004-0.008 inch) less than the gap measurement. Divide shim pack equally and install half of the shims



under top pin and other half under bottom pin.

**NOTE:** If unable to divide shims equally, install thicker shims under top pin.

Tighten pin mounting bolts to 83 N·m (60 ft.-lbs.) torque.

**39. PLANETARY GEARS.** To remove, raise and support front axle, then remove tire and wheel. Drain oil from wheel hub. Remove two screws securing cover (22—Fig. 31) to hub, then pry cover loose and remove cover and planetary gears.

Remove retaining rings (12) and retaining plate (16). Mark each gear and

shaft so the gears can be reinstalled in their original positions if reused. Remove gears, bearing rollers and thrust washers.

Inspect parts and renew as necessary. To reassemble, reverse the disassembly procedure. Fill wheel hub to correct level with Case FDL SAE 90 gear lubricant or equivalent.

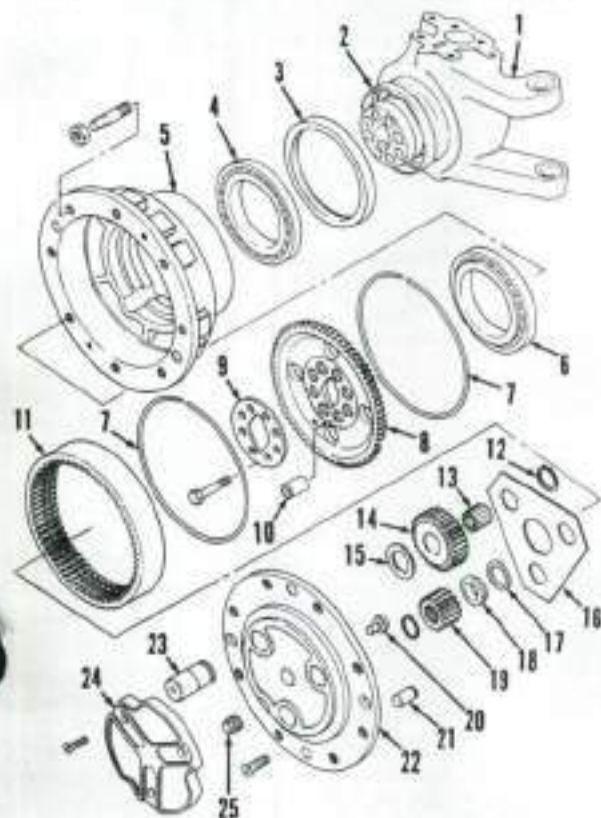


Fig. 31—Exploded view of final drive assembly used on Type 709/19 Carraro front drive axle.

1. Swivel housing
2. Wear sleeve
3. Oil seal
4. Bearing
5. Wheel hub
6. Bearing
7. Retaining rings
8. Ring gear carrier
9. Retaining plate
10. Ring dowel
11. Planetary ring gear
12. Snap ring
13. Needle bearings
14. Planet gear
15. Thrust washer
16. Thrust plate
17. Thrust washer
18. Spacer
19. Sun gear
20. Thrust button
21. Dowel
22. Hub cover & planetary carrier
23. Planet gear shaft
24. Cover
25. Drain plug

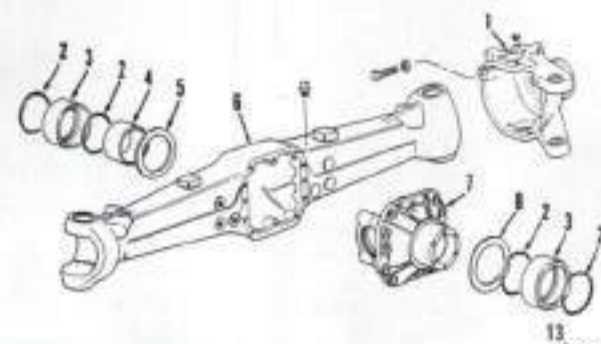


Fig. 32—Exploded view of Carraro Type 709/19 front drive axle used on late Models 1394, 1494 and 1594.

1. Swivel housing
2. "U" rings
3. Transition bushings
4. Sleeve
5. Thrust washer
6. Axle housing
7. Differential carrier housing
8. Thrust washer
9. Bearing pin
10. Shims
11. Seal
12. Bearing
13. Tie rod ends
14. Tie rod

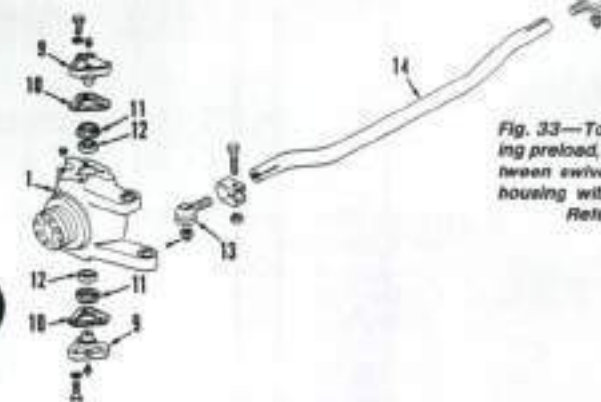


Fig. 33—To set swivel bearing preload, measure gap between swivel pin and swivel housing with a feeler gauge. Refer to text.

