CHAMPION®
MOTOR GRADERS

A Company within the Volvo Construction Equipment Group

Manual de Taller
Manuel D'Atelier
Shop Manual

CHAMPION
MOTOR GRADERS

700 Series
SHOP MANUAL

Introduction

The purpose of this Shop Manual is to detail disassembly and assembly procedures when overhauling Champion 700 Series motor graders equipped with model 8400 transmissions.

The Shop Manual applies to graders having Canadian serial numbers **16224**, **16245** and up. U.S. serial numbers **2021-2** to **2658-2**.

The step-by-step sequence provides a comprehensive and progressive method of servicing. Separate sections deal with each main area and begin at the front of the grader.

THINK SAFETY FIRST! Always put the grader in the **SERVICE POSITION**, described on page ii, before attempting any overhaul, maintenance or inspection procedure.

Safety warning symbols and instructions are included where there is a risk of either damage to the grader or injury to service personnel. It is important to use extreme care during these particular operations.

For the best performance from your grader, use only specified recommended lubricants and genuine CHAMPION spare parts.

Champion Road Machinery reserves the right to modify its products by changing any specification without notice.

In case of difficulty in obtaining Parts or Service for your motor grader, please contact Champion Road Machinery, Goderich, Ontario, Canada.

Telephone: 519-524-2601
Telefax: 519-524-5175 or 519-524-5185 or 519-524-4411
Telex: 069-55175 CHAMPARTS GDCH

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TITLE **SECTION**

Service Position

Before making any service, maintenance or inspection procedure, the grader must be placed in the SERVICE POSITION.

1. Park the grader on a level surface.
2. Place the transmission in NEUTRAL and apply the hand brake.
3. Lower the moldboard and all attachments to the ground. Do not apply down-pressure.
4. Shut down the engine.
5. If the grader is an articulated model, install both articulation locking pins.
6. Install chocks at the front and rear tandem wheels. Wedge the chocks in place.
7. Relieve residual hydraulic pressure by operating all control levers.
8. Some hydraulic circuits may contain lock valves. Operating the control levers in these circuits will not relieve residual hydraulic pressure. Such pressure must be relieved by loosening a fitting or electrically activating the solenoid valve. Wear face and eye protection. Danger of spraying oil!
9. Fasten a "DO NOT OPERATE" or similar warning tag on the steering wheel.
10. Remove and retain the ignition key.
11. Turn the battery isolation switch to the "OFF" position.
12. If the service procedure includes welding, you must disconnect the following items:
    a) The negative battery cable(s).
    b) Positve battery cable(s).
    c) Main power supply harness at the transmission controller.
    d) Transmission wiring harness at the transmission controller.
    e) Alternator wiring harness.

    Connect the arc-welder ground cable adjacent to the work area. Install the battery box cover(s). After completing your welding procedure, connect items a) through e) in the reverse order. Ensure to connect the negative battery cable(s) last.
13. Allow the engine and hydraulic system to cool before working in these areas.
14. Be aware of other service personnel in your work area.

Torque Guide

Fastener Thread Size (Coarse and Fine)	SAE Grade 5 Fastener			SAE Grade 8 Fastener		
	N.m	kgf.m	lbf.in.	N.m	kgf.m	lbf.in.
4-40	0,68	0,07	6	1,02	0,10	9
4-48	0,79	0,08	7	1,13	0,11	10
6-32	1,35	0,14	12	1,92	0,19	17
6-40	1,47	0,15	13	2,15	0,22	19
8-32	2,48	0,25	22	3,50	0,36	31
8-36	2,60	0,26	23	3,61	0,37	32
10-24	3,61	0,37	32	5,08	0,52	45
10-32	4,07	0,41	36	5,76	0,59	51
						lbf.ft
1/4-20	8,47	0,86	75	12,20	1,24	9
1/4-28	9,72	0,99	86	13,56	1,38	10
			lbf.ft			
5/16-18	17,62	1,80	13	24,40	2,49	18
5/16-24	18,98	1,93	14	27,12	2,76	20
3/8-16	31,18	3,18	23	47,45	4,84	35
3/8-24	33,89	3,46	25	47,45	4,84	35
7/16-14	47,45	4,84	35	75,57	7,60	55
7/16-20	54,23	5,53	40	81,35	8,29	60
1/2-13	75,92	7,74	56	108,46	11,06	80
1/2-20	88,13	8,99	65	122,02	12,44	90
9/16-12	108,46	11,06	80	149,14	15,21	110
9/16-18	122,02	12,44	90	176,26	17,97	130
5/8-11	149,14	15,21	110	230,49	23,50	170
5/8-18	176,26	17,97	130	244,05	24,89	180
3/4-10	271,16	27,65	200	379,63	38,71	280
3/4-16	298,28	30,42	220	433,86	44,24	320
7/8-9	433,86	44,24	320	623,68	63,60	460
7/8-14	488,09	49,77	360	677,91	69,13	500
1-8	650,79	66,36	480	921,96	94,01	680
1-12	718,58	73,27	530	1003,31	102,30	740
1-14	732,14	74,66	540	1030,42	105,07	760
1-1/8-7	813,49	82,95	600	1301,59	132,72	960
1-1/8-12	894,84	91,25	660	1464,28	149,31	1080
1-1/4-7	1138,89	116,13	840	1843,91	188,03	1360
1-1/4-12	1247,35	127,19	920	2033,73	207,38	1500
1-3/8-6	1491,40	152,08	1100	2413,36	246,09	1780
1-3/8-12	1708,33	174,20	1260	2765,87	282,04	2040
1-1/2-6	1979,50	201,85	1460	3199,73	326,28	2360
1-1/2-12	2182,87	222,59	1610	3606,48	367,76	2660

700 Series Lubrication Specifications

Application/ Fluid Code	Capacity	Lubricant Change Interval (see note)	Filter Change Interval	Fluid Type	Air Temperature Range During Fill Period °C -40 -30 -20 -10 0 10 20 30 40 50 °F -40 -22 -4 14 32 50 68 86 104 122
Hydraulic system - HO	42 US gal 159 L	1000 hr	First 100 hr then 500 hr	Hydraulic Oil*	O SAE 10W, ISO Grade 32 Dexron®II ATF
All Wheel Drive hydraulic system - HO	10 US gal 38 L	2000 hr	First 100 hr then 1000 hr	Hydraulic Oil*	O SAE 10W, ISO Grade 32 Dexron®II ATF
Tandems - drum brakes - HO	8.5 US gal 32 L (each side)	2000 hr	-	Hydraulic Oil	O SAE 10W, ISO Grade 32 Dexron®II ATF
Tandems - oil disc brakes - UTHF	26.5 US gal 100 L (each side)	1500 hr	-	Universal Tractor Hydraulic Fluid for Wet Disc Brakes	O SAE 10W, ISO Grade 32
Front wheel bearings	-	500 hr	Multi-Purpose Grease Extreme Pressure Lithium Soap Base		O NLGI EP2 FRONT WHEEL BEARINGS
All grease fittings - MPG	Until grease seeps from joint	-			NLGI EP0 or EP1 O NLGI EP2
All Wheel Drive pump drive gearbox - GO	0.3 US gal 1,0 L	First 100 hr then 1000 hr	-	Hypoid Gear Oil - API GL-5 MIL-L-2105C	SAE 85W-140 O SAE 80W-90 SAE 75W-90
All Wheel Drive planetary reduction unit - GO	0.4 US gal 1,5 L (each side)	First 100 hr then1000 hr	-	Hypoid Gear Oil - API GL-5 MIL-L-2105C	SAE 85W-140 O SAE 80W-90 SAE 75W-90
Final drive - single reduction lock/ unlock differential - GO	6 US gal 23 L	First 100 hr then 1000 hr	-	Hypoid Gear Oil - API GL-5 MIL-L-2105C	SAE 85W-90 O SAE 80W-90 SAE 75W-90
Final drive - double reduction lock/ unlock differential - GO	9 US gal 34 L	First 100 hr then 2000 hr	-	Hypoid Gear Oil - API GL-5 MIL-L-2105C	SAE 85W-90 O SAE 80W-90 SAE 75W-90
Drum brake/clutch fluid - MVBF	-	1 year	-	Motor Vehicle Brake Fluid	O SAE J 1703, DOT 3, ISO 4925
Transmission - EO	14 US gal 53 L	1000 hr	First 100 hr then 500 hr	Premium Quality Engine Oil* API CD/CE qualified to Allison C-3 and TO-2 specifications	SAE 30 O SAE 10W SAE 5W-20 SAE 0W-30

O Standard factory fill   *See **Cold Weather Operation**

NOTE: Service intervals are based on:
250 hours or 1 month, whichever comes first
500 hours or 3 months, whichever comes first
1000 hours or 6 months, whichever comes first
2000 hours or 12 months, whichever comes first

NLGI = National Lubricating Grease Institute
API = American Petroleum Institute
Consult your Champion Distributor for alternative lubricants
Refer to engine manual for engine lubricants

Cold Weather Operation

Lubricant Requirements for Transmission and Hydraulic Systems

When operating in temperatures below -20° C (-4° F), you can use the recommended oils provided the following conditions are met:

a) Before start up, the oil is preheated to a temperature above the minimum value for the indicated oil and viscosity range.

b) The operating temperature stays above the minimum value in the applicable range.

Failure to comply with these requirements may result in a malfunction or reduced life of the transmission or hydraulic components.

Cold Weather Start Up Procedure

If oil in the hydraulic circuit is cold, hydraulic functions may move slowly. Do not attempt grader operations until the hydraulic oil is warmed up. If you do not follow the proper warm up procedure, hydraulic pump damage may result.

1. Run the engine at approximately 1000 rpm for five minutes. Do not put load on the hydraulic system.
2. Cycle all hydraulic cylinders through their working range several times until the hydraulic functions operate normally.
3. The grader is now ready to operate under load.

CHAMPION MOTOR GRADERS

CIRCULATE TO:
PARTS MANAGER _____
SALES MANAGER _____
RETURN TO:
SERVICE MANAGER _____

10 August 1992

PRODUCT SUPPORT BULLETIN NO. 583

SUBJECT: New Clutch Master Cylinder Fluid

Champion Motor Graders no longer use DOT Brake Fluid in the clutch disengaging circuit beginning with S/N 22543 except for grader S/N 22548. The revised circuit uses **mineral based fluid** in the clutch master cylinder to disengage the clutch. Mineral based fluid is now used in the clutch master cylinder as well as the service brakes master cylinder.

Along with the fluid change, the following improvements will help you identify the new system:

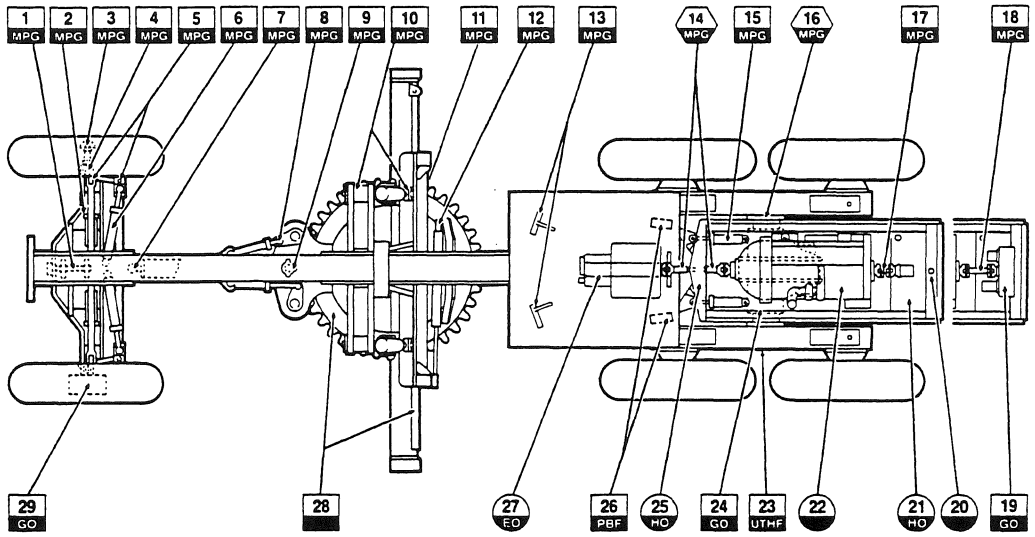
1. The clutch pedal effort is reduced by 50%.
2. The clutch pedal height reduced by 5cm (2.0"). This permits pressing the clutch pedal with the operators heel remaining on the cab floor.
3. The new slave cylinder has larger greaseable rod eyes, stronger rod guide, spring loaded lip seals and rubber bellows to keep contamination out.

When a positive identification of the mineral based fluid clutch master cylinder is made, use only a MINERAL based oil to replenish the reservoir. DO NOT USE DOT 3 BRAKE FLUID. In areas where temperatures never fall bellow -18°C or 0°F, use 10W hydraulic fluid. In areas where temperatures below -18°C are experienced, Champion specifies the following fluids for use in the clutch master cylinder:

-Champion P/N 58440 apply fluid
-Esso Univs N Arctic
-Shell Tellus T15
-Aero Shell Fluid 4

A copy of the lubrication chart reflecting the new clutch master cylinder fluid is printed on the back of this bulletin.

LUBRICATION CHART



MPG - Multi Purpose Grease
GO - Gear Oil
HO - Hydraulic Oil
PBF - Petroleum Base Fluid
UTHF - Universal Tractor Hydraulic Fluid
EO - Engine Oil
Check Daily
Check Weekly
Check Monthly

Champion recommends increasing the greasing frequency in extremely dusty or wet conditions, or if dry joints are apparent.

GREASE POINTS - MPG

1. **Pivot Pin** - Two fittings, weekly
2. **Leaning Wheel Cylinder** - Two fittings each side, weekly
3. **Wheel Bearings** - One fitting each side with EP2 grade only, weekly
4. **Knuckle Pivot Pin and King Pin** - Four fittings each side, weekly
5. **Drag Link/Pivot Block/Tie Bar** - **Standard** - Five fittings, weekly **Heavy Duty** - Nine fittings, weekly
6. **Steering Cylinder** - Two fittings each side, weekly
7. **Drawbar Ball Stud** - One fitting, weekly
8. **Circle Turn Cylinder and Crank** - Three fittings each side, weekly
9. **Circle Turn Valve** - One fitting, weekly
10. **Blade Lift System** - **Fixed Point** - Two fittings each side, weekly **Moveable Point** - Nine fittings, weekly
11. **Blade Tilt Cylinder/Tilt Quadrant** **Standard** - Two fittings each side, weekly **Heavy Duty** - Three fittings each side, weekly
12. **Circle Shift Cylinder** - One fitting each end, weekly
13. **Brake and Clutch Pedal Shafts** One fitting each shaft, weekly
14. **Upper and Lower Drive Shafts** Three fittings each shaft, monthly
15. **Articulation Cylinder** - Two fittings each side, weekly
16. **Tandem Sleeve Thrust Plate** - One fitting each side, monthly
17. **Hydraulic Pump Drive Shaft** - Two fittings, weekly
18. **A.W.D. Pump Drive Shaft** Three fittings, weekly

FLUID LEVELS & LUBRICANTS

19. **A.W.D. Pump Drive Gearbox** - GO - check level weekly
20. **Coolant** - See appropriate Engine Operation and Maintenance Manual - check level daily
21. **Hydraulic Oil Reservoir** - HO - check level daily
22. **Engine** - See appropriate Engine Operation and Maintenance Manual - check level daily
23. **Tandems** - UTHF - Suitable for wet disc brake applications - check level weekly
24. **Final Drives** - GO - check level weekly
25. **A.W.D. Hydraulic Reservoir** - HO - check level daily
26. **Oil Disc Brake & Clutch Reservoir** - PBF - check level weekly

⚠WARNING

INCORRECT FLUID WILL CAUSE BRAKE FAILURE. SEVERE PERSONAL INJURY OR DEATH COULD RESULT

27. **Transmission** - EO - check level daily - warm oil at idle and transmission in neutral
28. **Circle Top; Clamp and Guide Bearing Surfaces; Moldboard Upper and Lower Slide Rails** Every week or more often as required, wash with diesel fuel - lubricate with:
    1) Diesel fuel, or
    2) A light coating of Champion graphite spray, P/N 300CL moistened with diesel fuel, or
    3) A light coating of MPG
    Keep these bearing surfaces clean.
29. **A.W.D. Planetary Hub** - GO - check level weekly

Refer to 700 SERIES GRADER Operator's Manual for detailed information

LUBRICANT SPECIFICATIONS

AIR TEMPERATURE RANGE DURING FILL PERIOD	°C -40 -30 -20 -10 0 10 20 30 40 50 °F -40 -22 -4 14 32 50 68 86 104 122
HO - Hydraulic Oil	SAE 10W ISO Grade 32 Dexron • II ATF
UTHF - Universal Tractor Hydraulic Fluid Suitable for wet disc brake applications	SAE 10W ISO Grade 32 SAE 20W ISO Grade 51
GO - Hypoid Gear Oil API GL-5 MIL-L-2105C	SAE 85W 140 SAE 80W-90 SAE 75W 90
MPG - Multi Purpose Grease, Extreme Pressure, Lithium Soap Base	NLGI EP0 or EP1 NLGI EP2 NLGI EP2 FRONT WHEEL BEARINGS
EO - Engine Oil - Transmission (for Engine refer to Cummins Engine Manual) Premium Quality Motor Oil - API CD/CE Qualified to Allison C3 and TO-2 Specifications	SAE 30 SAE 10W SAE 5W 20 SAE 0W 30
PBF - Petroleum Base Fluid OIL DISC BRAKES & CLUTCH	Shell Aeroshell Fluid 4 Shell Tellus T15 Esso Univis N Arctic

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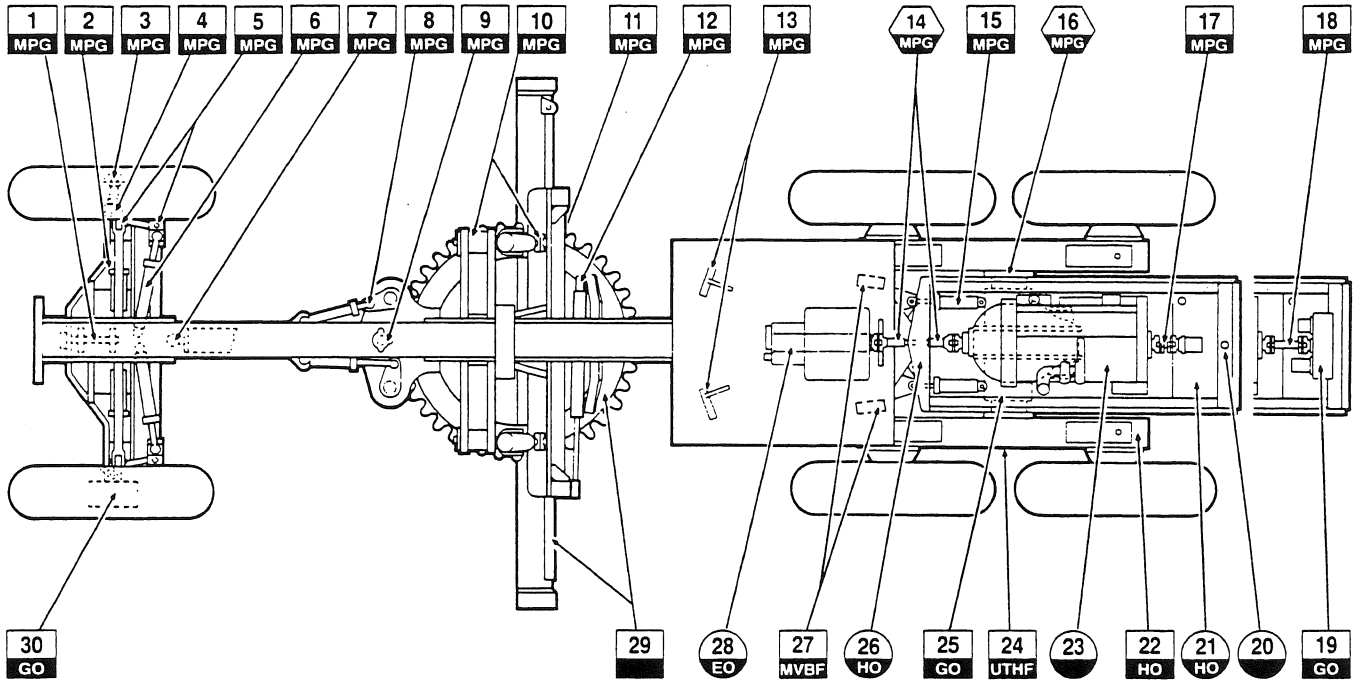
700 Series Lubrication Chart



MPG - Multi-Purpose Grease	**MVBF** - Motor Vehicle Brake Fluid	Check Daily	Check Monthly
GO - Gear Oil	**UTHF** - Universal Tractor Hydraulic Fluid	Check Weekly	
HO - Hydraulic Oil	**EO** - Engine Oil		

Key to Lubrication Points

GREASE POINTS - MPG

1. **Pivot Pin** - Two fittings, weekly
2. **Leaning Wheel Cylinder** - Two fittings each side, weekly
3. **Wheel Bearings** - One fitting each side with EP2 grade only, weekly
4. **Knuckle Pivot Pin and King Pin** - Four fittings each side, weekly
5. **Drag Link/Pivot Block/Tie Bar** - **Standard** - Five fittings, weekly **Heavy Duty** - Nine fittings, weekly
6. **Steering Cylinder** - Two fittings each side, weekly
7. **Drawbar Ball Stud** - One fitting, weekly
8. **Circle Turn Cylinder and Crank** - Three fittings each side, weekly
9. **Circle Turn Valve** - One fitting, weekly
10. **Blade Lift System - Fixed Point** - Two fittings each side, weekly **Moveable Point** - Nine fittings, weekly
11. **Blade Tilt Cylinder/Tilt Quadrant or Manual Link** - **Standard** - Two fittings each side, weekly **Heavy Duty** - Three fittings each side, weekly
12. **Circle Shift Cylinder** - One fitting each end, weekly
13. **Brake and Clutch Pedal Shafts** One fitting each, weekly
14. **Upper and Lower Drive Shafts** Three fittings each shaft, monthly
15. **Articulation Cylinder** - Two fittings each side, weekly
16. **Tandem Sleeve Thrust Plate** - One fitting each side, monthly
17. **Hydraulic Pump Drive Shaft** - Two fittings, weekly
18. **A.W.D. Pump Drive Shaft** Three fittings, weekly

FLUID LEVELS & LUBRICANTS

19. **A.W.D. Pump Drive Gearbox** GO - check level weekly
20. **Coolant** - See appropriate Engine Operation and Maintenance Manual - check level daily
21. **Hydraulic Oil Reservoir** - HO - check level daily
22. **Tandems** - HO - All models with drum brakes - check level weekly
23. **Engine** - See appropriate Engine Operation and Maintenance Manual - check level daily
24. **Tandems** - UTHF - All models with oil disc brakes (wet brakes) - check level weekly
25. **Final Drives** - GO - check level weekly
26. **A.W.D. Hydraulic Reservoir** - HO check level daily
27. **Drum Brake and Clutch Reservoirs** MVBF - check level weekly
28. **Transmission** - EO - check level daily - warm oil at idle and transmission in neutral
29. **Circle Top; Clamp and Guide Bearing Surfaces; Moldboard Upper and Lower Slide Rails** Every week or more often as required, wash with diesel fuel - lubricate with:
    1) Diesel fuel, or
    2) A light coating of Champion graphite spray, P/N 300CL moistened with diesel fuel, or
    3) A light coating of MPG

    Keep these bearing surfaces clean.
30. **A.W.D. Planetary Hub** - GO - check level weekly

Champion recommends increasing the greasing frequency in extremely dusty or wet conditions; also if dry joints are apparent.

Special Tools

Champion recommends the use of the following special tools. Order from your Champion Distributor.

Assembly	Section Ref. No.	Tool P/N and Description
Front Axle	1	18516 - Socket wrench - wheel 37116 - Installation drift - steering and leaning wheel cylinders and the tie bar bearings 37117 - Installation drift - pivot block bearing cups 37118 - Installation drift - radius arm bearing cones
Engine Clutches	7	5629 - Clutch Repair Pilot Shaft 45567 - Rivet Tool - Long solid anvil
8400 Transmission	8	29858 - Bearing shim tool 29859 - Deep-reach socket wrench
Lock/Unlock Differential Final Drive	10	18511 18512 — Outer bushing installation tools 18512 18513 — Inner bushing installation tools 43004 - Deep-reach socket wrench 45006 - Shift rail oil seal installation tool 45007 - Drive axle and bearing assembly installation drift
Standard Double Reduction Final Drive	11	18504 - Spiral pinion shaft bearing outer race removal tool 18505 - Spiral pinion shaft bearing cone installation tool 18507 18508 18509 18510 — Pinion cap bearing cup installation tools 18511 18512 — Outer bushing installation tools 18512 18513 — Inner bushing installation tools 33174 - Bull gear bearing outer race installation tool 43004 - Deep-reach socket wrench 45261 - Spiral pinion shaft bearing race installation tool 45294 - Spiral pinion shaft depth setting gauge
Standard Brakes and Tandems	12	377 - Brake adjusting wrench 5726 - Rear wheel puller plate 5727 - Rear wheel puller screw
Oil Disc Brakes and Tandems	13	5726 - Rear wheel puller plate 5727 - Rear wheel puller screw

SECTION 1
FRONT AXLE

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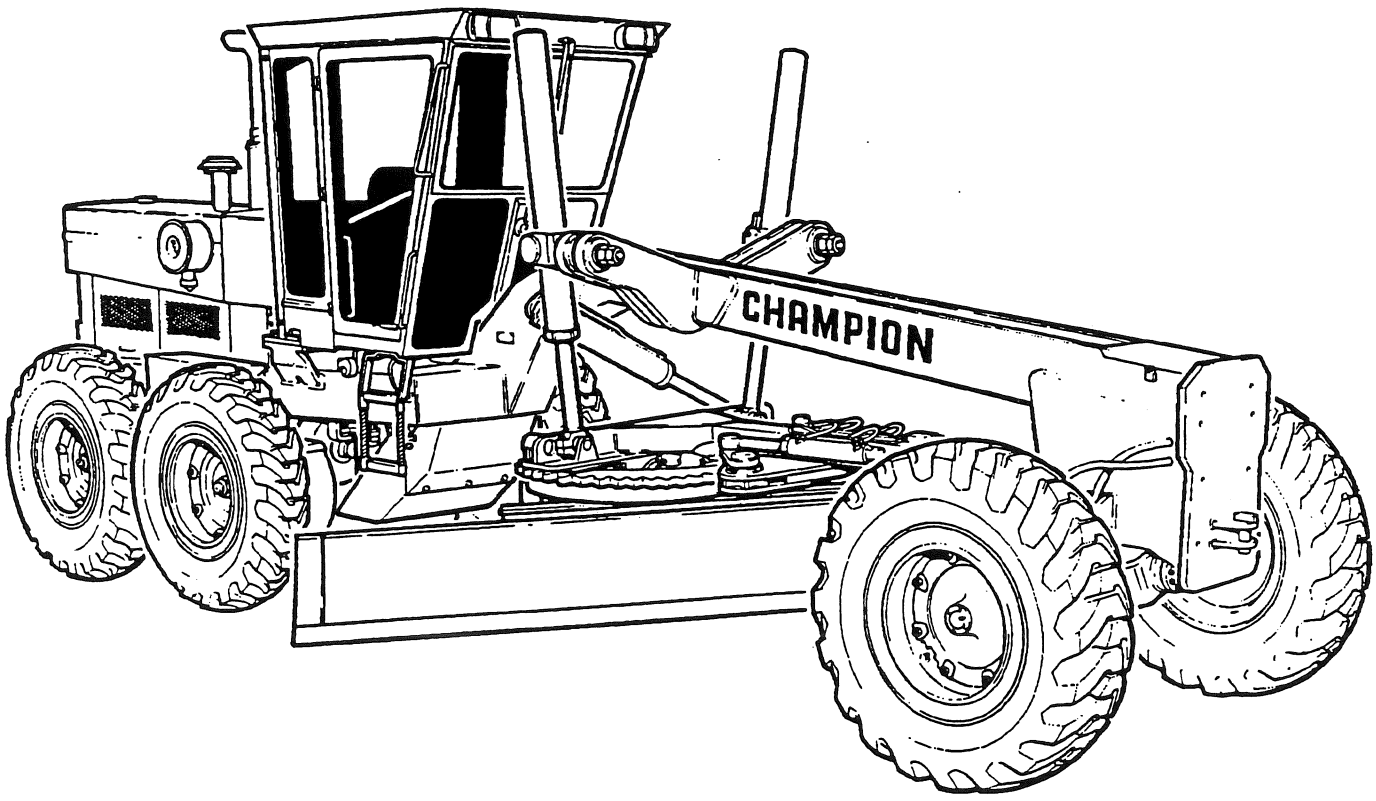

FRONT AXLE

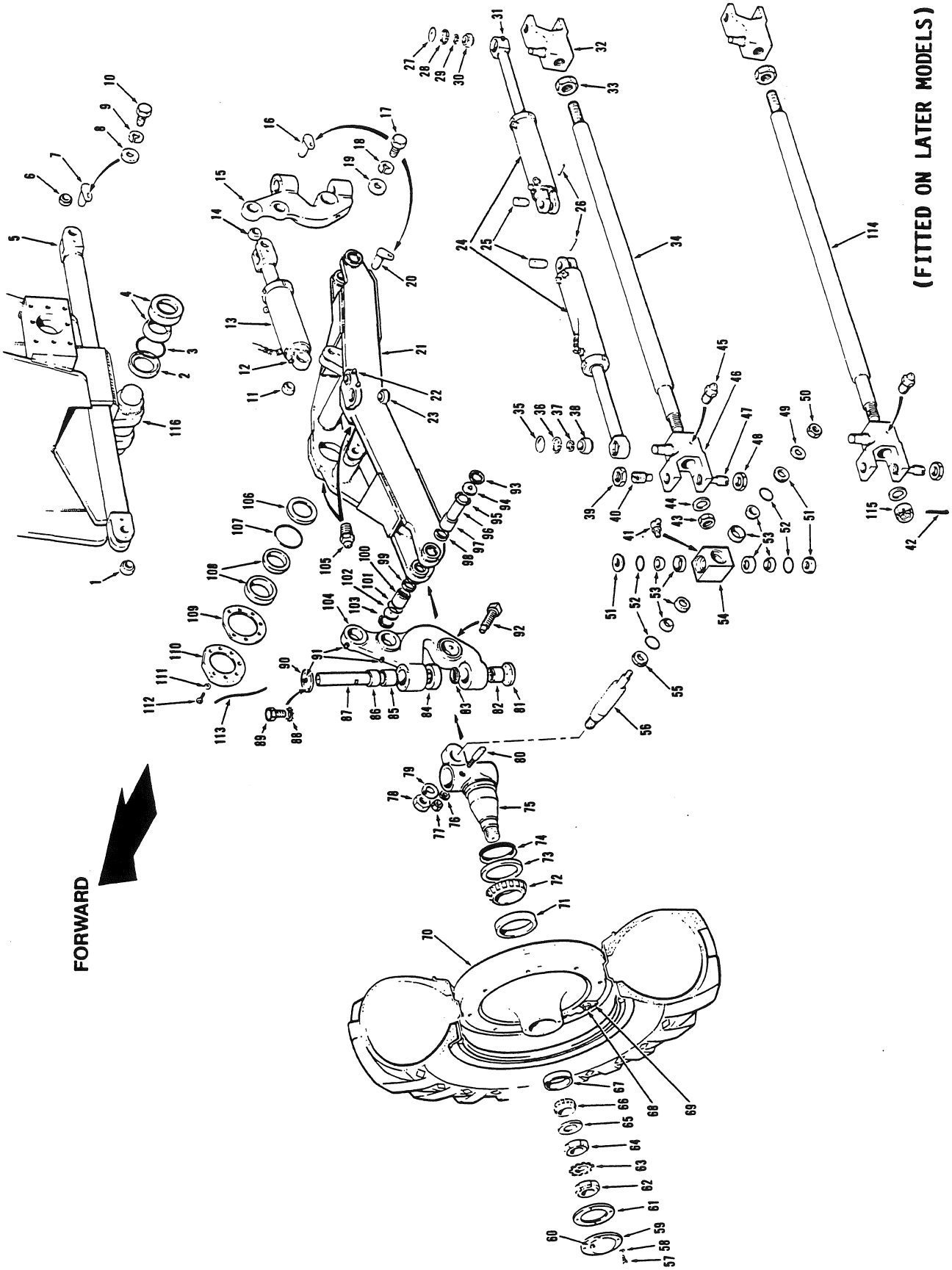

Fig. 1

Item	Description	Item	Description	Item	Description
1	Radial spherical brg.	40	Adjustment pin	79	Lockwasher
2	Back-up washer	41	Grease fitting	80	Key pin
3	O-ring	42	Cotter pin	81	Pin cap
4	Thrust bearing	43	Locknut	82	Needle bearing
5	Tie bar	44	Washer	83	Oil seal
6	Radial spherical brg.	45	Grease fitting	84	Thrust bearing
7	Bearing pin	46	Yoke - L.H.	85	Needle bearing
8	Flatwasher	47	Adjustment pin	86	Needle bearing
9	Lockwasher	48	Hex. jam nut	87	King pin
10	Hex. head capscrew	49	Flatwasher	88	Starwasher
11	Radial spherical brg.	50	Locknut	89	Machine screw
12	Grease fitting	51	Bearing retainer	90	Pin cap
13	Leaning wheel cylinder	52	O-ring	91	Grease fittings
14	Radial spherical brg.	53	Angular contact bearing	92	Set screw
15	Knuckle - R.H.	54	Pivot block	93	Snap ring
16	Bearing pin	55	Bearing retainer	94	Pin cap
17	Hex. head capscrews	56	Radius arm	95	O-ring
18	Lockwasher	57	Hex. head capscrews	96	Pivot pin
19	Flatwasher	58	Lockwasher	97	Needle bearing
20	Bearing pin	59	Hub cap	98	Oil seal
21	Axle frame	60	Grease fitting	99	Oil seal
22	Grease fitting	61	Gasket	100	Needle bearing
23	Radial bearing	62	Locknut - outer	101	O-ring
24	Steering cylinders	63	Lockwasher	102	Pin cap
25	Pivot pins	64	Locknut - inner	103	Snap ring
26	Roll pins	65	Washer - wheel bearing	104	Knuckle - L.H.
27	Expansion plug	66	Cone - outer bearing	105	Grease fittings
28	Snap ring	67	Cup - outer bearing	106	Back-up washer
29	Snap ring	68	Wheel nut	107	O-ring
30	Radial bearing	69	Rim clamps	108	Thrust bearing
31	Grease fitting	70	Front wheel	109	Shims
32	Yoke - R.H.	71	Cup - inner bearing	110	Pivot cap - Axle
33	Hex. jam nut	72	Cone - inner bearing	111	Lockwasher
34	Drag link	73	Back-up ring	112	Hex. head capscrews
35	Expansion plug	74	V ring seal	113	Lockwire
36	Snap ring	75	Spindle - L.H.	114	Drag link
37	Snap ring	76	Lockwasher	115	Castellated hex. nut
38	Radial bearing	77	Hex. nut	116	Axle pivot pin
39	Hex. jam nut	78	Hex. nut		

Key to Fig. 1

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General

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chances of foreign matter entering the front axle components causing damage. For a complete overhaul you will require a suitable lifting device, blocks and safety stands, four different installation drifts and a jack.

Discard all oil seals, O rings, snap rings, and gaskets. Inspect all bearings for signs of wear or damage. Clean all useable bearings and machined surfaces to remove old lubricant and foreign matter. Inspect the hydraulic cylinders for leaks or damage. A damaged scraper ring may score a cylinder rod, faulty O-rings will cause cylinder leakage. Refer to the 700 Series Parts Manual when ordering replacement parts. Refer to Lubrication Specifications detailed in the front of this manual for the recommended hydraulic oil and grease lubricants.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH ADEQUATE STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances appear in Metric (SI), Imperial and U.S. quantities. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

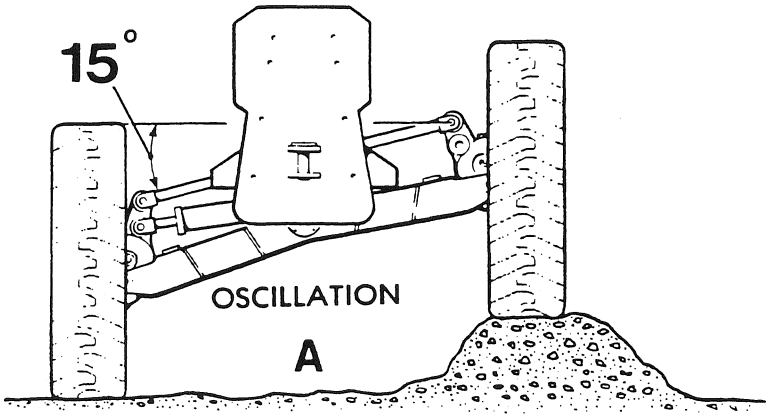
Description and Operation

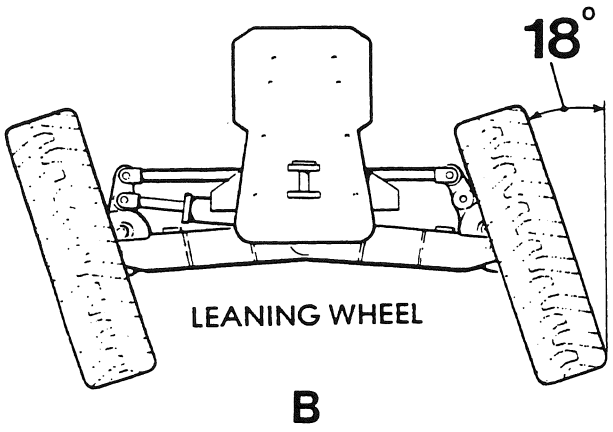
The major components of the front axle include the axle frame, leaning wheel knuckle and spindle assemblies, associated linkages and hydraulic cylinders. These components interact to perform the oscillation, wheel lean and steering functions.

The axle assembly is mounted to the main frame of the grader through the axle pivot and bearings. This design allows the axle to oscillate 15° from a level position (Fig. 2-A). The oscillating axle permits the front wheels to travel over uneven surfaces while transferring a minimum of motion to the main frame.

Wheel lean is achieved by one or two hydraulic cylinders acting on the leaning wheel knuckles. The knuckles are connected by a tie bar which ensures that knuckle movement is synchronized. The front wheels can lean a maximum of 18° to either side of a position perpendicular to the axle frame (Fig. 2-B). Front wheel lean may be used to offset loads on the moldboard, to decrease the turning radius of the machine and to improve stability when traversing a grade by maintaining the wheels in a vertical position.

The steering system is fully hydraulic. Twin steering cylinders act on the drag link assembly causing the spindles to pivot simultaneously (Fig. 2-C). Hydraulic flow is directed to the cylinders by the steering control unit operated by the steering wheel.





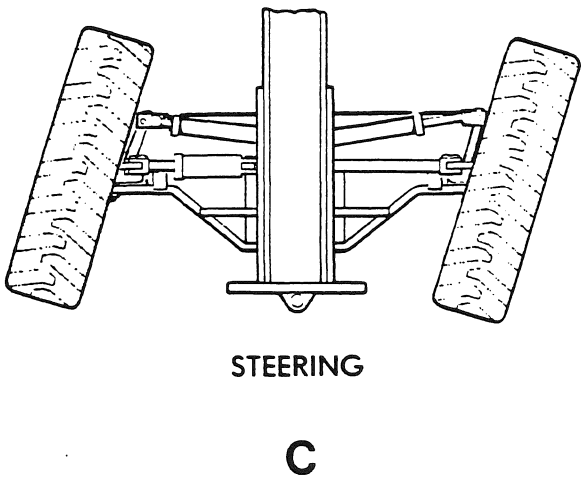


Fig. 2

Cleaning and Inspection

Cleaning - General

WARNING

ALKALI CLEANING SOLVENTS AND VAPORS ARE EXTREMELY HARMFUL AND CAN CAUSE SERIOUS INJURY TO EYES, LUNGS AND SKIN. ALWAYS WEAR PROTECTIVE CLOTHING, GOGGLES AND RESPIRATOR. USE UTMOST CARE WHEN HANDLING CHEMICALS.

CAUTION

YOU ARE RECOMMENDED TO WEAR COTTON GLOVES WHEN HANDLING BEARINGS. THIS PREVENTS SKIN ACIDS AND PERSPIRATION CONTAMINATING THE RACES AND ROLLING ELEMENTS.

Immerse small parts and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

Cleaning - Bearings

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning and Inspection (continued)

Inspection - Oil Seals, O-Rings and Snap Rings

Replace all oil seals, O-rings and snap rings. Lubricant loss through a worn seal can cause parts to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Apply a thin coating of sealant, Champion part number **19200** onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O-rings before installation.

Torque Guide

Application	Torque Value		
	N.m	**kgf.m**	**lbf.ft**
Rim Clamp Nuts	203	21	150
Spindle Outer Locknut	271 to 305	28 to 31	200 to 225

Special Tools

The following tools are recommended when overhauling the front axle. The tools help you to remove and install precision-machined parts.

Part Number	Description
18516	Socket wrench - wheel bearing locknut
37116	Installation drift - steering and leaning wheel cylinders and the tie bar bearings
37117	Installation drift - pivot block bearing cups
37118	Installation drift - radius arm bearing cones

Troubleshooting

Problem	Cause	Remedy
Excessive tire wear.	Incorrect toe-in adjustment.	Adjust toe-in.
	Physical damage.	Inspect the axle for physical damage, such as a bent tie rod or worn spindle and knuckle bearings. Repair or replace defective components as necessary.
Wheel shimmy.	Incorrect wheel bearing tension.	Disassemble and inspect the wheel bearing for wear or damage. Adjust the wheel bearing tension.
	Incorrect bearing tension in the pivot block.	Disassemble and inspect the pivot block bearings for wear or damage. Adjust the bearing tension in the pivot block.
	Loose yoke on drag link.	Inspect the left hand yoke and tighten the locknuts if necessary.
	Loose radius arm.	Inspect the radius arms and tighten the locknuts if necessary.
	Worn or damaged bearings in the knuckle or spindle.	Disassemble and inspect the knuckle and kingpin bearings for wear or damage. Replace bearings if necessary.

Troubleshooting (continued)

Problem	Cause	Remedy
Wheel shimmy (cont'd)	Steering system malfunction	Refer to hydraulics section for possible hydraulic malfunction.
Wheels lean when the machine is not in operation.	Worn seal components in the leaning wheel cylinder(s).	Disassemble and inspect the cylinders for worn or damaged components. Replace defective components as necessary.
	Malfunction in the counterbalance valve.	Disassemble and inspect the counterbalance valve for wear or damage. Repair or replace the valve as necessary.
Wheels will not lean.	Physical damage.	Inspect the axle frame, knuckle pivot pin and related components for physical damage. Repair or replace defective components.
	Leaning wheel system malfunction.	Refer to hydraulics section for possible hydrualic malfunction.
Front end bounce.	Incorrect tire inflation	Inflate tires to the correct pressure (see Operator's Manual).
	Incorrect rim installation.	Loosen the wheelnuts and retighten them in a diagonal pattern to the recommended torque.

Disassembly

WARNING

DO NOT WORK ON A MACHINE SUPPORTED ONLY BY THE MOLDBOARD OR BY INADEQUATE STANDS OR BLOCKS. HYDRAULIC FAILURE UNDER THESE CONDITIONS CAN RESULT IN PROPERTY DAMAGE AND PERSONAL INJURY.

Fig. 3
Begin disassembly by loosening the rim clamp nuts (68) on the wheel (70).

Fig. 4
Operate the moldboard to lift the front wheels off the ground. Lower the grader onto a stand under the front plate. Ensure that the tires are just touching the ground. Then remove the nuts (68), clamps (69) and remove the tire and rim, being careful of the axle, it may pivot upwards.

Fig. 5
Attach a safety lifting device to a wheel stud. Then, remove the capscrews (57), washers (58) and hubcaps (59). Discard the gasket (61).

NOTE

Disassembly and reassembly for the left and right-hand components of the front axle will be the same unless otherwise noted.

Fig. 6
Using a hammer and drift, bend back the tabs on the lockwasher (63). Remove the outer locknut (62), lockwasher (63), inner locknut (64) and the wheel bearing washer (65). Pull the wheel out slightly on the spindle and remove the outer bearing cone (66). Remove the wheel (70) from the spindle (75), being careful of the axle, it may pivot upwards.

Fig. 7
From the wheel, remove the back-up ring (73) and the inner bearing cone (72). Discard the back-up ring.

Fig. 8
Using a hammer and a drift, remove the inner (71) and outer bearing cup (67). Remove the old grease, clean and inspect the wheel for signs of damage and wear.

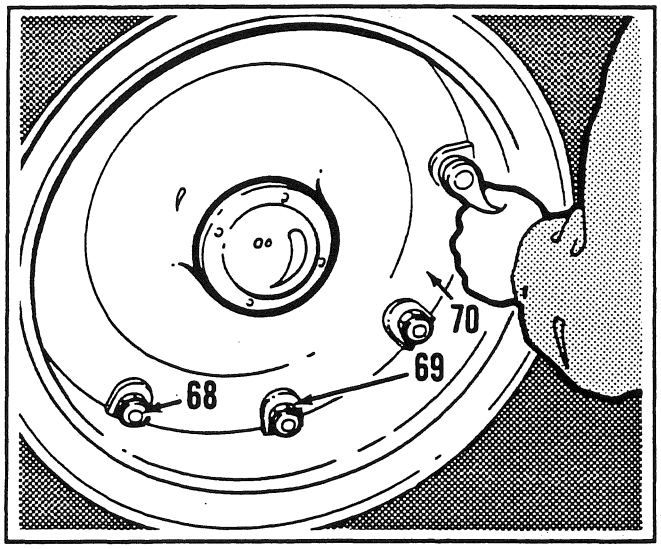


Fig. 3

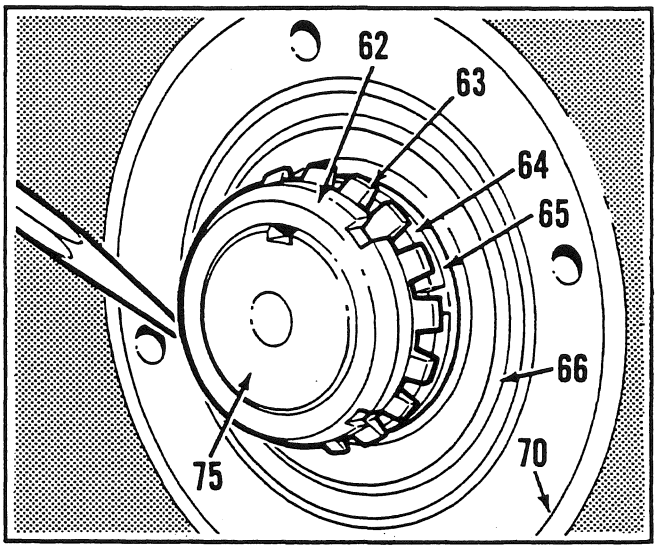


Fig. 6

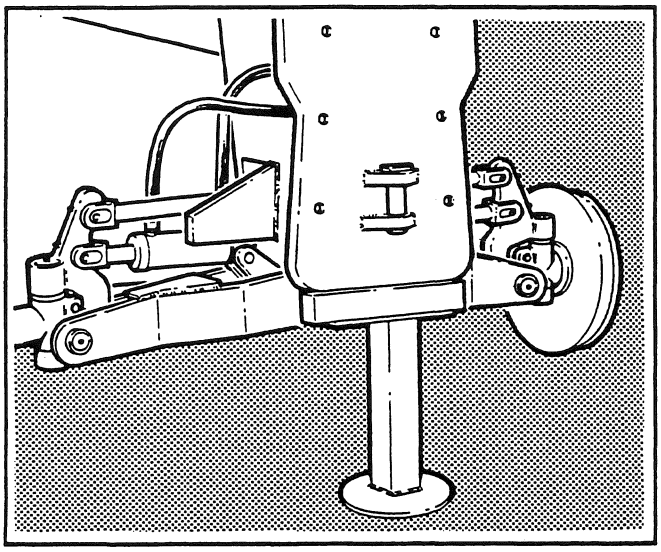


Fig. 4

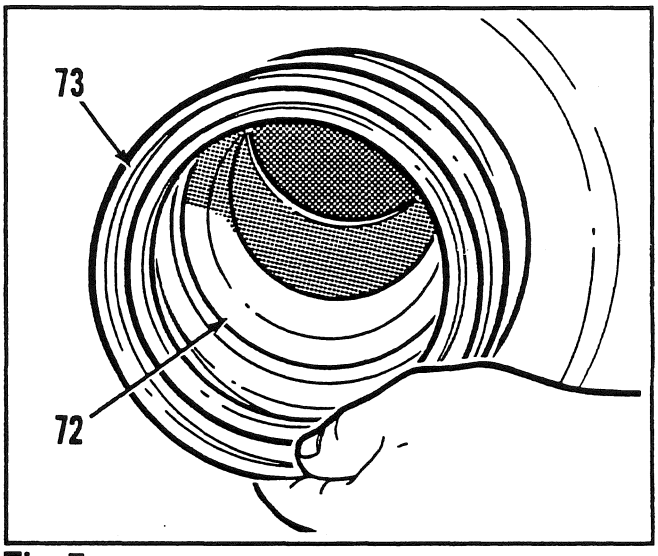


Fig. 7

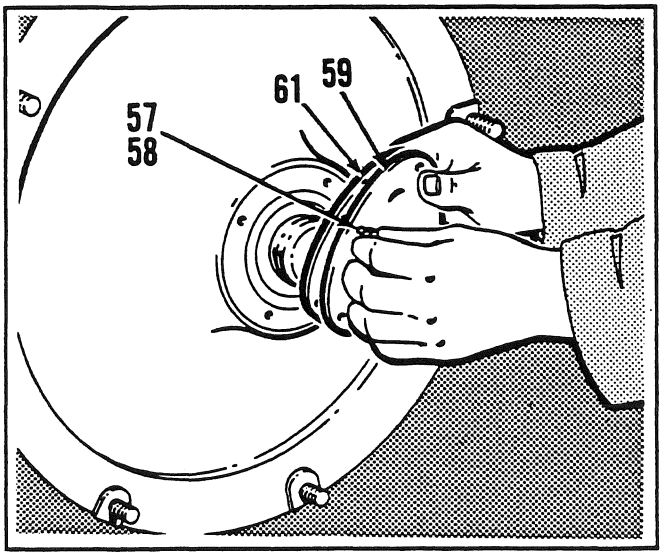


Fig. 5

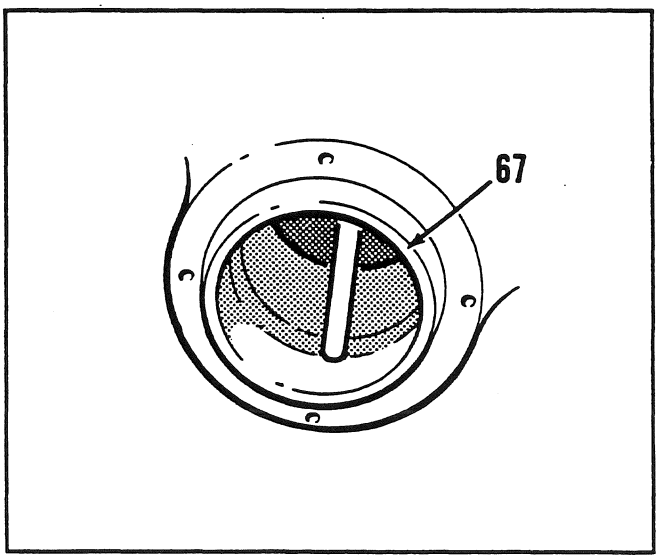


Fig. 8

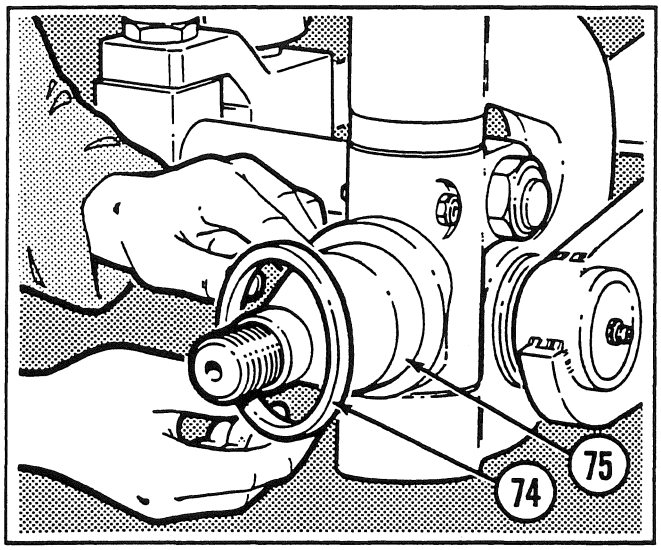


Fig. 9

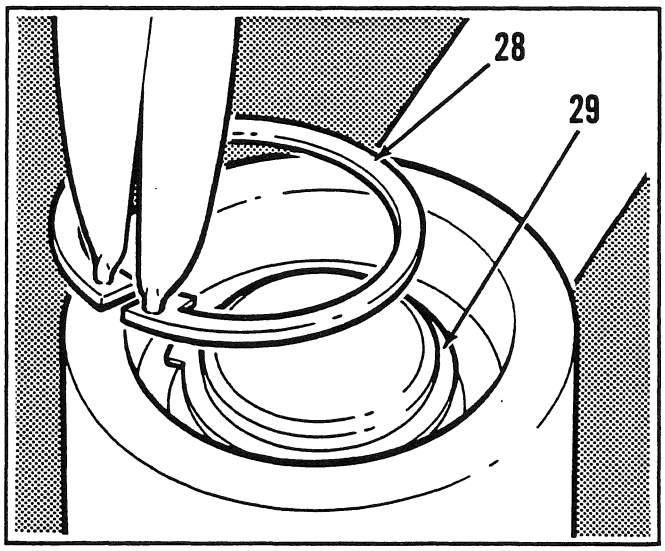


Fig. 12

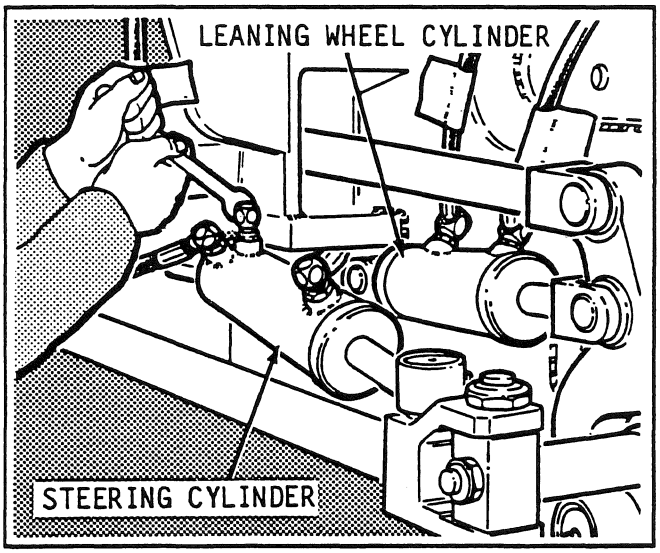


Fig. 10

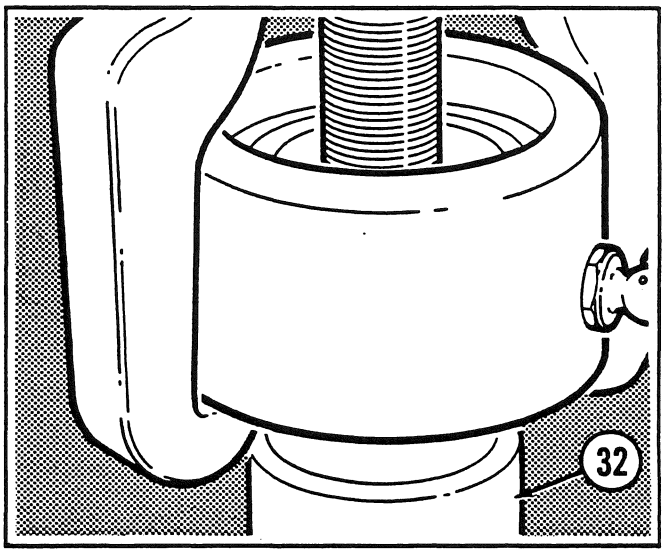


Fig. 13

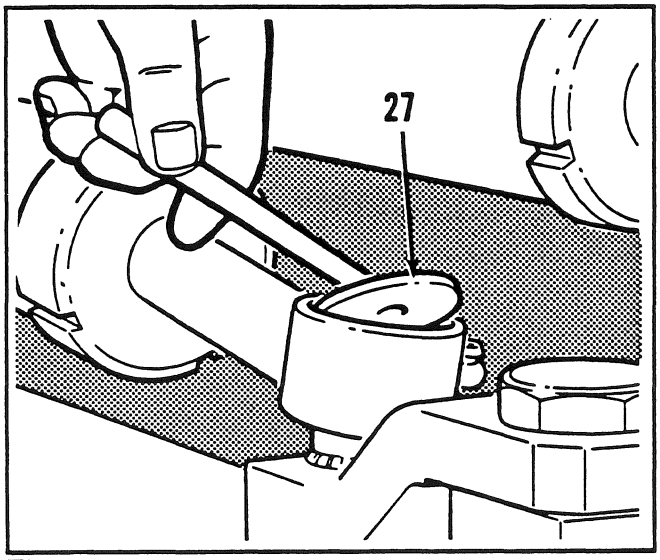


Fig. 11

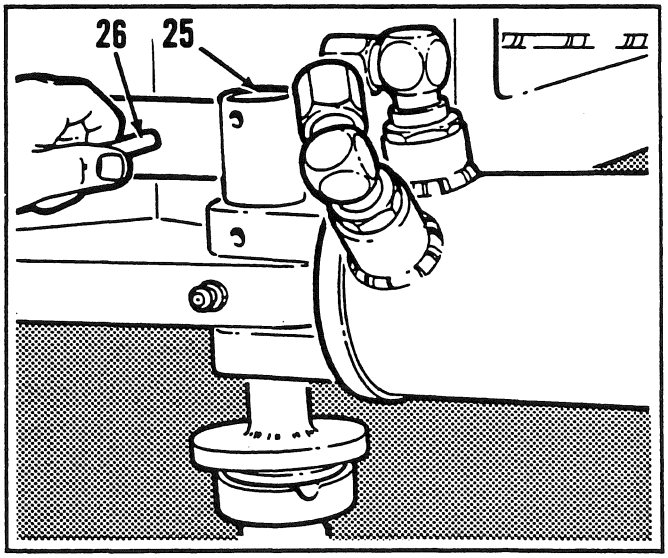


Fig. 14

Disassembly (continued)

Fig. 9
Remove and discard the V-ring seal (74) from the spindle (75).

Fig. 10

WARNING

WEAR EYE PROTECTION WHEN DISCONNECTING HOSES. RESIDUAL PRESSURE MAY REMAIN IN THE HYDRAULIC SYSTEM CAUSED BY THE LOCK VALVE.

To avoid confusion during reassembly, identify the hydraulic hoses for the leaning (13) and steering cylinders (24) and disconnect the hoses from the cylinders.

NOTE

Cap or plug all hoses and fittings to prevent contamination of the hydraulic system.

Fig. 11
To remove the steering cylinder, remove and discard the expansion plug (27) at the rod end.

Fig. 12
Remove and discard the two snap rings (28), (29) found at the rod end of the steering cylinder.

Fig. 13
Using a puller, remove the rod end of the steering cylinder from the pivot stud of the yoke (32).

Fig. 14
At the base end of the steering cylinder, remove the roll pin (26) from the pivot pin (25). Using a jack to force the pivot pin (25) up and out of the anchor lug, you then can remove the cylinder and place it on a clean work bench.

Disassembly (continued)

Fig. 15
Remove the radial bearing (30) from the rod end. Note the lip in the bottom of the bore of the rod end which permits removal and installation from one direction. Examine the bearing for signs of damage or wear.

Fig. 16
To remove the drag link, support the drag link with a lifting device. Remove the nuts (50) retaining the pivot blocks (54) to the radius arms (56).

Fig. 17
Remove the flatwasher (49), bearing retainer (51), and O-ring (52).

Fig. 18
Pull the pivot blocks (54) from the radius arms (56) and remove the outer contact bearing (53). The opposite contact bearing (53) and bearing retainer (51) will remain on the radius arm.

Fig. 19
Lift the drag link (34) away from the axle and place it on the workbench. Secure the right hand yoke (32) in a vise and remove both the top (39) and bottom jam nuts (48).

Fig. 20
Unscrew both the adjuster pins (40), (47) and remove the pivot block.

NOTE

Repeat these procedures to remove the pivot block from the left hand yoke.

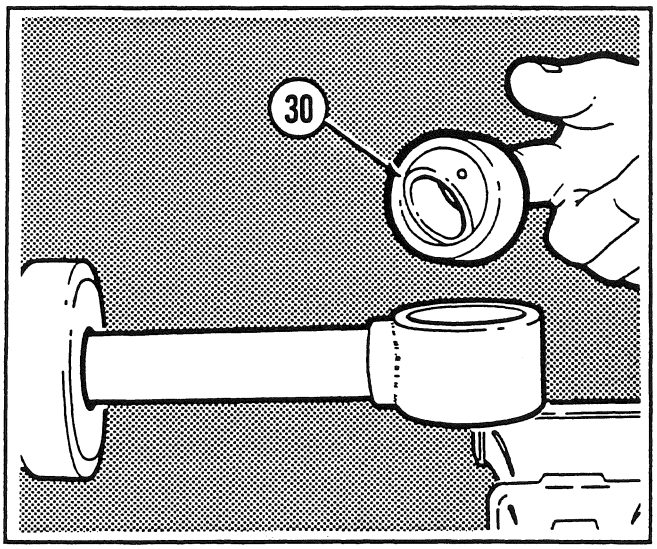


Fig. 15

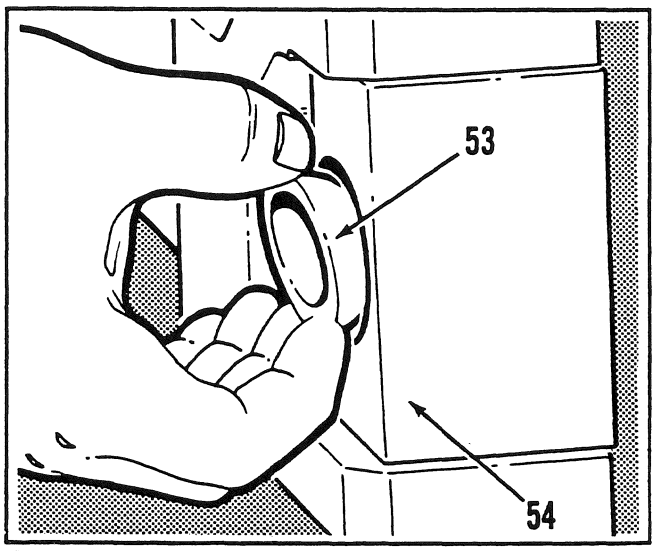


Fig. 18

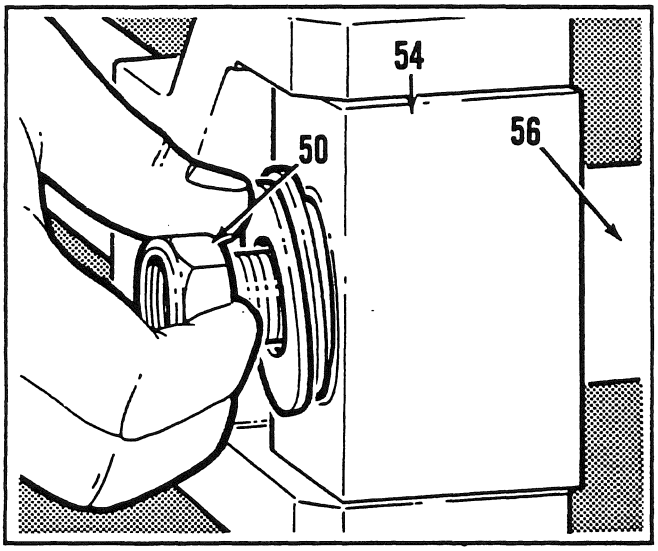


Fig. 16

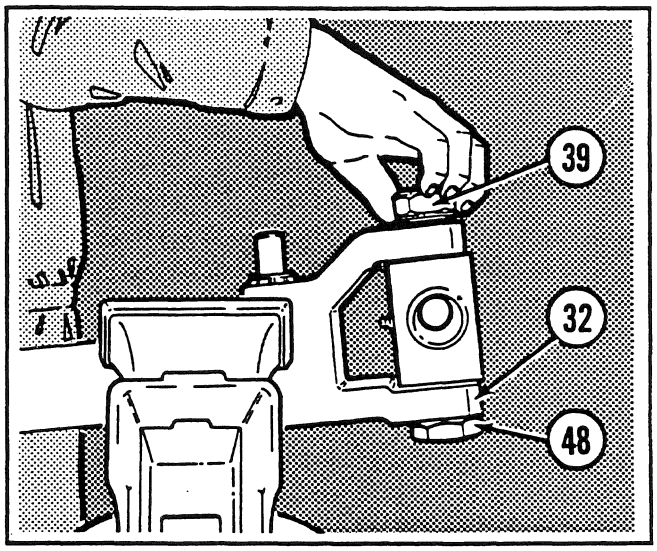


Fig. 19

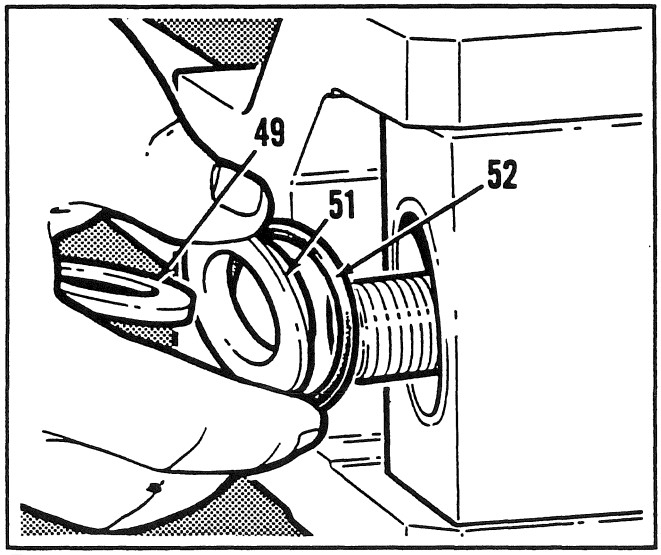


Fig. 17

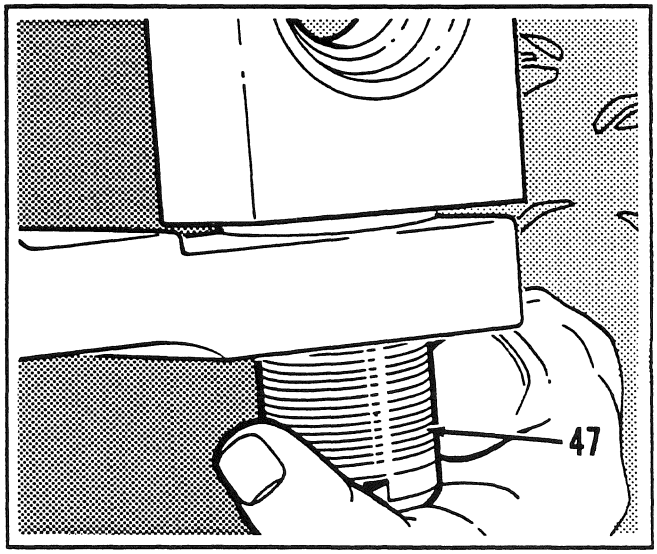
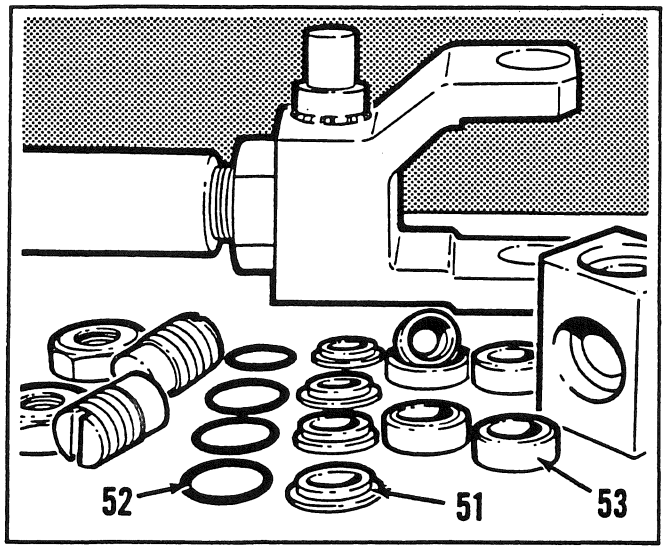


Fig. 20



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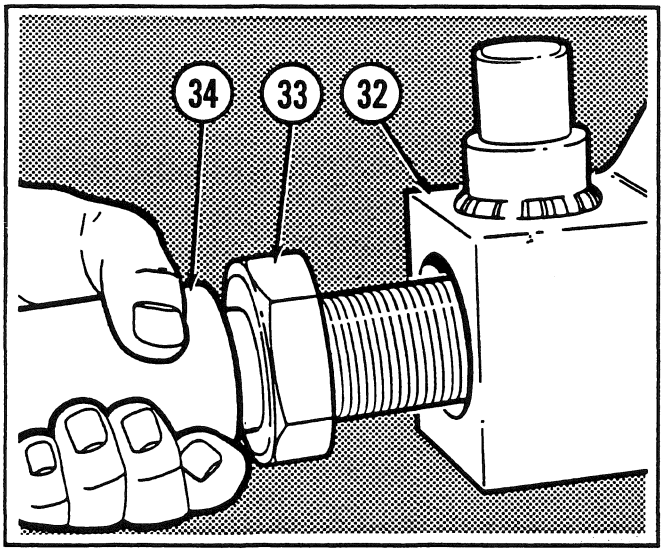

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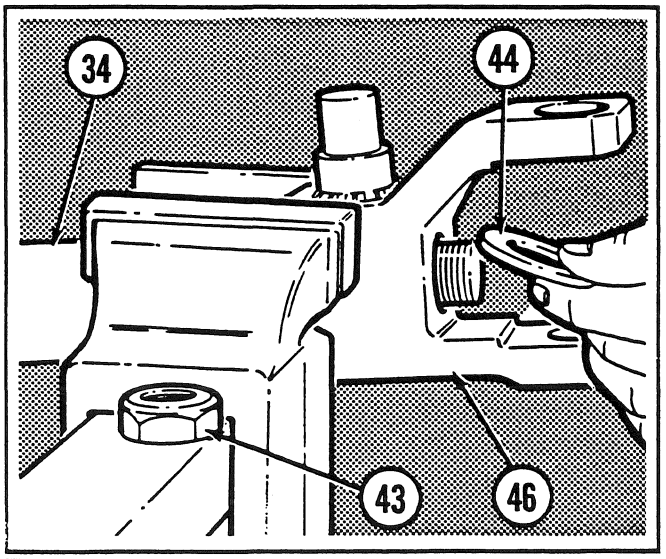


Fig. 23

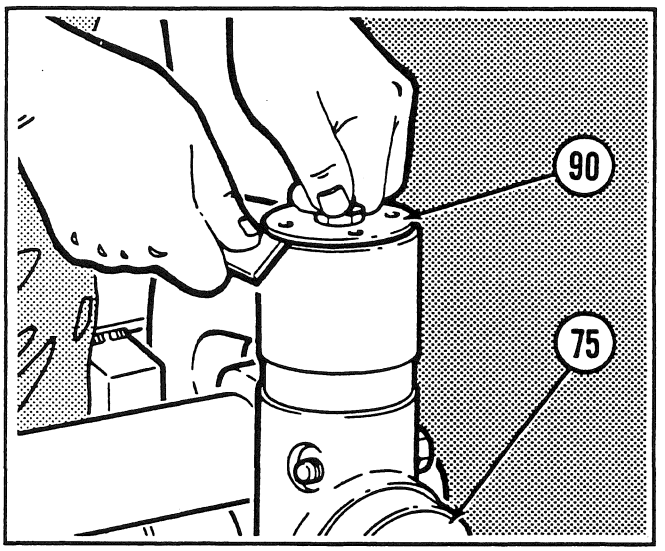


Fig. 24

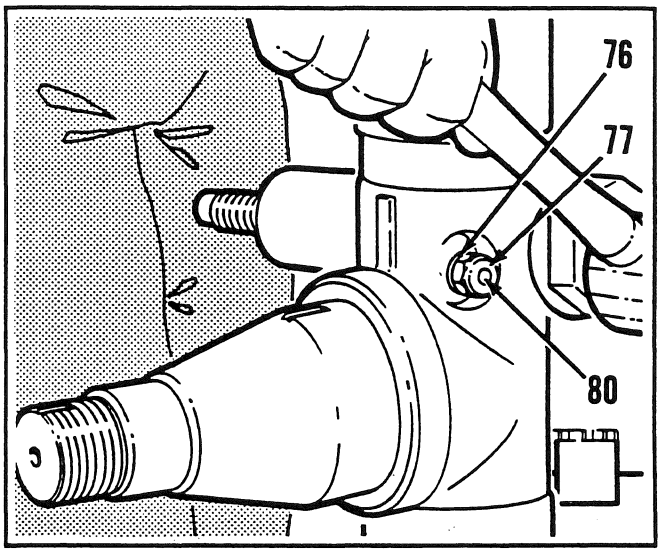


Fig. 25

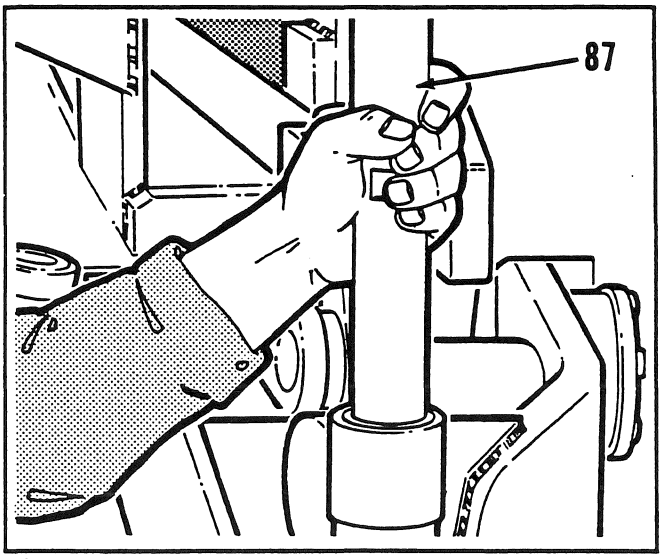


Fig. 26

Disassembly (continued)

Fig. 21
To disassemble the pivot blocks, remove the bearing retainers (51), remove and discard the O-rings (52), remove the angular contact bearings (53). Remove the contact bearing cups (53) pressed into the pivot block by using a hammer and small drift.

NOTE

Clean and inspect the pivot block and all pivot block components. Replace any parts that show signs of damage or wear. Discard all O-rings.

Fig. 22
Place the right hand yoke (32) in a vise and loosen the lock nut (33). Unscrew the drag link (34) from the yoke (32).

Fig. 23
Place the left hand yoke (46) in a vise and remove the lock nut (43) and flatwasher (44). Pull the drag link (34) out of the yoke (46).

NOTE

On later models the drag link is secured by a castellated hex. nut and a cotter pin.

Fig. 24
To remove the spindle (75) from the axle, remove the upper (90) and lower king pin caps (81).

Fig. 25
Back off the nut (77) retaining the key pin (80), strike the nut with a soft faced hammer to loosen the key pin. Remove the nut, lockwasher (76) and pull out the key pin.

Fig. 26
Using a jack and a drift, press out the king pin (87). Place the king pin (87) in a freezer or dry ice. Freezing will make reinstallation of the king pin much easier.

Disassembly (continued)

Fig. 27
Remove the spindle assembly (75) and thrust bearing (84).

Fig. 28
Place the spindle assembly in a vise and back off the nut (78) and lockwasher (79). Strike the nut to force the tapered end of the radius arm from the spindle (75). When the radius arm is loose, remove the nut, lockwasher and the radius arm (56).

Fig. 29
Reinstall the nut (50) onto the end of the radius arm to protect the threads. Use a bearing puller to press off the bearing retainer. Remove the nut, angular contact bearing cone (53) and retainer (55).

Fig. 30
To disconnect the tie bar (5), support the steering knuckle (104) and remove the hex. head capscrews (10), lockwasher (9), flatwasher (8) retaining the bearing pins (7). Force the pins out with a hammer and drift.

NOTE

Repeat these procedures to remove the bearing pins from both ends of the leaning wheel cylinder (13).

Fig. 31
Remove the cylinder from the axle and place it on a workbench. Using a hammer and a drift, remove the radial spherical bearing (30) from the leaning wheel cylinder base end.

Fig. 32
Using a hammer and a drift, remove the two needle bearings (85), (86) from the top of the steering knuckle (104).

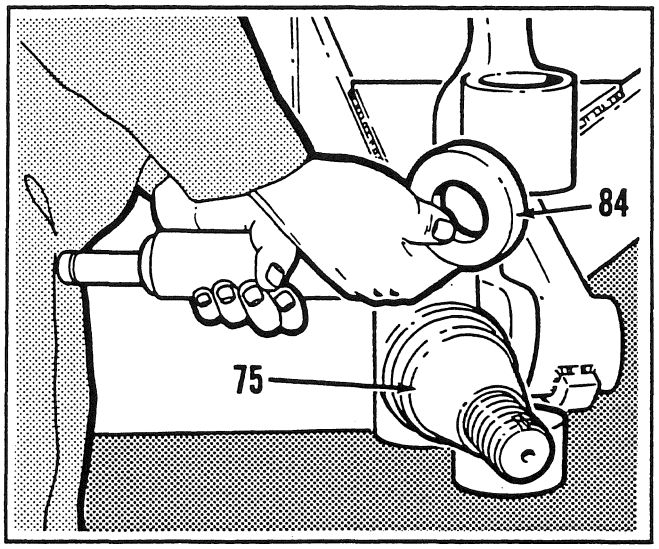


Fig. 27

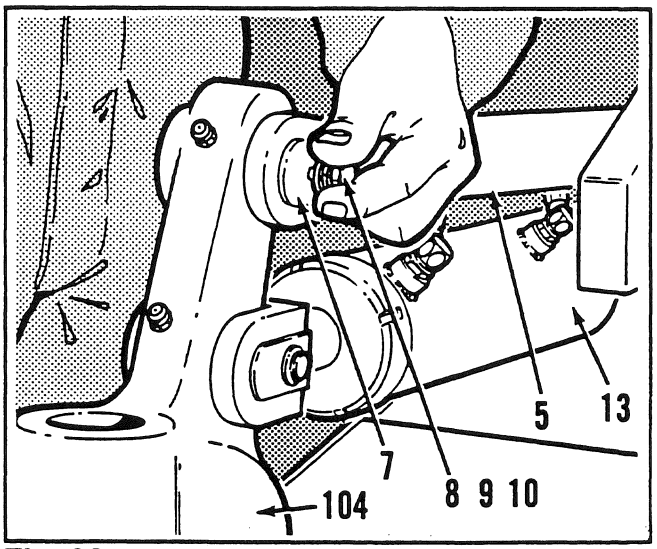


Fig. 30

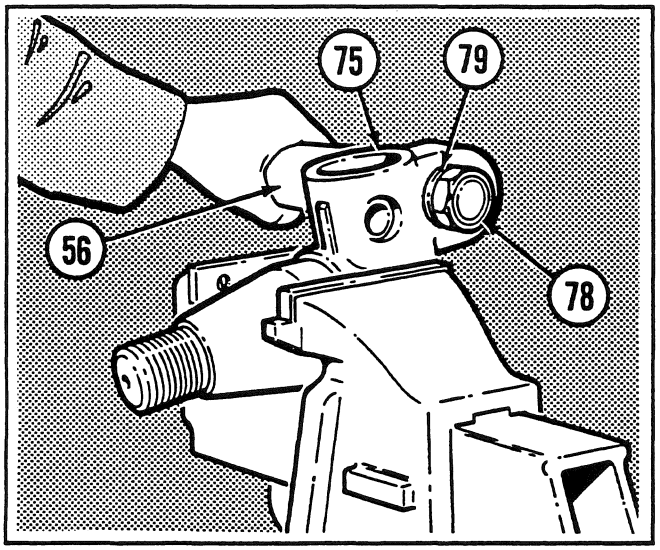


Fig. 28

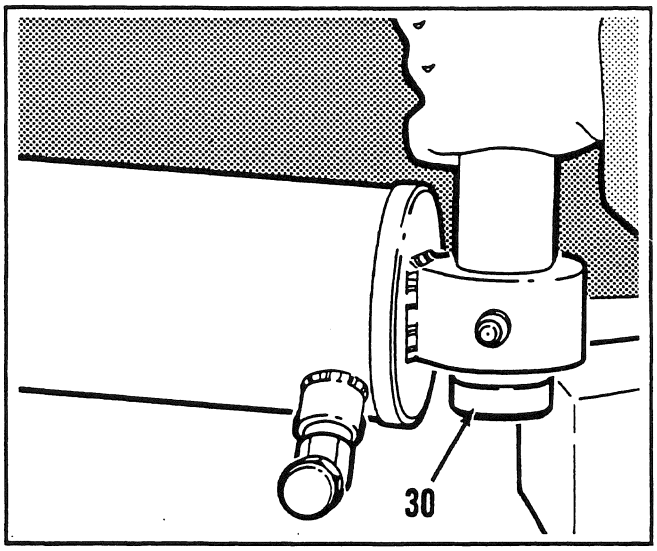


Fig. 31

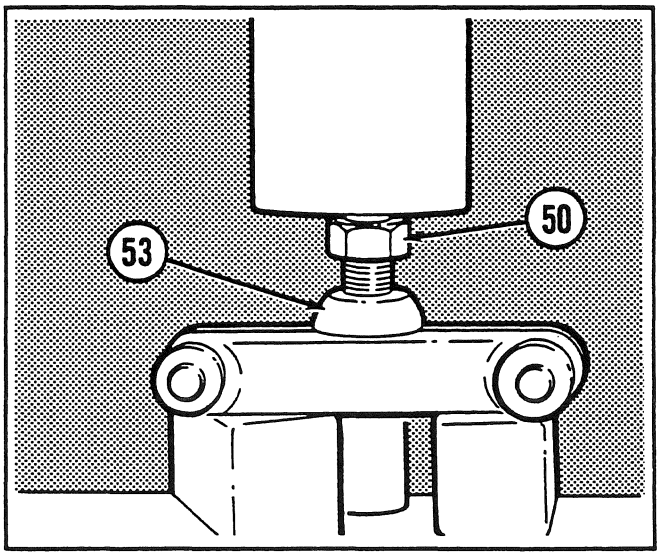


Fig. 29

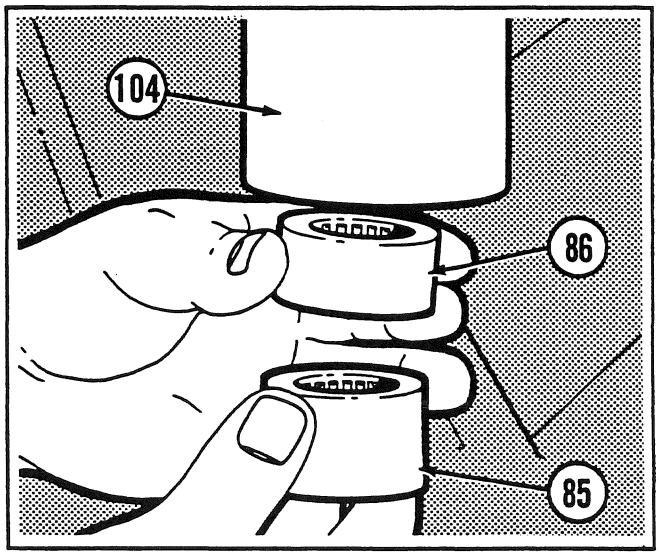


Fig. 32

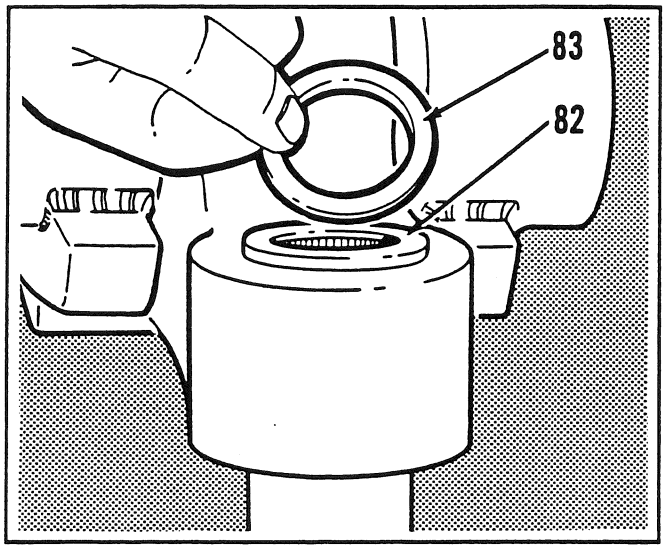


Fig. 33

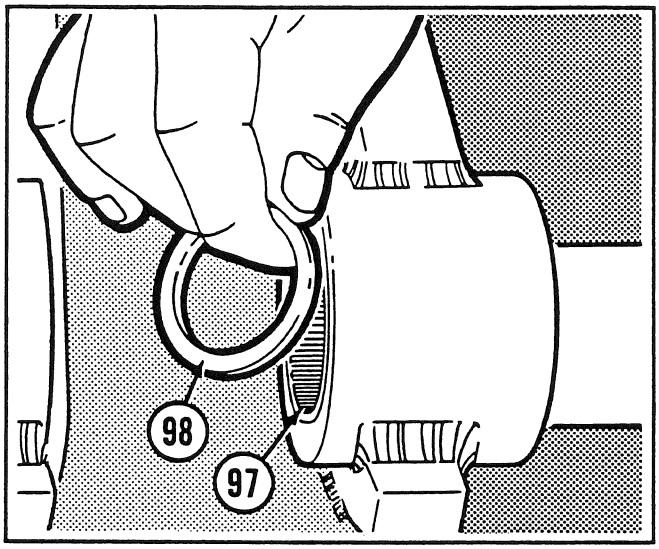


Fig. 36

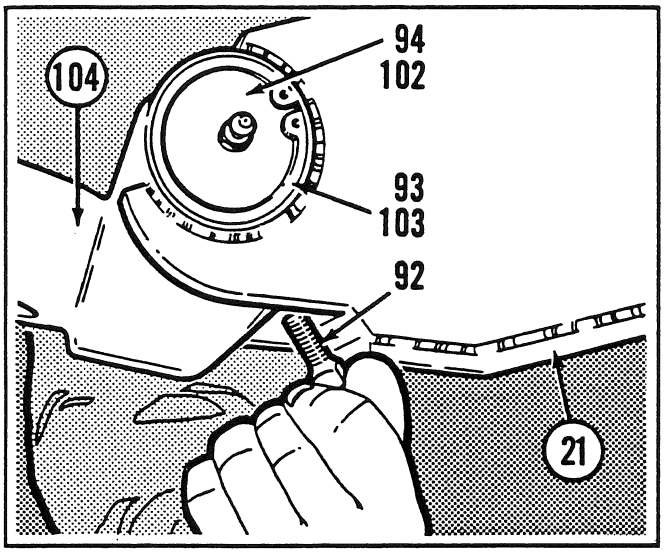


Fig. 34

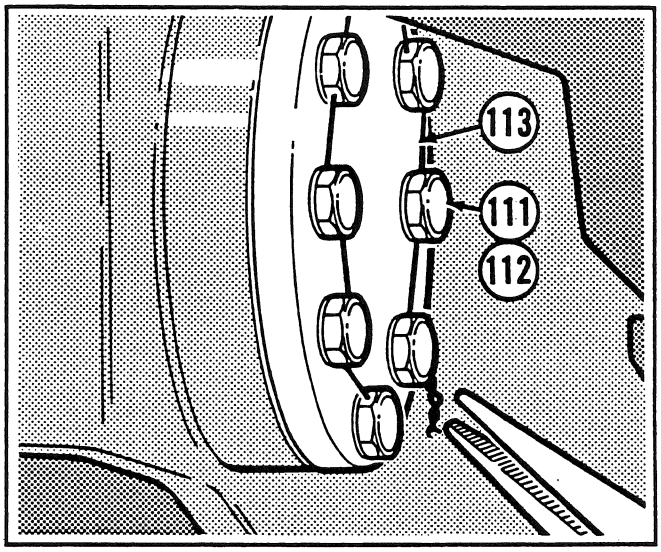
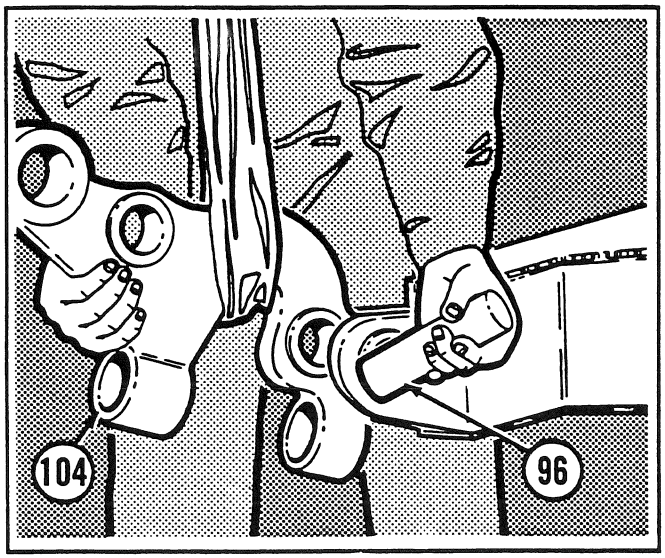


Fig. 37



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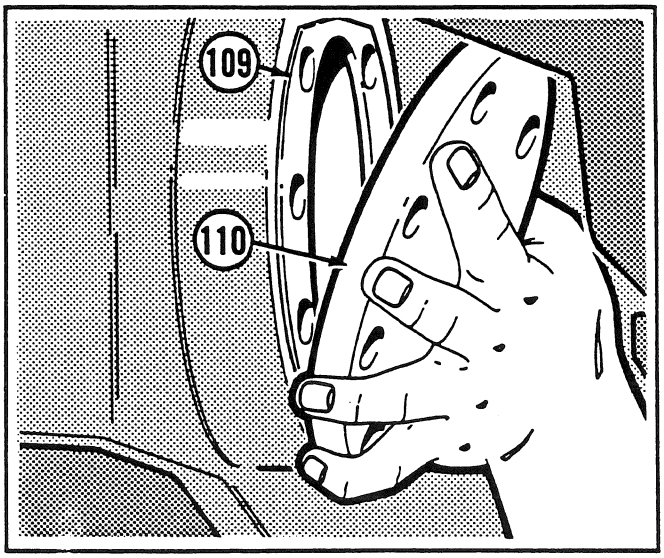


Fig. 38

Disassembly (continued)

Fig. 33
Using a jack and drift, press out the oil seal (83) and single needle bearing (82) from the bottom bore of the steering knuckle.

Fig. 34
To remove the steering knuckle (104) from the axle (21), remove the set screw (92) retaining the knuckle pivot pin. Remove the snap rings (93), (103) and pin caps (94), (102).

Fig. 35
Attach a safe lifting device to the steering knuckle (104) and force the pivot pin (96) out of the axle pads to remove the knuckle.

Fig. 36
Using a hammer and a drift, remove the oil seals (98), (99) and the needle bearings (97), (100) from the axle pads.

Fig. 37
Support the weight of the axle frame with a safe lifting device. Remove the lockwire (113), capscrews (112) and the lockwashers (111) from the pivot pin cap.

Fig. 38
Remove the axle pivot pin cap (110) and the shims (109) from the axle pivot pin.

Disassembly (continued)

Fig. 39
Remove any excess grease from the thrust bearing. Force the front axle (21) back and remove the thrust bearing cup (108) and the O-ring (107). Using a bearing puller, remove the thrust bearing cone (108) and backup washer (106) from the pivot pin.

NOTE

Lower the rear of the axle frame until it is below the pivot pin. Pull the axle frame forward. When the axle clears the front portion of the pivot pin, lower the axle to the ground.

Fig. 40
Remove the thrust bearing cup (4) and the O-ring (3) from the axle frame (21).

Fig. 41
Using a puller, remove the rear thrust bearing cone (4) and back-up washer (2) from the axle pivot pin.

Fig. 42
Using a hammer and drift, remove the spherical plain bearings (23) from the steering cylinder anchor lugs. Removal of the bearings is possible only from below, because of the anchor lug bores have a lower internal lip.

Reassembly

Before assembling any components, make a thorough inspection of all bearings and pins for signs of corrosion or wear. Grease the spherical bearings before installing the bearing pins to ensure that the grease grooves are aligned with the grease fittings.

Fig. 43
Use a hammer and installation drift (**special tool No. 37116**) to install the spherical plain bearings (23) into the front axle.

NOTE

The bearings can only be installed from the top of the anchor lug bores, because of the lower internal lip.

Fig. 44
Using a hammer and a drift, install the thrust bearing cup (4) into the axle frame (21).