**40. AXLE SHAFTS.** Axle half-shafts (4 and 9—Fig. 34), oil seal (3) and bushing (2) can be renewed with axle housing in place. Refer to paragraph 37 for removal of final drive and swivel housing. Pull axle shaft from housing. Remove oil seal and bushing using suitable slide hammer puller.

Install new seal with lip facing inward. Lubricate seal lip before installing axle shaft. Complete installation by reversing removal procedure.

**41. R&R DIFFERENTIAL.** To remove front differential, drain oil from axle housing and remove axle assembly from tractor as outlined in paragraph 25. Support swivel housing and wheel hub as an assembly using a suitable hoist and sling. Remove swivel pins, then remove each final drive as a complete assembly from axle housing. Withdraw axle shafts from housing. Remove differential carrier housing mounting nuts, then use two M10 bolts in threaded holes in carrier housing to separate carrier from axle housing. Use a suitable hoist to lift differential assembly out of axle housing.

**42. OVERHAUL DIFFERENTIAL.** Place differential assembly in a stand with flange end pointing downward. Put identification marks on bearing caps and carrier housing so caps can be reinstalled in their original positions. Remove adjuster locking plates (1—Fig. 35), bearing caps (9) and adjuster rings (3). Remove differential from carrier.

Remove oil seal carrier (17). Using special spanner wrench (CAS 1597), re-





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move pinion shaft locknut (15), then drive pinion shaft (7) out of carrier. Remove bearings (11), spacer (12) and shims (10 and 13) as necessary.

Remove carrier bearings (4) using a suitable puller. Remove bevel ring gear mounting bolts that are aligned with pinion gear shaft (24), then turn housing so retaining pin (25) falls out through ring gear bolt hole. Remove remaining ring gear mounting bolts

and remove gear from housing if necessary. Push pinion shaft out of housing, then withdraw pinion gears (22), side gears (21) and friction plates from housing. Remove axle shaft bushings from differential case as necessary.

Bevel ring gear (6) and pinion shaft (7) are serviced as a matched set only and must be installed as such. If bevel ring gear and pinion shaft, pinion shaft bearings or carrier housing are re-

newed, pinion shaft protrusion must be set as outlined in paragraph 44.

Reassemble by reversing the disassembly procedure while noting the following special instructions: Install backing plate (20) on side gears first, then alternately assemble friction plates beginning and ending with a plate with tabs (19). Align pin hole in pinion shaft (24) with hole in case, then install retaining pin (25). Apply Loctite 270 to threads of ring gear mounting bolts, then tighten to 70 N·m (52 ft.-lbs.) torque.

Check friction plate end play as outlined in paragraph 43. Adjust pinion shaft protrusion and bearing preload as outlined in paragraph 44. Reinstall differential in carrier housing making sure ring gear is aligned with housing drain plug (Fig. 36). Adjust bevel gear backlash and carrier bearing preload as outlined in paragraph 45.

Fig. 34—Exploded view of typical axle shafts used on Carraro 700/19 axle.

1. Axle housing
2. Bushing
3. Oil seal
4. Long shaft
5. Retaining ring
6. Bearing cap
7. Cross
8. Housing
9. Short shaft

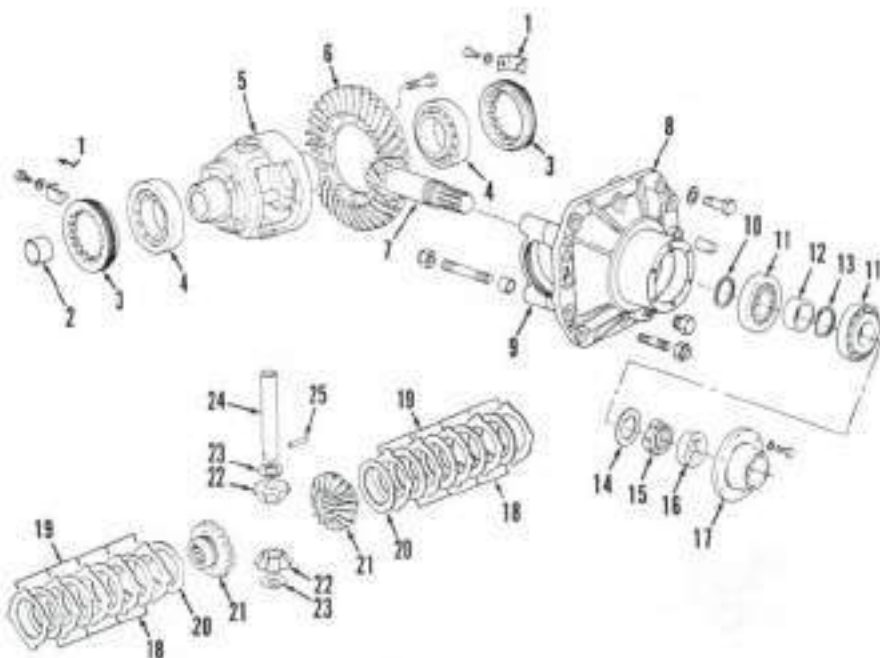
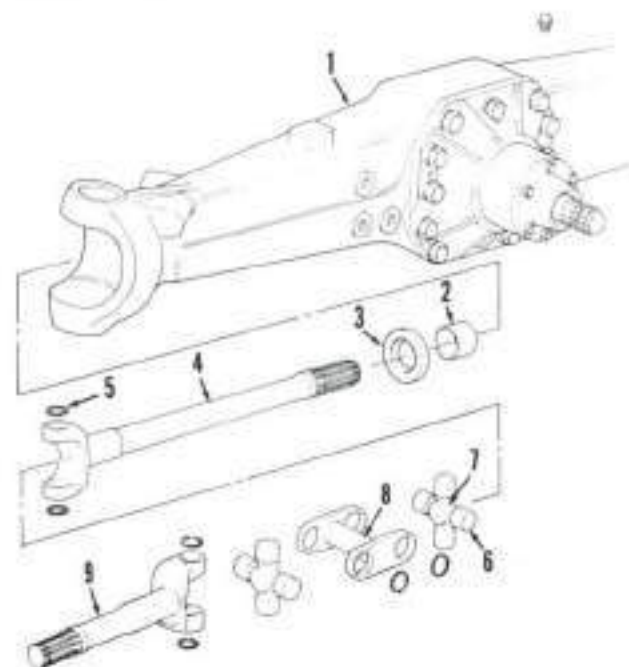