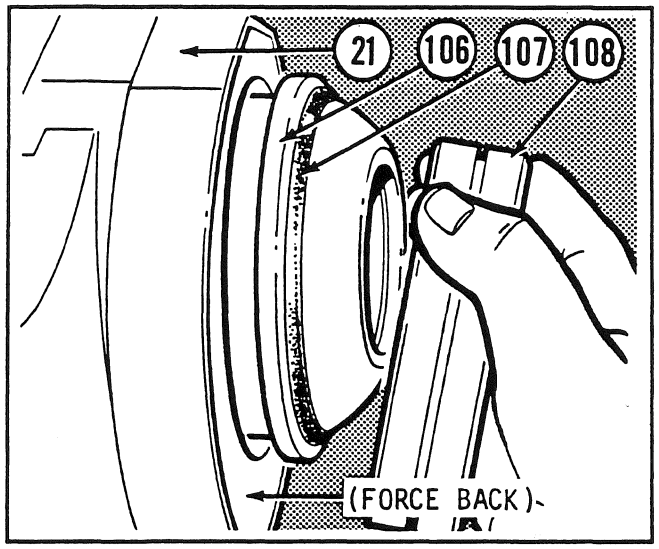


Fig. 39

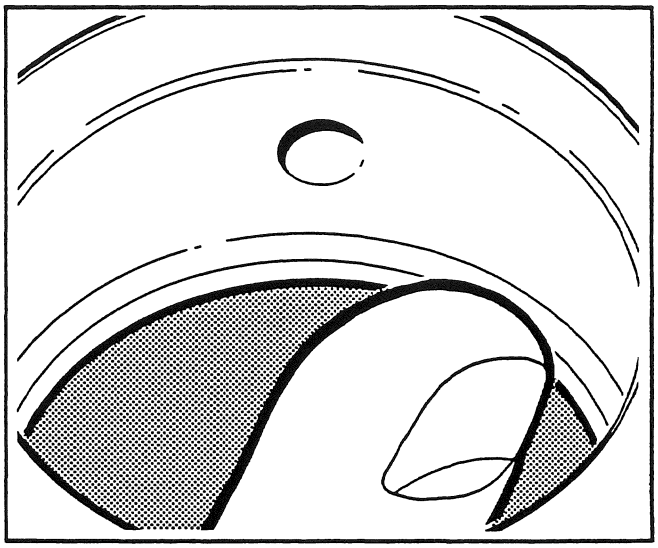
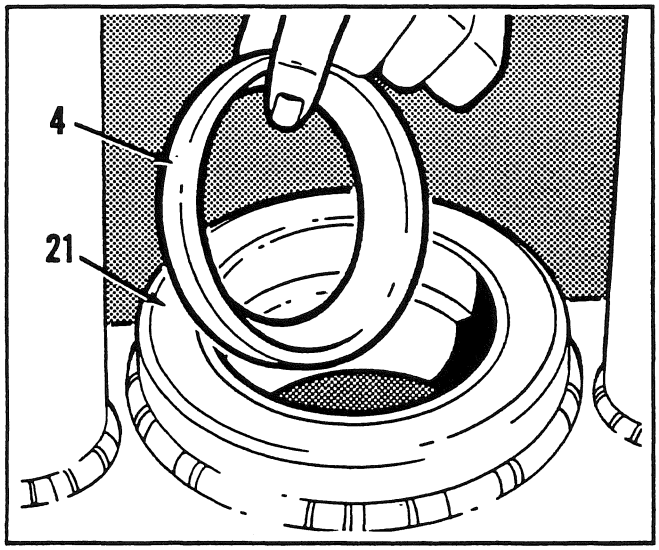


Fig. 42



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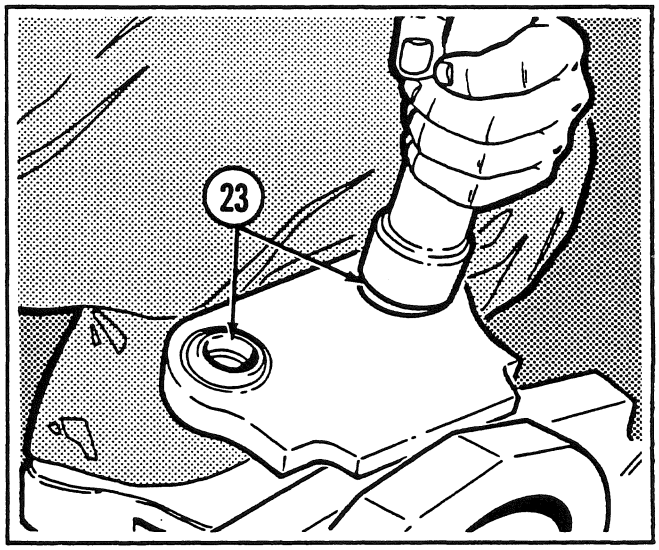


Fig. 43

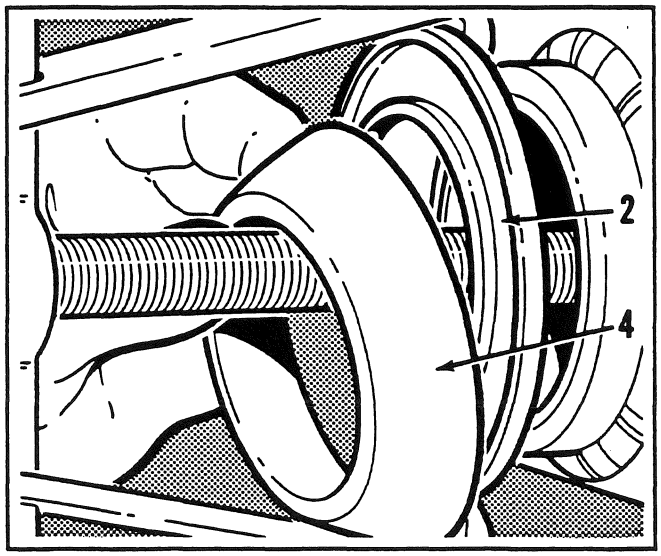


Fig. 41

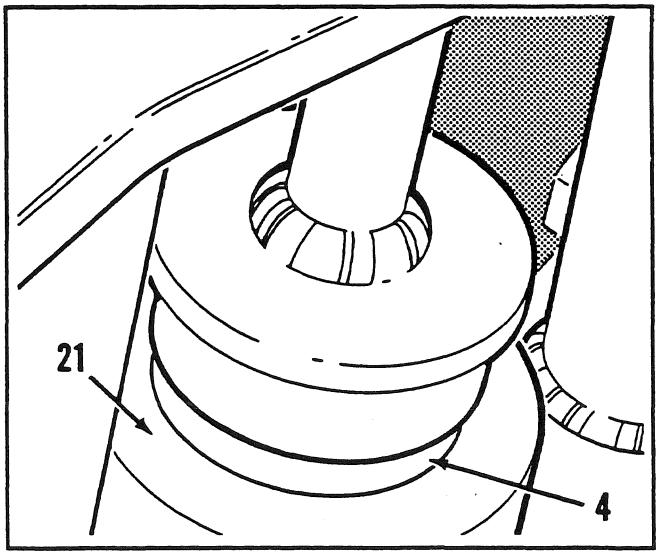


Fig. 44

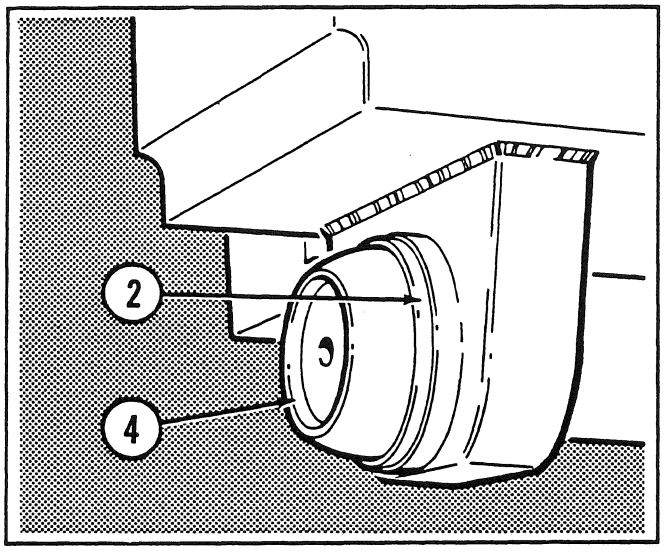


Fig. 45

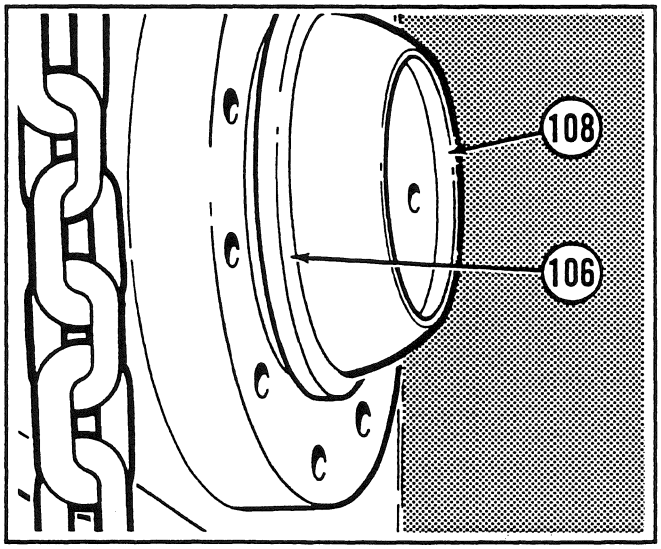


Fig. 48

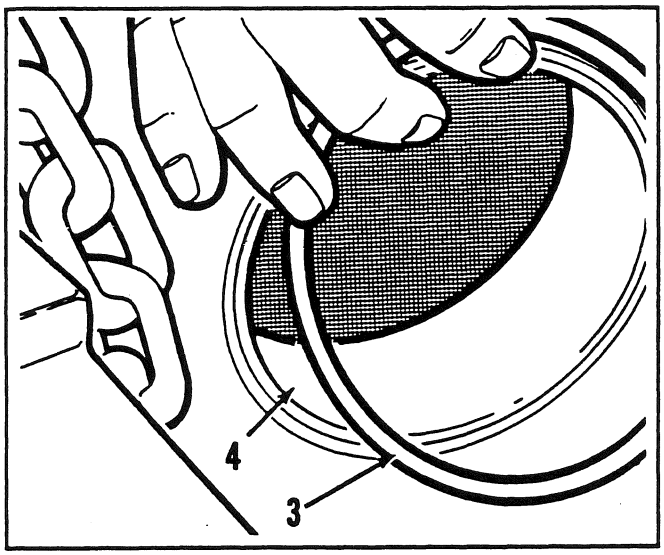


Fig. 46

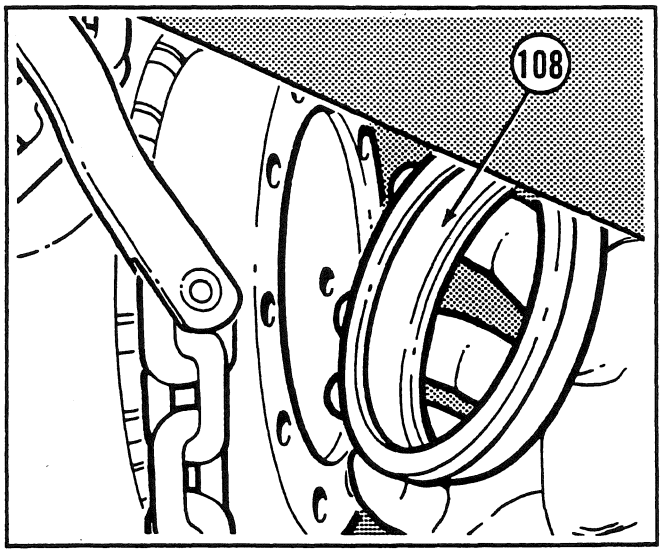


Fig. 49

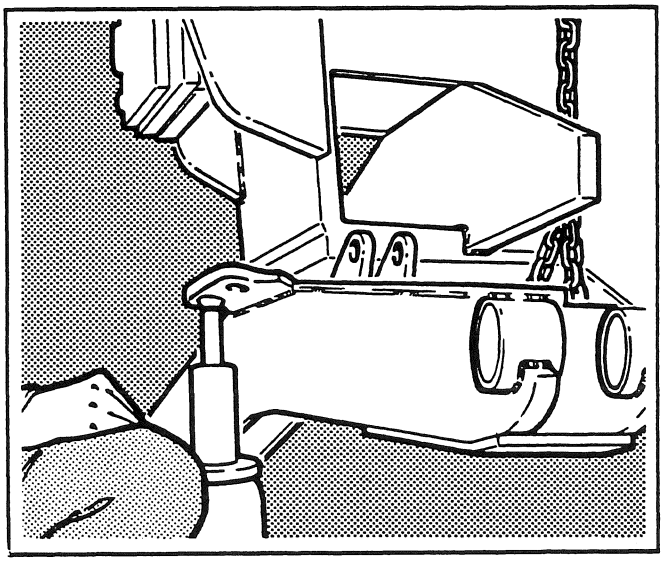


Fig. 47

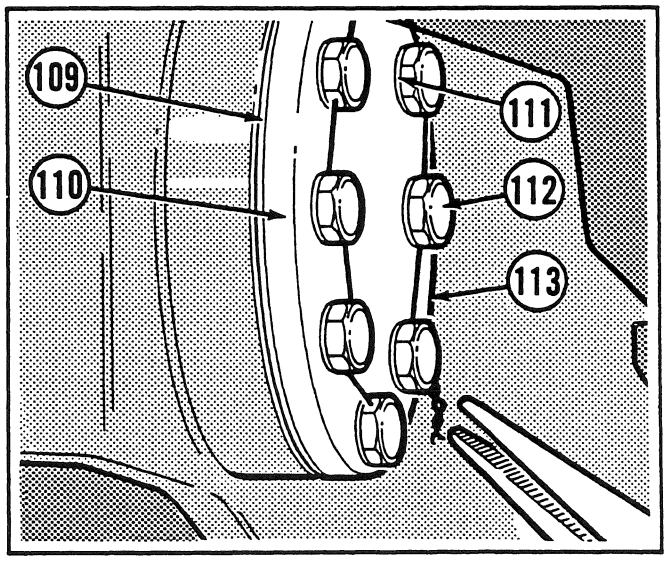


Fig. 50

Reassembly (continued)

Fig. 45
Install the back-up washer (2). Heat the rear thrust bearing cone (4) in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. Install the cone onto the pivot pin.

Fig. 46
Apply grease to the cup of the pivot bearing (4), lubricate and install a new O-ring (3) into the axle frame.

Fig. 47
Using a safe lifting device to raise the axle frame, position the front bearing bore over the pivot pin. Pull the frame as far back as possible. Using a jack, raise the back of the axle frame until the rear cup is aligned with the rear cone bearing.

Fig. 48
Install the back-up washer (106) onto the front pivot pin. Heat the front thrust bearing cone (108) in an oven or oil bath type heater to 121°C (250°) maximum. **DO NOT** use an induction heater. Install the cone onto the front pivot pin. Maneuver the axle frame (21) ahead so the rear thrust bearing cup and cone are engaged. Lubricate and install a new O-ring on the front thrust bearing.

Fig. 49
Install the front thrust bearing cup (108).

Fig. 50
Install the pivot cap (110) without any shims, tighten the capscrews (112) with lock washers (111) evenly until the axle stays in place when moved and released. Using a feeler gauge, measure the space between the axle pivot cap (110) and the axle frame (21). Four measurements are required, mathematically average the four measurements. This will allow you to determine the number of shims you will need. Install the shim pack (109), axle pivot cap and tighten the capscrews and lockwashers in a diagonal sequence to the recommended torque. Install a new lockwire (113) to secure the capscrews.

Reassembly (continued)

Fig. 51
Before installing the steering knuckles onto the axle, use a hammer and the appropriate drift to seat new needle bearings (97), (100) and install new oil seals (98), (99) into the axle pads. Apply a generous amount of grease to each bearing.

Fig. 52
Place the steering knuckle (104) in a press and use the appropriate drift to install new needle bearings (82), (85) in the upper and lower bosses of the knuckle. Also install a new oil seal (83) at the inner lower face of the knuckle boss with the seal lip facing the spindle.

Fig. 53
Use a safe lifting device to position the knuckle (104) between the axle pads (21). Make sure to align the slot in the knuckle pivot pin (96) with the set screw (92) when installing the pin.

Fig. 54
Apply thread locking compound, Champion part number **27528** to the set screw (92). Install the set screw and secure the pin (96) in position. Check to ensure that the pin pivots freely on the needle bearings.

Fig. 55
Lubricate and install new O-rings (95), (101).

Fig. 56
Install the pin caps (94), (102) and new snap rings (93), (103). Grease the pivot and axle pad needle bearings.

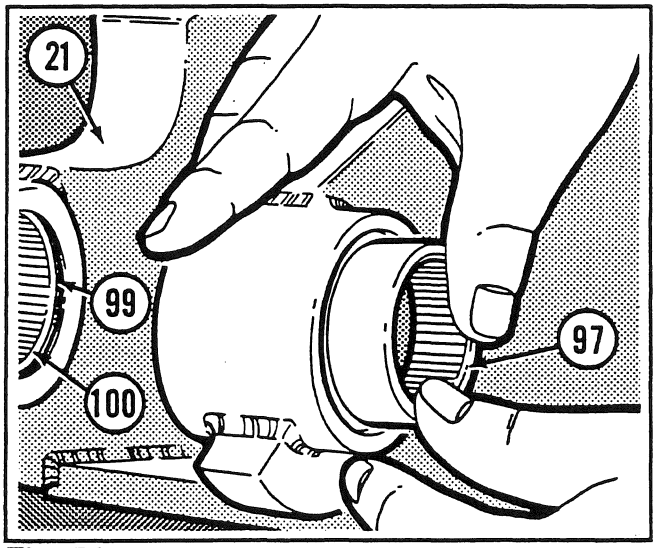
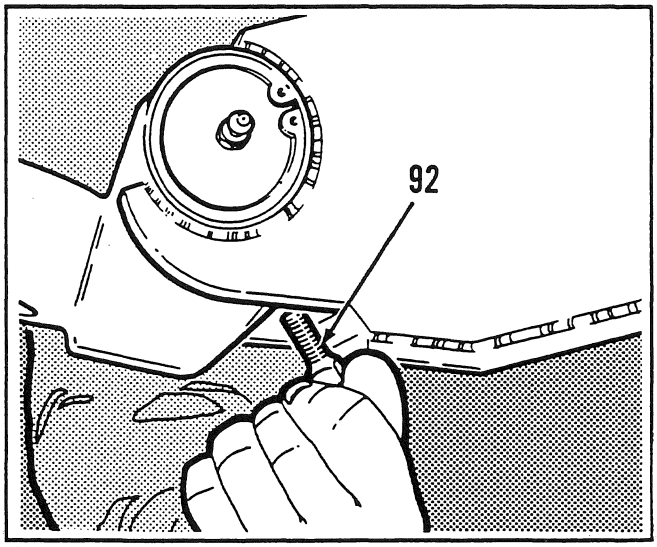


Fig. 51



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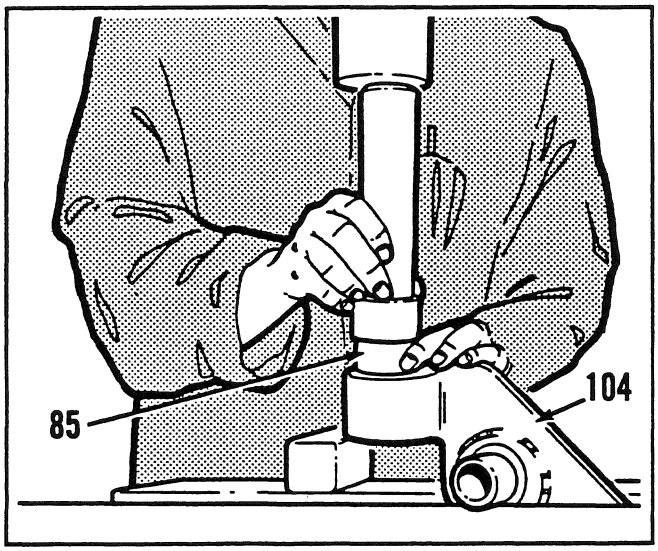


Fig. 52

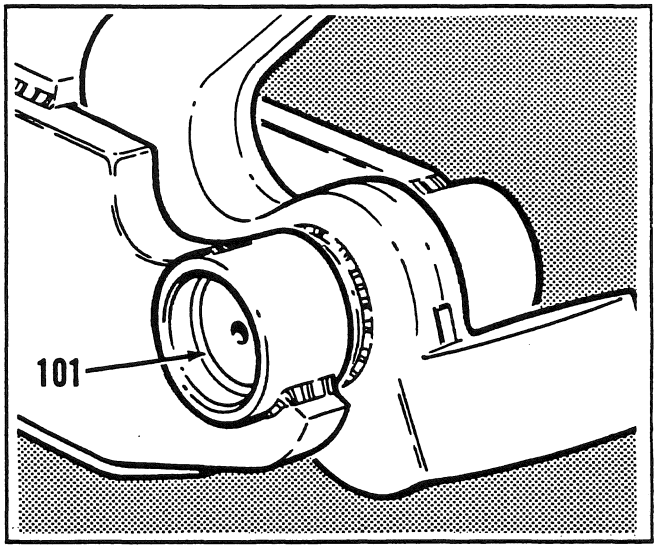


Fig. 55

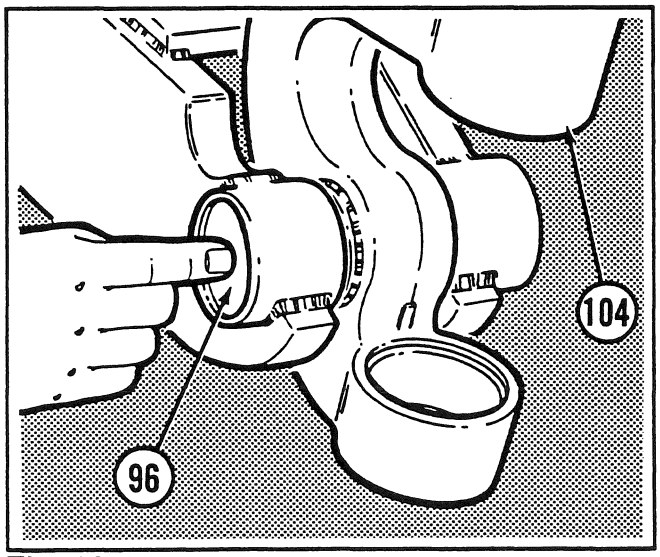


Fig. 53

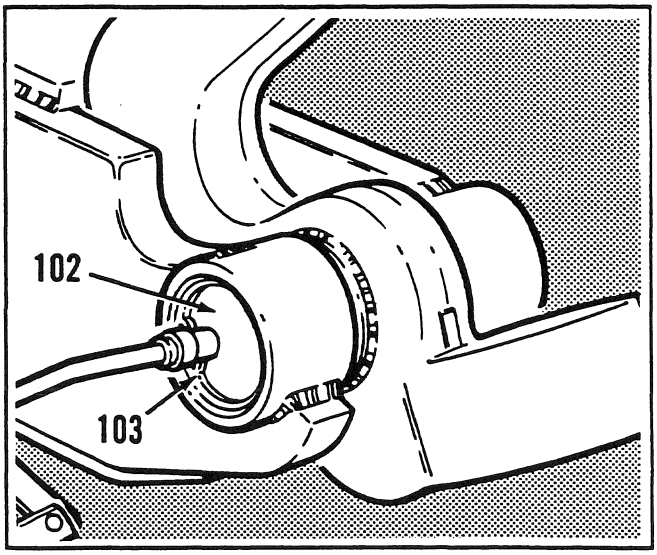


Fig. 56

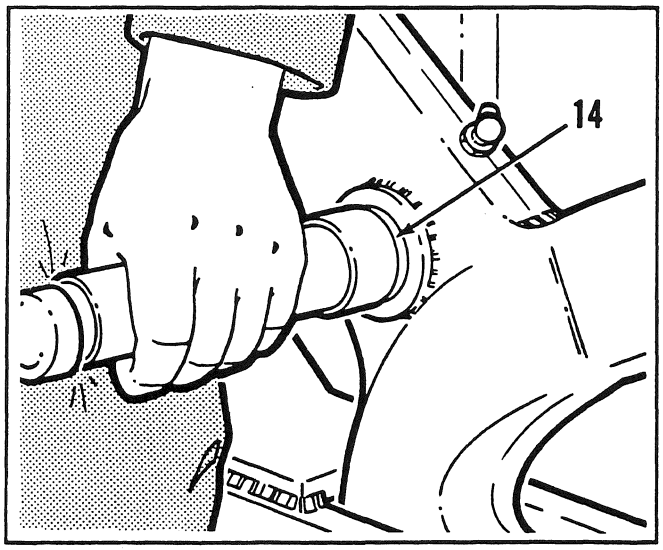


Fig. 57

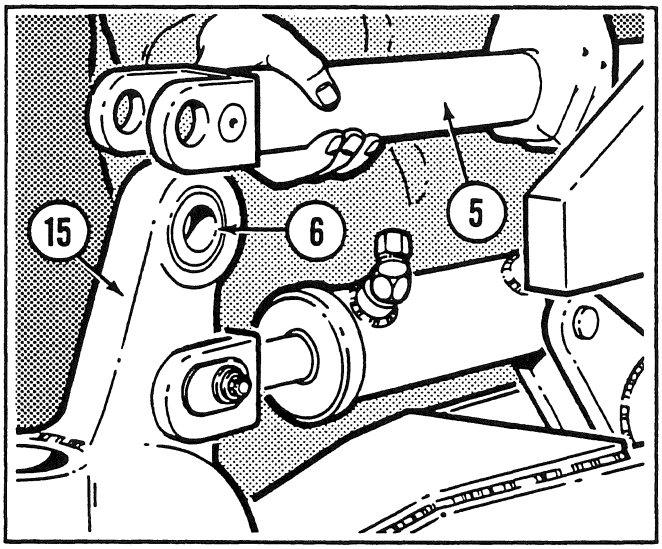
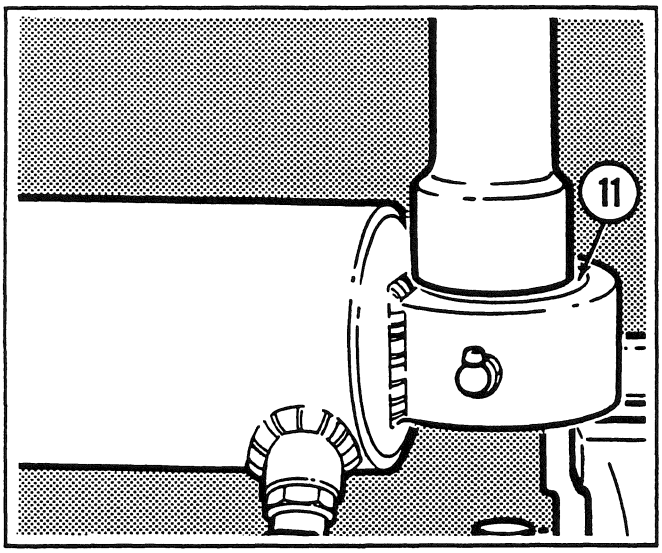


Fig. 60



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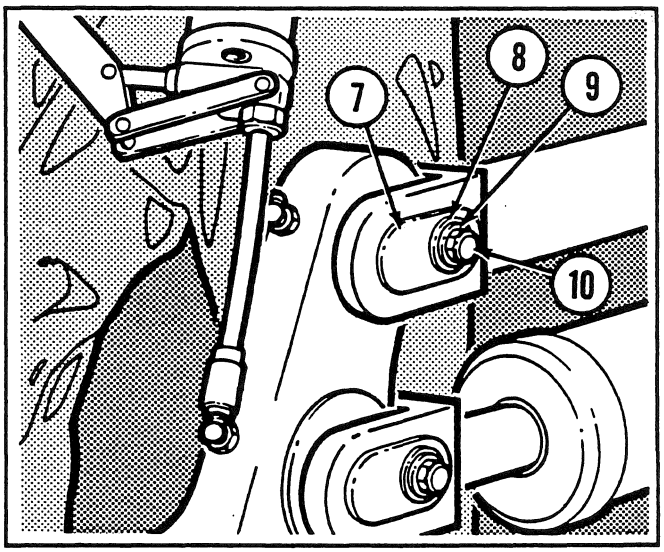


Fig. 61

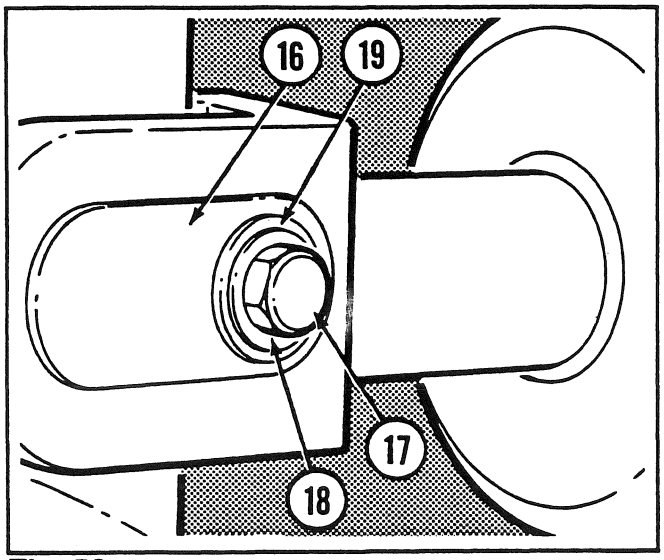


Fig. 59

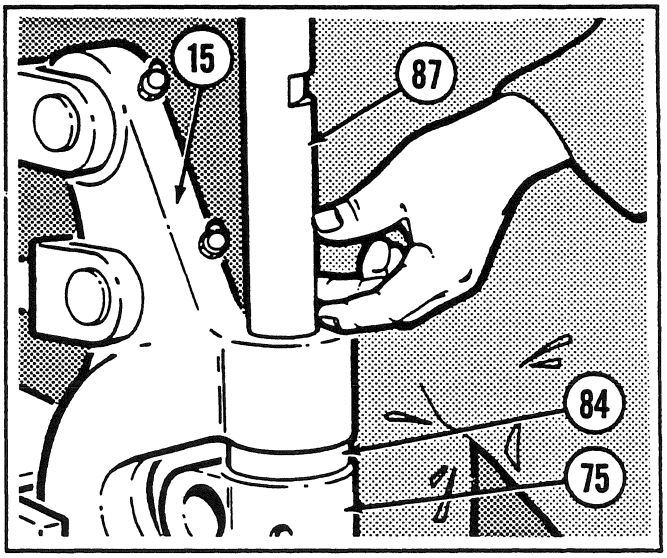


Fig. 62

Reassembly (continued)

Fig. 57
Using a hammer and an installation drift (**special tool No. 37116**), install the radial spherical bearing (14) into the leaning wheel cylinder knuckle bore.

Fig. 58
On the workbench, grease the spherical plain bearing (11) for the leaning wheel cylinder and install it with a hammer and an installation drift (**special tool No. 37116**) into the base end on the wheel cylinder.

Fig. 59
Mount the leaning wheel cylinder onto the axle frame and install the bearing pins (16), (20). Install the flatwasher (19), lockwasher (18) and tighten the capscrews (17) to retain the bearing pins.

Fig. 60
Install the spherical plain bearing (6) into the upper bore of the steering knuckle (15). Mount the tie bar (5) and install the bearing pins (7).

Fig. 61
Secure the bearing pins (7) with a flatwashers (8), lockwashers (9) and capscrews (10). Apply grease into both the tie bar and leaning wheel cylinder grease fittings.

Fig. 62
Install the spindle (75) and thrust bearing (84) into the steering knuckle (15). Remove the king pin (87) from the freezer or dry ice and install it. Make sure to align the slot on the king pin with the key pin (80) hole in the spindle.

Reassembly (continued)

Fig. 63
Retain the king pin in position by installing the key pin (80) with the flat side against the slot of the king pin (87). Tap the key pin into place and secure it with a lockwasher (76) and nut (77).

Fig. 64
Apply silicone sealant to the top pin cap (90) and bottom pin cap (81). Install and secure the caps with star washers (88) and capscrews (89). Apply grease into both pin cap grease fittings.

Fig. 65
To assemble the drag link (34), secure the left end of the drag link in a vise and slide the left hand yoke (46) onto it, install the flatwasher (44) and locknut (43). Tighten the locknut until it is snug against the yoke. Ensure that the yoke can still rotate.

NOTE

On later models the drag link is secured by a castellated hex. nut and a cotter pi

Fig. 66
Place the other end of the drag link (34) in a vise and thread the right hand yoke (32) as close to its original position as possible.

Fig. 67
To assemble the pivot blocks (54) begin by installing the angular contact bearing cups (53) using an installation drift (**special tool No. 37117**). Lubricate the contact bearing cup and cones (53) and install them. Install the O-rings (52), and the O-ring retainers (51). Make sure that the O-rings are properly seated.

Fig. 68
Now install the pivot blocks (54) with the grease fittings facing the yokes and secure them with the adjusting pins (40), (47) and jam nuts (39), (48). Install the jam nuts loosely.

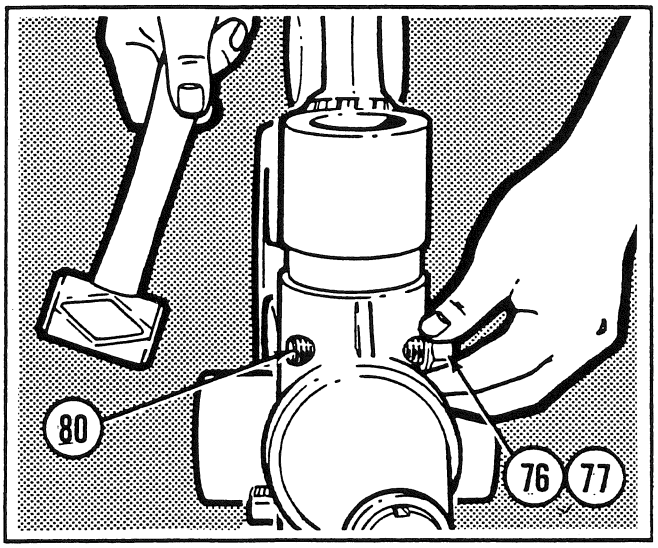


Fig. 63

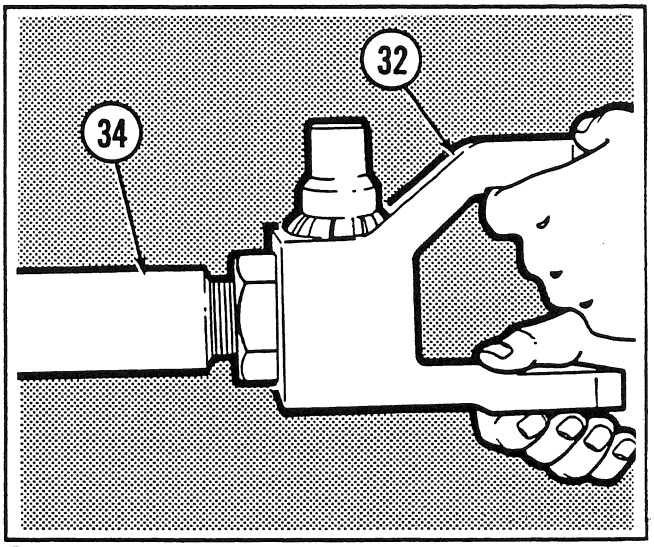


Fig. 66

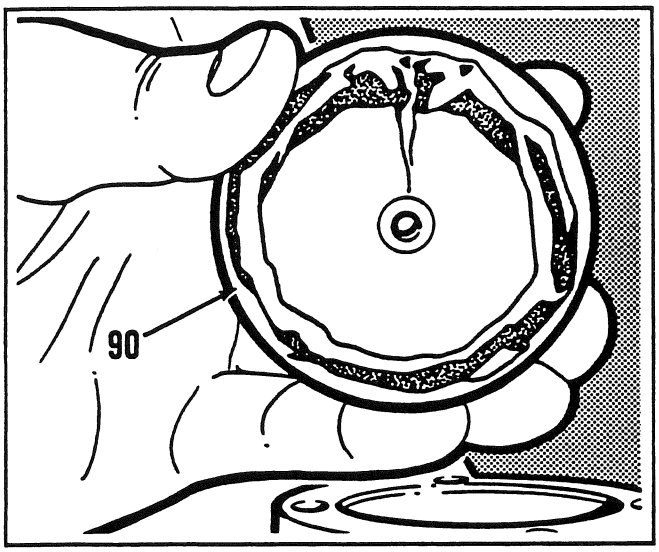


Fig. 64

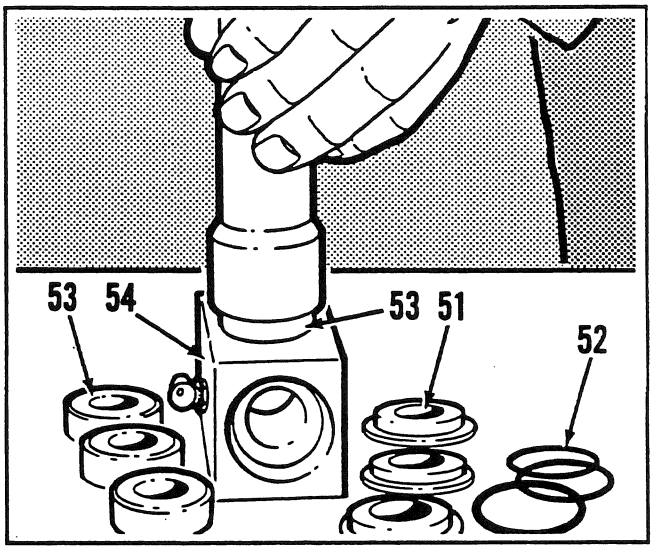


Fig. 67

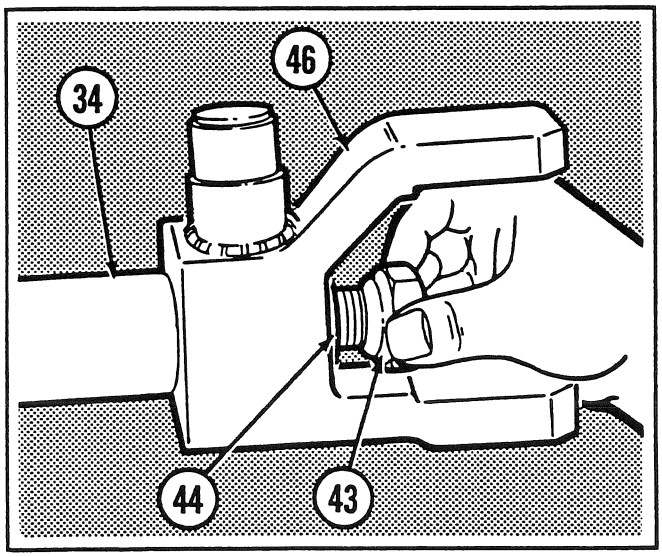


Fig. 65

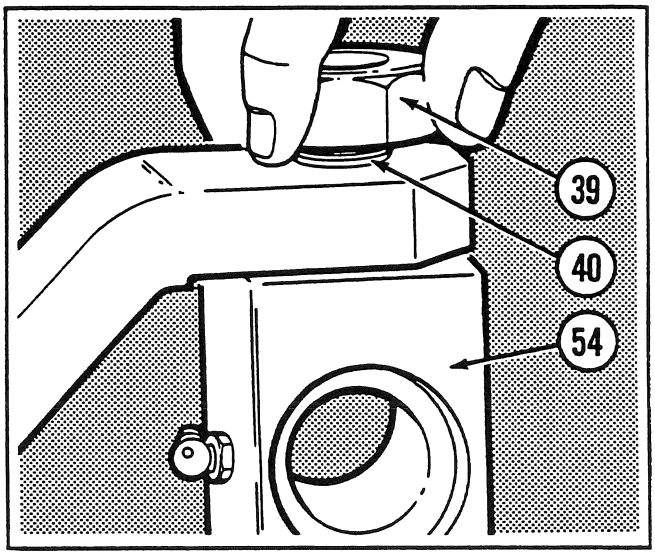


Fig. 68

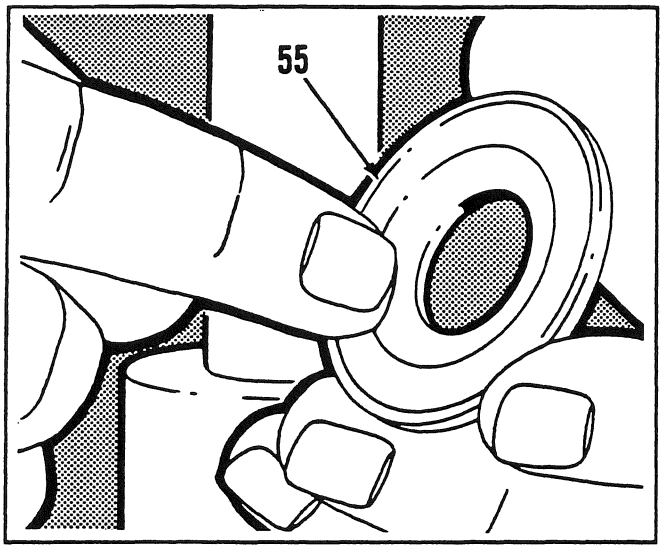
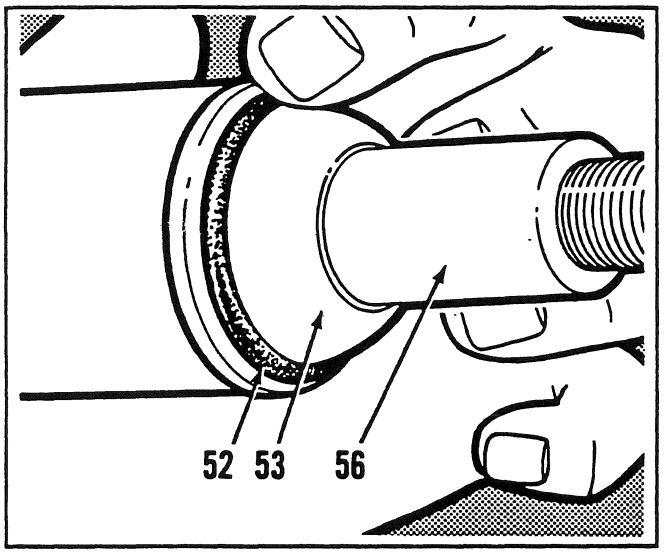


Fig. 69



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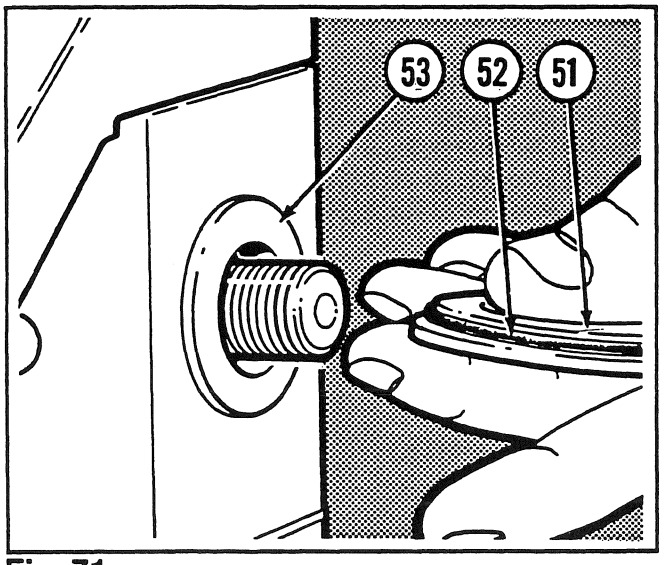


Fig. 71

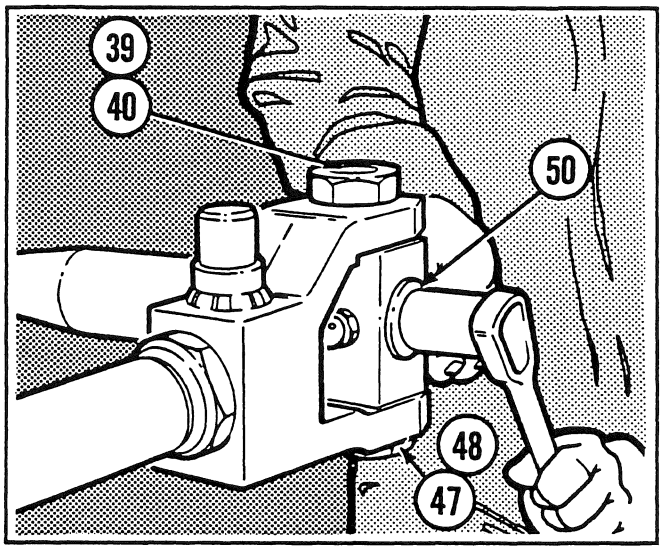


Fig. 72

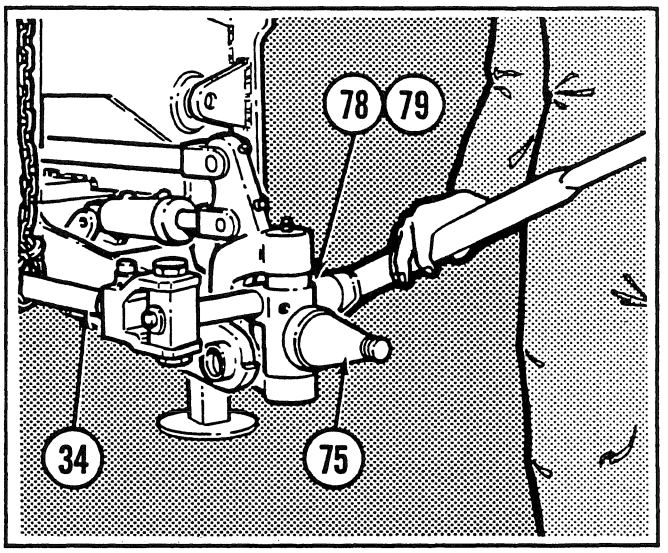


Fig. 73

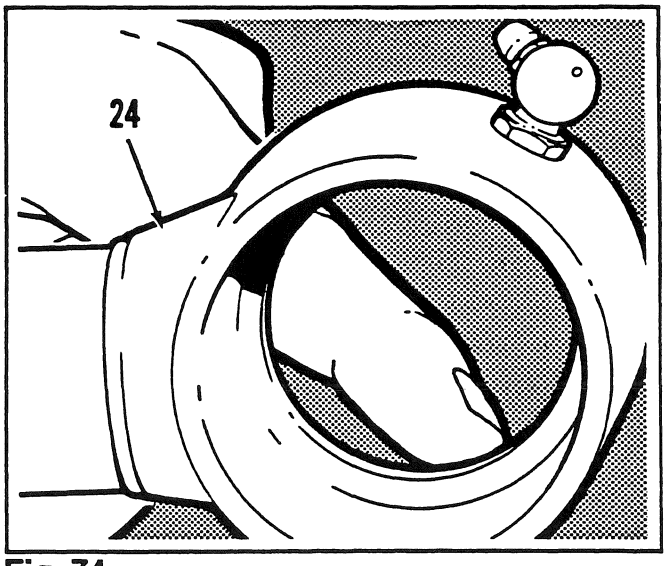


Fig. 74

Reassembly (continued)

Fig. 69
Secure the radius arm vertically in a vise and install the bearing retainer (55) ensuring that the beveled surface is facing downwards

Fig. 70
Use a hammer and an installation drift (**special tool No. 37117**), install the bearing cone (53). Lubricate and install a new O-ring (52) and insert the radius arm (56) into the pivot block and drag link assembly with the pivot studs on the yoke facing upwards.

Fig. 71
Install the bearing cone (53), O-ring (52) and the O-ring retainer (51). Make sure that the O-ring is seated before installing the washer (49) and **new** locknut (50).

Fig. 72
Slightly tighten the adjustment pins (40), (47) and the radius arm locknut (50), this compresses the pivot block bearings. Ensure that the top and bottom of the pivot blocks are equally spaced between the inner faces of the yokes. Lubricate the pivot block bearings with grease recommended in the Lubrication Specifications at the front of this Shop Manual. **Make sure you see grease seeping out of the O-rings.** If necessary, tighten or loosen the adjustment pins (40), (47) and the locknut (50) until you achieve the proper adjustment. Holding the adjustment pins with a screwdriver, tighten the jam nuts (39), (48).

Fig. 73
Support the drag link (34) with a lifting device and install each radius arm into the bore on the spindles (75). Install the lockwasher (79) and tighten the nut (78).

Fig. 74
When installing the radial spherical plain bearing into the rod end of the steering cylinder (24), note the lip in the bottom of the bore permits installation of the spherical plain bearing (30), (38) from the top only.

Reassembly (continued)

Fig. 75
Install the spherical plain bearings (30), (38) into the steering cylinder (24) using an installation drift (**special tool No. 37116**). Mount the steering cylinder (24) onto the axle frame (21) and force the radial bearing down onto the pivot stud.

Fig. 76
Install the external snap ring (36), followed by the internal snap ring (37).

Fig. 77
Install a new expansion plug (35) using a hammer and a drift. Secure the expansion blugs by indenting the center of the plug. Make sure all expansion plugs have a central vent hole.

Fig. 78
At the base end of the steering cylinder (24) use a jack and drift to press the pivot pin up into the anchor lugs. With a hammer and drift, force the roll pin (26) into the pivot pin (25) to secure it.

Fig. 79
Install the inner (71) and outer (67) bearing cups into the wheel and apply a generous amount of grease in the bore.

Fig. 80
Install a new V-ring seal (74) and back-up ring (73) on the spindle (75) with the back-up ring in the groove of the V-ring. Apply grease to the spindle and pack the inner bearing cone (72) with grease and install it on the spindle.

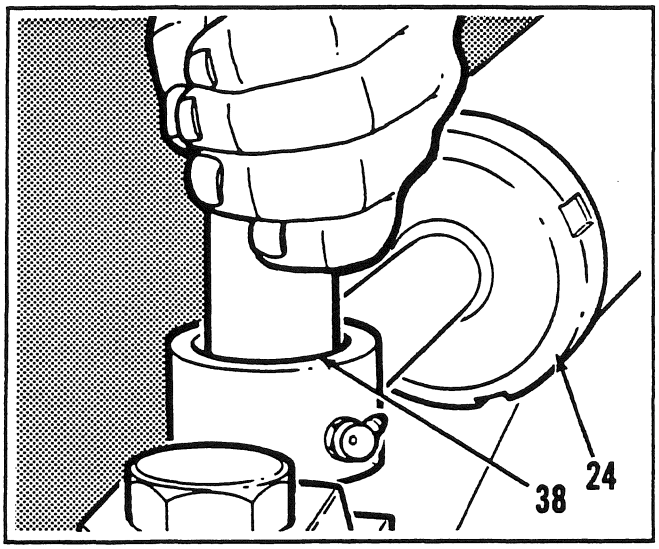
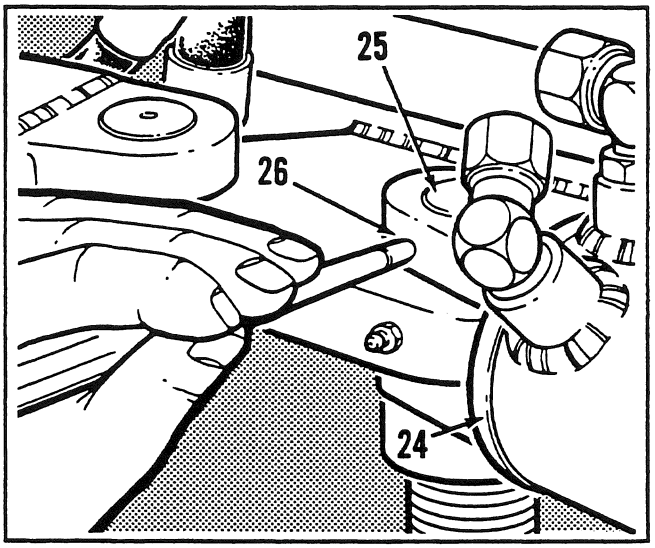


Fig. 75



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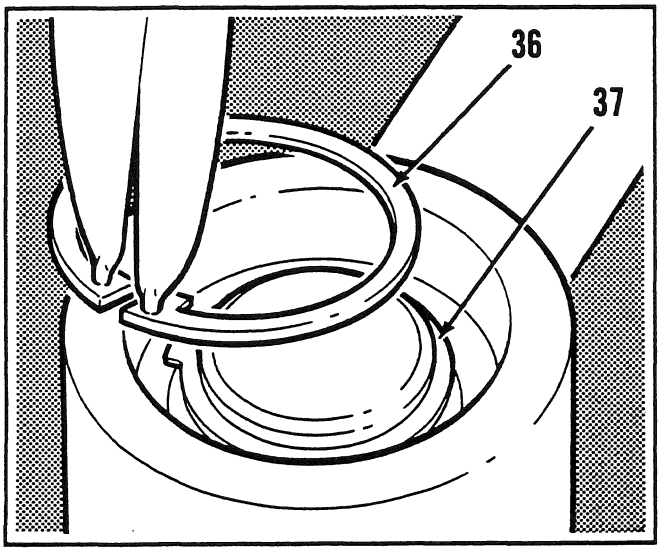
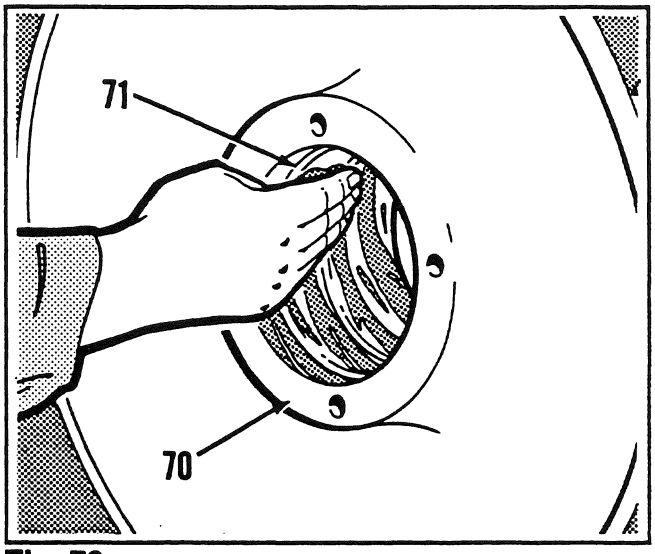


Fig. 76



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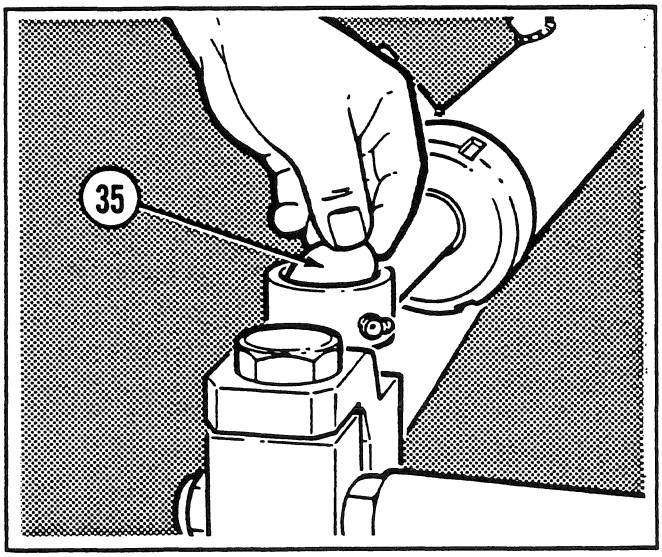

Fig. 77

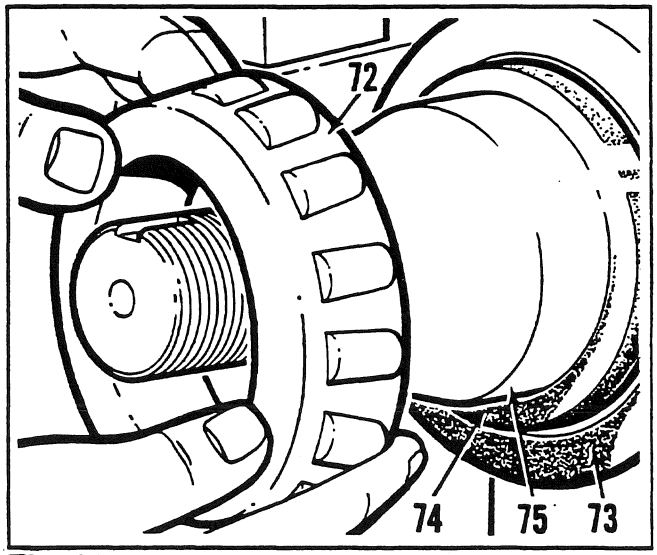

Fig. 80

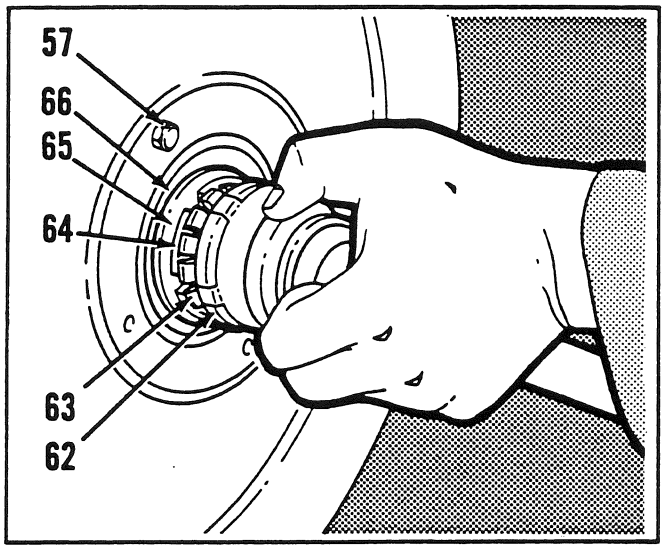

Fig. 81

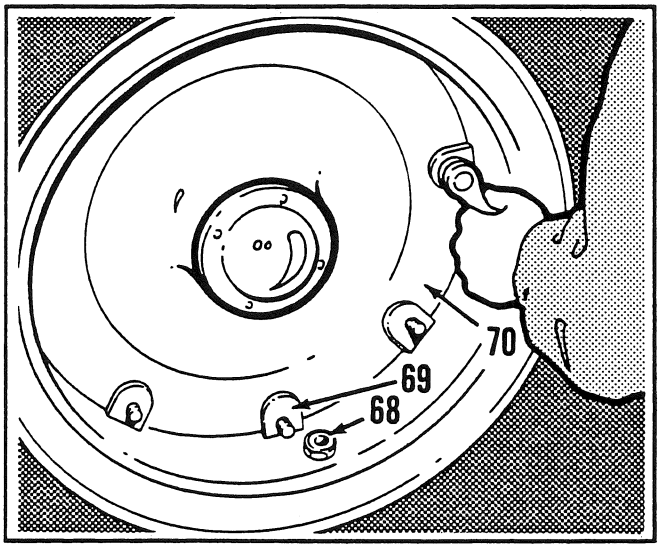

Fig. 84

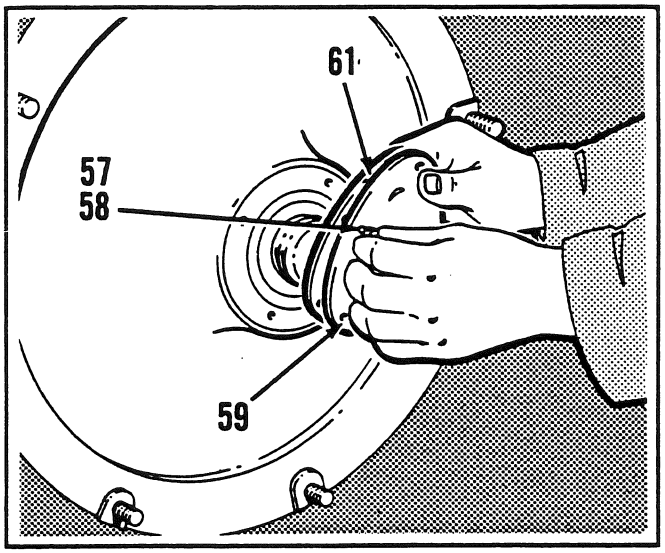

Fig. 82

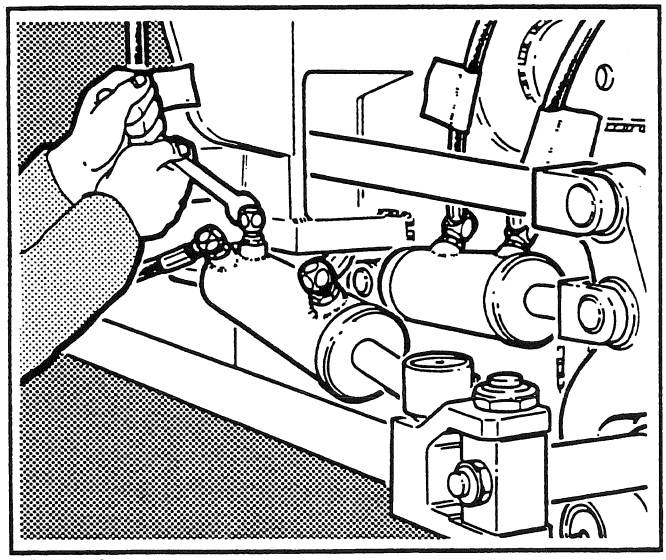
Fig. 83

Reassembly (continued)

Fig. 81
Attach a safe lifting device to the wheel (70) and slide it on to the spindle (75). Pack the outer bearing cone (66) with grease and install it on the spindle. Install the bearing washer (65) and the inner wheel nut (64). Set wheel preload by installing one of the hubcab screws (57) with a torque wrench. Tighten the wheel nut until 1 to 2 kgf.m (8 to 12 lbf-ft.) are needed to turn the wheel with the torque wrench. Install the lockwasher (63) and the outer wheel nut (62) using a socket wrench (**special tool No. 18516**) tighten it to the recommended torque. Bend the tabs so they fit into the slots on both wheel nuts.

NOTE

ALWAYS install the wheel nuts (62), (64) with the chamfer facing outwards from the wheel.

Fig. 82
Install the hubcap (59), the lockwashers (58) and the capscrews (57) with a new hubcap gasket (61).

Fig. 83
Reconnect the hydraulic hoses to all the cylinders and grease all fittings.

NOTE

DO NOT over-lubricate the wheel bearing cones. Excess grease can rupture the hub cap gasket.

Fig. 84
Before installing the rims and tires, tighten all the nuts and capscrews on the axle to the recommended torques.

Maneuver the tire and rim onto the wheel and place the rim clamps on the wheel studs and retain them with nuts. Tighten the nuts to the specified torque, in a diagonal sequence. Repeat these procedures for the other wheel.

Do another preload check on the wheels by rotating them. The wheels should rotate one and one half turns before stopping.

To check the preload of the axle pivot pin, stand on one of the front wheel rims and hold onto the tire. The weight of an average man 82,0 kg (180 lbs.) should pivot the axle.

To start the grader, turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the front end of the machine, remove the supports. Raise the moldboard to lower the front of the machine onto its wheels.

Reassembly (continued)

Toe-in Adjustment

Fig. 85

Check the toe-in of the front wheels by making a mark on the tires behind the axle, level with the centre line of the spindle. Measure the distance between tires at these marks.

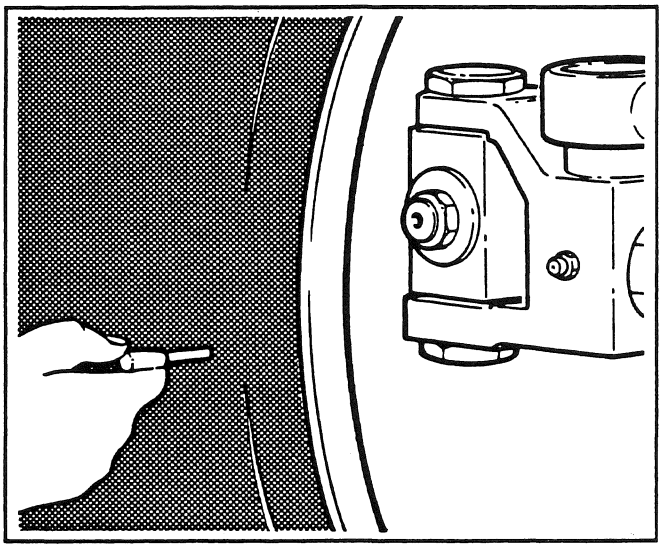

Fig. 85

Fig. 86

Drive the grader forward to position the markings on the centre line of the spindles in front of the axle and record this measurement. The front measurement should be 13,0 mm to 16,0 mm (1/2 in. to 5/8 in.) less than the measurement taken behind the front axle.

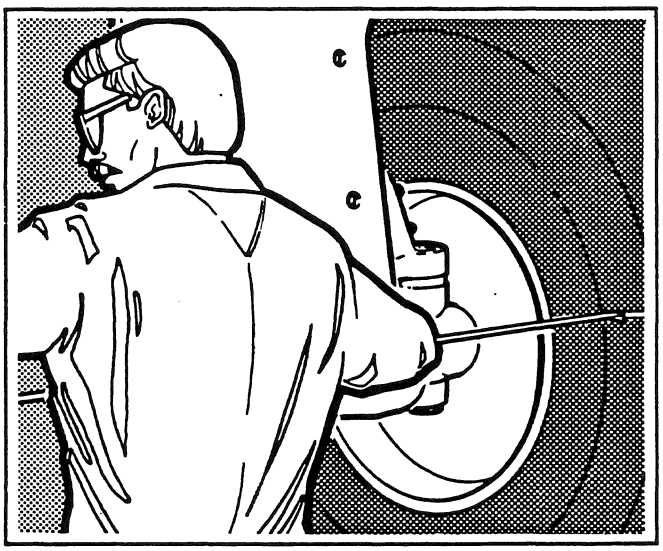

Fig. 86

Fig. 87

To adjust the toe-in, first loosen the hex. jam nut (33) at the right hand yoke (32). Then use a pipe wrench to rotate the drag link (34). This varies the length of the drag link and changes the toe-in. When the toe-in is correct tighten the hex. jam nut to secure the drag link.

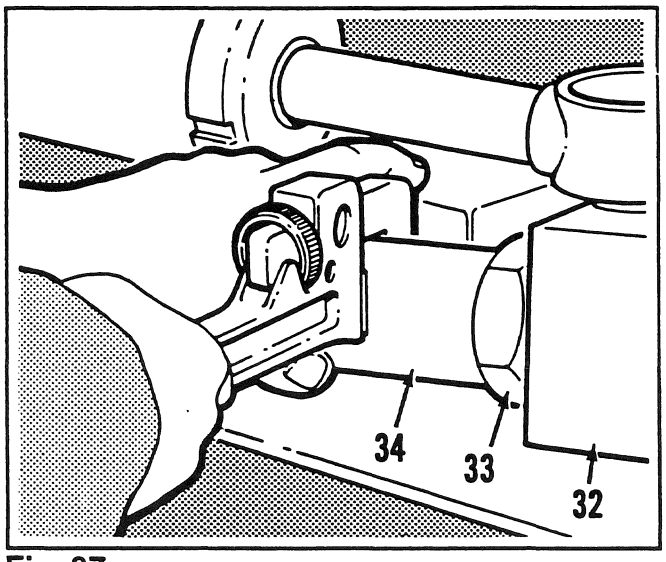

Fig. 87

The front axle disassembly and reassembly is now complete.

Road test the grader to check for leaks and to ensure the front axle functions properly and is safe for the operator.

SECTION 1

MODELS 780/780A FRONT AXLE

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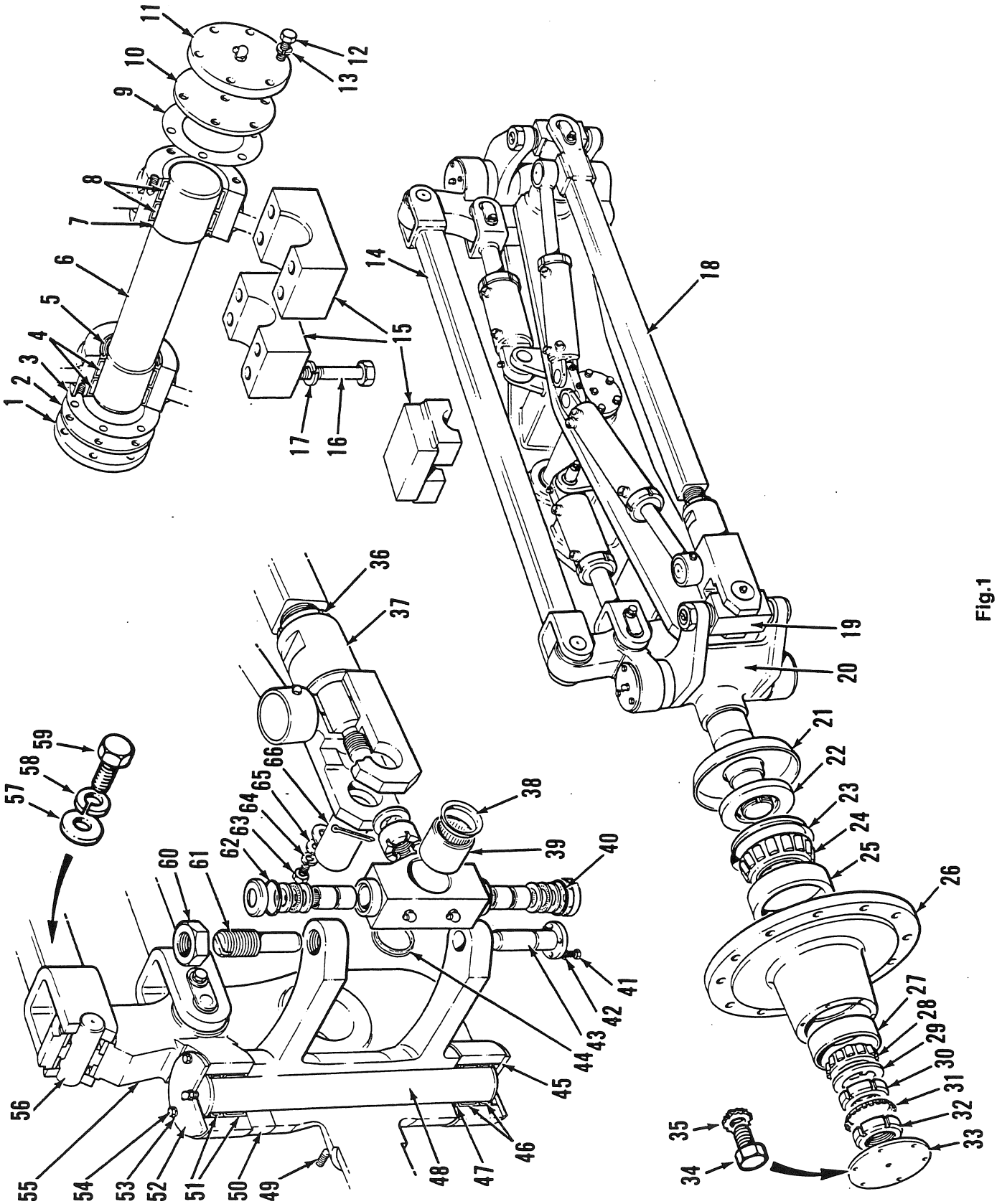
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Fig.1

Item	Description
1	Thrust cap
2	Thrust washer
3	Shim
4	Needle roller bearings
5	Seal
6	Pivot pin
7	Seal
8	Needle roller bearings
9	Shim
10	Thrust washer
11	Thrust cap
12	Bolt
13	Lockwasher
14	Tie bar
15	Mounting block matched halves
16	Bolt
17	Lockwasher
18	Drag link
19	Pivot block
20	Spindle and radius arm assembly
21	Dust seal
22	Deflector spacer
23	V ring seal
24	Inner bearing cone
25	Inner bearing cup
26	Wheel and hub
27	Outer bearing cup
28	Outer bearing cone
29	Lockwasher
30	Inner locknut
31	Tabwasher
32	Outer locknut
33	Hub cap
34	Bolt
35	Starwasher
36	Locknut
37	Adjusting collar
38	Seal
39	Needle roller bearing
40	O ring
41	Bolt
42	Starwasher
43	Radius arm pin
44	Seal
45	King pin cap
46	Needle roller bearing
47	Seal
48	King pin
49	Setscrew
50	Thrust washer
51	Needle roller bearings
52	King pin cap
53	Starwasher
54	Bolt
55	Knuckle
56	Bearing pin
57	Flatwasher
58	Lockwasher
59	Bolt
60	Locknut
61	Adjustment pin
62	O ring
63	Bolt
64	Lockwasher
65	Flatwasher
66	Bearing pin

Key to Fig. 1

General

Make sure proper shop tools are available and in good working order. You will need a safe lifting device, blocks or proper stands and a hydraulic jack.

Refer to the 700 Series Parts Manual P/N **L 3008** for spare parts information.

Service Position Precaution

NOTE: *Always place the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure. Refer to the SERVICE POSITION procedure on page (ii) in the front of this Shop Manual.*

Description

The Model 780 front axle is designed for the arduous applications of heavier Champion motor graders. It is capable of handling the higher front axle loads while maintaining the mobility of a standard front axle. This axle has wider spacing (track width) between the front tires to allow full axle mobility with 20.5 x 25 tires. The pivot pin, king pins and knuckle pins are supported by double row needle roller bearings.

The front axle performs three essential functions:

- Hydraulic assisted steering turns the front wheels to either side.
- You can lean the front wheels to the left or right. This reduces the turning radius, counteracts side loads created by the action of the moldboard, and provides stability on side slopes.
- The central pivot pin allows the front axle to oscillate from a level position when traveling over uneven ground.

Cleaning and Inspection

Cleaning

Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used. Do not use gasoline.

Use a flat-bladed tool to remove silicone sealant residue.

Do not clean ground or polished parts in water, steam, alkaline solutions or a hot solution tank.

Immediately dry parts after cleaning. Use soft, clean paper or cloth rags. You can also dry parts - except bearings - using moisture-free compressed air.

NOTE: *Do not dry bearings with compressed air. Spinning bearings with compressed air can damage the races and rollers.*

Apply grease or system oil to undamaged parts that are ready for assembly. If storing parts for some time, apply a rust inhibitor to all surfaces. Wrap parts in rust inhibitor impregnated paper before storing.

Inspection

Inspect all tapered roller bearing cups and cones. Replace the bearing if you see the following defects.

a) Center of the large diameter end of the roller worn level with or below the outer surface of the roller.

b) Radius of the large diameter end of the roller worn to a sharp edge.

c) Visible roller grooves in the cup or cone inner race surfaces.

d) Deep cracks in the cup, cone inner race or roller surfaces.

e) Bright wear marks on the roller cage outer surface.

f) Etched and pitted rollers or cup and cone inner race surfaces that touch the rollers.

g) Cup and cone inner race surfaces that touch the rollers damaged by spalling and flaking.

Replace worn or damaged front axle assembly parts. Following are examples of what to check, repair or replace.

a) Replace any fasteners if the corners of the head are worn.

b) Replace damaged washers.

c) Replace all oil seals, O rings, V rings and cotter pins.

d) Clean parts and apply new silicone sealant P/N **56427** where required when front axle is assembled.

e) Remove nicks, scratches and burrs from machined or ground surfaces. Use a fine file, india stone, emery cloth or crocus cloth.

f) Clean and repair threads. Use a die or tap of the correct size. You can also use a fine file.

NOTE: *Threads must be clean and undamaged to ensure correct values when fasteners are torque-tightened.*

Lubrication

It is important to use the correct type of grease when lubricating the front axle. Refer to the front of this Shop Manual or your **700 Series Operator's Manual** for complete details of temperature range and appropriate grease specifications.

In most applications, the front axle requires lubricating only once a week. Champion recommends lifting the front wheels off the ground at every fourth greasing. Place a safe, adequate stand under the nose plate before greasing. Always increase the lubrication intervals in extremely dusty or wet conditions, or if the joints are dry.

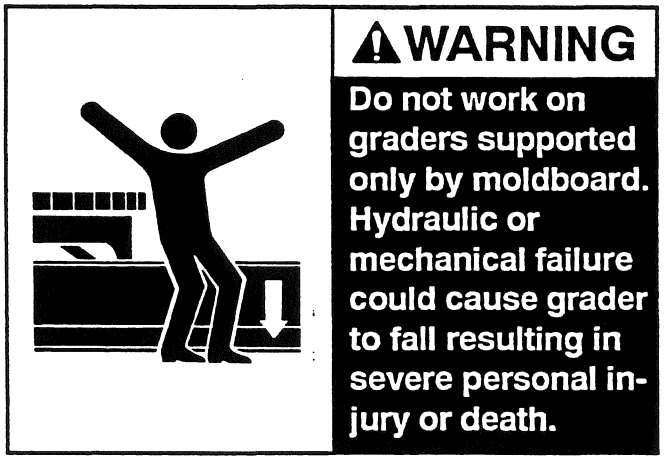
Torque Guide

Page No.	Application	Torque Value		
		lbf·ft	N·m	kgf·m
44	Bolts retaining pivot pin thrust cap	36	49	5
44	Bolts retaining mounting block halves	290	393	40
45	Bolts retaining pivot pin thrust cap	36	49	5
47	Nuts retaining wheels	460	624	64
49	Inner locknut retaining wheel bearings	100	135	14
49	Outer locknut retaining wheel bearings	200	271	28
49	Nuts retaining wheels	460	624	64
50	Locknut retaining pivot block adjusting pin	2100	2847	290

Front Axle Pivot Pin Bearings - Disassembly

1. During this service procedure, you will have to start the engine several times. Be sure that it is safe to start the engine each time it is required. Remember to remove and retain the ignition key when you shut down the engine.

2.



Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Position the moldboard at 90° to the frame. Apply down pressure to the moldboard and lift the front end of the grader until the tires are just touching the ground. Place a safe, adequate stand under the nose plate.

3. Shut down the engine. Remove and retain the ignition key.

4. Identify the steering and leaning wheel hydraulic hoses to avoid confusion during assembly.

5. Disconnect the steering cylinder hydraulic hoses. Plug and cap all open ports and fittings to prevent contamination.

6. Disconnect the left-hand leaning wheel cylinder hoses. Plug and cap all open ports and fittings to prevent contamination.

7. Disconnect the right-hand leaning wheel cylinder hoses. Plug and cap all open ports and fittings to prevent contamination.

8. Remove the bolts (59), lockwashers (58) and flatwashers (57) securing the tie bar bearing pins (56). Use a hammer and metal drift to remove the bearing pins. Remove the tie bar (14). Attach a safe lifting device to the drag link (18).

9. Use a hammer and center punch to mark the pivot pin mounting blocks (15). The marks will help identify the upper and lower mounting block matched halves during assembly.

10. Remove the bolts (16) and lockwashers (17) retaining the lower mounting block halves (15). Remove the lower mounting block halves.

11. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Apply down pressure to the moldboard and lift the front end of the grader until it is clear of the front axle frame. Remove the safety stand.

12. Lower the lifting device and allow the front axle to roll over slowly (see **Fig. 2**). Remove the lifting device and roll the front axle away from the grader.

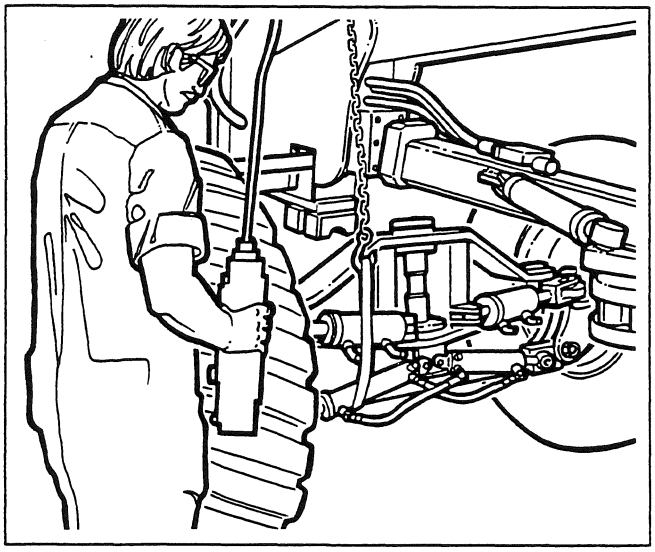


Fig. 2

13. Lower the front end of the grader and place the safety stand under the nose plate. Shut down the engine. Remove and retain the ignition key.

14. Remove the bolts (12) and lockwashers (13) retaining the front and rear thrust caps (1 and 11). Remove the thrust caps, thrust washers (2 and 10) and any shims (3 and 9) from the axle frame bosses.

15. Remove the pivot pin (6) out of the bearings (see **Fig. 3**).

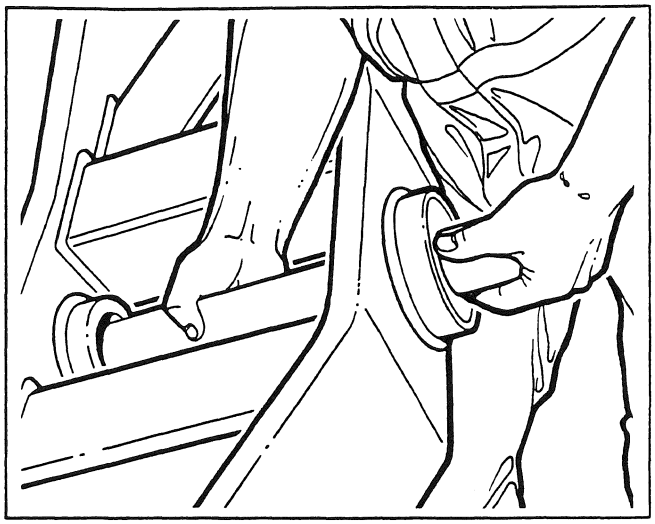


Fig. 3

16. Use a hammer and appropriate tubular drift to remove the needle roller bearings (4 and 8) and seals (5 and 7). Discard the seals.

17. The front axle pivot pin bearing disassembly is now complete. Place the parts to one side for cleaning and inspection.

Front Axle Pivot Pin Bearings - Assembly

1. Lubricate the needle roller bearings (4 and 8) with grease. Use a hammer and appropriate tubular drift to install the bearings into the axle frame front and rear bosses (see **Fig. 4**). Lubricate and install new seals (5 and 7). The seal lips should face outward.

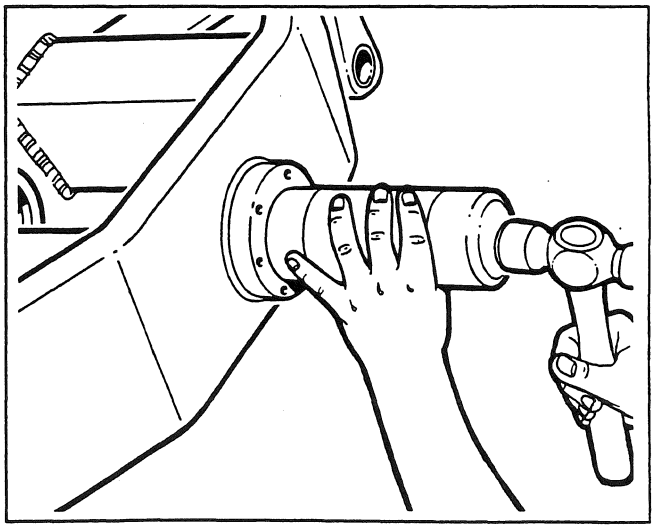


Fig. 4

2. Lubricate the pivot pin (6) with grease. Use a rubber or hide mallet to install the pivot pin into the bearings; taking care not to damage the seals.

3. Install the thrust cap (11), thrust washer (10) and three shims (9) onto the rear boss face of the axle frame. Retain the thrust cap with bolts (12) and lockwashers (13). Tighten the bolts in a diagonal sequence to the specified torque.

4. Install the thrust cap (1) and thrust washer (2) onto the front boss face of the axle frame. Do not install any shims. Retain the thrust cap with bolts (12) and lockwashers (13). Do not torque-tighten the bolts.

5. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Apply down pressure to the moldboard and lift the front end of the grader until it is clear of the safety stand. Remove the stand.

6. Roll the axle assembly under the grader front end. Attach a safe lifting device to the drag link (18). Use the lifting device to slowly turn the axle over (see **Fig. 5**). Take care that the axle does not turn over-center.

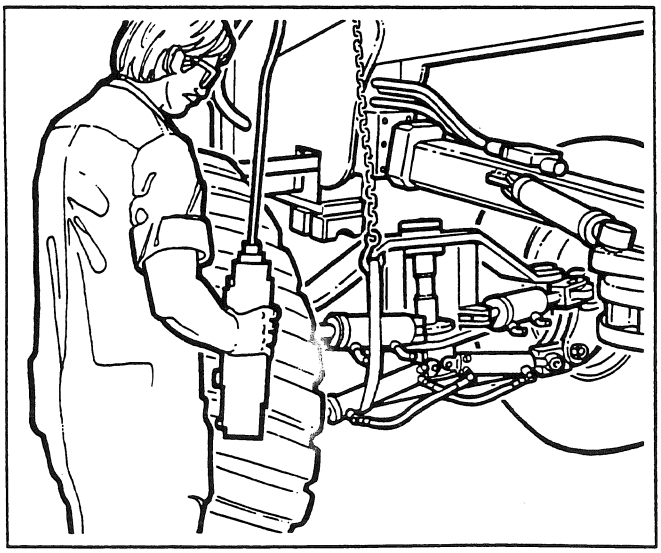


Fig. 5

7. Make sure the mounting block mating faces (15) are clean. Place the safety stand under the nose plate and lower the front end of the grader onto the axle frame. Align the pivot pin with the mating groove of the upper pivot blocks. Shut down the engine. Remove and retain the ignition key.

8. Align the match marks and install the lower mounting block halves (15). Retain the mounting block halves with bolts (16) and lockwashers (17). Tighten the bolts to the specified torque (see **Fig. 6**).

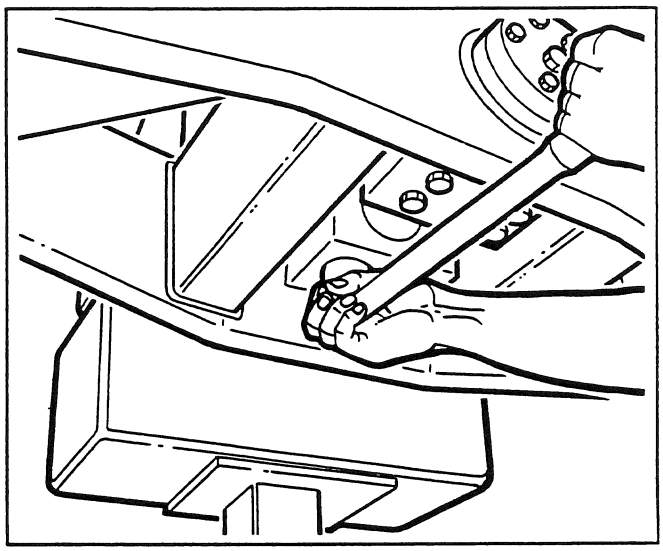


Fig. 6

9. Install the tie bar (14). Lubricate and install the bearing pins (56). Retain the bearing pins with bolts (59), lockwashers (58) and flatwashers (57).

10. Reconnect the left-hand leaning wheel cylinder hoses. Reconnect the right-hand leaning wheel cylinder hoses. Reconnect the steering cylinder hoses.

11. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Apply down pressure to the moldboard and lift the front end of the grader until it is clear of the safety stand. Remove the stand.

12. Set the end float by tightening the front thrust cap bolts until the thrust cap is snug against the pivot pin. Do not overtighten the bolts as you can bend the thrust cap. Lower the grader front end. Shut down the engine. Remove and retain the ignition key.

13. Use feeler gauges to measure the gap between the front thrust cap and the axle frame boss face in three or four places (see **Fig. 7**). The average of these measurements determines the number of shims you will need.

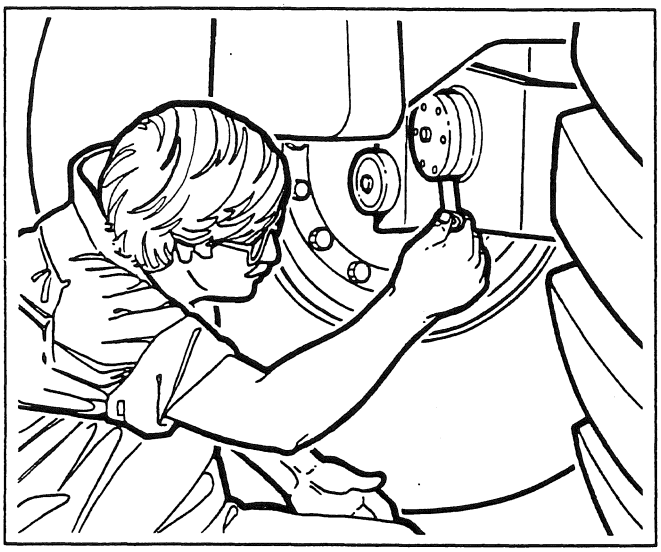


Fig. 7

14. Remove the thrust cap and thrust washer. Now install the thrust cap, thrust washer, required number of shims (3), and another shim equal to the end float specification of 0.003 to 0.005 inch (0,076 to 0,127 mm). Retain the thrust cap with bolts (12) and lockwashers (13). Tighten the bolts in a diagonal sequence to the specified torque.

15. Lubricate both front axle thrust caps through the grease fittings. Road test the grader to ensure that the front axle is working properly and is correctly adjusted.

King Pin Bearings and Spindle Thrust Bearing - Disassembly

1. Since many components are duplicated on both sides of the grader, the following steps describe the disassembly and assembly procedures for the left-hand side only.

2.

⚠ WARNING

Do not work on graders supported only by moldboard. Hydraulic or mechanical failure could cause grader to fall resulting in severe personal injury or death.

Loosen the wheel nuts. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Position the moldboard at 90° to the frame. Apply down pressure to the moldboard and lift the front end of the grader until the tires are just touching the ground. Place a safe, adequate stand under the nose plate.

3. Shut down the engine. Remove and retain the ignition key.

4. Remove the tire and rim. Attach a safe lifting device onto one of the wheel studs.

5. Remove the bolt (63), lockwasher (64) and flatwasher (65) retaining the pivot block bearing pin (66). Use a hammer and appropriate metal drift to remove the bearing pin. This disconnects the drag link (18) from the pivot block (19).

6. Remove the bolts (54) and starwashers (53) retaining the king pin caps (52 and 45). Remove the caps. Remove the setscrew (49) from the spindle (20).

7. Use a jack and appropriate drift to remove the king pin (48) (see **Fig. 8**). Use the lifting device to remove the spindle/wheel hub assembly. Remove the thrust bearing (50).

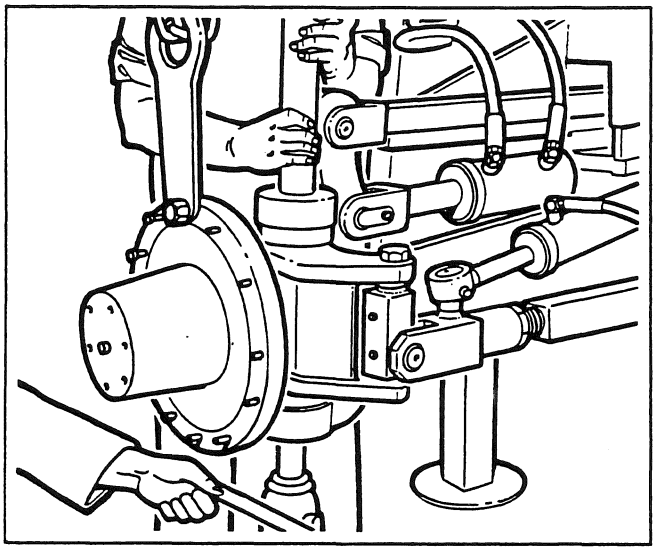


Fig. 8

8. Use a hammer and appropriate tubular drift to remove the two needle roller bearings (51) from the top bore of the knuckle (55) (see **Fig. 9**).

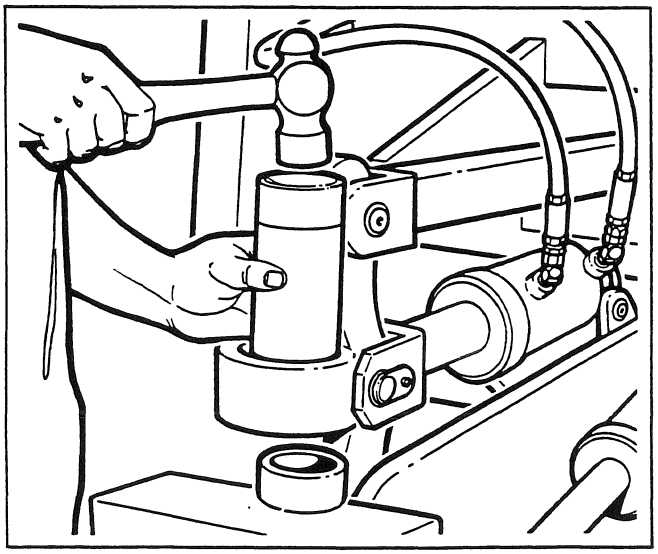


Fig. 9

9. Use a jack and appropriate tubular drift to remove the two needle roller bearings (46) and seal (47) from the bottom bore of the knuckle (see **Fig. 10**). Discard the seal.

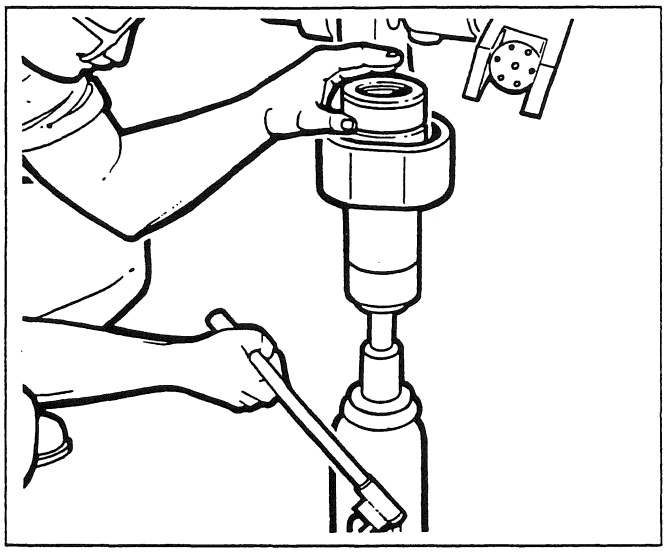


Fig. 10

10. The left-hand king pin bearing and spindle thrust bearing disassembly is now complete. Place the parts to one side for cleaning and inspection.

King Pin Bearings and Spindle Thrust Bearing - Assembly

1. Place the king pin (48) in a freezer or dry ice. Freezing causes the king pin to shrink and makes installation easier.

2. Lubricate the needle roller bearings (46 and 51) with grease. Use a hammer and appropriate tubular drift to install the bearings into the upper and lower bores of the knuckle (55) (see **Fig. 11**). Lubricate and install a new seal (47) at the top face of the knuckle lower bore. The seal lip should face upward.

3. Use the lifting device to maneuver the spindle/wheel hub assembly into position at the knuckle. Install the thrust bearing (50) in between the spindle and knuckle upper boss.

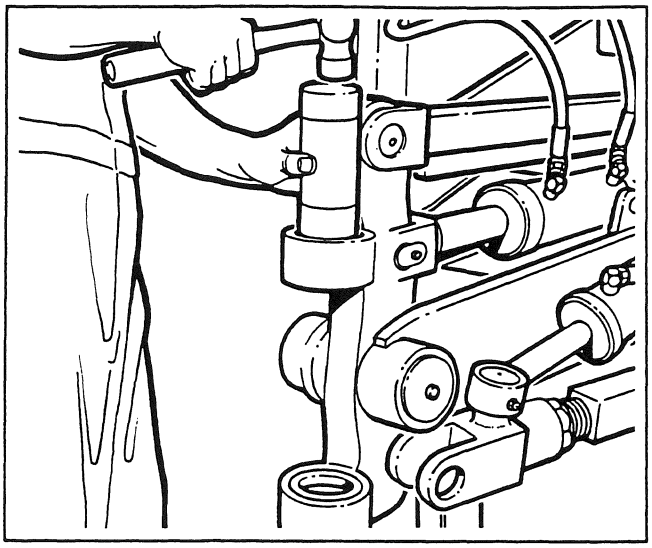


Fig. 11

4. Carefully install the king pin. Make sure you align the slot in the king pin with the tapped hole for the setscrew (49) (see **Fig. 12**). As previously stated, freezing the king pin helps make the installation easier. Install the setscrew to secure the king pin. Check to see that the spindle pivots freely on the king pin.

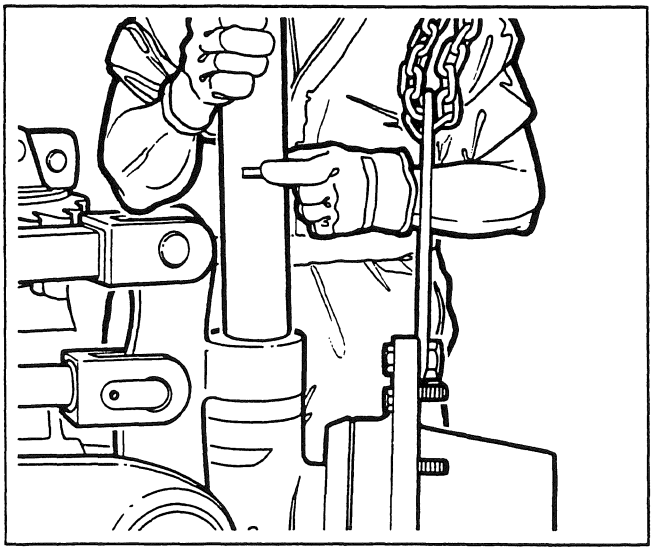


Fig. 12

5. Apply a bead of silicone sealant P/N **56427** to the king pin caps (45 and 52). Install the caps and retain them with bolts (54) and starwashers (53). Lubricate both king pin caps through the grease fittings.

6. To install the pivot block bearing pin (66), you must first remove the pivot block (19). Loosen the adjustment pin locknut (60) and remove the adjustment pin (61). Remove the bolts (41) and starwashers (42) retaining the radius arm pin (43). Remove the radius arm pin. Remove the pivot block.

7. Check the pivot block needle roller bearing (39) and seals (38 and 44) for serviceability. Replace parts as necessary. Lubricate the bearing with grease.

8. Install the pivot block into the yoke of the drag link (18) and retain with the pivot block bearing pin. Secure the pin with the bolt (63), lockwasher (64) and flatwasher (65).

9. Install the pivot block in between the spindle radius arms. Install the radius arm pin and retain with the bolts and starwashers. Install the adjustment pin and locknut. For the proper adjustment procedure, see **Pivot Block and Toe-in Adjustments** in this section. Lubricate the pivot block and pivot block pin through the grease fittings.

10. Install the tire and rim on the wheel. Tighten the wheel nuts in a diagonal sequence to the specified torque. Road test the grader to ensure that the spindle and knuckle are working correctly.

Wheel Bearings - Disassembly

⚠WARNING

Do not work on graders supported only by moldboard. Hydraulic or mechanical failure could cause grader to fall resulting in severe personal injury or death.

1. Since many components are duplicated on both sides of the grader, the following steps describe the disassembly and assembly procedures for the left-hand side only.

2. Loosen the wheel nuts. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Position the moldboard at 90° to the frame. Apply down pressure to the moldboard and lift the front end of the grader until the tires are just touching the ground. Place a safe, adequate stand under the nose plate.

3. Shut down the engine. Remove and retain the ignition key.

4. Remove the tire and rim. Attach a safe lifting device onto one of the wheel studs.

5. Remove the bolts (34) and starwashers (35) retaining the hub cap (33). Remove the hub cap.

6. Use a hammer and appropriate drift to bend back the tabs of the tabwasher (31) (see **Fig. 13**). Remove the outer locknut (32). Remove and discard the tabwasher. Remove the inner locknut (30). Remove the lockwasher (29).

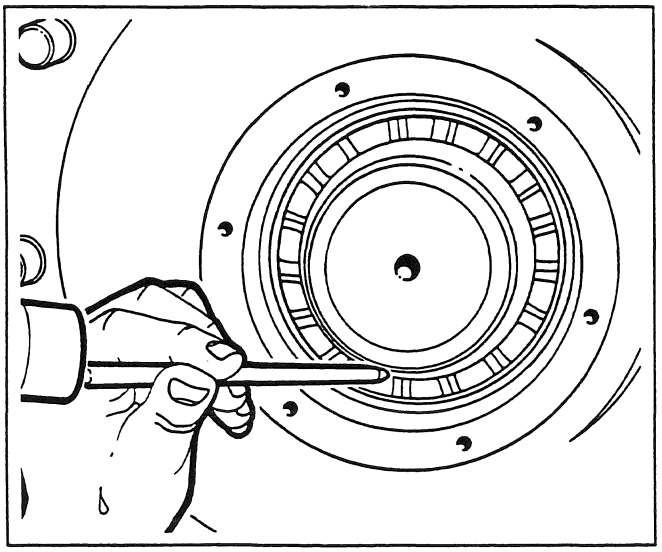


Fig. 13

7. Pull the wheel (26) out slightly on the spindle (20). Remove the outer bearing cone (28). Remove the wheel. Remove the inner bearing cone (24).

8. Remove and discard the V ring seal (23) from the deflector spacer (22). Remove the deflector spacer and dust seal (21). Discard the dust seal.

9. Use a hammer and appropriate soft metal drift to remove the inner and outer bearing cups (25 and 27) (see **Fig. 14**).

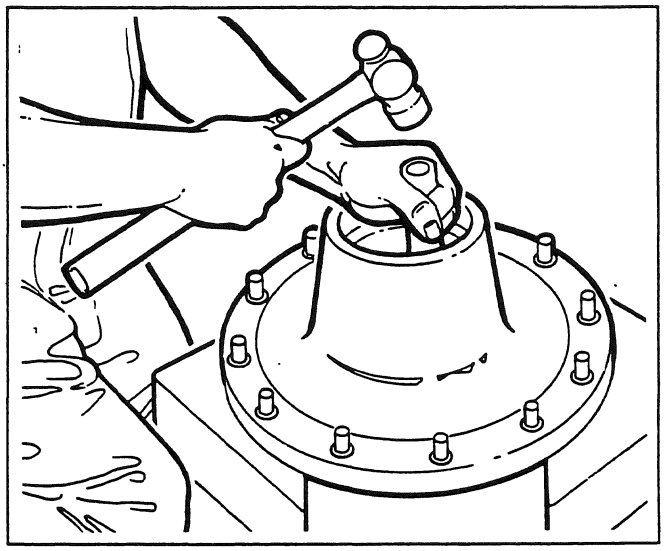


Fig. 14

10. The front axle wheel bearing disassembly is now complete. Place the parts to one side for cleaning and inspection.

Wheel Bearings - Assembly

1. Lubricate the outside diameter of the inner and outer bearing cups (25 and 27) with oil. Use a hammer and appropriate bearing driver to install the bearing cups into the wheel counterbores (see **Fig. 15**). Lubricate the wheel bore and inside diameter of the bearing cups with a generous amount of grease.

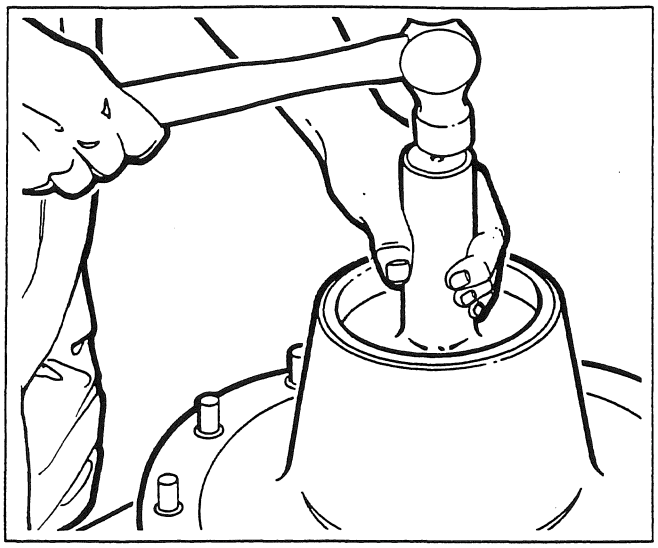


Fig. 15

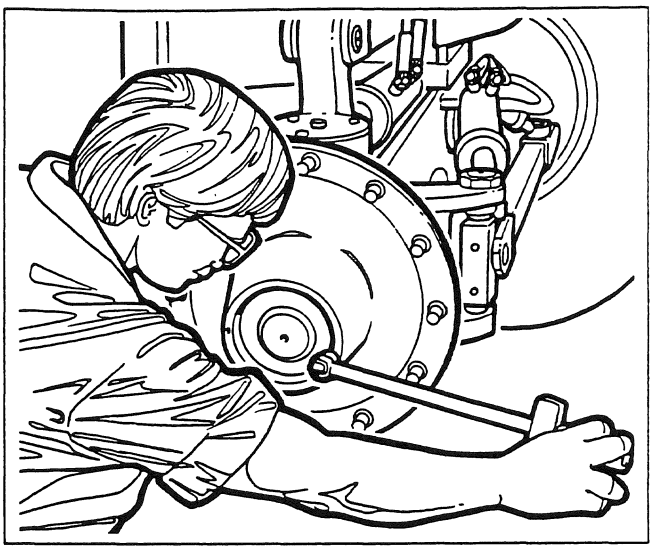


Fig. 16

2. Install a new dust seal (21), deflector spacer (22) and new V ring seal (23). Apply grease onto the spindle (20).

3. Generously lubricate the inner bearing cone (24) with grease and install it onto the spindle. Attach a safe lifting device to the wheel (26) and install it onto the spindle. Generously lubricate the outer bearing cone (28) with grease and install it onto the spindle.

4. Install the lockwasher (29). Install the inner locknut (30).

5. Install one of the hub cap bolts (34) to help determine the wheel bearing preload. Tighten the inner locknut to the specified torque or until 8 to 12 lbf•ft (11 to 16 N•m; 1,1 to 1,6 kgf•m) of torque, applied at the hub cap bolt, is needed to turn the wheel (see **Fig. 16**).

6. After setting the wheel bearing preload, install a new tabwasher (31). Install the outer locknut (32) and tighten to the specified torque. Bend the tabwasher tabs until they fit into the slots of both locknuts.

7. Apply a bead of silicone sealant P/N **56427** to the hub cap (33). Install the hub cap and retain it with bolts (34) and starwashers (35). Lubricate the hub cap until the wheel bearings are full of grease.

8. Install the tire and rim on the wheel. Tighten the wheel nuts in a diagonal sequence to the specified torque.

9. Recheck the wheel bearing preload by pushing the wheel, which should rotate one and one half turns before stopping. Road test the grader to ensure that the wheel bearings are working properly and are correctly adjusted.

Pivot Block and Toe-in Adjustments

1. Proper pivot block and toe-in adjustment is essential to ensure reduced tire wear and stable operation of the grader.

2. Start the procedure with the left-hand pivot block. You will need to tighten or loosen the adjustment pin (61) found at the top of the pivot block (19).

3. Tighten the adjustment pin until grease just passes through the O rings (40 and 62) when you lubricate the pivot block.

4. When the adjustment is correct, hold the adjustment pin with a screwdriver. Tighten the locknut (60) to the specified torque. Repeat steps 3 and 4 for the right-hand pivot block.

5. Before starting the toe-in measurement, ensure that the wheels are straight and are not leaning to the left or right. If necessary, move the grader forward and backward to remove any tread distortions.

6. Start the toe-in check by making a mark on the tires behind the axle frame and at the same level as the center line of the spindle. Measure the distance between the tires at these marks (see **Fig. 17**).

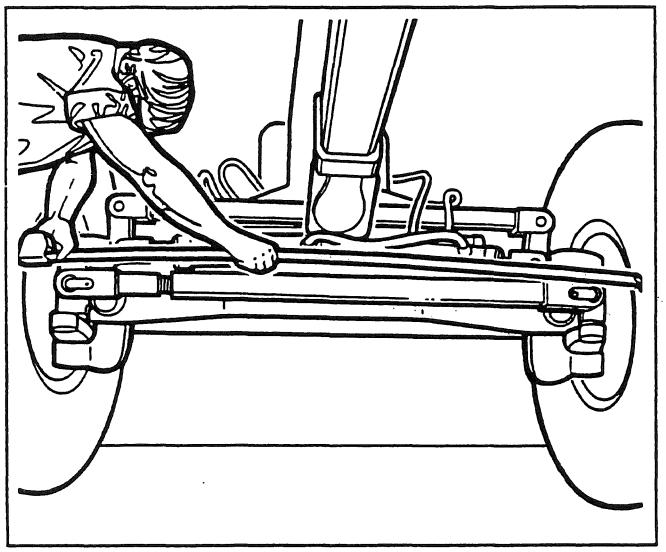


Fig. 17

7. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Slowly drive the grader forward so the marks on the tires are in front of the axle frame and are at the same level as the center line of the spindle. Shut down the engine and retain the ignition key.

8. Again measure the distance between the tires at the marks (see **Fig. 18**). The front measurement should be one half to five eighths of an inch (1,3 cm to 1,6 cm) less than the rear measurement.

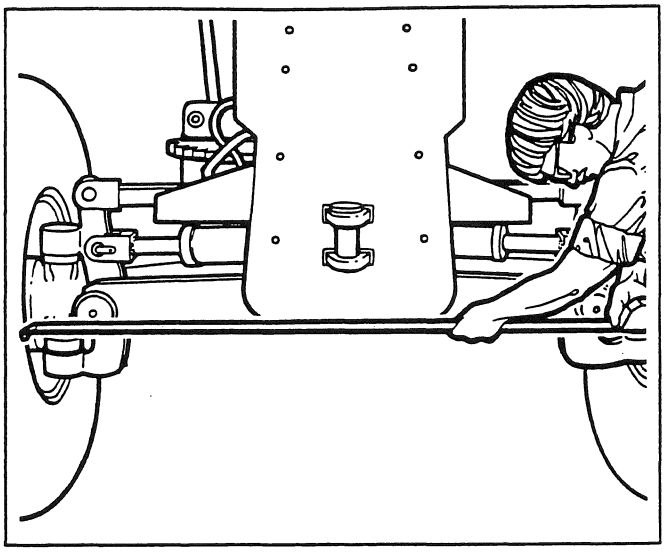


Fig. 18

9. To adjust the toe-in, loosen the locknut (36) on the drag link (18). Use a wrench to turn the adjusting collar (37) (see **Fig. 19**). Turning the adjusting collar varies the length of the drag link and changes the toe-in measurement.

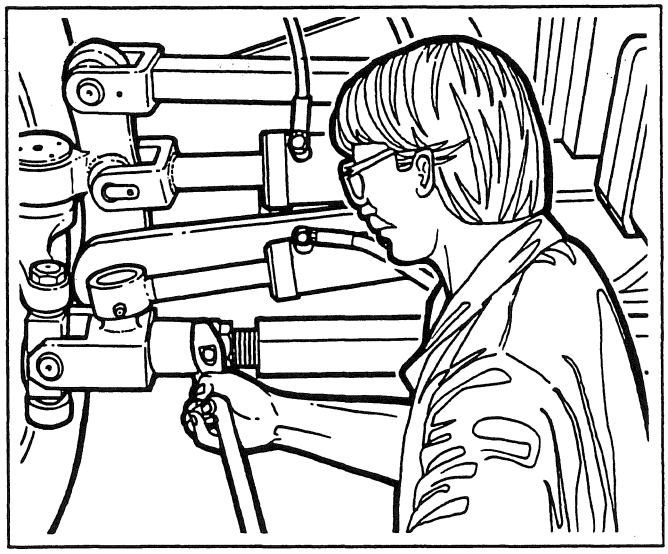


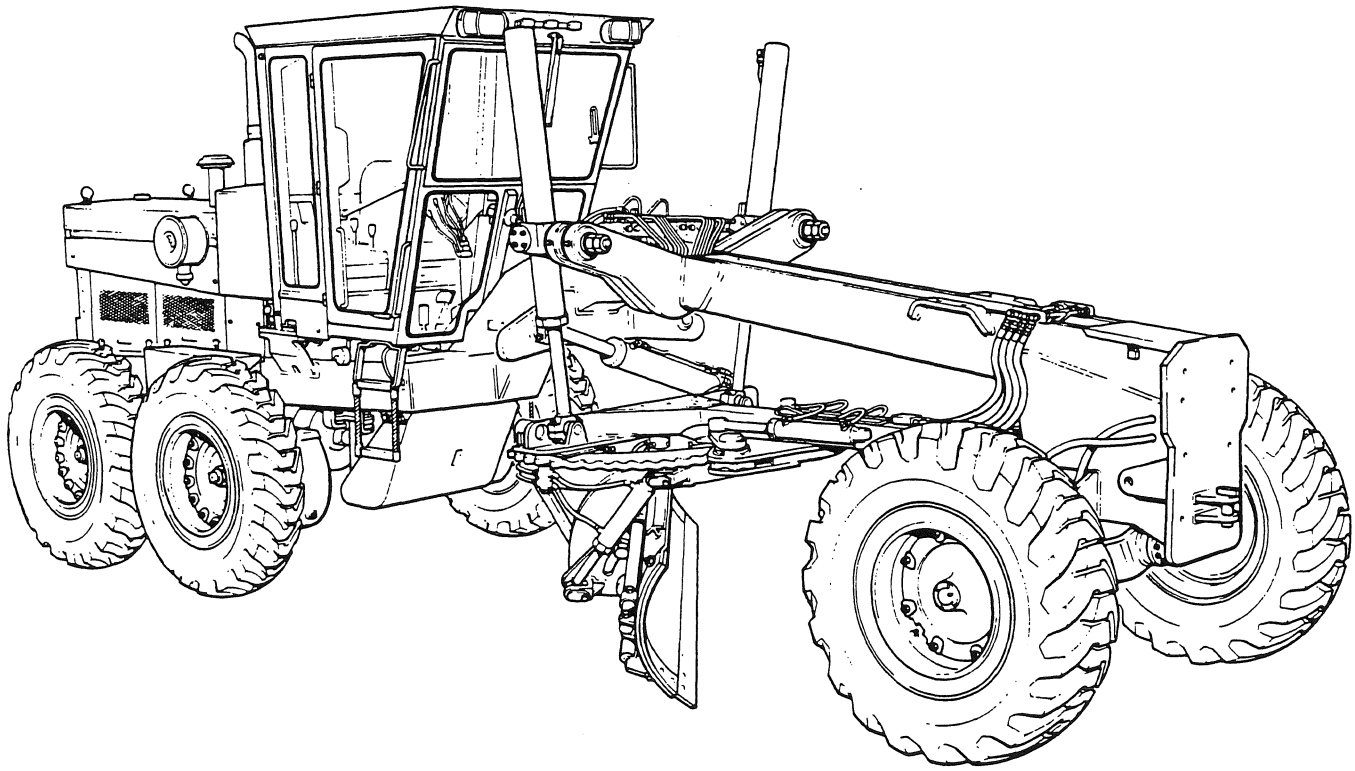
Fig. 19

10. Once you have completed the toe-in adjustment, retain the adjusting collar and tighten the locknut. Re-check the toe-in measurement.

11. The pivot block and toe-in adjustments are now complete.

SECTION 2

CIRCLE, DRAWBAR AND MOLDBOARD



CHAMPION®
ROAD MACHINERY

CIRCULATE TO:
PARTS MANAGER_____
SALES MANAGER_____

RETURN TO:
SERVICE MANAGER_____

PRODUCT SUPPORT BULLETIN No. 507

SUBJECT: Timing Circles with New Tooth Profile (Standard and Heavy Duty) August, 1989

Starting at production grader serial number **19895**, Champion introduced a new circle and drive pinion tooth profile. The shape appears as if the end of the circle and drive pinion teeth has been cut square. A slightly different circle timing adjustment method is required for the new tooth profile. Perform this timing adjustment at the first 250 hours, every 500 hours or as required.

For the new tooth profile only, refer to the 700 Series Shop Manual P/N **L 2005**, section 2, and revise the following steps.

Fig. 55, Page 21. Circle drive pinion tooth root to tip clearance is no longer measured.

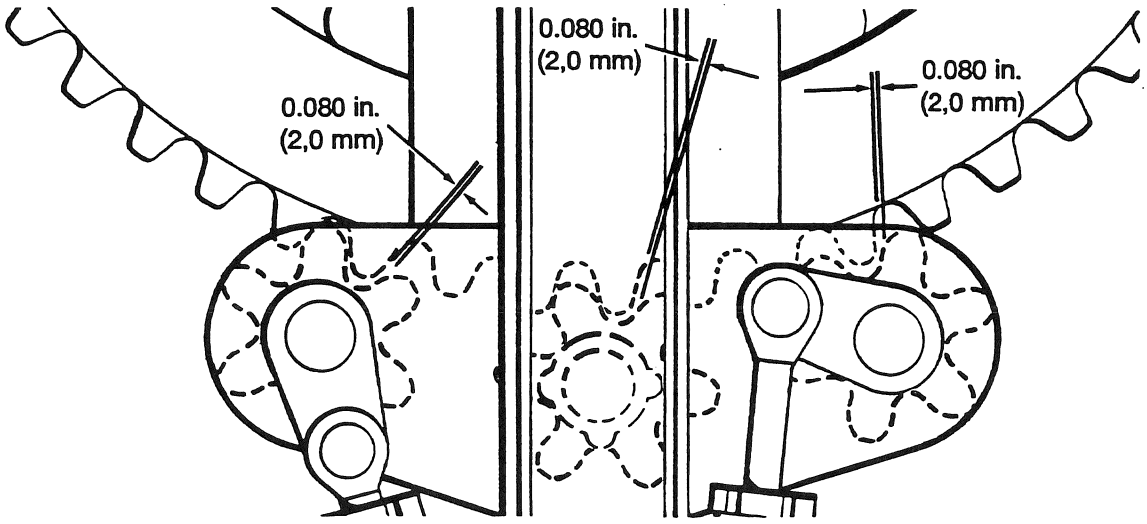
Adjust the front guide plate(s) to contact the inner face of the circle. Contact should be across the complete width of the guide plate(s). Refer to the illustration and use feeler gauges to measure the backlash of both drive pinions. This should be 0.080 in. (2,0 mm). The shape of the teeth allows you to measure the backlash at any location along the tooth. Adjust the guide plates to maintain drive pinion and valve pinion backlash.

Fig. 56, Page 24. Circle turn valve pinion tooth root to tip clearance is no longer measured.

The circle turn valve pinion backlash must also be 0.080 in. (2,0 mm). If not, check parts for wear.

Fig. 57, Page 24. Two guide plates no longer contact the circle.

Adjust the clearance of the rear guide plates to 0.040 to 0.080 in. (1,0 to 2,0 mm) evenly between the guide plates and the circle. When the circle adjustment is complete, install and tighten all clamp and guide plate nuts to the specified torque.



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CIRCLE, DRAWBAR AND MOLDBOARD

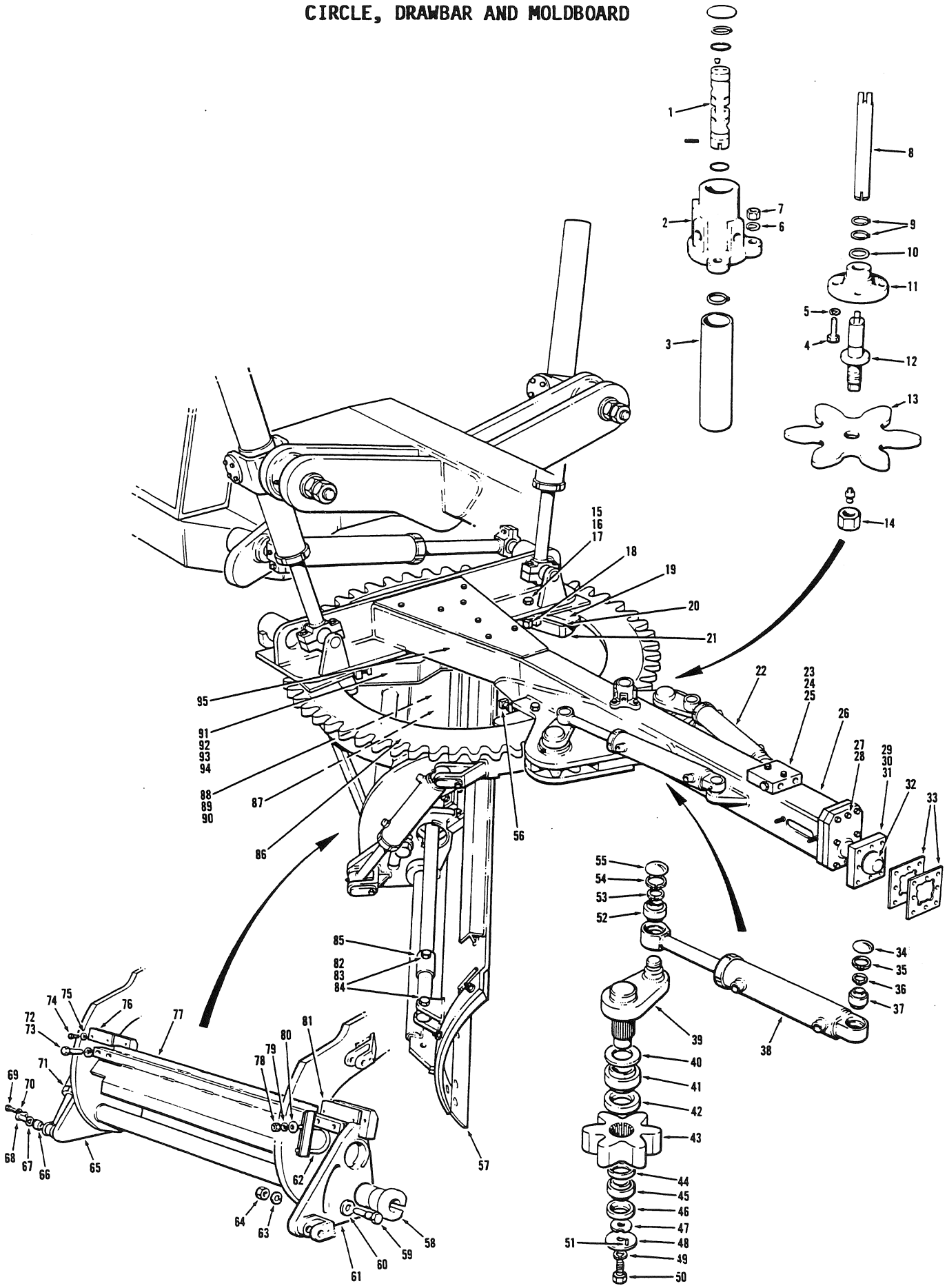


Fig. 1

Item	Description	Item	Description	Item	Description
1	Spool	33	Shim pack	65	Quadrant
2	Circle turn valve	34	Expansion plug	66	Spherical bearing
3	Hose guard tube	35	Snap ring	67	Snap ring
4	Capscrew	36	Snap ring	68	Lower pin
5	Lockwasher	37	Spherical bearing	69	Capscrew
6	Lockwasher	38	Circle turn cylinder	70	Lockwasher
7	Nut	39	Crank	71	Power tilt cylinder
8	Drive shaft	40	Seal	72	Capscrew
9	Snap ring	41	Spherical bearing	73	Lockwasher
10	Thrust washer	42	Seal	74	Capscrew
11	Pinion shaft bearing	43	Drive pinion	75	Lockwasher
12	Pinion shaft	44	Seal	76	Quadrant wear plate
13	Valve pinion	45	Spherical bearing	77	Cylinder guard
14	Locknut	46	Seal	78	Nut
15	Bolt	47	Notch washer	79	Lockwasher
16	Nut	48	Retaining washer	80	Plain washer
17	Jam nut	49	Lockwasher	81	Quadrant wear plate
18	Setscrew	50	Capscrew	82	Bolt
19	Guide plate	51	Roll pin	83	Lockwasher
20	Shim pack	52	Spherical bearing	84	Nut
21	Clamp plate	53	Snap ring	85	Piston rod extension
22	Circle turn cylinder	54	Snap ring	86	Circle
23	Cushion valve	55	Expansion plug	87	Slide shift cylinder
24	Capscrew	56	Setscrew	88	Bolt
25	Lockwasher	57	Moldboard	89	Lockwasher
26	Drawbar	58	Lower slide casting	90	Nut
27	Capscrew	59	Quadrant pivot bolt	91	Drive arm
28	Lockwasher	60	Retaining washer	92	Bolt
29	Drawplate	61	Quadrant	93	Lockwasher
30	Capscrew	62	U clamp	94	Nut
31	Lockwasher	63	Lockwasher	95	Hydraulic swivel joint
32	Ball stud	64	Nut		

Key to Fig. 1

General

Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks; a hydraulic jack and normal shop tools.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

THE SERVICE POSITION IS AS FOLLOWS:- PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH PROPER STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS.

THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

Description

The circle, drawbar and moldboard is the working area of the grader. The circle is a heavy steel fabrication suspended under the drawbar. Teeth on the circle circumference mesh with two drive pinions. Two hydraulic cylinders and cranks transmit power through the drive pinions to turn the circle.

The drawbar is a "T"-shaped welded assembly connected at four points to the grader. The front is mounted on a pivoting ball stud. The two sides of the rear cross-member include ball pin anchors for the blade lift cylinder ball caps. The circle shift cylinder, attached to the drawbar and frame arch, moves the drawbar sideways.

Cleaning and Inspection

Cleaning - Bearings and Small Parts

You are recommended to wear cotton gloves when handling bearings. This prevents transfer of skin acids and perspiration onto bearing races.

Immerse bearings and small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags. Make sure all oil passages are unblocked. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning - Large Welded Assemblies

Large welded assemblies are most easily cleaned using a high-pressure detergent spray. Use a brush soaked in diesel fuel to remove old lubricant. Protect all wear surfaces from corrosion by drying them quickly and applying fresh lubricant.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all spherical races, cups and teflon-lined cones for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - Gaskets, Oil Seals and Snap Rings

Replace all gaskets, oil seals and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency. Lubricate all oil seal lips with system oil.

Cleaning and Inspection (Continued)

Inspection - Gears and Shafts

Examine teeth of all pinion gears for wear caused by contamination, misalignment, etc. Inspect shafts for signs of bent or twisted splines and replace any deformed cranks.

Torque Guide

Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 30	Drawplate capscrews	244	25	180
Fig. No. 40	Pinion bearing capscrews	31	3	23
Fig. No. 57	Circle clamp and guide plate nuts	1301,5	133	960
Fig. No. 64	Slide shift cylinder anchor nut	1003	102	740
Fig. No. 66	Slide shift cylinder guard capscrews	339	34,5	250
Fig. No. 67	Slide shift cylinder U clamp nuts	13,5	1,4	10
Fig. No. 71	Slide shift cylinder piston rod anchor nut	1003	102	740

Adjustments

Fig. No.	Application	mm	in.
Fig. No. 47, Fig. No. 48, Fig. No. 49	Clearance between circle face and drawbar (add this dimension to the total thickness of the inside edge of the circle and the clamp plate lip)	1,58	1/16
Fig. No. 55	Clearance between root of circle teeth and tips of both drive pinions	1,6 - 3	.06 - .12
Fig. No. 57	Clearance between third guide plate and circle inside edge	1,6	.06

Troubleshooting

Problem	Cause	Remedy
Circle turns under load.	Drive cylinders are passing oil.	Replace the cylinder packing.
	Cushion valve leaking.	Replace the cushion valve.
Circle will not turn.	Obstruction in the circle turn mechanism.	Remove debris from the circle turn mechanism.
	Circle out of adjustment.	Adjust the circle.
	Drive pinion/drive shaft for the timing valve slipped, damaged or broken.	Adjust, repair or replace the drive pinion or shaft.
	Damaged or broken circle drive mechanism.	Repair or replace circle drive components as required.
	Circle timing is out of adjustment.	Adjust the circle timing
	Hydraulic malfunction.	See Hydraulics Section.
Circle turns in the wrong direction.	Timing valve spool is 180° out of adjustment.	Adjust the timing valve.
Circle turns in one direction only.	Circle turn cushion valve out of adjustment.	See Hydraulics Section.
Moldboard is loose.	Lower slide castings are worn.	Replace the lower slide castings.
	Upper slide rail or wear plates are worn.	Install new wear plates. **DO NOT** install wear plates so that the clearance is too tight. The wear plates will be damaged.
Moldboard drifts under load.	Tilt cylinders are passing oil.	Replace the cylinder packing.
	Power tilt lock valve is malfunctioning.	Repair or replace the lock valve.

Circle, Drawbar and Moldboard - Removal and Disassembly

Fig. 2
Park the grader on level ground. Place the transmission mode lever in **Neutral.** Centralize the circle, drawbar and moldboard assembly using the circle shift and blade lift cylinders. Tilt the moldboard (57) forward. Move the moldboard to the right as far as possible using the slide shift cylinder (87). Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **Service Position.**

Fig. 3
Remove the capscrews (74) and lockwashers (75) retaining the quadrant wear plates (76 and 81). Remove the wear plates.

Fig. 4
Tilt the moldboard (57) as far back as possible. Remove the nut (84), bolt (82) and lockwasher (83) retaining the slide shift cylinder piston rod or rod extension (85) to the moldboard lugs.

Fig. 5
Retract the piston rod. Place a block of wood between the end of the rod and the moldboard lugs. Support the end of the moldboard (57) with a safe lifting device. Push the moldboard out of its slides using the slide shift cylinder. **Make sure** that the slide shift cylinder piston rod does not bend or become damaged during this procedure. Fully retract the piston rod. Move the moldboard to a safe place.

Fig. 6
Support the slide shift cylinder (87). Remove the nuts (78), lockwashers (79), plain washers (80) and U clamp (62).

Fig. 7
Remove the capscrews (72) and lockwashers (73) retaining the slide shift cylinder guard (77). Carefully remove the guard.

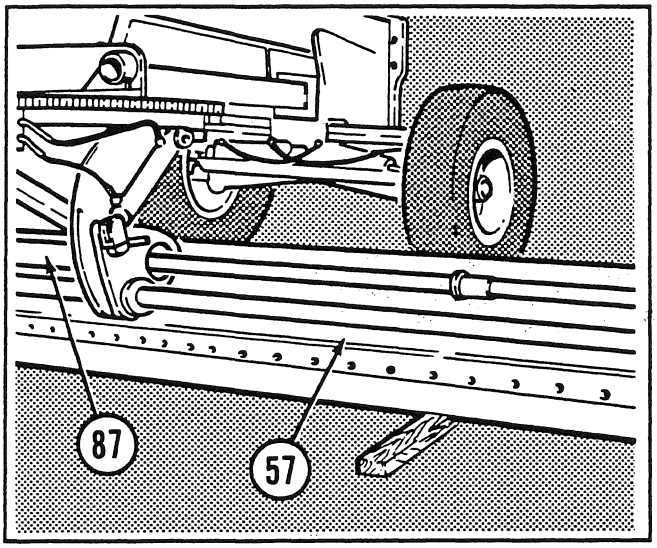


Fig. 2

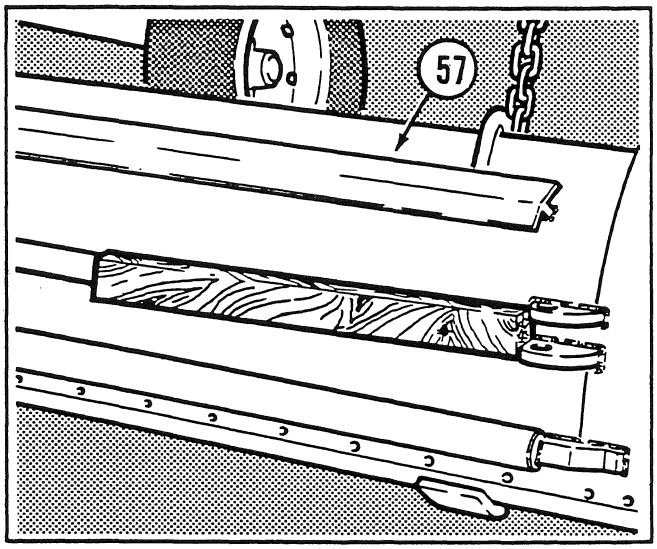


Fig. 5

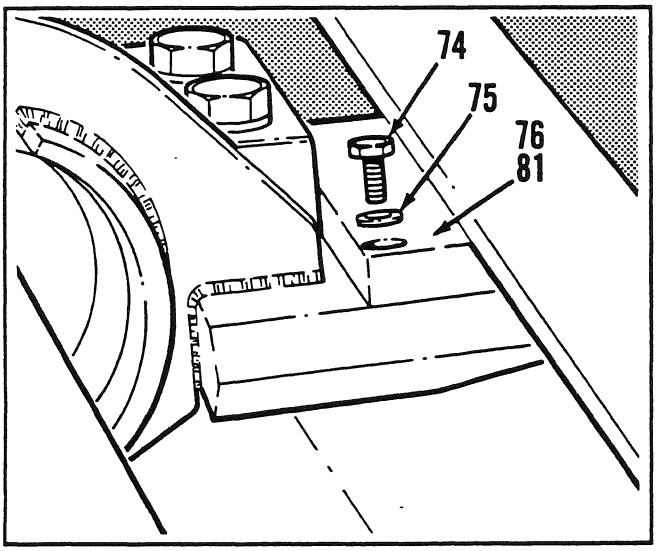


Fig. 3

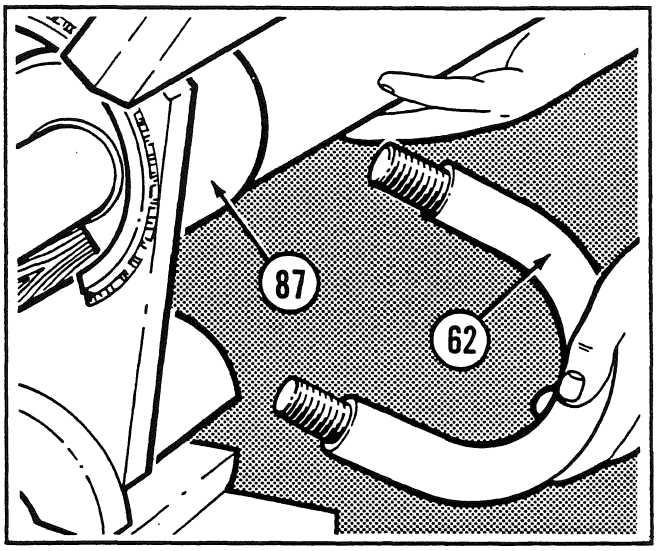


Fig. 6

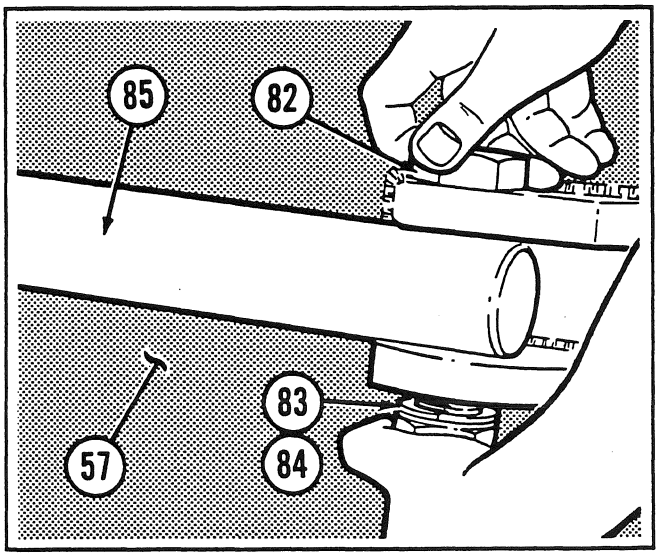


Fig. 4

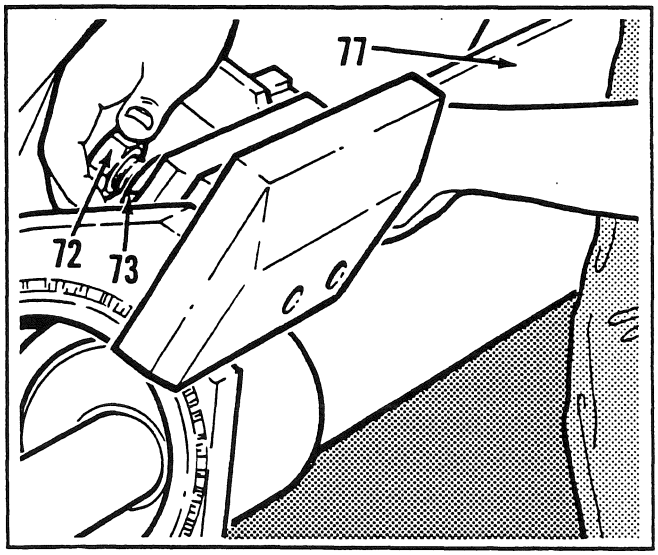


Fig. 7

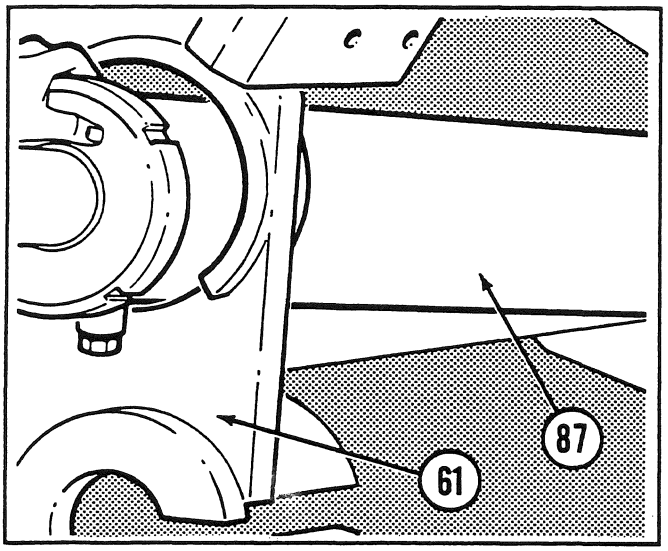


Fig. 8

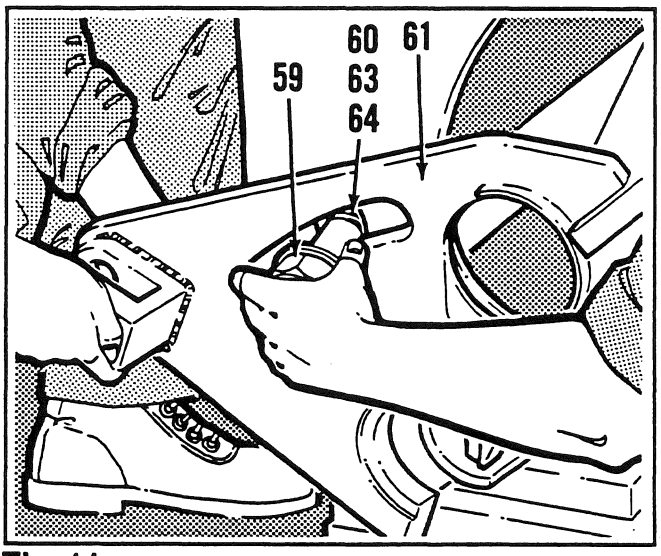


Fig. 11

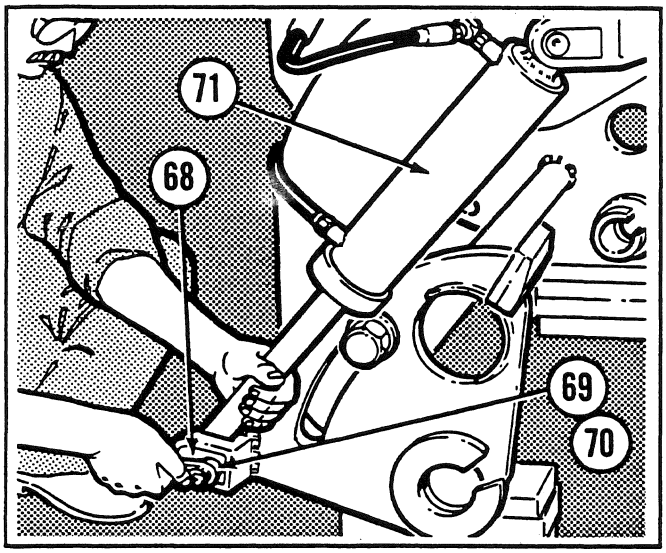


Fig. 9

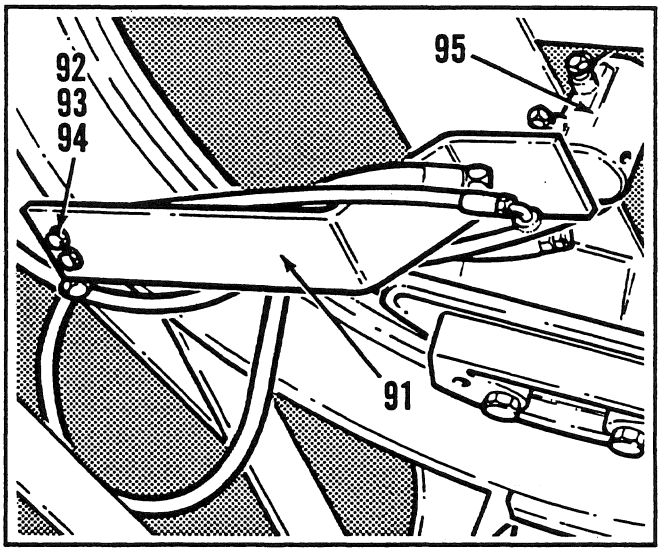


Fig. 12

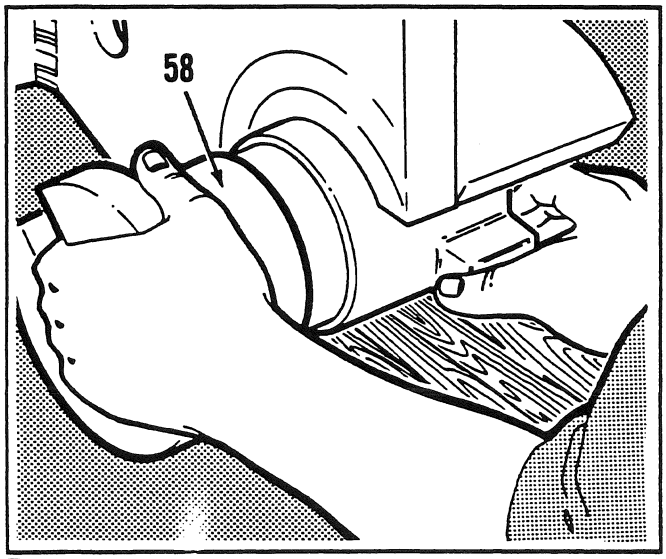


Fig. 10

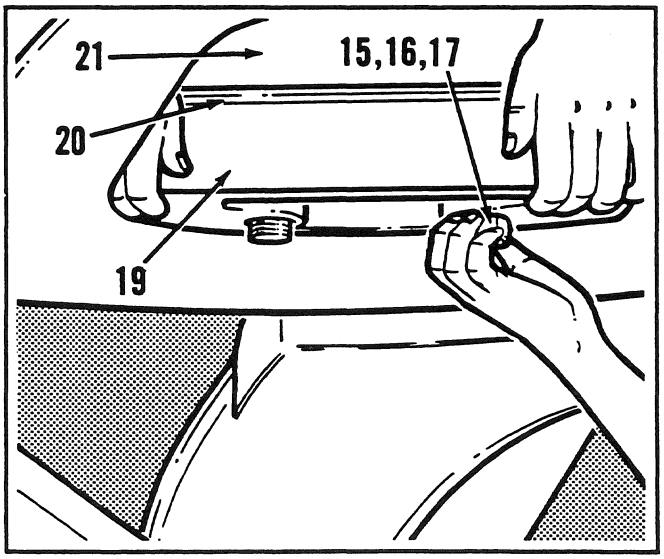


Fig. 13

Circle, Drawbar and Moldboard - Removal and Disassembly (Continued)

Fig. 8
Disconnect the hoses from the slide shift cylinder (87). Identify the hoses to avoid confusion during assembly. Remove the fittings from the cylinder. Plug the hoses and cylinder ports to prevent contamination. Remove the cylinder anchor bolt (88), nut (90) and lockwasher (89). Remove the cylinder through the access hole in the right hand quadrant (61).

Fig. 9
Fully extend the power tilt cylinder (71) or manual tilt link. Remove the capscrew (69) and lockwasher (70) retaining the lower pin (68). Remove the pin using a hammer and soft metal drift. Carefully retract the cylinder. Disconnect the hoses. Plug the hoses and fittings to prevent contamination. Remove the capscrew and lockwasher retaining the upper pin. Remove the pin using a slide hammer. Remove the cylinder or link. When replacing spherical bearings (66), remove and discard the snap rings (67).

Fig. 10
A lug retains the lower slide casting (58). Turn the casting 180° and align the lug with the openings in the circle arm and quadrant. Support and remove the casting.

Fig. 11
Remove the quadrant pivot bolt (59), retaining washer (60), nut (64) and lockwasher (63). Support and remove the quadrant (61). Repeat the steps in **Fig. 9** through **Fig. 11** for the other side.

Fig. 12
Before separating the circle (86) from the drawbar (26), support the circle arms on proper blocks and the front of the circle on a secure stand. Disconnect both ends of the hoses between the hydraulic swivel joint assembly (95) and the circle. Plug the hoses and fittings to prevent contamination. Remove the nuts (94), bolts (92) and lockwashers (93) securing the drive arm (91). Remove the drive arm.

Fig. 13

Support the guide plates (19) and clamp plates (21). Remove the bolts (15), jam nuts (17), nuts (16), plates and shim packs (20).

Circle, Drawbar and Moldboard - Removal and Disassembly (Continued)

Fig. 14
Start the grader and carefully drive it forward, disengaging the circle (86) teeth from the drive pinions (43).

Fig. 15
Raise and move the drawbar (26) to one side using the blade lift and side shift cylinders. Attach chains securely at three points around the circle (86). Raise and move the circle away from the grader using the lifting device. Center and level the drawbar and secure safely.

Fig. 16
To disassemble the circle turn mechanism, disconnect the hoses from the circle turn cylinders (22 and 38) and circle turn valve (2). Plug the hoses and fittings to prevent contamination. Cut a slot in the expansion plug (55). Remove and discard the expansion plug and external snap ring (54).

Fig. 17
Remove both cylinder ends from the studs using a puller. Inspect the spherical bearings (52) and studs for excessive wear or damage. Replace defective bearings.

Fig. 18
Before disassembling the crank (39) and drive pinion (43), mark the position of the crank in relation to one of the drive pinion teeth. This will help during assembly and in the circle timing procedure.

Fig. 19
Remove the capscrew (50), lockwasher (49), retaining washer (48) and notch washer (47). Remove and discard the roll pin (51). Remove the crank (39) from the drive pinion (43) using a hydraulic jack.

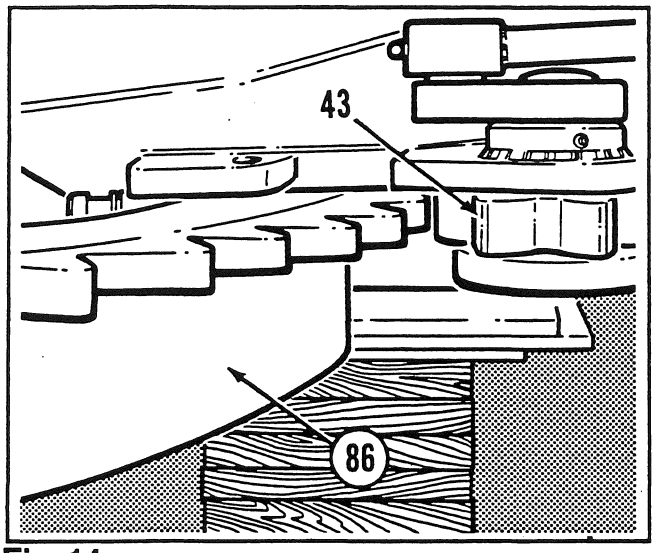


Fig. 14

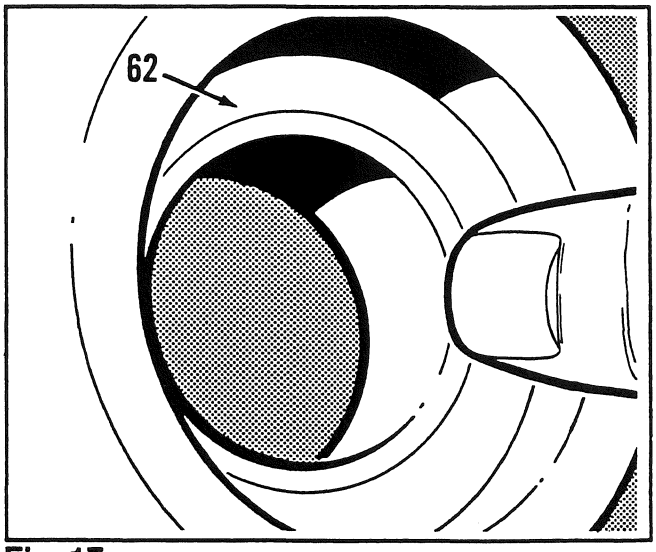


Fig. 17

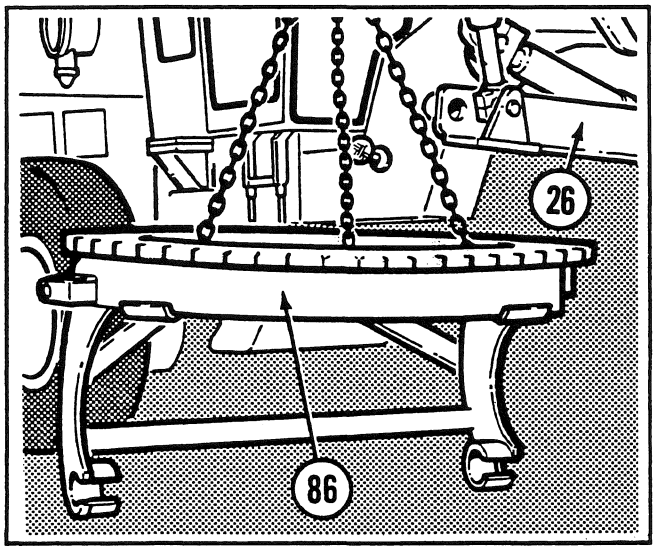


Fig. 15

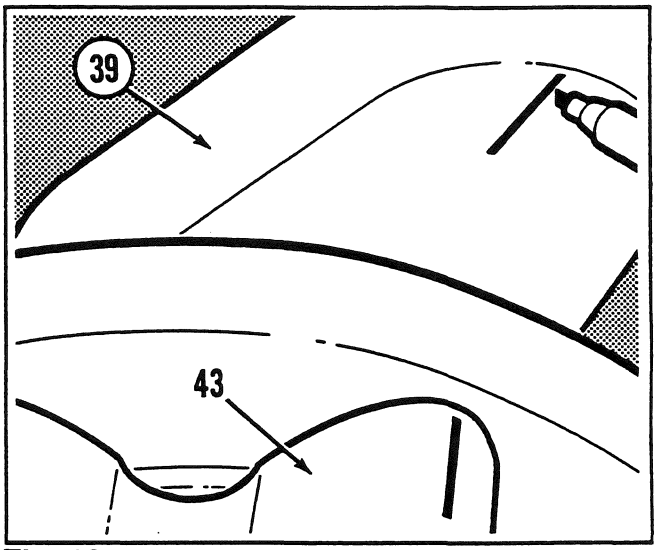


Fig. 18

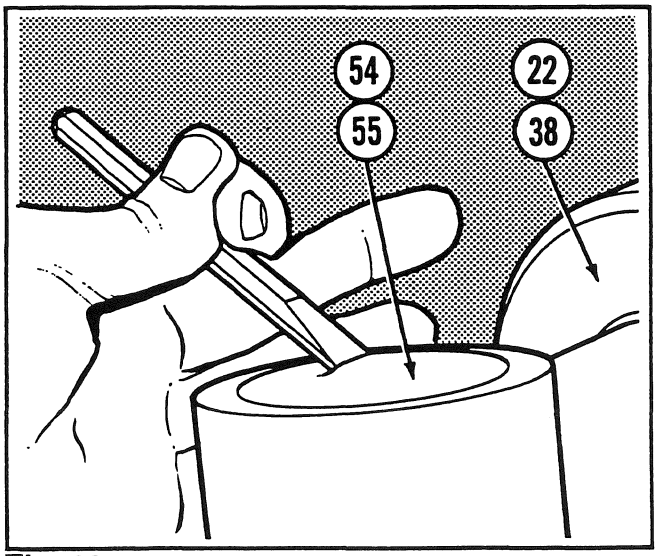


Fig. 16

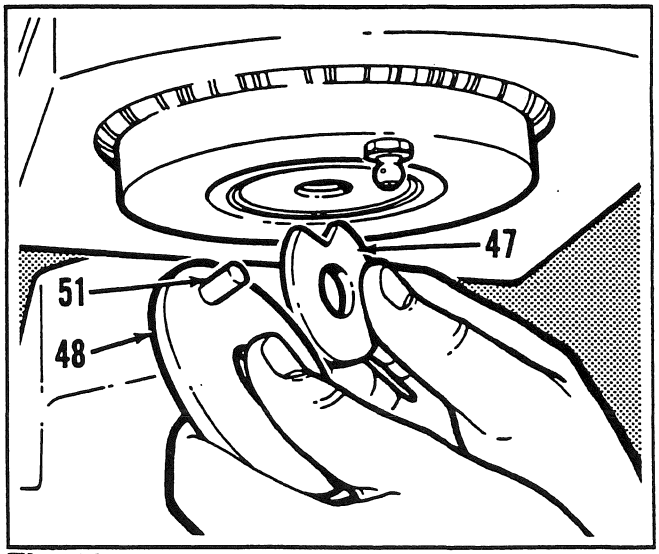


Fig. 19

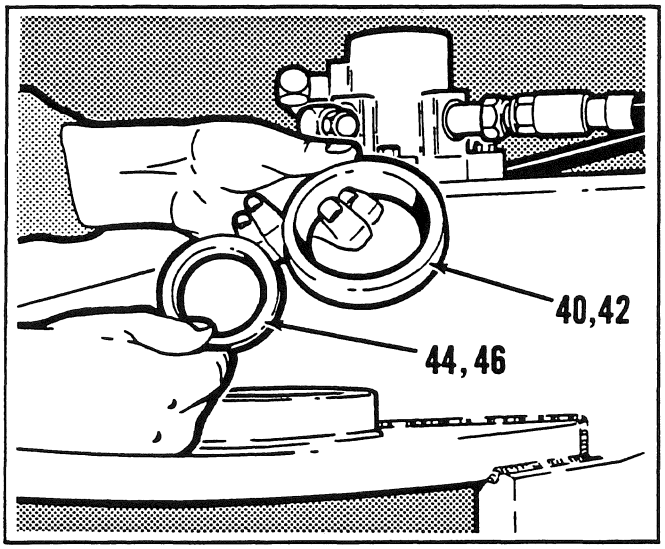


Fig. 20

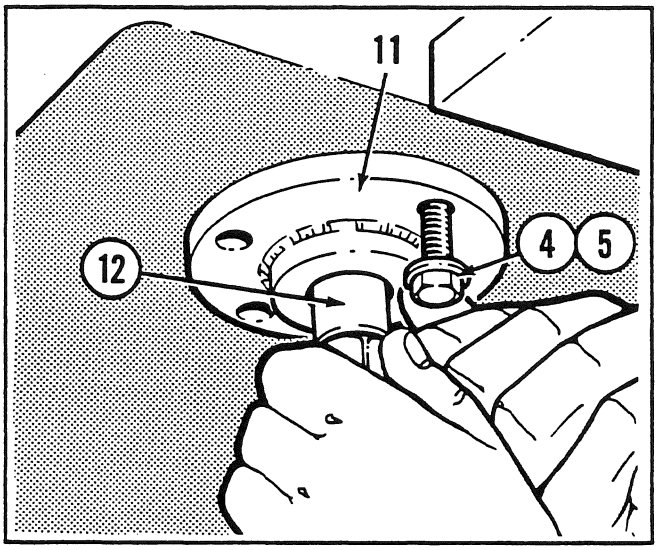


Fig. 23

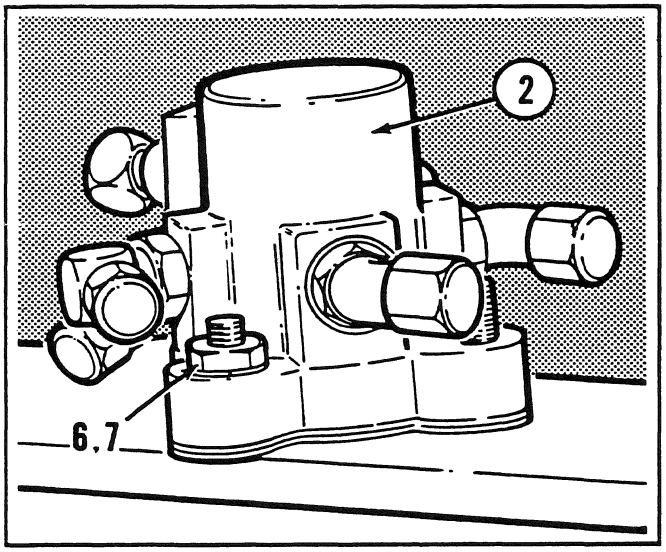


Fig. 21

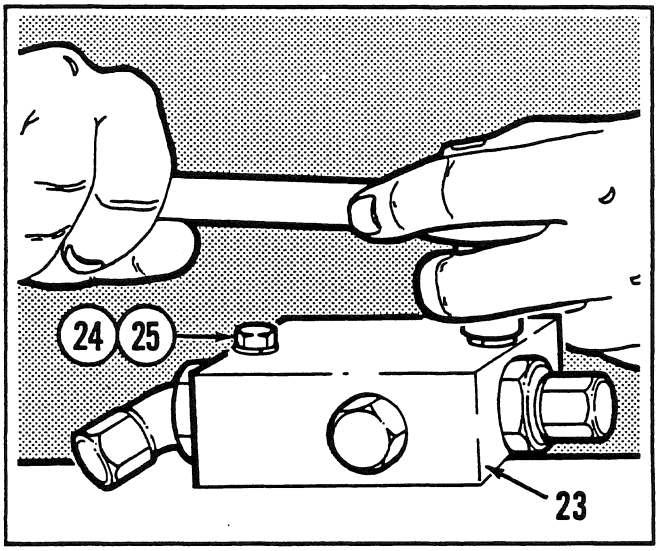


Fig. 24

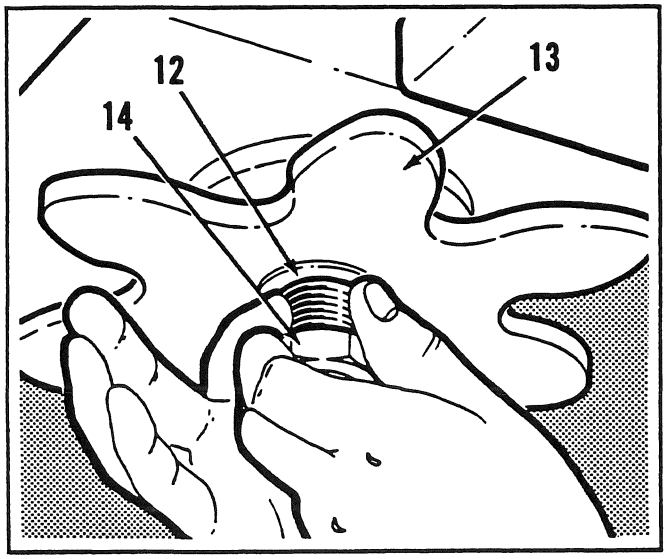


Fig. 22

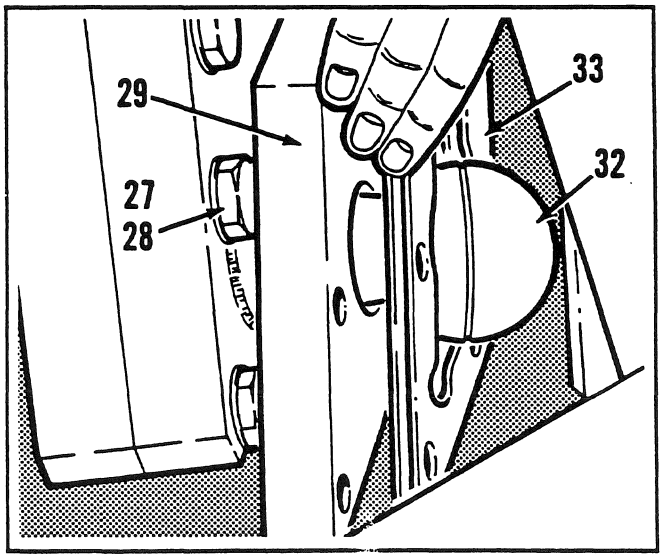


Fig. 25

Circle, Drawbar and Moldboard - Removal and Disassembly (Continued)

Fig. 20
Remove the spherical bearing (41) from the crank (39) using a bearing separating device. Remove and discard the top and bottom seals (40 and 42). Remove the drive pinion (43). Remove the spherical bearing (45) from the lower boss using a soft metal drift. Remove and discard the top and bottom seals (44 and 46). Inspect the bearings for excessive wear or damage. Replace defective bearings.

Fig. 21
Disconnect any remaining lines and hoses from the circle turn valve (2). Plug the hoses and fittings to prevent contamination. Remove the nuts (7) and lockwashers (6) retaining the valve. Remove the valve and discard any spacer gaskets. Remove the drive shaft (8) and hose guard tube (3).

Fig. 22
Remove the valve pinion locknut (14) and inspect for possible re-use. Locknuts can normally be re-used twice from new. If in doubt, discard the part. Remove the valve pinion (13) from the pinion shaft (12).

Fig. 23
Remove the capscrews (4) and lockwashers (5) retaining the pinion shaft bearing (11). Remove and discard the snap ring (9). Remove the pinion shaft (12) and thrust washer (10) from the bearing. Inspect the shaft and bearing for excessive wear or damage. Replace defective parts.

Fig. 24
Disconnect the lines and hoses from the cushion valve (23). Cap the hoses and fittings to prevent contamination. Remove the capscrews (24) and lockwashers (25) retaining the cushion valve. Remove the valve.

Fig. 25
To disconnect the ball stud (32), support the front of the drawbar using the lifting device. Remove the capscrews (30) and lockwashers (31) retaining the drawplate (29). Move the drawbar (26) away from the frame, ensuring there is sufficient slack in the hoses. Remove the shim pack (33). To replace the ball stud, remove the capscrews (27) and lockwashers (28).

Circle, Drawbar and Moldboard - Assembly and Installation

Fig. 26
Following disassembly of the circle, drawbar and moldboard, refer to **Cleaning and Inspection** on pages 2 and 3 of this Shop Manual Section. Thoroughly clean and inspect all applicable parts before assembling the circle, drawbar and moldboard.

Fig. 27
To begin the drawbar assembly, determine the required shim pack (33) thickness. Place the drawplate (29) on the frame and retain with the capscrews (30) and lockwashers (31). Tighten the capscrews.

Fig. 28
Measure the gap between the drawplate (29) and the frame on all four sides. Assemble a shim pack (33) equal to the average of the four measurements. Remove the capscrews (30), lockwashers (31) and drawplate.

Fig. 29
Place the shim pack (33) over the ball stud (32). Lubricate the socket with the type of grease recommended in the Lubrication Specifications at the front of this Shop Manual.

Fig. 30

Move the drawbar (26) forward until the ball stud (32) is firmly installed in the socket. Align the shim pack (33) and drawplate (29). Install the capscrews (30) and lockwashers (31). Tighten the capscrews to the specified torque.

Fig. 31
Install the cushion valve (23) on the drawbar (26) and retain with the capscrews (24) and lockwashers (25). Clean the fittings and re-connect the lines and hoses to the valve.

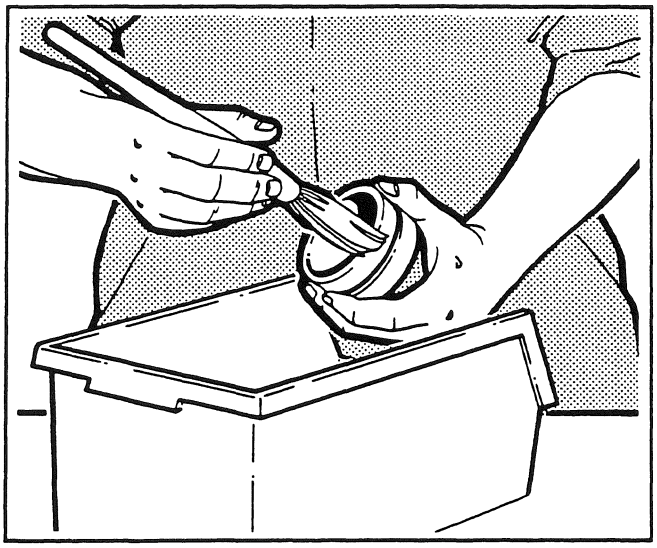


Fig. 26

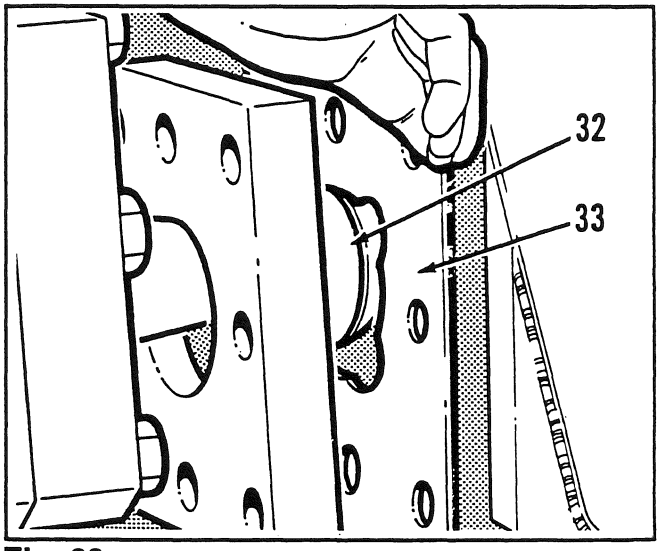


Fig. 29

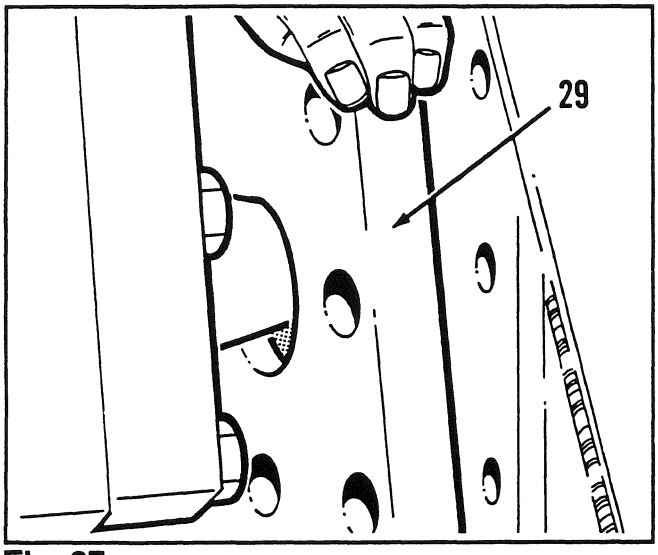


Fig. 27

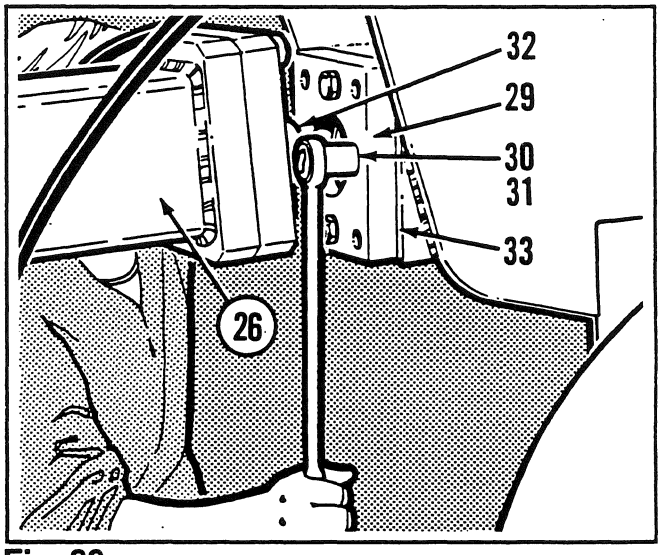
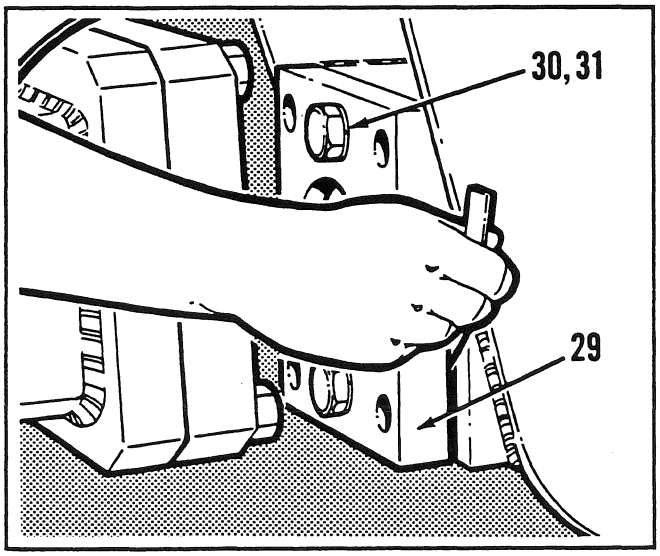


Fig. 30



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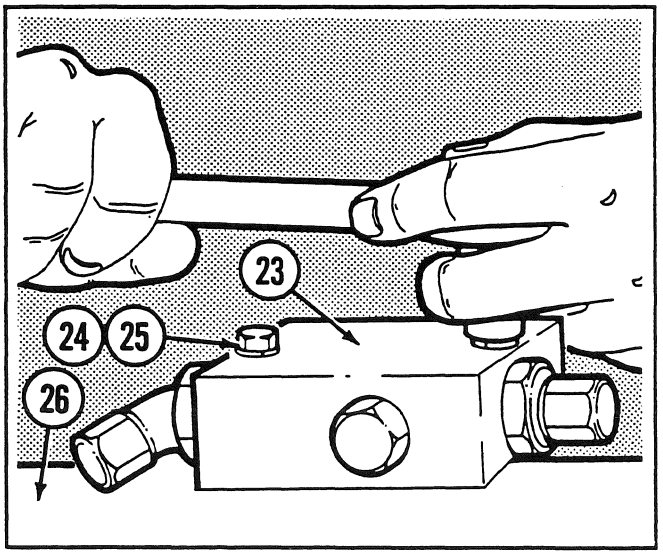


Fig. 31

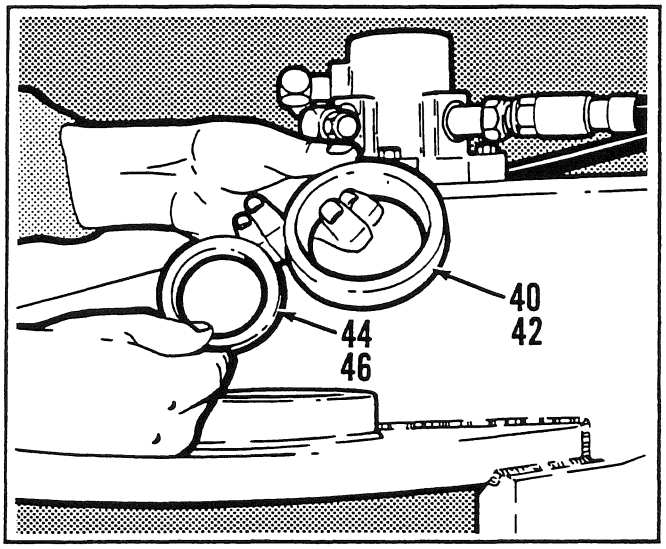


Fig. 32

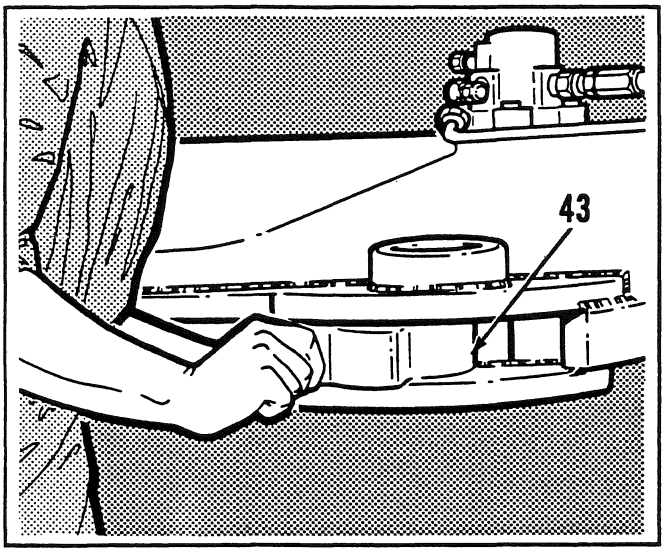


Fig. 33

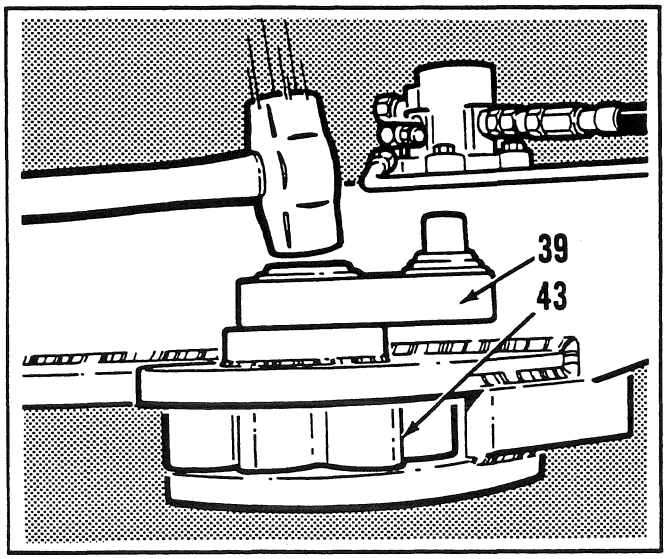


Fig. 34

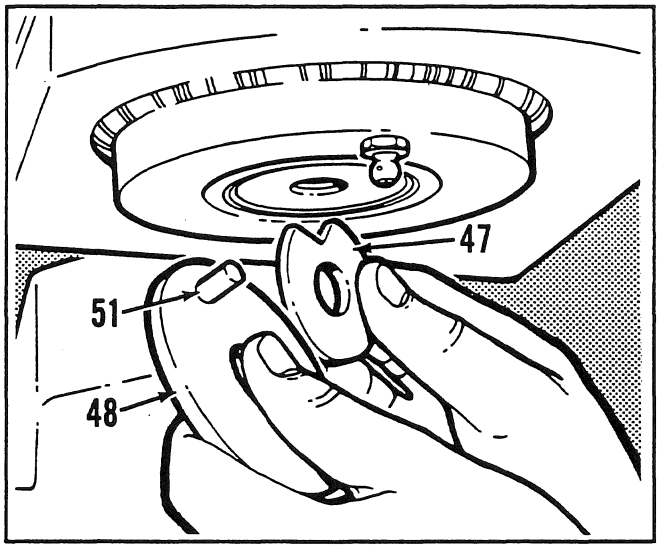


Fig. 35

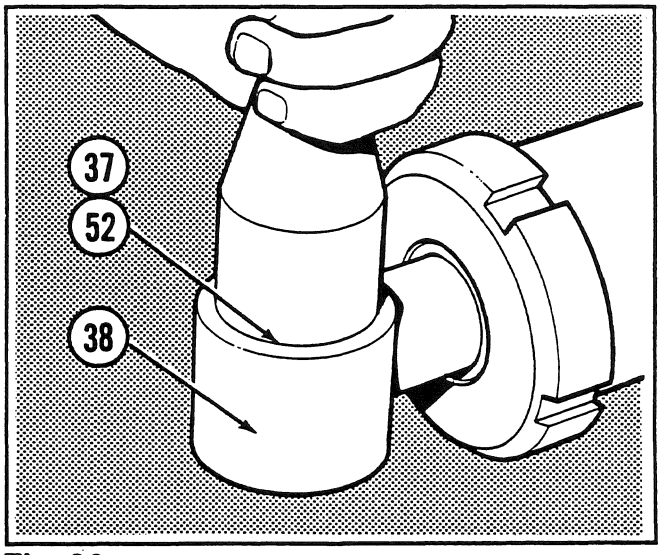


Fig. 36

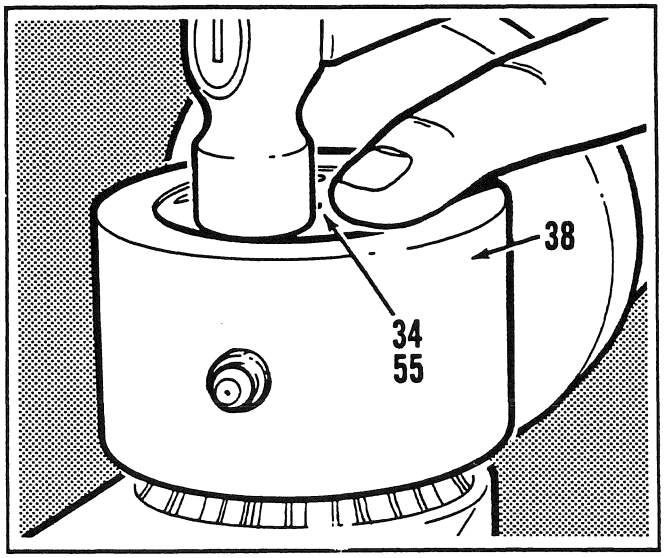


Fig. 37

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 32
Install the crank (39), with the splined shaft pointing up, into a vise. Lubricate and install a new top seal (40), lip pointing up. Apply a coating of grease onto all surfaces of the spherical bearing (41). Install the bearing using a soft metal tubular drift with the same diameter as the bearing inner race. Lubricate and install a new bottom seal (42), lip pointing down.

Fig. 33
Apply a coating of grease onto all surfaces of the spherical bearing (45) and upper and lower boss bores. Install the bearing into the lower boss using a soft metal tubular drift with the same diameter as the bearing outer race. Lubricate and install a new top seal (44), lip pointing down. Carefully install the drive pinion (43). Make sure the aligning mark drawn previously is visible. Apply anti-seize compound, part number **30453** onto the splines.

Fig. 34
Remove the crank (39) from the vise and turn it over. Align the two marks drawn previously. Engage the splines. Install the crank through the drive pinion (43) using an appropriate hammer. Make sure the lower spherical bearing (45) is not displaced.

Fig. 35
Check the installation for alignment. Install a new roll pin (51). Lubricate and install a new bottom seal (46), lip pointing up. Install the notch washer (47) and retaining washer (48). Secure the crank assembly with the capscrew (50) and lockwasher (49).

Fig. 36
If you are installing new spherical bearings (37 and 52), first apply a coating of grease onto all surfaces of the bearings. Install the bearings into the circle turn cylinder (38) using a soft metal tubular drift with the same diameter as the bearing outer race. Install new snap rings (36 and 53).

Fig. 37
Install the circle turn cylinder (38) using a soft metal tubular drift with the same diameter as the bearing inner race. Install new snap rings (35 and 54). Install new expansion plugs (34 and 55). Secure the expansion plugs by indenting the center of the plug. Make sure all expansion plugs have a central vent hole. Repeat the steps in **Fig. 32** through **Fig. 37** for the other side.

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 38
Make sure that the cranks are properly positioned for the circle timing operation. Fully retract the right hand circle turn cylinder. The crank should point forward. A line should pass along its axis and through the center point of both anchor studs.

Fig. 39
Position the left hand crank so that the turn cylinder anchor stud, crank center line and crank stud make a 90° angle.

Fig. 40
Install the pinion shaft (12) into the bearing (11) and thrust washer (10). Secure with a new snap ring (9). Install the pinion shaft and bearing assembly. Secure with the capscrews (4) and lockwashers (5). Tighten the capscrews to the specified torque.

Fig. 41
Install the drive shaft (8) into the drawbar (26) and connect the notched ends of the two shafts. Install the hose guard tube (3). Install the circle turn valve (2) with new gaskets.

Fig. 42
Carefully turn the pinion shaft (12) from below to engage the drive shaft (8) with the spool (1). Make sure the circle turn valve (2) sits evenly on the drawbar. If required, install several spacer gaskets to provide proper clearance for the shaft. Secure the valve with the nuts (7) and lockwashers (6).

Fig. 43
Install the valve pinion (13) on the pinion shaft (12). Retain the pinion with the locknut (14), refer to text for **Fig. 22.** Re-connect all hoses.

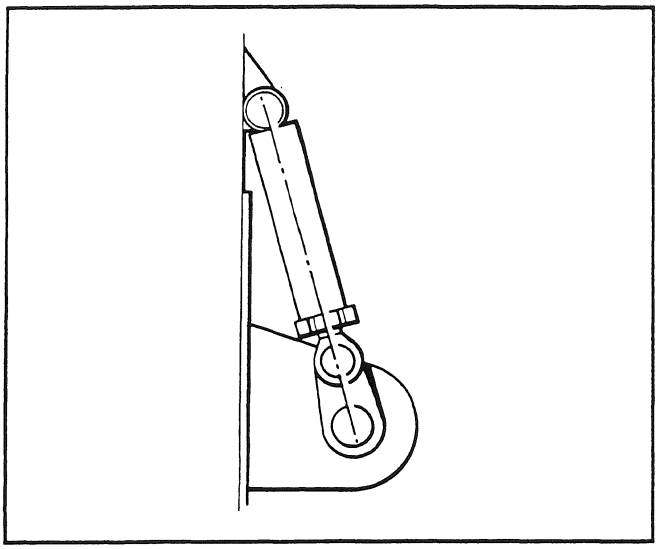


Fig. 38

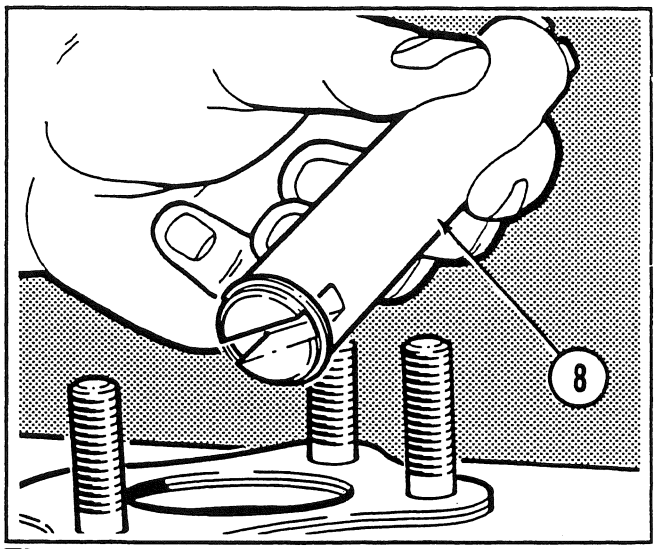


Fig. 41

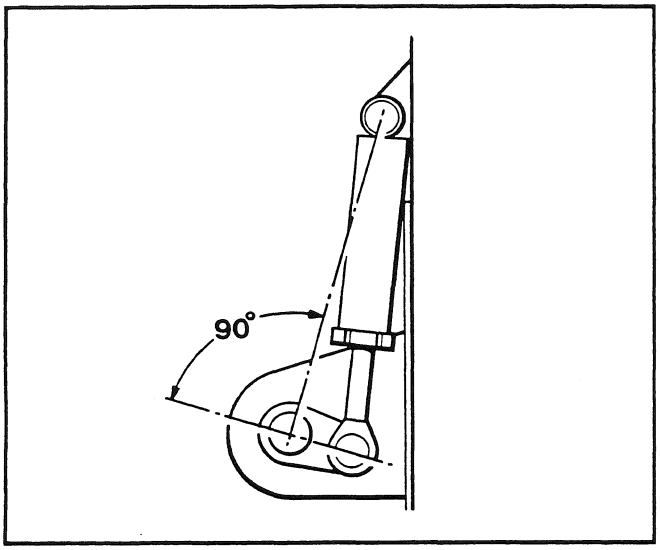


Fig. 39

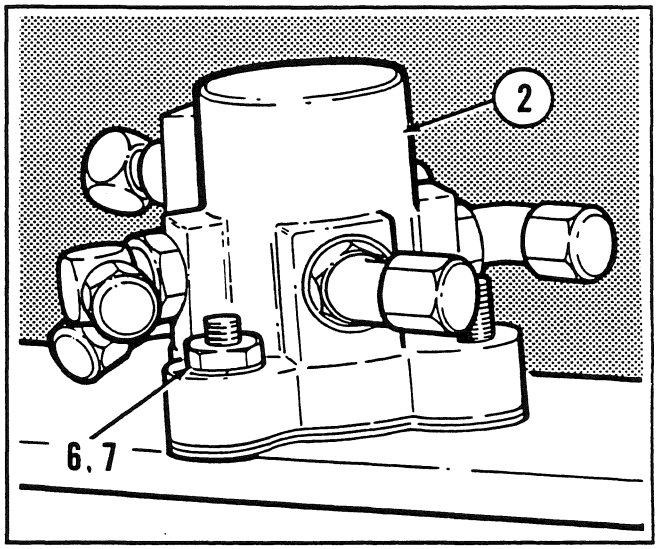


Fig. 42

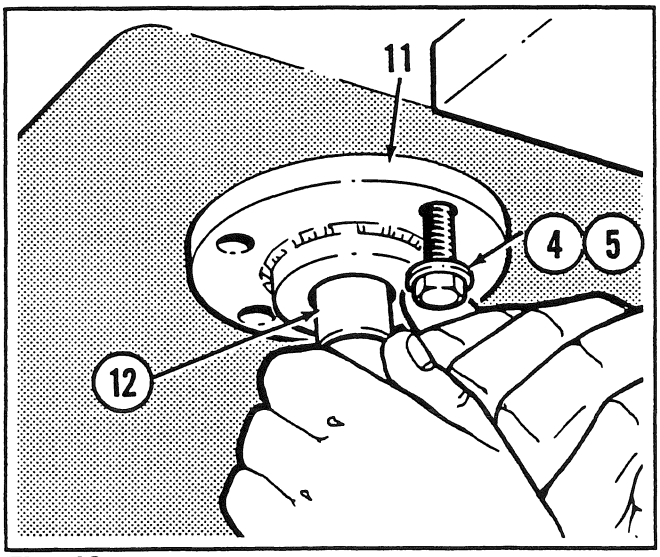


Fig. 40

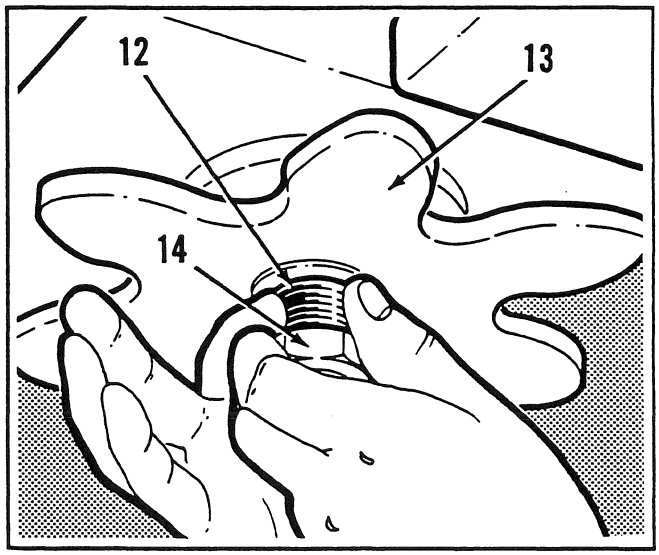


Fig. 43

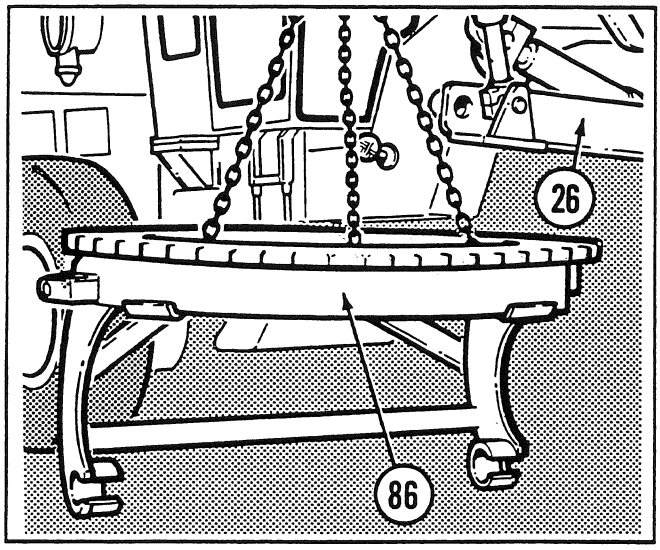


Fig. 44

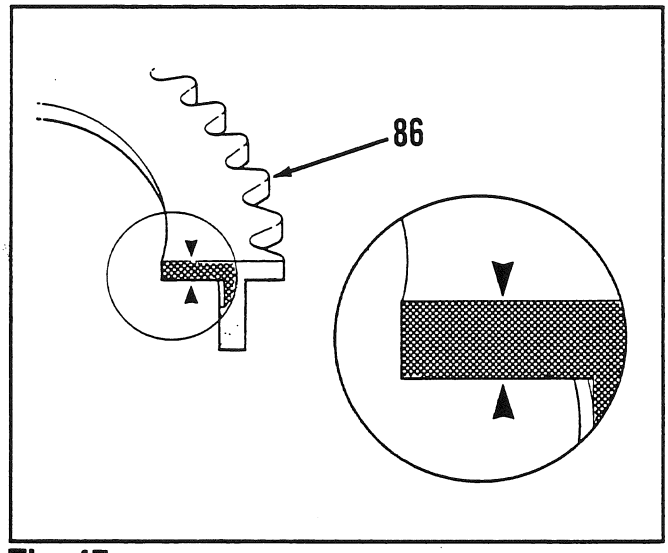
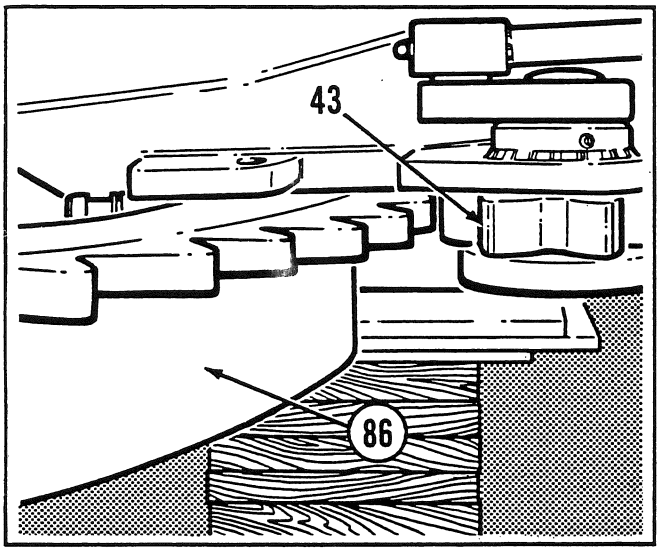


Fig. 47



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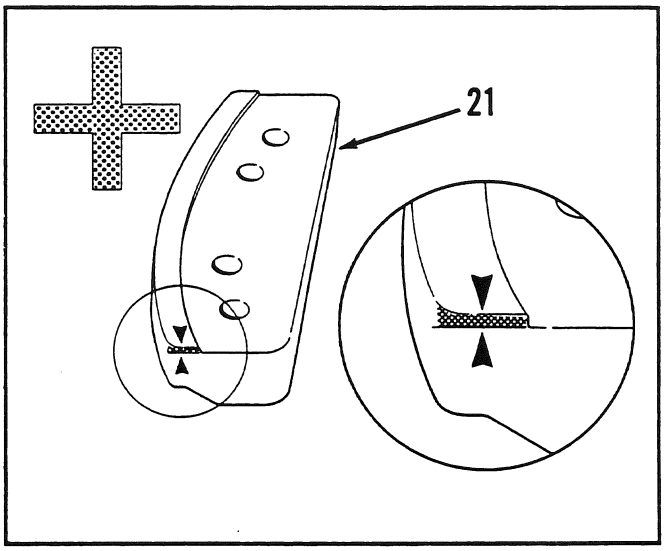


Fig. 48

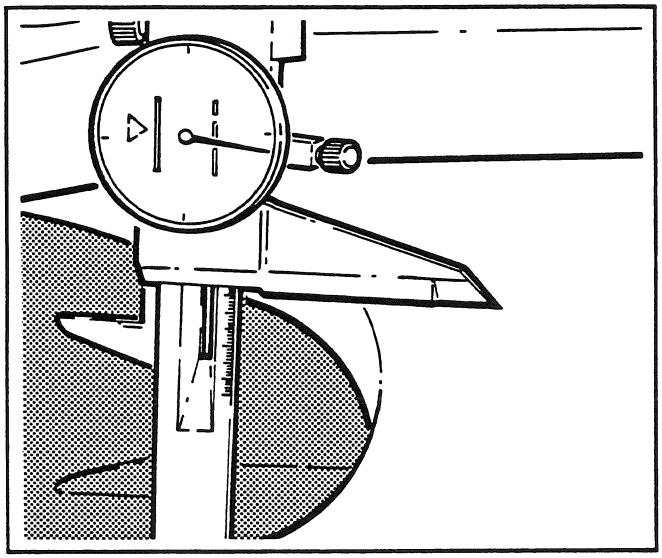


Fig. 46

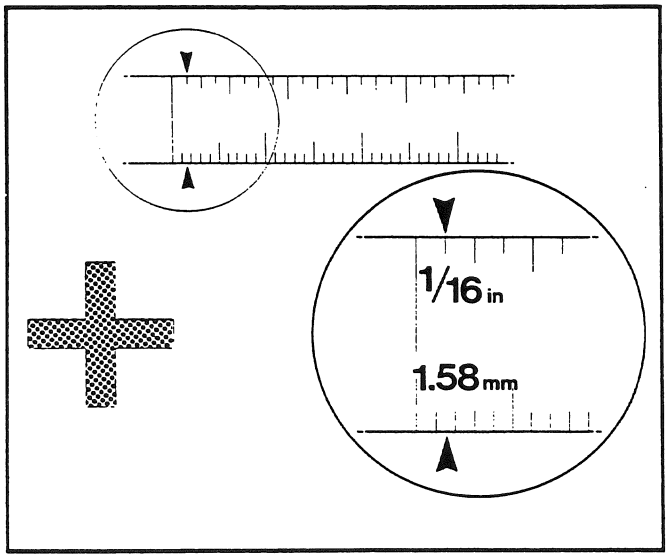


Fig. 49

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 44
Raise and move the drawbar (26) to one side using the blade lift and circle shift cylinders. Attach chains securely at three points around the circle (86). Raise and move the circle under the grader using the lifting device. Support the circle arms on proper blocks and the front of the circle on a secure stand. Remove the lifting chains. Center and lower the drawbar onto the circle.

Fig. 45
Start the grader and carefully drive it backward, meshing the circle (86) teeth and drive pinions (43).

Fig. 46
Clearance between the circle (86) and drawbar (26) is adjusted using shim packs (20). Before installing the clamp plates (21) and guide plates (19), you must calculate the thickness of the shim pack.

Fig. 47
Measure the thickness of the inside edge of the circle (86).

Fig. 48
Measure the thickness of the lip of the clamp plate (21). Add the thickness dimension in **Fig. 47** to this measurement.

Fig. 49
Now, add the clearance specification of 1,58 mm (1/16 in.) to the total of the thickness dimensions measured in **Fig. 47** and **Fig. 48.**

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 50
Measure the thickness of the guide plate (19) and subtract this figure from the total calculated in **Fig. 49.** The final figure is the equivalent to the shim pack thickness.

Fig. 51
Assemble a shim pack (20), equal in thickness to the final figure calculated in **Fig. 50.** Repeat the procedure from **Fig. 47** through **Fig. 51** for each clamp and guide plate assembly.

Fig. 52

Install the bolts (15). Install the shim pack (20) between the guide plate (19) and clamp plate (21). Carefully install the plate and shim assembly. Secure the assembly with the nuts (16 and 17). Note that no washers are used. **DO NOT** fully tighten the nuts. Circle adjustment is the next step.

Fig. 53
To adjust the circle, measure and record the distance from the inside diameter edge of the circle to the drawbar frame. Place your rule along the length of the drawbar rear cross-member for constant points of reference. Repeat this procedure on the opposite side of the grader.

Fig. 54
Adjust the guide plates (19) using the right and left hand setscrews (18) until the distance is equal on both sides.

Fig. 55
Measure the gap between the root of the circle teeth and the tips of both drive pinions (43). The designed clearance is 1,6 mm to 3 mm (.06 in. to .12 in.). Adjust the guide plate (19) using the front setscrew (56) until you have the proper clearance.