Fig. 35—Exploded view of Carraro Type 700/19 front drive axle limited slip differential assembly.

- |                                 |                  |                               |
|---------------------------------|------------------|-------------------------------|
| 1. Adjuster locking plates      | 10. Shim         | 18. Friction plates, splined  |
| 2. Bushing                      | 11. Bearings     | 19. Friction plates with tabs |
| 3. Adjuster rings               | 12. Spacer       | 20. Backing plate             |
| 4. Carrier bearings             | 13. Shim         | 21. Side gear                 |
| 5. Differential case            | 14. Washer       | 22. Thrust washer             |
| 6. Bevel ring gear              | 15. Locknut      | 23. Pinion shaft              |
| 7. Bevel pinion gear            | 16. Oil seal     | 25. Retaining pin             |
| 8. Differential carrier housing | 17. Seal carrier |                               |
| 9. Bearing cap                  |                  |                               |

**43. DIFFERENTIAL FRICTION PLATE END PLAY.** To check friction plate end play, place differential assembly in a vertical position. Mount a dial indicator so probe extends through axle shaft opening and contacts the end of one of the side gears. Insert a screwdriver or other suitable tool through opening in side of differential cage, pry side gear upward and measure end play.

Correct end play is 0.03-0.20 mm (0.001-0.008 inch). End play can be adjusted by replacing 2.8 mm thick spacer (20—Fig. 35) with a 2.9 mm thick spacer plate. Renew friction plates if end play is still not within specified tolerance.

Repeat procedure for plates on opposite side.

**44. PINION SHAFT PROTRUSION AND BEARING PRELOAD.** To set pinion shaft protrusion, install bearing cups in carrier housing. Install carrier bearing caps (9—Fig. 35) and tighten nuts to 198 N·m (145 ft.-lbs.) torque. Install bearing cones in carrier using a bolt, flat washers and nut (Fig. 38) to hold bearings in place. Tighten nut and bolt until bearing cones are difficult to turn.

Measure and record diameter of carrier bearing cap bore (A—Fig. 38). Place a shaft (3), having a diameter of at least 25 mm (1 inch) and having a cross hole drilled through it, across bearing bores as shown. Measure and record diameter (B) of shaft. Insert a depth gage through hole in shaft and measure distance (C) from top of shaft to face of inner bearing cone.

To determine correct thickness of shims (10—Fig. 35) required to provide desired pinion shaft protrusion, use the





Align Ring Gear  
With Drain Plug

Fig. 36—When installing differential unit in carrier housing, make certain ring gear is on same side as housing drain plug.

following calculations: Subtract diameter of shaft (B—Fig. 38) from depth gage measurement (C). Add this figure to one-half the diameter of carrier bearing bore (A). The result is dimension (E). Then subtract dimension etched on gear end of pinion shaft (dimension is in millimeters) from dimension (E). The resulting dimension will be correct shim (10—Fig. 35) thickness to install to properly set pinion shaft protrusion.

Install correct thickness shim (10) on pinion shaft with chamfered side towards gear end of shaft. Press inner bearing cone onto shaft until seated against shim.

To set pinion shaft bearing preload, assemble pinion shaft in carrier minus seal (16) and seal carrier (17). Install spacer (12) and a shim 0.5 mm (0.020 inch) thicker than original shim removed during disassembly. Install outer bearing cone and the old locknut (15).