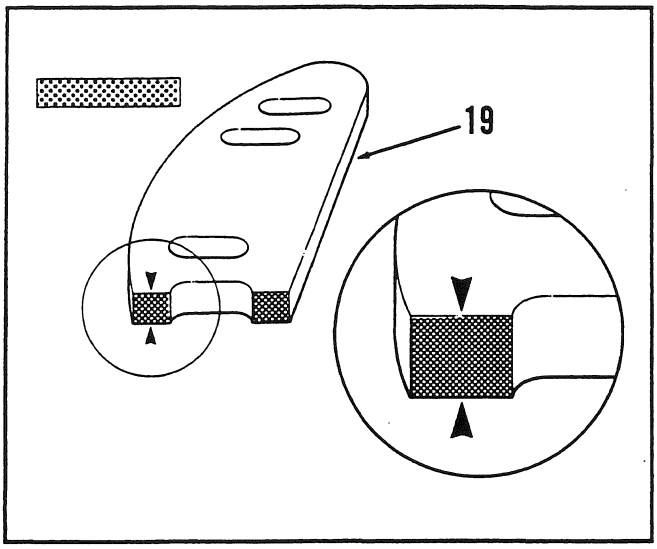
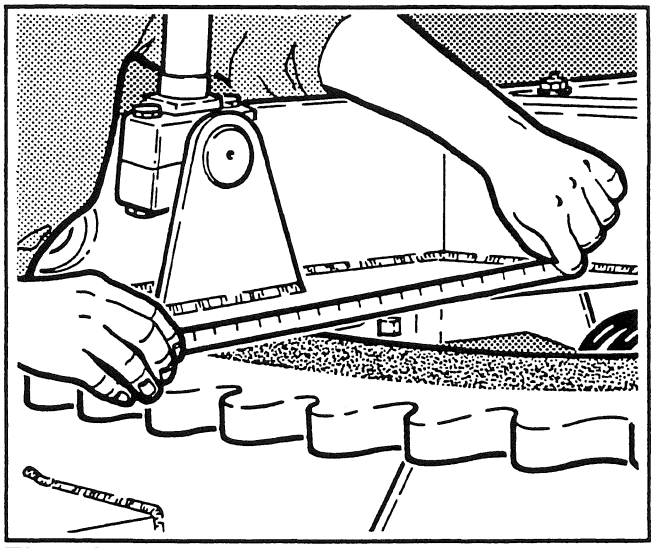


Fig. 50



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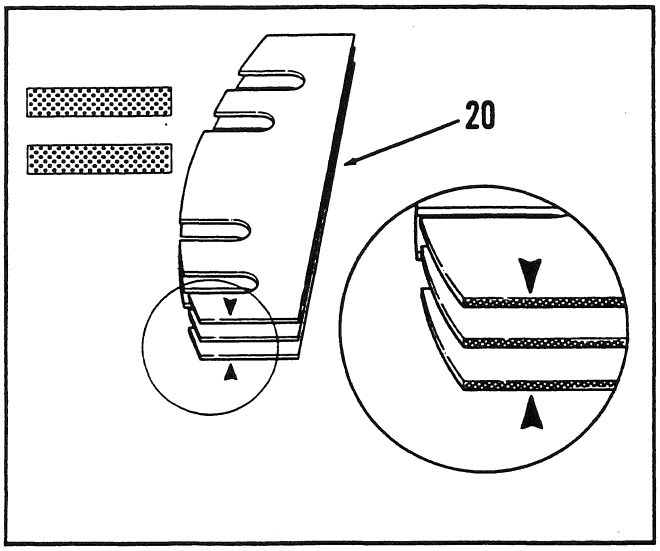

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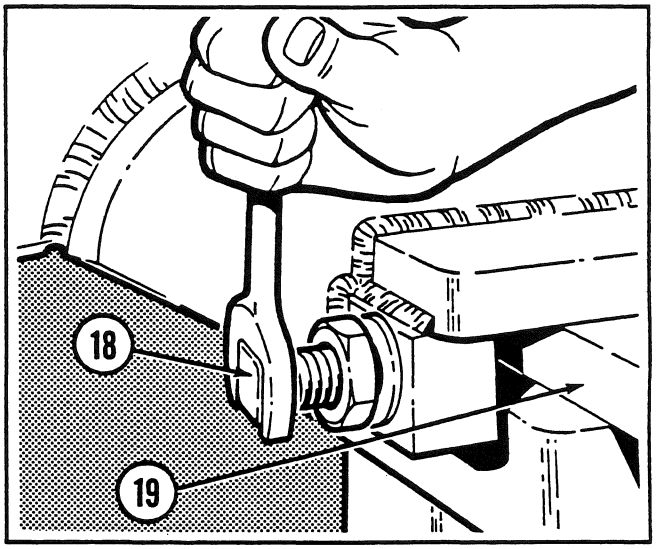

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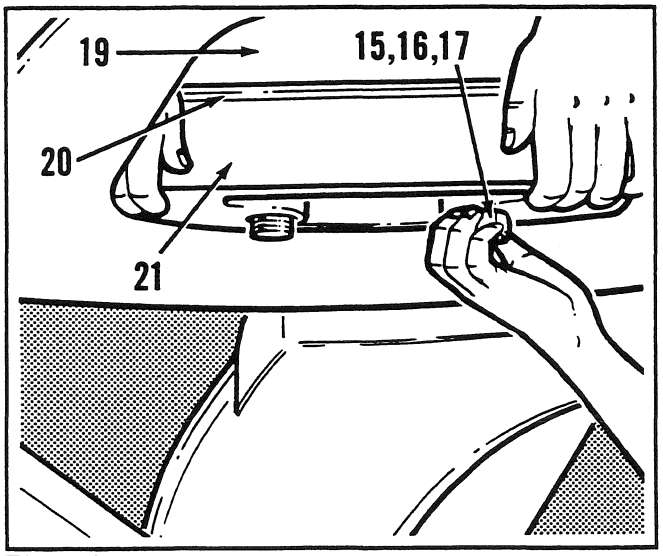

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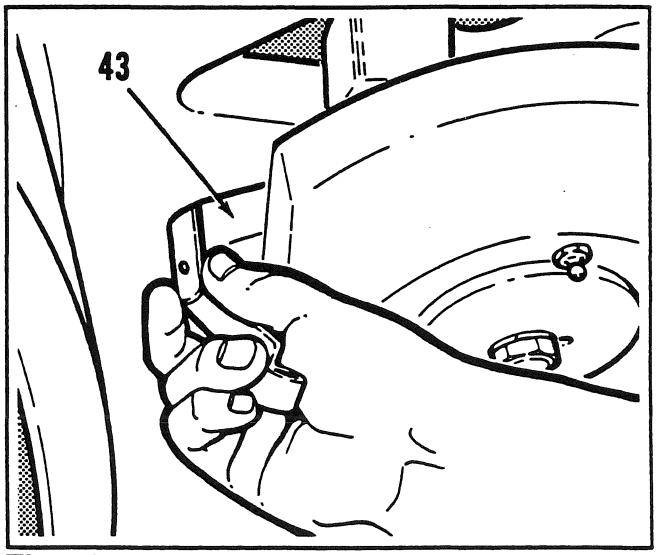

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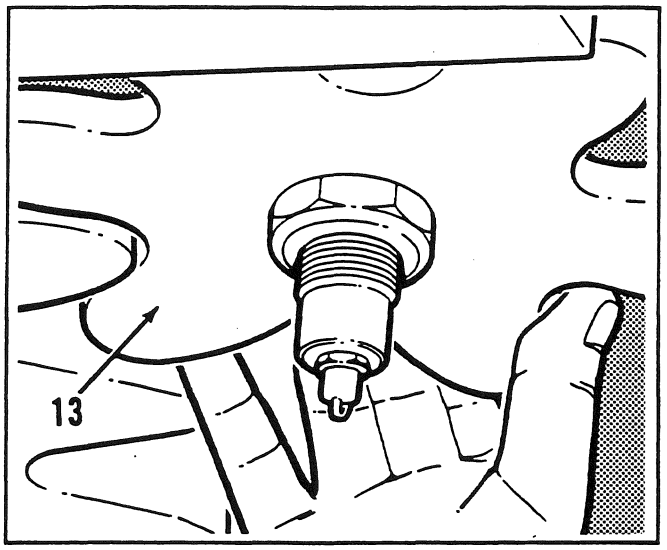

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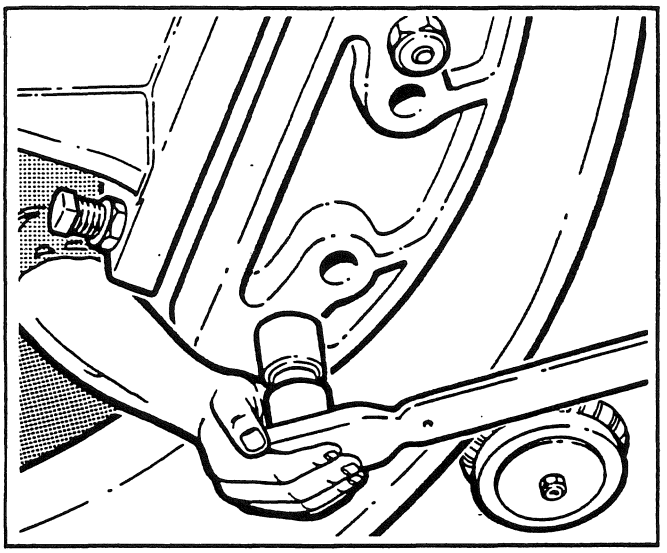

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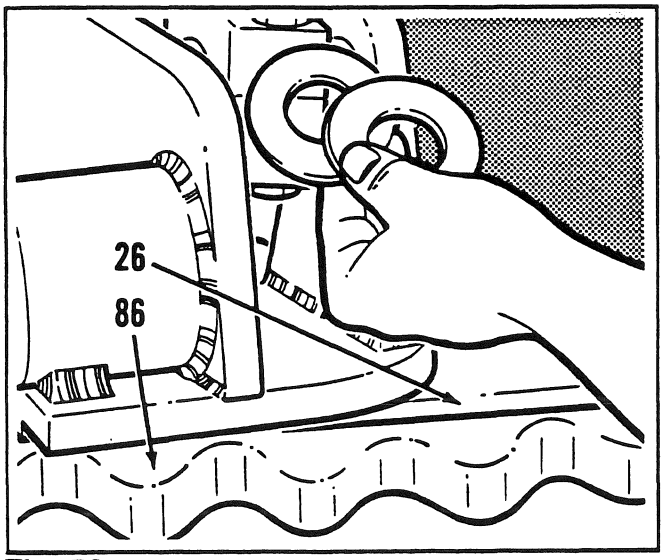

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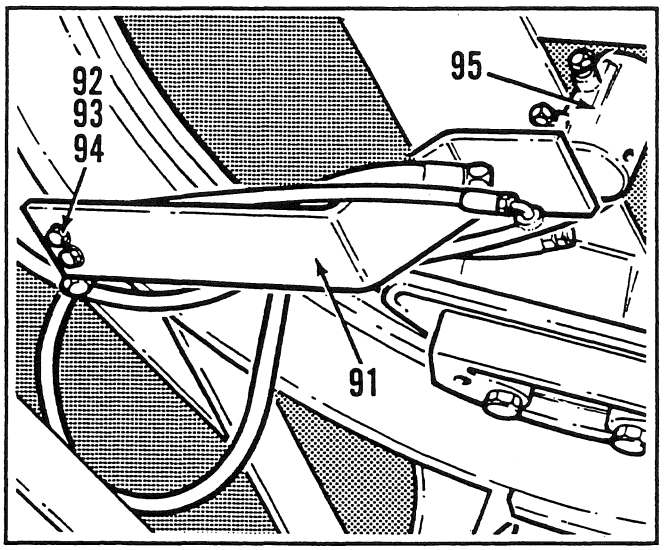
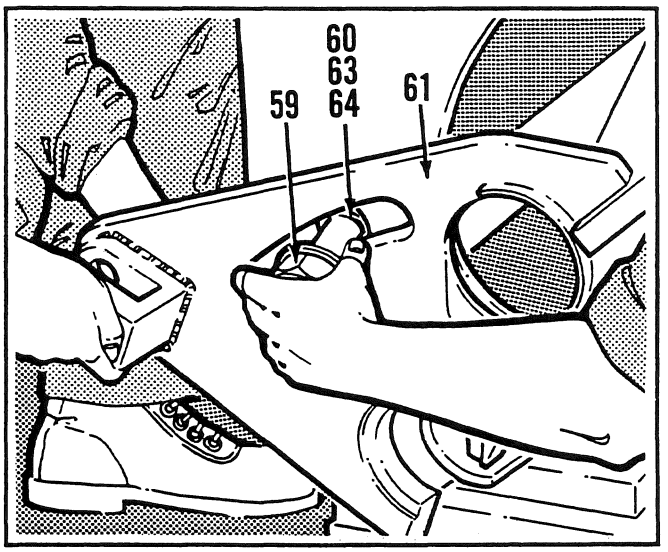


Fig. 59



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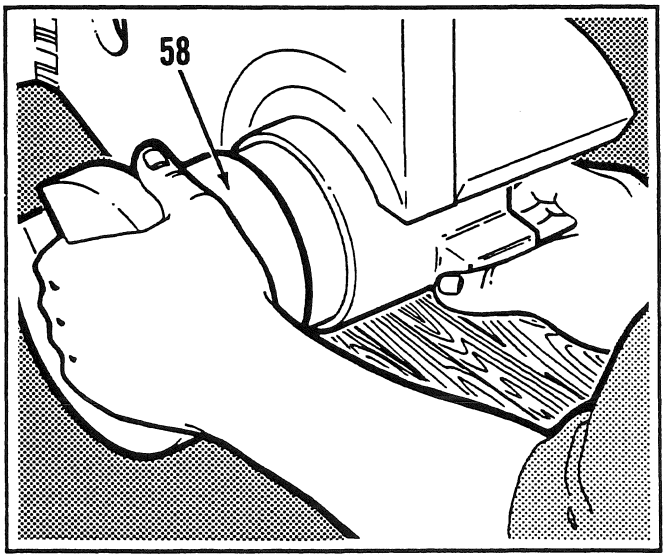


Fig. 61

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 56
After you have adjusted the drive pinion clearance, check the circle turn valve pinion (13) for free play. If there is no free play, the drive pinion and/or circle teeth may be excessively worn. Check for wear and replace parts as necessary.

Fig. 57
Check that only two guide plates (19) are actually contacting the circle (86). Adjust the setscrews to give the third guide plate a 1,6 mm (.06 in.) clearance. When the circle adjustment is complete, install and tighten all clamp and guide plate nuts to the specified torque.

Fig. 58
As a final check, make sure that the clearance between the circle (86) face and the drawbar (26) is correct at both ends. Install shims where required.

NOTE

Refer to Product Support Bulletin No. 442, dated February, 1987, giving important lubrication recommendations for the circle and moldboard.

Fig. 59
Install the drive arm (91) and secure with the bolts (92), nuts (94) and lockwashers (93). Re-connect both ends of the hoses between the hydraulic swivel joint assembly (95) and the circle (86).

Fig. 60
Support and install the quadrant (61). Install the quadrant pivot bolt (59), retaining washer (60), nut (64) and lockwasher (63).

Fig. 61
Support the lower slide casting (58). Turn the retaining lug and align with the openings in the circle arm and quadrant. Carefully install the casting.

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 62
If you are installing new spherical bearings (66), first apply a coating of grease onto all surfaces of the bearings. Install the bearings into the power tilt cylinder (71) or manual tilt link using a soft metal tubular drift with the same diameter as the bearing outer race. Install new snap rings (67).

Fig. 63
Install the power tilt cylinder (71) or manual tilt link using a soft metal tubular drift with the same diameter as the bearing inner race. Retain with the upper and lower (68) pins, capscrews (69) and lockwashers (70). **DO NOT** re-connect the hoses. Repeat the steps in **Fig. 60** through **Fig. 63** for the other side.

Fig. 64
Install the slide shift cylinder (87) through the access hole in the right hand quadrant. Install the fittings on the cylinder. Re-connect the hoses. Install the cylinder anchor bolt (88), nut (90) and lockwasher (89). Tighten the nut to the specified torque.

Fig. 65
Remove the caps from the power tilt cylinder fittings. **Simultaneously** move the quadrants (61 and 65) **by hand,** otherwise the quadrants could move independently and damage the slide shift cylinder. Fully extend the cylinder piston rods. Re-connect the hoses.

Fig. 66
Install the slide shift cylinder guard (77) and retain with the capscrews (72) and lockwashers (73). Tighten the capscrews to the recommended torque.

Fig. 67
Support the slide shift cylinder (87). Install the U clamp (62), plain washers (80), lockwashers (79) and nuts (78). Tighten the nuts to the specified torque. Check all hoses for correct re-connection and freedom of routing.

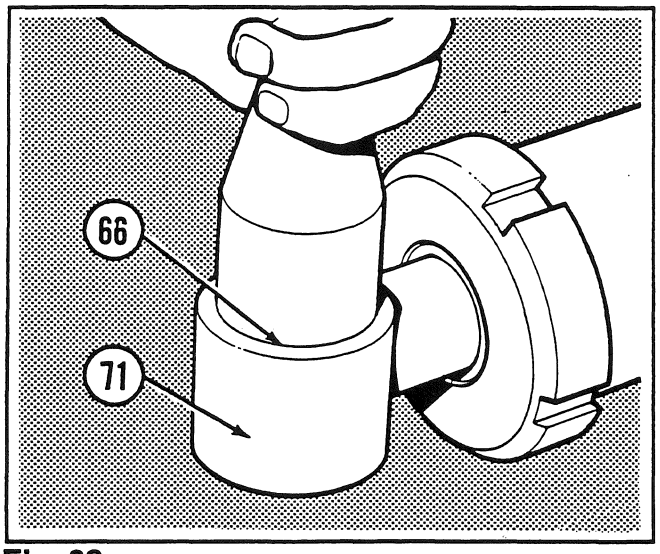
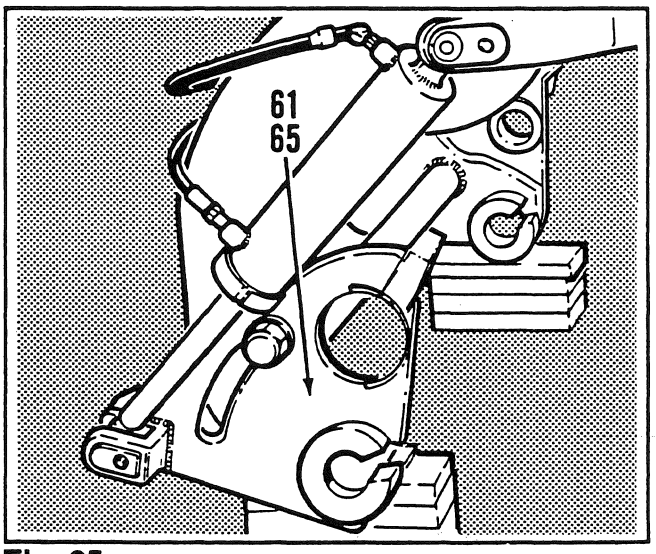


Fig. 62



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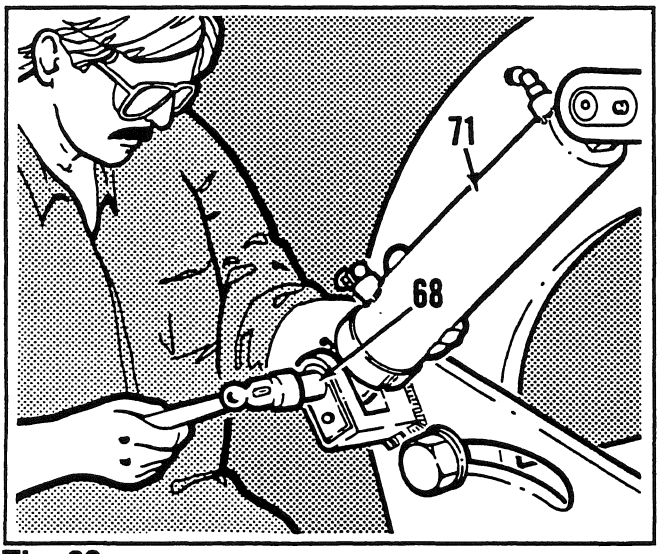

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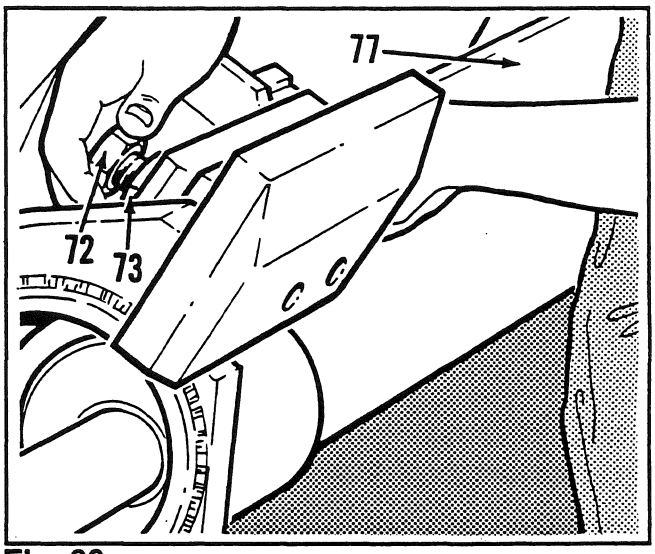


Fig. 66

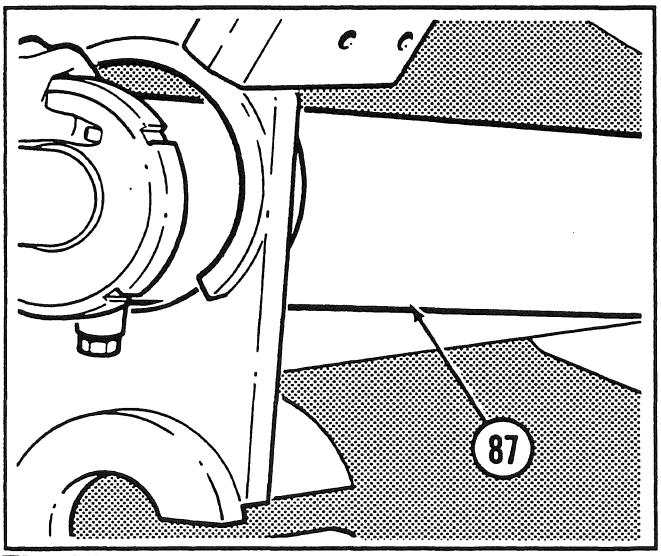
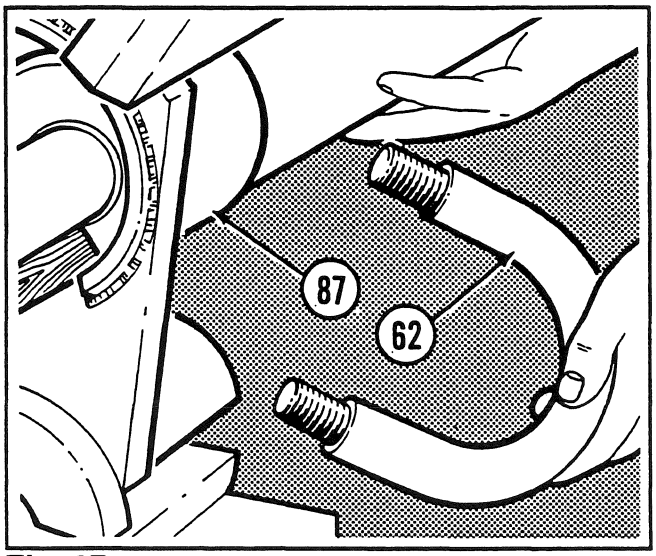


Fig. 64



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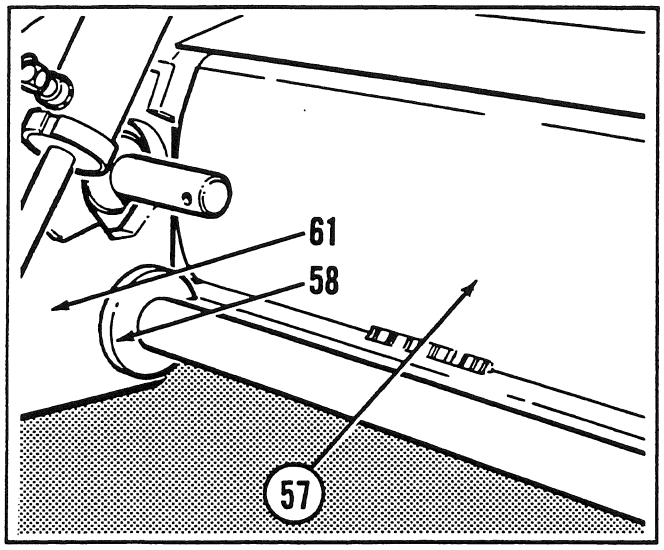


Fig. 68

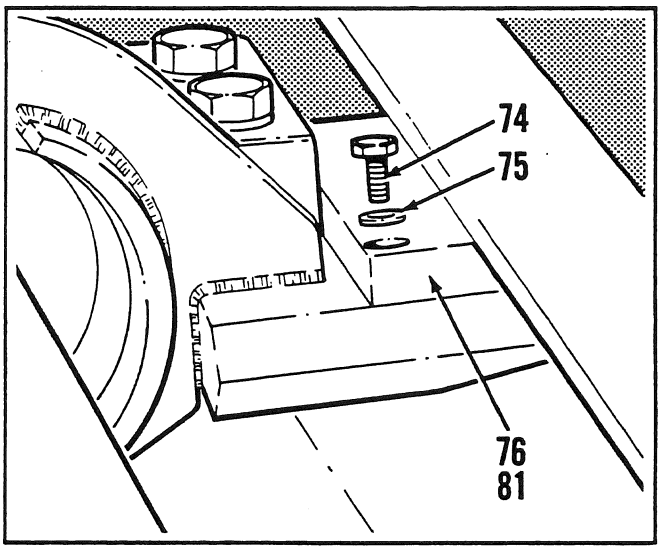
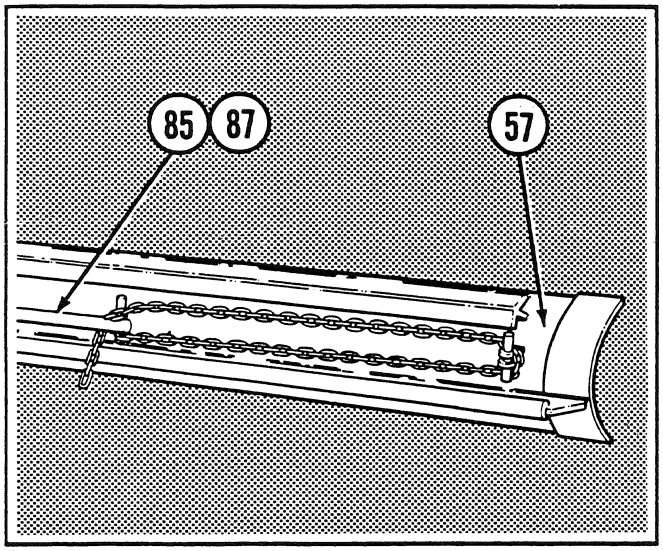


Fig. 71



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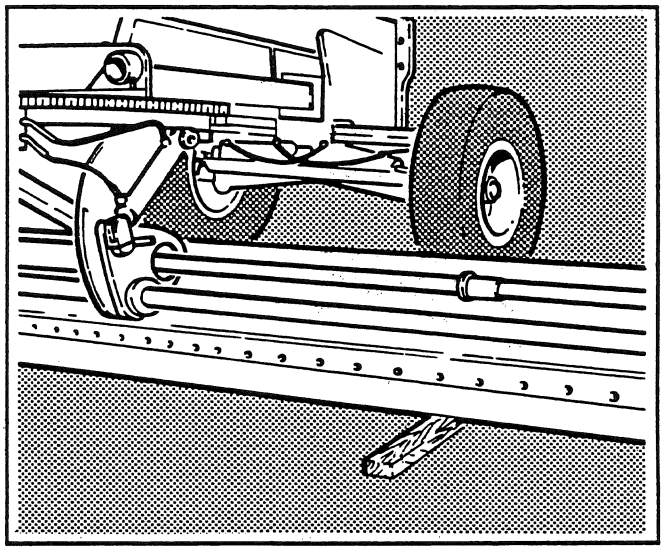


Fig. 72

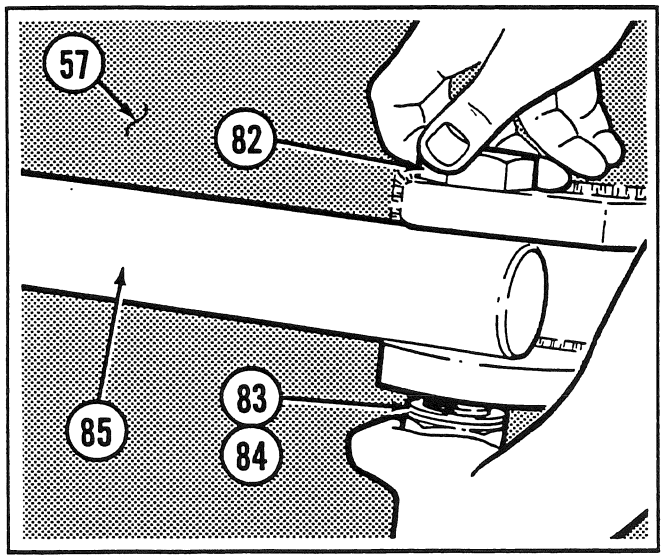


Fig. 70

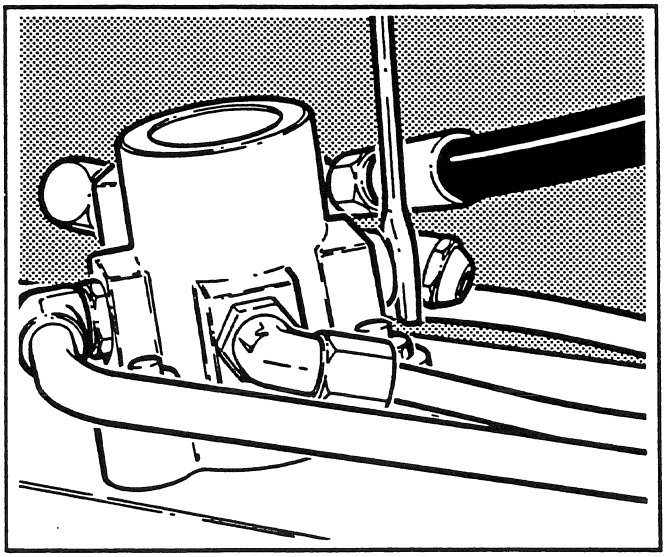


Fig. 73

Circle, Drawbar and Moldboard - Assembly and Installation (Continued)

Fig. 68
Raise the moldboard (57) using the lifting device. Align the upper and lower slide rails with the right hand quadrant (61) and lower slide casting (58).

Fig. 69
Fully extend the slide shift cylinder (87) piston rod or rod extension (85). Connect the piston rod to the moldboard (57) using a chain.

Fig. 70
With the free end of the moldboard (57) raised from the floor, retract the slide shift cylinder (87) and pull the moldboard into place. Make sure the lower slide rail aligns with the left hand slide casting. When the moldboard is safely in place, remove the chain. Install the bolt (82), nut (84) and lockwasher (83) retaining the slide shift cylinder piston rod or rod extension (85) to the moldboard lugs.

Fig. 71
Tilt the moldboard (57) forward and rest the front edge on a secure stand. Tighten the nut (84) to the specified torque. Install the quadrant wear plates (76 and 81) and retain with the capscrews (74) and lockwashers (75).

Fig. 72
Move the circle, drawbar and moldboard assembly under the frame using the circle shift and blade lift cylinders. Lower the moldboard onto wooden blocks. Assembly and installation is now complete. You should now make the following adjustments in the circle timing procedure.

Circle Timing

Fig. 73
You have made two of the three steps in the circle timing procedure by centralizing the circle and positioning the cranks. The third step in the sequence is the adjustment of the circle turn valve spool (1). To start, find the forward left port on the valve. Disconnect the hose and immediately plug the hose and fitting.

Circle, Drawbar and Moldboard - Circle Timing (Continued)

Fig. 74

Look inside the open port. You should see only the shiny surface of the spool (1). If this is the case, the spool is in the proper position. Re-connect the hose.

Fig. 75

If you see a only a dark portion, the spool (1) needs adjustment.

Fig. 76

To adjust the spool, first loosen the locknut (14) retaining the valve pinion (13).

Fig. 77

Turn the pinion shaft (12) until the shiny surface of the spool (1) is visible. Only a slight adjustment is necessary.

Fig. 78

Tighten the locknut (14). Check the position of the spool (1) and make sure that it has not moved when tightening the locknut. Re-connect the hose.

Fig. 79

You are ready to test the system. Start the engine and push the circle turn control lever forward. The circle should turn smoothly in a clockwise direction. If the circle turns in a counter-clockwise direction when the lever is pushed forward, the spool (1) is 180° out of position. Repeat the steps in **Fig. 76** through **Fig. 78**, but this time, turn the pinion shaft (12) 180°. The circle timing is now complete and should not normally need adjusting again.

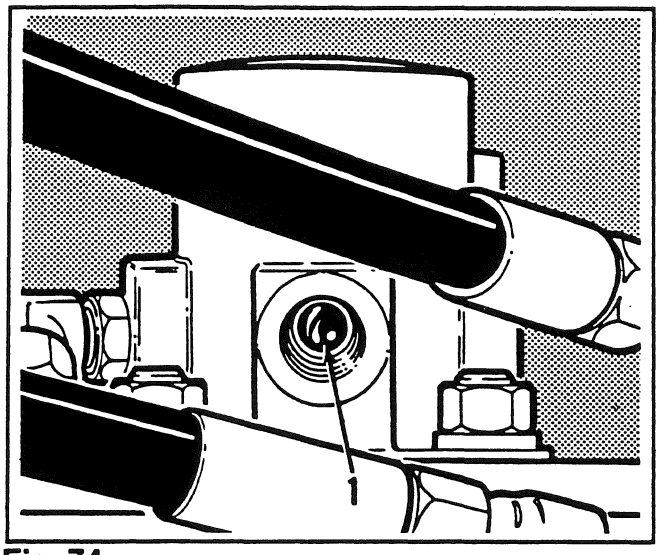


Fig. 74

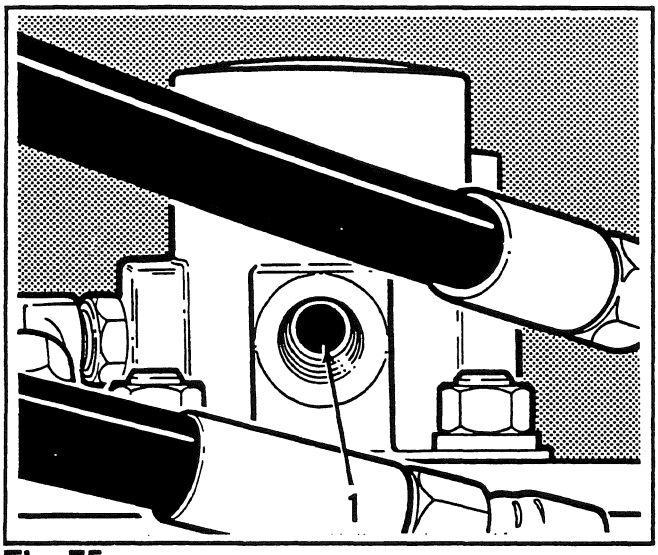
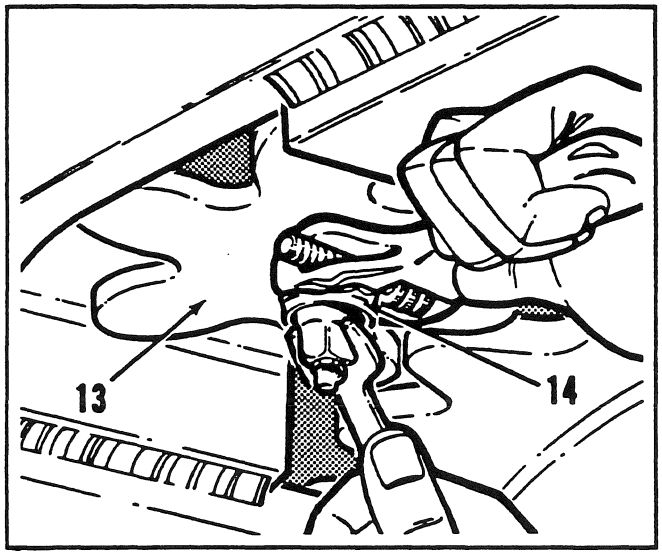


Fig. 75



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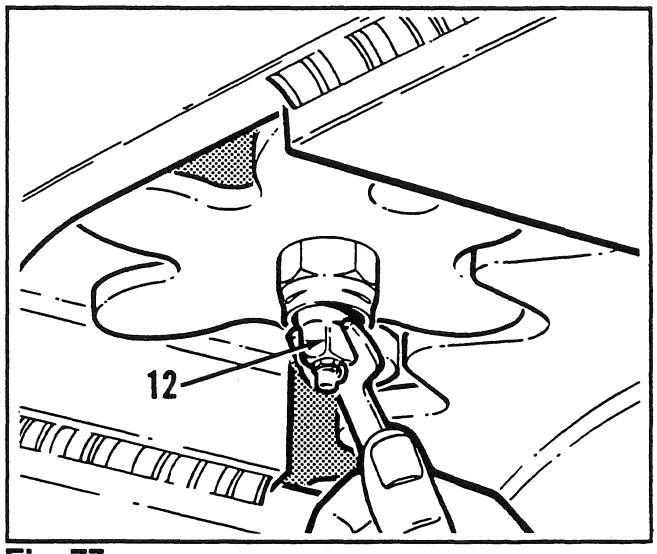

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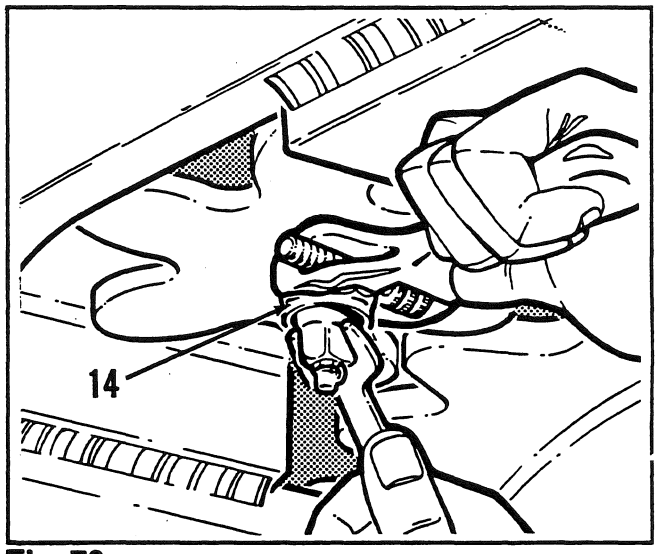


Fig. 78

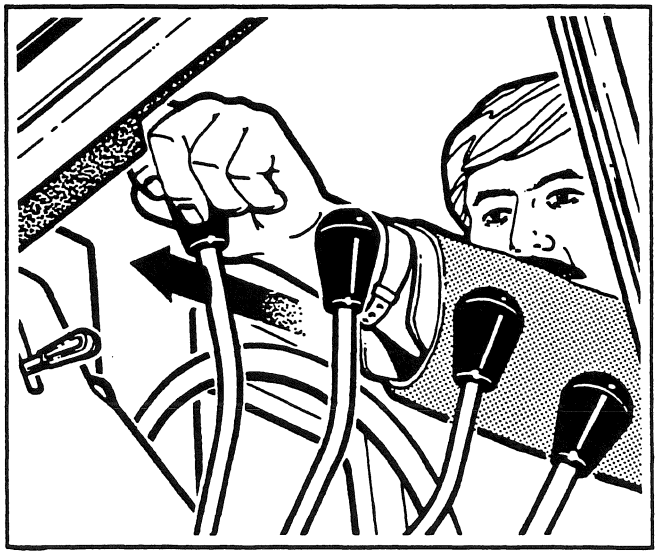
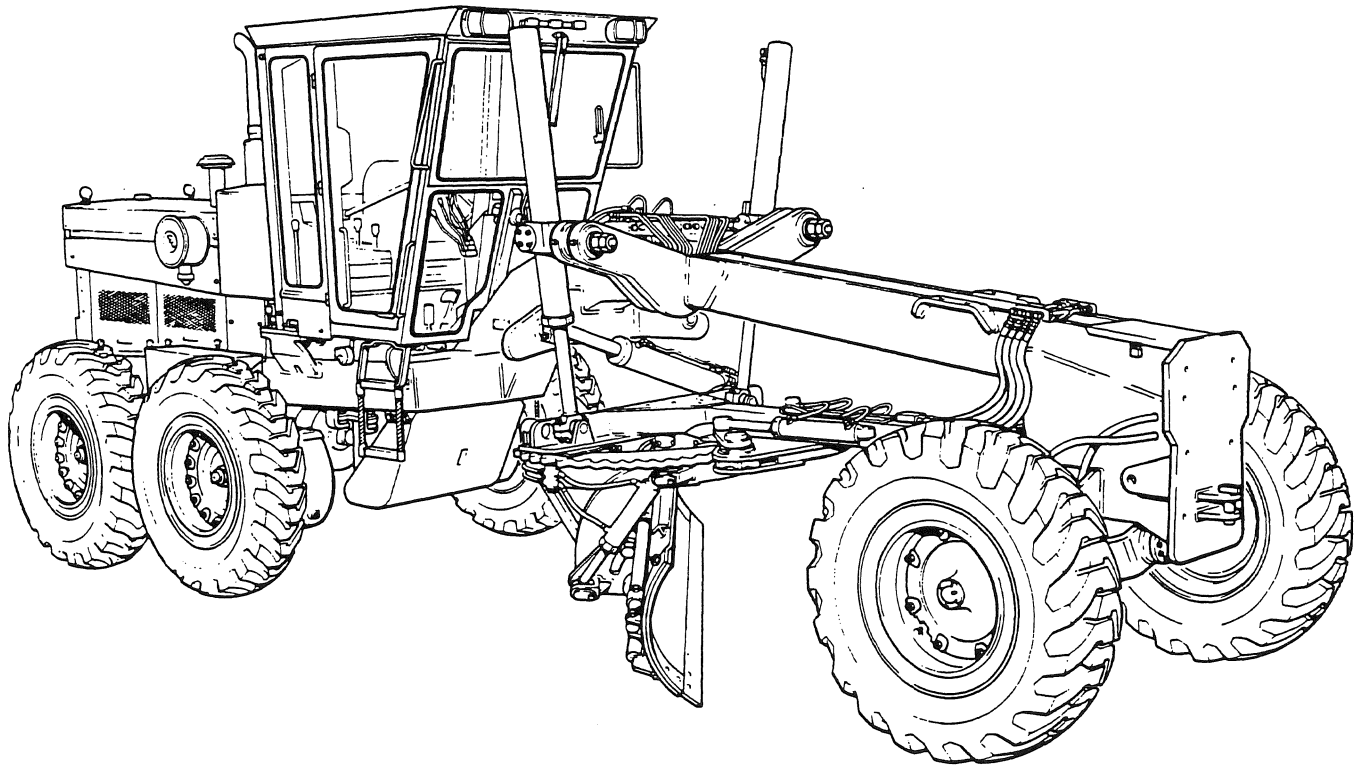


Fig. 79

SECTION 3

BLADE LIFT ASSEMBLY



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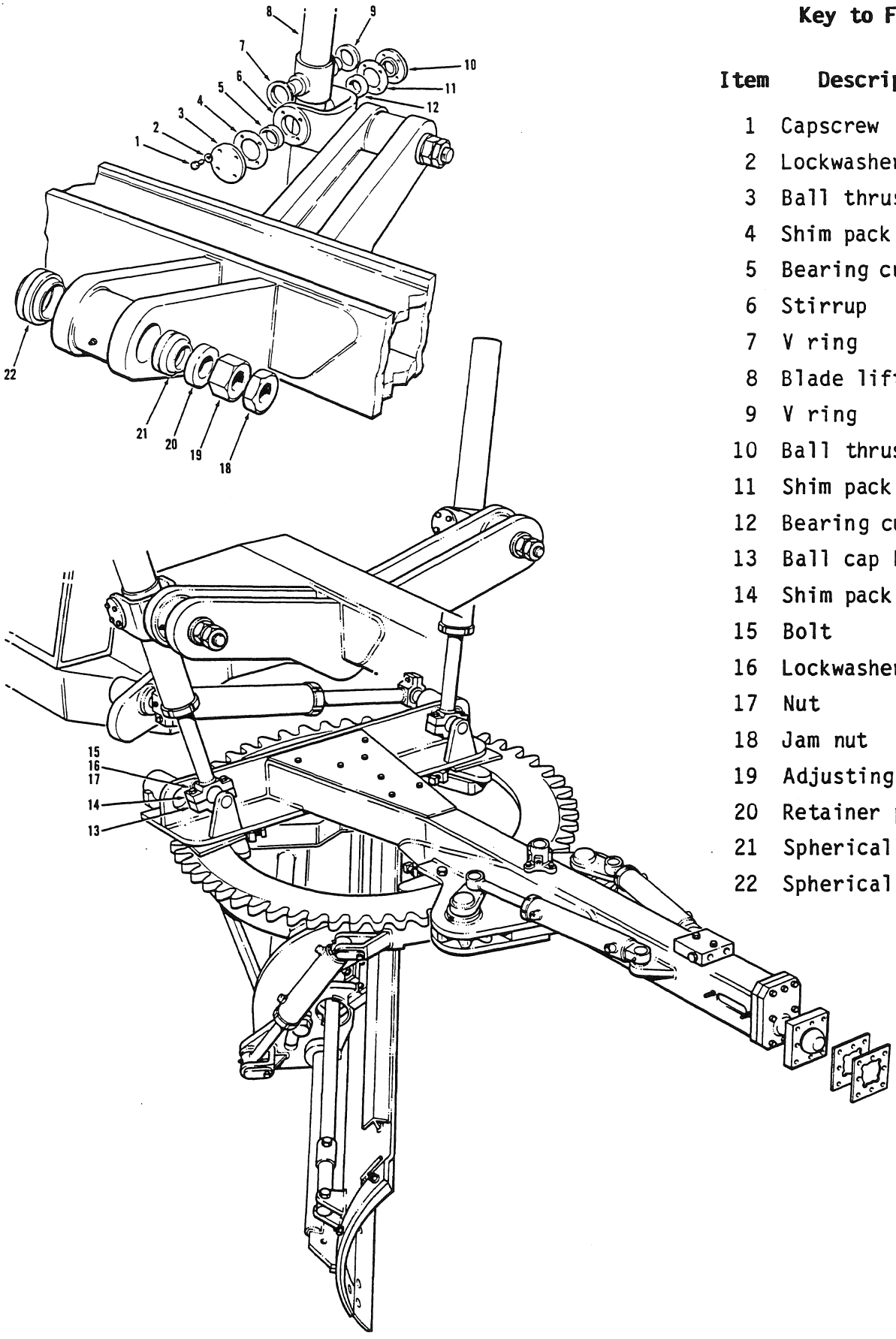
BLADE LIFT ASSEMBLY



Key to Fig. 1

Item	Description
1	Capscrew
2	Lockwasher
3	Ball thrust cap
4	Shim pack
5	Bearing cup and cone
6	Stirrup
7	V ring
8	Blade lift cylinder
9	V ring
10	Ball thrust cap
11	Shim pack
12	Bearing cup and cone
13	Ball cap half
14	Shim pack
15	Bolt
16	Lockwasher
17	Nut
18	Jam nut
19	Adjusting nut
20	Retainer plate
21	Spherical bearing
22	Spherical bearing

Fig. 1

General

Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks; and normal shop tools.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

THE SERVICE POSITION IS AS FOLLOWS:- PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH PROPER STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS.

THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

Description

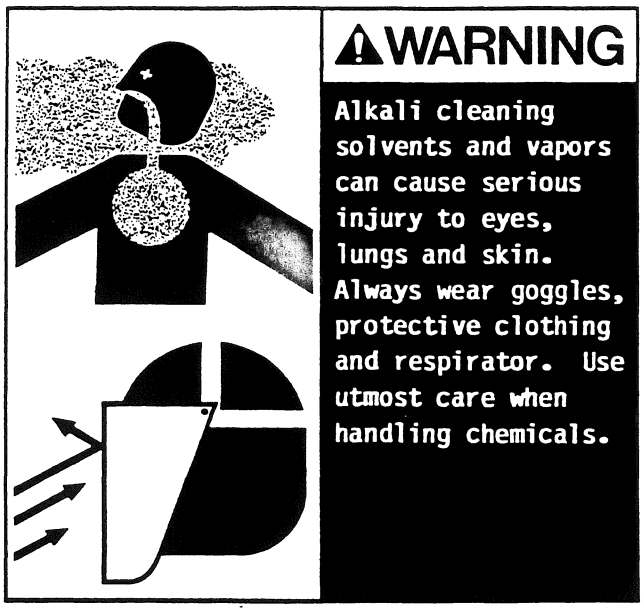
The two blade lift cylinders raise or lower the drawbar, circle and moldboard and can be used either together or independently. Refer to the 700 Series Operator's Manual for full instructions.

Both blade lift cylinders pivot in stirrups which are supported by spherical bearings in the blade lift arms.

The two sides of the drawbar rear cross-member include ball pin anchors for the blade lift cylinder ball caps.

Cleaning and Inspection

Cleaning - Bearings and Small Parts



You are recommended to wear cotton gloves when handling bearings. This prevents transfer of skin acids and perspiration onto bearing races.

Immerse bearings and small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags. Make sure all oil passages are unblocked. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all spherical races, cups and teflon-lined cones for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - Seals

Replace all seals. Handle seals carefully; particularly when being installed. Cutting, scratching or curling of the sealing lips seriously reduced efficiency. Lubricate all sealing lips with system oil.

Torque Guide

Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 20	Ball thrust cap capscrews	108,5	11	80
Fig. No. 22	Ball cap nuts	230,5	23,5	170
Fig. No. 23	Ball cap nuts	230,5	23,5	170
Fig. No. 24	Stirrup jam nut	542	55	400

Adjustments

Fig. No.	Application	kg	lb
Fig. No. 18	Spring scale tension at top of cylinder	7 - 11	15 - 25
Fig. No. 21	Spring scale tension at top of cylinder	7 - 11	15 - 25

Blade Lift Assembly - Disassembly

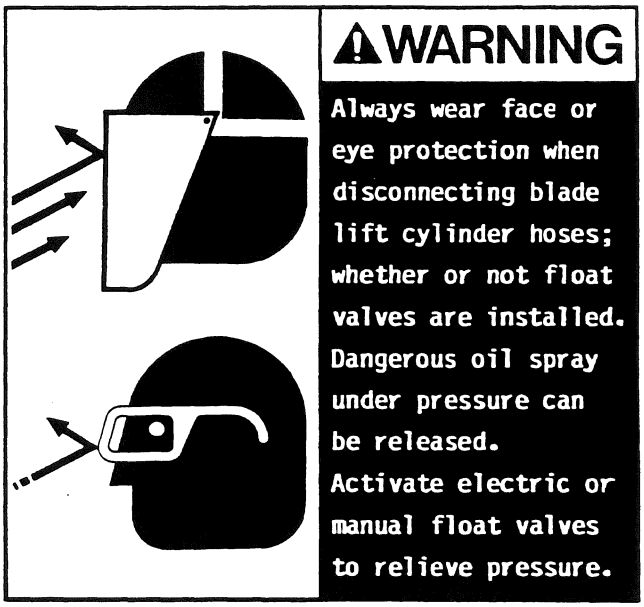
Fig. 2
Park the grader on level ground. Place the transmission mode lever in **Neutral.** Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **Service Position** .

Fig. 3
Attach a safe lifting device to the upper end of the blade lift cylinder (8). Loosen the jam nut (18) and adjusting nut (19) on the stirrup (6).

Fig. 4
Remove the bolts (15), nuts (17) and lockwashers (16) retaining the ball cap half (13). Remove the ball cap half and shim packs (14). The blade lift cylinder ball cap halves are a matched set. **Never** mix these parts with other ball cap assemblies.

Fig. 5
Fully retract the blade lift cylinder (8) piston rod. Temporarily install the shim packs (14) and ball cap half (13). Secure with the bolts (15), nuts (17) and lockwashers (16). **Make sure** you align the matched set marks.

Fig. 6



Carefully disconnect the hoses. Disconnect wiring harnesses on graders equipped with electric float valves.

Fig. 7
Remove the capscrews (1), lockwashers (2), ball thrust caps (3 and 10) and shim packs (4 and 11).

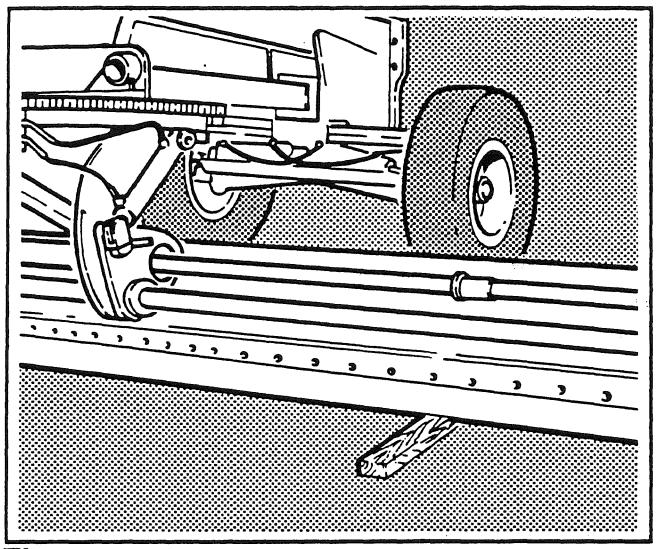
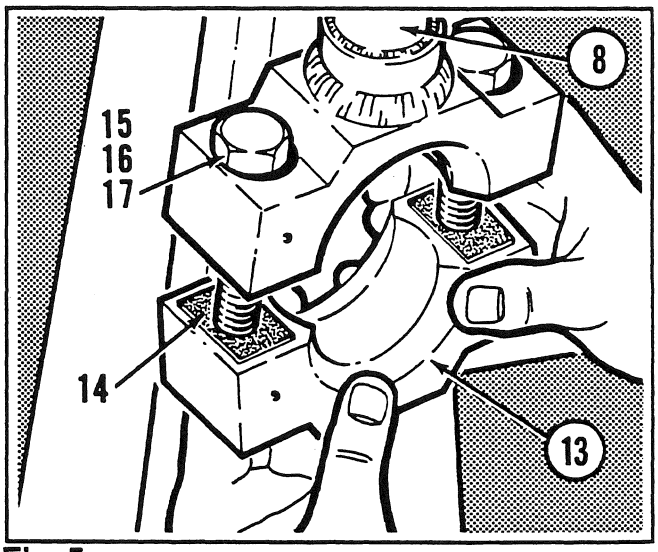


Fig. 2



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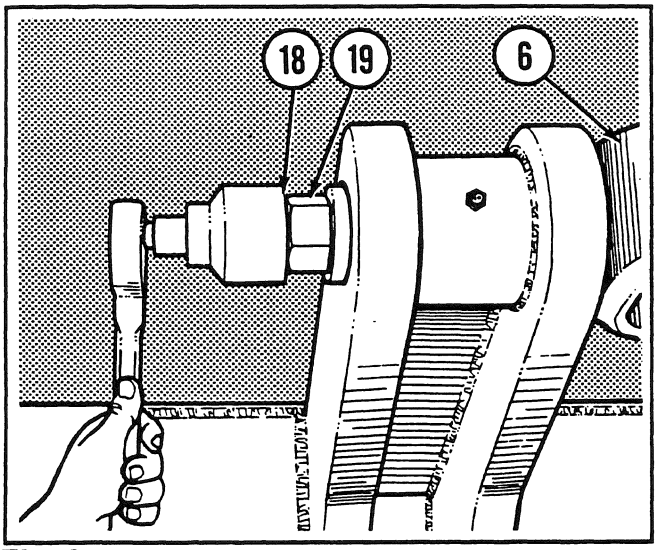

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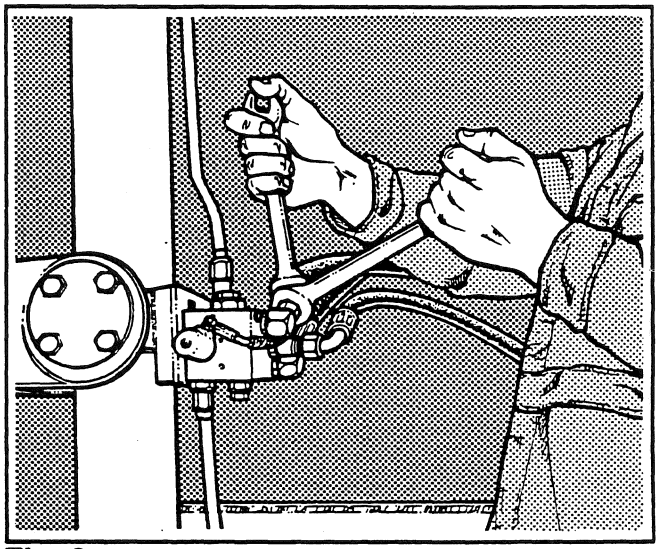

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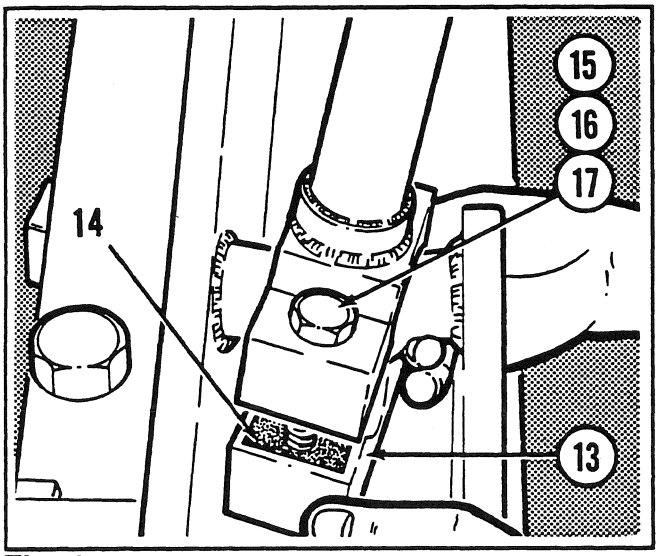

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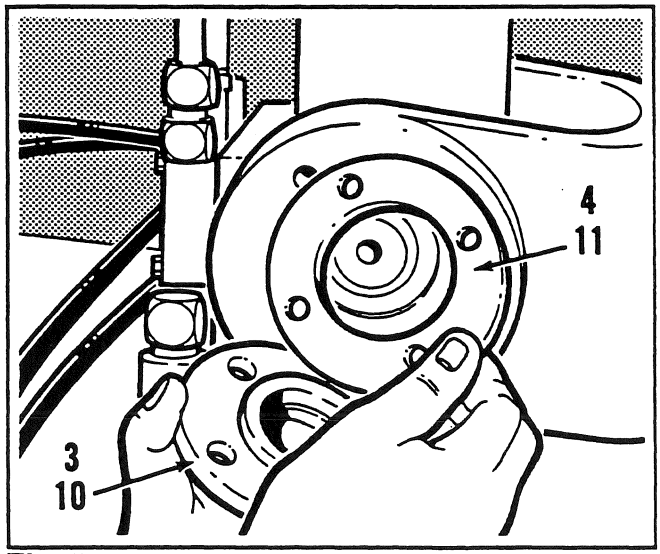

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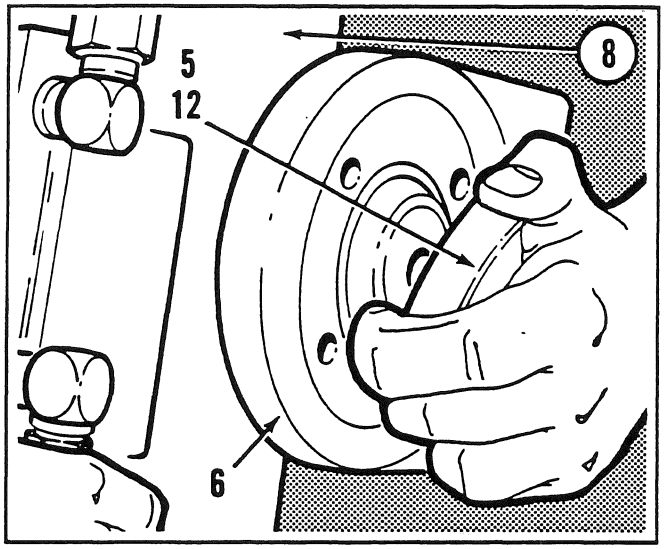

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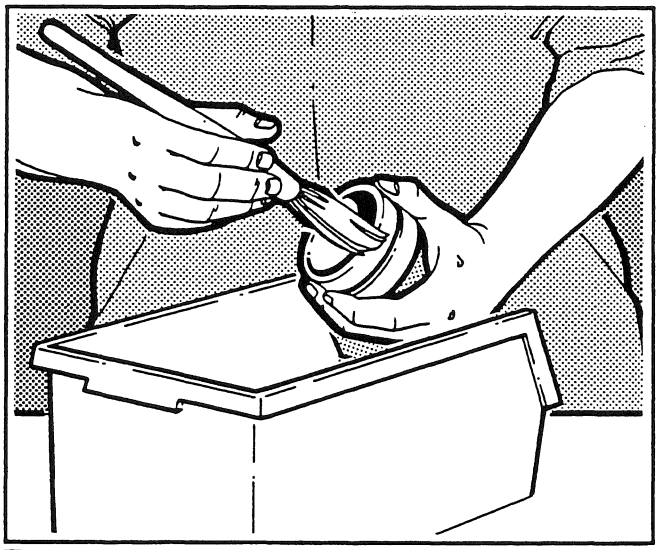
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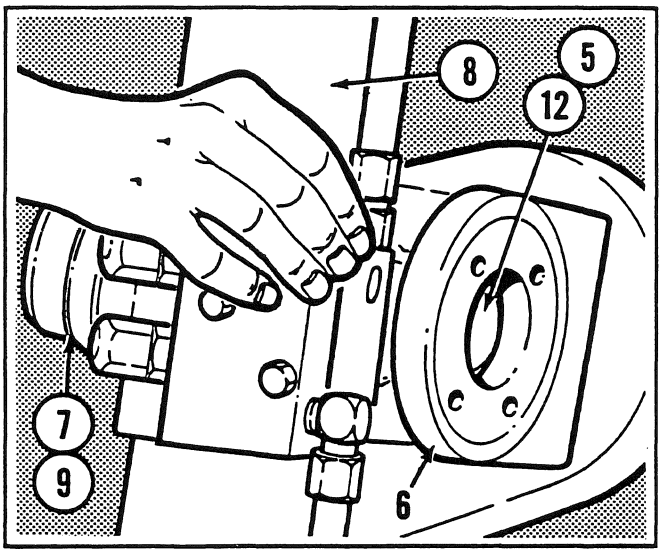

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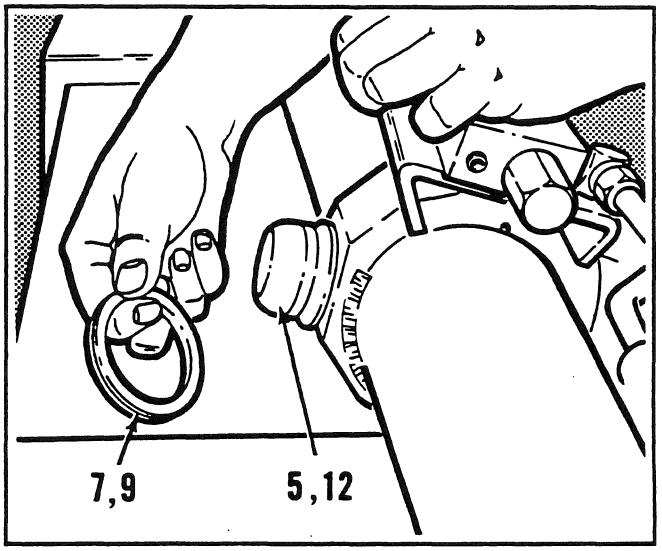

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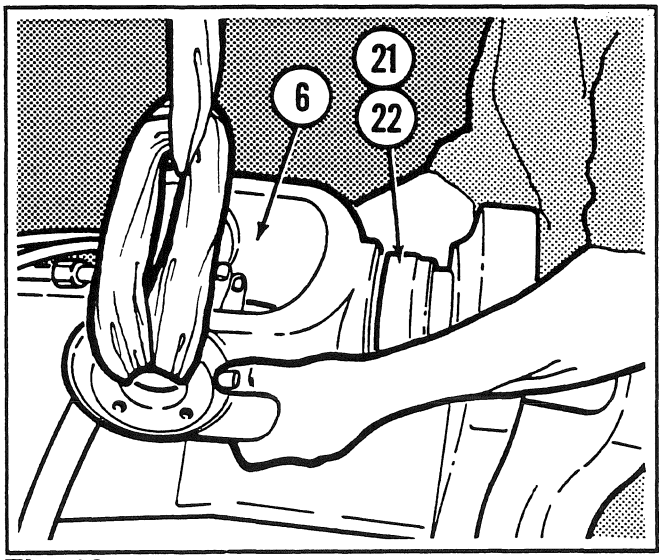


Fig. 10

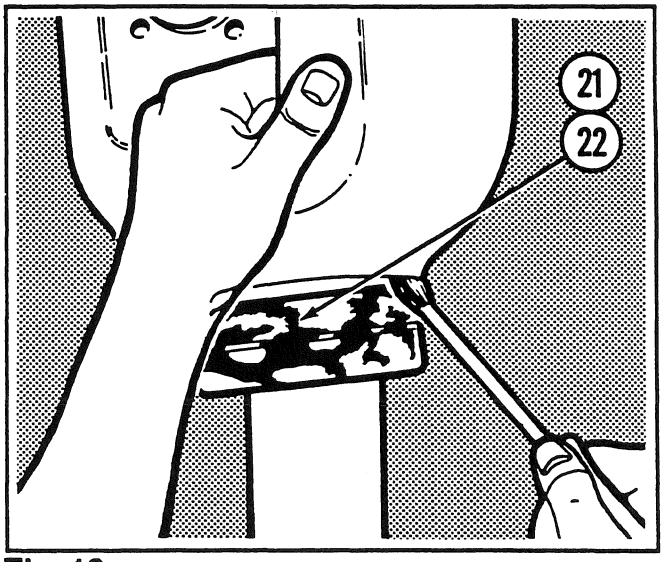


Fig. 13

Blade Lift Assembly - Disassembly
(Continued)

Fig. 8
Move the blade lift cylinder (8) barrel sideways in the stirrup (6) using a bearing puller. Remove the bearing cup (5). Repeat this procedure to remove the bearing cup (12) from the opposite side of the stirrup.

Fig. 9
Turn the blade lift cylinder (8) barrel and remove it from the stirrup (6). Remove and discard the V ring seals (7 and 9). Remove the bearing cones (5 and 12) using a bearing puller. Lower the cylinder to the ground.

Fig. 10
Attach a safe lifting device to the stirrup (6). Remove the jam nut (18), adjusting nut (19) and retainer plate (20). Carefully remove the stirrup and bearing assembly from the blade lift arm. Remove the spherical bearings (21 and 22). Install the nuts to prevent thread damage. Repeat the steps in **Fig. 3** through **Fig. 10** for the other side. The blade lift assembly is now disassembled.

Blade Lift Assembly - Assembly

Fig. 11
Following disassembly of the blade lift assembly, refer to **Cleaning and Inspection** on page 2 of this Shop Manual Section. Thoroughly clean and inspect all applicable parts before assembling the blade lift assembly.

Fig. 12
Apply a coating of anti-seize compound, Champion part number **30453,** onto the blade lift cylinder trunnion pins. Install the bearing cones (5 and 12) onto the trunnion pins. Lubricate and install new V ring seals (7 and 9).

Fig. 13
Apply a coating of anti-seize compound, Champion part number **30453,** onto the outside diameter of the spherical bearings (21 and 22) and the bores of the blade lift arms. Install the bearing (21) using a soft metal tubular drift with a diameter the same size as the bearing outer race. **Make sure** the blade lift arm bores and bearings are clean and burr-free.

Blade Lift Assembly - Assembly (Continued)

Fig. 14
Install the bearing (22) using a soft metal tubular drift with the same diameter as the bearing outer race. Remove the nuts. Attach a safe lifting device to the stirrup (6). Carefully install the stirrup into the blade lift arm. Install the retainer plate (20) and adjusting nut (19). Tighten the nut sufficiently to seat the bearings. **DO NOT** over-tighten.

Fig. 15
Attach a safe lifting device to the upper end of the blade lift cylinder (8). Turn the blade lift cylinder barrel and install it in the stirrup (6). Take care to align the bearing cones (5 and 12) with the stirrup bores during installation.

Fig. 16
Ensure that the V ring seals (7 and 9) are intact and correctly positioned. Apply a coating of anti-seize compound, Champion part number **30453**, onto the outside diameter of the bearing cups (5 and 12). Carefully install the bearing cups into the stirrup bores using a soft metal hammer.

Fig. 17
Install the ball thrust caps (3 and 10) **without** shim packs (4 and 11). Install the capscrews (1) and lockwashers (2). Tighten the capscrews until one thrust cap is tight against the stirrup.

Fig. 18
Loosen, but **DO NOT** remove the lifting device. Attach a spring scale to the top fitting of the cylinder (8). Pull on the spring scale and tighten the capscrews (1) of the other ball thrust cap until the tension on the scale agrees with the adjustment specified in the front of this Shop Manual Section.

Fig. 19
Measure the gap between the ball thrust cap and the machined face of the stirrup (6) in at least four different places. Assemble a shim pack with a thickness equal to the average of these measurements.

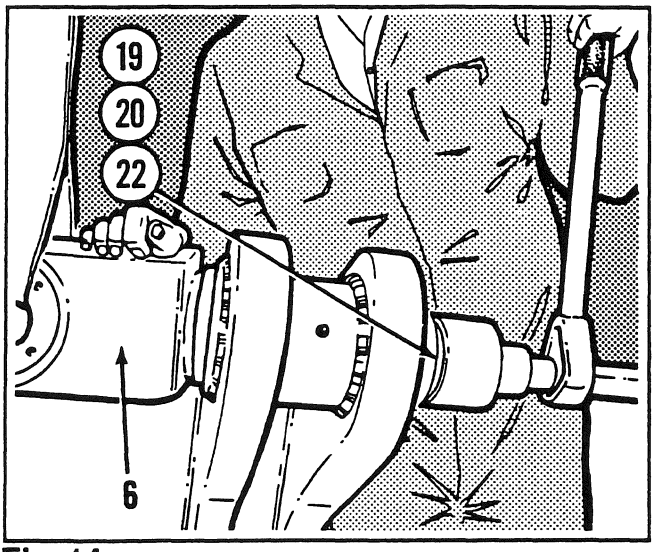


Fig. 14

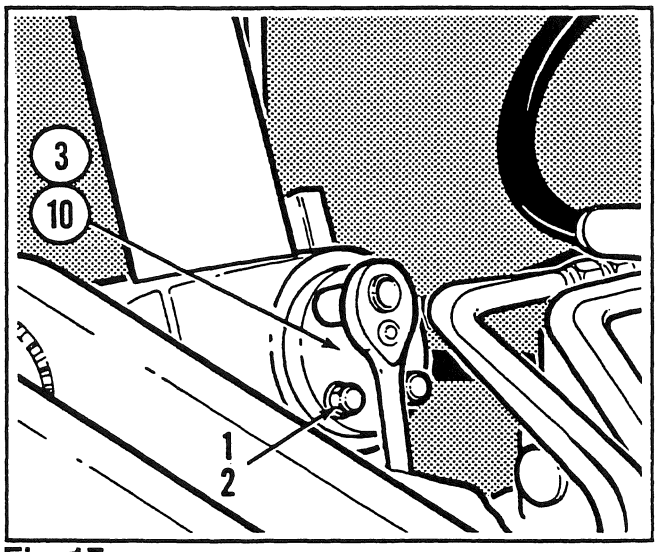


Fig. 17

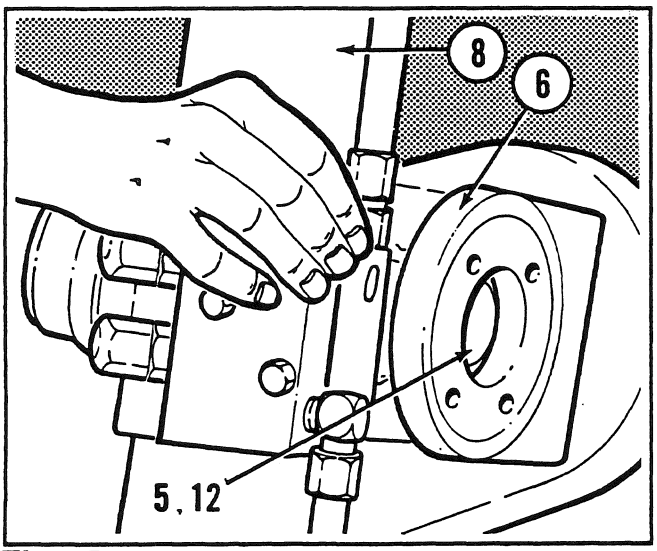


Fig. 15

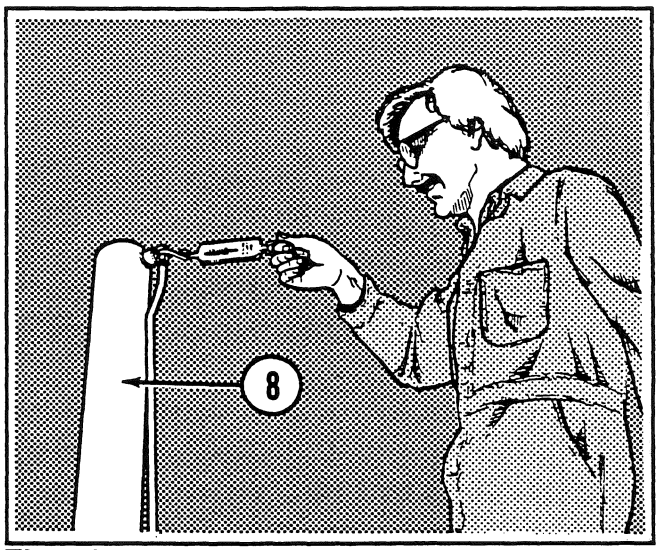


Fig. 18

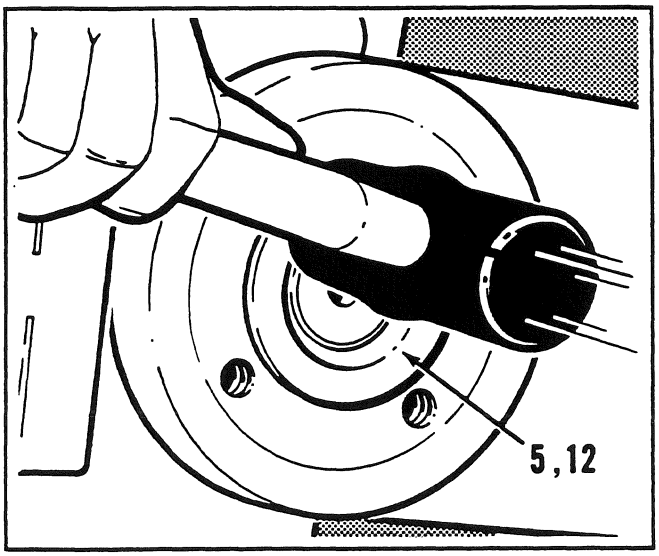


Fig. 16

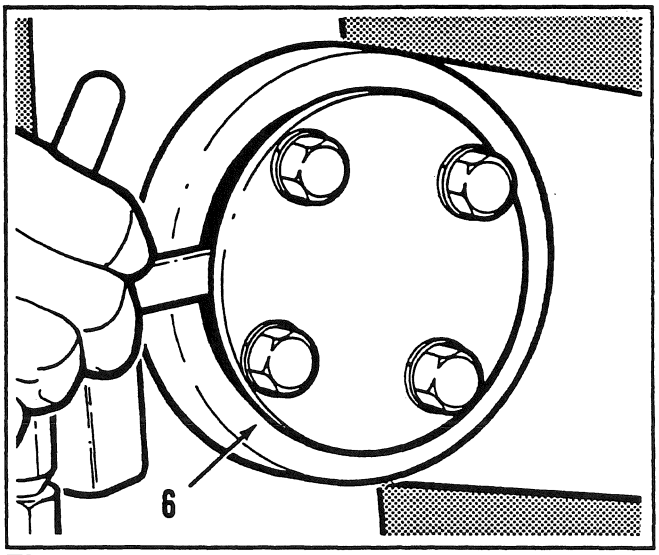
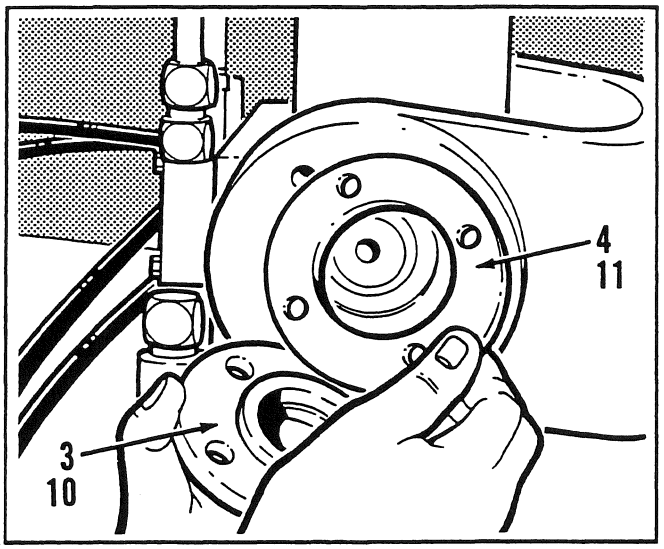


Fig. 19



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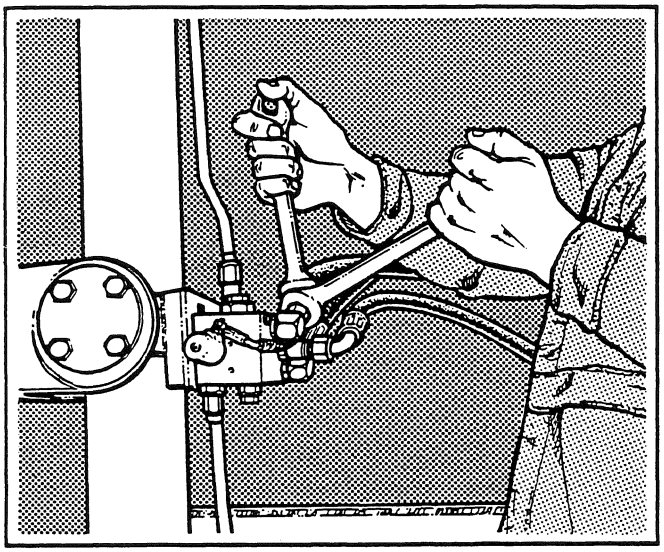
Fig. 21

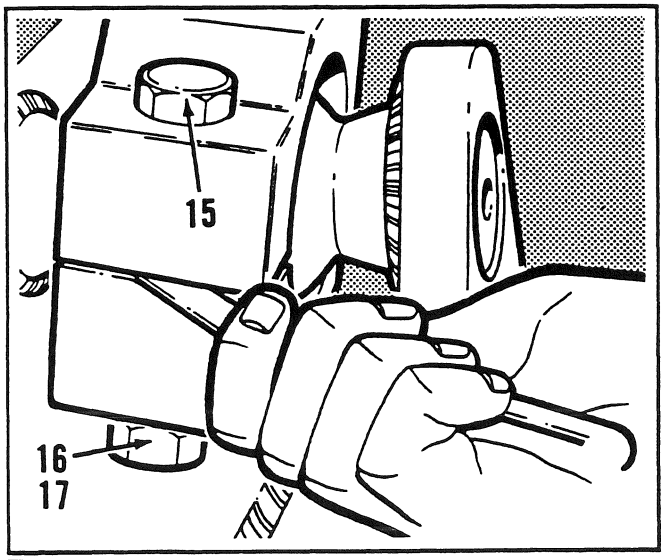

Fig. 22

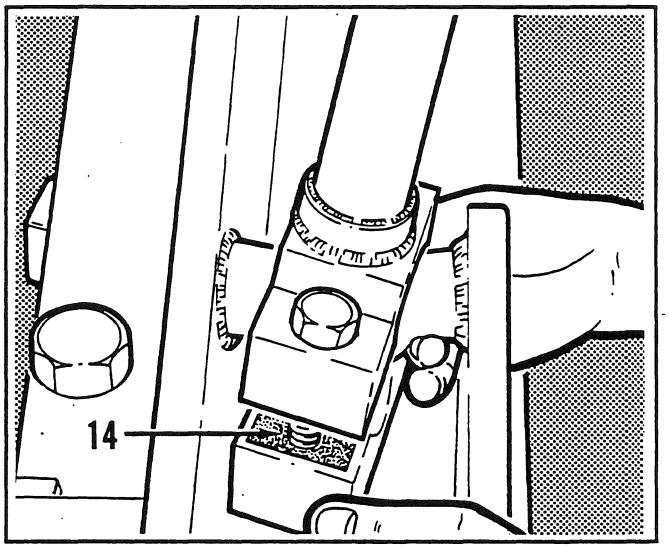

Fig. 23

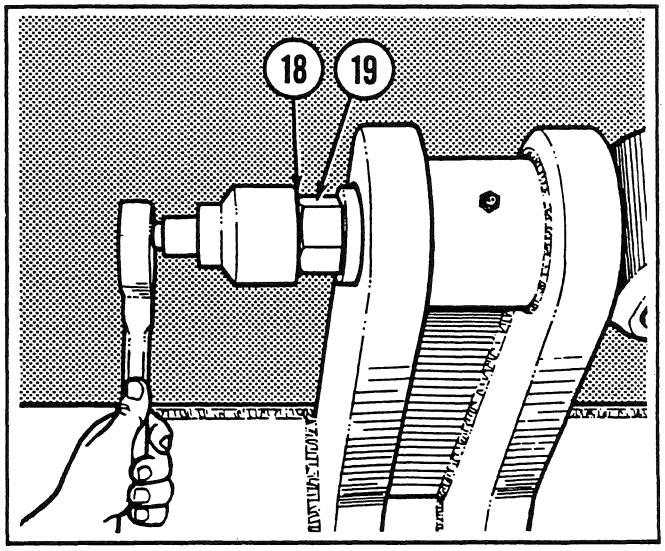

Fig. 24

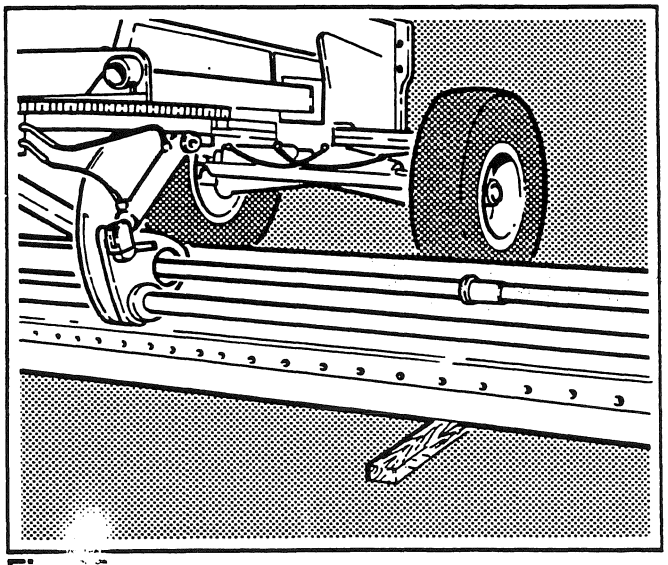
Fig. 25

Blade Lift Assembly - Assembly (Continued)

Fig. 20
Divide the shim pack in half. Remove both ball thrust caps (3 and 10). Re-install the caps and shim packs (4 and 11). Install the capscrews (1) and lockwashers (2). Tighten the capscrews to the specified torque.

Fig. 21
Pull on the spring scale and check to see if it agrees with the adjustment specified in the front of this Shop Manual Section. Re-connect the hoses. Re-connect the wiring harnesses for graders equipped with electric float valves.

Fig. 22
Determine the size of the ball cap shim packs (14). Install the matched ball cap halves **without** shims. Secure with the bolts (15), nuts (17) and lockwashers (16). Tighten the nuts to the specified torque. Measure the gap between the ball cap halves.

Fig. 23
Install shim packs (14) equal in thickness to this measurement. Tighten the ball cap nuts (17) to the specified torque.

Fig. 24
Loosen the stirrup adjusting nut (19). Install the jam nut (18). Hold the adjusting nut with a wrench. Tighten the jam nut to the specified torque. Lubricate the blade lift spherical bearings with grease recommended in the Lubrication Specifications at the front of this Shop Manual. **Make sure** you see grease seeping out of the bearings. Ensure the stirrup assembly is free to rotate.

Fig. 25
Repeat the steps in **Fig. 13** through **Fig. 24** for the other side. The blade lift assembly in now completely assembled.

SECTION 4

HYDRAULICS

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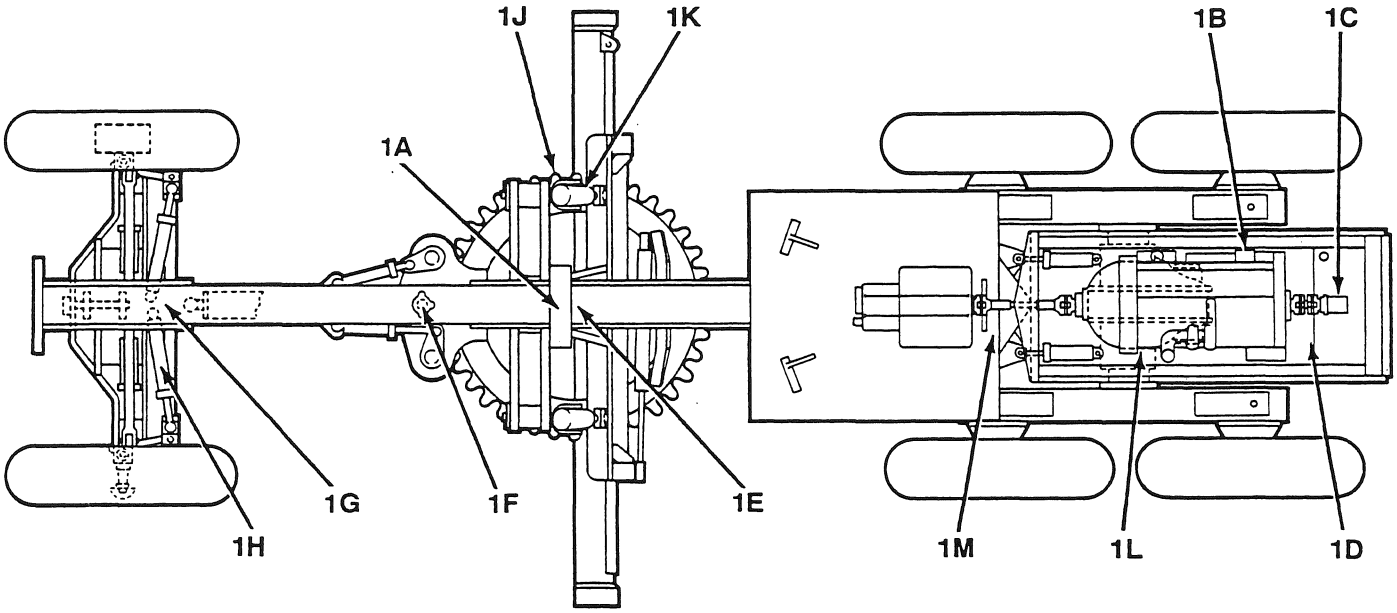
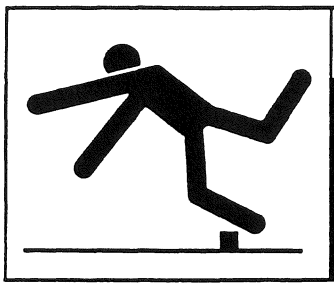


Fig. 1 Hydraulic System Components

Item	Description and Location
1A	Manifold valve assembly (on top of front frame)
1B	Main hydraulic pump (rear, right-hand side of engine)
1C	Transmission/Steering hydraulic pump (under radiator at rear of grader)
1D	Relief valves (front face of hydraulic tank on left-hand side)
1E	Hydraulic swivel joint (center of circle and beneath drawbar)
1F	Circle turn valve (on top of drawbar)
1G	Cushion valves (on top of drawbar and in nose section of front frame)
1H	Hydraulic cylinders (various locations)
1J	Power tilt lock valves (on either side of circle outer diameter)
1K	Counterbalance valves (on the blade lift cylinders and in nose section of front frame)
1L	Solenoid valves (various locations; depending on attachments and if grader is articulated)
1M	Accumulators (on the blade lift cylinders, circle shift cylinder and oil disc brakes)

Key to Fig. 1



⚠ CAUTION

Before starting any service procedure, make sure work area is clean and safe.

General

A clean work area will reduce the chance of foreign matter entering and contaminating the hydraulic system.

Make sure proper shop tools are available and in good working order. You will need a workbench with a vise.

Refer to the 700 Series Parts Manual P/N L **3008** for spare parts information. For specific major repair kits and seal kits, refer to both the 700 Series Parts Manual and the Champion Service Parts Kit Booklet P/N L **21000**.

Service Position Precaution

NOTE: *Always place the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure. Refer to the SERVICE POSITION procedure on page (ii) in the front of this Shop Manual.*

Description

Champion graders use separate hydraulic circuits for the right-hand manifold valves, left-hand manifold valves, transmission and steering system.

The primary hydraulic system to the right-hand and left-hand manifold valve is an open center design. Oil is supplied from the hydraulic tank through two suction strainers to the main and steering hydraulic pumps. The primary hydraulic circuit uses a dual section gear type pump which is directly driven from the engine. The transmission/steering circuit uses a dual section gear type pump mounted behind the engine and driven by a driveshaft.

Two relief valves, mounted to the front of the hydraulic tank, regulate pressure in the primary circuits.

On articulated machines, the articulation circuit is connected in series with the left-hand primary hydraulic circuit. When the operator energizes the electric solenoid valve, oil is directed by the valve spool to the cylinders. Oil leaving the cylinders continues to the left-hand manifold valve assembly and does not return directly to the hydraulic tank. Thermal relief lock and cross-over relief valves are built into the electric solenoid valve to protect the system from excessive pressure.

The manifold valve assemblies each contain four valve sections. Cables connect the hydraulic control levers to the control valve spools. Moving the control levers directs oil through the valve sections to the cylinders.

All of the hydraulic cylinders are double-acting and the basic design varies only in diameter and stroke.

Oil returns from the cylinders through the manifold valve sections into the return line. Return oil from both manifold valve assemblies and the steering circuit flows to the hydraulic filter.

The spin-on, 7 micron hydraulic filter is mounted directly below the fuel tank on the left-hand side of the grader. A bypass valve built into the filter head protects the filter from excessive pressure. The valve allows return oil to bypass the filter if the oil is too cold and thick to flow through the filter, or the filter is plugged by contamination.

NOTE: *Changing the filter at 500 hour intervals and the hydraulic oil at 1000 hour intervals is essential for long hydraulic component life.*

A counterbalance/lock valve is used in the leaning wheel circuit. It is also used in the blade lift circuit of some models without optional blade float. The valve traps oil in the cylinder and prevents the leaning wheel cylinders "drifting" or the blade lift cylinder piston rods "creep descending" faster than the pump can supply oil. Without the valve, cavitation (voids in the oil) could result.

Oil for the power tilt and moldboard slide shift cylinders is directed through the hydraulic swivel joint. The hydraulic swivel joint includes a spool and an outer body. The spool is sealed by O rings. The hydraulic swivel joint prevents hoses from twisting when the circle turns a complete 360 degrees.

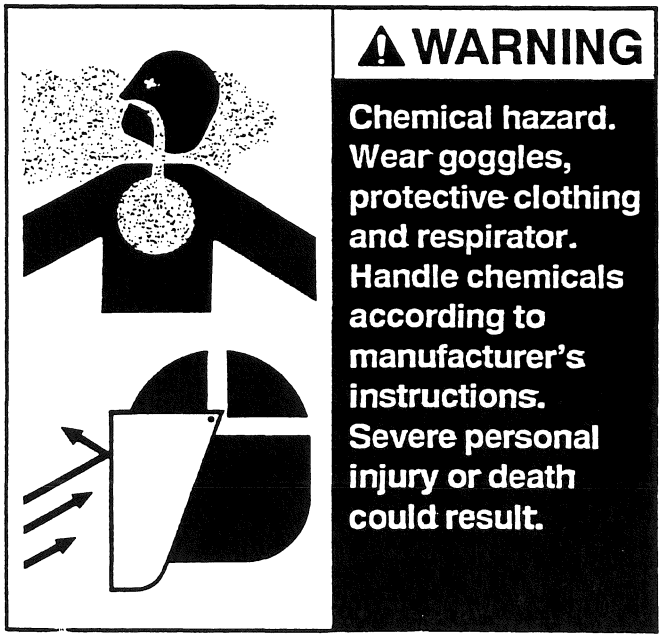
The cushion valve is a crossover relief valve used in the steering and circle turn hydraulic circuits. The valve protects these systems from excessive pressure caused by shock loads. As the oil pressure reaches the preset level of the valve, the internal poppet unseats and allows oil to bypass into the other line.

The circle turn valve is mounted to the top of the drawbar. The valve controls the operation sequence of the two circle turn cylinders. The circle turn valve sprocket meshes with the circle teeth and turns the valve spool. The circle turn valve directs oil to the correct end of the cylinders at the proper time.

Cleaning and Inspection

Cleaning

Immerse small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate parts to remove all foreign matter.



Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags. Make sure all oil passages are unblocked. Apply system oil to undamaged parts that are ready for assembly. If storing parts for some time, apply a rust inhibitor to all surfaces. Wrap parts in rust inhibitor impregnated paper before storing.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Gaskets, Oil Seals, O Rings and Snap Rings

Replace all gaskets, oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency. Lubricate all oil seal lips with fresh system oil.

Inspection - Gears and Shafts

Examine teeth of all pump gears for wear caused by contamination, misalignment, etc. Inspect shafts for signs of bent or twisted splines and seal wear. Replace any deformed shafts.

Torque Guide

Sub-section/ Fig. No.	Application	Torque Value lbf·ft	N·m	kgf·m
4A / 16	Spool collar	10	14	1,4
4A / 17	Capscrews retaining spool positioner cap	10	14	1,4
4A / 18	Load check plugs	20	27	2,8
4A / 34	Load check plug	20	27	2,8
4A / 37	Capscrews retaining float positioner cap	10	14	1,4
4A / 38	Anti-cavitation check body	20	27	2,8
4A / 42	Nuts retaining tie studs	32	43	4,4
4A / 42	Bolts holding down manifold valve assy.	19	26	2,6
4A / 44	Bolts retaining bonnet plate	10	14	1,4
4B / 40	Nuts retaining primary hydraulic pump	57	77	7,9
4C / 42	Bolts retaining trans./steering hyd. pump	45	61	6,2
4C / 44	Bolts retaining hyd. pump to bracket	80	108,5	11,1
4G / 12	Seat to cushion valve housing	13	17	1,8
4G / 19	Bolts retaining cushion valve	13	17	1,8
		lbf·in.	**N·m**	**kgf·m**
4L / 21	Tube assembly into solenoid valve body	100	11	1,1
4L / 22	Nut retaining solenoid coil	65 - 75	7 - 8	0,75 - 0,86
4L / 24	Nuts securing mounting foot tie rod	115	13	1,3

Hydraulic Test Procedure - All Models

Main Hydraulic Pump and Circuit - Both Sides

⚠ WARNING

Do not work under grader or near wheels when engine is running.

Specifications

2100 psi ± 100 psi at 2100 rpm (full flow) and oil temperature at 100° F.
145 bar ± 6,9 bar at 2100 rpm (full flow) and oil temperature at 38° C.

Equipment

0 - 3000 psi (0 - 200 bar) pressure gauge. Hose must be long enough to easily read the gauge from the cab.

Test Procedure

1. Lower the moldboard and all attachments. Block **all** wheels. Apply the hand brake.
2. Remove the transmission guard cover. Connect the pressure gauge to the inlet hose of the left-hand manifold valve.

   NOTE: Graders S/N 20121 and up are supplied with a quick disconnect coupler P/N 51286; otherwise install a tee fitting connecting the pressure gauge to the inlet hose. ***Champion recommends that you use only this location for testing. Never "dead head" the gauge into the hose.***

3. Make a visual check, then start the engine. Operate the blade lift control levers and fully retract the cylinders.
4. Run the engine at 2100 rpm, pull the left-hand blade lift control lever and read the gauge. **Do not use the hand throttle.**

   NOTE: Do not hold at the relief position for more than 15 seconds.

5. Record the pressure reading and shut down the engine.
6. To test the right-hand side, repeat steps 1 to 5, but in step 2 connect the gauge to the inlet hose of the right-hand manifold valve and in step 4 pull the right-hand blade lift control lever.

   NOTE: If two pressure gauges are available, both sides can be checked at the same time.

Adjustment Procedure - If adjustment is required, proceed as follows:

1. Place the grader in the SERVICE POSITION (refer to the procedure on page (ii) in the front of this Shop Manual). Drain the oil from the hydraulic tank into a clean container - capacity 25 U.S. gallons (95 liters).
2. Remove the cartridge from the relief valve body needing adjustment. Replace the internal O ring and back-up ring as described in this Shop Manual section under Relief Valves.

   NOTE: The left-hand relief valve is for the left-hand manifold valve.

Champion Part No.	Thickness		Approximate Change	
	Inches	mm	psi	bar
50065	0.040 in.	1,02 mm	250	17,2
50066	0.020 in.	0,50 mm	150	10,3
50067	0.010 in.	0,25 mm	75	5,2

   NOTE: Do not add shims between the end cap and spring. This will limit poppet travel and reduce flow rate of the relief valve. This could lead to component damage.

4. Refill the hydraulic tank with clean oil. Refer to your 700 Series Operator's Manual for the recommended types and viscosities. Test the hydraulic system.

Hydraulic Test Procedure - All Models continued

⚠ WARNING

Do not work under grader or near wheels when engine is running.

Steering System - Main Relief

Specifications

2100 psi ± 100 psi at 2100 rpm (full flow) and oil temperature at 100° F.
158 bar ± 6,9 bar at 2100 rpm (full flow) and oil temperature at 38° C.

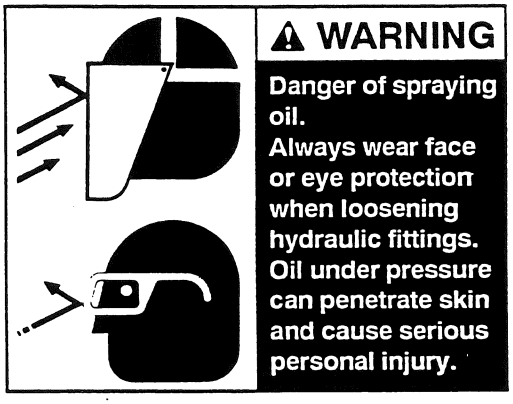
Equipment

0 - 3000 psi (0 - 200 bar) pressure gauge. Hose must be long enough to easily read the gauge from the cab. #8 JIC steel cap and plug.

Test Procedure

1. For a detailed test procedure, refer to Product Support Bulletin No. **512** (page 2 of form **F-503**). **Champion recommends that you use the approved test method.** Place the grader in the SERVICE POSITION.
2. Connect the pressure gauge to the test port of the steering control unit (Orbitrol valve) inlet hose.

   *NOTE: Graders S/N 20121 and up are supplied with a quick disconnect coupler P/N 51286; otherwise install a tee fitting connecting the pressure gauge to the inlet hose. **Never "dead head" the gauge into the hose.***



⚠ WARNING

Danger of spraying oil.
Always wear face or eye protection when loosening hydraulic fittings.
Oil under pressure can penetrate skin and cause serious personal injury.

3. Disconnect one hose at the steering control unit leading to the front axle. Use a **steel cap** and **steel plug** to plug the open port and hose. Do not use plastic caps.
4. Do not touch the steering wheel. Make a visual safety check, then start the engine and run at 2100 rpm. Slowly turn the steering wheel and observe the pressure gauge. Return the grader to the SERVICE POSITION and reconnect the hose to the steering control unit.
5. Refer to Product Support Bulletin No. **512** (page 3 of form **F-503**) for information on pressure adjustment.

   *NOTE: On the remote mounted steering relief/priority valve, flow adjustment is made externally. Pressure adjustment is made internally. Refer to Product Support Bulletin No. **512** (page 3 of form **F-503**).*

Hydraulic Test Procedure - All Models continued

⚠ WARNING

Do not work under grader or near wheels when engine is running.

Steering System - Cushion Valve

Specifications

Method 1: On grader - 1150 psi ± 100 psi (79 bar ± 6,9 bar) at 2100 rpm.

NOTE: The steering wheel must be turned one complete revolution every two seconds.

Method 2: Off grader - 800 psi ± 50 psi (55 bar ± 3,5 bar). Cracking pressure - can only be checked by using a hand pump.

Equipment

0 - 3000 psi (0 - 200 bar) pressure gauge. Hose must be long enough to easily read the gauge from the cab.

Test Procedure

1. For a detailed test procedure, refer to Product Support Bulletin No. **512** (page 3 of form **F-503**). **Champion recommends that you use the approved test method.**
2. Connect the pressure gauge to the test port of the steering control unit (Orbitrol valve) inlet hose.

   *NOTE: Graders S/N 20121 and up are supplied with a quick disconnect coupler P/N 51286; otherwise install a tee fitting connecting the pressure gauge to the inlet hose. **Never "dead head" the gauge into the hose.***
3. Turn the steering wheel until the front wheels reach the locked position.
4. Run the engine at 2100 rpm and continue to evenly turn the steering wheel one complete revolution every two seconds. Record the gauge reading.
5. Repeat steps 3 and 4 for the other side and record the gauge reading.
6. Return the grader to the SERVICE POSITION.

   NOTE: It is important that you turn the steering wheel at the correct speed.

Adjustment Procedure

Refer to Product Support Bulletin No. **512** (page 4 of form **F-503**).

Hydraulic Test Procedure - All Models continued

Circle Cushion Valve

Specifications

2000 psi ± 100 psi (138 bar ± 6,9 bar). Cracking pressure - can only be checked by using a hand pump.

Test and Adjustment Procedure

Refer to this Shop Manual section under Cushion Valves.

NOTE: The circle cushion valve cannot be checked or adjusted using the grader hydraulic system. Excessive back pressure will give inaccurate readings.

STEERING HYDRAULIC SYSTEM CHECKS AND ADJUSTMENTS

Ref. No. F-503(01/90)

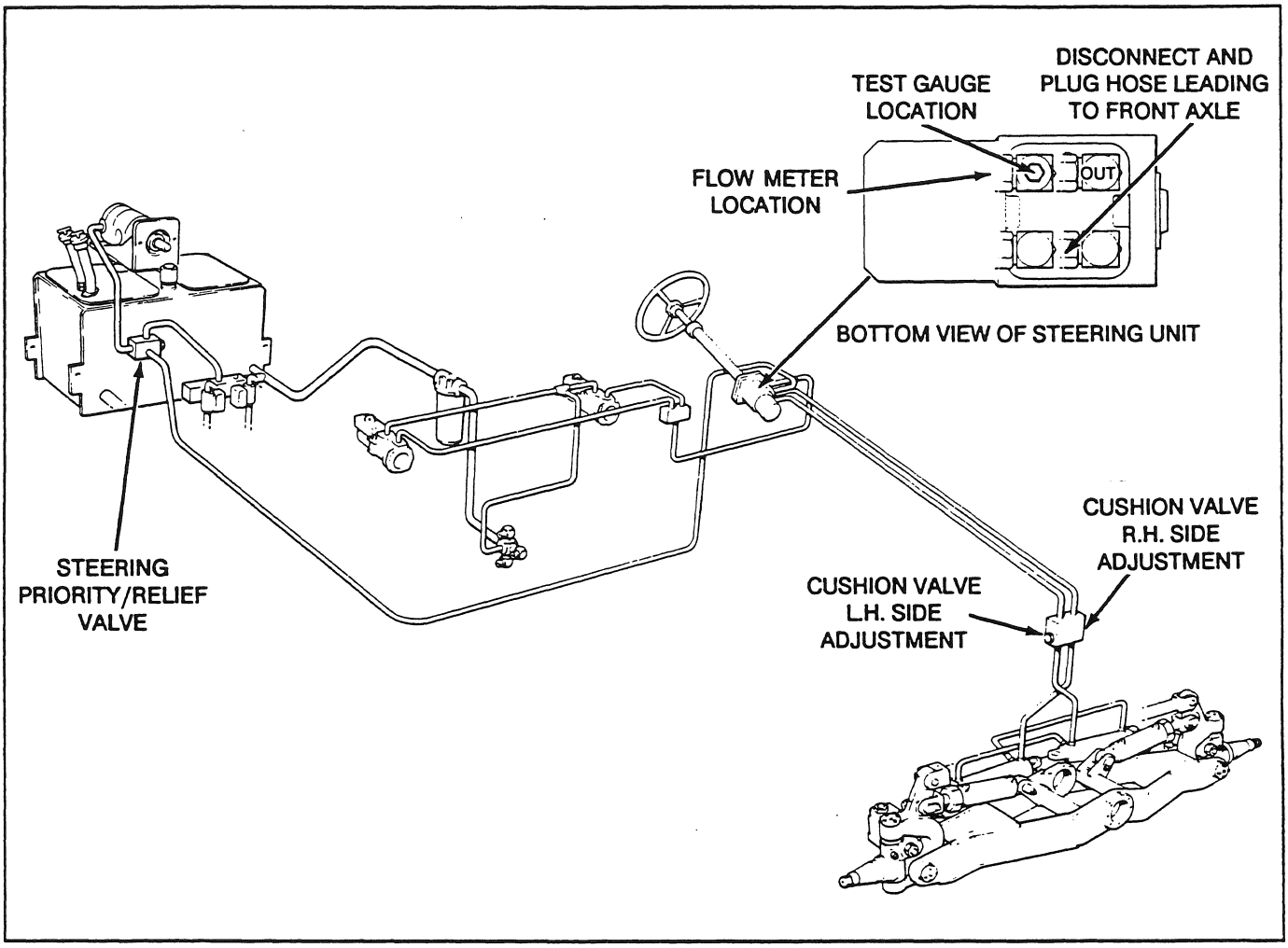


Fig. 1

Steering hydraulic system effective on grader serial numbers 19982, 19984, 19985, 19996, 20005, 20104, 20106, 20120 and up.

Steering System Pressure Checks (Fig. 1)

IMPORTANT NOTE: Some graders are equipped with the supplemental steering assist system. Do not test this system as described in steps 4 and 5, following. No pressure relief is incorporated. Perform the supplemental steering assist system daily pre-start check as described in the 700 Series Operator's Manual P/N L 4012. Check the basic steering system as follows.

1. Install a 0 - 3000 psi (0 - 207 bar) test gauge in the 1/8 in. pipe port on the inlet line fitting to the steering unit. Position the gauge so that it can be easily read from inside the cab.

   NOTE: Some machines do not have the inlet line fitting with the 1/8 in. pipe port. You can use a tee fitting or drill and tap the existing fitting. On machines S/N 20312 and up, except S/N 20324, a male quick-disconnect coupling P/N 51286 is installed in the inlet line fitting. The mating female quick-connect coupling P/N 51287 is found in the tool box.

2. *NOTE: Before starting step 2, ensure the primary hydraulic system relief valves are operating and set correctly.*

   When it is safe to do so start the engine. Run the engine for one minute at idle; then raise the rpm to high idle. Operate the blade lift control levers and retract the cylinders. Hold the control levers in the retracted position for 30 seconds, and release them for 15 seconds. Cycle the levers this way until the hydraulic oil temperature in the tank reaches approximately 100°F (38°C).

3. To test the steering system relief valve, place the grader in the SERVICE POSITION (refer to your 700 Series Shop Manual P/N **L 2005**). Clean around the hydraulic tank filler neck cap. Remove and replace the cap to relieve the tank pressure. Disconnect one hose at the steering unit leading to the front axle (refer to Fig. 1). Use a **steel cap** and **steel plug** to plug the open port and hose. Do not use plastic caps. Danger of hot oil.

4. Do not touch the steering wheel. **When it is safe to do so** start the engine and run at idle. Slowly turn the steering wheel while observing the pressure gauge. You will only be able to physically turn the steering wheel 1/4 revolution. If the gauge reading is above the specification listed on Page 6 (i.e., the relief setting is too high for the gauge), release the steering wheel. This allows the steering unit to revert to 'open center' and reduces the pressure. This is a check only. If the setting does not meet the specification, return the grader to the SERVICE POSITION and adjust the steering system relief valve as explained later in this procedure.

5. For the actual hydraulic test, adjust the engine speed to 2100 rpm. Repeat the above test and note the gauge reading. The steering system relief valve setting is listed on Page 6. If the setting does not meet this specification, return the grader to the SERVICE POSITION and adjust the steering system relief valve as explained later in this procedure. Repeat steps 4 and 5.

   NOTE: Do not hold at the relief position for more than 5 seconds. Never "dead head" the pressure line into the steering unit with a pressure gauge. Damage to the gauge and pump could result.

6. Return the grader to the SERVICE POSITION. Remove the steel cap and plug. Reconnect the hose from the front axle to the steering unit. Danger of hot oil.

7. **When it is safe to do so** start the engine and adjust the engine speed to 2100 rpm.

8. Turn the steering wheel to the left until the wheels reach the locked position. **At 2100 rpm, continue to evenly turn the steering wheel 1 revolution every 2 seconds.** It is important to turn the steering wheel at this rate to maintain a consistent output flow rate from the steering unit, test to test. Observe the pressure gauge and record the value as "left side cushion valve"

9. Repeat step 8, but turn the steering wheel to the right lock and record the gauge reading under "right side cushion valve".

10. If the values obtained in steps 8 and 9 do not meet the specification listed on Page 6, adjust or repair the cushion valve. The grader must be in the SERVICE POSITION when you adjust or repair the cushion valve. Retest as described in steps 7, 8 and 9 **only when it is safe to do so.** Danger of hot oil.

Steering Relief Valve Adjustment (Fig. 2)

1. Place the grader in the SERVICE POSITION.

2. Carefully remove the cap and spring. A small amount of oil will escape.

3. Use a magnet to remove the spool. Place the spool on a clean workbench.

4. Use a flat bladed screwdriver to prevent the spool from turning.

5. Insert an Allen wrench into the set screw at the opposite end of the spool.

6. **Be careful,** as little as one turn on the set screw changes the relief setting by 400 to 500 psi (28 to 34 bar). Turn the set screw counter-clockwise to reduce pressure and clockwise to increase pressure. Do not allow the spool to turn when making adjustments.

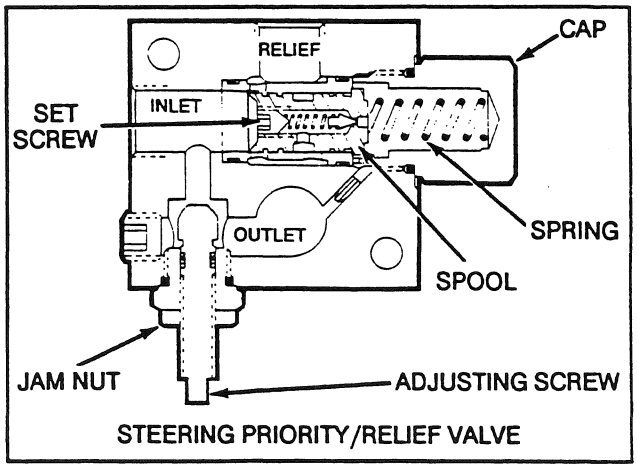


Fig. 2

7. Install the spool into the valve body.

   NOTE: The spool and valve body are a matched set. You cannot interchange other spools and valve bodies.

8. Install the spring and cap. Ensure the spring seats correctly on the spool end. Retest according to the instructions described in **Steering System Pressure Checks.**

9. If any adjustment does not meet the specification listed on Page 6, rebuild or replace the valve P/N **53619**. Order repair kit P/N **55249** from Champion's Parts Distribution Centre or your Champion Distributor.

Steering Cushion Valve Adjustment (Figs. 1 and 3)

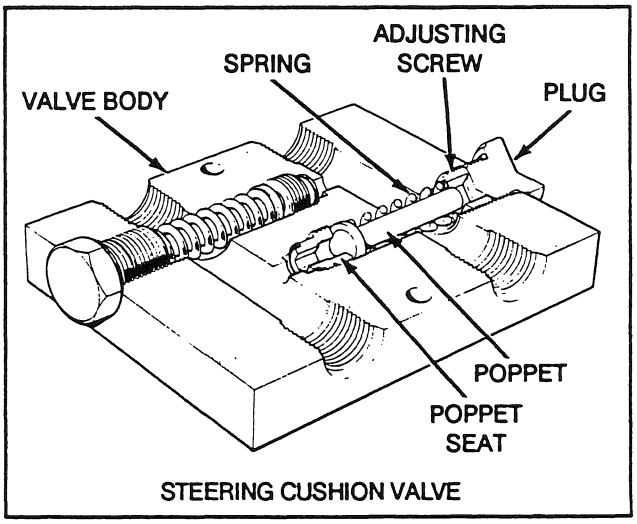
1. Place the grader in the SERVICE POSITION.

2. Determine if the left-hand or right-hand side of the cushion valve requires adjusting:

   a. If the gauge reading is incorrect when steering to the right, the adjustment is on the left-hand side when viewed from the operator's seat.

   b. If the gauge reading is incorrect when steering to the left, the adjustment is on the right-hand side when viewed from the operator's seat.

3. Clean around the hydraulic tank filler neck cap. Remove and replace the cap to relieve the tank pressure.



STEERING CUSHION VALVE

Fig. 3

4. Remove the plug on the side of the valve requiring adjustment (see step 2). Use an Allen wrench to turn the adjusting screw. Turn counter-clockwise to reduce pressure and clockwise to increase pressure.

   NOTE: One complete turn changes the setting by approximately 500 to 700 psi (34 to 48 bar).

5. Install the plug and retest as described in steps 8 and 9 in **Steering System Pressure Checks.**

6. If you cannot obtain the correct setting, rebuild or replace the valve P/N **23748**. Order repair kit P/N **26317** from Champion's Parts Distribution Centre or your Champion Distributor.

7. To bench test a rebuilt steering cushion valve, install a pressure gauge and hand pump. The valve should crack open at 1000 psi (69 bar). Refer to service video tape **#VS 2015** - Hydraulic Components for full details.

Steering System Flow Checks

1. Place the grader in the SERVICE POSITION.

2. Clean around the hydraulic tank filler neck cap. Remove and replace the cap to relieve the tank pressure

3. Connect a 0 - 25 U.S. gpm (0 - 95 L/min) in-line flow meter to the inlet hose of the steering unit. Connect the output end of the flow meter with the inlet fitting of the steering unit. If the flow meter has a built in shut-off valve, open the valve fully.

4. *NOTE: Before starting step 4, ensure the primary hydraulic system relief valves are operating and set correctly.*

   When it is safe to do so start the engine. Operate the blade lift control levers and retract the cylinders. Hold the control levers in the retracted position for 30 seconds, and release them for 15 seconds. Cycle the levers this way until the hydraulic oil temperature in the tank reaches approximately 100°F (38°C)

5. Check and record the flow meter readings at 750 rpm and at 2100 rpm. Do not turn the steering wheel and do not press either the clutch or brake pedals during the flow tests.

   Flow at 750 rpm should be 7 U.S. gpm (26 L/min)
   Flow at 2100 rpm should be 12 ±1 U.S. gpm (45 ± 4 L/min).

6.

Test conditions	Results	Remedy
Flow at 750 rpm Flow at 2100 rpm	Low Low	Rebuild or replace pump. Clean or repair steering priority/relief valve
Flow at 750 rpm Flow at 2100 rpm	O.K. Low (e.g., 10 U.S. gpm)	- Adjust priority valve and increase flow to 12 ±1 U.S. gpm (45 ±4 L/min)
Flow at 750 rpm Flow at 2100 rpm	O.K. High (e.g., 14 U.S. gpm)	- Adjust priority valve and decrease flow to 12 ±1 U.S. gpm (45 ±4 L/min)

Steering System Flow Adjustment (Fig. 2)

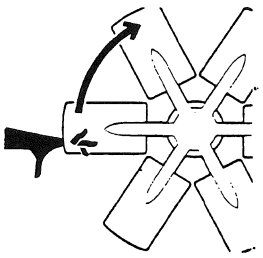
1. To adjust the priority valve, loosen the jam nut. Turn the adjusting screw in to decrease flow and out to increase flow.

   NOTE: A one half turn of the adjusting screw changes the flow rate by approximately 3 U.S. gpm (11 L/min).

2. Tighten the jam nut and retest the system.

3. After correctly adjusting the priority valve, remove the flow meter. Danger of hot oil.

⚠ WARNING



Rotating fan, drive shaft and belts.

Do not run engine when working in this area.

Severe personal injury could result.

⚠ WARNING

Hot pressurized oil.

Wear face and hand protection when working with hoses.

Failure to do so could result in severe personal injury.

Specifications

Steering system relief valve setting ..... 2300 (±100) psi (158 [±7] bar)
Steering system cushion valve setting (L.H. and R.H.) ..... 1150 (±100) psi (79 [±7] bar)
Steering system flow at 750 rpm ..... 7 U.S. gpm (26 L/min)
Steering system flow at 2100 rpm ..... 12 U.S. gpm (45 L/min)

NOTE: The steering system cushion valve setting listed above applies specifically to the checking and adjustment procedure detailed in this publication.

SECTION 4A
HYDRAULICS
Manifold Valve Assembly

S/N 16224, 16245 to 19291. U.S. S/N 2021-2 to 2658-2

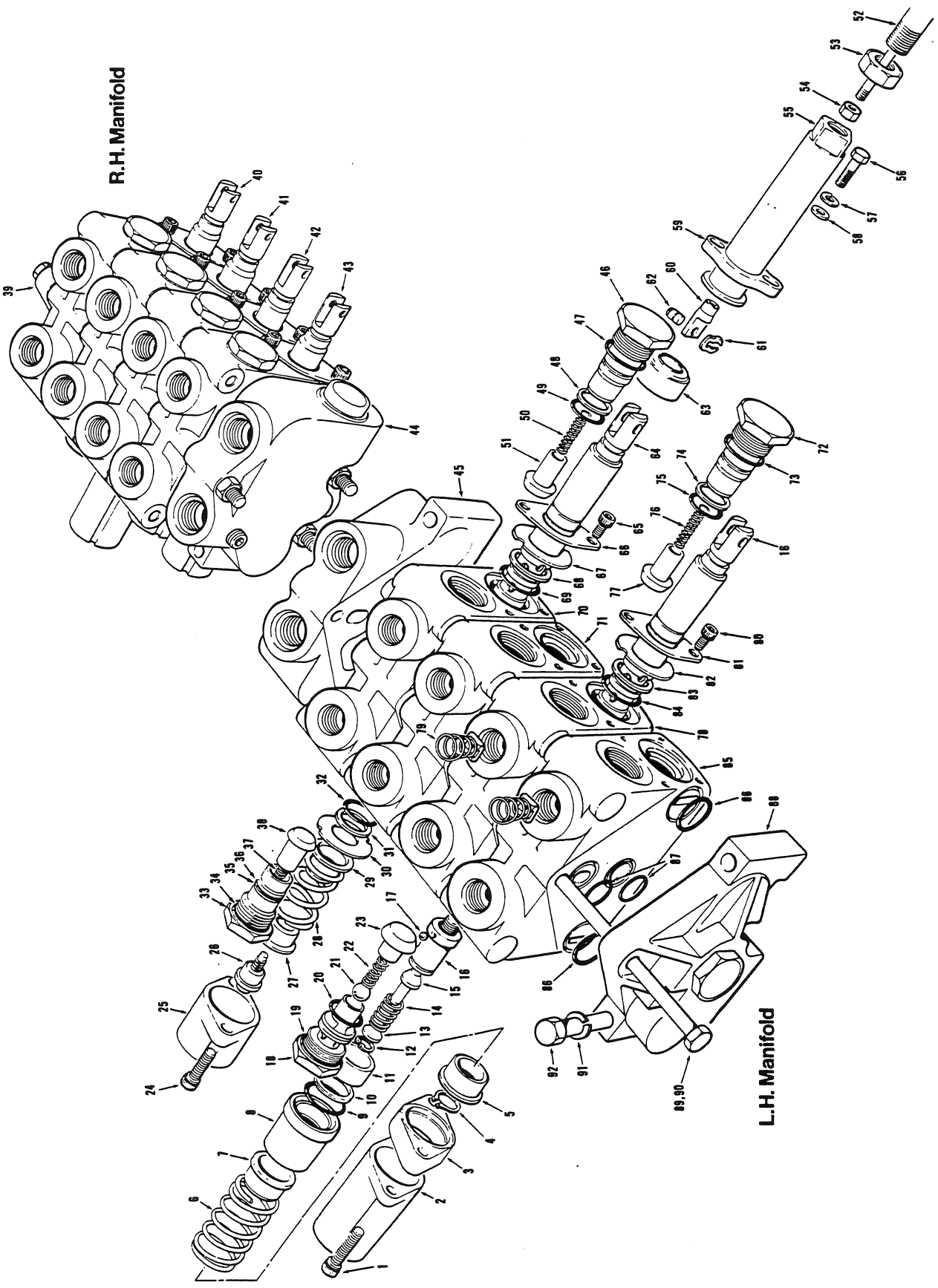


Fig. 1A Manifold Valve Assembly
S/N 16224, 16245 to 19291. U.S. S/N 2021-2 to 2658-2

Item	Description	Item	Description	Item	Description
1	Capscrew	32	O ring	63	Spacer
2	Float positioner cap	33	Load check plug	64	Spool
3	Spacer	34	O ring	65	Capscrew
4	Retainer ring	35	Back-up washer	66	Seal plate
5	Spring collar	36	O ring	67	Retainer plate
6	Spring	37	Spring	68	Back-up washer
7	Spring collar	38	Poppet	69	O ring
8	Detent sleeve	39	End cover	70	Valve section - L.H.
9	O ring	40	Valve section - R.H.	71	Valve section - R.H.
10	Seal	41	Blade lift valve section - R.H.	72	Load check plug
11	Sleeve	42	Valve section - R.H.	73	O ring
12	Retaining ring	43	Valve section - R.H.	74	Back-up washer
13	Shim	44	Inlet cover	75	O ring
14	Spring	45	Inlet cover	76	Spring
15	Poppet	46	Load check plug	77	Poppet
16	Spool	47	O ring	78	Blade lift valve section
17	Steel ball	48	Back-up washer		L.H./optional float
18	Anti-cavitation check body	49	O ring	79	Orifice restrictor
19	O ring	50	Spring	80	Capscrew
20	O ring	51	Poppet	81	Seal plate
21	Steel ball	52	Cable	82	Retainer plate
22	Spring	53	Jam nut	83	Back-up washer
23	Poppet	54	Nut	84	O ring
24	Capscrew	55	Bonnet	85	Blade tilt valve section - L.H.
25	Spool positioner cap	56	Bolt	86	O ring (large)
26	Spool collar	57	Lockwasher	87	O ring (small)
27	Spring collar	58	Flatwasher	88	End cover - L.H.
28	Spring	59	Plate	89	Tie stud
29	Spring collar	60	Adapter	90	Nut
30	Retainer plate	61	Retaining ring	91	Lockwasher
31	Back-up washer	62	Pin	92	Bolt

Key to Fig. 1A

S/N **16224, 16245** to **19291**. U.S. S/N **2021-2** to **2658-2**

Manifold Valve Assembly - Removal

Fig. 2

Descriptive procedures for removal, disassembly, assembly and installation are the same for the left-hand and right-hand manifold valve assemblies. The left-hand manifold is described in this sub-section. Steam clean the manifold. Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual. Remove the hydraulic tank filler cap to release any pressure and replace the cap loosely.

Fig. 3

Identify all hoses, tubes and cables with their respective valve sections. Identify the orientation of the valve sections to the cable ends (see **Fig. 5**).

NOTE: *The spool and valve sections are a matched set and cannot be separately interchanged with another spool orvalve section.*

Fig. 4

Remove the hoses and tubes as required. Cap all fittings and ports to prevent contamination.

Fig. 5

To ensure the proper cable adjustment for assembly, measure the location of the jam nut (53) on the cable hub and note this measurement. With two wrenches, hold the cable (52) and remove the jam nut (53). Do not rotate the bonnet (55). Remove the bolts (56) and washers (57 and 58) securing the bonnet to the valve section. Remove the bonnet and spacer (63) from the valve section.

Fig. 6

Install two capscrews (65) to finger tightness to retain the seal plate (66). Remove the retaining ring (61) and pin (62) from the cable (52). Do not sharply bend the cable when removing it. Ensure the components do not slide down the cable between the cab and frame.

Fig. 7

Evenly loosen the three hold down bolts (92) and the three tie studs (89) and nuts (90). Remove the hold down bolts and lockwashers (91).

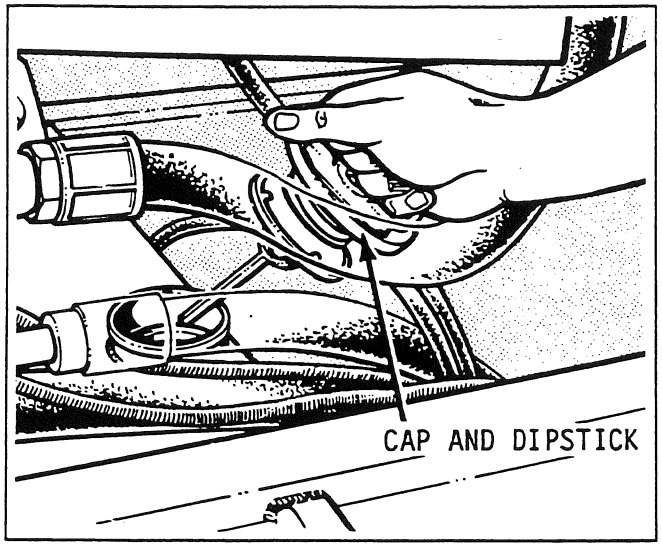


Fig. 2

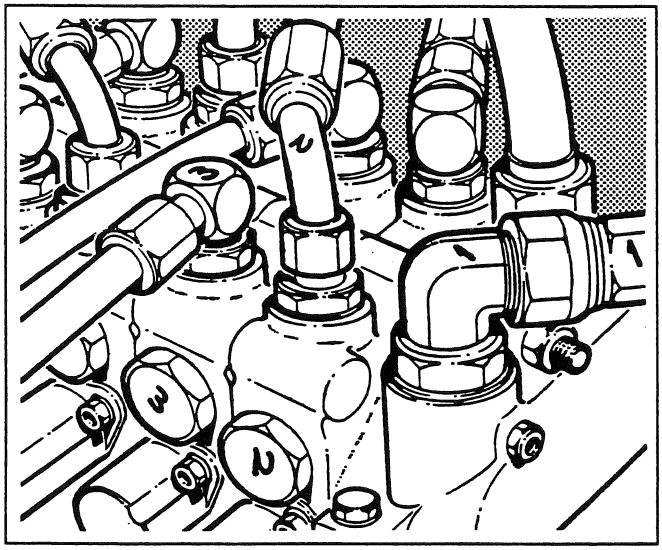


Fig. 3

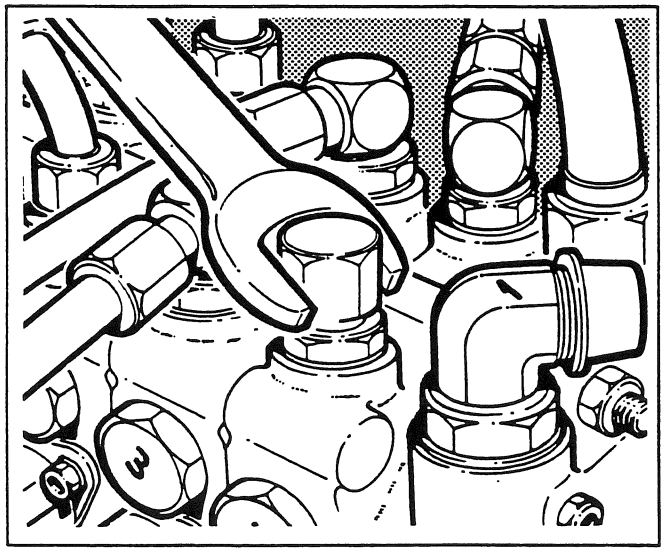


Fig. 4

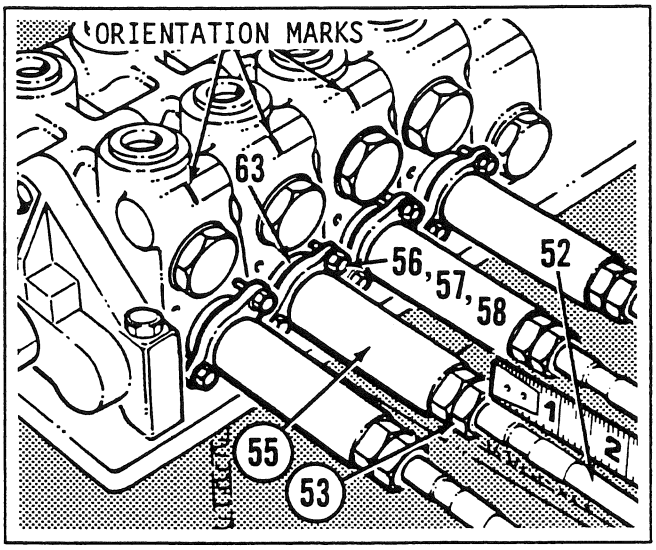


Fig. 5

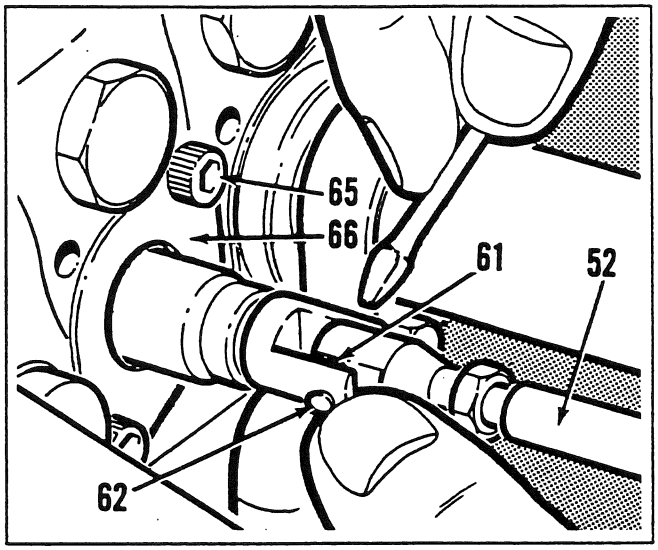


Fig. 6

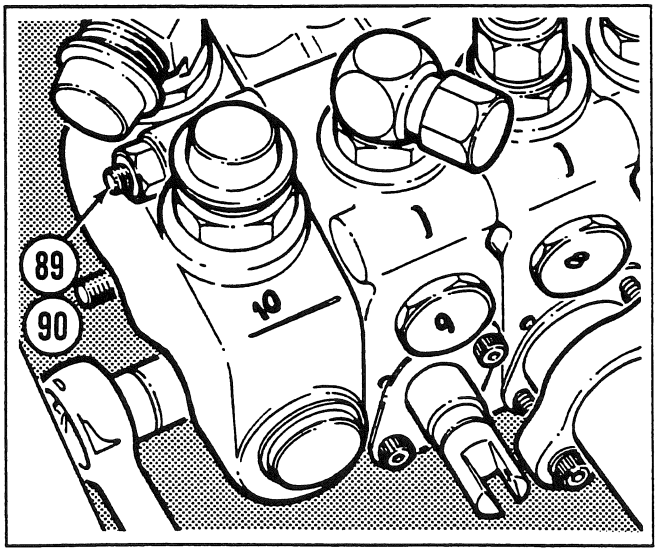


Fig. 7

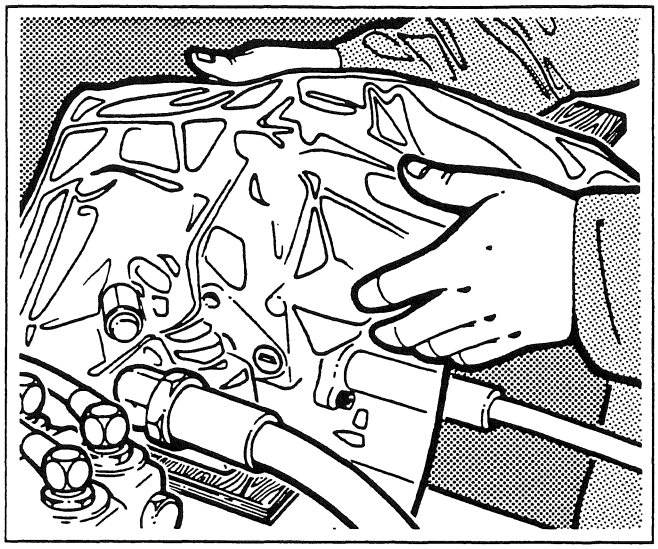


Fig. 8

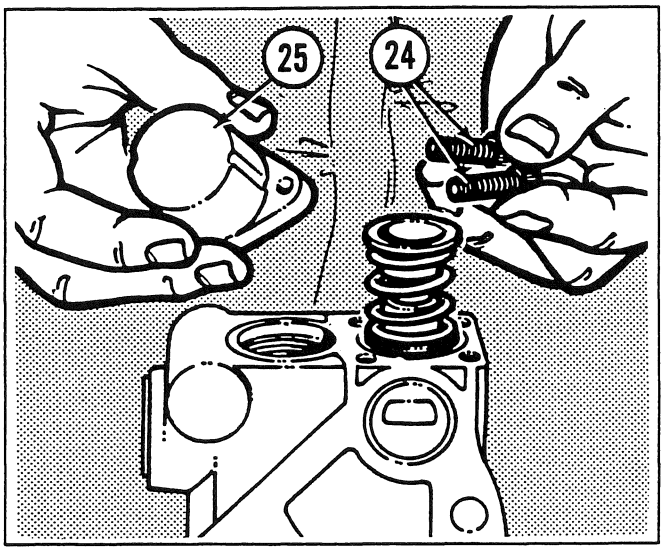


Fig. 11

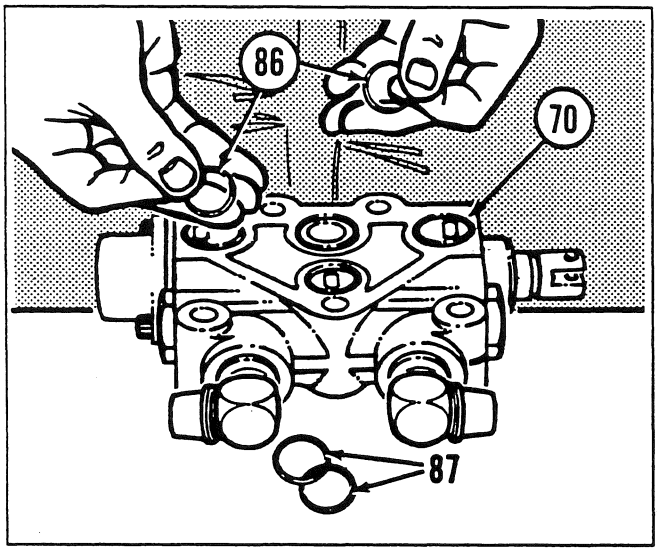


Fig. 9

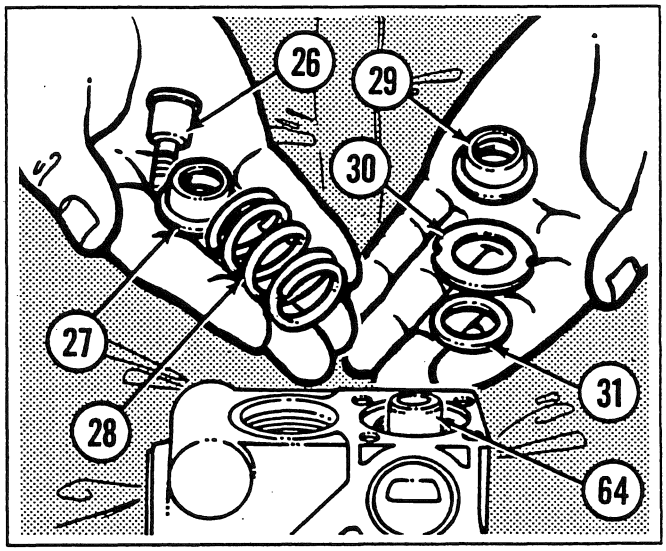


Fig. 12

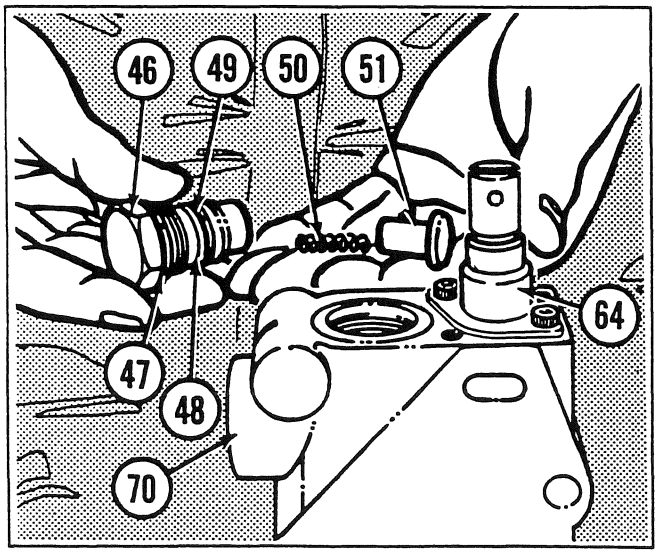


Fig. 10

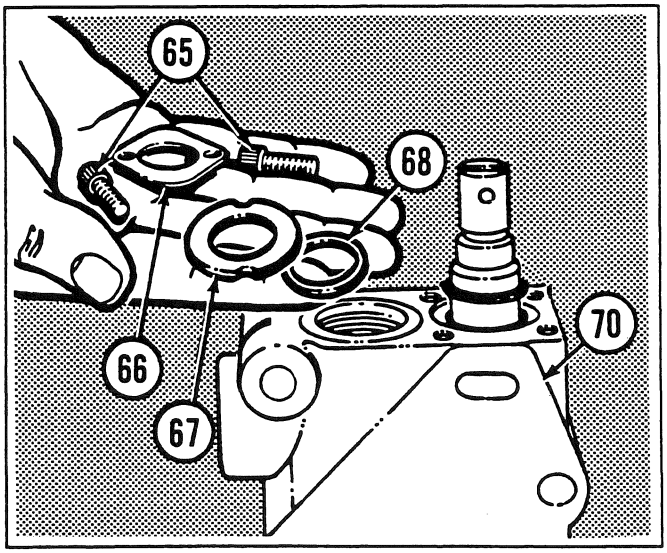


Fig. 13

Manifold Valve Assembly - Removal continued

Fig. 8
Insert a flat smooth plywood board under the manifold valve assembly making the service procedures much easier. Remove the nuts (90) and the three tie studs (89). Carefully separate the valve sections. Remove the valve section requiring service and place it on a clean workbench. Cover the remaining manifold valve sections with a clean plastic sheet to prevent contamination of the hydraulic system.

Disassembly (Standard Valve Section)

Fig. 9
Remove and discard the O rings (86 and 87).

Fig. 10
Place the valve section (70) in a vise with soft jaws. Do not overtighten the vise. Remove the fittings and load check plug (46). Be careful that the wrench does not damage the spool (64). Using a magnetic pick-up tool, remove the spring (50) and poppet (51). Invert the valve section in the vise and remove the other load check plug (33), spring (37) and poppet (38). Discard both the O rings (47 and 49) and back-up washers (35 and 48) from each load check plug. Note the orientation of the back-up washer relative to the O ring.

Fig. 11
Remove the capscrews (24) and the spool positioner cap (25).

Fig. 12
Prevent the spool (64) from rotating. Do not use pliers as they will destroy the surface finish. Unscrew the spool collar (26) and remove the spring collar (27), spring (28) and the remaining spring collar (29). Using a magnetic pick-up tool, remove the retaining plate (30) and back-up washer (31). Discard the back-up washer.

Fig. 13
Invert the valve section (70) in the vise. Remove the two temporary capscrews (65), seal plate (66) and retainer plate (67). Discard the back-up washer (68).

Disassembly (Standard Valve Section)

continued

Fig. 14

Remove the spool and discard the O rings (32 and 69). Inspect all components for serviceability. Refer to **Cleaning and Inspection** found in the front of this Shop Manual section.

Fig. 17

Install the spool positioner cap (25) with the drain opening facing downwards when the valve is assembled on the grader. Install and tighten the capscrews (24) to the specified torque.

Assembly (Standard Valve Section)

Fig. 15

Place the valve section (70) in a vise with soft jaws. Generously lubricate the valve section and spool (64) and install the spool according to the orientation mark. Lubricate and install a new O ring (69) and new back-up washer (68) on the spool. Install the retainer plate (67), seal plate (66) and secure the assembly with capscrews (65) to finger tightness only.

Fig. 18

Lubricate and install the poppet (38) and spring (37). Lubricate and install new O rings (34 and 36) and back-up washers (35 and 48) on both load check plugs (33 and 46). Ensure the correct location of the back-up washer. Lubricate and install both load check plugs into the valve section (70). Tighten them to the specified torque. Inspect the hose fitting O rings and install the fittings into the valve section.

Fig. 16

Invert the valve section (70) in the vise. Lubricate and install a new O ring (32) and a new back-up washer (31) on the spool (64). Install the retainer plate (30), spring collar (29) and spring (28). Prevent the spool from rotating. Do not use pliers as they will destroy the surface finish. Insert the spool collar (26) into the spring collar (27) onto the spool. Tighten the spool collar to the specified torque.

Fig. 19

Remove the valve section (70) from the vise and place it on a clean workbench. Lubricate and install new O rings (86 and 87) in the counterbores of the valve section. Servicing a standard valve section is now complete. Refer to the installation procedures if no other valve sections need servicing.

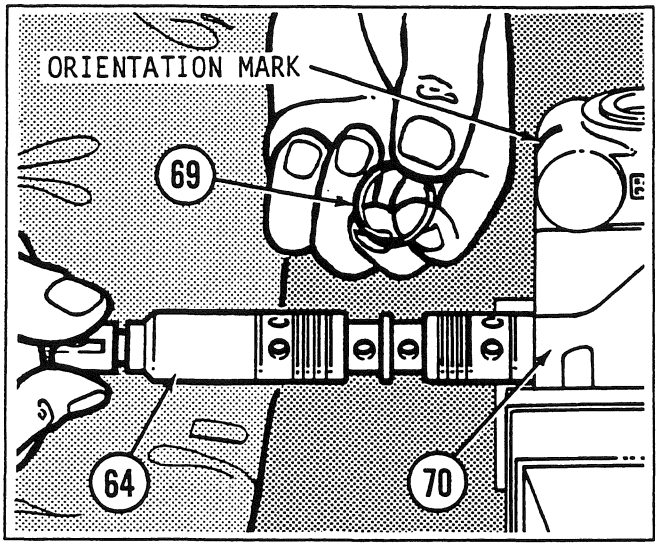


Fig. 14

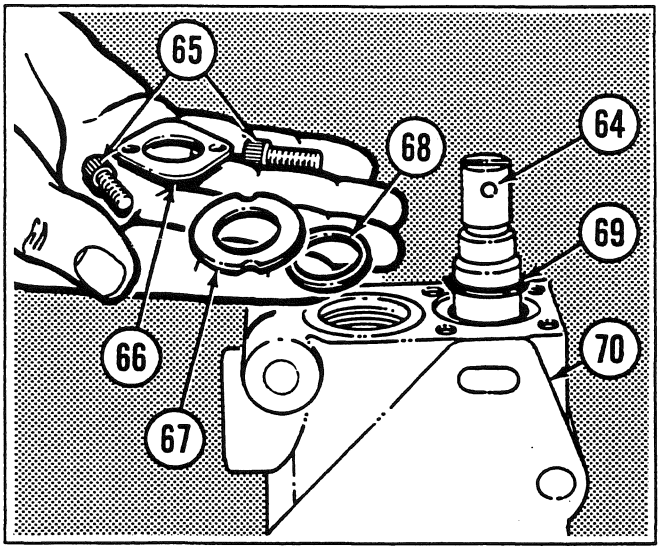


Fig. 15

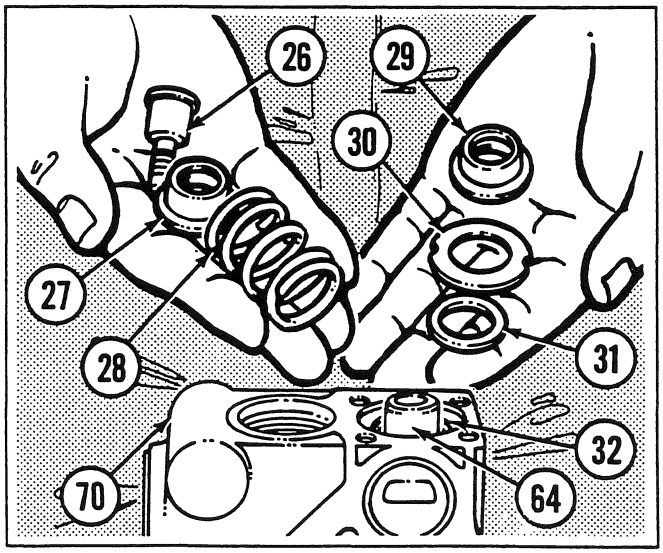
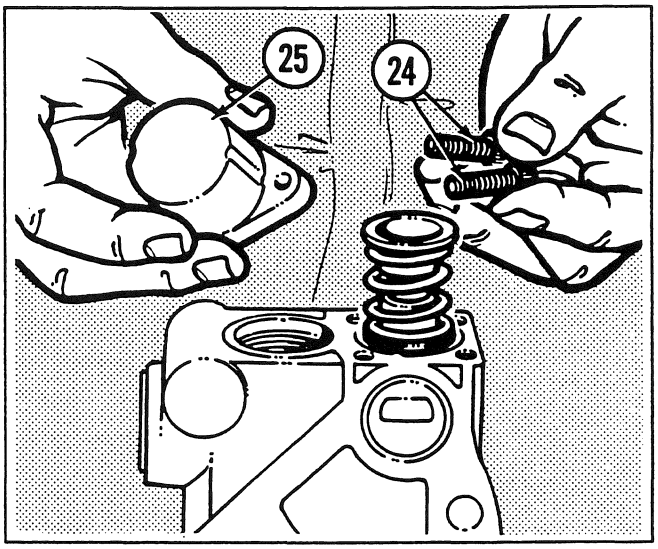


Fig. 16



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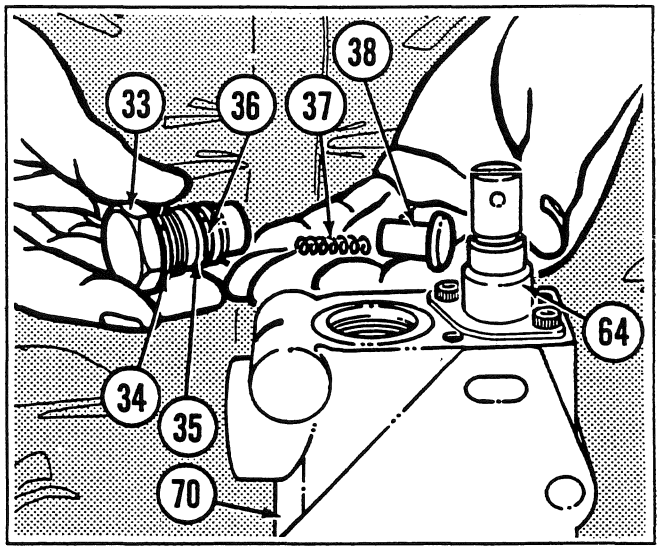

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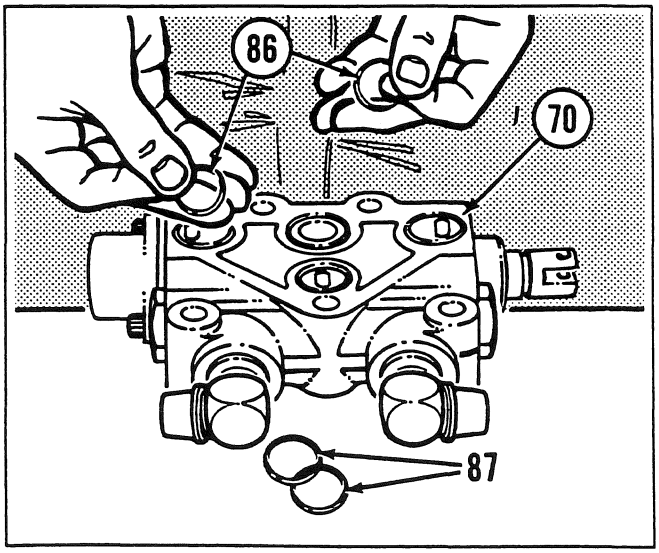

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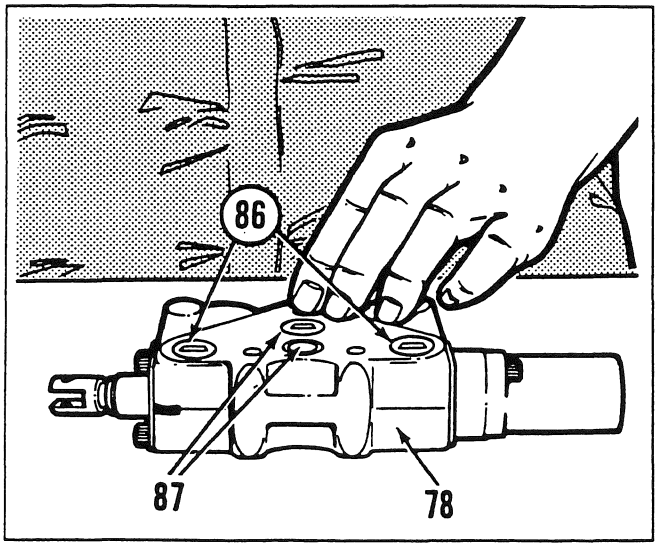

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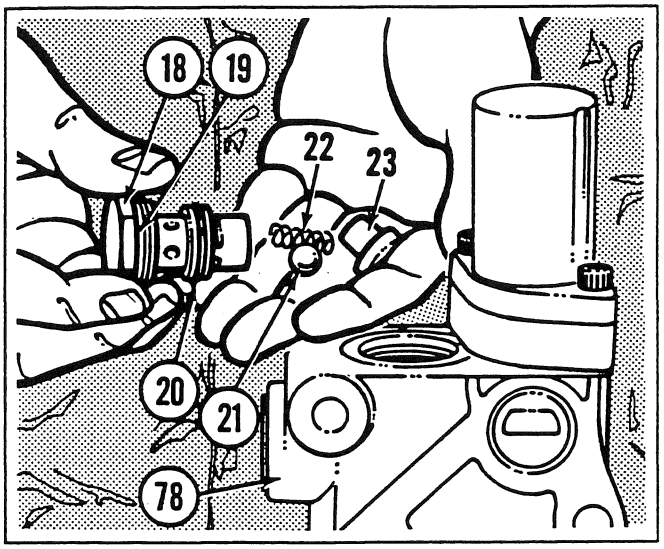

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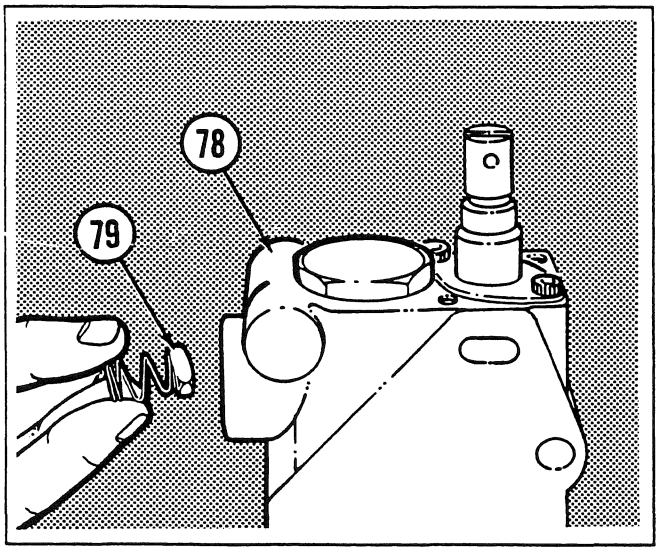

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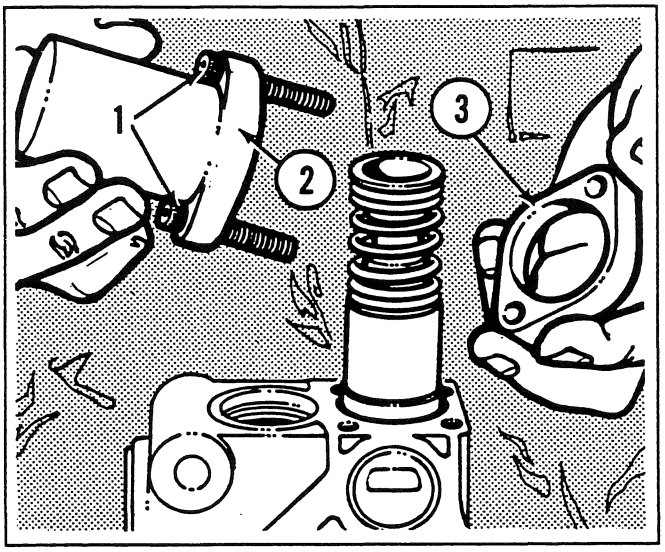

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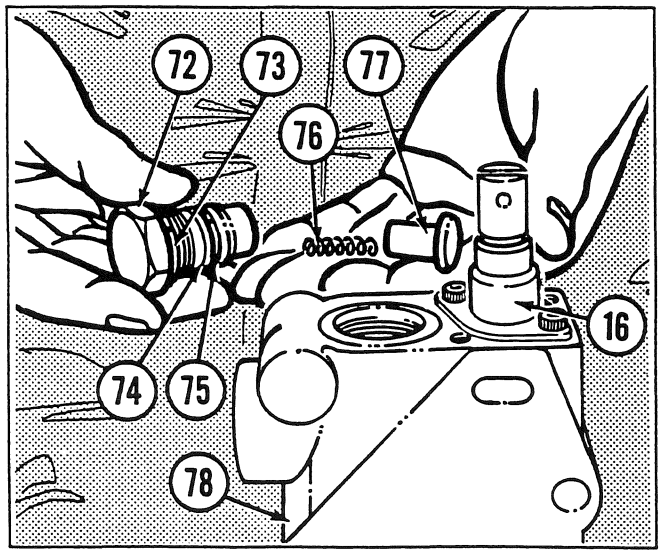

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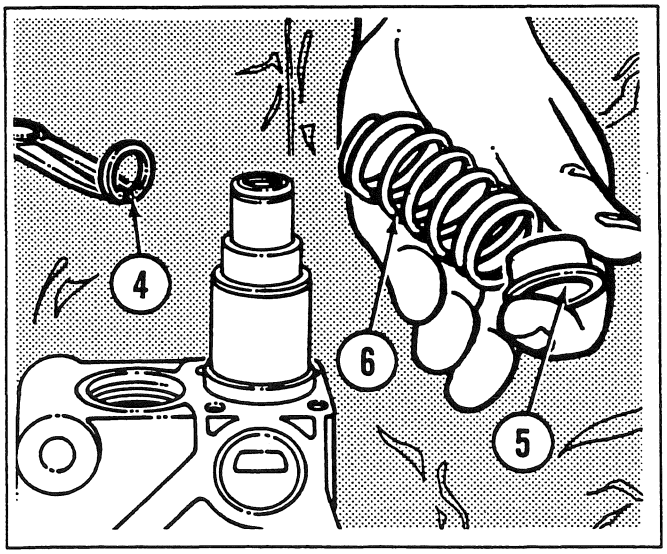


Fig. 25

Disassembly (Blade Lift Valve Section with Optional Float)

Fig. 20
With the manifold valve assembly already disassembled, remove the valve section (78) and place it on a clean workbench. Remove and discard the valve section O rings (86 and 87).

Fig. 21
Place the valve section (78) in a vise with soft jaws. Do not overtighten the vise. Remove the hose fittings and the orifice restrictor (79) in the port closest to the clevis end of the spool. Cap the ports.

Fig. 22
Remove the load check plug (72) from the valve section (78) and discard the O rings (73 and 75) and back-up washer (74). Using a magnetic pick-up tool, remove the spring (76) and poppet (77).

Fig. 23
Invert the valve section (78) in the vise. Remove the anti-cavitation check body (18) and discard the O rings (19 and 20). Using a magnetic pick-up tool, remove the steel ball (21), spring (22) and poppet (23).

Fig. 24
Remove the capscrews (1), float positioner cap (2) and spacer (3).

Fig. 25
With care, force down the spring collar (5) and spring (6) by hand. Remove the retaining ring (4).

Disassembly (Blade Lift Valve Section with Optional Float) continued

Fig. 26
Carefully remove the remaining spring collar (7). Using a magnetic pick-up tool, remove the four steel balls (17) from underneath the spring collar. Be ready, they could drop out. Remove the detent sleeve (8).

Fig. 27
Remove and discard the O ring (9) and seal (10) from inside the detent sleeve (8).

Fig. 28
Remove the steel sleeve (11).

Fig. 29
Invert the valve section (78) in the vise. Remove the two temporary capscrews (80), seal plate (81) and retainer plate (82). Remove and discard the back-up washer (83). Remove the valve section from the vise and place it on a clean workbench.

Fig. 30
Carefully remove the spool (16) from the valve section (78) and discard the O ring (84).

Fig. 31
Remove the retaining ring (12) from the spool end (16). Using a magnetic pick-up tool, remove the shim (13), spring (14) and poppet (15). Inspect all parts for serviceability. Refer to **Cleaning and Inspection** found in the front of this Shop Manual section.

Assembly (Blade Lift Valve Section with Optional Float)

Fig. 32
Assemble the spool (16) by inserting the poppet (15), spring (14) and shim (13). Secure the assembly with a new retaining ring (12).

Fig. 33
Generously lubricate the spool (16) with system oil. Carefully install the spool in the valve section (78) according to the orientation marks. Place the valve section in a vise with soft jaws. Do not overtighten the vise. Lubricate and install a new spool O ring (84) and back-up washer (83). Install the retainer plate (82) and seal plate (81). Retain them with two capscrews (80) to finger tightness only.

Fig. 34
Install the spring (76) into the poppet (77) and place them into the valve section (78). Install new O rings (73 and 75) and back-up washers (74). Lubricate and install the load check plug (72) into the valve section and tighten it to the specified torque. Be careful not to damage the spool (16).

Fig. 35
Invert the valve section (78) in the vise. Install the steel sleeve (11) over the spool (16). Lubricate and install a new seal (10) and O ring (9) into the detent sleeve (8). Lubricate the spool (16) and carefully install the detent sleeve with a back and forth rotation into position on the spool. Using grease to hold the four steel balls (17) in the spool (16), install the spring collar (7) over the steel balls.

Fig. 36
Install the spring (6) and the remaining spring collar (5). With care, compress the spring and install a new retainer ring (4).

Fig. 37
Install the spacer (3) with the counterbore towards the valve section (78). Install the float positioner cap (2) with the drain opening facing downwards when the valve is assembled onto the grader. Install and tighten the capscrews (1) to the specified torque.

Assembly (Blade Lift Valve Section with Optional Float) continued

Fig. 38
Lubricate and install new O rings (19 and 20) on the anti-cavitation check body (18). Install the steel ball (21) and apply a small amount of grease to retain it in the check body. Place the spring (22) into the poppet (23). Install and seat them into the valve section (78). Install and tighten the anti-cavitation check body (18) to the specified torque.

Fig. 39
Inspect and install the hose fitting closest to the float positioner cap (2). Install the orifice restrictor (79) and the remaining hose fitting.

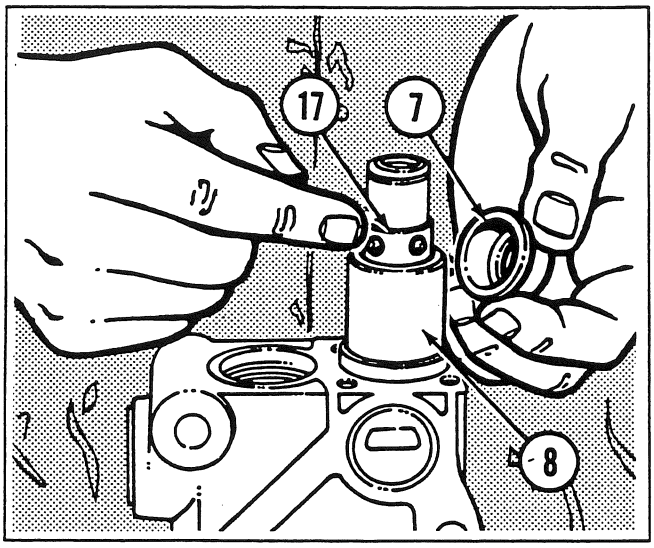
Fig. 40
Remove the valve section (78) from the vise. Lubricate and install four new O rings (86 and 87). Servicing a blade lift valve section is now complete. Refer to the installation procedures if no other valve sections need servicing.

Manifold Valve Assembly - Installation

Fig. 41
Remove the plastic sheet from the manifold valve assembly. Lubricate and install new O rings (86 and 87) in the counterbores of each valve section including the inlet cover (45) and end cover (88). Make sure the valve section O rings do not drop out of position. Install the serviced valve sections into their correct locations.

Fig. 42
Be careful not to dislodge any O rings (86 and 87) and insert a tie stud (89) through the valve sections. Secure the assembly with a nut (90). Install the remaining tie studs and nuts. Evenly tighten the nuts to the specified torque. Remove the plywood board and install the hold down bolts (92) and lockwashers (91). Tighten the bolts to the specified torque.

Fig. 43
Remove the two capscrews (65) holding the seal plate (66). Ensure the cable (52) has not been kinked and install the pin (62). Secure the spring with the retaining ring (61). Position the spacer (63) and thread the bonnet into place. Secure the plate (59) with the flatwashers (58), lockwashers (57) and bolts (56) to finger tightness.



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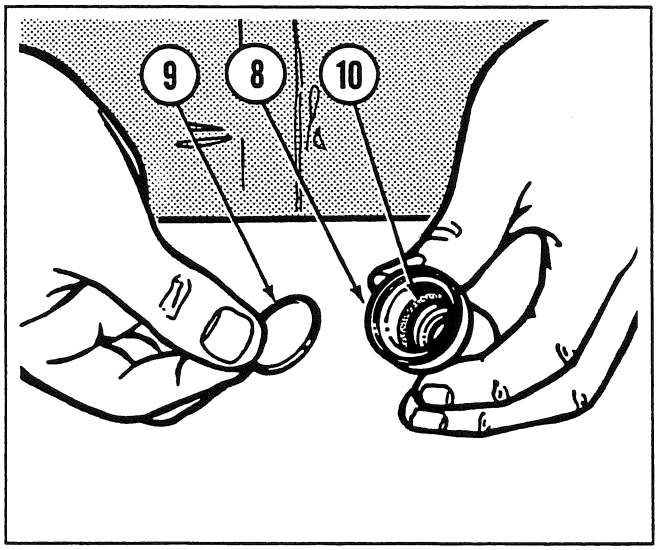

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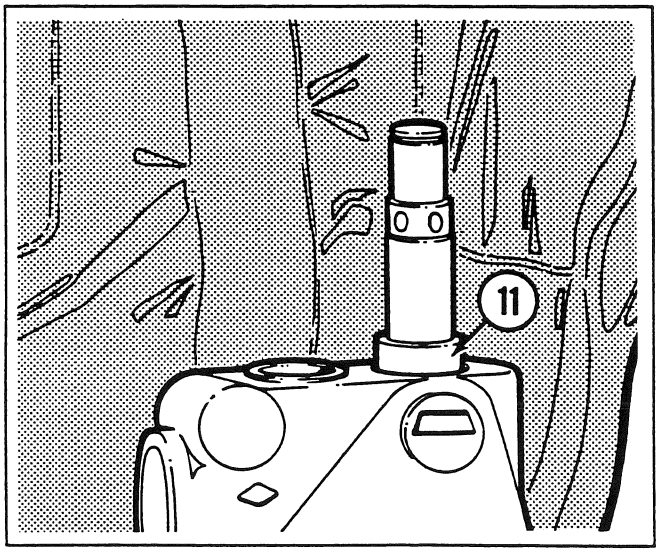

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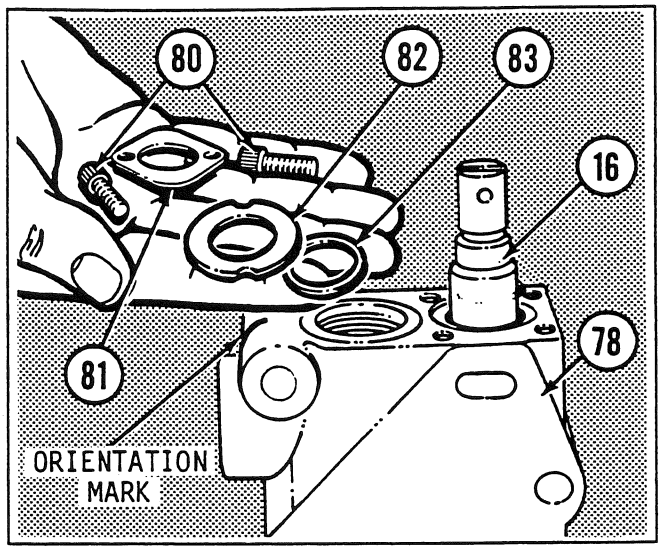

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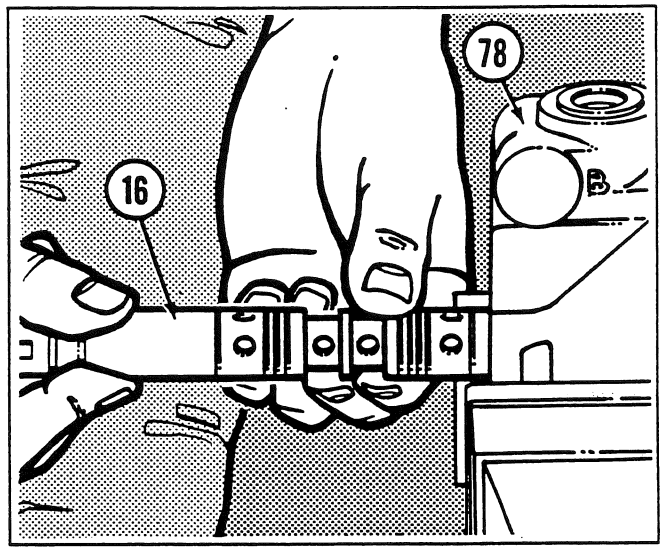

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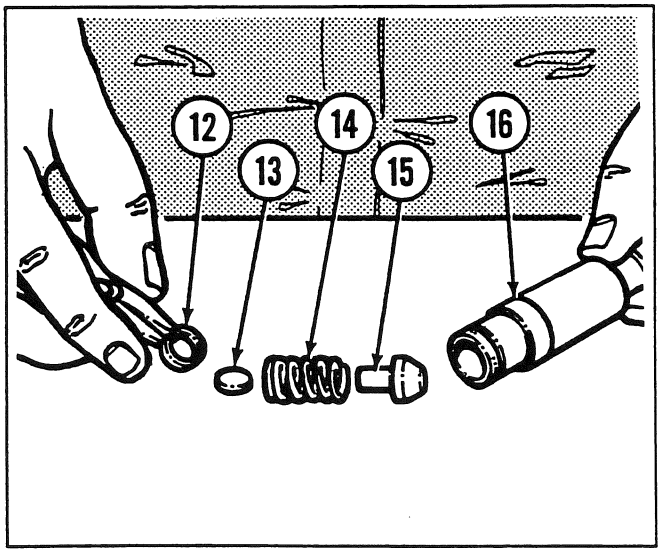

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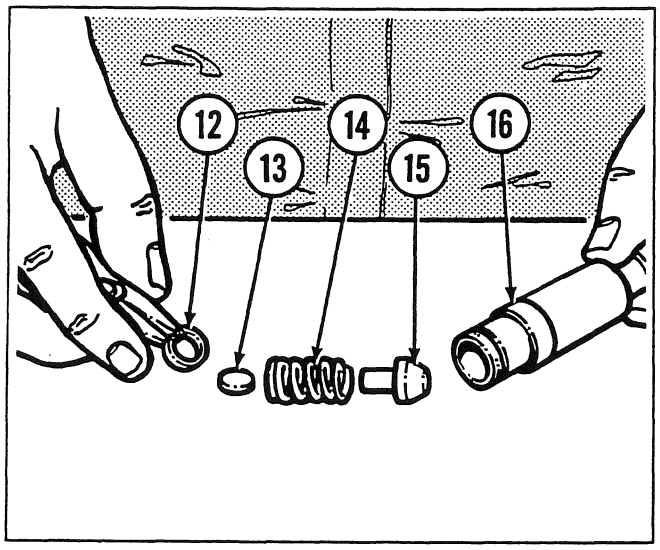

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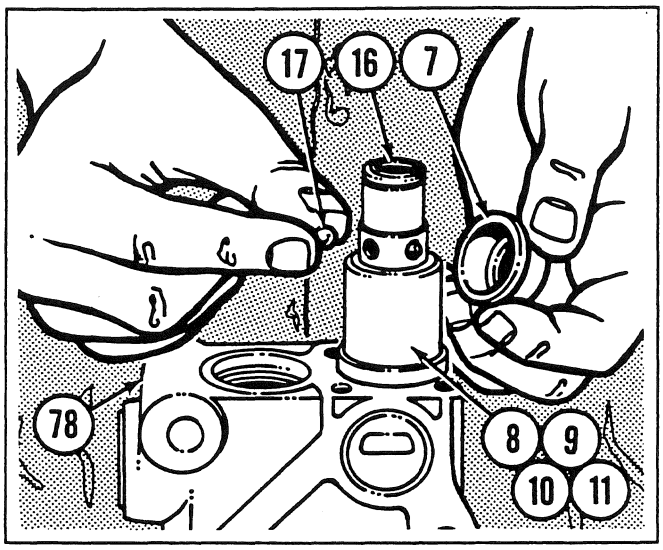

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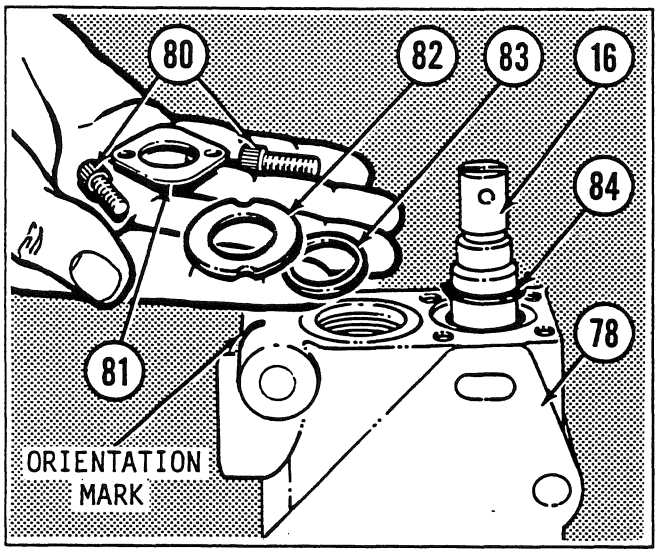

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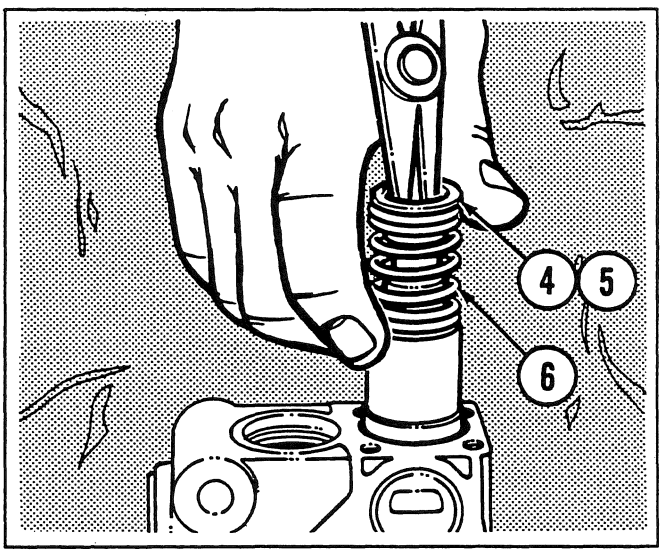

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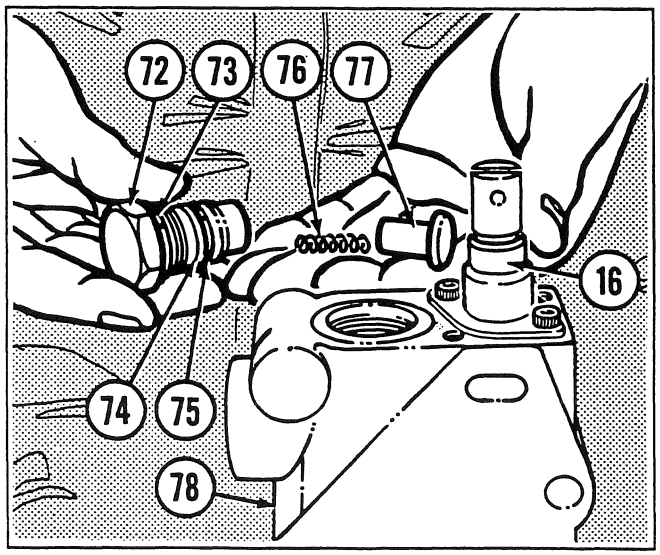

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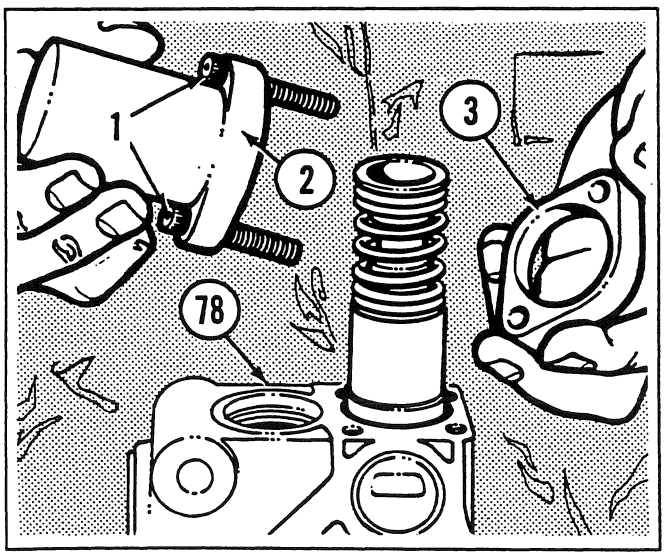

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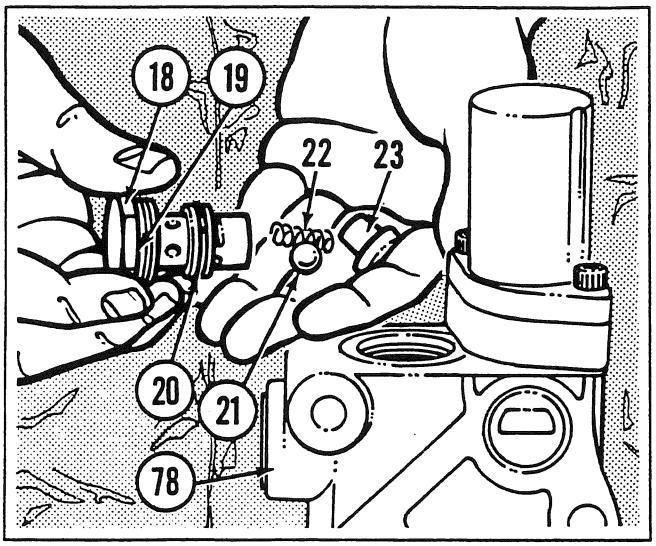

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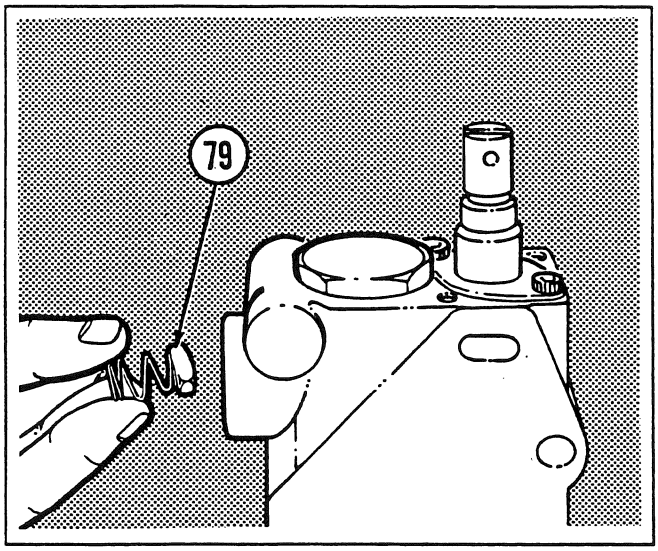
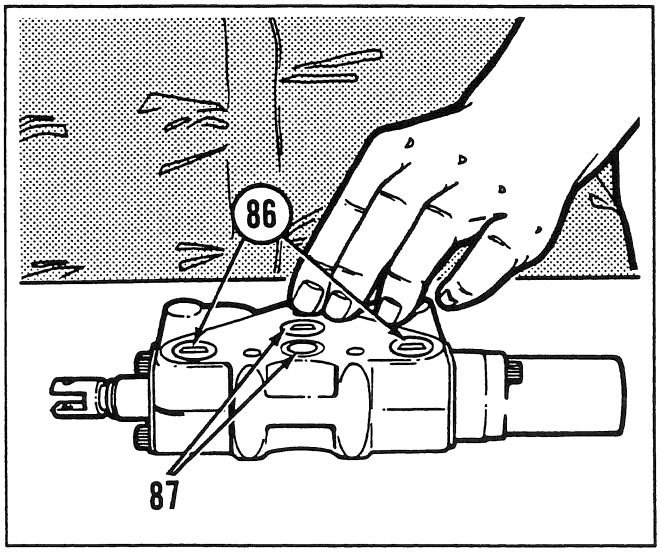


Fig. 39



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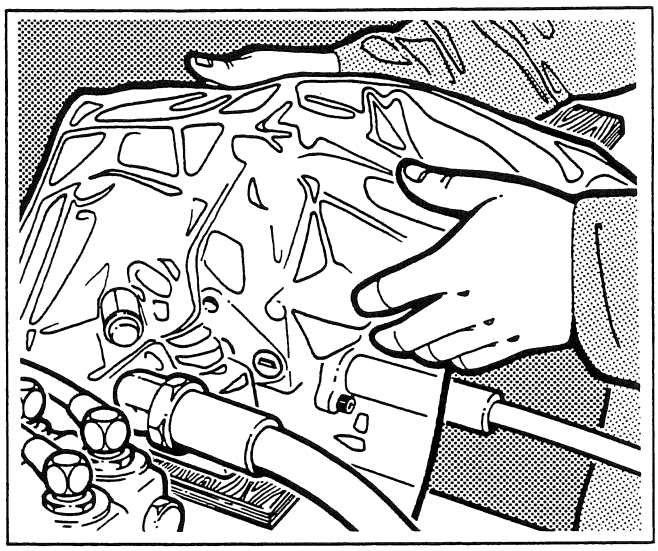
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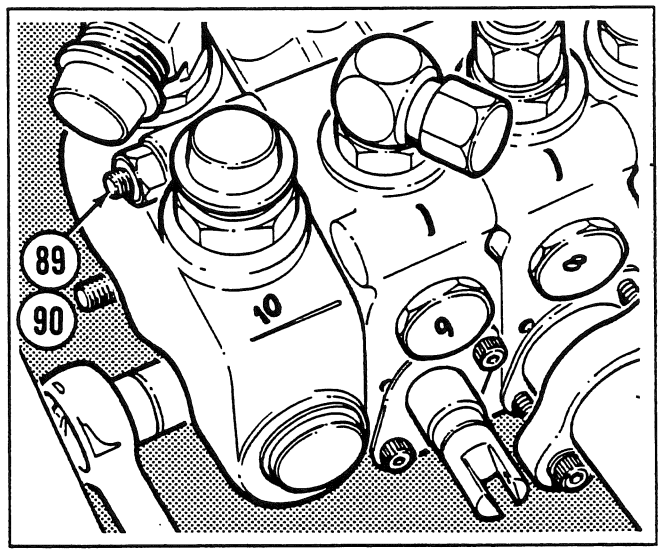

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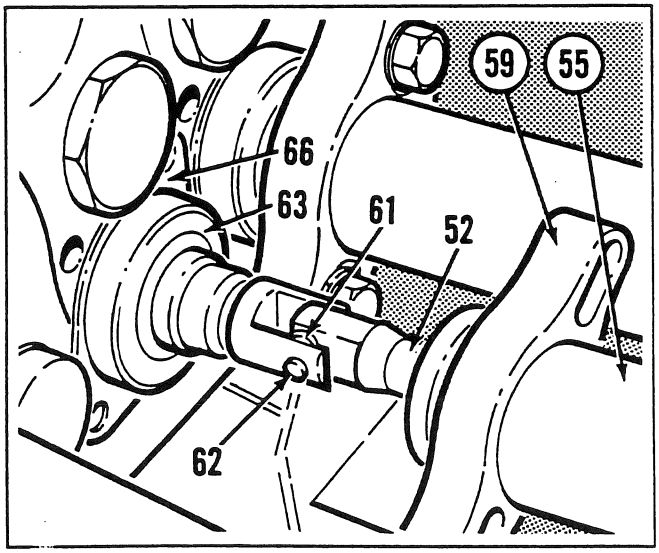

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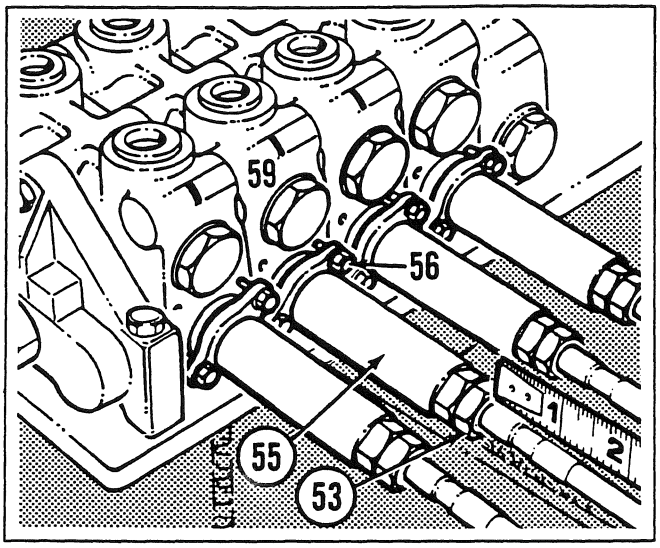

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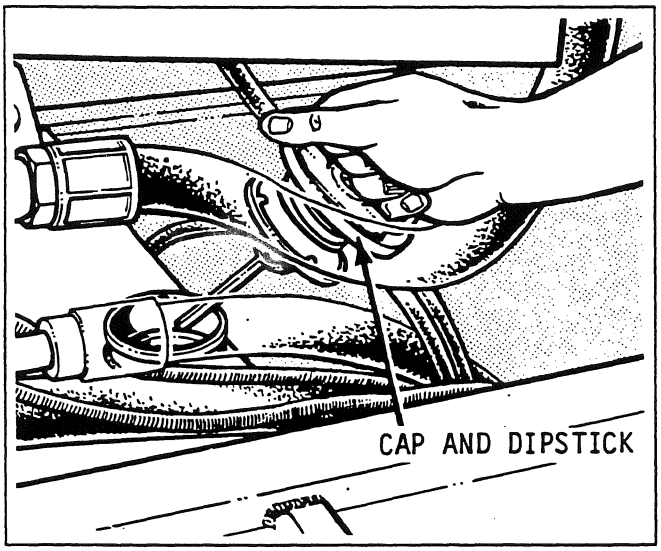


Fig. 45

Manifold Valve Assembly - Installation
continued

Fig. 44
Install and tighten the jam nut (53) against the bonnet (55). Referring to the measurement noted in **Fig. 5**, reposition the bonnet and make any adjustments. Tighten the two bolts (56) retaining the plate (59) to the specified torque. Uncap and connect the hoses and tubes. Repeat the procedures (**Figs. 43** and **44**) to install any remaining cables. Operate all the control levers to ensure that no binding or sticking occurs. Refer to **Inspection - Binding/Sticking Problems.**

Fig. 45
Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and operate all hydraulic control levers. Lower the moldboard and all attachments to the ground. Do not apply down pressure. Shut down the engine. Check the grader hydraulic filter strainer for damage. Replace it if necessary. Check the hydraulic fluid level and for leaks.

Inspection - Binding/Sticking Problems

When servicing the manifold valve assembly, binding or sticking could occur. With the grader in the SERVICE POSITION, operate all the control levers. If binding or sticking occurs, use the following procedure.

1. Loosen and remove the manifold hold down bolts.

2. Evenly loosen the manifold tie studs and ensure the valve section is free of contamination and the O rings have not dislodged.

3. Evenly torque the tie studs to 30 lbf·ft (40,7 N·m; 4,2 kgf·m).

4. Install the hold down bolts and tighten them to the specified torque.

5. Operate the control levers and check for binding or sticking.

6. Check the cables for kinks or the lever bushings for binding.

If problems persist, repeat steps 1 through 6, but reduce the tie bolt torque by 2 lbf·ft (2,7 N·m; 0,3 kgf·m) each time these steps are required to a minimum torque of 26 lbf·ft (35,3 N·m; 3,6 kgf·m). If binding or sticking continues, you must service the defective valve sections.

Cables

Teflon-lined cables, introduced on grader S/N **18063**, reduce binding problems. Champion recommends installing teflon-lined cables on earlier machines.

SECTION 4B
HYDRAULICS

Main Hydraulic Pump

S/N 16224, 16245 to 20804 and 20807. U.S. S/N 2021-2 to 2658-2

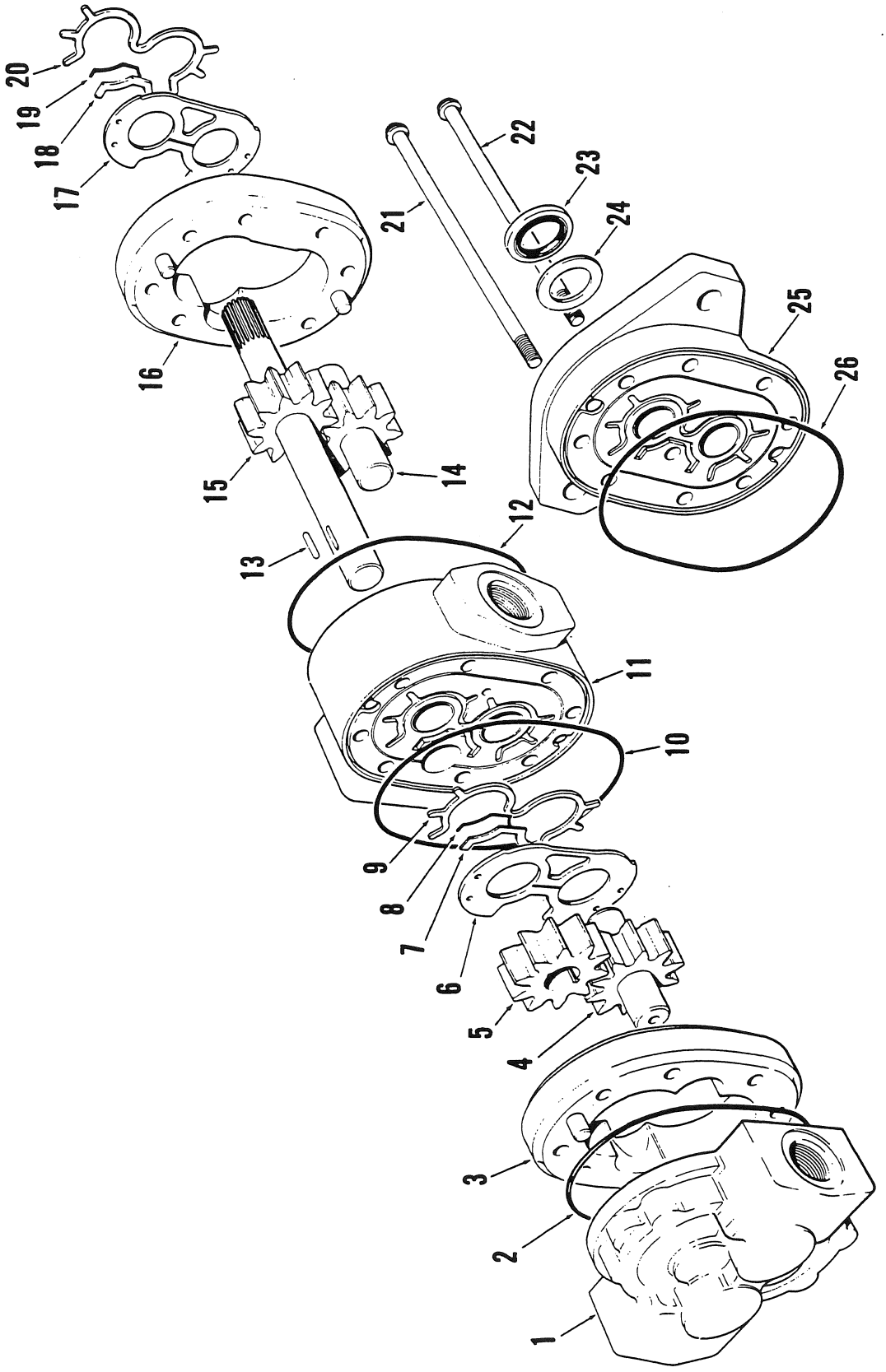


Fig. 1B Main Hydraulic Pump
S/N 16224, 16245 to 20804 and 20807. U.S. S/N 2021-2 to 2658-2

Item	Description	Item	Description	Item	Description
1	Backplate	10	O ring	19	Molded O ring
2	O ring	11	Adapter plate	20	Gasket
3	Rear body	12	O ring	21	Capscrews (hex. head)
4	Idler gear	13	Key	22	Capscrews (hex. head)
5	Slip fit gear	14	Idler gear	23	Oil seal
6	Wear plate	15	Driveshaft assembly	24	Back-up washer
7	Seal	16	Front body	25	Front plate
8	Molded O ring	17	Wear plate	26	O ring
9	Gasket	18	Seal		

Key to Fig. 1B

S/N **16224**, **16245** to **20804** and **20807**. U.S. S/N **2021-2** to **2658-2**

Introduction of Premium Quality Gear Pumps

Starting at grader S/N **20805**, **20806**, **20808** and up, Champion has changed the main hydraulic pump installation on all models. The new pump and hydraulic changes introduced with Series III models provide an efficient, extended-life system.

On all models, the main hydraulic pump is mounted onto the engine accessory drive housing. The end of the pump is supported by a bracket attached to the engine block. The proven twin-flow hydraulic system concept is retained and the pump configurations are as follows:

Graders Equipped with Oil Disc Brakes

These graders use a two-section pump. Each pump section has its own 1-1/4 in. diameter suction hose (versus the single 1-1/2 in. suction hose) and separate, identical relief valves as before. Nitrogen accumulators in the hydraulic system provide reserve braking power for these graders.

Graders Equipped with Drum Brakes

On graders equipped with drum brakes, a third section is added. This third section is small and supplies oil only to the reserve braking device. This effectively uses different hydraulic circuits for the braking and steering functions.

Oil for the third section is supplied internally from the adjacent pump section. The third section uses a relief valve mounted to the manifold block on the hydraulic tank. All three relief valves have identical part numbers. Oil leaving the brake booster joins the main hydraulic and steering return flow at the five-way connector located below the cab on the left-hand side of the frame.

Kits, containing shaft and section seals for the two- and three-section pumps, are available from Champion's Distribution Center or your Champion Distributor.

Main Hydraulic Pump - Removal

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Remove the side panels. Remove the hydraulic tank filler cap to release any pressure and replace the cap loosely. The primary hydraulic pump is a single inlet, dual output gear pump. It is mounted to the adaptor plate and driven directly from the engine accessory drive. Both output sections are identical in displacement and each section uses a remote mounted relief valve located at the front of the hydraulic tank.

Fig. 3
Before removing any hoses, make sure that the pump and surrounding area are clean.

Fig. 4
Loosen the suction hose clamp and remove the hose from the pump. Cap the suction hose and port to prevent contamination.

Fig. 5
Identify the pressure hoses with their respective pump sections.

Fig. 6
Remove the pressure hoses. Cap all fittings and ports to prevent contamination.

Fig. 7
While supporting the weight of the pump with your hand, remove the mounting nuts. Remove the pump.

NOTE: *Effective on models 710 through 730A S/N **19982, 19984, 19985, 19986, 20005, 20104, 20106, 20120** and up, a support bracket is installed between the engine block and the main hydraulic pump. Remove the bolts and lockwashers securing the pump to the bracket.*

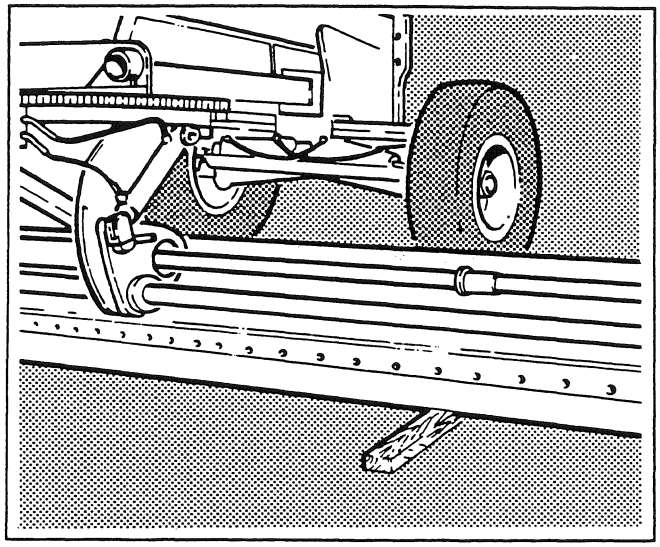


Fig. 2

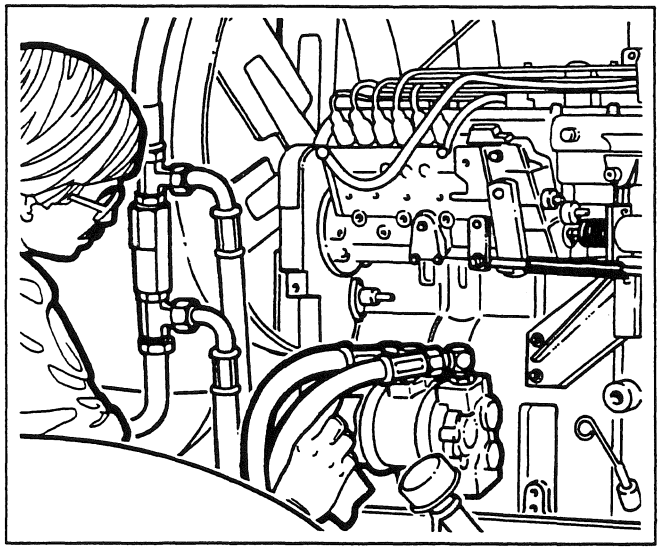


Fig. 3

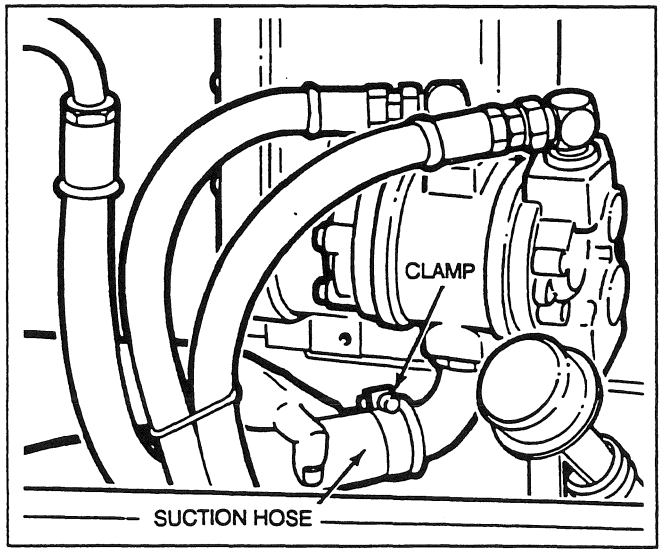


Fig. 4

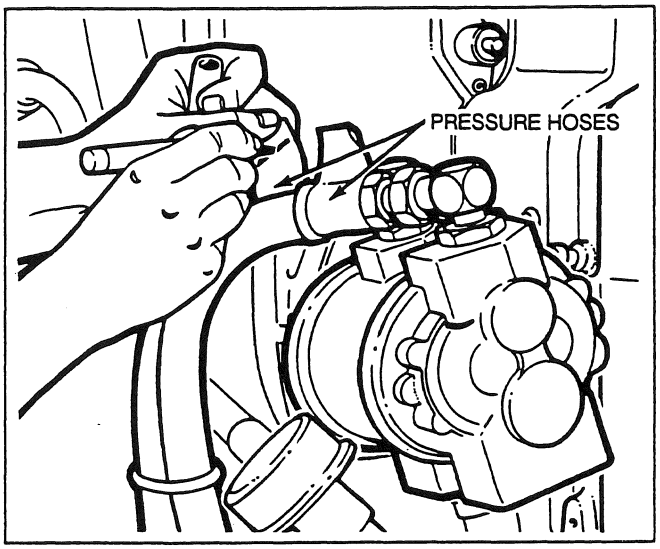


Fig. 5

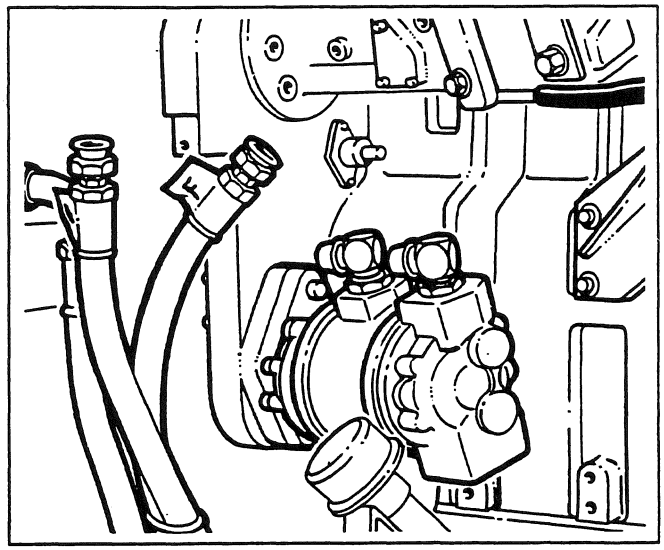


Fig. 6

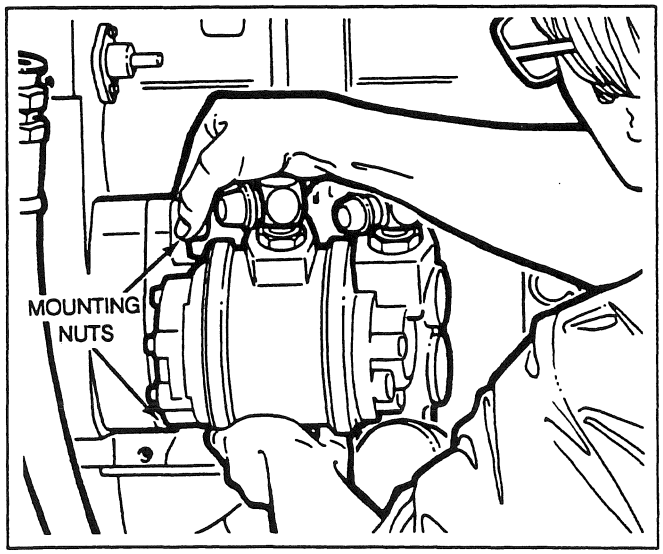


Fig. 7

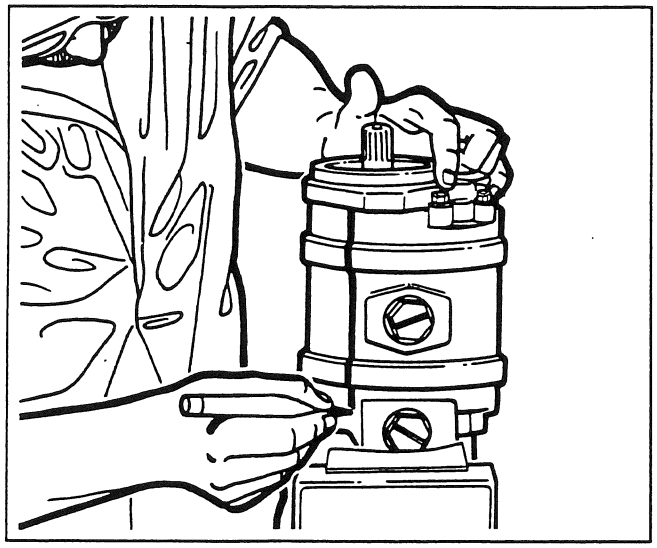
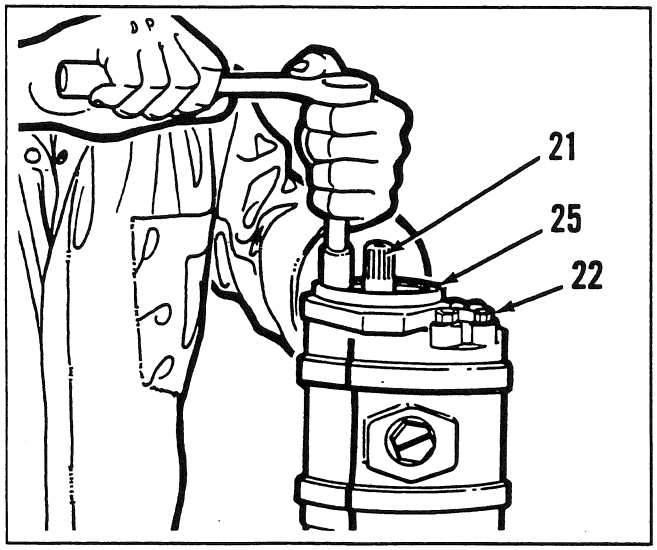


Fig. 8



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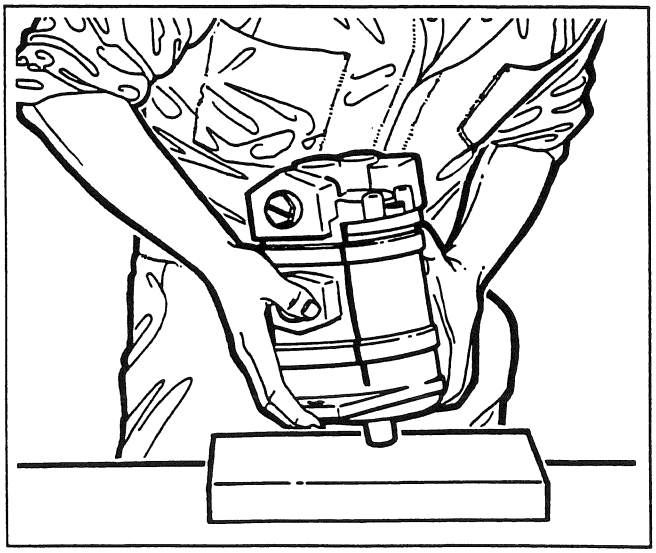

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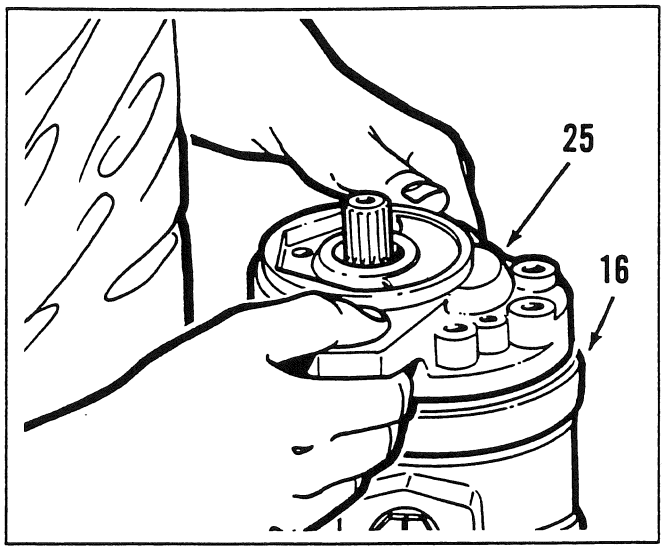

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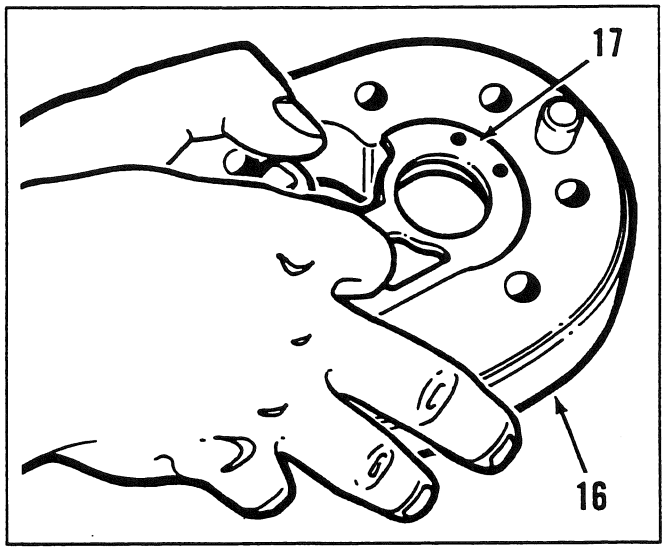

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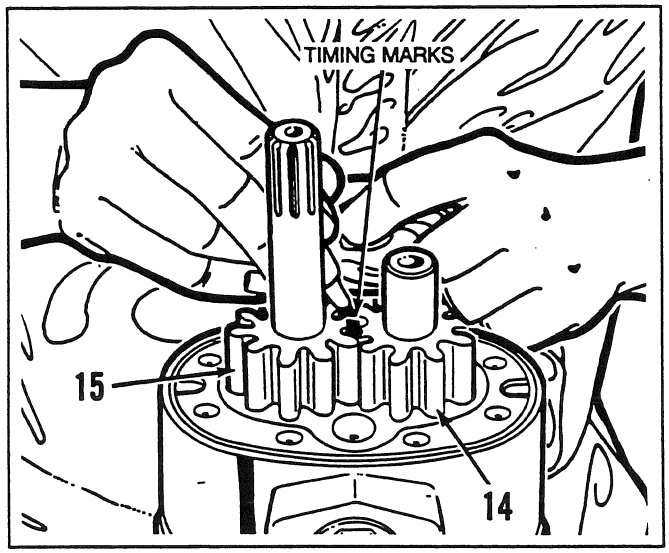


Fig. 13

Main Hydraulic Pump - Disassembly

Fig. 8
Secure the back plate end of the pump in a vise with soft jaws. Mark the pump across all sections. This will help when you assemble the pump.