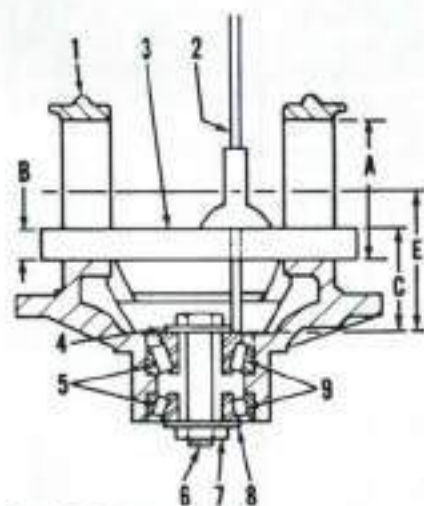


Fig. 38—Diagram showing method of securing pinion shaft bearings in carrier housing to allow depth gage measurement to be taken when setting pinion bearing preload. Refer to text.

- |                  |                 |
|------------------|-----------------|
| 1. Bearing cap   | 6. Bolt         |
| 2. Depth gage    | 7. Nut          |
| 3. Pinion shaft  | 8. Washer       |
| 4. Washer        | 9. Bearing caps |
| 5. Bearing cones |                 |

Tighten locknut to 450 N·m (330 ft.-lbs.) torque. Rotate pinion shaft to seat bearings, then mount a dial indicator so probe contacts end of pinion shaft. Move pinion shaft and record end play. Disassemble pinion shaft and reduce shim thickness an amount equal to measured end play plus 0.5 mm (0.020 inch) to obtain desired bearing preload of 0.5 mm (0.020 inch).

#### 45. DIFFERENTIAL CARRIER BEARINGS AND BEVEL GEAR BACKLASH. Pinion shaft protrusion and bearing preload must be properly

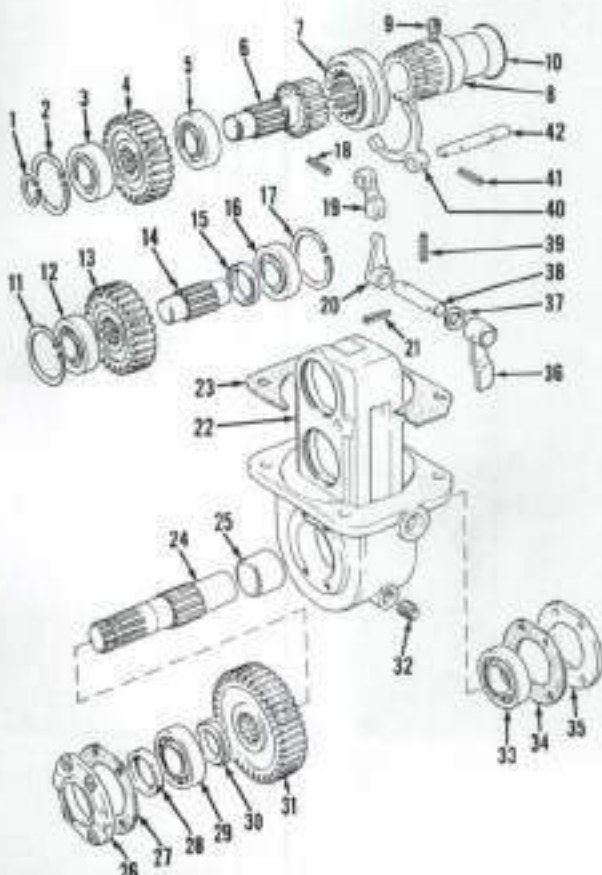
set before adjusting differential carrier bearings.

Install differential assembly in carrier housing (Fig. 36). Install bearing adjuster rings and carrier bearing caps, but do not tighten bearing cap nuts to final torque at this time. Turn adjuster ring on ring gear side clockwise until ring gear contacts pinion gear. Turn adjuster ring on opposite side clockwise until all bearing end clearance is removed. Tap on bearing caps with a plastic mallet to align bearings. Mount a dial indicator so probe contacts outer tip of ring gear tooth, then hold pinion shaft and move ring gear in each direction to check backlash. Move ring gear sideways to obtain recommended backlash of 0.15-0.25 mm (0.006-0.010 inch) by loosening one adjuster ring one notch at a time and tightening opposite adjuster ring the same amount each time.

After bevel gear backlash is correctly set, turn the adjuster ring on each side one-half to one notch clockwise to provide desired bearing preload. Tighten carrier bearing cap nuts to 210 N·m (155 ft.-lbs.) torque, then recheck for correct backlash. Install locking plates in notches of adjuster rings to secure adjustment.

Fig. 39—Exploded view of transfer gearbox used on some models equipped with Carraro front drive axles and synchromesh transmissions.

1. Snap ring
2. Snap ring
3. Front bearing
4. Drive shaft gear
5. Rear bearing
6. Drive shaft
7. Sliding gear
8. Transmission drive coupling
9. Adjusting screw
10. Snap ring
11. Snap ring
12. Front bearing
13. Intermediate gear
14. Intermediate shaft
15. Rear spacer
16. Rear bearing
17. Snap ring
18. Roll pin
19. Selector jaw
20. Inner level
21. Roll pin
22. Gearbox housing
23. Gasket
24. Output shaft
25. Rear spacer
26. Front cover
27. Gasket
28. Oil seal
29. Front bearing
30. Front spacer
31. Output gear
32. Drain plug
33. Rear bearing
34. Gasket
35. Rear cover
36. Outer lever
37. Oil seal
38. Lower selector shaft
39. Roll pin
40. Selector fork
41. Roll pin
42. Upper selector shaft





## Paragraphs 46-49

## CASE INTERNATIONAL (DAVID BROWN)

## TRANSFER GEARBOX

## All Synchronmesh Models With Carraro Axle

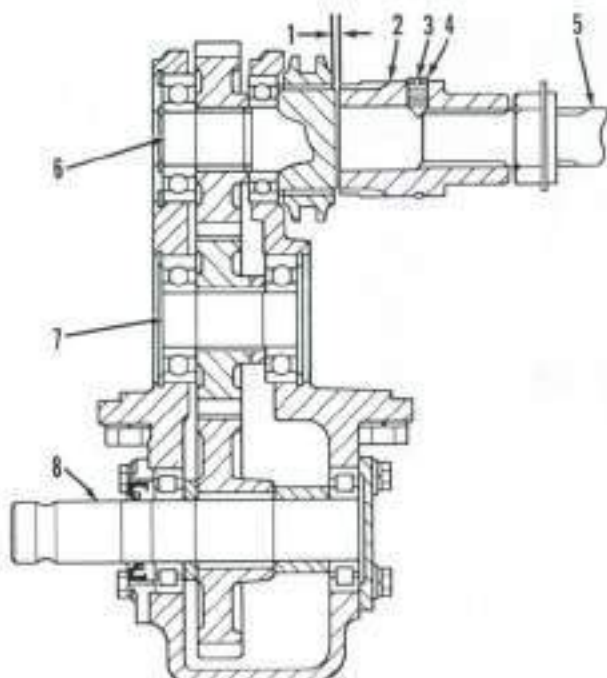
**46. REMOVE AND REINSTALL.** Remove drive shaft. Drain oil from transfer gearbox and transmission case. Drain fuel tanks. Remove drive shaft. Disconnect selector cable from gearbox selector arm, then remove cable bracket from frame. Remove fuel tank crossover pipe. Push selector arm rearward to disengage gearbox sliding clutch from transmission drive coupling. Support transfer gearbox, remove mounting bolts and lower gearbox from transmission housing.

To reinstall, reverse the removal procedure. Tighten mounting nuts and bolts to 163 N·m (120 ft.-lbs.) torque. Fill transmission housing with Case PTF Fluid, Hy-Tran Plus or equivalent fluid.

**47. OVERHAUL.** With transfer gearbox removed, disassemble as follows: Drive roll pin from selector fork (40—Fig. 39 or 58—Fig. 40) and shaft.

Fig. 41—Cross-sectional view of transfer gearbox used on some models equipped with Carraro front drive axle. Clearance (1) between shaft and drive coupling must not exceed 0.3 mm (0.012 inch).

2. Transmission drive coupling
3. Snap ring
4. Adjusting screw
5. Transmission input pinion shaft
6. Input shaft
7. Intermediate shaft
8. Output shaft



Remove sliding clutch and selector fork. Remove snap rings (1 and 2), then drive input shaft (6) rearward from housing.

Remove drive gear (4) and bearings. Remove snap rings (11 and 17), then drive intermediate shaft (14) rearward from housing. Remove gear (13), spacer (15) and bearing. Remove output shaft front and rear covers (26 and 35). Press output shaft (24) out through front of housing. Drive roll pins out of selector linkage and disassemble linkage as necessary.

Clean all parts and inspect for excessive wear or damage. Renew output shaft oil seal (28) and selector shaft oil seals. Lubricate lip of seals with grease before reinstalling shafts.

Reassemble by reversing the disassembly procedure. Tighten output shaft cover mounting bolts to 27 N·m (20 ft.-lbs.) torque. If a new input shaft (6), sliding clutch assembly or transmission drive coupling is installed, transmission drive coupling clearance must be adjusted as outlined in paragraph 48.

**48. TRANSMISSION DRIVE COUPLING ADJUSTMENT.** The transmission top cover must be removed to measure clearance (1—Fig. 41) between transfer gearbox input shaft and transmission drive coupler (2). If clearance exceeds 0.3 mm (0.012 inch), disengage snap ring (3) that holds drive coupling adjusting screw (4). Turn adjusting screw until clearance is less than 0.3 mm (0.012 inch), then reinstall snap ring over adjusting screw.