Fig. 9
Loosen the capscrews (21 and 22) in a star pattern to prevent warping the front plate (25). Remove the capscrews.

Fig. 10
Remove the pump from the vise. Carefully bump the end of the shaft on a block of wood to separate the plates.

Fig. 11
With the back plate (1) again secured in a vise with soft jaws, separate the front plate (25) from the front body (16).

Fig. 12
Remove the front body (16) and discard the wear plate (17).

Fig. 13
Apply a marking dye to the mating teeth of the driveshaft assembly (15), and idler gear (14). This ensures correct timing during assembly. Remove the idler gear.

Main Hydraulic Pump - Disassembly
continued

Fig. 14
Remove the adapter plate (11) from the rear body (3).

Fig. 15
Remove the key (13) and withdraw the driveshaft assembly (15) from the adapter plate (11).

Fig. 16
Remove and discard the wear plate (6).

Fig. 17
Apply a marking dye to the mating teeth of the idler gear (4), and slip fit gear (5). This ensures correct timing during assembly. Remove the idler gear and slip fit gear.

Fig. 18
Remove the rear body (3) from the back plate (1). Remove and discard the O ring (2).

Fig. 19
Remove and discard the gasket (20), seal (18), molded O ring (19) and O ring (26) from the front plate (25). Remove and discard the gasket (9), seal (7), molded O ring (8) and O rings (10 and 12) from the adapter plate (11).

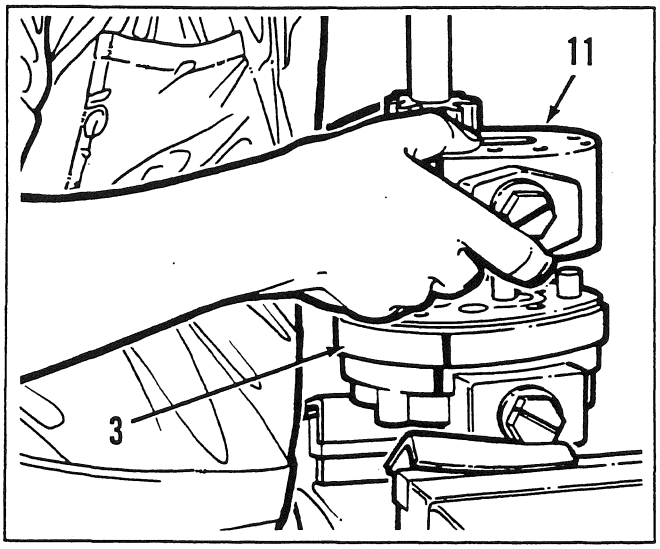
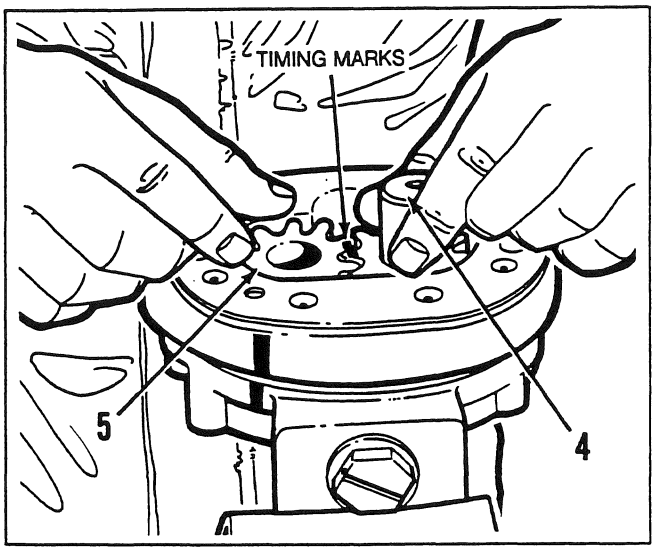


Fig. 14



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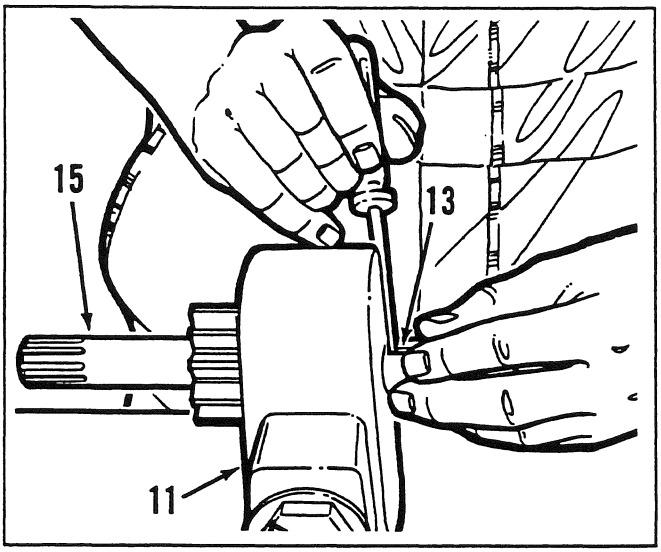
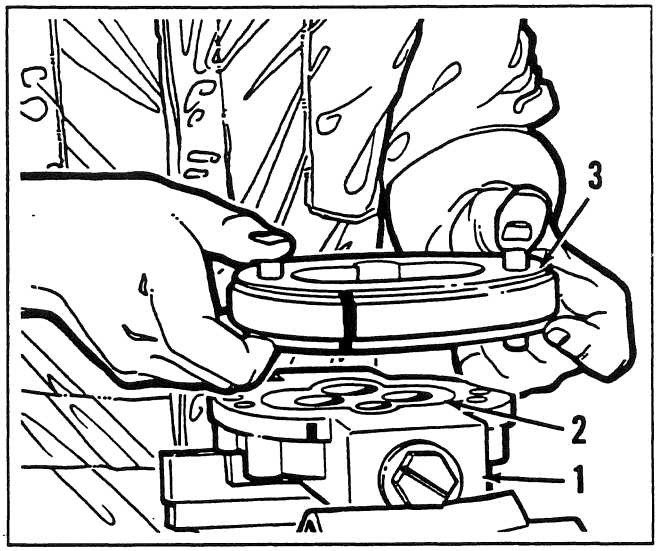


Fig. 15



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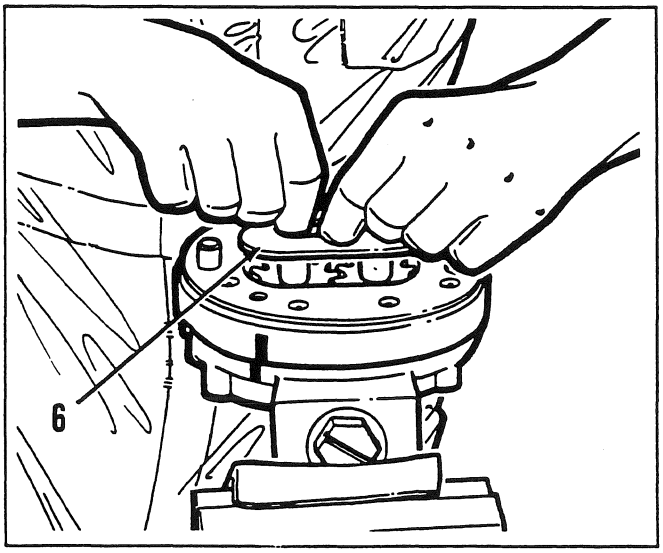
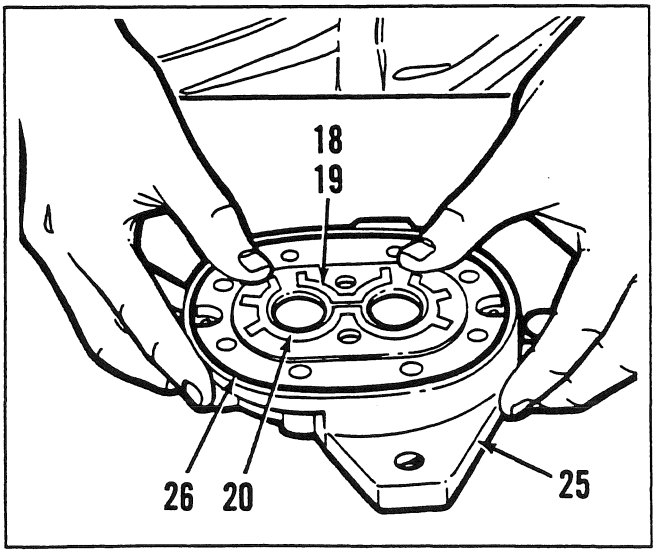


Fig. 16



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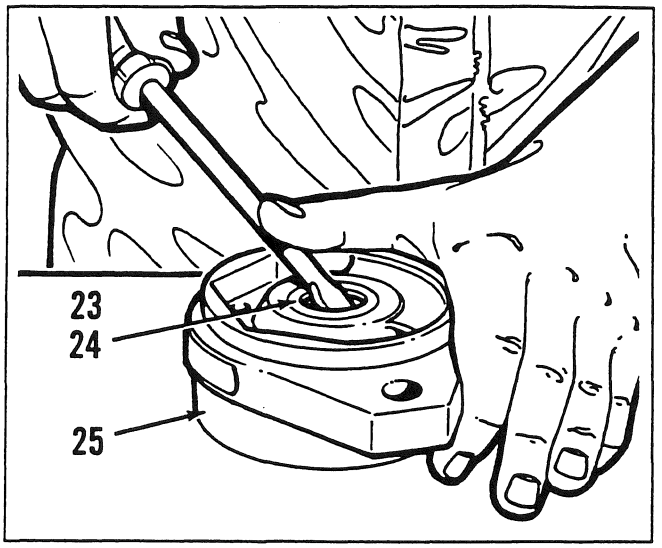


Fig. 20

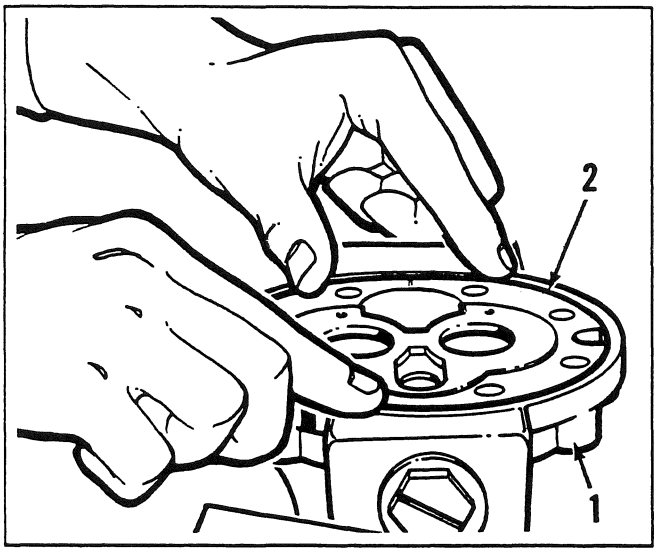
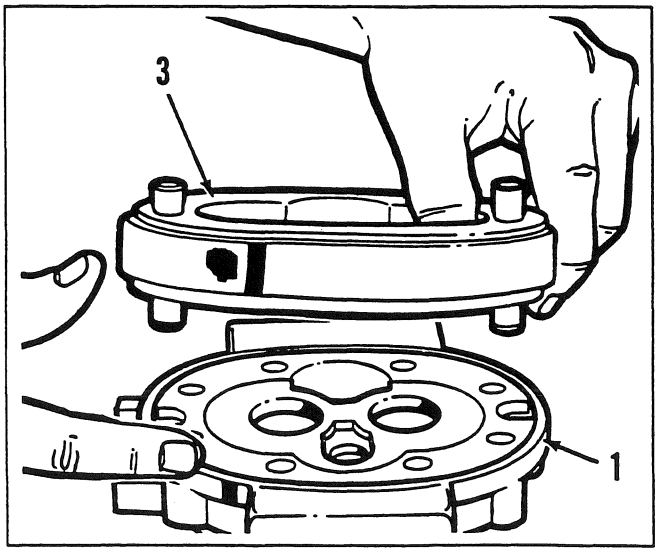


Fig. 21



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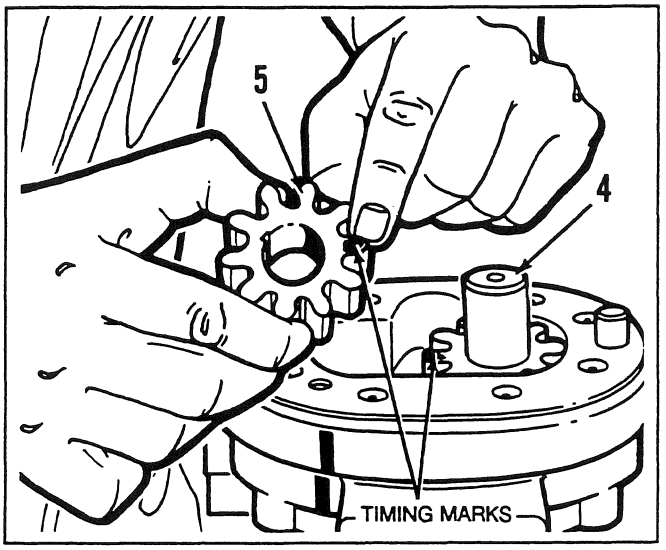
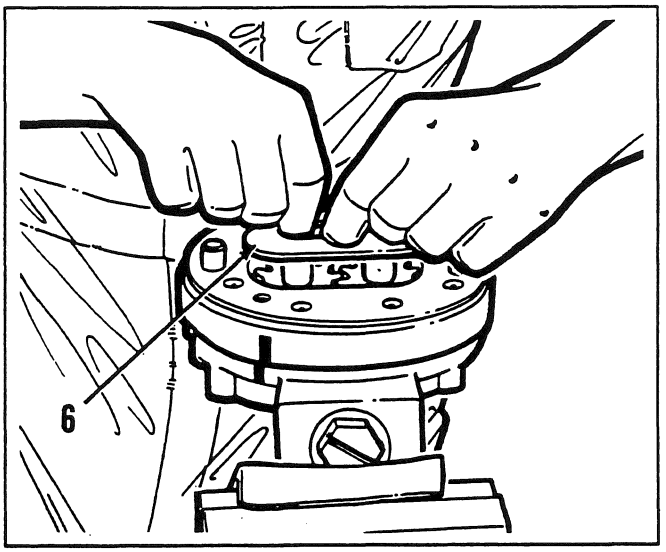


Fig. 23



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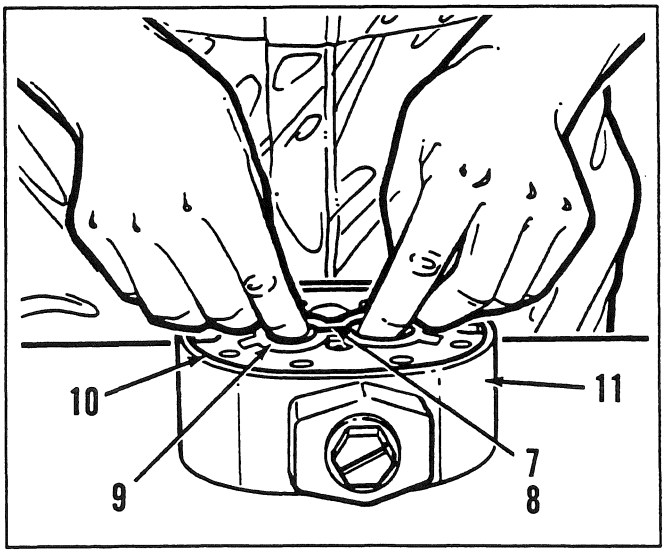


Fig. 25

Main Hydraulic Pump - Disassembly

continued

Fig. 20

Use a flat blade screwdriver to remove the main shaft oil seal (23) from the front plate (25). Be careful not to damage the bore. Discard the oil seal and back-up washer (24). Disassembly is now complete. Inspect all parts for serviceability. Refer to **Inspection** at the end of this sub-section.

Fig. 23

Lubricate and install the idler gear (4) and slip fit gear (5) so that the timing marks are aligned and exposed.

Main Hydraulic Pump - Assembly

Fig. 21

When assembling the pump, ensure all components are free from contamination. Always use clean system oil to lubricate parts before assembly. With the back plate (1) in a vise with soft jaws, lubricate and install a new O ring (2).

Fig. 24

Install a new wear plate (6) with the bronze side toward the gear set and the cut-out on the suction side of the pump.

Fig. 22

Align the assembly marks on the back plate (1) and rear body (3). Install the rear body and carefully tap into place.

Fig. 25

Working on the adapter plate (11), lubricate and install new O rings (10 and 12). Note the V groove in the gasket (9). Lubricate and install a new gasket with the groove facing down. Ensure that it seats correctly. Lubricate and install a new molded O ring (8) and new seal (7).

Main Hydraulic Pump - Assembly continued

Fig. 26
Lubricate the bushing and install the driveshaft assembly (15) into the adapter plate (11). Install the key (13) into the driveshaft.

Fig. 27
Install the adapter plate (11) onto the rear body (3). Ensure you align the assembly marks and that the key (13) engages the slip fit gear (5).

Fig. 28
Install the front body (16), and carefully tap into place. Ensure you align the assembly marks on the front body and adapter plate (11).

Fig. 29
Install the idler gear (14), making sure to align the timing marks.

Fig. 30
Lubricate and install a new wear plate (17) with the bronze side towards the gears and the cut-out on the suction side of the pump.

Fig. 31
Note the V groove in the gasket (20). Lubricate and install a new gasket with the groove facing down. Ensure that it seats correctly. Lubricate and install a new molded O ring (19), seal (18) and O ring (26) in the front plate (25).

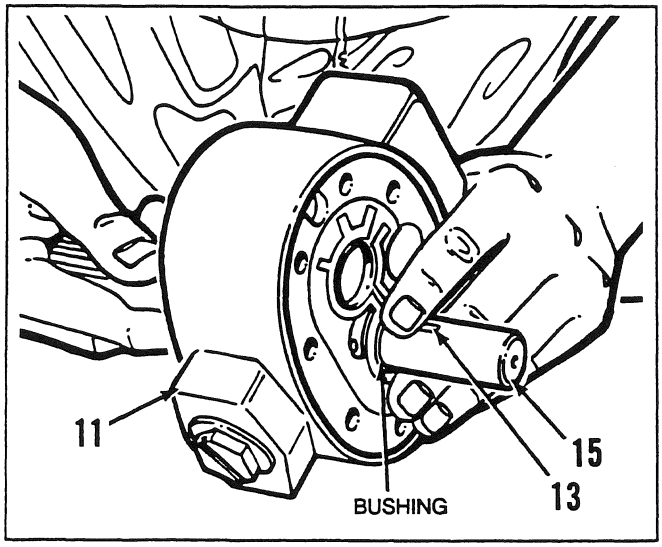
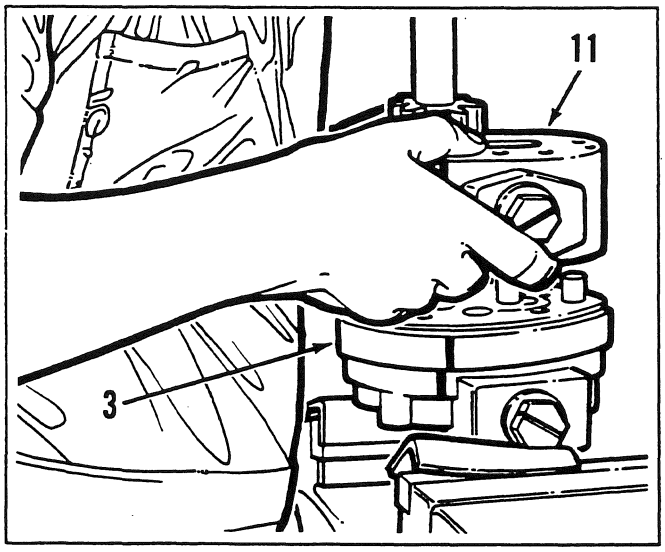


Fig. 26



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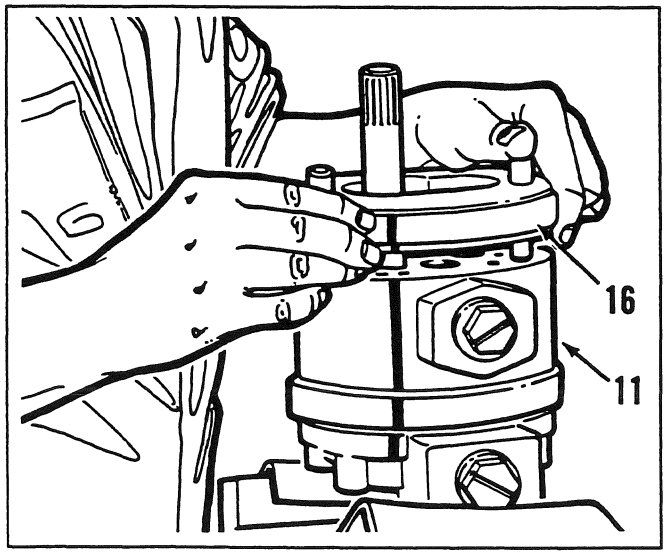

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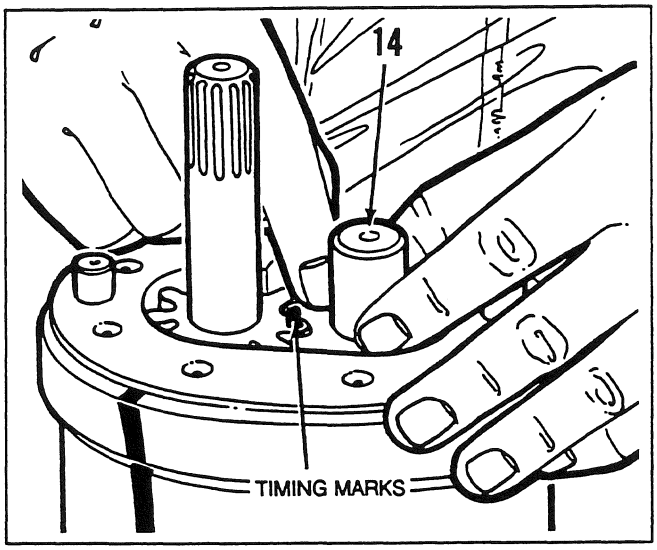

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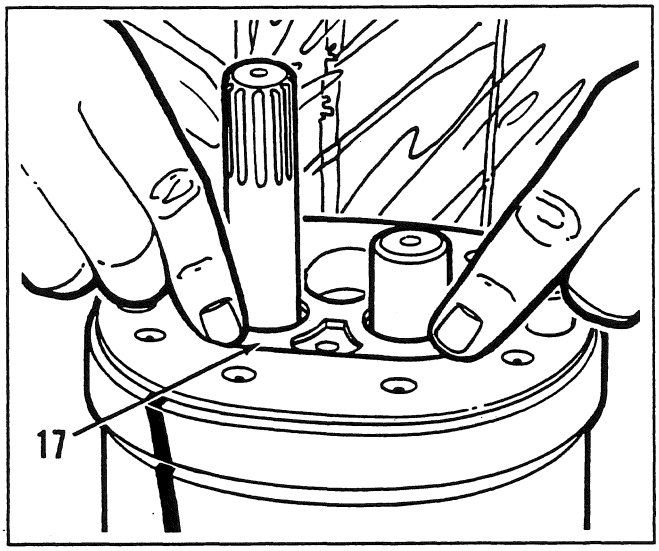

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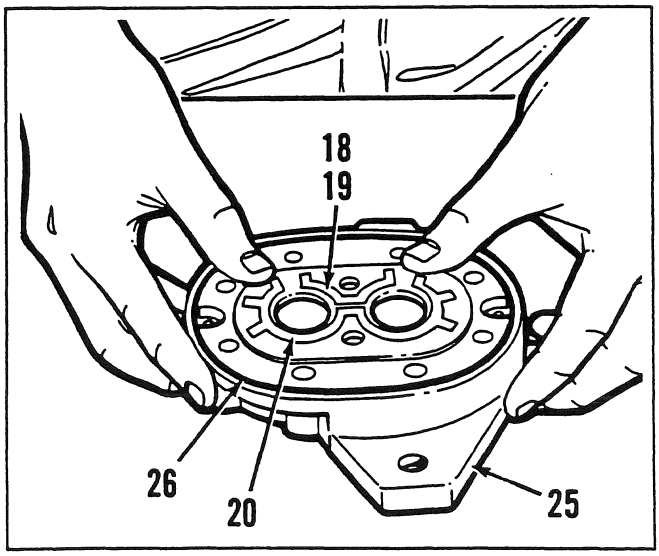


Fig. 31

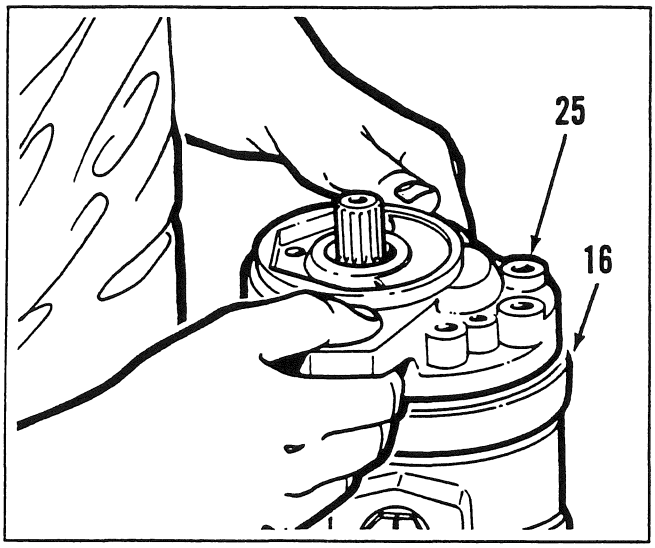
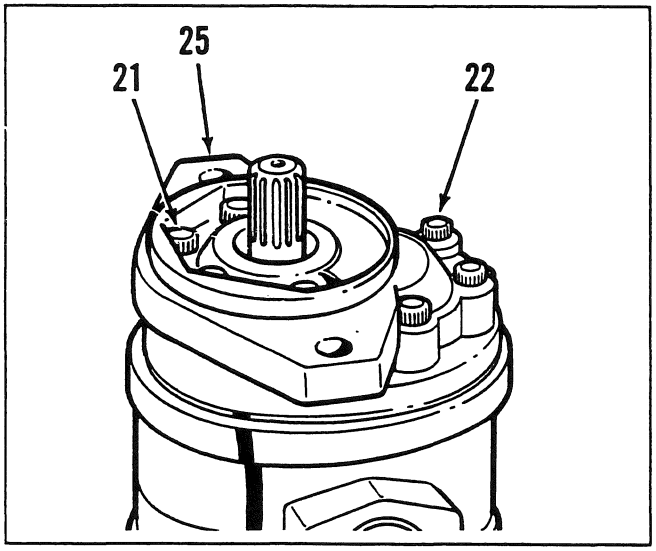


Fig. 32



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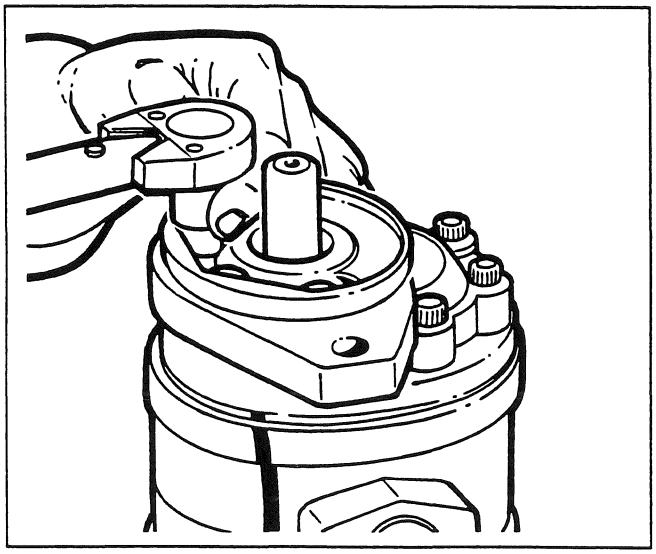

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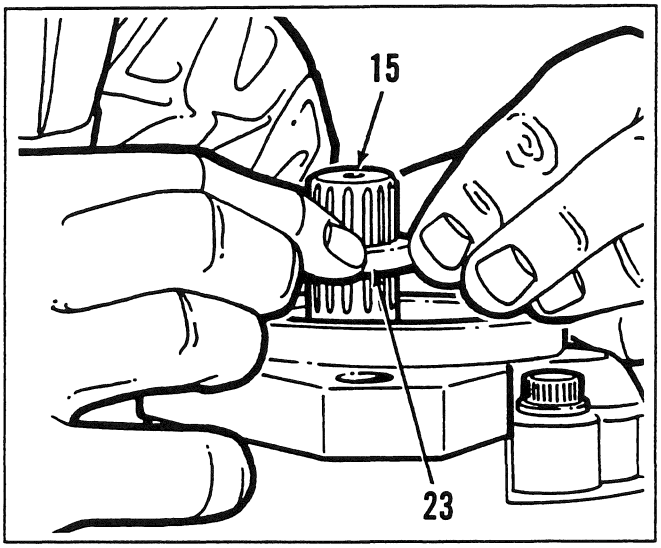


Fig. 35

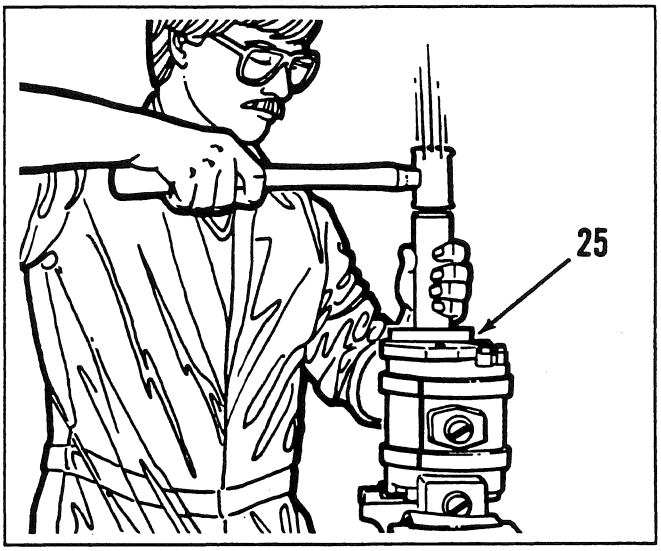


Fig. 36

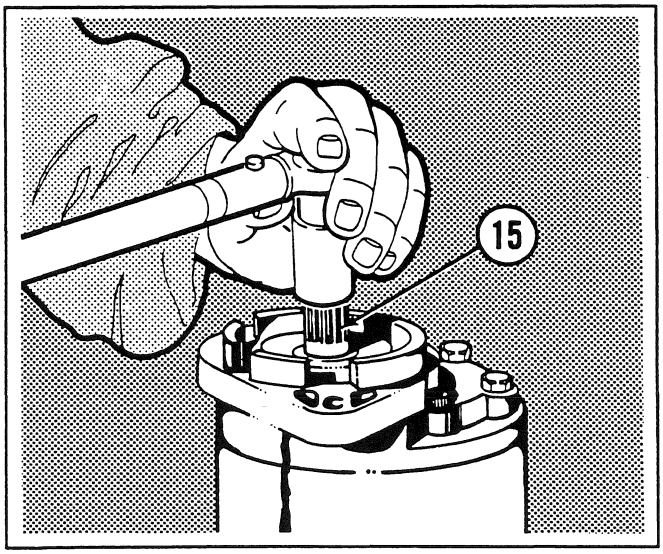


Fig. 37

Main Hydraulic Pump - Assembly continued

Fig. 32
Install the front plate (25) onto the front body (16). Check the alignment marks and carefully tap the front plate into place.

Fig. 33
All capscrews (21 and 22) are made of stress-proof material and must not be replaced with standard capscrews. Note the two lengths of capscrews. Install the longer capscrews (21) in the front plate (25) first. Install the shorter capscrews (22) in the remaining holes of the front plate. Rotate each capscrew counterclockwise until a click is heard and felt; then continue installing the capscrews. This prevents cross-threading.

Fig. 34
The capscrews must be torque-tightened in three increments: 25 lbf·ft (33,9 N·m; 3,5 kgf·m), 35 lbf·ft (47,4 N·m; 4,8 kgf·m), and 45 lbf·ft (61 N·m; 6,2 kg·m) in a star pattern.

Fig. 35
With a single layer of transparent tape covering the driveshaft assembly splines (15), slide a new back-up washer (24) into place. Lubricate the lip of a new oil seal (23) and slide it over the shaft, lip end first. Completely remove the transparent tape. Ensure no adhesive or tape stay under the seal.

Fig. 36
Use an appropriate soft metal drift to seat the oil seal (23) square to the front plate (25).

Main Hydraulic Pump - Installation

Fig. 37
Priming the pump is an important step during installation. Begin by filling each pump cavity, through the inlet side, with the correct system oil. Turn the driveshaft (15) in the proper direction of operation, then refill the pump cavities. The pump is now ready for installation.

Main Hydraulic Pump - Installation

continued

Fig. 38
Install a new Cummins gasket between the engine block and adapter, and a new Champion gasket on the pump side of the adapter.

Fig. 39
As you install the pump, ensure it seats fully, then secure with the mounting nuts and washers.

NOTE: *Do not draw the pump into place with the nuts.*

Fig. 40
Tighten the mounting nuts to the specified torque.

NOTE: *Effective on models 710 through 730A S/N **19982, 19984, 19985, 19986, 20005, 20104, 20106, 20120** and up, a support bracket is installed between the engine block and the main hydraulic pump. Secure the pump to the bracket with the bolts and lockwashers. Champion recommends updating earlier machines to include the support bracket. Contact your Champion Distributor for details.*

Fig. 41
Remove the caps from the pressure hose fittings. Check the condition of O rings and install the pressure hoses to their correct locations.

Fig. 42
Remove the caps from the suction hose and port. Install the hose. Tighten the clamp securely to ensure a leak-proof seal and to prevent air entering the hydraulic system. This is extremely important to prevent pump cavitation.

Fig. 43
Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so. Run the pump at half engine speed and no load. Build pressure by operating the left-hand blade lift cylinder control lever for approximately ten seconds. Operate the right-hand blade lift cylinder control lever for approximately ten seconds. Continue to build pressure intermittently for three to four minutes. Increase engine speed to full throttle and repeat the above procedure. Lower the moldboard to the ground. Do not apply down pressure. Shut down the engine. Check the hydraulic fluid level and for leaks. Replace the side panels.

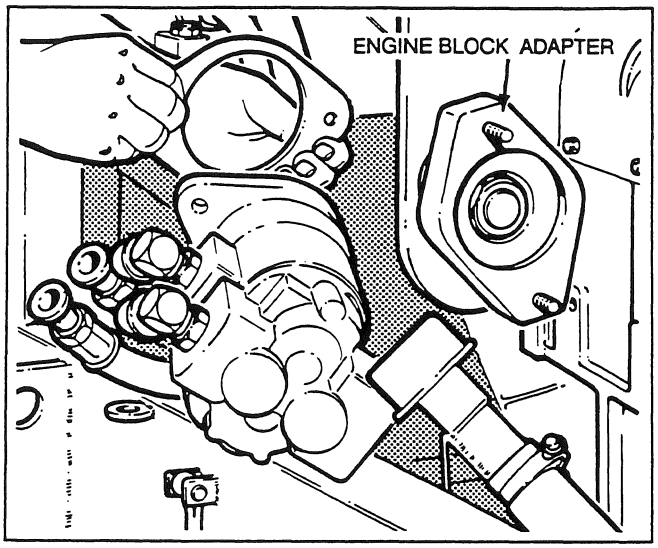


Fig. 38

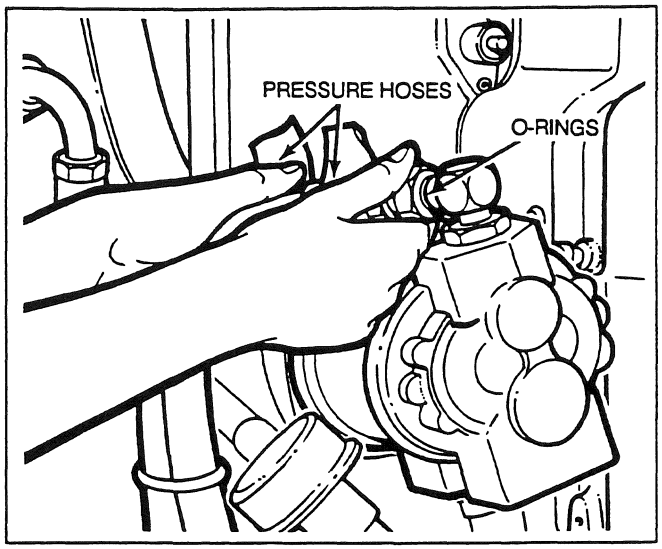


Fig. 41

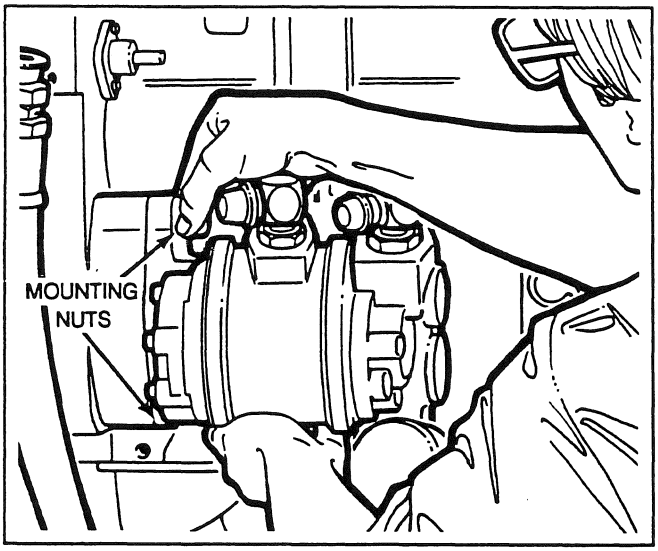


Fig. 39

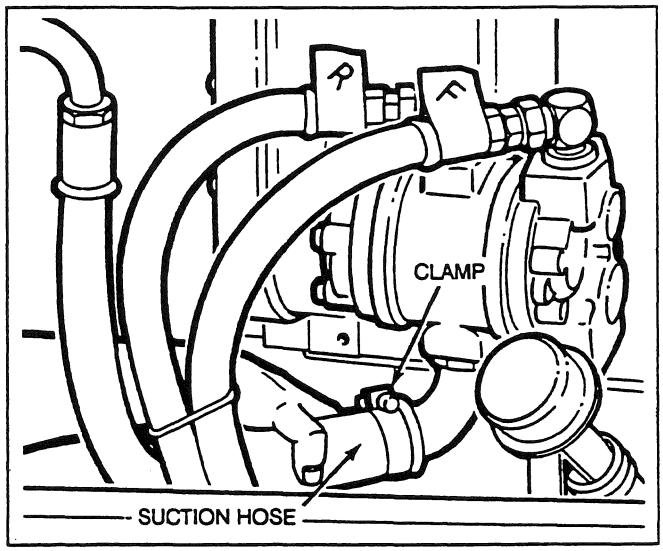


Fig. 42

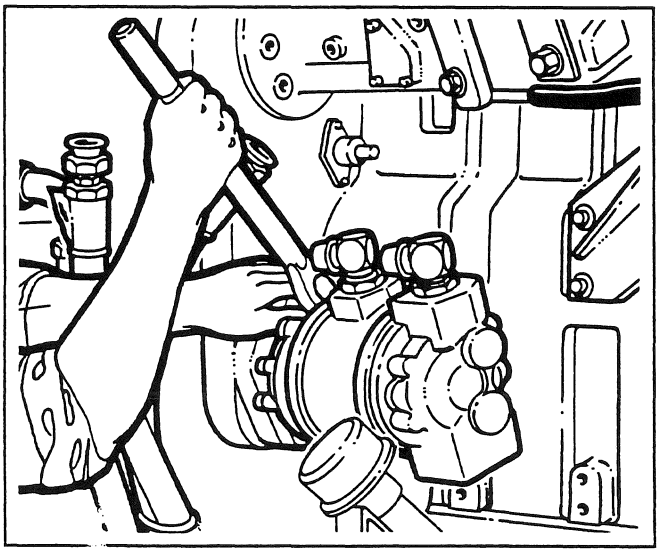


Fig. 40

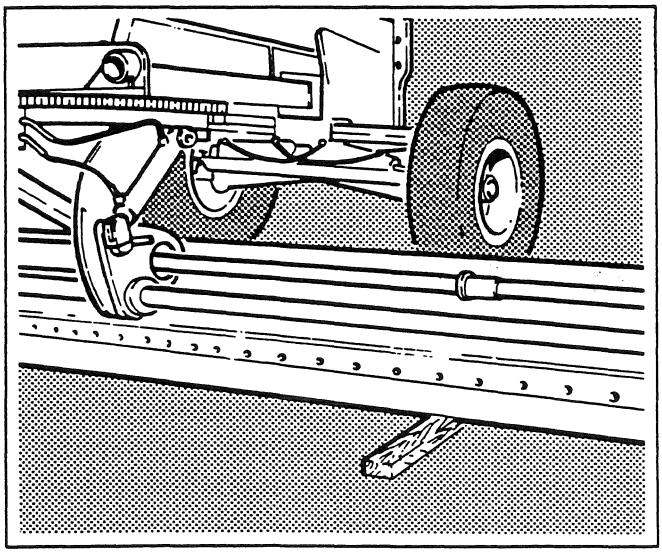


Fig. 43

Main Hydraulic Pump - Inspection

Inspection - General

1. Clean and dry all parts.

2. Remove nicks and burrs from all parts with emery cloth.

Inspection - Gear Assembly

1. Check the driveshaft assembly splines (15) for twisted or broken teeth. Check for a broken keyway in the driveshaft where the slip fit gear (5) is installed.

2. Inspect both the driveshaft assembly (15) and idler gear shafts (4 and 14) at bushing points and oil seal (23) area for rough surfaces and excessive wear.

3. If the bushing area for the driveshaft assembly (15) or idler gear shafts (4 and 14) is less than 0.873 inch (22,2 mm), replace the gear assembly.

4. Inspect gear faces for scoring and excessive wear.

5. If the gear face widths for models 710 through 730A are less than 0.909 inch (23,1 mm), or 1.045 inch (26,5 mm) for models 740 through 780A, replace the gear assembly.

6. Ensure the retaining rings are in the grooves on either side of the driveshaft assembly gear (15) and idler gears (4 and 14).

7. Smooth any sharp gear teeth edges with emery cloth.

Inspection - Front Plate, Back Plate and Adapter Plate

1. The oil grooves in the bushings of the front plate (25), back plate (1), and adapter plate (11) should align with the dowel pin holes and be 180 degrees apart. This places the oil grooves closest to their respective dowel pin holes.

2. If the inside diameter of the bushings exceeds 0.879 inch (22,3 mm), replace the front plate (25), back plate (1) and adapter plate (11). Bushings are not available as separate items.

3. Bushings in the front plate (25) and the gasket side of the adapter plate (11) should be flush with the face.

4. Check for scoring on the face of both the back plate (1) and adapter plate (11). Replace either plate if the wear exceeds 0.0015 inch (0,038 mm).

Inspection - Body

1. Check the inside gear pockets for excessive scoring or wear.

2. Replace the body assemblies (3 and 16) if the inside diameter of the gear pockets exceeds 2.108 inches (53,5 mm).

Main Hydraulic Pump - Troubleshooting

Problem	Cause	Remedy
Noisy pump caused by cavitation	Oil too heavy	Change to the proper viscosity
	Oil filter plugged	Clean the filters
	Suction hose plugged or too small	Clean the hose and check for size
Hot oil	Oil supply low	Fill the hydraulic tank
	Contaminated oil	Drain the hydraulic tank and refill with fresh system oil
	Relief valve setting too high or too low	Set to the correct pressure
	Oil viscosity too light	Drain the hydraulic tank and refill with the proper viscosity system oil
	Excessive internal wear	Disassemble the pump and replace parts as needed
Oil seal leakage	Worn oil seal	Replace the oil seal
	Worn driveshaft	Replace the driveshaft
	Broken seal or gasket	Replace the seals or gaskets only if the leak persists after replacing the oil seal and driveshaft
	Bushings out of position	Disassemble the pump and replace the front plate
	Excessive internal wear	Disassemble the pump and replace parts as needed
Foaming oil	Low oil level	Fill the hydraulic tank with fresh system oil
	Air leaking into the suction hose	Tighten the suction hose clamp
	Wrong kind of oil	Drain the hydraulic tank and refill with non-foaming system oil as specified in the 700 Series Operator's Manual

SECTION 4C
HYDRAULICS

Transmission/Steering Hydraulic Pump

S/N 16224, 16245 to 19981, 19883, 19986 to 19995, 19997 to 20004, 20006 to 20103, 20105, 20107 to 20119, 20804 and 20807. U.S. S/N 2021-2 to 2658-2

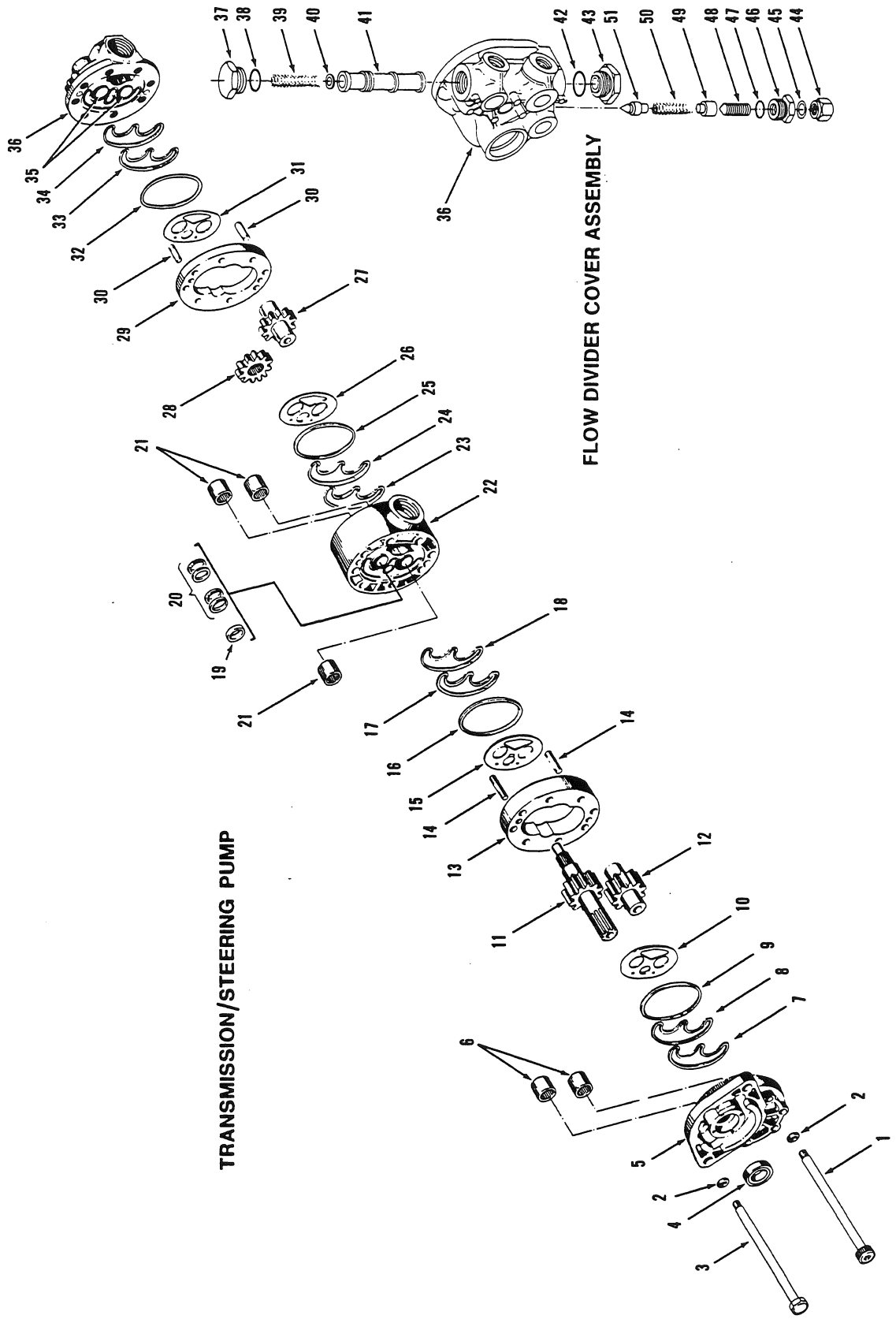


Fig. 1C Transmission/Steering Hydraulic Pump

S/N **16224**, **16245** to **19981**, **19883**, **19986** to **19995**, **19997** to **20004**, **20006** to **20103**, **20105**, **20107** to **20119**, **20804** and **20807**. U.S. S/N **2021-2** to **2658-2**

Item	Description	Item	Description	Item	Description
1	Capscrews (socket hex. head)	18	E ring	35	Needle bearings
2	Flatwasher	19	Back-up ring	36	Flow divider cover
3	Capscrews (hex. head)	20	Shaft seals	37	Plug
4	Shaft seal	21	Needle bearings	38	O ring
5	Front plate	22	Bearing plate	39	Spring
6	Needle bearings	23	E ring	40	Orifice disc
7	E ring	24	E seal	41	Flow divider piston
8	E seal	25	Sealing ring	42	O ring
9	Sealing ring	26	Wear plate (grooved)	43	Plug
10	Wear plate	27	Idler gear	44	Cap
11	Drive gear	28	Drive gear	45	Copper gasket
12	Idler gear	29	Gear plate	46	Plug
13	Gear plate	30	Dowel pin	47	O ring
14	Dowel pin	31	Wear plate	48	Setscrew
15	Wear plate (grooved)	32	Sealing ring	49	Spring guide
16	Sealing ring	33	E seal	50	Spring
17	E seal	34	E ring	51	Relief poppet

Key to Fig. 1C

S/N **16224, 16245** to **19981, 19883, 19986** to **19995, 19997** to **20004, 20006** to **20103, 20105, 20107** to **20119, 20804** and **20807**. U.S. S/N **2021-2** to **2658-2**

NOTE: *Items 37 to 51 are not found on graders S/N **19982, 19984, 19985, 19996, 20005, 20104, 20106, 20120** and up. These machines are equipped with a remote mounted flow divider/relief valve. Refer to Product Support Bulletin No. **512** and form No. **F-503 (01/90)** for details.*

Introduction of Premium Quality Gear Pumps

Starting at grader S/N **20805, 20806, 20808** and up, Champion has changed the transmission/steering hydraulic pump installation on all models. The new pump and hydraulic changes introduced with Series III models provide an efficient, extended-life system.

The two-section transmission/steering hydraulic pump is located below the radiator and driven by the engine crankshaft as before. The increased displacement of the transmission section eliminates the need for the belt-driven clutch pump introduced at grader S/N **19885**. The steering section installation remains unchanged as the priority flow divider/relief valve was remote mounted when Series III models were introduced.

Two spring-type lip seals provide sealing between the transmission and steering sections. The cavity between the seals is vented to the clutch housing through a 3/8 in. hose. This prevents pressure build-up and dirt entering the pump.

A kit containing shaft and section seals is available. Contact Champion Parts Distribution Center or your Distributor.

Transmission/Steering Hydraulic Pump - Removal

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Remove the hydraulic tank filler cap to release any pressure and replace the cap loosely. The transmission/steering pump is located below the radiator and is driven by a driveshaft. Remove the panels to gain access to the pump. For more information on steering, refer to Section 1, **Front Axle**, and Section 5, **Steering Unit and Column**, in this Shop Manual.

Fig. 3
Loosen both ends of the hydraulic suction hose. Remove the tank end first since the hose may contain oil. Remove the other end. Cap the hose and fitting to prevent contamination.

Fig. 4
Remove the steering pressure hose. Cap the hose and fitting. Remove the steering bypass hose. Cap the hose and fitting. Place a container under the transmission pressure hose and remove the hose. Oil from the transmission cooler will drain into the container. Cap the port and fitting.

Fig. 5
Remove the transmission suction hose. Cap the hose and fitting to prevent contamination.

Fig. 6
Remove the hydraulic pump mounting bolts. Remove the pump.

Transmission/Steering Hydraulic Pump - Disassembly

Fig. 7
Secure the flow divider cover (36) in a vise with soft jaws. Do not overtighten the vise. Evenly loosen the capscrews (1 and 3) in a star pattern. Remove the capscrews and flatwashers (2). Clearly identify each section to its mating section, preferably with light punch marks, to ensure proper assembly.

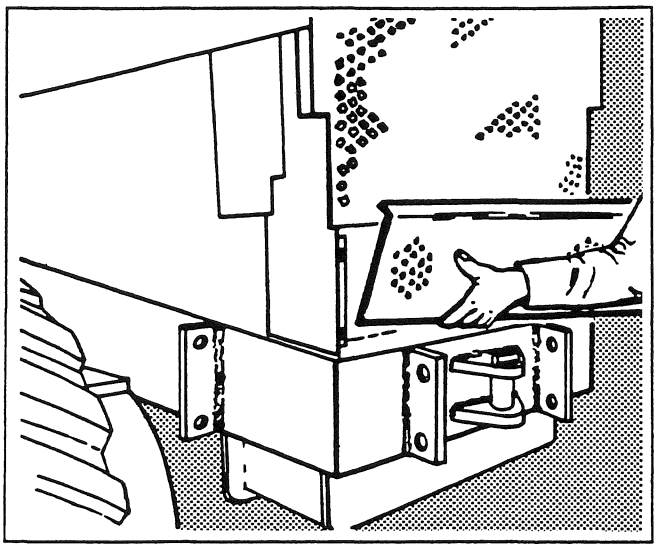


Fig. 2

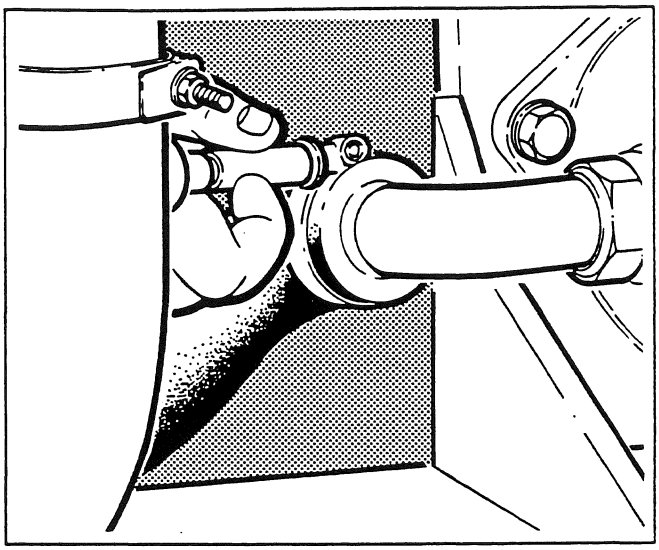


Fig. 5

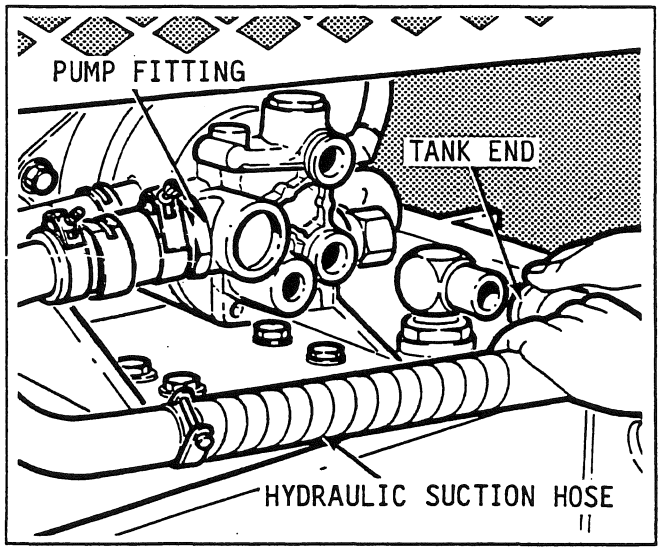
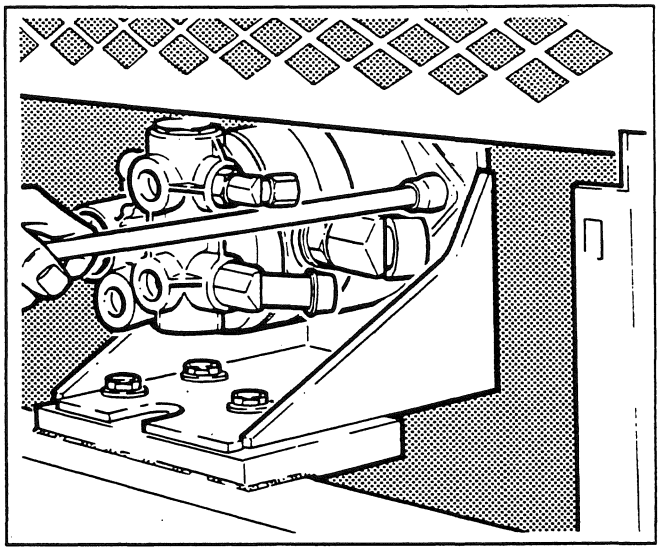


Fig. 3



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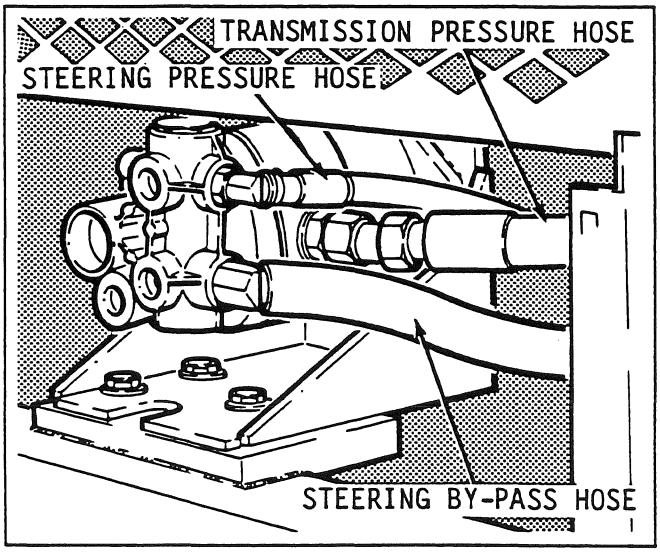

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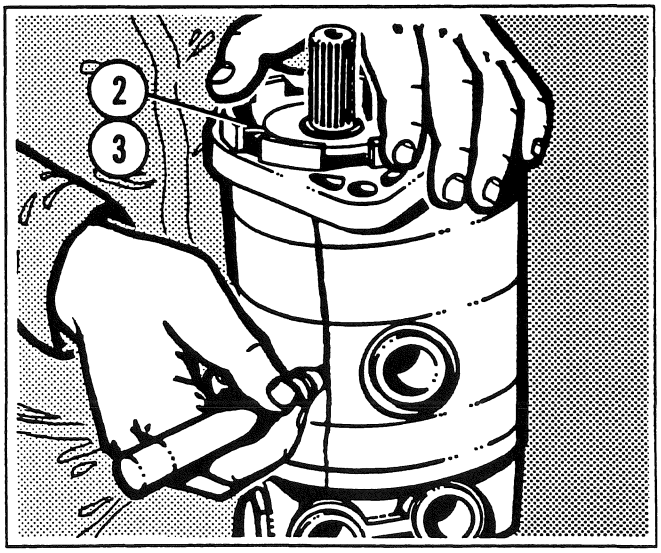


Fig. 7

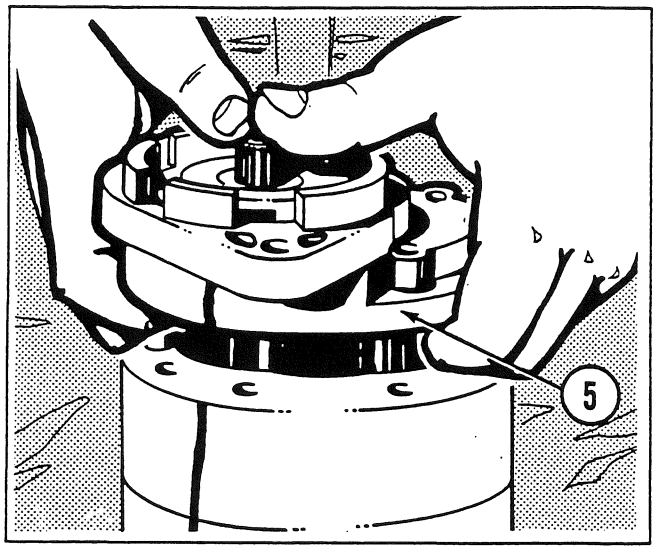
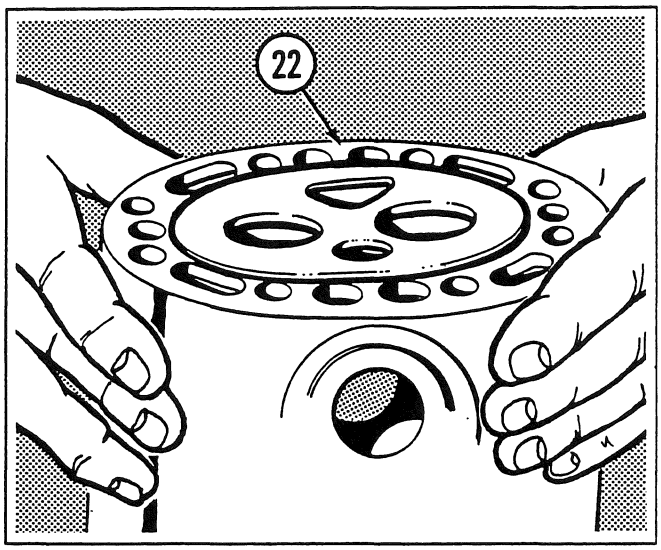


Fig. 8



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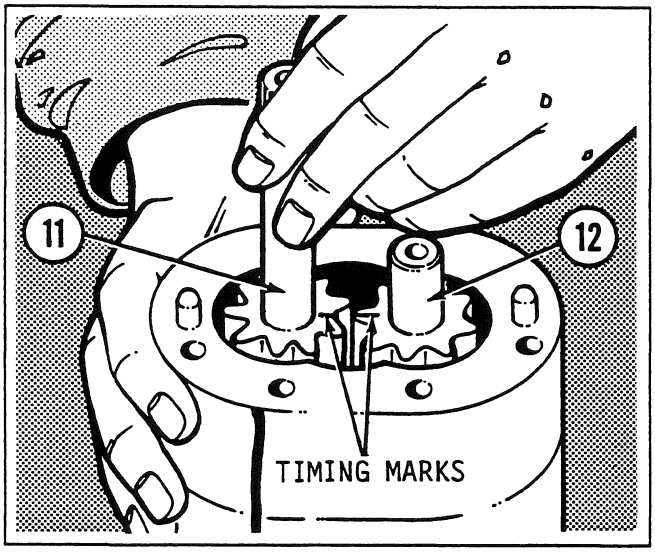

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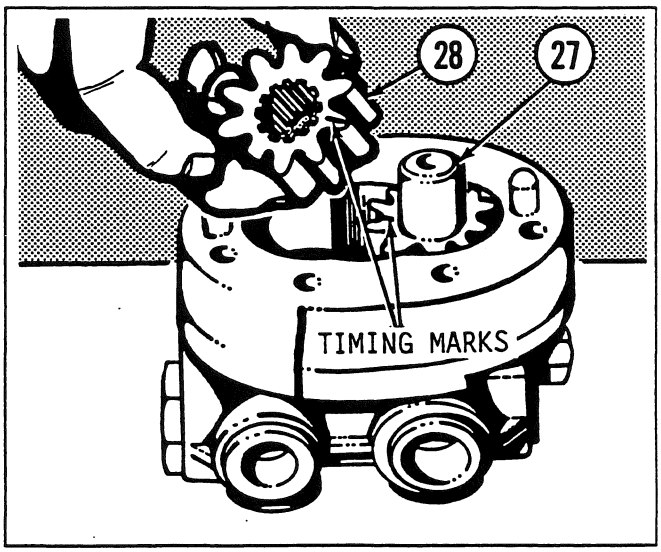

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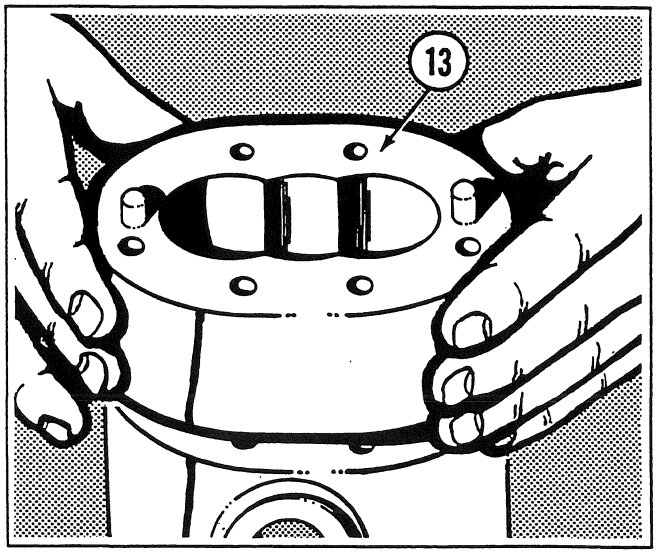


Fig. 10

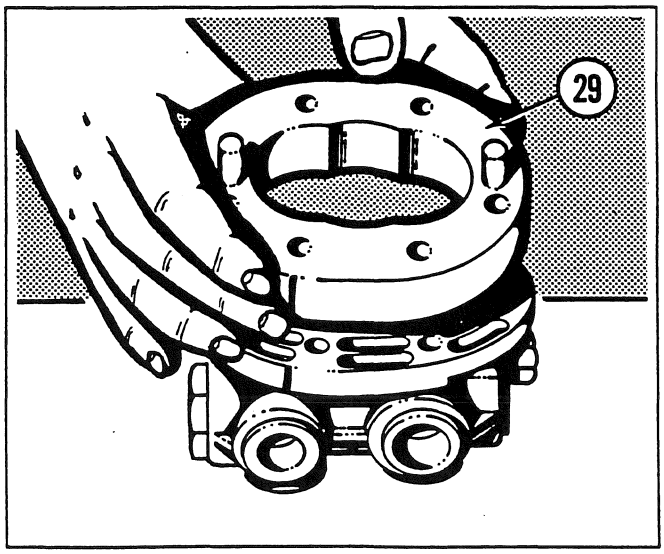


Fig. 13

Transmission/Steering Hydraulic Pump - Disassembly continued

Fig. 8
Carefully remove the front plate (5).

Fig. 9
Apply a marking dye to the mating gear teeth of the drive gear (11) and idler gear (12). This ensures correct timing during assembly. Remove the gears.

Fig. 10
Remove the gear plate (13).

Fig. 11
Remove the bearing plate (22).

Fig. 12
Apply a marking dye to the mating gear teeth of the drive gear (28) and idler gear (27). This ensures correct timing during assembly. Remove the gears.

Fig. 13
Remove the gear plate (29).

Transmission/Steering Hydraulic Pump - Disassembly continued

Fig. 14
Working on the flow divider cover (36), carefully remove and discard the wear plate (31) and sealing ring (32). Remove and discard the E seal (33) and the E ring (34). If using a screwdriver, be careful not to damage the aluminum housing.

Fig. 15
Invert the flow divider cover (36) in the vise. Remove the cap (44) and copper gasket (45).

*NOTE: Steps **Fig. 15** through **Fig. 18** apply only to graders S/N **16224, 16245** to **19981, 19983, 19986** to **19995, 19997** to **20004, 20006** to **20103, 20105** and **20107** to **20119**. U.S. S/N **2021-2** to **2658-2**.*

Fig. 16
Accurately count and record the number of exposed threads on the setscrew (48). You will use this as a starting point for setting the relief valve. Unthread the set screw to relieve the spring (50) tension.

Fig. 17
Remove the plug (46) and inspect the O ring (47). Using a small magnetic pick-up tool, remove the spring guide (49), the spring (50) and the relief poppet (51).

Fig. 18
To reduce spring tension on the flow divider piston (41), loosen both plugs (37 and 43). Remove the plugs, piston and spring (39). Using a magnetic pick-up tool, remove the orifice disc (40) from the piston.

Fig. 19
Working on the bearing plate (22), remove and discard the grooved wear plate (15), sealing ring (16), E seal (17) and E ring (18). Repeat for the other side of the bearing plate.

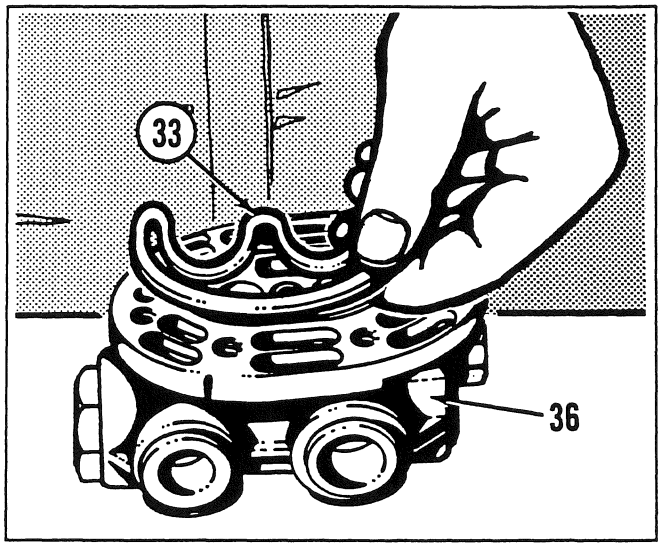
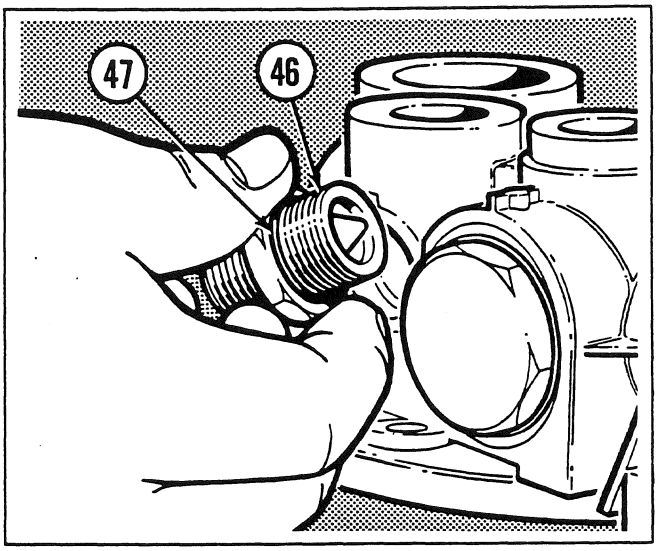


Fig. 14



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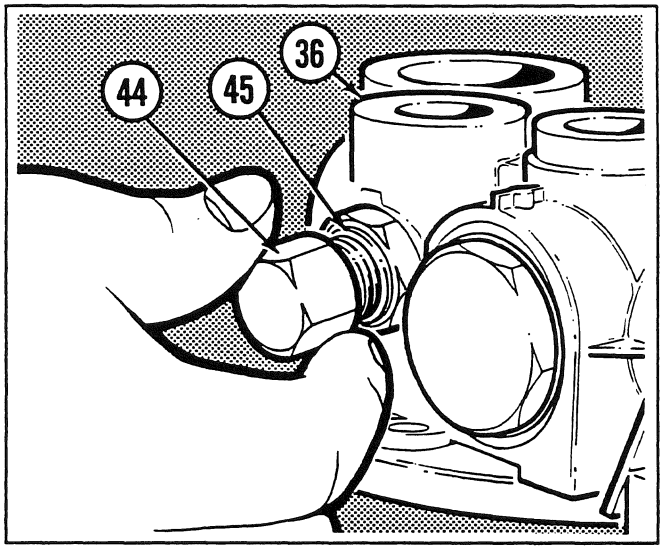
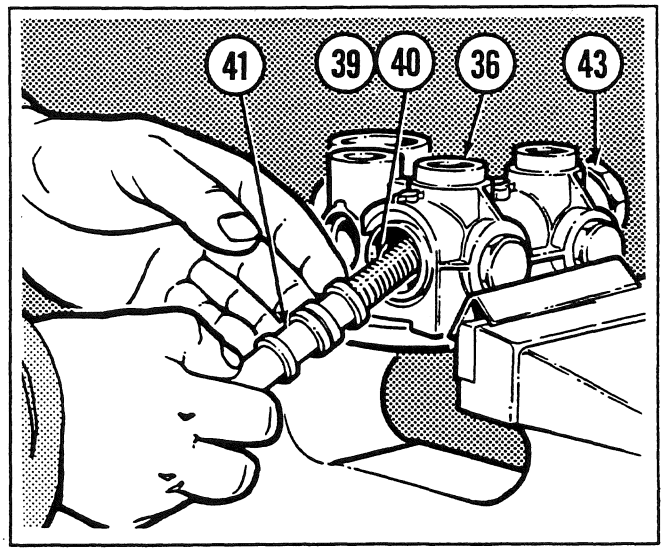


Fig. 15



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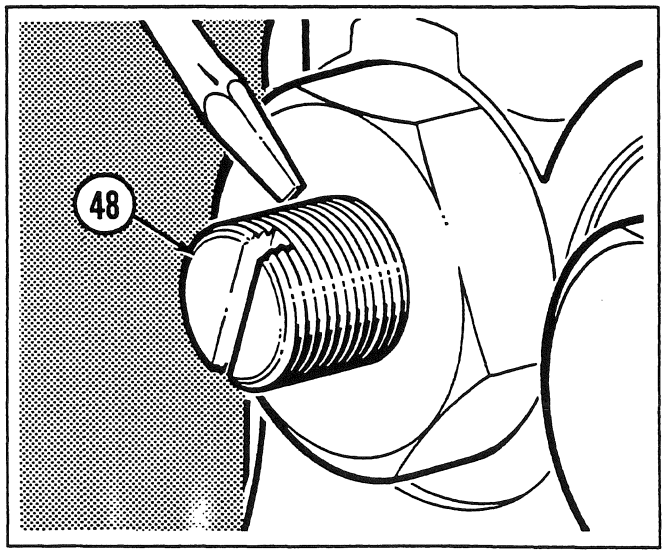
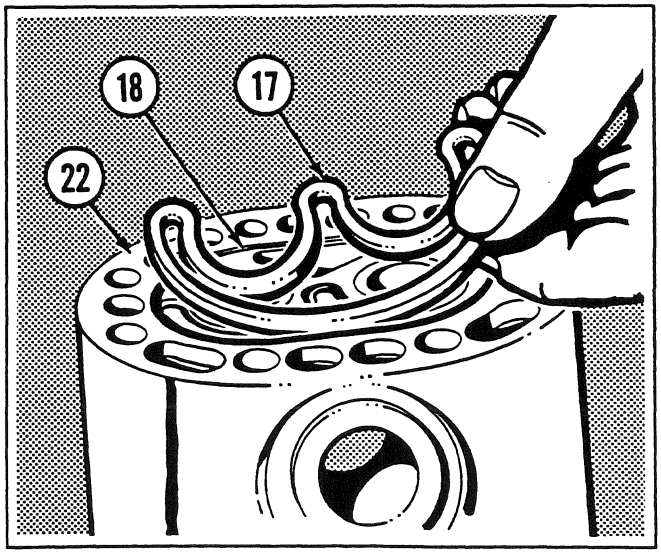


Fig. 16



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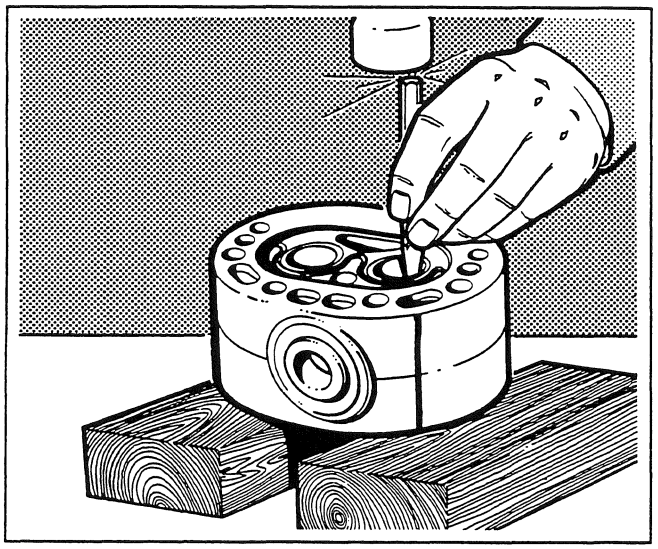


Fig. 20

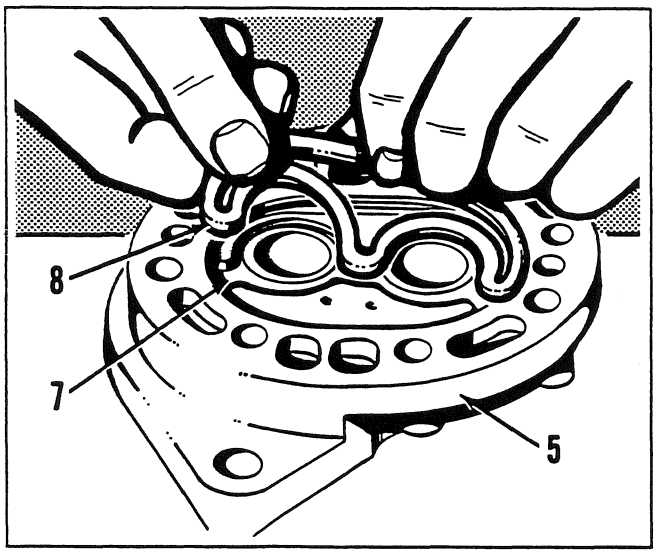


Fig. 21

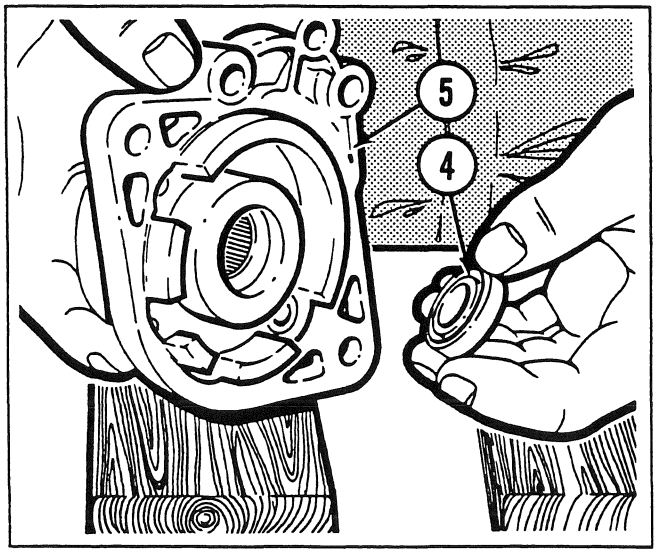


Fig. 22

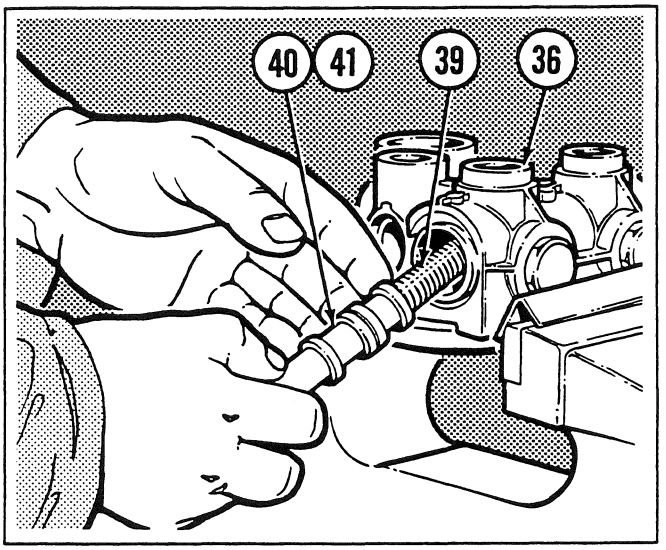


Fig. 23

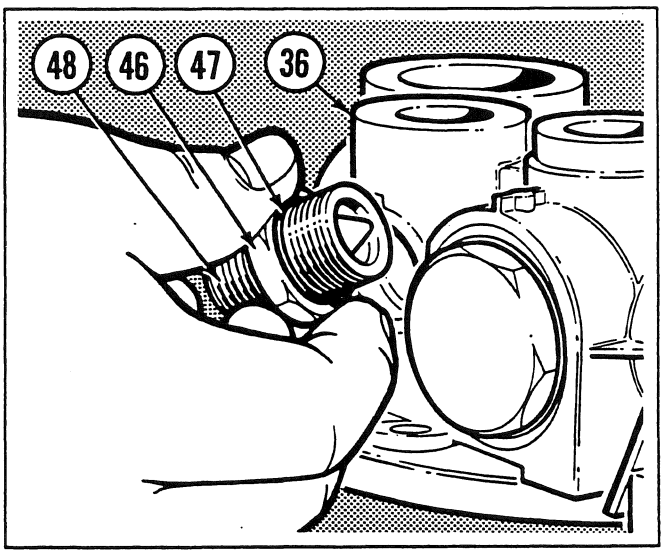


Fig. 24

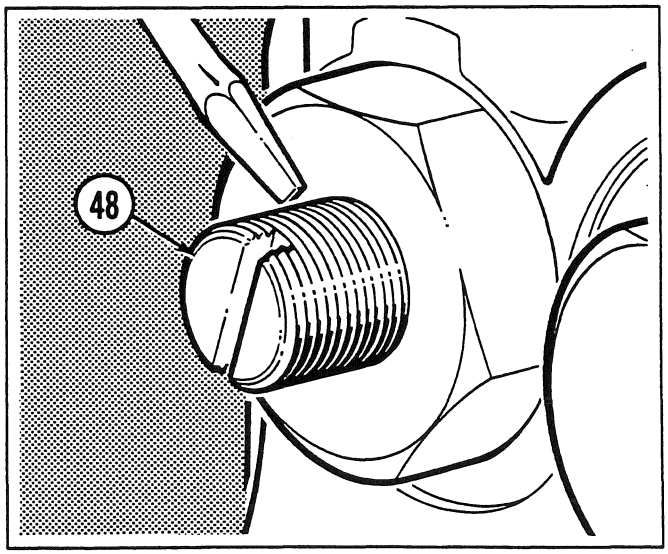


Fig. 25

Transmission/Steering Hydraulic Pump - Disassembly continued

Fig. 20
Using a punch, carefully remove the back-up ring (19) and the four shaft seals (20). Be careful not to damage the bore with the punch (damaged pumps must be replaced). Discard the seals and back-up ring.

Fig. 21
Working on the front plate (5), remove and discard the wear plate (10). Notice there are no grooves on the underside of the wear plate. Remove and discard the sealing ring (9), E seal (8) and E ring (7).

Fig. 22
Support the front plate (5) on wooden blocks. Using a punch and being careful not to damage the bore, remove and discard the main shaft seal (4). Disassembly is now complete. Inspect all parts for serviceability. Refer to **Inspection and Cleaning** found at the front of this Shop Manual section.

Transmission/Steering Hydraulic Pump - Assembly

Fig. 23
Place the orifice disc (40) into the flow divider piston (41) followed by the spring (39). Generously lubricate the piston and insert it into the flow divider cover (36) from the same direction it was removed. Inspect the O rings (38 and 42) on each of the plugs (37 and 43). Generously lubricate each plug and install them into the flow divider cover. Tighten the plugs.

NOTE: *Steps **Fig. 23** through **Fig. 26** apply only to graders S/N **16224, 16245** to **19981, 19983, 19986** to **19995, 19997** to **20004, 20006** to **20103, 20105** and **20107** to **20119**. U.S. S/N **2021-2** to **2658-2**.*

Fig. 24
Place the relief poppet (51) into the flow divider cover (36) followed by the spring (50) and the spring guide (49). With the O ring (47) inspected and lubricated, install the plug (46) and setscrew (48). Install the flow divider cover in a vise with soft jaws. Do not overtighten the vise. Tighten the plug.

Fig. 25
Thread the setscrew (48) into the plug (46) leaving the same number of threads exposed as noted before (**Fig. 16**). This will be a base setting for adjustment. Always use an accurate pressure gauge for the final setting.

Transmission/Steering Hydraulic Pump - Assembly continued

Fig. 26
Install the copper gasket (45) and cap (44). Tighten the cap to protect the setscrew (48).

Fig. 27
Invert the flow divider cover (36) in the vise. Do not overtighten the vise. Generously lubricate the seal ring grooves. Install a new E ring (34) and E seal (33), making sure they are seated correctly.

Fig. 28
Install a new ungrooved wear plate (31) with the bronze side up. Ensure it is correctly positioned in the flow divider cover. Install a new sealing ring (32) and generously lubricate the seal, wear plate and bearings.

Fig. 29
Install the gear plate (29) and align the dowel pins (30) and the assembly marks. Tap the dowel pins to ensure that they are fully seated.

Fig. 30
Install and align the idler gear (27) and drive gear (28), with the timing marks exposed, into the flow divider cover (36).

Fig. 31
Sealing compound is applied to the outside diameter of all new shaft seals (20) during manufacture and must not be removed before installation. Ensure that you have inspected the bearing plate (22). Using an appropriate drift, install the first seal with the lips facing downward into the bearing plate bore. Seat the seal against the inner ridge face of the bore. Install the second seal, touching the first seal, with the lip facing upward. Install the remaining six seals with the lips of the seals alternately facing down and up. The lips of the eighth seal should be facing downward. Inspect and install a new back-up ring (19) so it is just below the surface of the bearing plate bore. Ensure the weep hole is plugged.

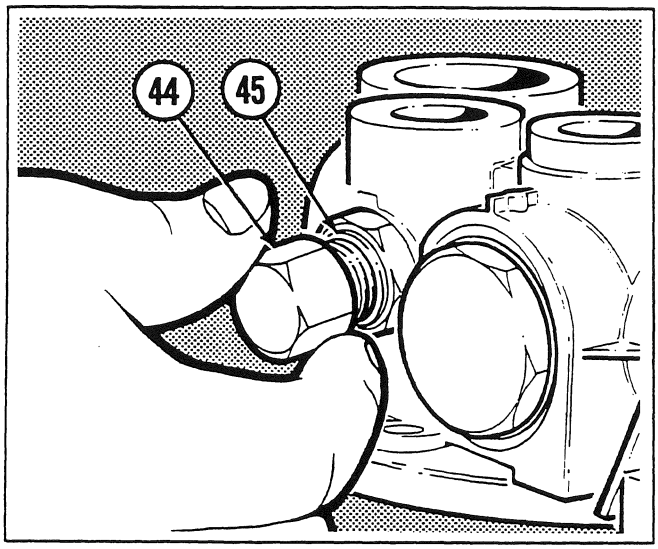


Fig. 26

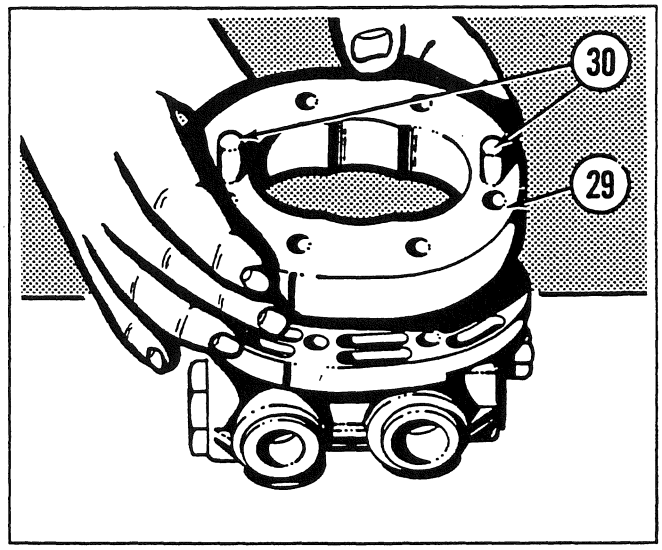


Fig. 29

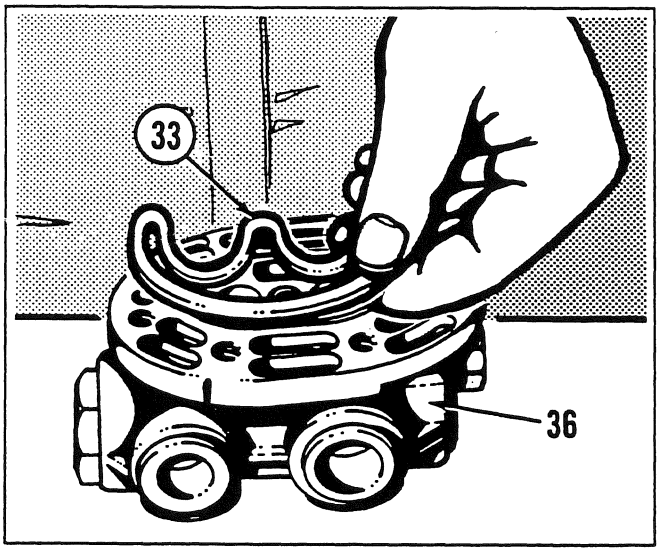


Fig. 27

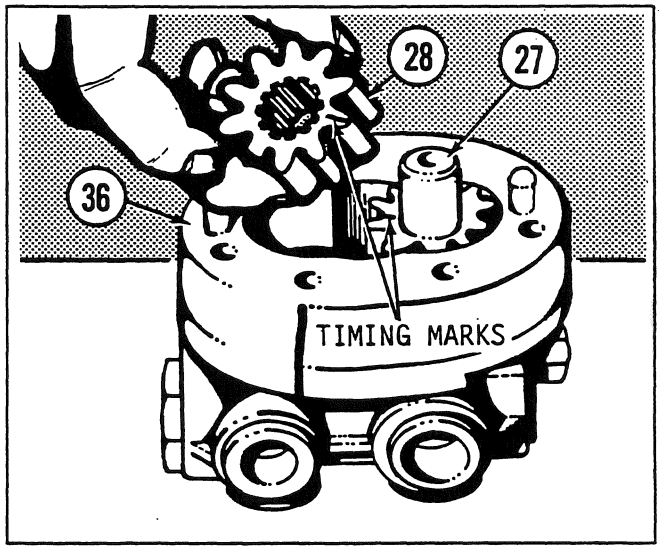


Fig. 30

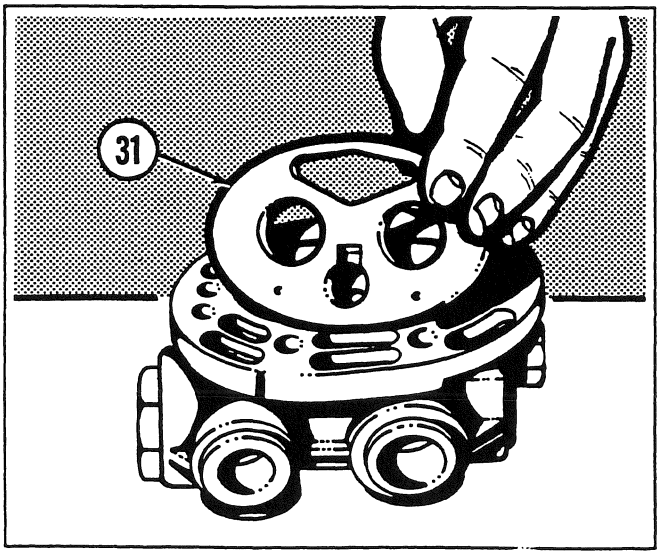


Fig. 28

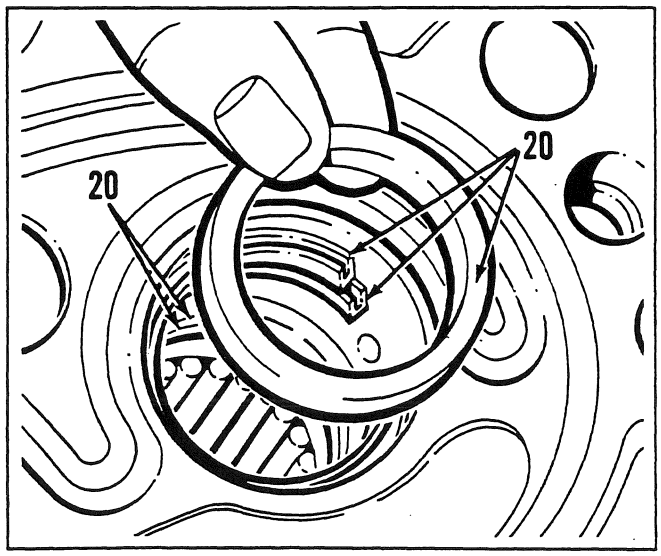


Fig. 31

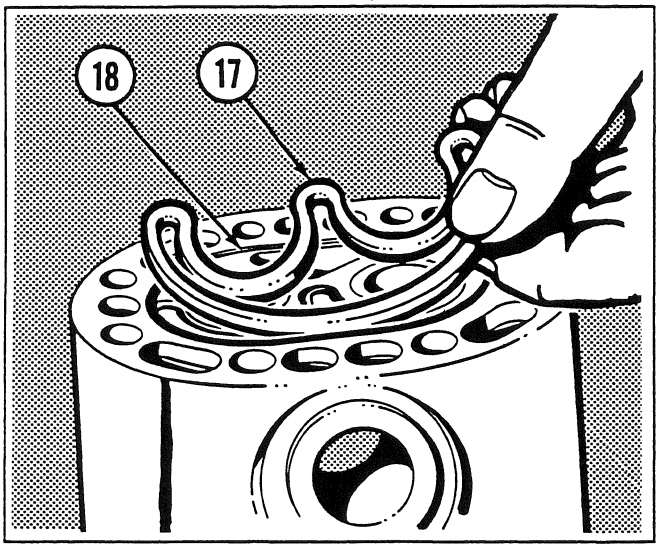


Fig. 32

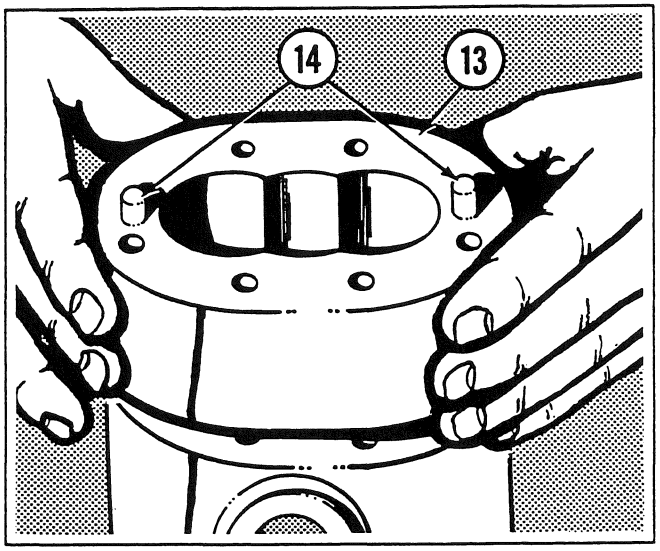


Fig. 35

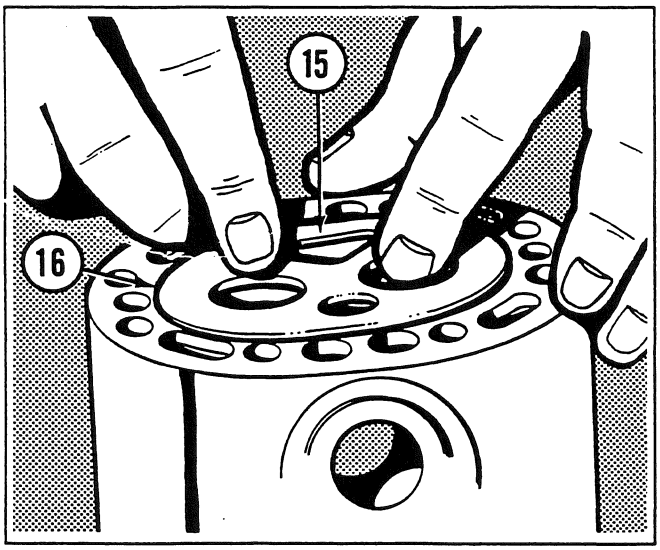


Fig. 33

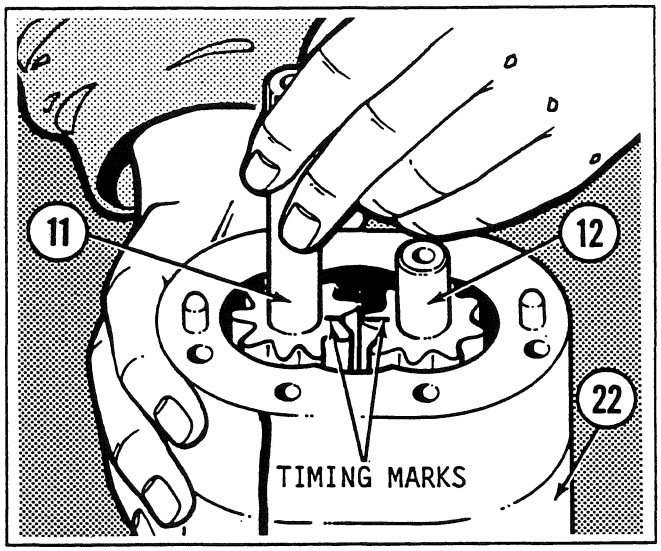


Fig. 36

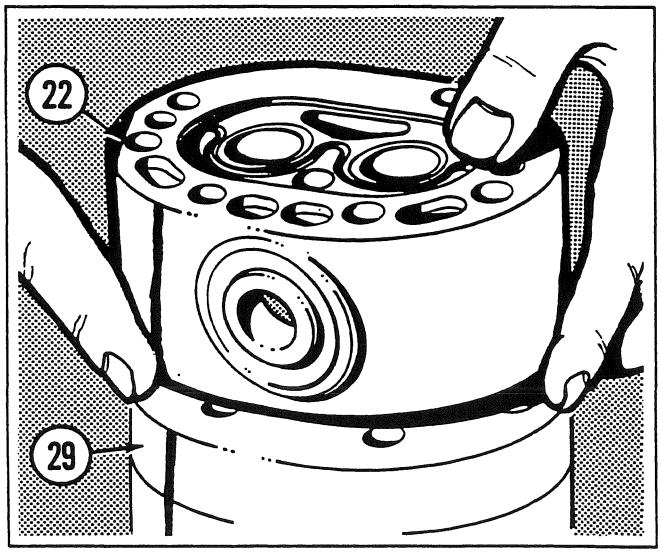


Fig. 34

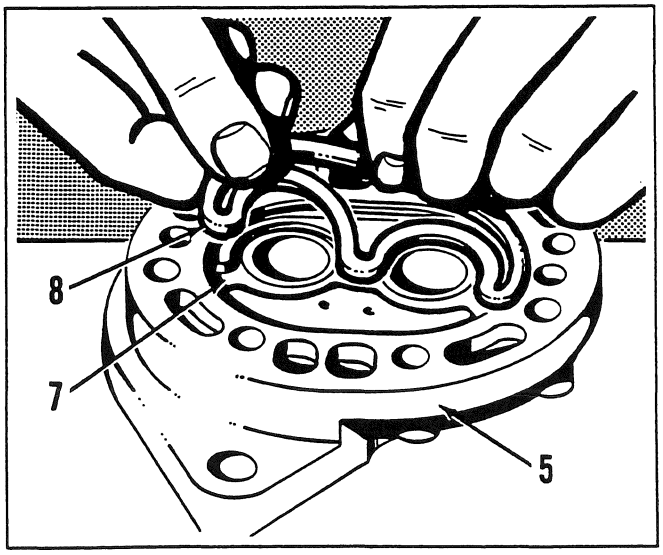


Fig. 37

Transmission/Steering Hydraulic Pump - Assembly continued

Fig. 32
Generously lubricate the grooves of the bearing plate (22). Lubricate and install a new E ring (18) and E seal (17). Ensure that they are seated correctly in the grooves.