## Power Shift Models With Carraro Axle

**49. R&R AND OVERHAUL.** To remove transfer gearbox, first drain oil from gearbox and transmission case.

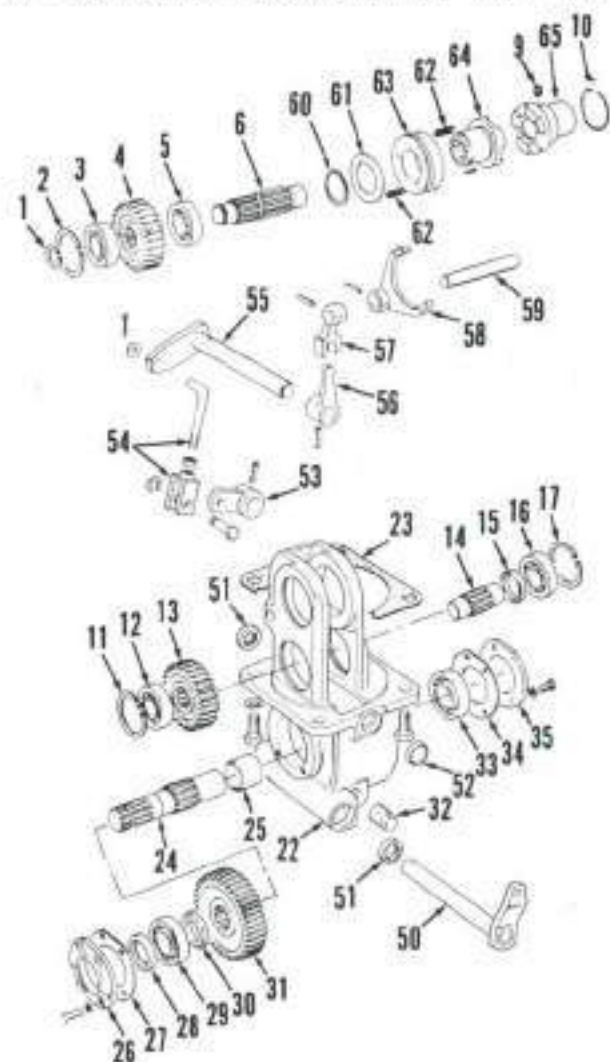


Fig. 40—Exploded view of transfer gearbox used on Models 1294, 1394, 1494 and 1594 equipped with synchronmesh transmission and Carraro front drive axle. Shift linkage is slightly different on Model 1594. Refer to Fig. 39 for legend except for the following items.

50. Lower selector shaft
51. Oil seals
52. Flag
53. Operating lever
54. Operating link & circlip
55. Upper selector shaft
56. Selector lever
57. Selector jaw
58. Selector fork
59. Shaft
60. Snap ring
61. Thrust washer
62. Springs
63. Clutch sleeve
64. Sliding clutch
65. Drive coupling

Remove main drive shaft. Disconnect selector cable from selector arm (23—Fig. 42). Remove mounting bolts and lower gearbox from transmission case.

To disassemble, remove selector shaft (1) and forks (3). Remove front and rear covers (21 and 18). Drive out-

put shaft (10) out of housing and withdraw drive gear (17) and sliding clutch assembly.

Inspect parts and renew if necessary. Renew oil seal (20) in front cover.

To reassemble, reverse the disassembly procedure.

## MANUAL STEERING GEAR

Model 1190 may be equipped with manual steering utilizing a recirculating ball type steering box bolted to the gearbox cover.

### REMOVE AND REINSTALL

#### Model 1190

50. To remove steering gear unit, remove steering wheel (4—Fig. 43) and dust seal (5). Disconnect controls and wiring to instrument panel. Remove drop arm (13—Fig. 44) and unbolt and remove instrument panel as a unit. Unbolt and remove steering gear assembly from transmission noting spacer (6, 7 and 24—Fig. 44) placement.

Reinstall by reversing removal procedure.

### STEERING GEAR AND COLUMN OVERHAUL

#### Model 1190

51. **DISASSEMBLY.** With steering gear and steering wheel removed, remove locknut (6—Fig. 43) and unscrew adjustable bearing cone (7). Remove the 12 loose bearing balls (9). Remove both ball nut pegs (17 and 22—Fig. 44) and shims (18 and 21), then withdraw steering shaft (19—Fig. 43) and ball nut assembly (16) from bottom of unit. Lower bearing race (10) and spherical seat (11) can now be removed from steering column (14) and rubber baffle (12) from steering shaft (19). Unscrew ball nut assembly (16) from steering shaft (19) and retrieve the 28 loose steel balls (17). Remove locating screw (20—Fig. 44) and withdraw cross-shaft (15).

If cross-shaft bushings (1 and 25—Fig. 44) are to be renewed, note size and location before removal for proper in-

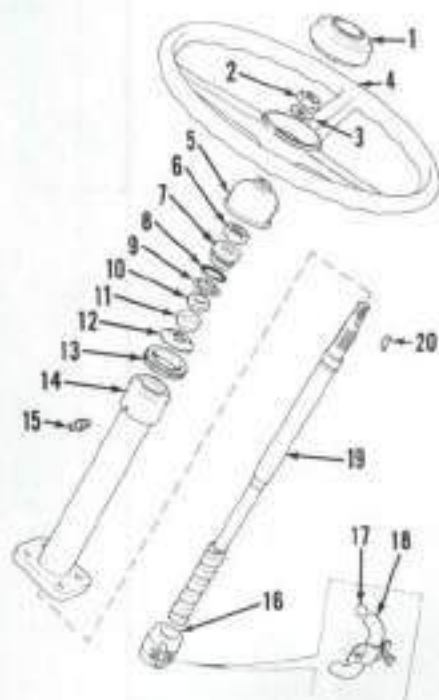


Fig. 43—Exploded view of steering column and related parts for 1190 models equipped with manual steering.

- |                            |                     |
|----------------------------|---------------------|
| 1. Cap                     | 11. Spherical seat  |
| 2. Nut                     | 12. Rubber baffle   |
| 3. Washer                  | 13. Grommet         |
| 4. Steering wheel          | 14. Steering column |
| 5. Dust seal               | 15. Cross shaft     |
| 6. Locknut                 | 16. Steering nut    |
| 7. Adjustable bearing cone | 17. Steel ball      |
| 8. "O" ring                | 18. Transfer tube   |
| 9. Steel balls             | 19. Steering shaft  |
| 10. Lower bearing race     | 20. Woodruff key    |

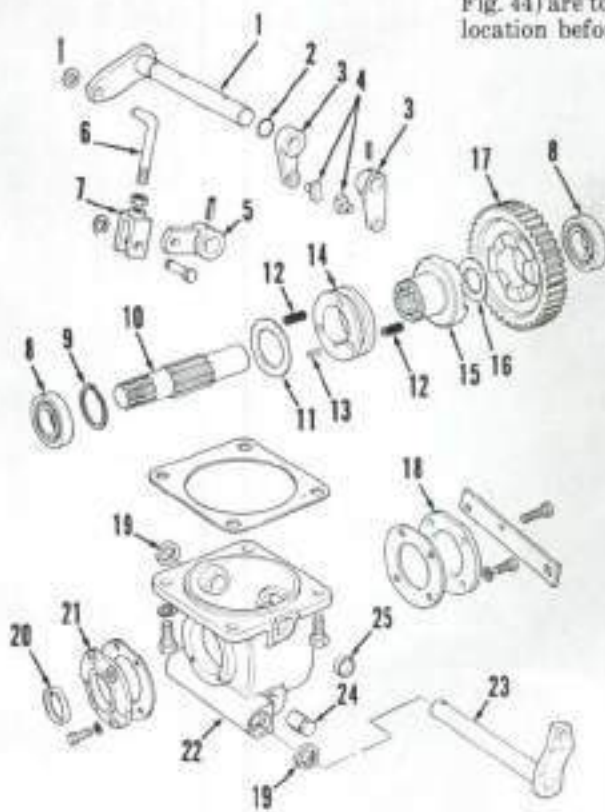


Fig. 42—Exploded view of transfer gearbox used on models with powershift transmission and Carraro front drive axle. Note that selector linkage is slightly different on 1594 models.

- |                    |
|--------------------|
| 1. Selector shaft  |
| 2. "O" ring        |
| 3. Selector arms   |
| 4. Trunnion pins   |
| 5. Selector lever  |
| 6. Link            |
| 7. Clavis          |
| 8. Bearing         |
| 9. Snap ring       |
| 10. Output shaft   |
| 11. Thrust washer  |
| 12. Springs        |
| 13. Key            |
| 14. Clutch sleeve  |
| 15. Sliding clutch |
| 16. Thrust washer  |
| 17. Drive gear     |
| 18. Rear cover     |
| 19. Oil seals      |
| 20. Oil seal       |
| 21. Front cover    |
| 22. Housing        |
| 23. Selector shaft |
| 24. Drain plug     |
| 25. Plug           |

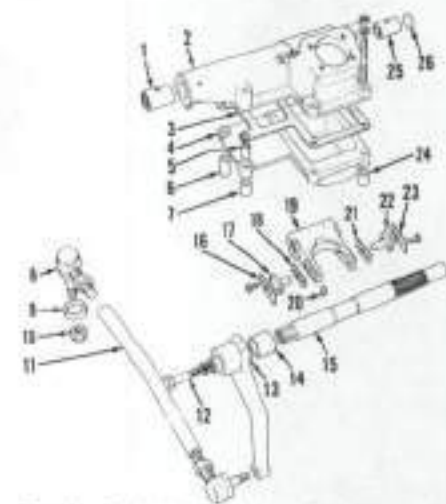


Fig. 44—Exploded view of steering box and its related parts used on 1190 models with manual steering.

- |                    |                     |
|--------------------|---------------------|
| 1. Bushing (long)  | 14. Dust shield     |
| 2. Steering box    | 15. Cross-shaft     |
| 3. Gasket          | 16. Tab washer      |
| 4. Scrub           | 17. Ball nut peg    |
| 5. Dewul           | 18. Shim            |
| 6. Spacer          | 19. Rocker arm      |
| 7. Spacer          | 20. Locating screw  |
| 8. Drag link end   | 21. Shim            |
| 9. Dust shield     | 22. Ball nut peg    |
| 10. Nut            | 23. Tab washer      |
| 11. Drag link tube | 24. Spacer          |
| 12. Bolt           | 25. Bushing (short) |
| 13. Drop arm       | 26. Core plug       |



## Paragraphs 52-57

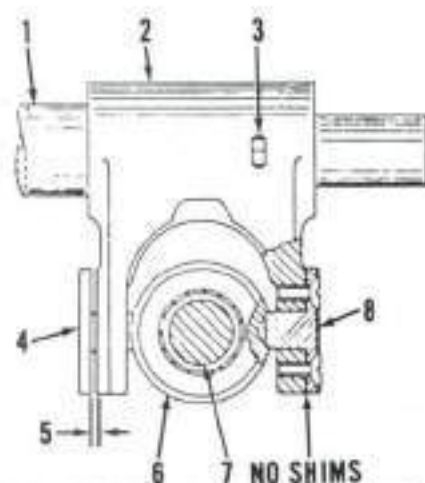


Fig. 45—View showing method of selecting shims for correct ball nut preload. Refer to paragraph 53 for procedure.

stallation. Lubrication holes in bushings (1 and 25) and gearbox (2) must be aligned and cross-shaft (15) must turn freely.