Fig. 33
Note the two grooves on the underside of the new wear plate (15). Apply a light coating of grease and install the wear plate with the bronze side up. Ensure it is correctly positioned in the bearing plate. Lubricate and install a new sealing ring (16). Repeat for the other side of the bearing plate.

Fig. 34
Generously lubricate the bearings and install the bearing plate (22) onto the gear plate (29). Ensure the assembly marks are aligned and engage the dowel pins.

Fig. 35
Install the remaining gear plate (13) and align the assembly marks. Ensure the dowel pins (14) are seated by tapping them into place.

Fig. 36
Generously lubricate the wear plate (15), shaft seals (20) and needle bearings of the bearing plate (22). Install the drive gear (11) with a slight twisting action as it slides through the seals. Install the idler gear (12) with the timing mark exposed and matched with the drive gear timing mark.

Fig. 37
Working on the front plate (5), lubricate the grooves. Lubricate and install a new E ring (7) and E seal (8). Ensure that they seat correctly in the grooves.

Transmission/Steering Hydraulic Pump - Assembly continued

Fig. 38
Apply grease to the underside of a new wear plate (10) and install it with the bronze side up. Ensure it is correctly positioned in the front plate (5). Lubricate and install a new sealing ring (9) into the front plate.

Fig. 39
Place a single layer of transparent tape over the splines on the drive gear (11) shaft. Lubricate the needle bearings (6) and the wear plate (10) and slide the front plate (5) onto the gear plate (13).

Fig. 40
Generously lubricate the inner lip of a new shaft seal (4) and slide it down over the drive gear (11) shaft. Completely remove the transparent tape. Ensure no adhesive or tape stay under the seal. Use an appropriate drift to seat the seal. Ensure that it is square to the shaft and flush with the housing bore. Stake the front plate around the seal in three places. Take care not to damage the seal.

Fig. 41
All capscrews (1 and 3) are made of stress proof material and should not be replaced with standard capscrews. Install the capscrews and the flatwashers (2). Turn each capscrew counterclockwise until a click is heard and felt; then fully install the capscrews. This prevents the capscrews from cross-threading into the flow divider cover (36).

Fig. 42
The capscrews must be torque-tightened in three increments: 25 lbf·ft (33,9 N·m; 3,5 kgf·m), 35 lbf·ft (47,4 N·m; 4,8 kgf·m), and 45 lbf·ft (61 N·m; 6,2 kgf·m) in a star pattern. After each increment is completed, rotate the pump drive gear (11) shaft.

Transmission/Steering Hydraulic Pump - Installation

Fig. 43
Priming the pump is an important step during installation. Begin by filling each pump cavity, through the inlet side, with the correct system oil (refer to the 700 Series Operator's Manual). Turn the pump shaft in the proper direction of operation, then refill the pump cavities. Apply a light coating of anti-seize compound P/N **30453** to the drive coupler and splines of the transmission/steering pump driveshaft. Install the pump.

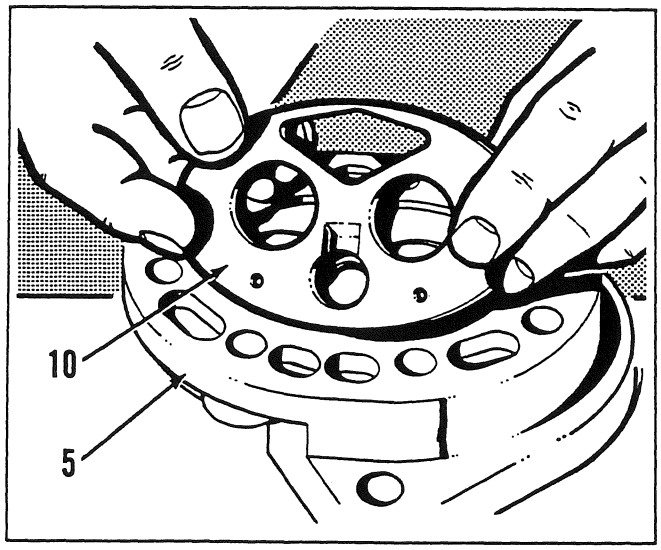


Fig. 38

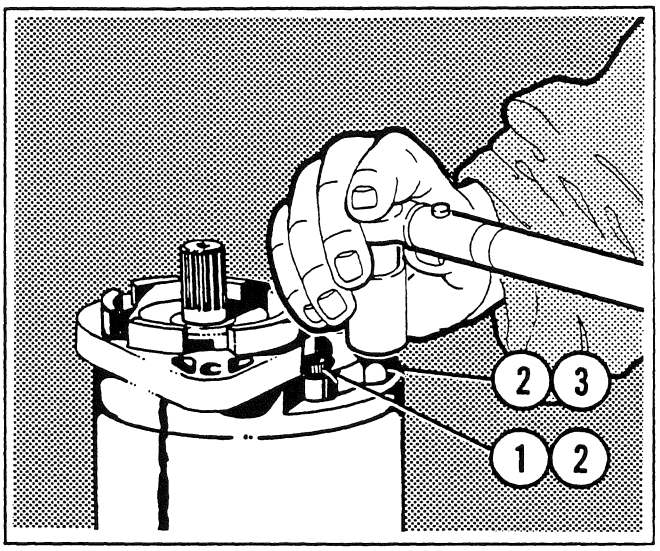


Fig. 41

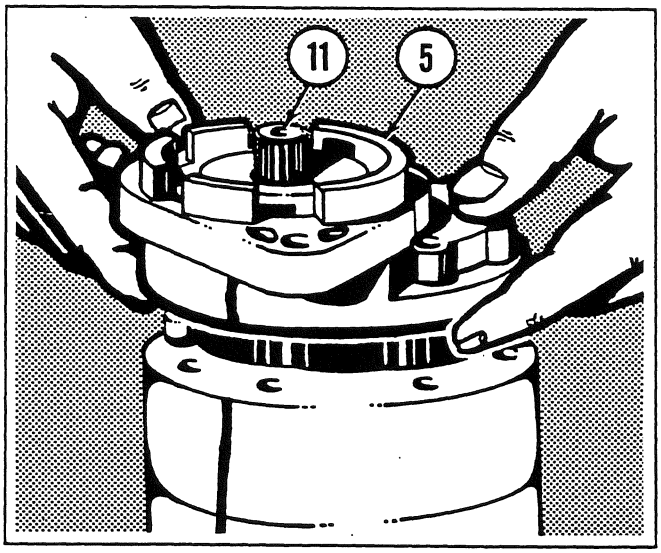


Fig. 39

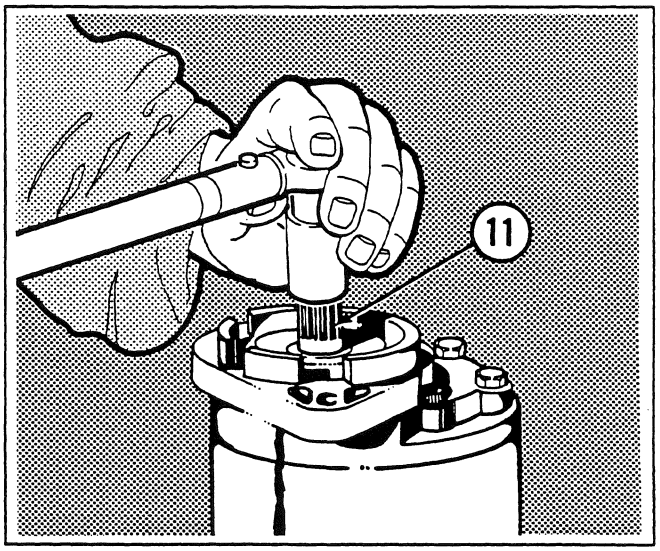


Fig. 42

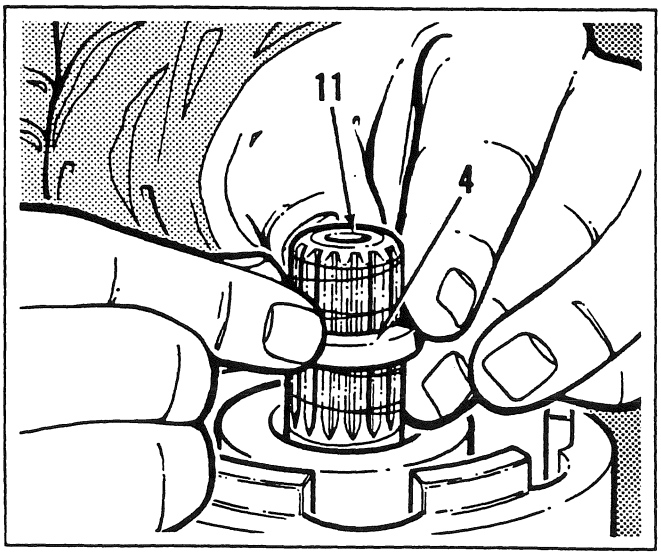


Fig. 40

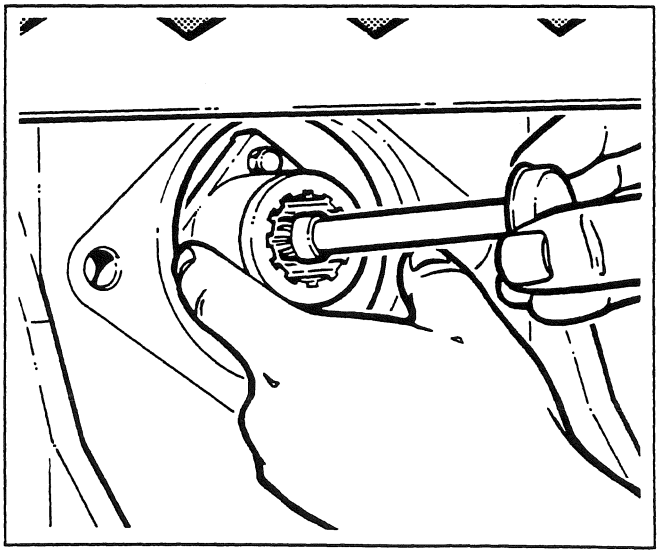


Fig. 43

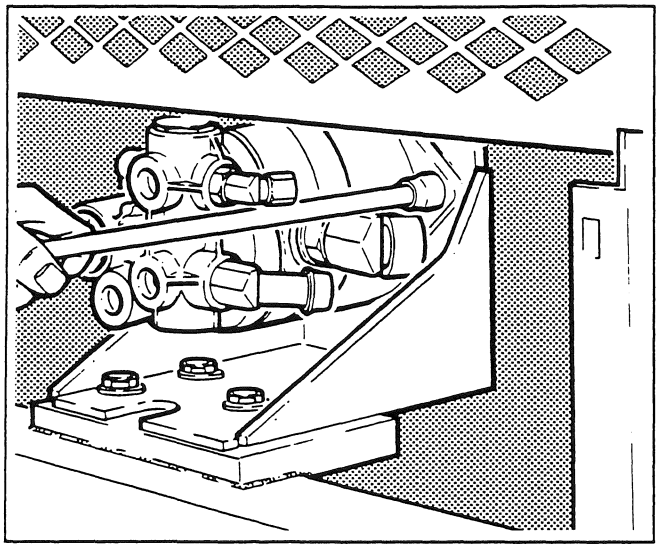


Fig. 44

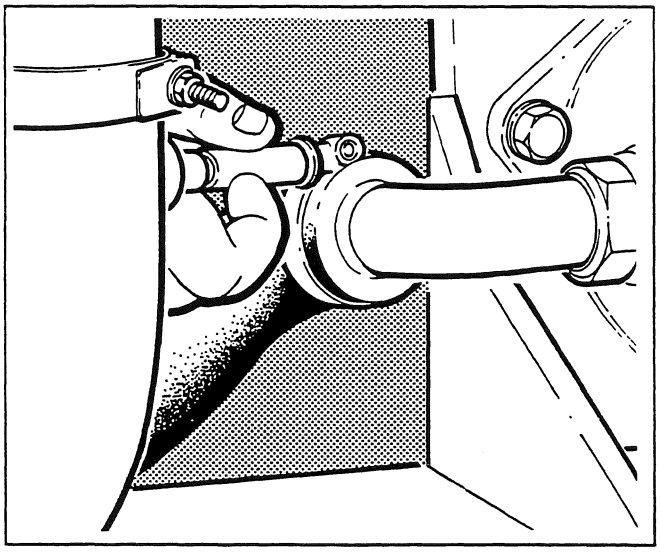


Fig. 45

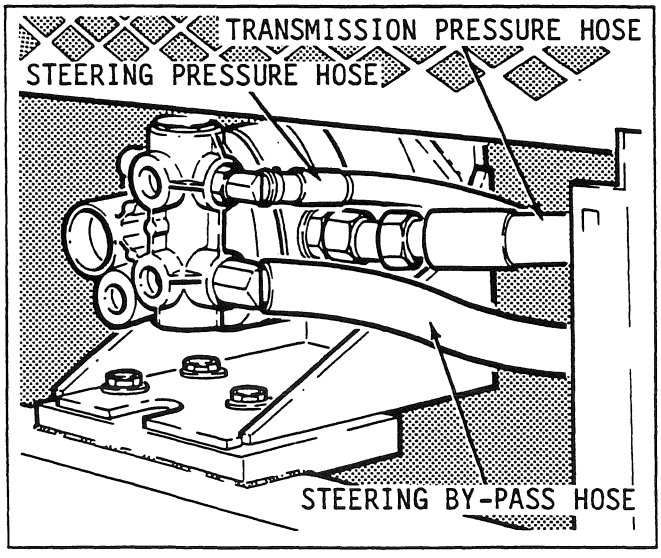
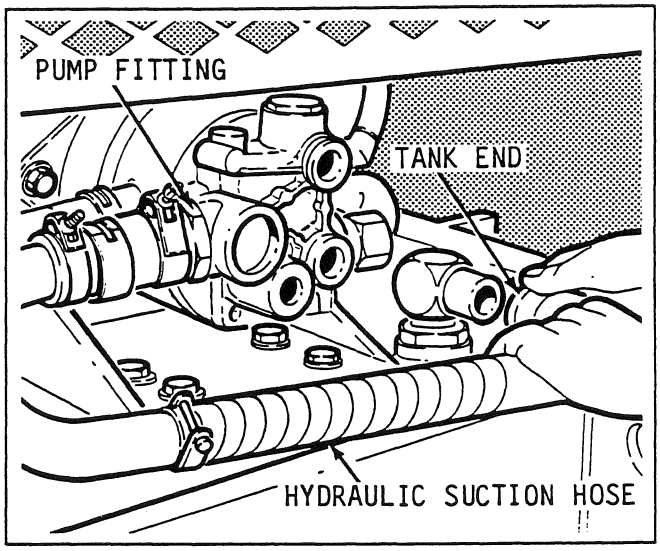


Fig. 46



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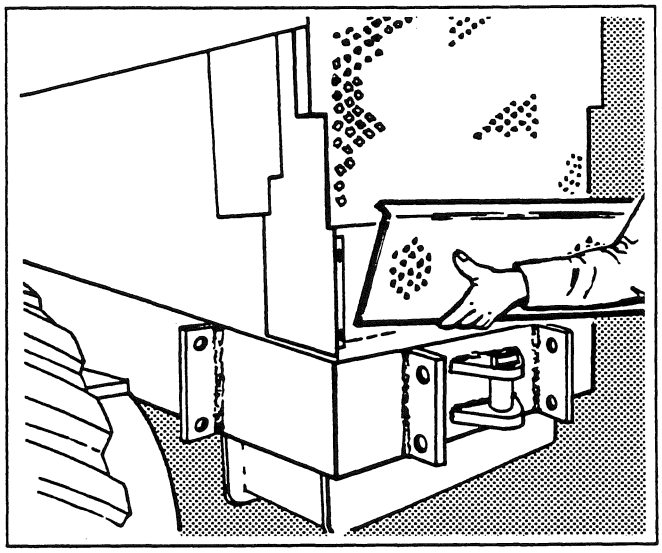


Fig. 48

Transmission/Steering Hydraulic Pump - Installation continued

Fig. 44
Support the weight of the pump. Install the two mounting bolts and lockwashers. Ensure that the pump is tight against the mounting bracket before tightening the bolts to the specified torque.

Fig. 45
Remove the caps from the transmission suction hose and port. Install the hose. Tighten the clamp securely to ensure a leak-proof type seal and to prevent air entering the hydraulic system. This is extremely important to prevent pump cavitation.

NOTE: *You can buy upgrade kits to reduce transmission suction line restriction. Champion recommends updating earlier machines. Refer to Product Support Bulletin No. **461** or contact your Champion Distributor for details.*

Fig. 46
Uncap the transmission pressure hose and fitting. Install the hose. Uncap the steering bypass and steering pressure hoses and fittings. Install the hose. Ensure a tight seal on all three hoses.

Fig. 47
Uncap the steering pump suction hose and fittings. Install the hose. Tighten the hose clamps securely to prevent air being drawn into the suction hose of the pump.

Fig. 48
Inspect the hose connections for leaks. Check the hydraulic fluid level and the transmission fluid level. Replace the side panels. The transmission/steering pump is now ready for a break-in period. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so. Idle the engine for a minimum of 60 seconds. Shut down the engine. Check the fluid levels and for leaks. Test the flow and pressure of the steering system before putting the grader back into service. Refer to Product Support Bulletin No. **512** and form No. **F-503 (01/90)**. After completing all checks, replace the panels.

SECTION 4D
HYDRAULICS
Relief Valves

Effective on grader S/N **19982, 19984, 19985,19996, 20005, 20104, 20106, 20120** and up, the relief valves are mounted onto a return manifold block. However, the overhaul procedure and specifications remain unchanged.

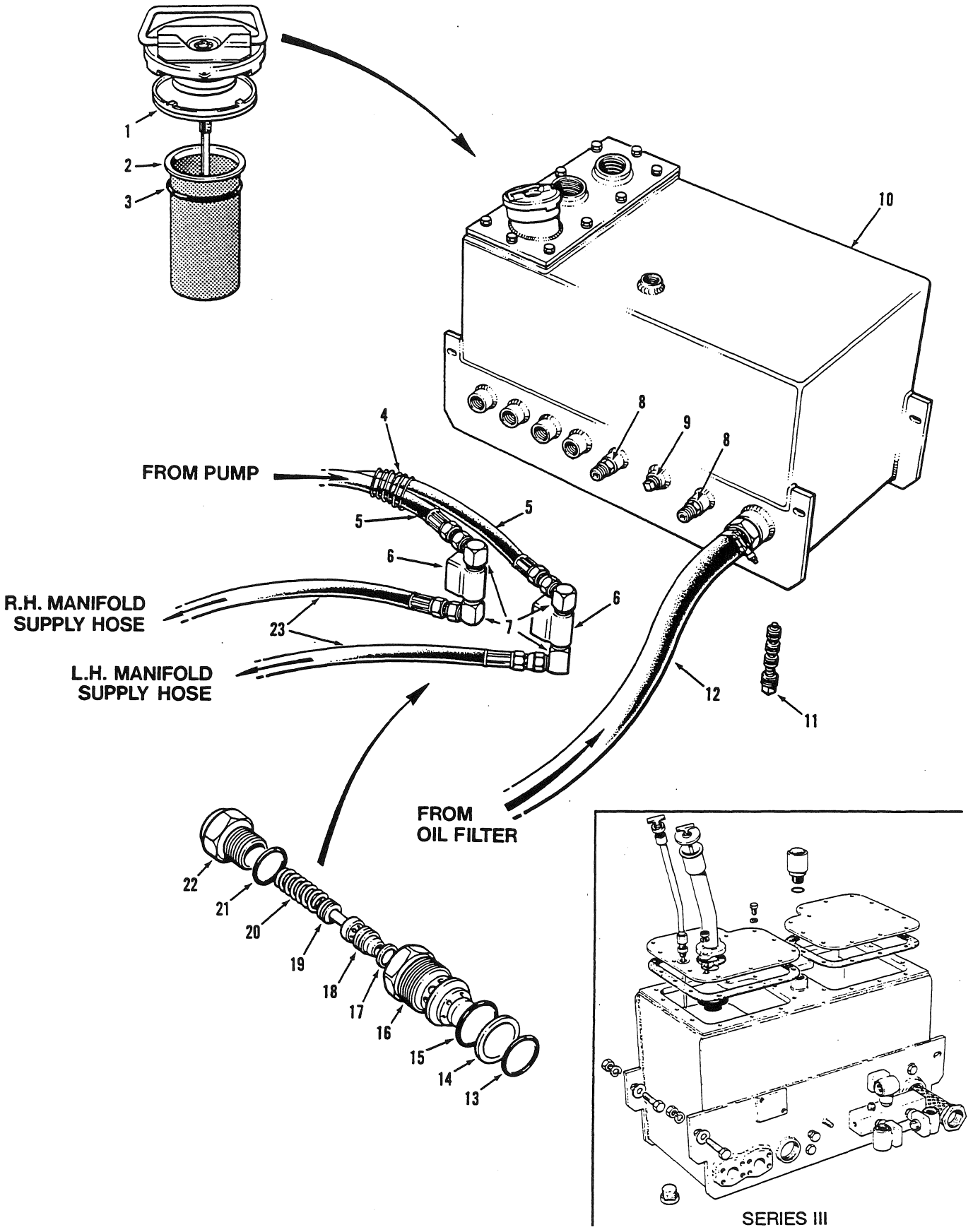


Fig. 1D Relief Valves

Item	Description	Item	Description	Item	Description
1	Filler cap	9	Plug	17	Piston ring
2	Strainer	10	Hydraulic oil tank	18	Poppet
3	O ring	11	Magnetic plug	19	Shims (various thicknesses)
4	Hose straps	12	Hose - return	20	Spring
5	Hoses - from hydraulic pump	13	O ring	21	O ring
6	Relief valves	14	Back-up washer	22	Cap
7	Fittings	15	O ring	23	Hoses - supply (to hydraulic manifold valve assembly)
8	Jam nut (connectors)	16	Body		

Key to Fig. 1D

Relief Valves - Description (Fig. 1D)

The relief valves protect parts by limiting the pressure in the hydraulic system. Two relief valves are installed on the front of the hydraulic tank and are connected to both supply hoses from the primary hydraulic pump. When pressure in the system exceeds the relief valve setting, the poppet moves off its seat and opens a passage to the hydraulic tank.

To check a relief valve setting, install a 0 - 3000 psi (0 - 207 bar) pressure gauge in one of the test ports on the inlet section of the manifold valve assembly. Operate the blade lift cylinders to the full retracted stroke. The pressure gauge shows the setting of that section's relief valve. To adjust to the specified 2100 psi (145 bar), remove the cap and add shims to increase the pressure or remove shims to decrease the pressure. Refer to the shim chart below. Install the cap. Recheck the pressure setting. Repeat this procedure for the other relief valve.

Relief Valve Settings - Full Flow

Valve Description	Rigid and Articulated Frame
Left-hand and Right-hand Relief Valve	2100±100 psi (145±7 bar)

Relief Valve Shim P/N	Approximate psi (bar) Change
50065	250 psi (17 bar)
50066	150 psi (10 bar)
50067	75 psi (5 bar)

Relief Valves - Removal and Disassembly

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Remove the hydraulic tank filler cap (1) to release any pressure and replace the cap loosely. Place a 25 U.S. gallon (96 liter) capacity container under the hydraulic tank (10). Remove the magnetic plug (11) from the tank and drain the oil. Clean and inspect the magnetic plug. Clean the threads of the magnetic plug and apply thread sealant P/N **19167**. Install the magnetic plug in the tank. Do not overtighten.

NOTE: *You need not remove the entire valve body to adjust the valve. Remove the body (16) and inspect the O ring (13) and back-up washer (14) - see step* ***Fig. 6.***

Fig. 3
Identify the hoses (5 and 33) to prevent confusion during assembly. Remove the hoses from the relief valve (6) and clean up any oil leakage. Cap the hoses and fittings to prevent contamination.

Fig. 4
Loosen the jam nut (8) on the connector joining the relief valve (6) to the hydraulic oil tank (10). Remove the relief valve and cap the connector to prevent contamination.

Fig. 5
Place the relief valve (6) in a vise. Unscrew the body (16) until a second wrench will fit on the cap (22). Loosen the cap.

Fig. 6
Remove the body as an assembly. Remove and discard the back-up washer (14) and O ring (13) from the relief valve (6). Note the location of each.

Fig. 7
Remove the cap (22) from the body (16). Withdraw the spring (20) and poppet (18). Remove and discard the O ring (21). Note that the shims (19) located between the spring and poppet may stick on either the spring or poppet. Remove the shims. Remove and discard the O ring (15) from the body (16). Inspect all parts for serviceability. Inspect the relief valve body for cracks. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

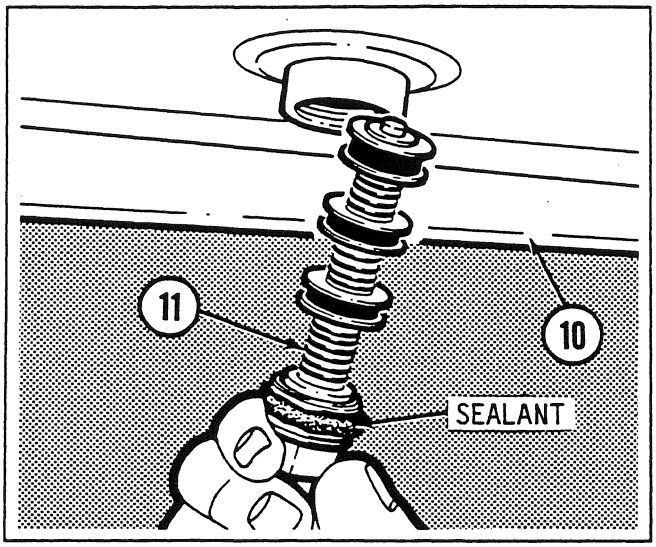


Fig. 2

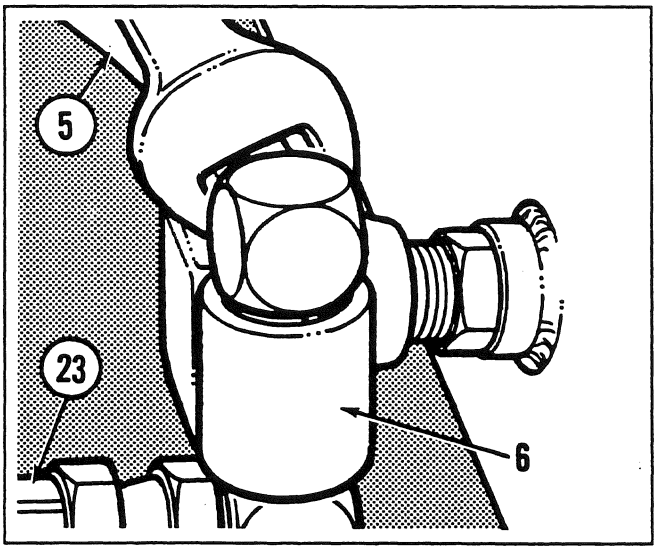


Fig. 3

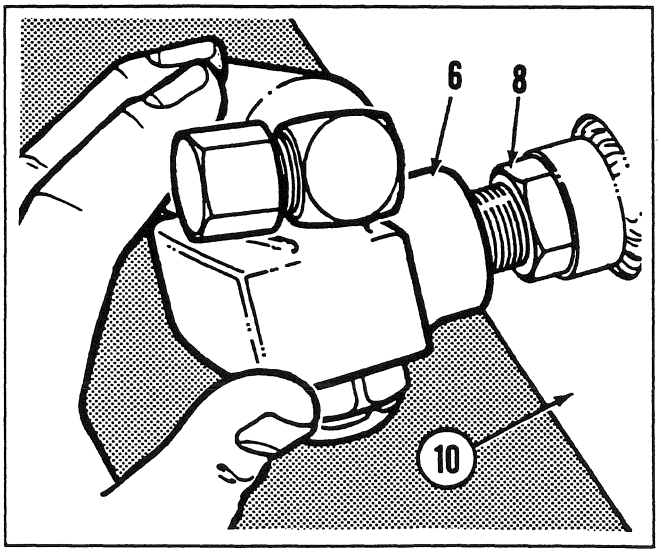


Fig. 4

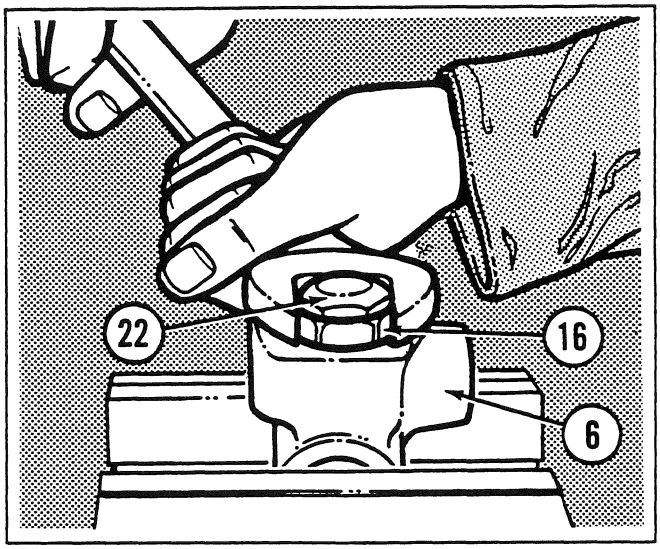


Fig. 5

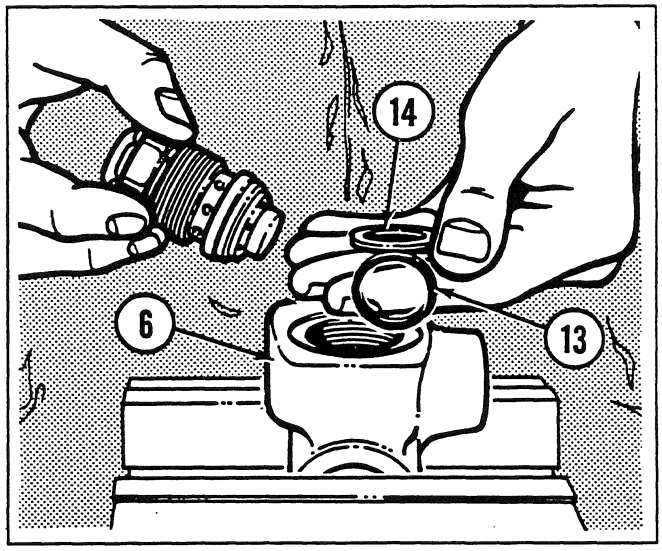


Fig. 6

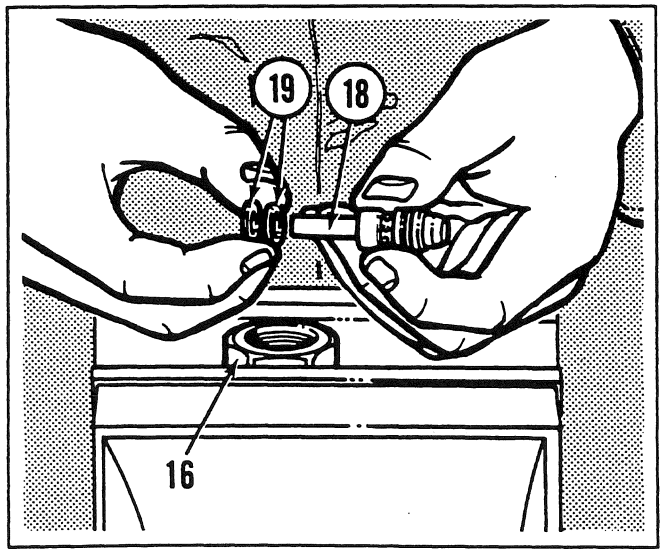


Fig. 7

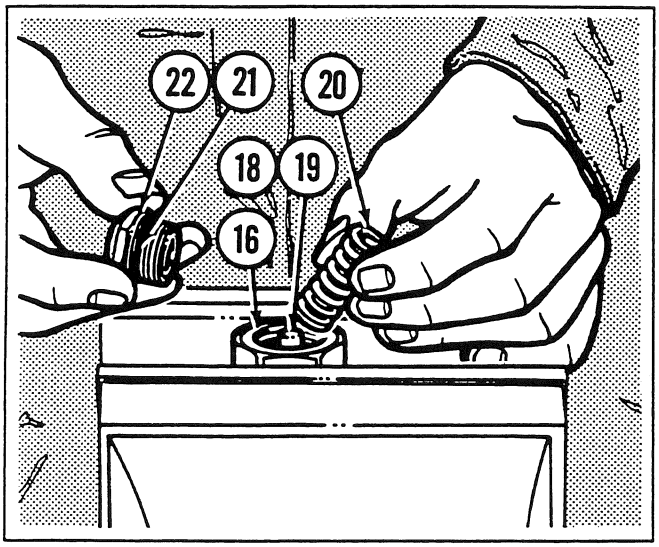


Fig. 8

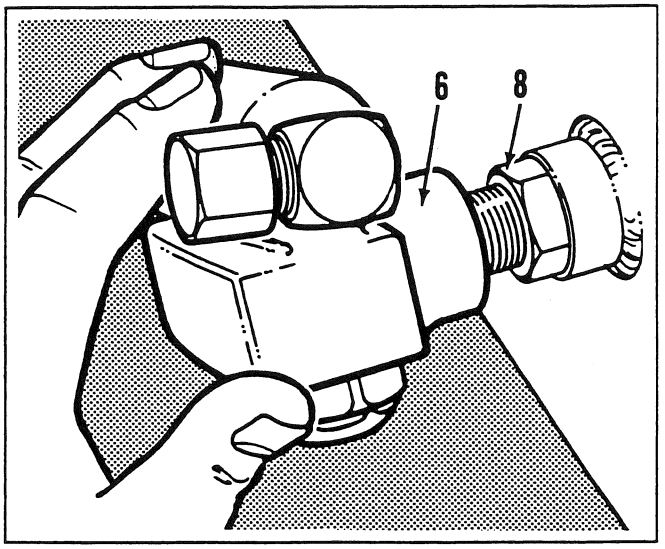


Fig. 11

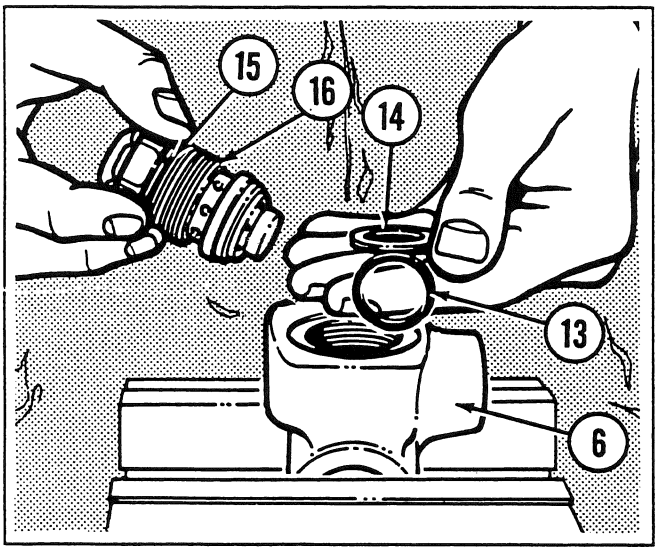


Fig. 9

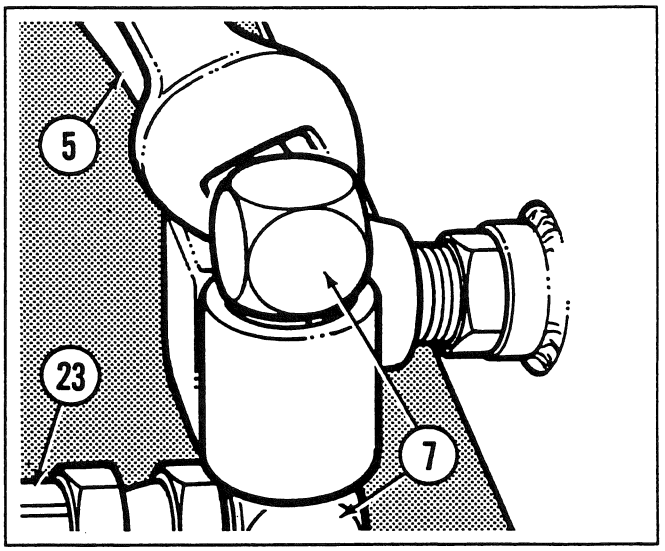


Fig. 12

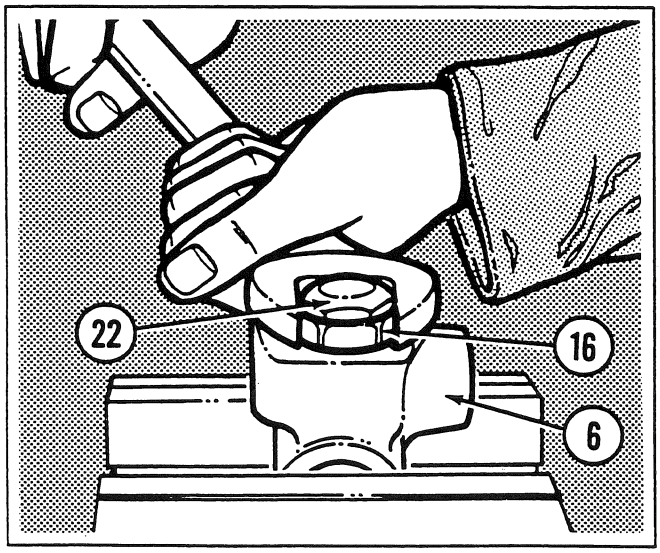


Fig. 10

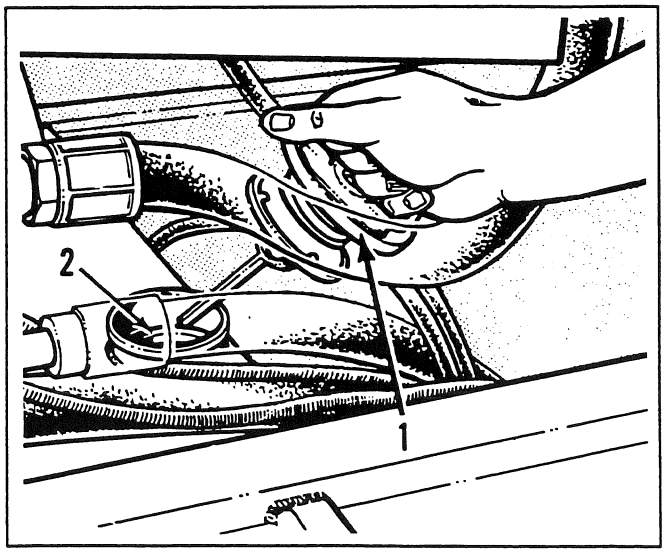


Fig. 13

Relief Valves - Assembly and Installation

Fig. 8
Lubricate and install a new poppet (18) in the body (16). The piston ring (17) on the poppet is not available separately. The poppet and piston ring must be replaced as a complete assembly. Place the shims (19) on the poppet followed by the spring (20).

NOTE: *Replace the exact thickness of shims removed. The shims determine the relief valve setting. See page 4D-1for more information. Never add shims between the spring (20) and the cap (22). This will restrict poppet movement and increase back pressure by reducing flow rating. Component damage could result.*

Lubricate the new O ring (21) and install it on the cap (22). Install the cap onto the body (16).

Fig. 9
Install the relief valve (6) in a vise. Lubricate and install a new O ring (13) followed by a new back-up washer (14). Ensure that they seat properly. Lubricate and install a new O ring (15) on the body (16).

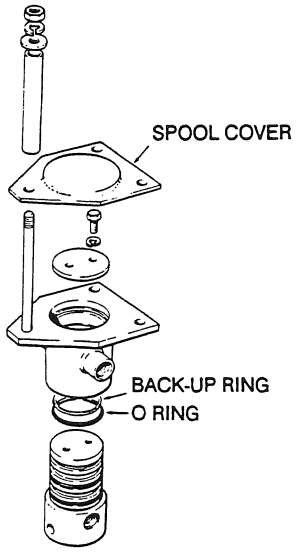
Fig. 10
Install the body (16) into the relief valve (6). Install the cap (22) into the body. Do not overtighten. Tighten the body into the relief valve. Do not overtighten. Test the relief setting before installation.

Fig. 11
Uncap and inspect the O ring on the hydraulic tank connector. Install the relief valve onto the connector. Tighten the jam nut (8) to secure the relief valve.

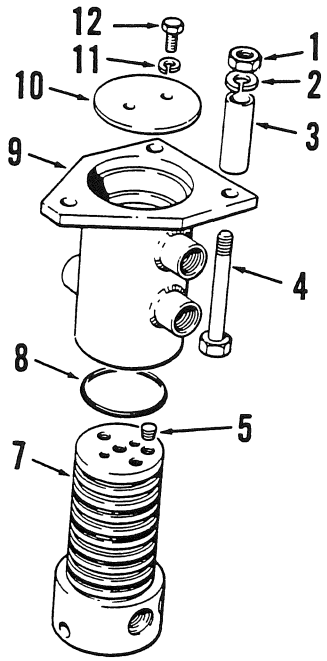
Fig. 12
Inspect the O rings on the fittings (7) and install the hoses (5 and 23) to the correct locations. Secure the hoses with plastic tie straps (4).

Fig. 13
Remove the hydraulic tank filler cap (1). Inspect the strainer (2) and replace if damaged. Fill the hydraulic tank with fresh system oil as listed in the 700 Series Operator's Manual. Check for the correct fluid level. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so. Operate all hydraulic functions and inspect for leaks. Test the relief valve settings with an accurate pressure gauge. The relief valve settings for both rigid and articulated frame graders are listed on page 4D-1. Lower the moldboard and all attachments to the ground. Shut down the engine. Recheck the hydraulic fluid level. Replace the side panels.

SECTION 4E
HYDRAULICS
Hydraulic Swivel Joint



Hydraulic Swivel Joint from Grader S/N **18590**



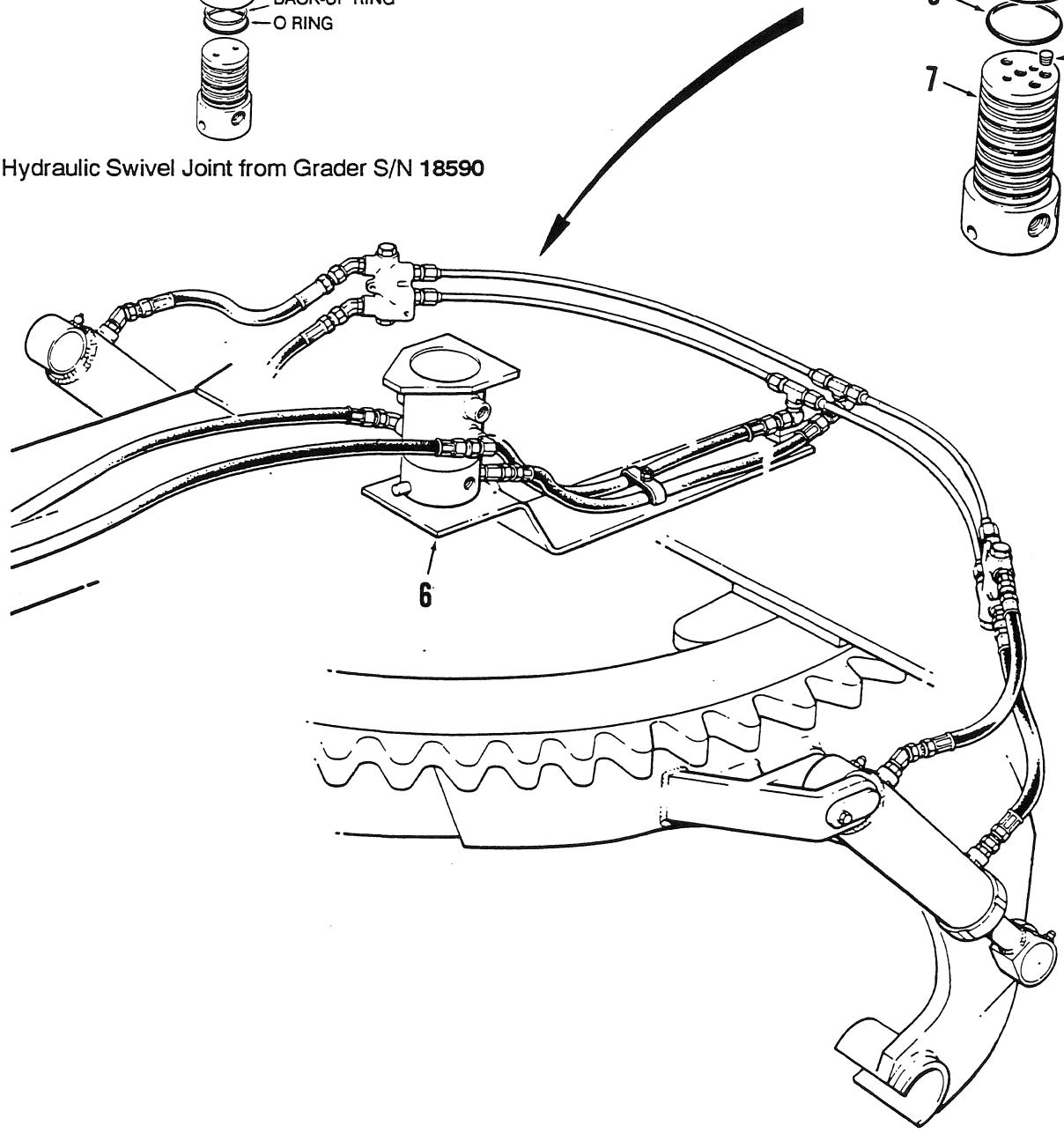


Fig. 1E Hydraulic Swivel Joint

Item	Description	Item	Description	Item	Description
1	Nut	5	Pipe plug	9	Body
2	Lockwasher	6	Drive arm	10	Washer
3	Spacer	7	Spool	11	Lockwasher
4	Bolt	8	O ring	12	Bolt

Key to Fig. 1E

Hydraulic Swivel Joint - Description (Fig. 1E)

The hydraulic swivel joint is used on all Champion road graders. It is located in the center of the circle and underneath the drawbar frame.

The hydraulic swivel joint spool is turned by a drive arm fastened to the circumference of the circle. The hydraulic swivel joint allows 360 degrees of circle rotation without twisting the hoses to the moldboard slide shift cylinder and power tilt cylinders.

The spools used in the power moldboard tilt and the manual moldboard tilt are different and are not interchangeable. Although the overhaul procedure is the same for both types of hydraulic swivel joints, be careful when ordering parts.

Hydraulic Swivel Joint - Removal

Fig. 2
This sub-section describes the service procedure for the hydraulic swivel joint used with power moldboard tilt. Servicing the manual moldboard tilt hydraulic swivel joint is identical except the spool is shorter and has a smaller diameter.

Fig. 3
Ensure the moldboard blade is fully rolled back and resting on the ground. Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section.

Fig. 4
Remove the four nuts and lockwashers securing the cover plate to the drawbar. Remove the three nuts (1) and lockwashers (2) securing the cover plate to the hydraulic swivel joint. Remove the cover plate.

Fig. 5
Remove the three spacers (3).

NOTE: *Effective on graders from S/N **18590**, remove the cover protecting the spool washer (10).*

Fig. 6
Identify the hoses to prevent confusion during assembly.

Fig. 7
Support the drive arm (6) with a block of wood. Remove the hoses from the body(9) and clean up any oil leakage. Cap the fittings to prevent contamination.

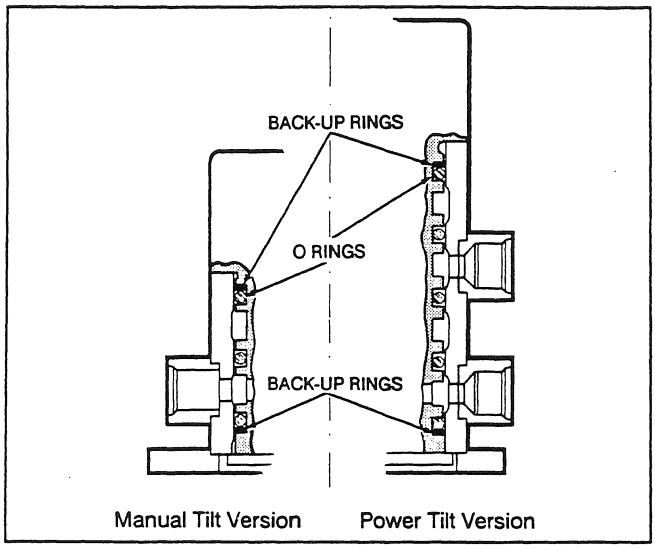


Fig. 2

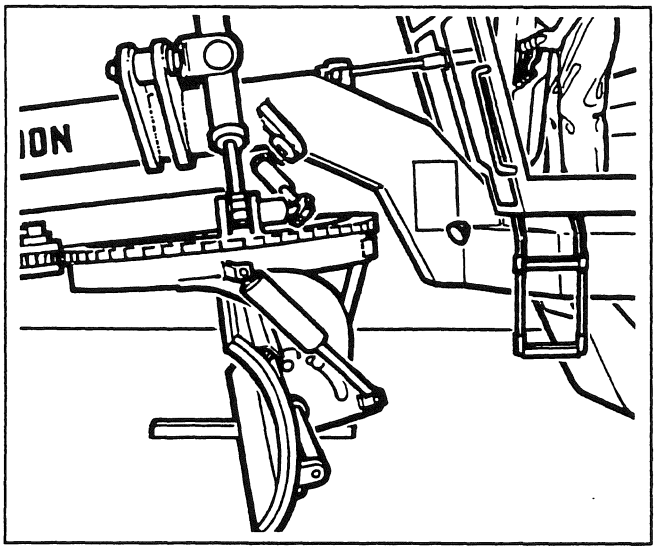


Fig. 3

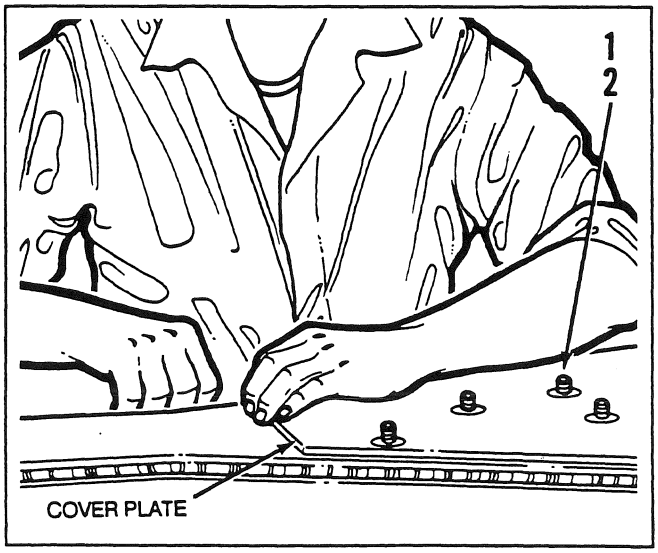


Fig. 4

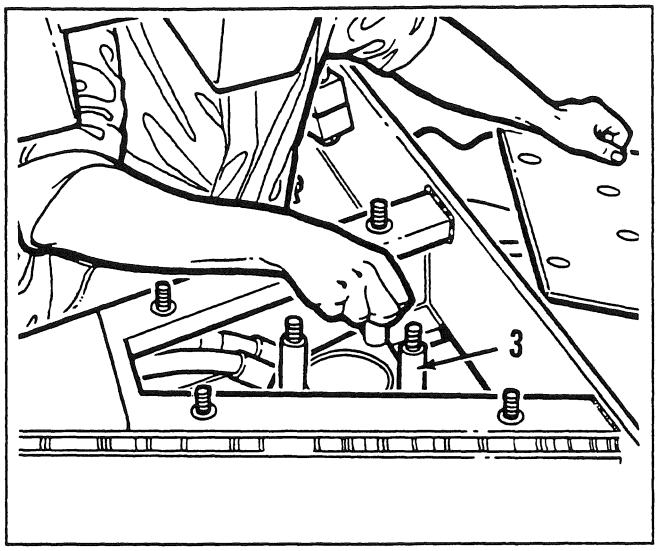


Fig. 5

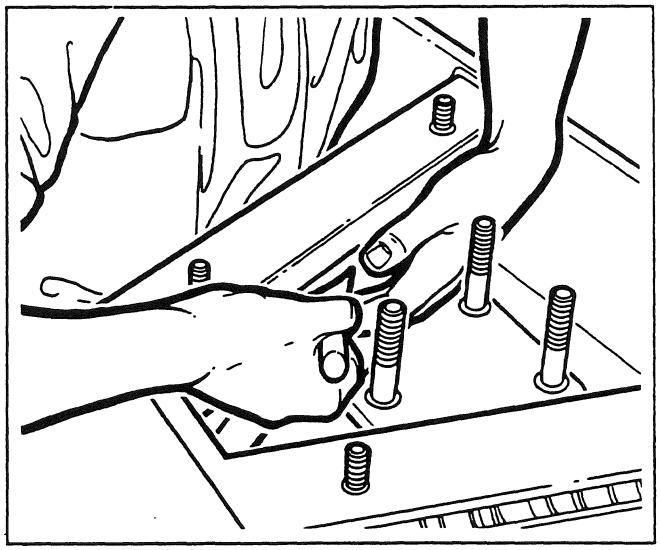


Fig. 6

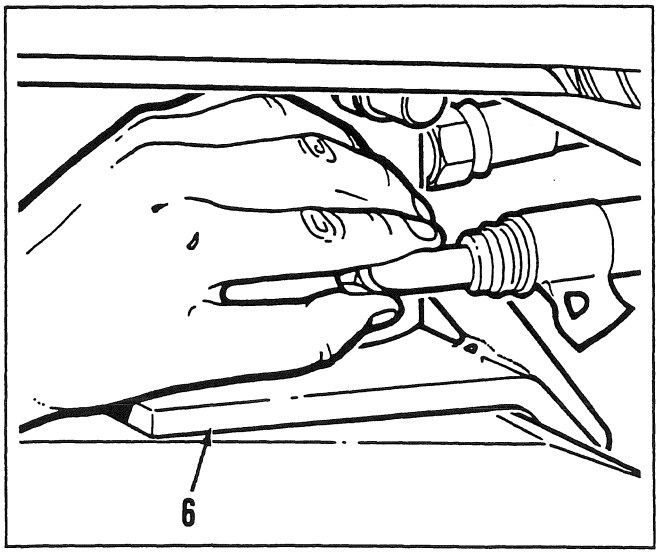


Fig. 7

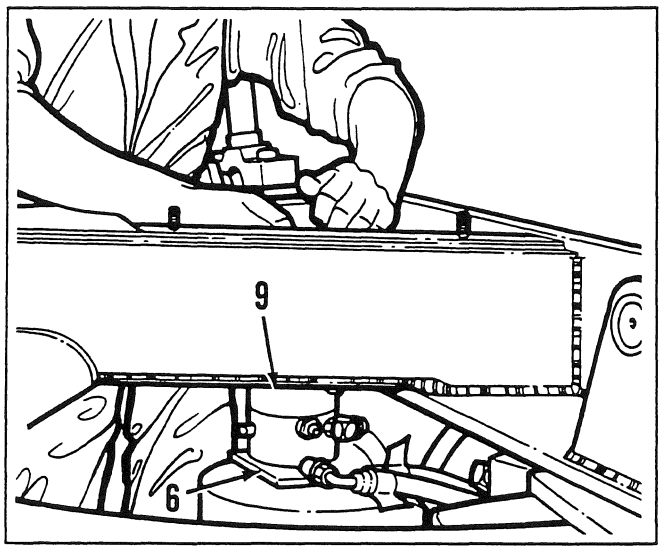


Fig. 8

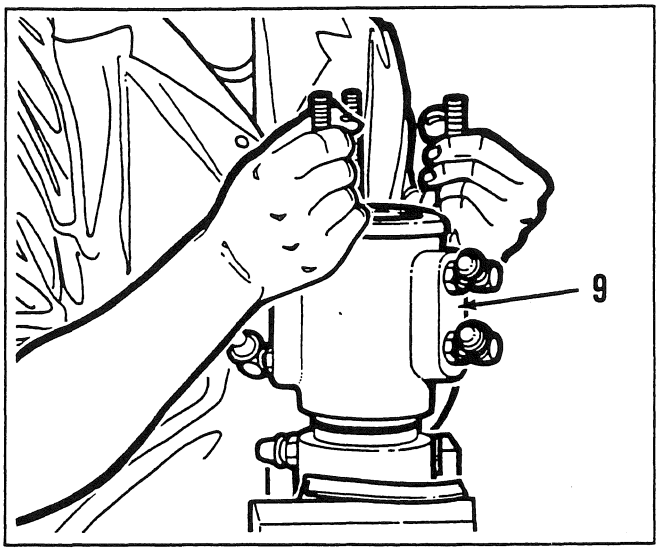


Fig. 11

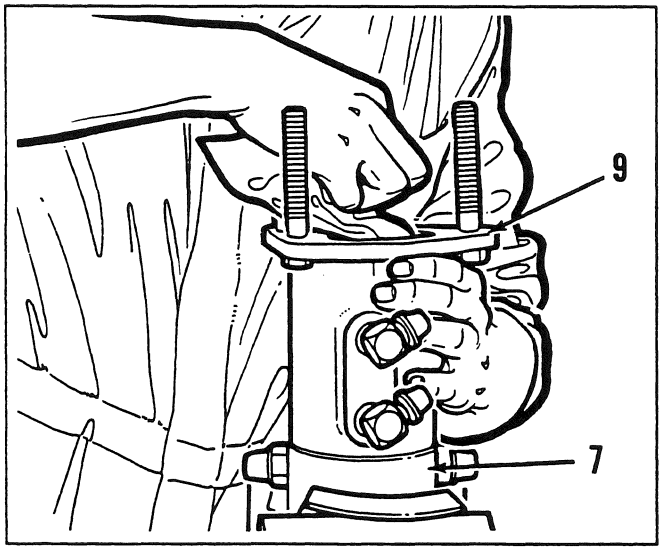


Fig. 9

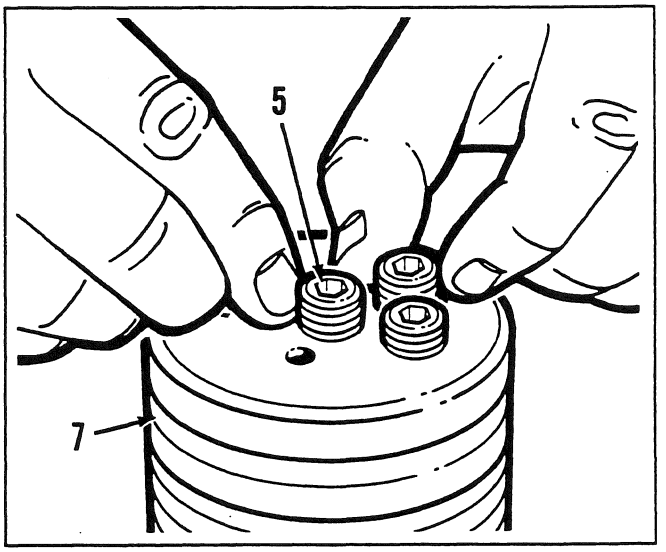
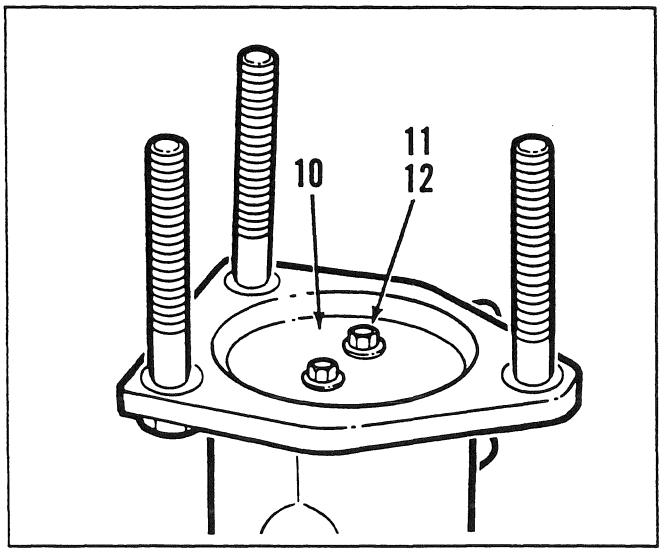


Fig. 12



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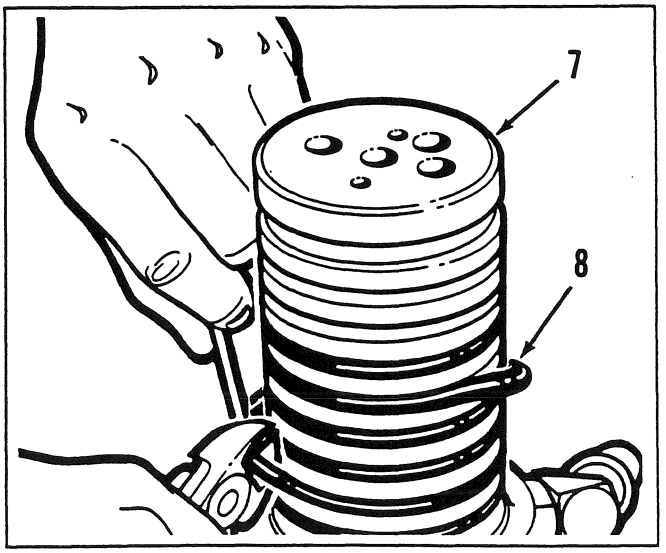


Fig. 13

Hydraulic Swivel Joint - Removal *continued*

Fig. 8
Rotate the body (9) 90 degrees and slide the body from the drive arm (6).

Fig. 11
Carefully remove the body (9) by lifting it straight up.

Hydraulic Swivel Joint - Disassembly

Fig. 9
Place the bottom of the spool (7) in a vise with soft jaws. Clean the top surface of the body (9).

Fig. 12
Remove the pipe plugs (5) from the spool (7).

Fig. 10
Remove the two bolts (12) and lockwashers (11). Remove the washer (10).

Fig. 13
Remove and discard the O rings (8) from the spool (7).

Hydraulic Swivel Joint - Disassembly

continued

Fig. 14

Thoroughly clean the spool (7) and body (9). Inspect the spool and body for serviceability. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

NOTE: *The body and spool are a matched set and cannot be separately interchanged with another body or spool.*

Hydraulic Swivel Joint - Assembly

Fig. 15

Place the base of the spool (7) in a vise with soft jaws. Place a clean plastic bag over the spool to prevent the O rings (8) from being cut when they are installed. Secure the bag in place with adhesive tape.

Fig. 16

Generously lubricate and install new O rings (8) over the bag on the spool (7). When all O rings are in place, remove the plastic bag and ensure the O rings are seated properly.

NOTE: *Effective on graders from S/N **18590**, lubricate and install back-up rings in the top and bottom grooves. Champion recommends you upgrade earlier machines. Refer to Product Support Bulletin No. **489**.*

Fig. 17

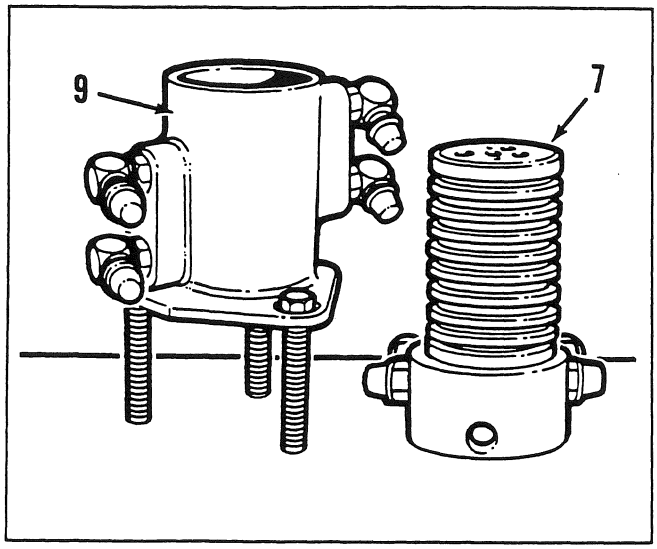
Apply thread sealant P/N **19167** to each of the pipe plugs (5). Install the pipe plugs into the spool (7). Tighten the pipe plugs and remove any excess thread sealant.

Fig. 18

Apply a coat of nonfibrous grease to the base of the spool (7) and O rings (8).

Fig. 19

Carefully install the body (9) over the spool (7) ensuring the O rings (8) are not damaged.



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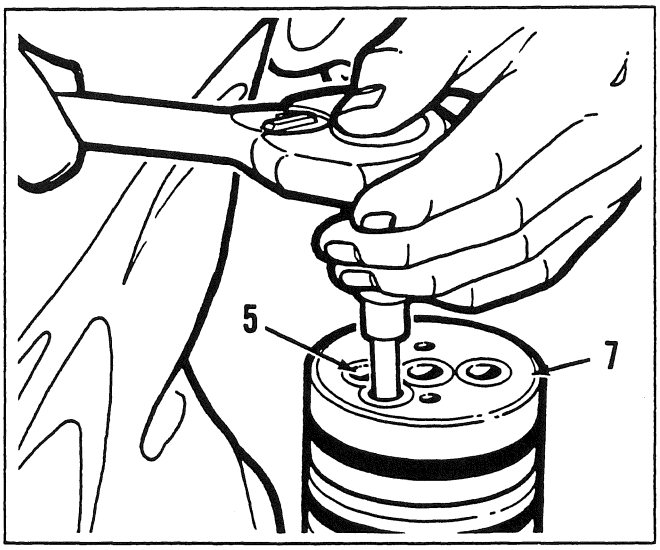

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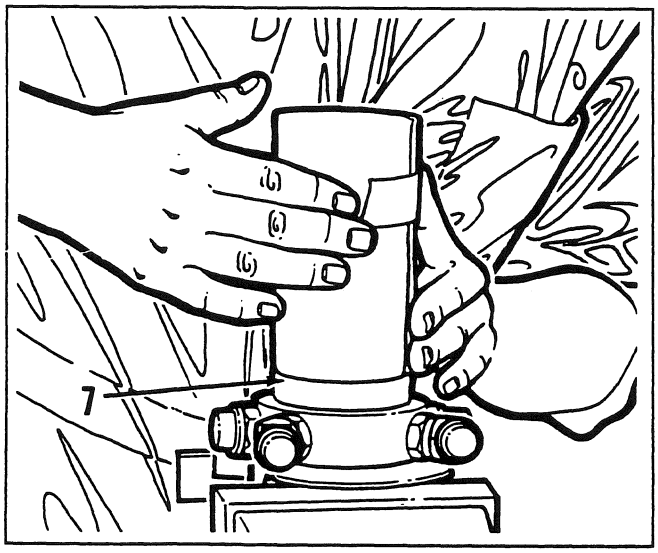

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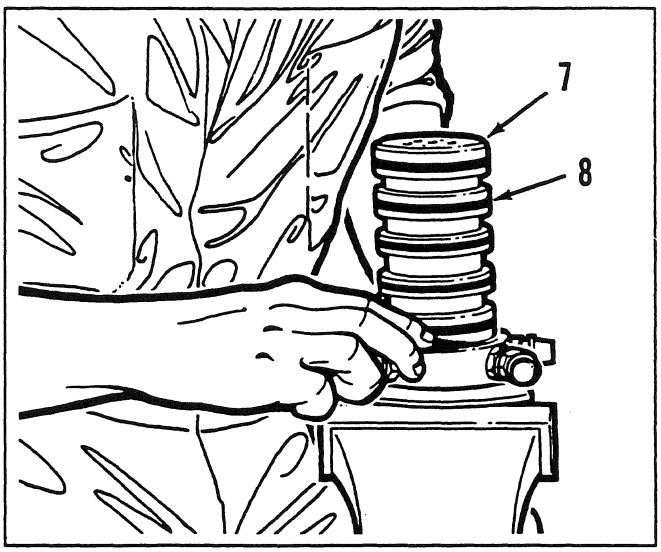

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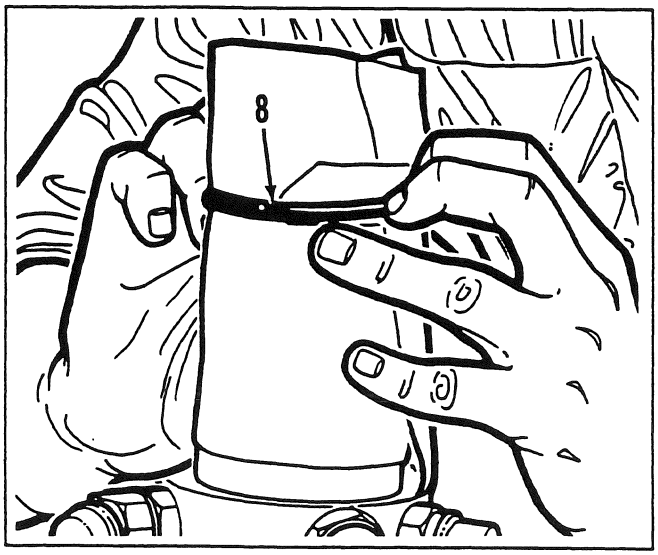
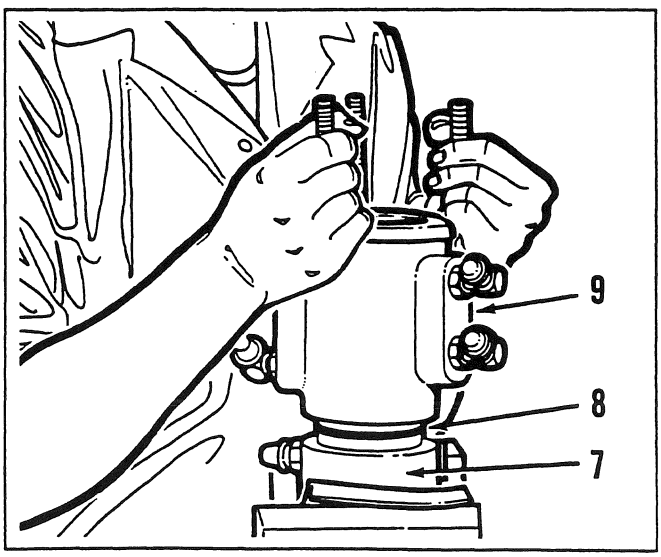


Fig. 16



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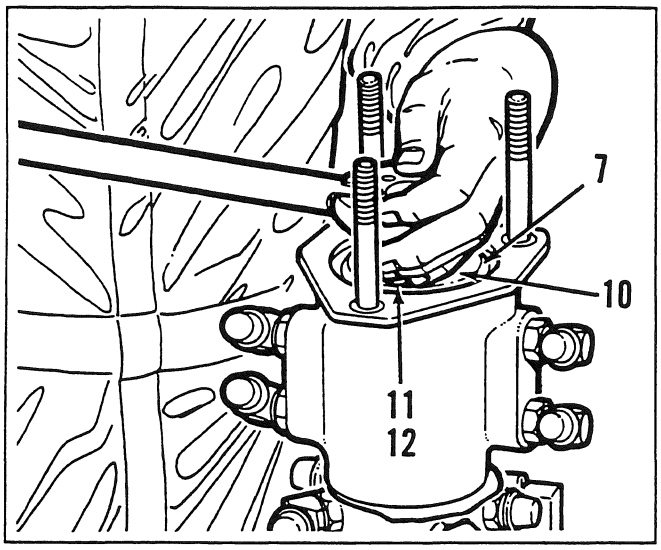
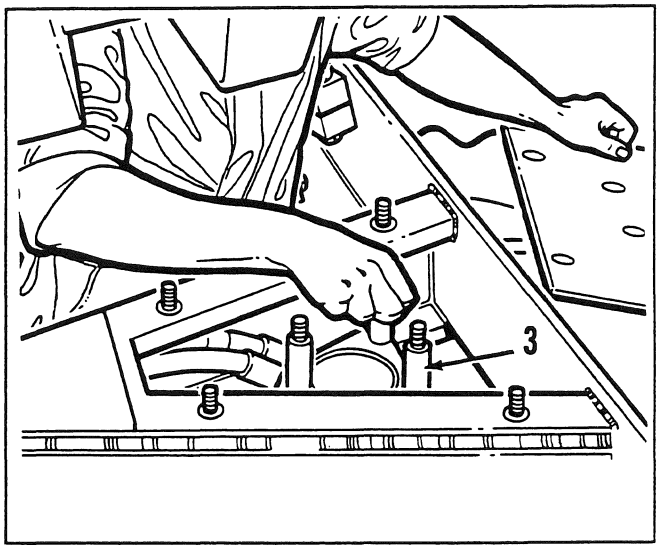


Fig. 20



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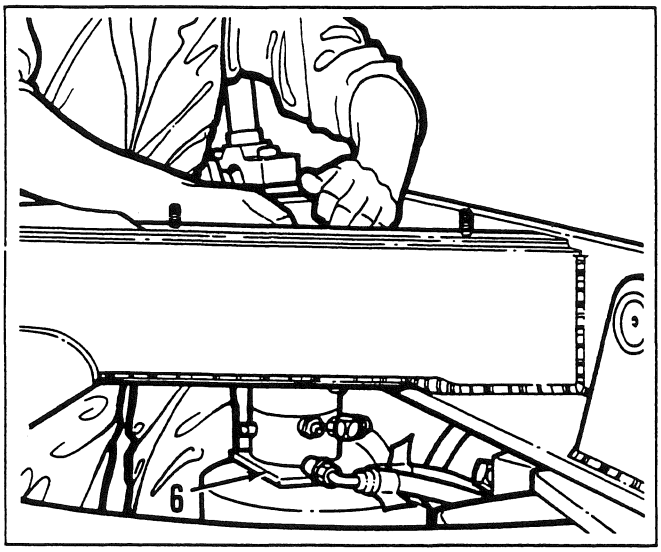

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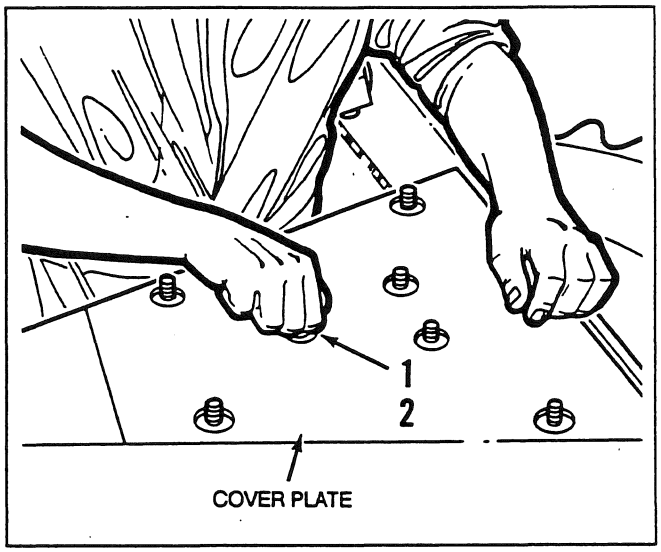

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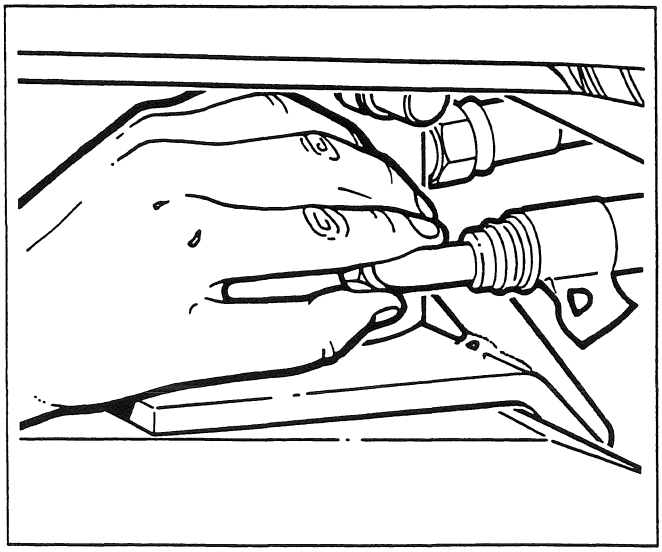

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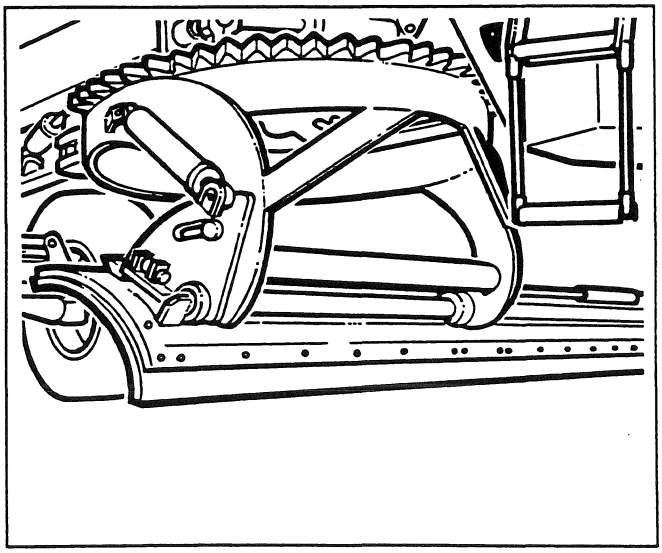


Fig. 25

Hydraulic Swivel Joint - Assembly continued

Fig. 20
Coat the underside of the washer (10) with nonfibrous grease. Secure the washer to the spool (7) with bolts (12) and lockwashers (11).

NOTE: *Effective on graders from S/N **18590**, install the cover protecting the spool washer (10). Seal the cover by applying a bead of gasket eliminator P/N **32338** around the joint. Refer to Product Support Bulletin No. **489**.*

Hydraulic Swivel Joint - Installation

Fig. 21
Slide the body (9) onto the drive arm (6). Reposition the body.

Fig. 22
Connect all hoses to the correct locations.

Fig. 23
Install the three spacers (3).

Fig. 24
Position the cover plate. Secure it to the drawbar with the four nuts and lockwashers. Install the three nuts (1) and lockwashers (2) securing the hydraulic swivel joint to the cover plate.

Fig. 25
Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so. Raise the moldboard off the ground. Operate the slide shift cylinder and power tilt cylinders to purge any air in the system. Test the hydraulic swivel joint by moving the slide shift cylinder and power tilt cylinder pistons to the end of their strokes in both directions. Do not hold the control lever in the power position with a cylinder at the end of its stroke for more than ten seconds. Shut down the engine. Inspect the hydraulic swivel joint for leaks.

SECTION 4F
HYDRAULICS
Circle Turn Valve

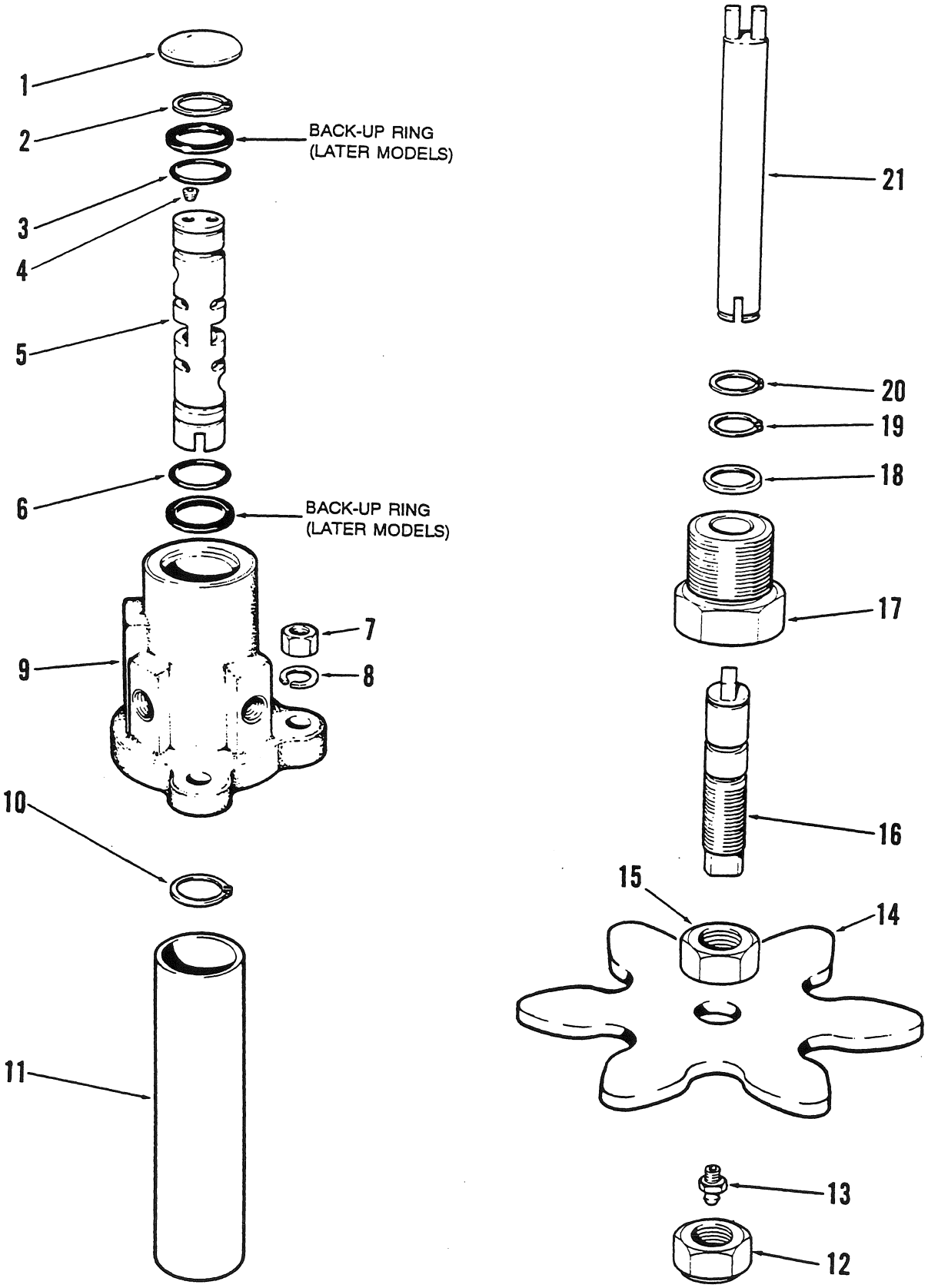


Fig. 1F Circle Turn Valve

Item	Description	Item	Description	Item	Description
1	Expansion plug	8	Lockwasher	15	Nut
2	Snap ring	9	Body	16	Pinion shaft
3	O ring	10	Snap ring	17	Bearing
4	Pipe plug	11	Guard tube	18	Thrust race
5	Spool	12	Locknut	19	Snap ring
6	O ring	13	Grease fitting	20	Snap ring
7	Nut	14	Valve pinion	21	Driveshaft

Key to Fig. 1F

Circle Turn Valve - Description (Fig. 1F)

The circle turn valve is installed on top of the drawbar and is a major component of all Champion circle turn systems.

The function of the circle turn valve is to distribute oil to the correct end of each circle turn cylinder in the proper sequence, depending upon the direction of circle rotation.

Champion road graders use two hydraulic cylinders to turn the circle. For satisfactory operation and long life, the circle must be properly adjusted and kept that way. Now and then, for one reason or another, the circle will not turn smoothly and as part of the servicing procedure you will have to re-time the circle turn valve.

Circle Turn Valve - Removal

Fig. 2
Rotate the circle and moldboard to the circle timing position. The right-hand circle turn cylinder should be fully retracted and the crank arm should point forward. A line should pass along its axis and through the center point of both anchor studs.

Fig. 3
The left-hand circle turn cylinder should be positioned so that the anchor stud, crank center line and crank stud make a 90 degree angle.

NOTE: *It is important you position the circle turn cylinders correctly. If this is not possible, refer to Section 2,* ***Circle, Drawbar and Moldboard****, of this Shop Manual before proceeding.*

Fig. 4
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section.

Fig. 5
Identify all hydraulic hoses, tubes and fittings to prevent confusion during assembly. Carefully disconnect the hydraulic hoses and tubes from the circle turn valve. Cap all hydraulic hoses, tubes and fittings to prevent contamination.

Fig. 6
Remove the nuts (7) and lockwashers (8) securing the circle turn valve to the drawbar.

Fig. 7
Remove the circle turn valve from the drawbar.

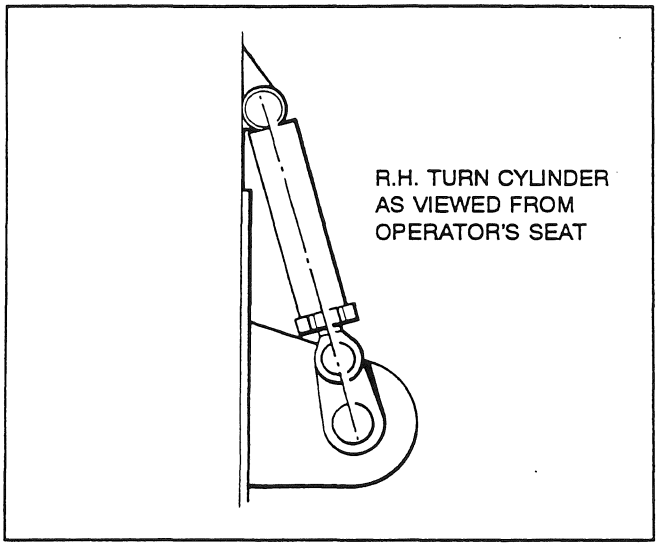
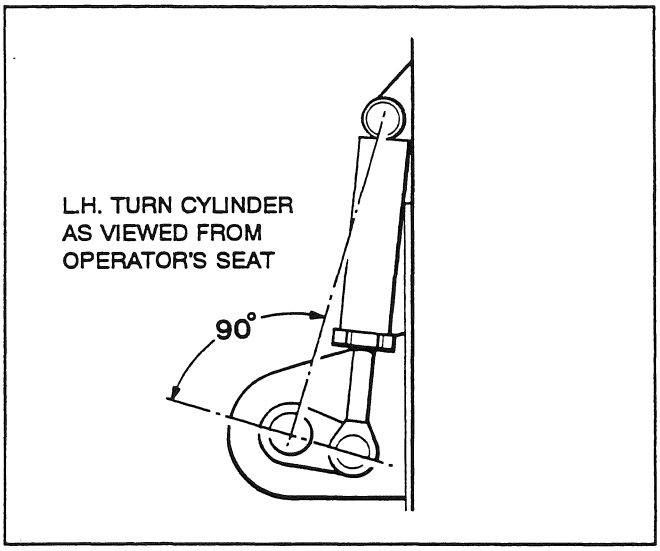


Fig. 2



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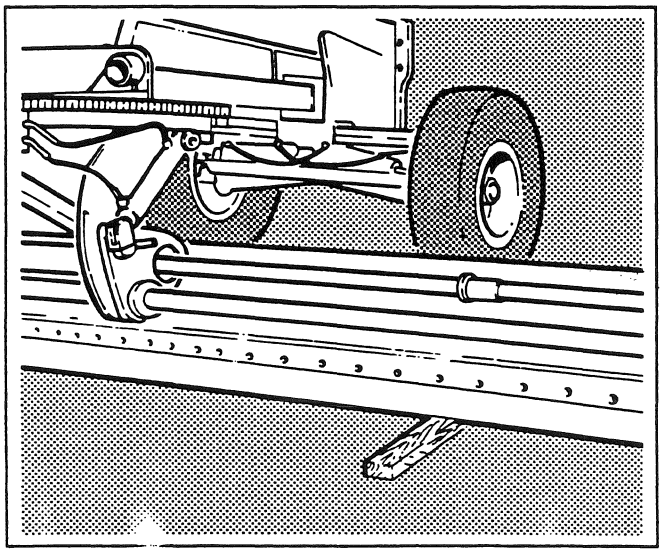


Fig. 4

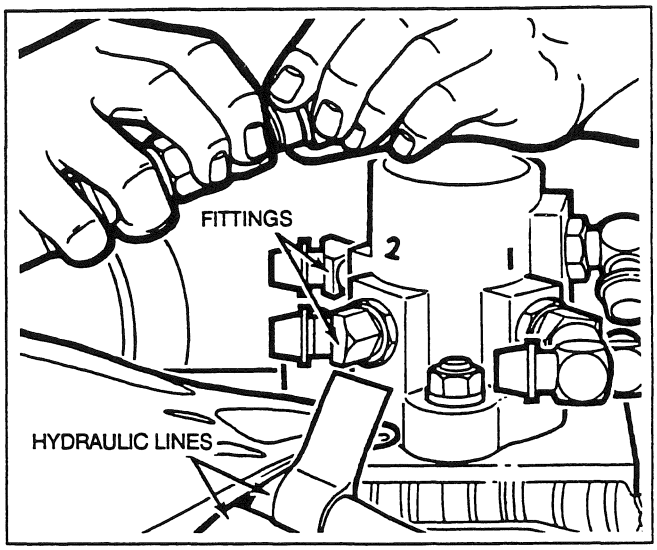


Fig. 5

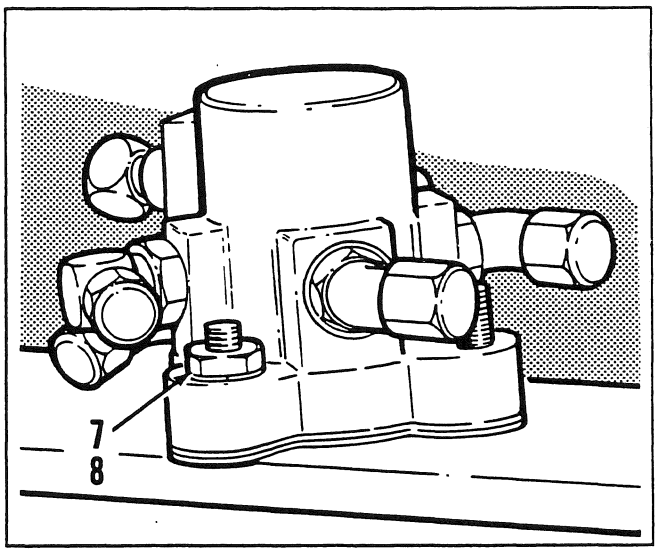


Fig. 6

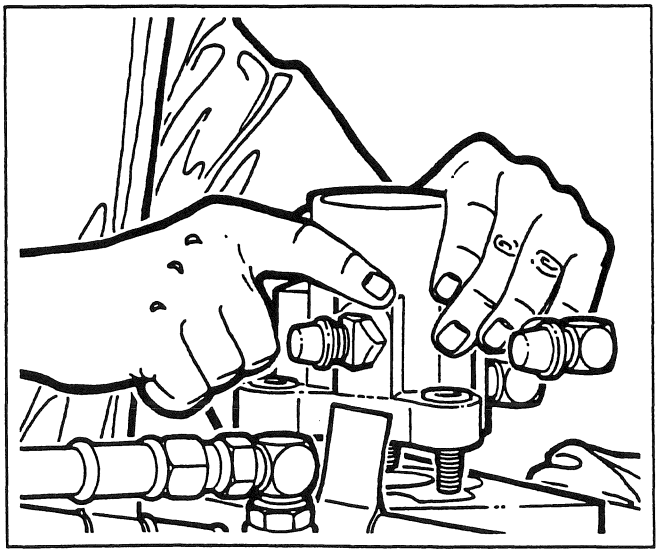


Fig. 7

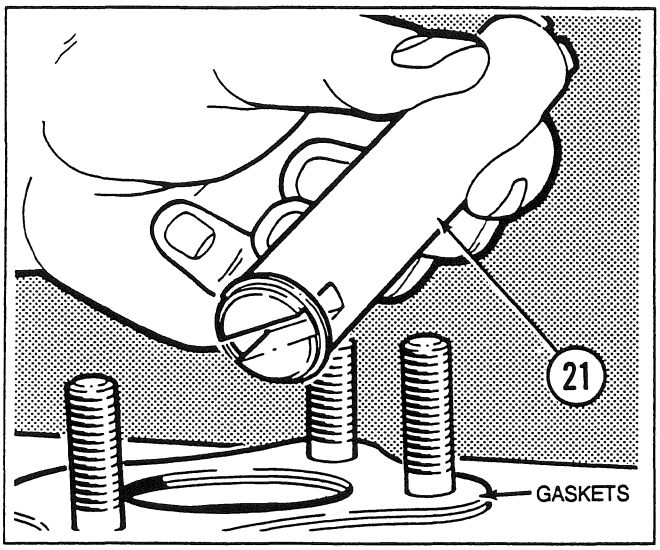


Fig. 8

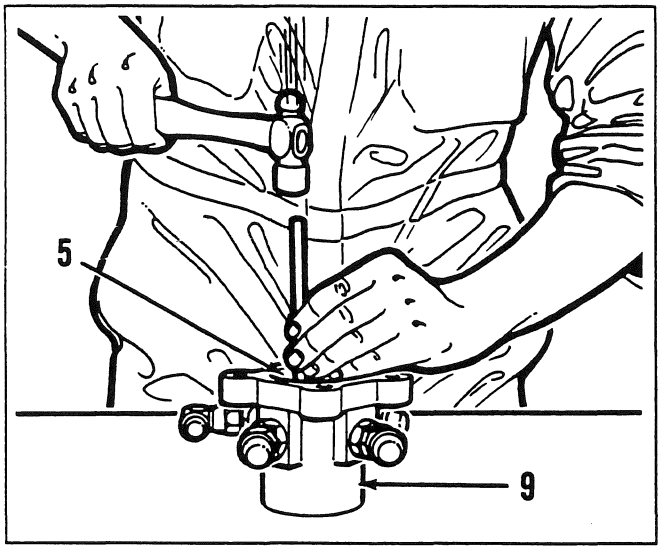


Fig. 9

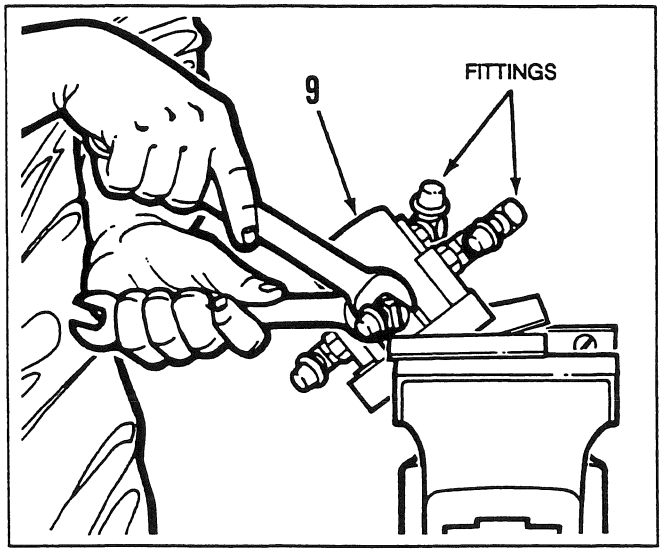
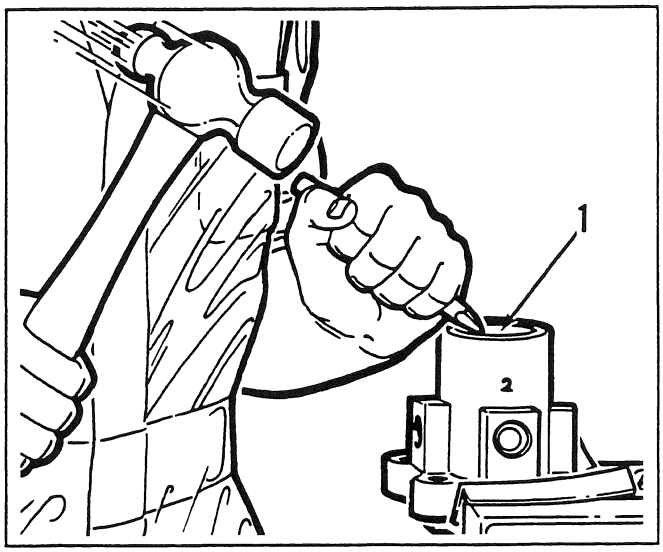


Fig. 10



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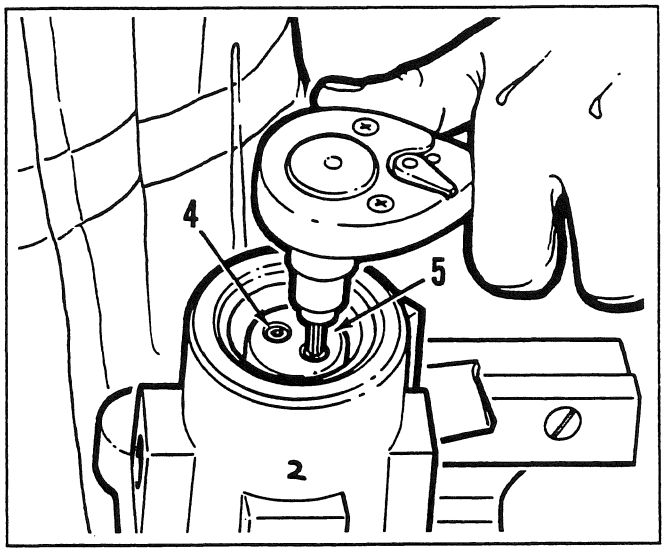


Fig. 12

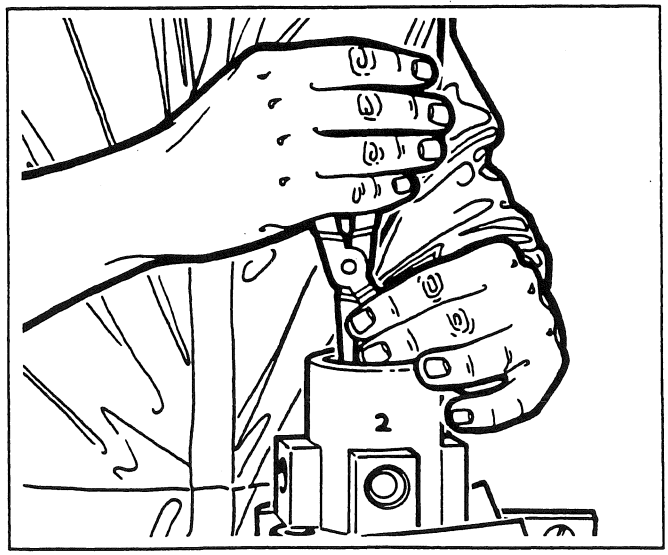


Fig. 13

Circle Turn Valve - Removal continued

Fig. 8
Count and record the number of gaskets since they also serve as shims. Remove and discard the gaskets. Withdraw the driveshaft (21) and guard tube (11). Refer to Section 2 **Circle, Drawbar and Moldboard** of this Shop Manual for information regarding the removal of the valve pinion and bearing if required.