**52. REASSEMBLY.** Remove transfer tube (18—Fig. 43) and place ball nut (16) over ball track on lower end of steering shaft (19). Insert steel balls (17) into ball nut until full, place remaining balls in transfer tube (18) with grease and fit tube to ball nut. Place rubber baffle (12) in groove on steering shaft and insert up through housing.

Position rocker arm (19—Fig. 44) in steering box (2) with stop down. Reinstall cross-shaft (15) and secure with locating screw (20).

**53. BALL NUT PEG PRELOAD.** Install one ball nut peg (8—Fig. 45) minus shims (18 and 21—Fig. 44) and tighten the two cap screws securely. Install second ball nut peg (4—Fig. 45) and tighten the two cap screws evenly only until inner end of peg causes ball nut to lightly bind. Using a feeler gage, measure gap between ball nut peg (4) and rocker arm (2). See 5—Fig. 45. Shims (18 and 21—Fig. 44) to be used in final assembly should be 0.025-0.076 mm (0.001-0.003 inch) less than measured gap (5—Fig. 45). Divide shims as equally as possible between the two ball nut pegs (17 and 22—Fig. 44) for installation and secure bolts with tab washers (16 and 23).

**54. STEERING SHAFT END PLAY.** Insert spherical seat (11—Fig. 43) on steering shaft (19) with flat face down, then install lower race (10) with round face in spherical seat (11). Drop in the 12 loose bearing balls (9). Install "O" ring (8) in groove of adjustable bearing cone (7) and thread onto steering shaft

(19) until all play is removed from bearing assembly. Shaft (19) should still turn freely. Back off adjustable bearing cone (7)  $\frac{1}{4}$  turn to provide 0-0.076 mm (0.000-0.003 inch) end play of steering shaft. Hold adjustable bearing cone in position, install locknut (6) with recessed side against adjustable bearing cone and tighten to 163 N·m (120 ft.-lbs.) torque.

## CASE INTERNATIONAL (DAVID BROWN)

## DRAG LINK

## Model 1190

**55. ADJUSTMENT.** Drag link ends are serviced as a unit only and must be renewed as such. Adjust length of drag link (11—Fig. 44) so spindle contacts stop on axle before internal steering gear stops wheel movement.

## POWER STEERING

Hydrostatic power steering is optional on Model 1190 and standard on all other models. Hydrostatic steering systems are comprised of a pump, steering (control) valve and steering cylinder. Tractors are steered hydraulically with no mechanical link between steering wheel and front axle.

Power steering pump for 1190 and 1194 models is a 16 L/min. (4.2 gpm) Hobourn-Eaton pump having a remote reservoir containing filter and breather assemblies. All other models use a 10.5 L/min. (2.8 gpm) Sundstrand pump utilizing differently arranged remote filter, breather and reservoir systems or a reservoir as an integral part of the pump.

All models use an Orbitrol OSP-100 or OSP-125 steering valve. Service procedures are similar for either valve.

ter is relocated to a remote reservoir. Manufacturer recommends renewing steering system oil and oil filter after every 400 hours of operation. Recommended oil is CASE TCH Fluid or equivalent. Refer to the following table for approximate system capacities.

1190-1194 . . . . .	0.9 L (1.0 qt.)
All Other Models . . . . .	1.25 L (1.5 qt.)

## BLEEDING STEERING SYSTEM

## Side Mounted Steering Cylinders

**57.** Fill reservoir to proper level with specified fluid and raise front of tractor until front wheels clear the ground.

If steering pump has been drained, renewed or overhauled, it will be necessary to prime pump. Place fuel shut-off in STOP position and use starter to turn engine over for 10 or 15 seconds. Push fuel shut-off to RUN position and start and run engine for 10 or 15 seconds, then shut off engine. Repeat procedure and leave engine running at idle speed.

## FILTER

## All Models

**56.** The steering system oil filter (17—Fig. 49) is located in the reservoir (19). Note that in some applications, fil-

Fig. 46—Exploded view of Hobourn-Eaton steering pump used on Models 1190 and 1194.

1. Pulley
2. Mounting plate
3. Retaining ring
4. Bearing
5. "O" ring
6. Body
7. Oil seal
8. "O" ring
9. End plate
10. Bushing
11. "O" ring
12. Alignment pin
13. Cam ring
14. Rollers
15. Carrier
16. Drive pin
17. Shaft
18. Retaining ring
19. Manifold plate
20. Bushing
21. Cover
22. Retaining ring
23. Relief valveassy.
24. Outlet union
25. Reservoir