Fig. 11
Remove and discard the expansion plug (1).

Circle Turn Valve - Disassembly

Fig. 9
Mark the spool (5) to the body (9) with light punch marks. This will help you re-time the circle.

NOTE: *This step is valid only on graders where the circle turns in the correct direction relative to the control lever action. If this is not the case, do not mark the spool to the body.*

Fig. 12
Prevent the spool (5) from turning and remove the two pipe plugs (4).

Fig. 10
Clamp the base of the body (9) in a vise with soft jaws. Do not overtighten the vise. Be careful not to break the mounting lugs. Remove all fittings and inspect the O rings.

Fig. 13
Carefully remove and discard the snap ring (2).

Circle Turn Valve - Disassembly continued

Fig. 14
Remove the body (9) from the vise. Remove and discard the snap ring (10).

Fig. 15
Use a slight twisting action to remove the spool (5) out of the bottom of the body (9). Ensure the punch marks made in step **Fig. 9** do not damage the bore.

Fig. 16
Remove and discard the O rings (3 and 6) from the spool (5).

NOTE: *Later graders also include back-up rings. Remove and discard the back-up rings.*

Fig. 17
Inspect the body (9) and spool (5) for wear and scoring. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

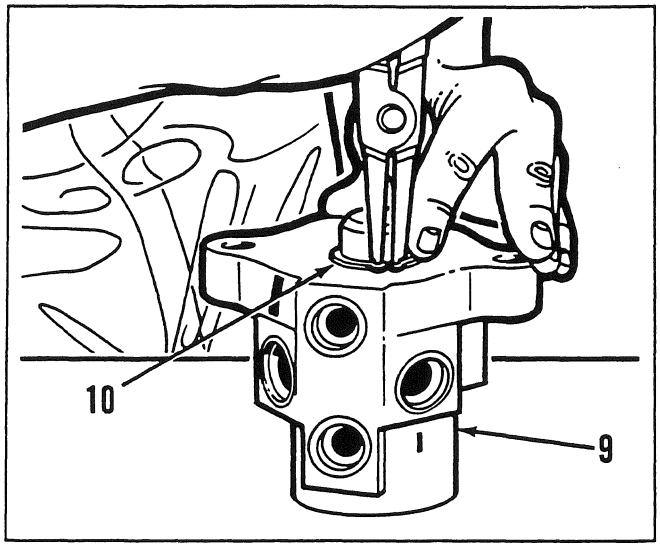
Circle Turn Valve - Assembly

Fig. 18
Ensure the body (9) and spool (5) are free from contamination.

NOTE: *The body and spool are a matched set and cannot be separately interchanged with another body and spool.*

Generously lubricate the spool (5) and new O rings (3 and 6). Carefully install the O rings over the spool. Champion recommends installing back-up rings on earlier graders. Lubricate and install new back-up rings. Ensure that the O rings are seated properly.

Fig. 19
Apply a generous amount of system oil to the spool (5) and use a slight twisting action to carefully install the spool into the body (9).



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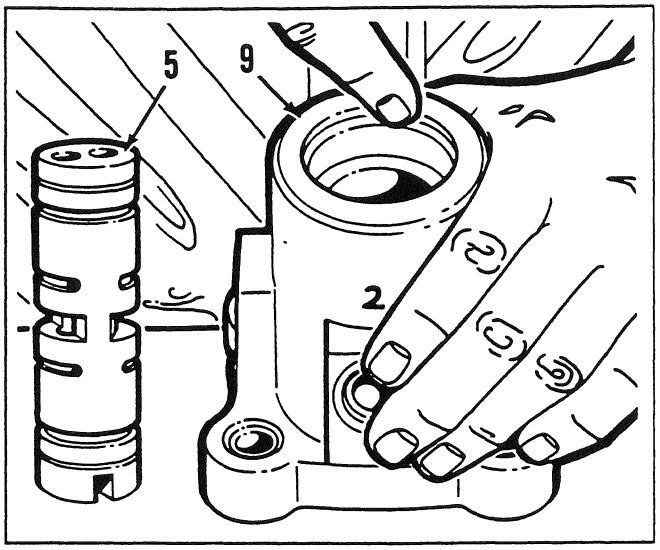

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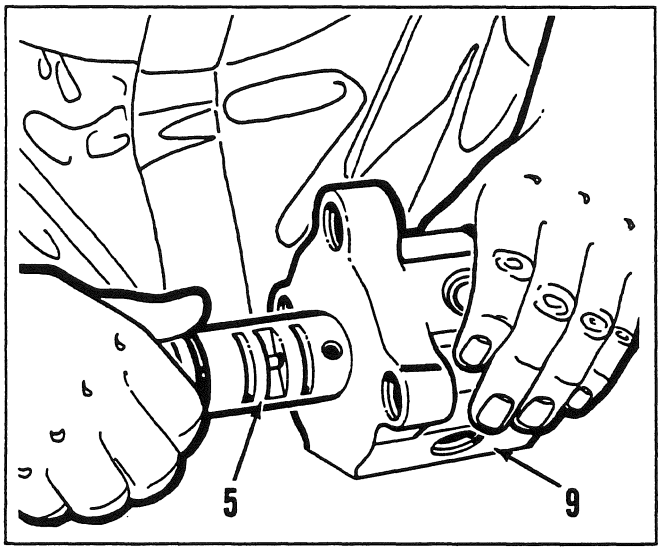

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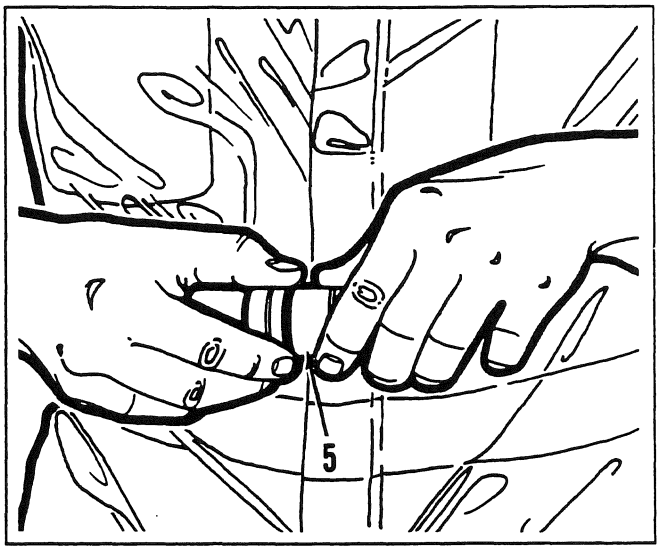


Fig. 18

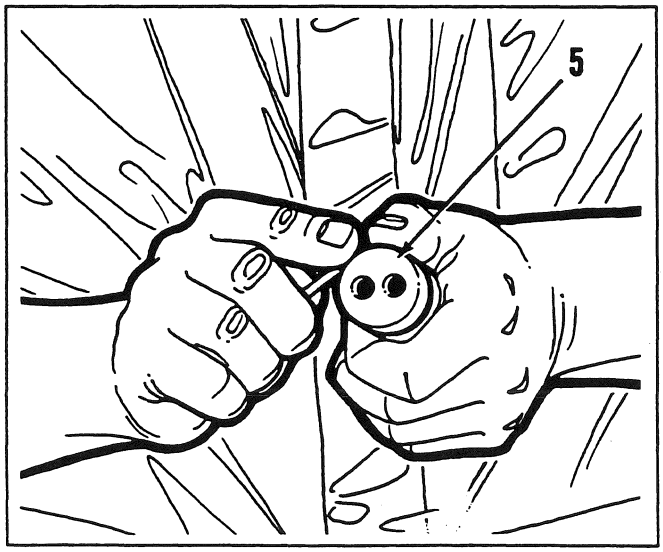


Fig. 16

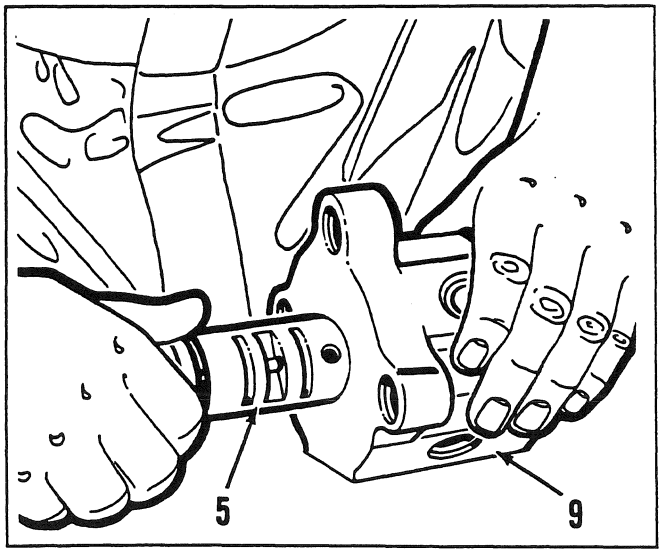


Fig. 19

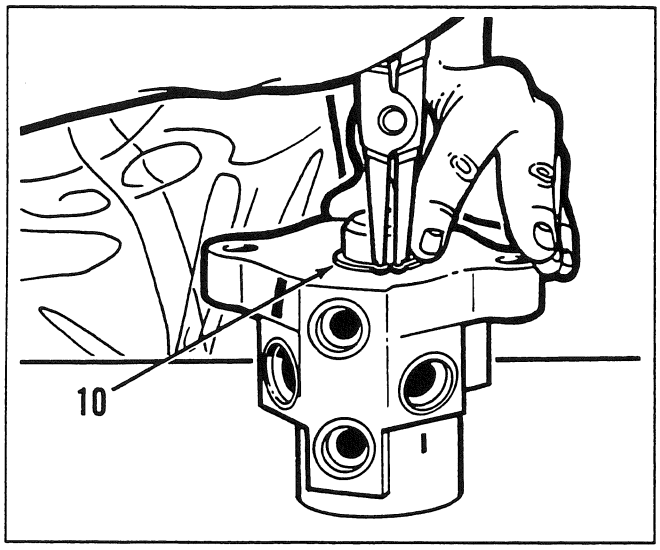
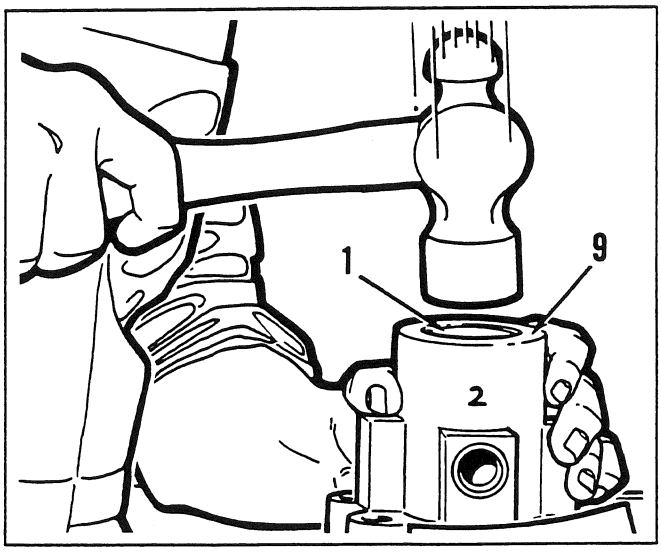


Fig. 20



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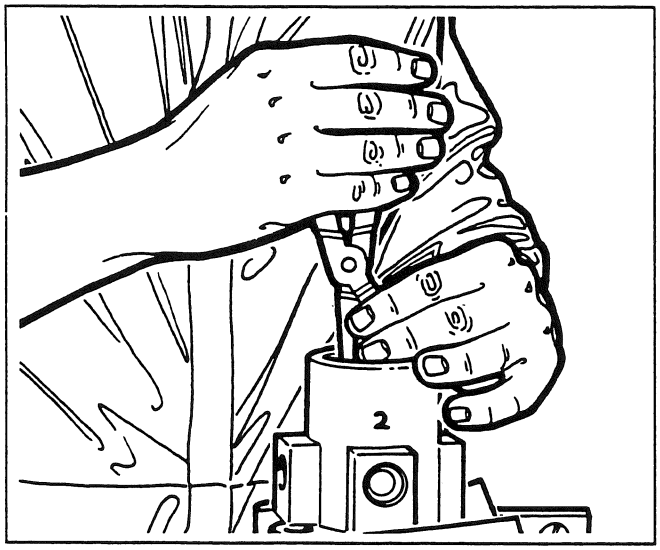
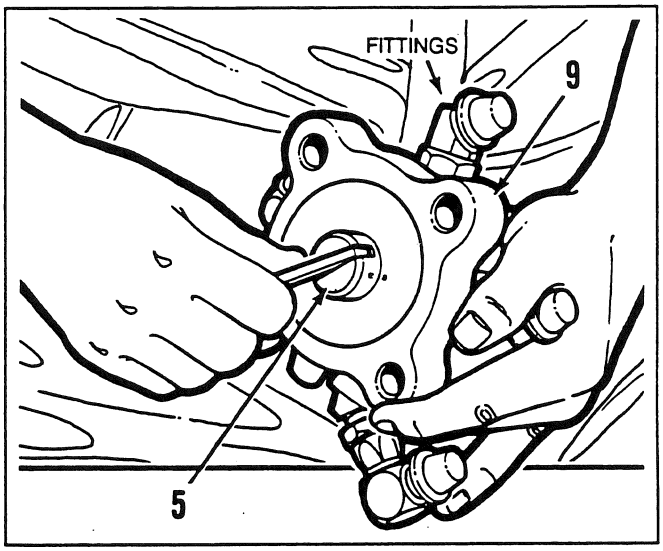


Fig. 21



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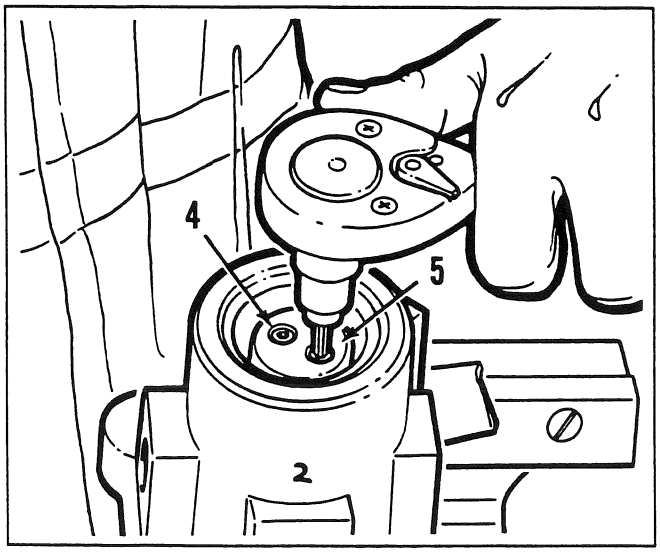

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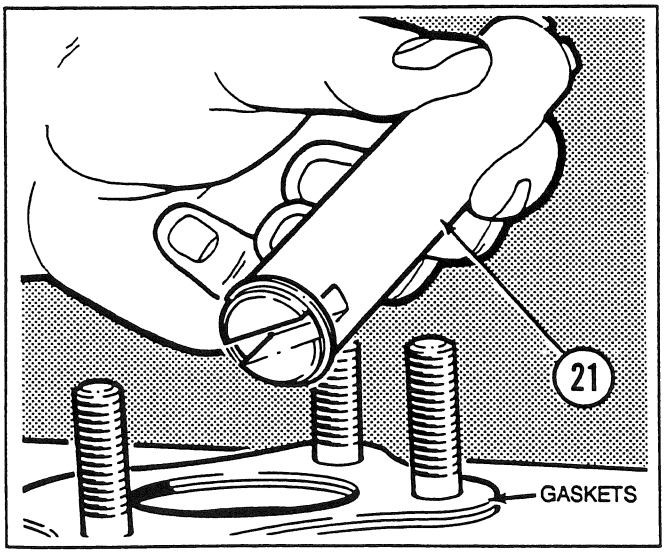


Fig. 25

Circle Turn Valve - Assembly continued

Fig. 20
Install a new snap ring (10) in the lower groove.

Fig. 21
Place the circle turn valve in a vise with soft jaws. Do not overtighten the vise. Install a new snap ring (2).

Fig. 22
Apply a light coating of thread sealant P/N **19167** to each pipe plug (4). Install the two pipe plugs into the spool (5). Prevent the spool from turning and fully tighten the pipe plugs. Wipe off any excess thread sealant.

Fig. 23
Tap a new expansion plug (1) in place in the body (9). Retain the expansion plug by indenting the center.

Fig. 24
With the fittings installed to the proper locations, realign the spool (5) to the body (9) according to the punch marks. You will correctly time the circle turn valve later.

Circle Turn Valve - Installation

Fig. 25
Install the guard tube (11). Lower the driveshaft (21) into the drawbar frame and connect the notched end into the pinion shaft (16). Place the same number of new gaskets on the drawbar as were removed during disassembly. The gaskets also act as shims to prevent the spool (5) from bottoming out on the driveshaft (21).

Circle Turn Valve - Installation continued

Fig. 26
Install the circle turn valve.

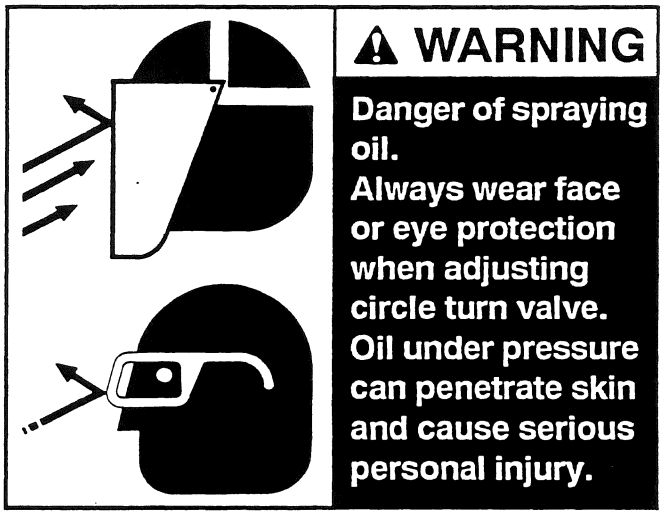
Fig. 27
Retain the body (9) with the lockwashers (8) and nuts (7).

Fig. 28
Remove the plugs from all hydraulic hoses, tubes and fittings. Connect each hydraulic hose and line to its correct location.

Circle Timing

Fig. 29
Whenever the circle turn valve has been removed, you must make a circle timing check. You have performed two of the three steps in the circle timing procedure by ensuring correct drive pinion clearance and positioning the circle turn cylinders and cranks. Refer to Section 2, **Circle, Drawbar and Moldboard**, of this Shop Manual for more information. The third step in the sequence is adjusting the circle turn valve spool (5). To start, find the forward left port on the circle turn valve. Disconnect the hydraulic hose and immediately cap the hose to prevent contamination. Remove the fitting.

Fig. 30



Look inside the open port. You should see the shiny surface of the spool (5) completely blocking the port. If this is the case, the spool is in the proper position. Reconnect the hydraulic hose.

Fig. 31
If you see a dark portion, the spool (5) needs adjustment.

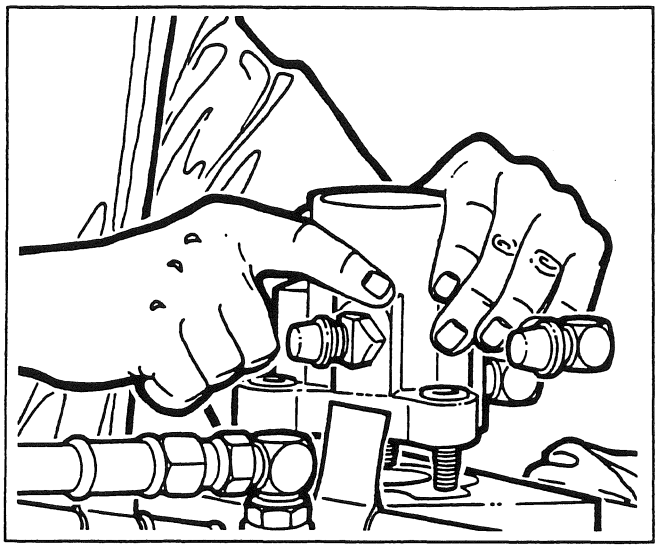


Fig. 26

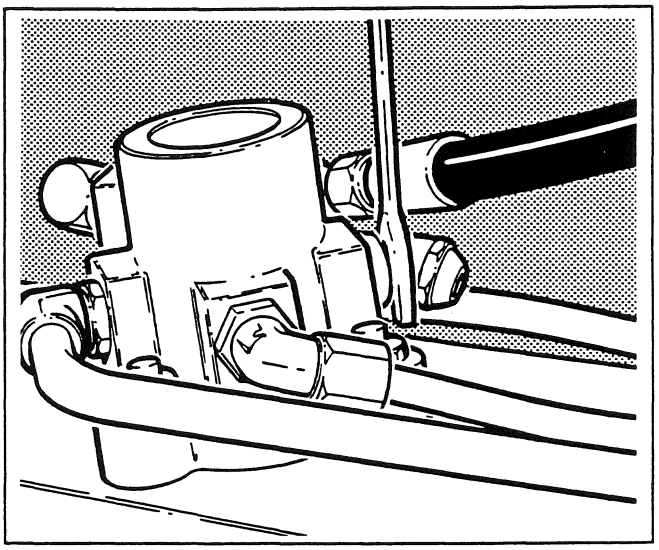


Fig. 29

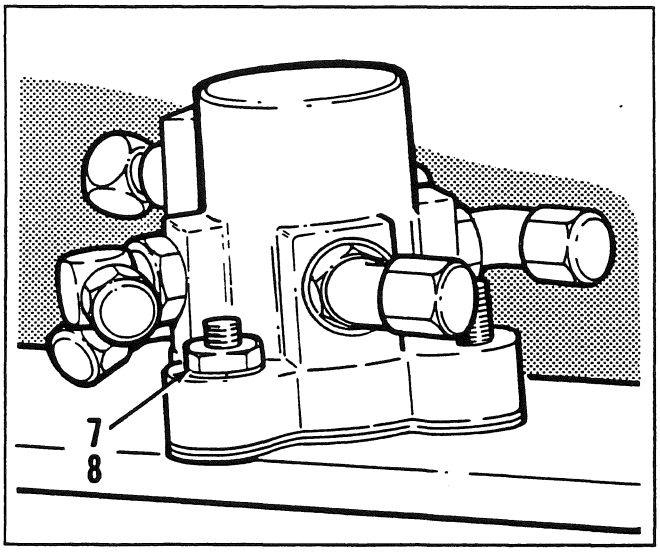


Fig. 27

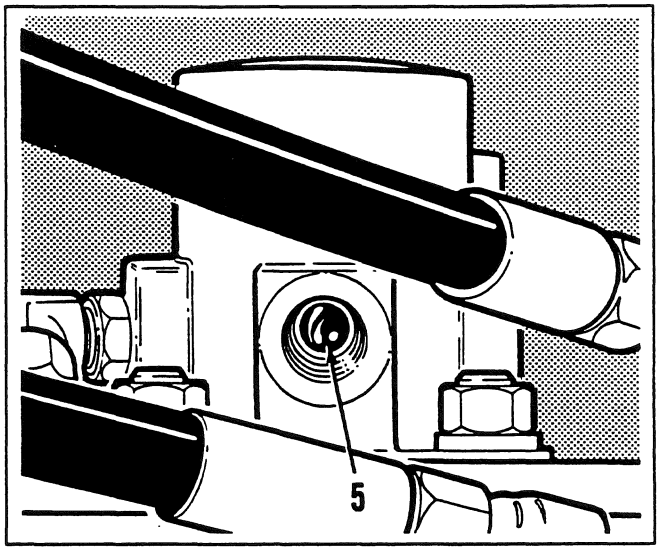


Fig. 30

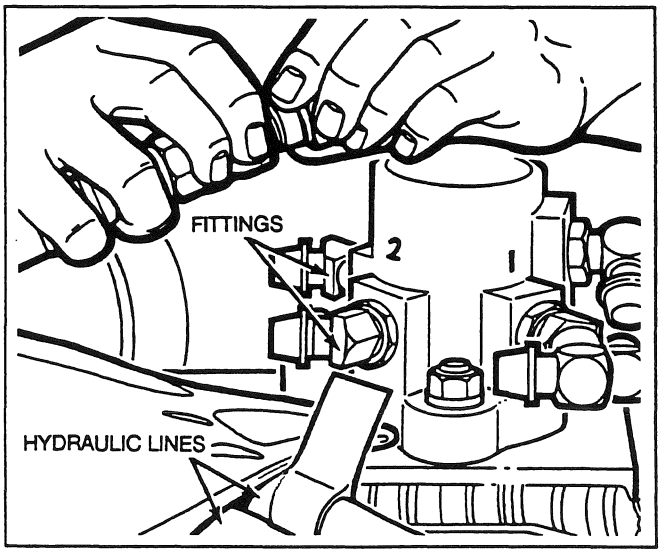


Fig. 28

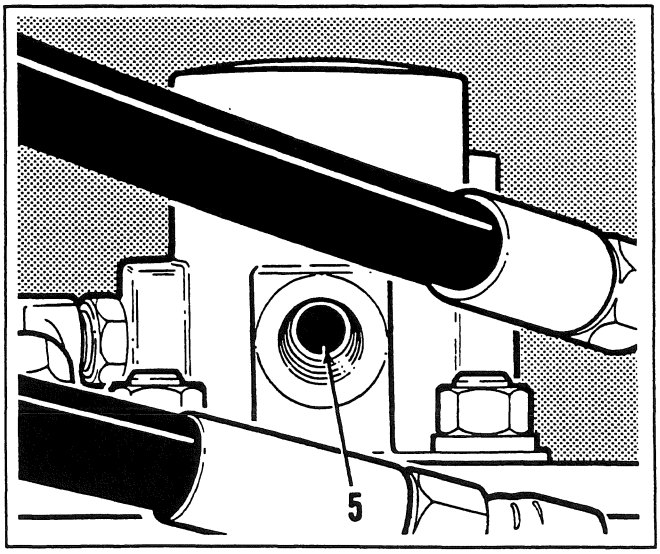


Fig. 31

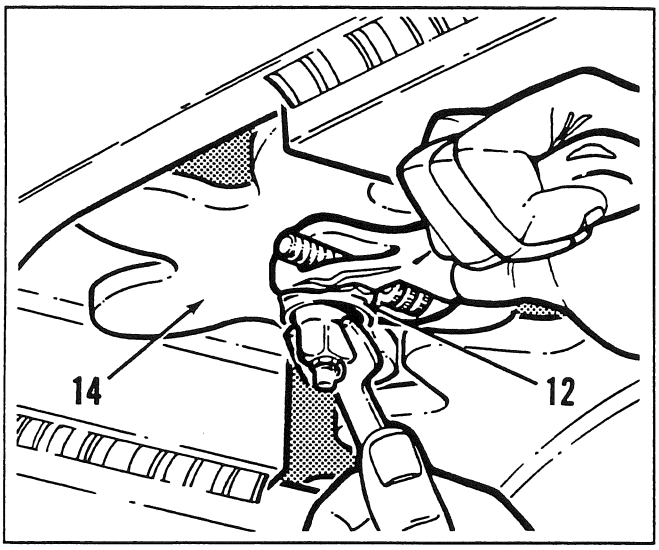


Fig. 32

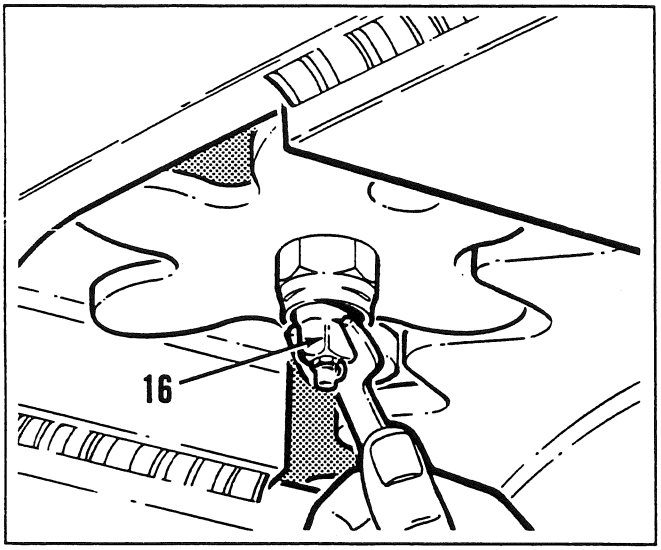


Fig. 33

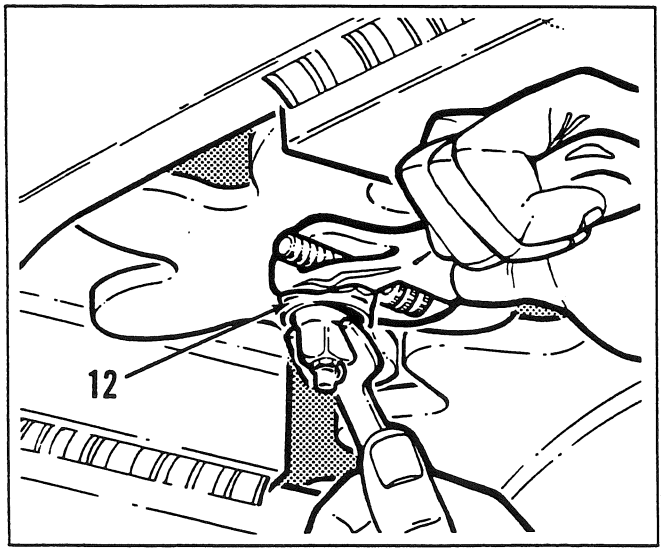


Fig. 34

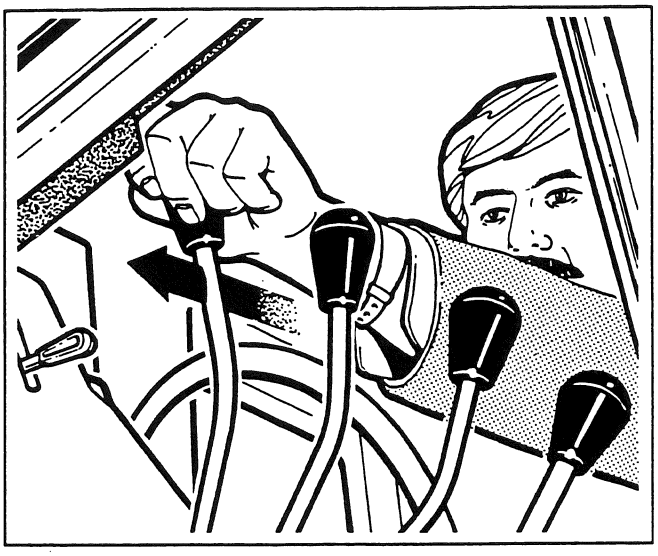


Fig. 35

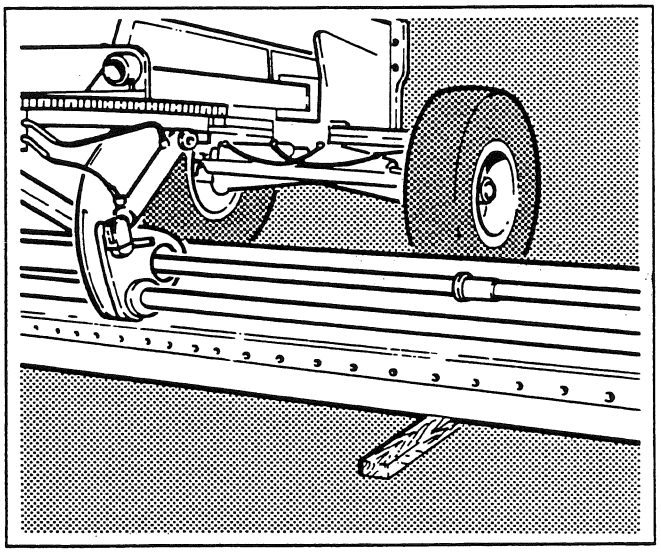


Fig. 36

Circle Timing continued

Fig. 32
To adjust the spool (5), first loosen the locknut (12) retaining the valve pinion (14).

Fig. 33
Turn the pinion shaft (16) until the shiny surface of the spool (5) is visible and completely blocks the port. Move the spool back and forth until you can see the edges. Now centralize the spool.

Fig. 34
Tighten the locknut (12). Check the position of the spool (5) and make sure that it has not moved when tightening the locknut. Install the fitting and reconnect the hydraulic hose.

Fig. 35
Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and push the circle turn control lever forward. The circle should turn smoothly in a clockwise direction. If the circle turns in a counter-clockwise direction as viewed from the operator's seat when the lever is pushed forward, the spool (5) is 180 degrees out of position. Repeat steps **Fig. 32** through **Fig. 34**, but this time, turn the pinion shaft (16) 180 degrees. Circle timing is now complete.

Fig. 36
Shut down the engine. Check the hydraulic fluid level and for leaks.

SECTION 4G
HYDRAULICS
Cushion Valves

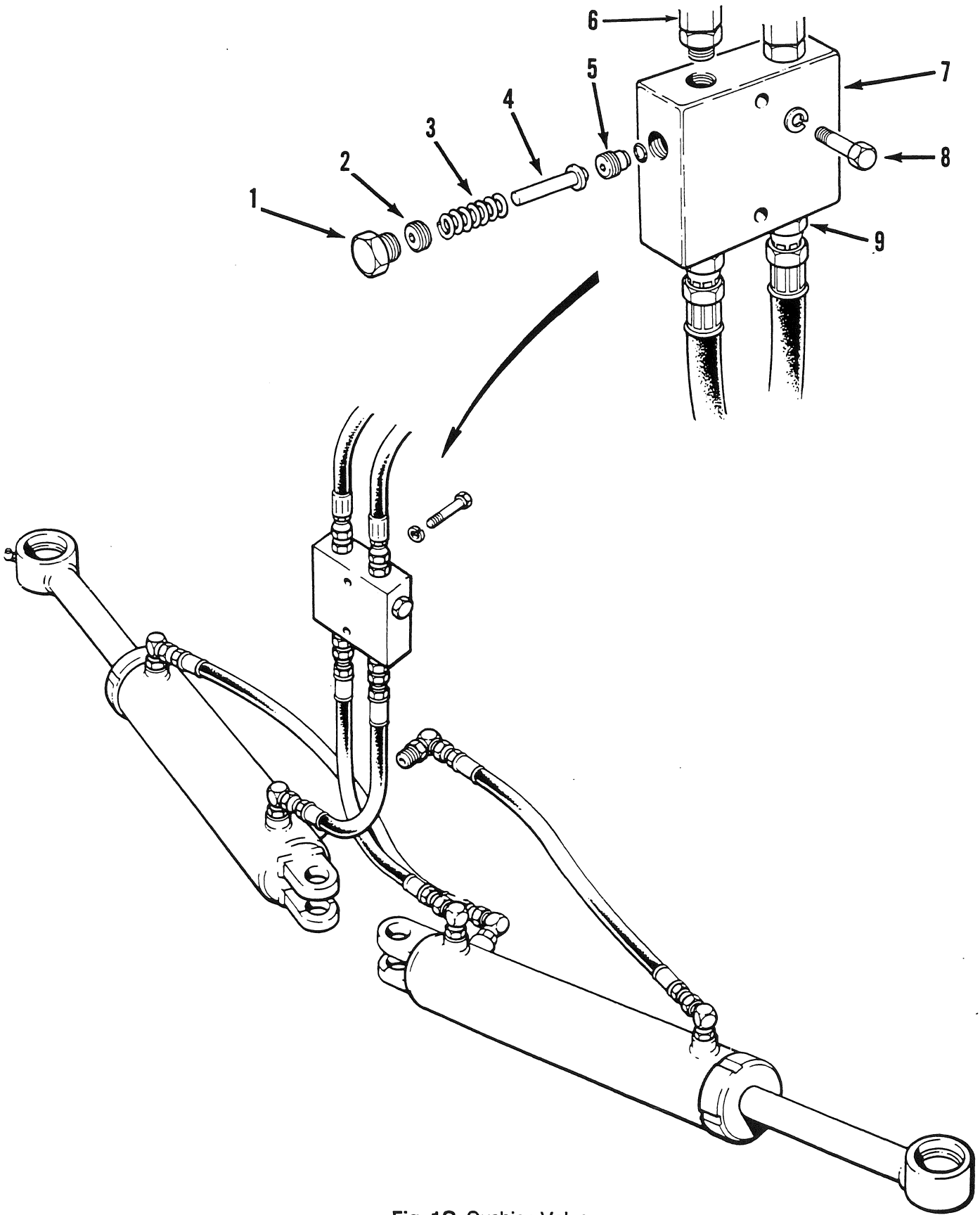


Fig. 1G Cushion Valve

Item	Description	Item	Description	Item	Description
1	O ring plug	4	Poppet	7	Cushion valve
2	Adjusting screw	5	Seat	8	Bolt
3	Spring	6	Connector	9	Connector

Key to Fig. 1G

Cushion Valve - Description (Fig. 1G)

The cushion valve is a cross-over relief valve used in the Champion steering and circle turn hydraulic circuits to protect these systems from excess pressure caused by shock loads. As the pressure reaches the preset level of the valve, the poppet pushes against the spring and moves from its seat. This allows oil to bypass into the other line.

You will find the steering hydraulic circuit cushion valve located in the nose of the main frame. The circle turn hydraulic circuit cushion valve is mounted on top of the drawbar. Both cushion valves look identical, but each has a different pressure setting. The internal springs have different compression rates and pressure ranges. Therefore, the valves cannot be interchanged by simply adjusting the setting.

This sub-section describes bench servicing the steering hydraulic circuit cushion valve. However, the same procedure applies to the circle hydraulic circuit cushion valve.

Cushion Valve Location	Cracking Pressure 1/2 U.S. gpm (hand pump)	Reset Pressure Refer to Fig. 17, following
Circle	2000±100 psi (138±7 bar)	1600 psi (110 bar)
Steering	800±50 psi (55±3 bar)	650 psi (45 bar)

Cushion Valve - Removal

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section.

Fig. 3
Identify the two hydraulic hoses from the steering cylinders to prevent confusion during assembly. Cap the fittings and ports to prevent contamination. Disconnect the hoses.

Fig. 4
Disconnect the top hydraulic hoses. Cap the fittings and ports to prevent contamination.

Fig. 5
Remove the two bolts (8) securing the cushion valve (7) to the frame. Remove the cushion valve.

Cushion Valve - Disassembly

Fig. 6
Place the cushion valve (7) into a vise with soft jaws. Do not overtighten the vise. Remove the connectors (6 and 9) and hoses.

Fig. 7
Remove the O ring plugs (1).

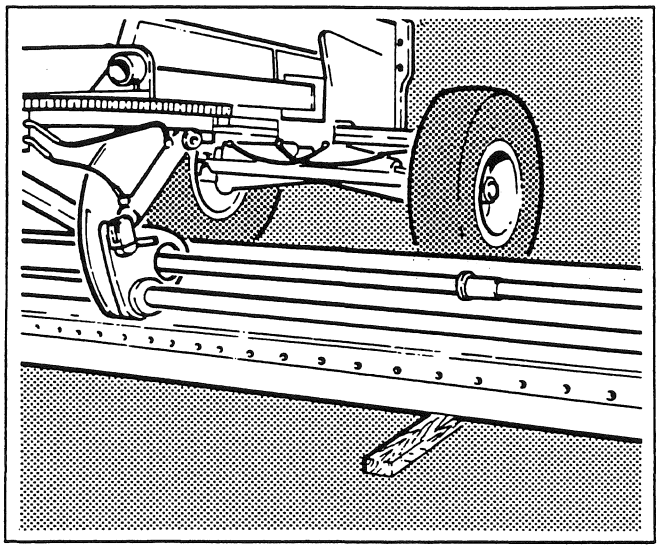


Fig. 2

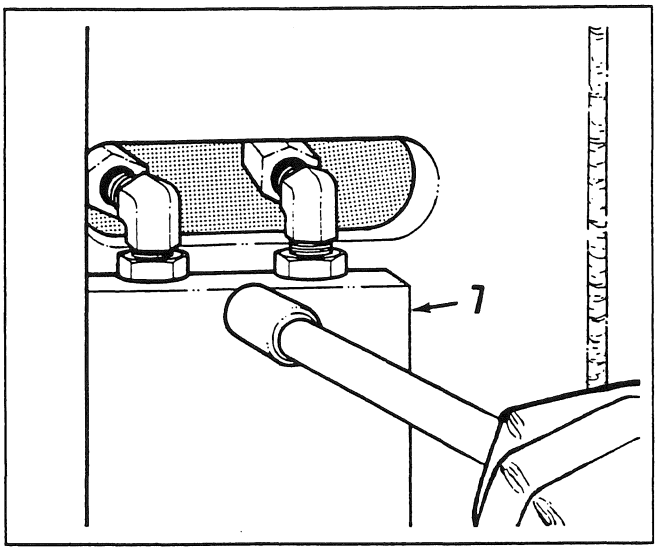


Fig. 5

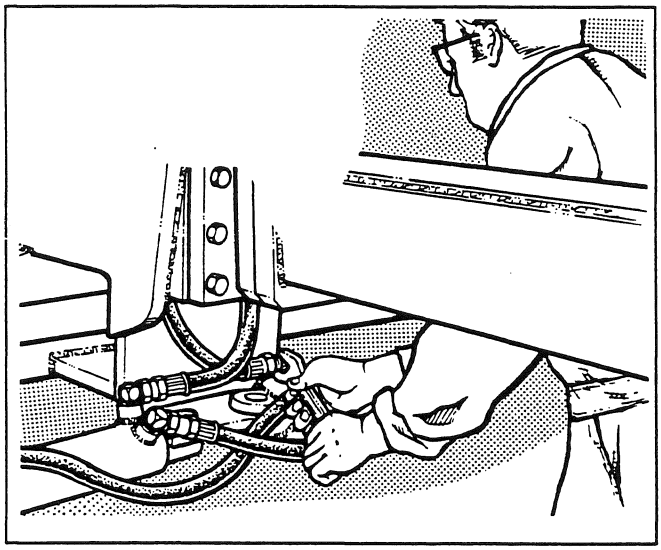


Fig. 3

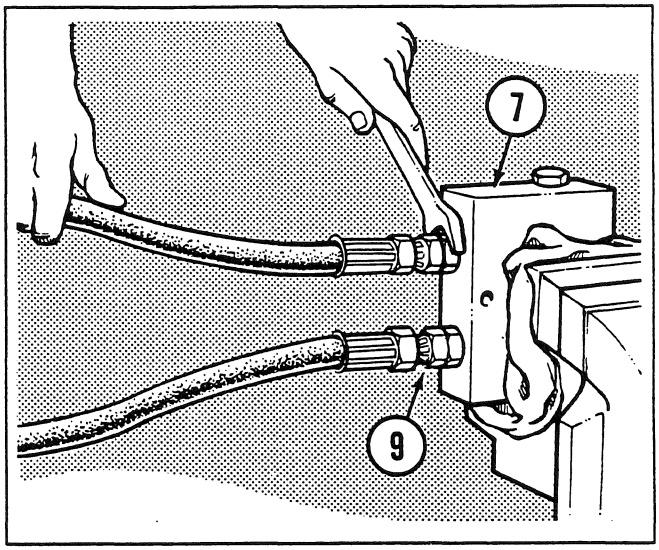


Fig. 6

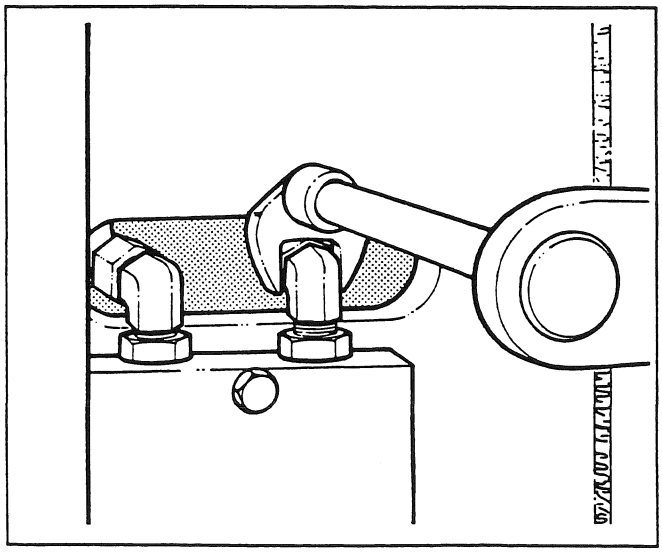


Fig. 4

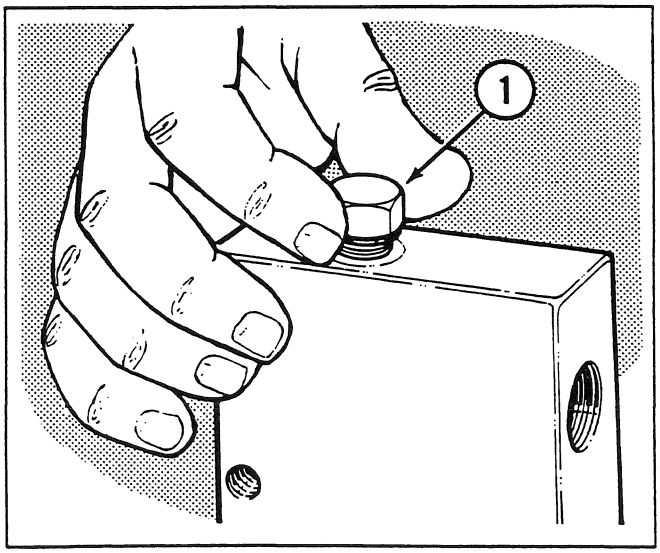


Fig. 7

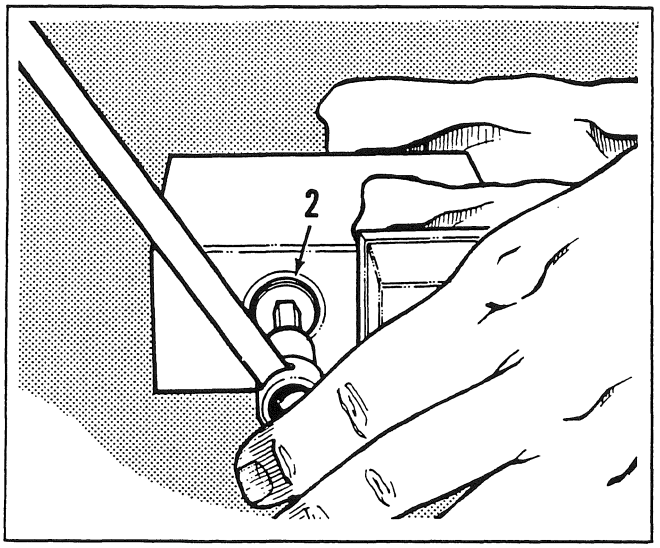


Fig. 8

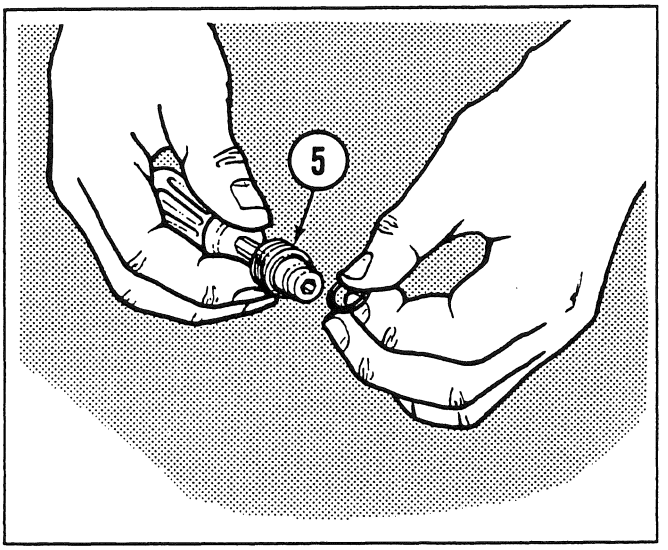


Fig. 11

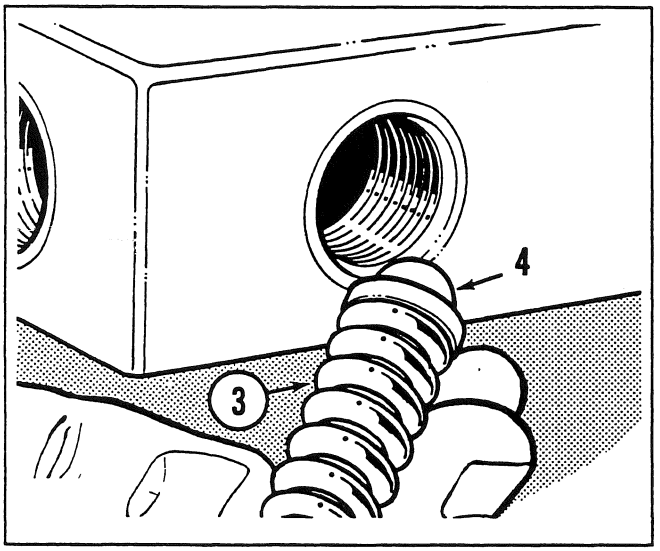


Fig. 9

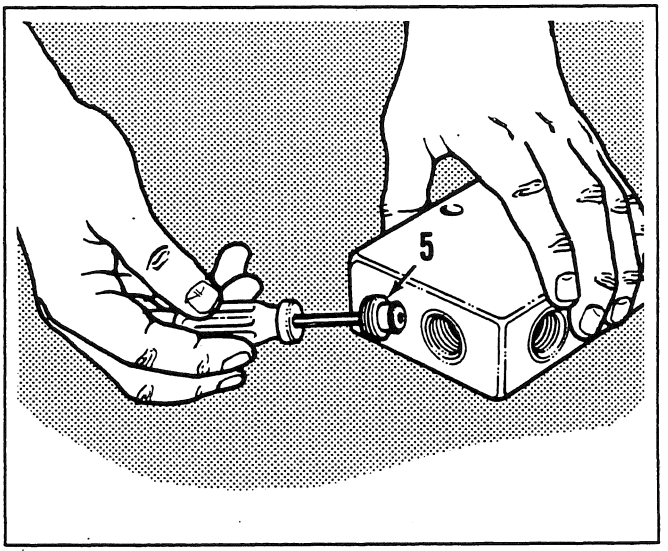


Fig. 12

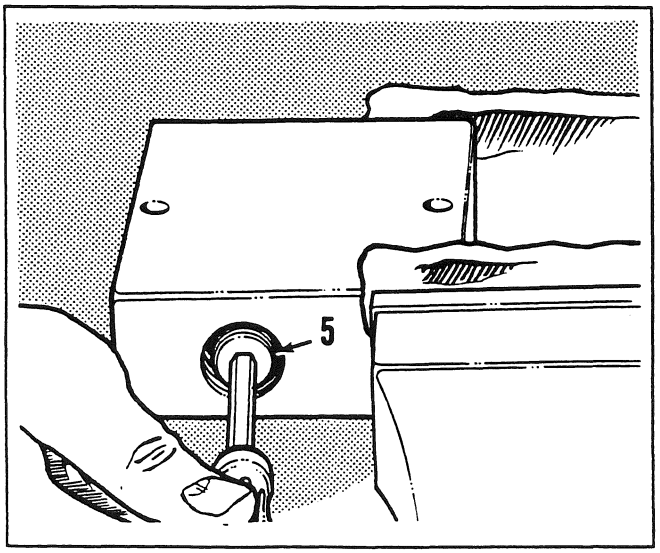


Fig. 10

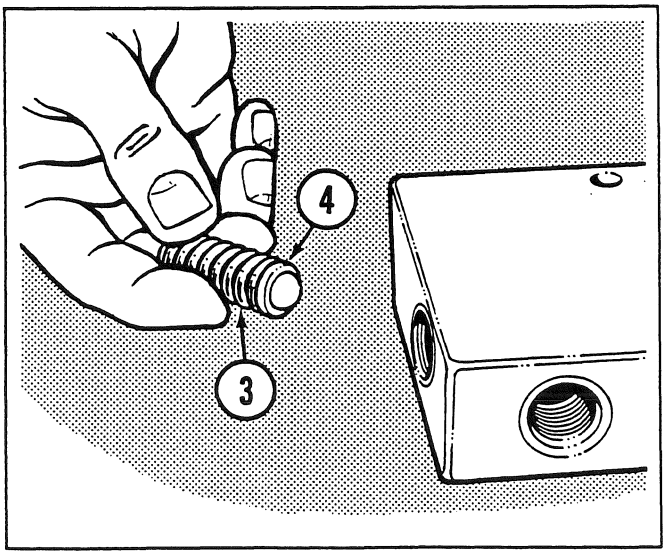


Fig. 13

Cushion Valve - Disassembly continued

Fig. 8
Use an Allen wrench to remove the adjusting screws (2).

Fig. 9
Remove the springs (3) and poppets (4).

Fig. 10
Remove the seat (5). Remove and discard all O rings. Inspect all parts for serviceability. Refer to **Cleaning and Inspection** found in the front of this Shop Manual section.

Cushion Valve - Assembly

Fig. 11
Lubricate and install a new O ring on the seat (5).

Fig. 12
Install the seat (5) in the housing and tighten it to the specified torque. Prevent the seat from turning by staking it in three places.

Fig. 13
Install the poppet (4) and spring (3).

Cushion Valve - Assembly continued

Fig. 14
Install the adjusting screw (2). Lubricate and install a new O ring onto the plug (1). Install the plug. Repeat this assembly procedure for the opposite side of the cushion valve (7).

Fig. 17
If adjustment is needed, remove the plug on the side opposite to the section that was pressurized. Use an Allen wrench to turn the adjusting screw (2) to the correct relief setting. Turn the adjusting screw clockwise to increase the setting or counterclockwise to decrease it. Repeat this operation for the opposite side of the cushion valve. Reduce the setting to the reset figure (see chart on Page 4G-1). The valve should close. Maximum leakage at reset pressure is 60 drops/minute.

Cushion Valve - Adjustment

Fig. 15
Install a steel plug in one port. In the other port on the same side, install a means of supplying hydraulic power, such as a hand pump, and a calibrated pressure gauge.

Fig. 16
Build pressure with the hand pump until the gauge shows the cushion valve relieving oil to the opposite port. Carefully release the pressure.

Cushion Valve - Installation

Fig. 18
Lubricate and install new O rings on the connectors (6 and 9). Install the connectors to finger tightness. Install the two hydraulic hoses. Uncap the top hydraulic hoses and connect them to the cushion valve (7).

Fig. 19
Fasten the cushion valve (7) to the frame with the two bolts (8). Tighten the bolts to the specified torque.

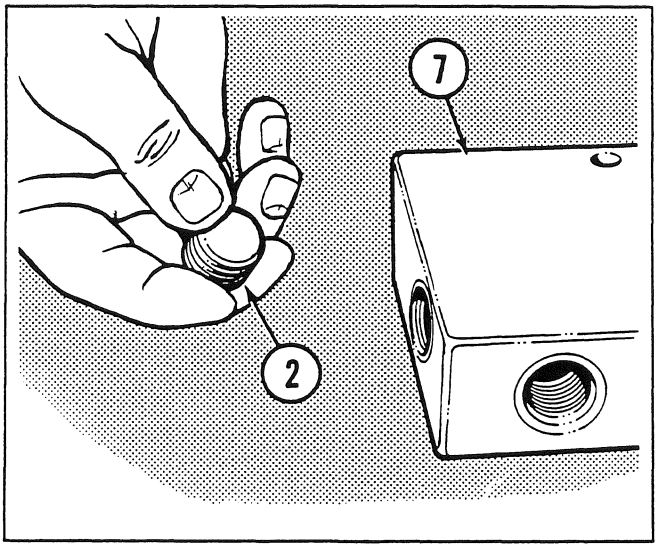


Fig. 14

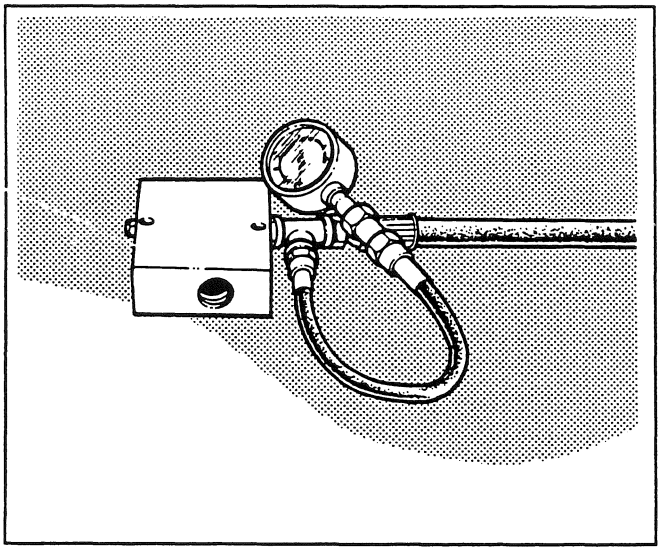


Fig. 15

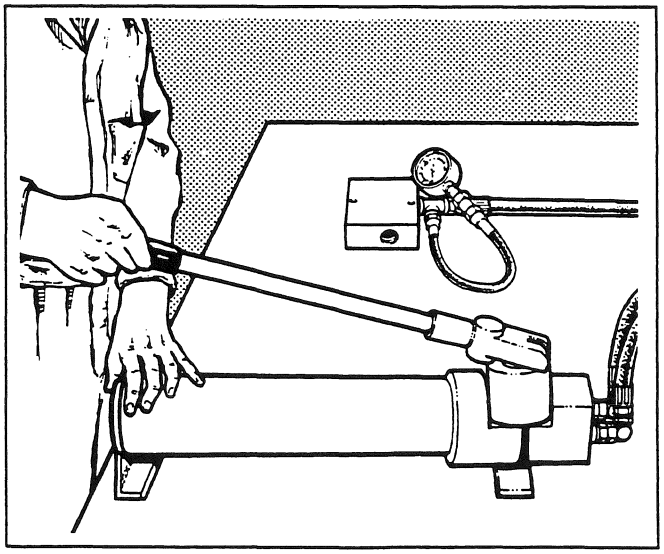


Fig. 16

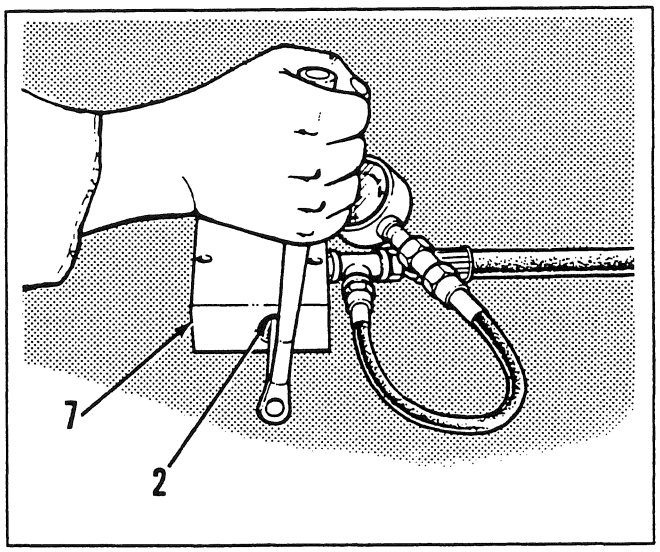


Fig. 17

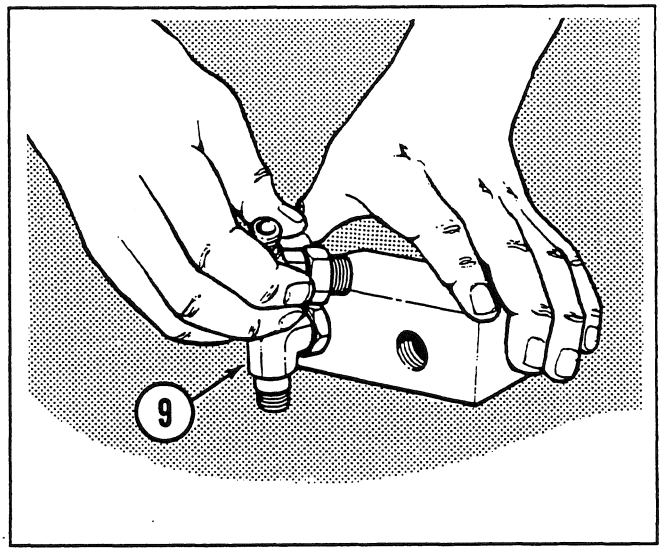


Fig. 18

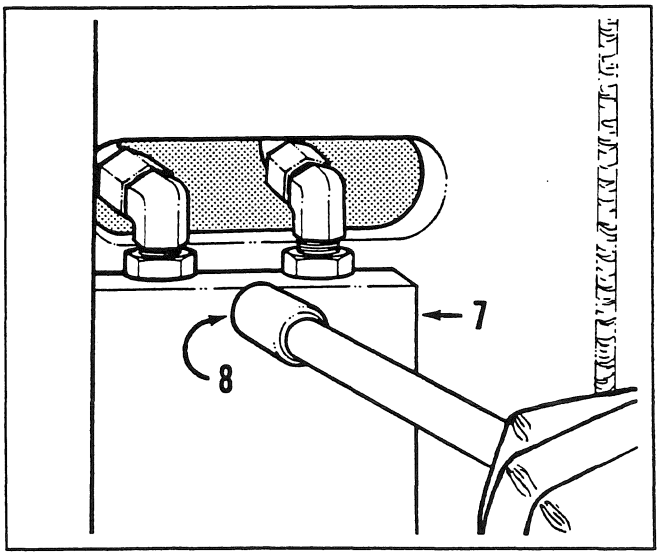


Fig. 19

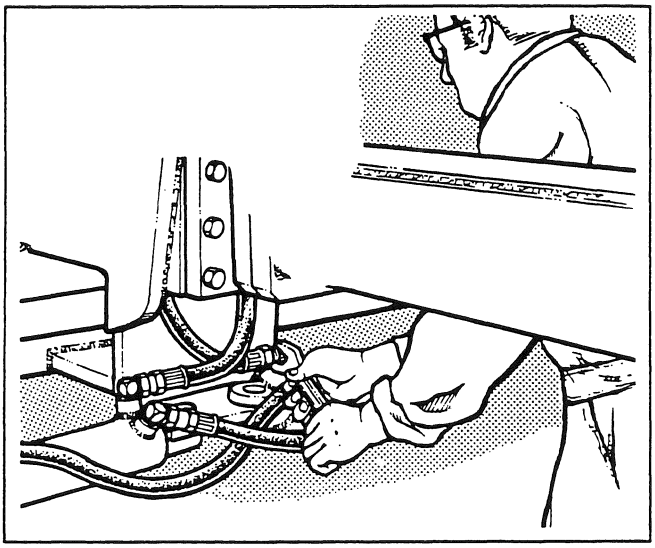


Fig. 20

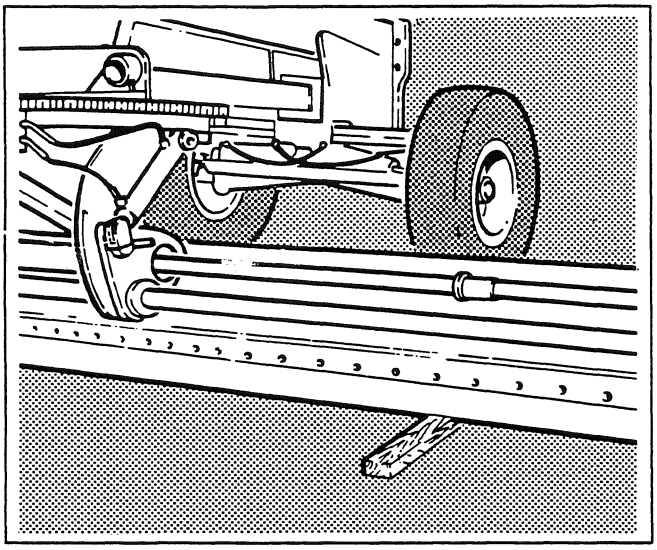


Fig. 21

Cushion Valve - Installation continued

Fig. 20

Connect the hoses to the steering cylinders. Fully tighten the connectors (6 and 9) at the cushion valve (7).

Fig. 21

Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and operate the steering cylinders from one power stroke to the other. Shut down the engine. Check the hydraulic fluid level and for leaks.

SECTION 4H
HYDRAULICS
Hydraulic Cylinders

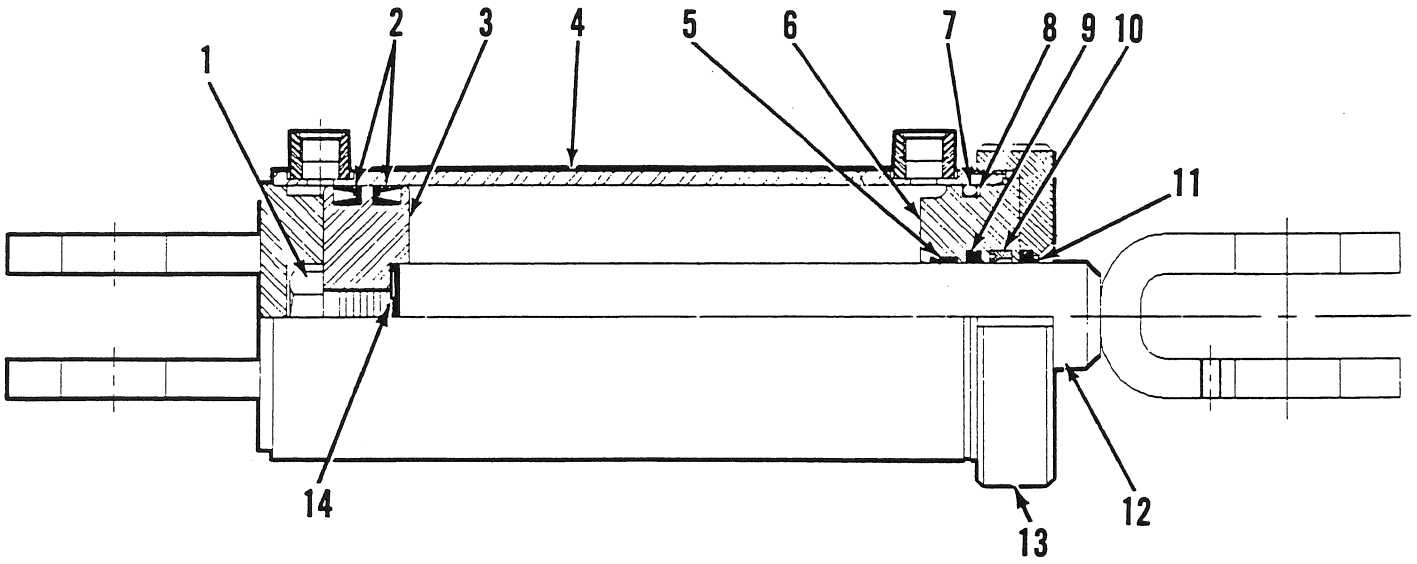


Fig. 1H Typical Hydraulic Cylinder

Item	Description	Item	Description	Item	Description
1	Piston retaining bolt	6	Gland	11	Wiper
2	Pison seals	7	90 durometer O ring	12	Piston rod
3	Piston	8	Back-up ring	13	Cylinder nut
4	Cylinder barrel	9	Buffer ring	14	O ring
5	Wear ring	10	Rod seal		

Key to Fig. 1H

Torque Guide - Cylinder Nut and Piston Retaining Bolt

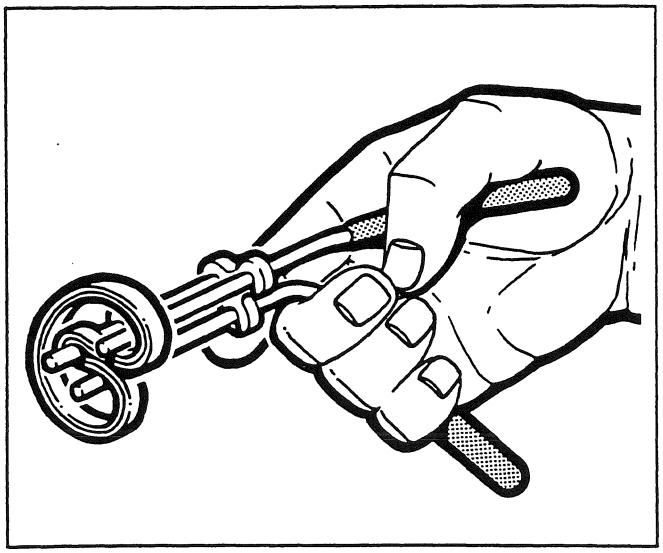
Cylinder Application	Cylinder Nut	Piston Rod Bolt
Slide shift (heavy duty with 1/2 in. NC tie bolts)	80 lbf·ft (108 N·m; 11 kgf·m)	680 lbf·ft (922 N·m; 94 kgf·m)
Circle turn (standard & heavy duty) Front-mounted wing lift Power tilt (standard & heavy duty) R.H. and L.H. leaning wheel (dual & 4+2) R.H. and L.H. steering (standard, heavy duty & 4+2) Windrow eliminator Wing slide	250 lbf·ft (339 N·m; 35 kgf·m)	280 lbf·ft (380 N·m; 39 kgf·m)
A-frame Articulation Circle shift (standard, rotary & heavy duty) R.H. and L.H. Hi-lift (standard, rotary & heavy duty) Leaning wheel (single, L.H. & R.H. heavy duty) Models 710/710A power tilt Rear mounted wing lift Ripper lift, tilt and tooth tilt Scarifier Slide shift (standard)	500 lbf·ft (678 N·m; 69 kgf·m)	680 lbf·ft (922 N·m; 94 kgf·m)
Rotary lock (moveable point blade lift only)	500 lbf·ft (678 N·m; 69 kgf·m)	1360 lbf·ft (1844 N·m; 188 kgf·m)

Torque Guide - Piston Nut

P/N **37H-16** deflected thread nut - 400 lbf·ft (542 N·m; 55 kgf·m)
P/N **37H-20** deflected thread nut - 400 lbf·ft (542 N·m; 55 kgf·m)
P/N **37D-20** nylon insert locknut - 1500 lbf·ft (2034 N·m; 207 kgf·m)

Buffer Ring and Rod Seal Installation Tool (See Fig. 21)

Cylinder Size	Installation Tool Part Number
3 in. cylinder	49765
4 in. and 5 in. cylinders	49766
4 in. heavy duty cylinder	49822



Using Buffer Ring and Rod Seal Installation Tool

NOTE: Champion has made several improvements to hydraulic cylinders. This information concerns the current cylinder design. However, since there is a high degree of interchangeability with earlier cylinders, Champion strongly advises you to upgrade older style cylinders to current production standards.

Hydraulic Cylinder - Disassembly

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Relieve all hydraulic pressure. Take care with hydraulic circuits that contain lock valves. Disconnect the hoses. Cap the fittings and ports to prevent contamination. Remove the cylinder from the grader.

Fig. 3
Drain any oil remaining in the cylinder in an appropriate container.

Fig. 4
Place the cylinder barrel (4) in a vise with soft jaws.

Fig. 5
Use the appropriate size cylinder wrench to remove the cylinder nut (13) from the barrel (4).

NOTE: The cylinder nut is secured with threadlocking compound. You may have to heat the nut or apply considerable force when using the wrench.

Fig. 6
Carefully remove the gland (6) from the cylinder barrel (4).

Fig. 7
Slowly remove the piston rod (12) and piston (3) from the cylinder barrel (4). Be prepared to catch any remaining oil in an appropriate container. Handle the piston rod with care to prevent accidentally damaging the chrome plated surface.

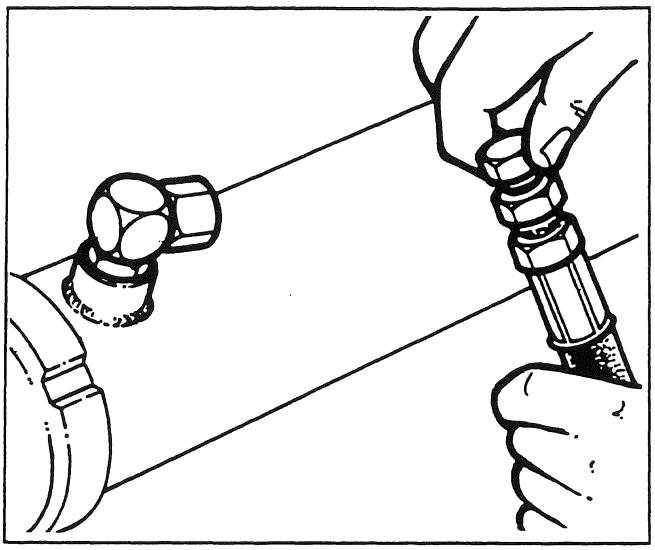


Fig. 2

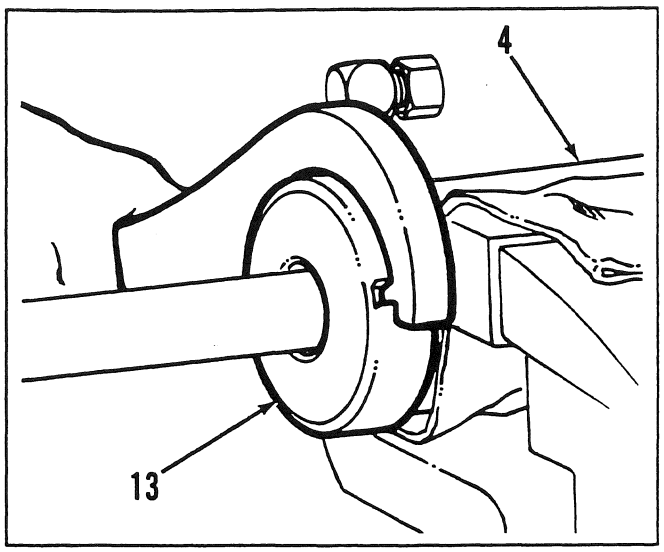


Fig. 5

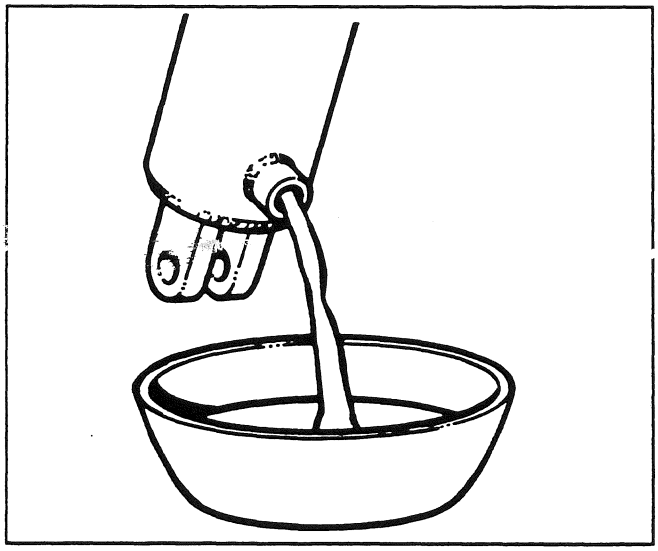


Fig. 3

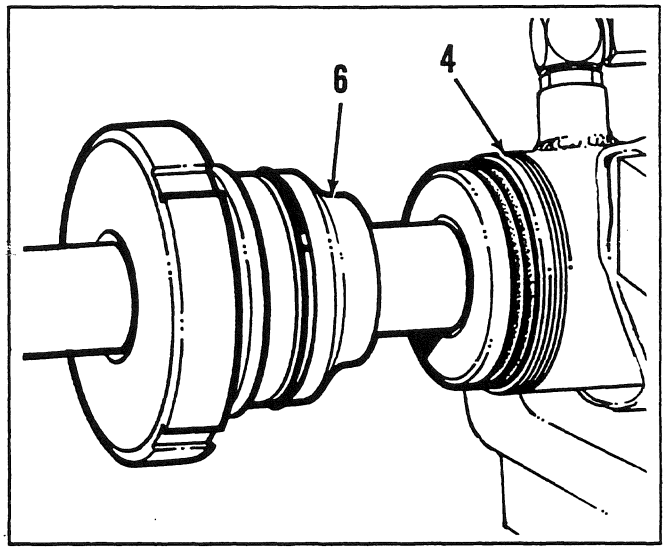


Fig. 6

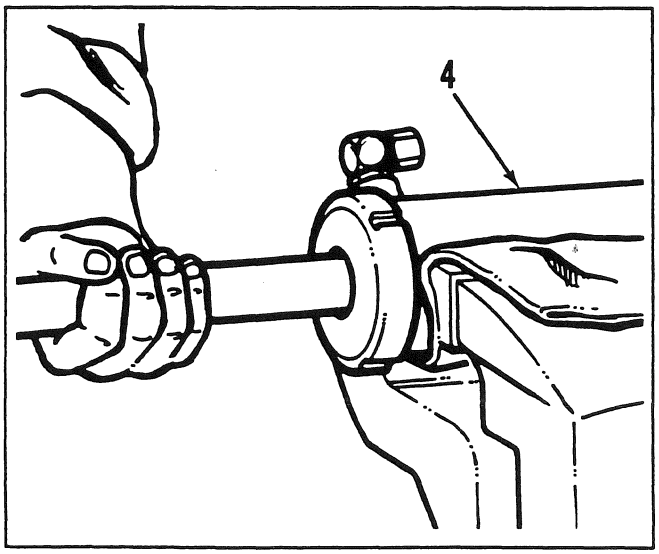


Fig. 4

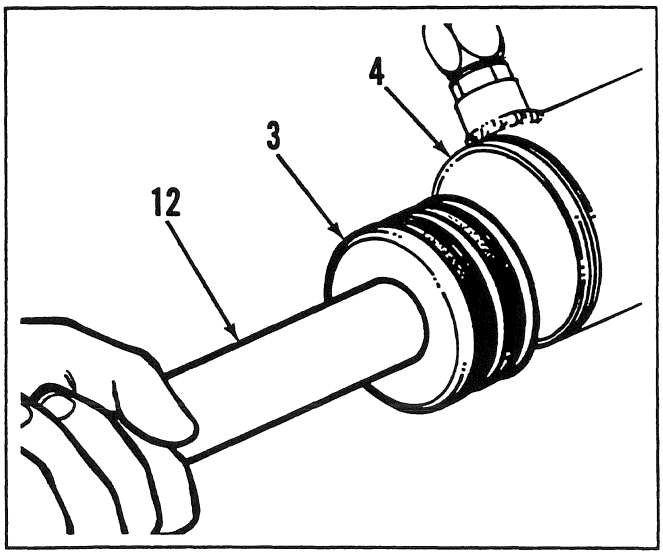


Fig. 7

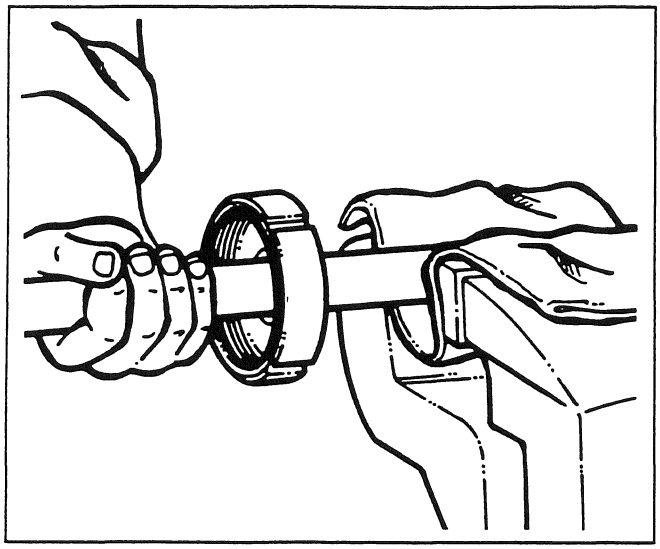


Fig. 8

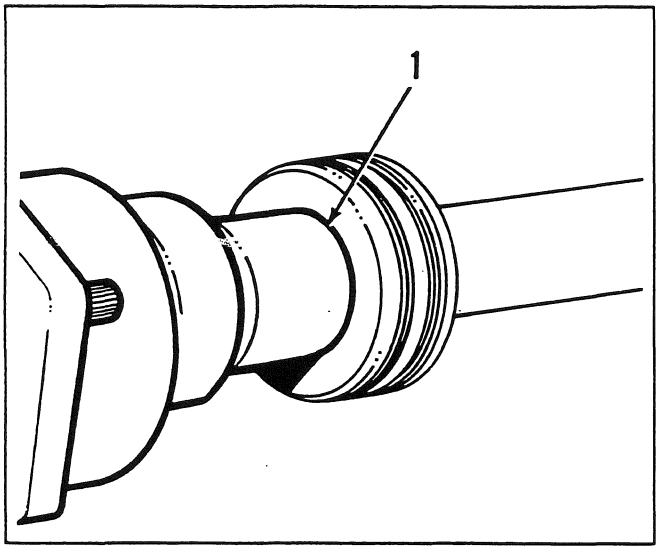


Fig. 9

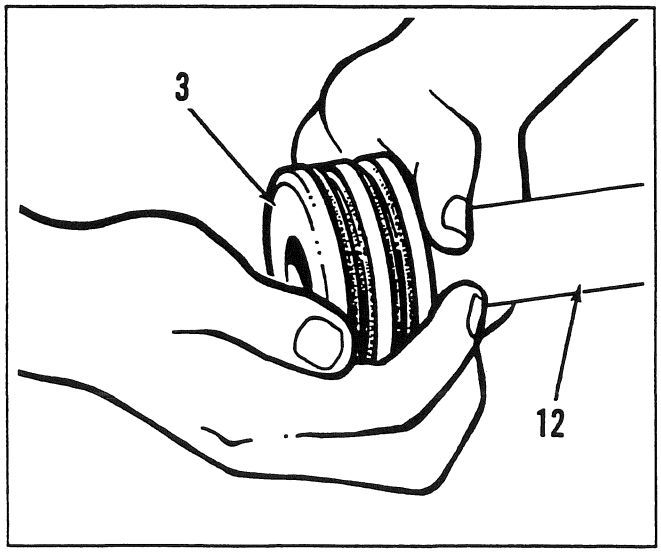
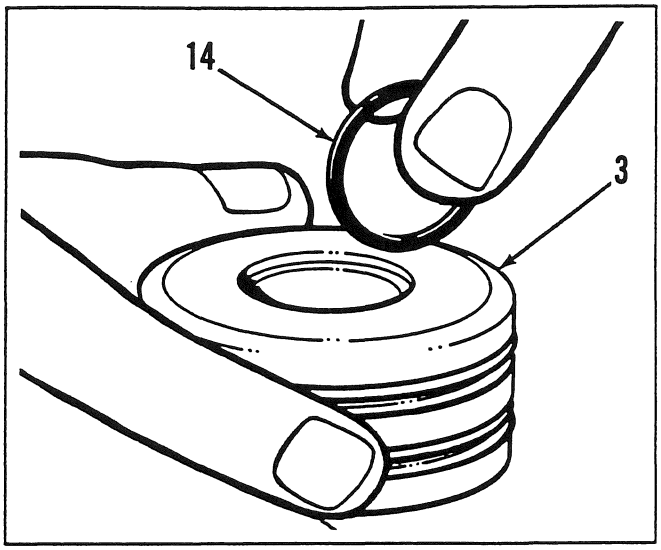


Fig. 10



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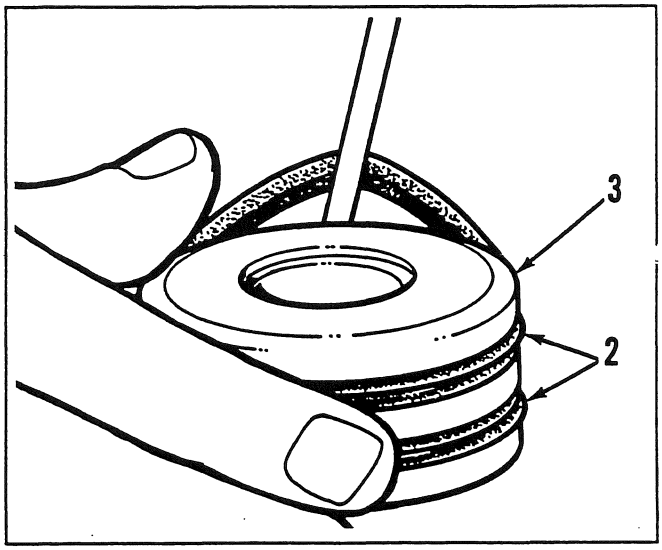

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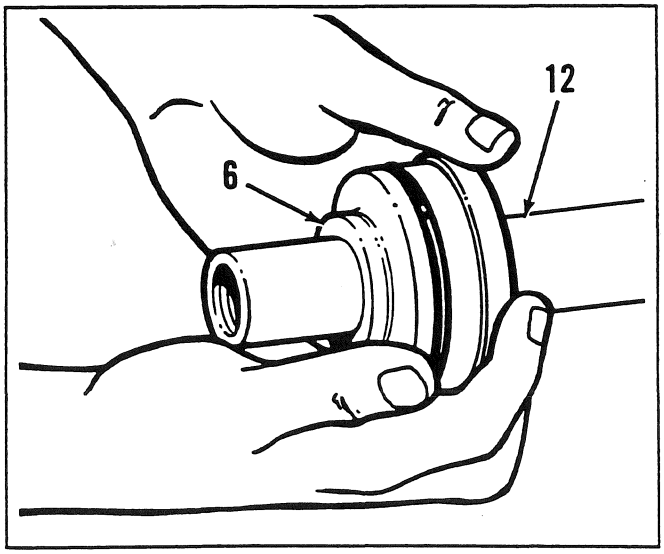


Fig. 13

Hydraulic Cylinder - Disassembly continued

Fig. 8
Remove the cylinder barrel (4) from the vise. Secure the piston rod bearing end between the soft jaws of the vise.

Fig. 9
Remove the piston retaining bolt (1). For pistons retained by a nut, remove and discard the nut.

NOTE: *The piston retaining bolt is secured with thread-locking compound.*

Fig. 10
Remove the piston (3) from the piston rod (12).

Fig. 11
Remove and discard the O ring (14) from the piston (3).

Fig. 12
Remove and discard the seals (2) from the piston (3).

Fig. 13
Remove the gland (6) from the piston rod (12).

Hydraulic Cylinder - Disassembly continued

Fig. 14
Remove and discard the 90 durometer O ring (7) and back-up ring (8) from the gland (6).

Fig. 15
Remove and discard the wear ring (5), buffer ring (9) and rod seal (10) from the gland (6).

Fig. 16
Remove the cylinder nut (13) from the piston rod (12).

Fig. 17
Remove and discard the wiper (11) from the cylinder nut (13). Inspect all parts for serviceability. Refer to **Cleaning and Inspection** found in the front of this Shop Manual section. Use a hone to remove shallow scratches from the cylinder barrel bore. Use fine emery paper to remove scratches from the piston.

Hydraulic Cylinder - Assembly

NOTE: *When upgrading older style hydraulic cylinders to current production standards, contact Champion's Parts Distribution Center for complete details of the appropriate FA kits.*

Fig. 18
Lubricate and install a new wiper (11) in the counterbore of the cylinder nut (13). Note that the wiper lip must point to the outside of the cylinder nut.

Fig. 19
Lubricate the piston rod (12) and carefully install the cylinder nut (13).

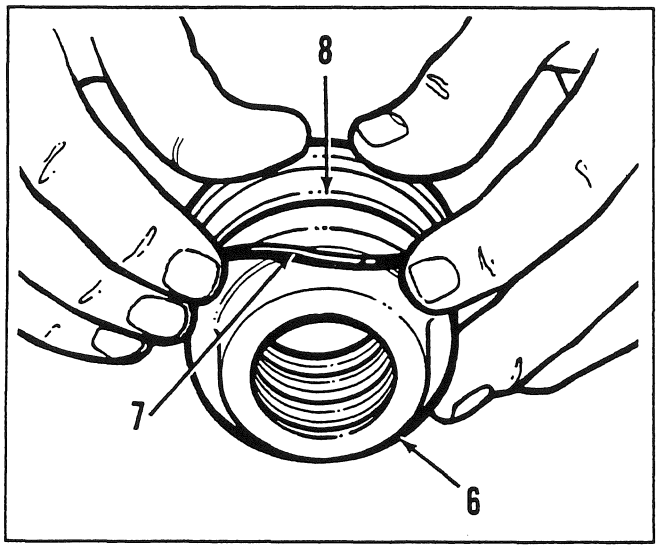
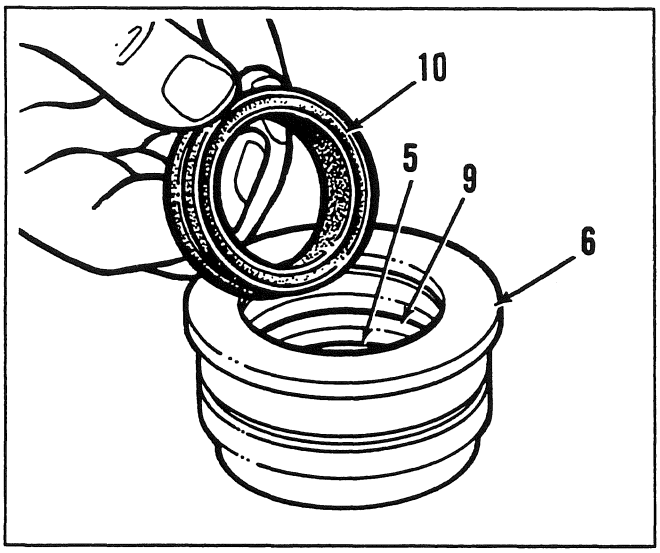


Fig. 14



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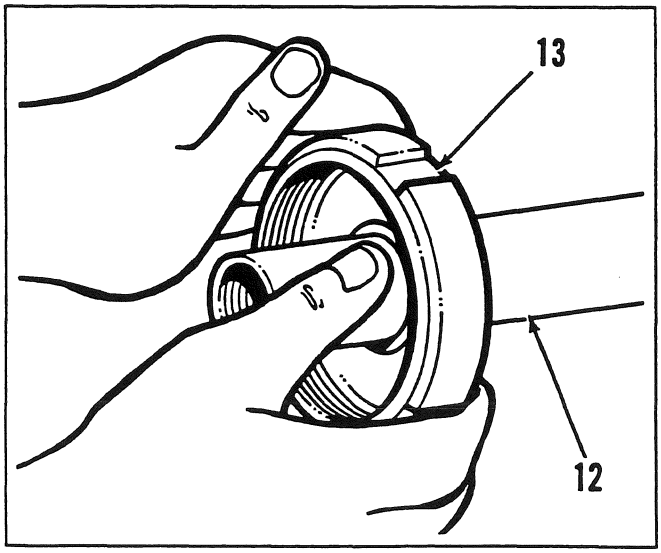


Fig. 16

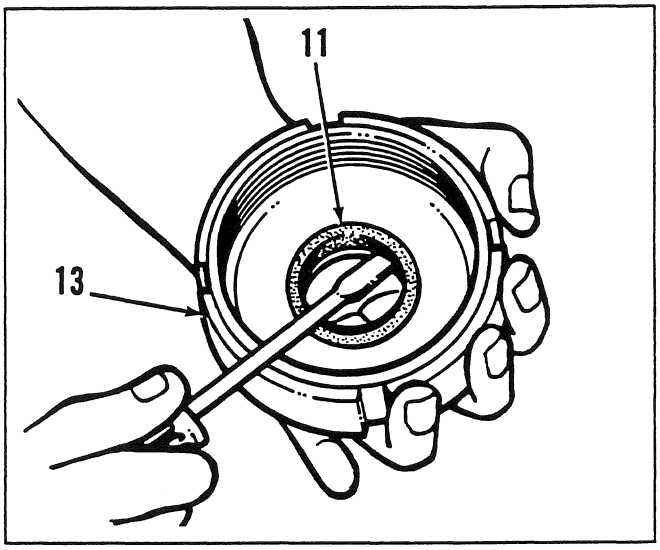


Fig. 17

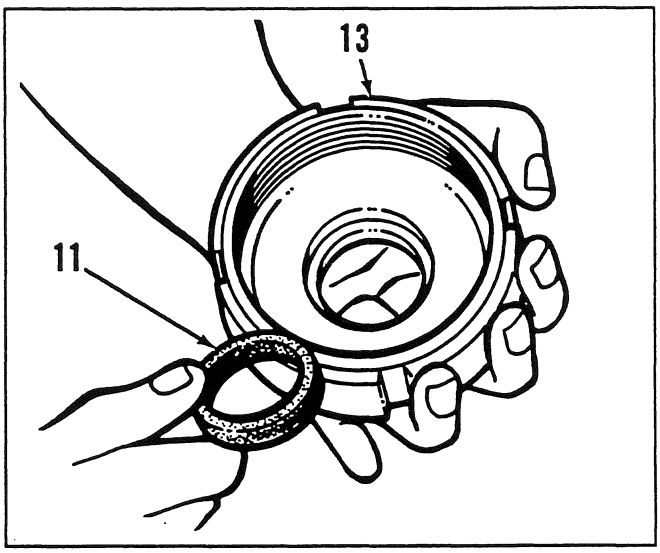


Fig. 18

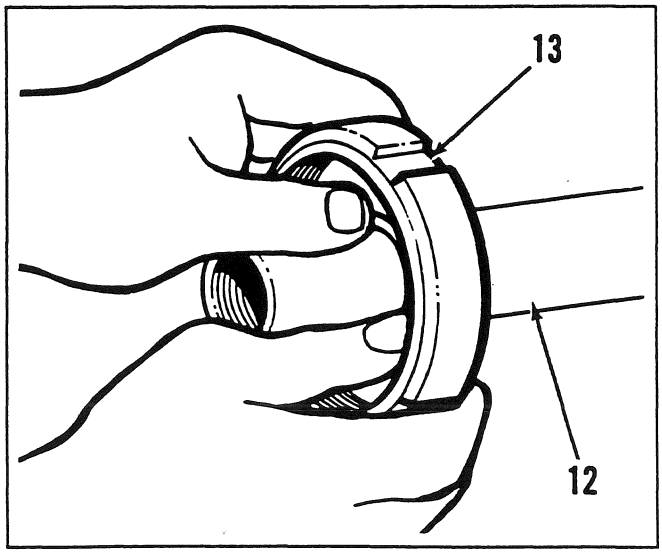


Fig. 19

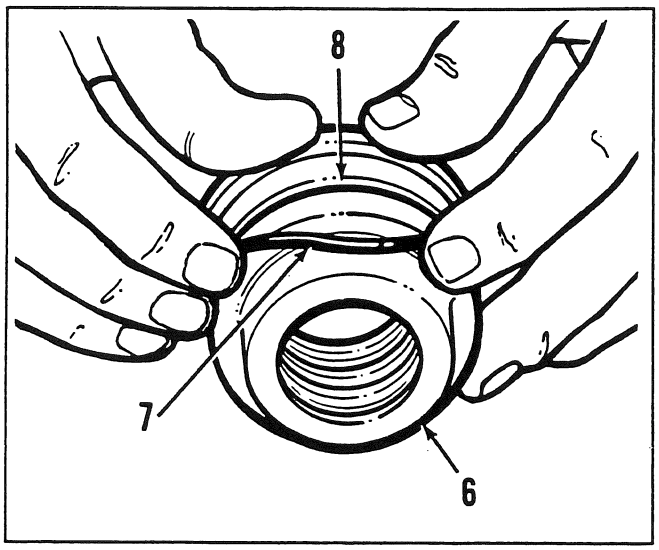
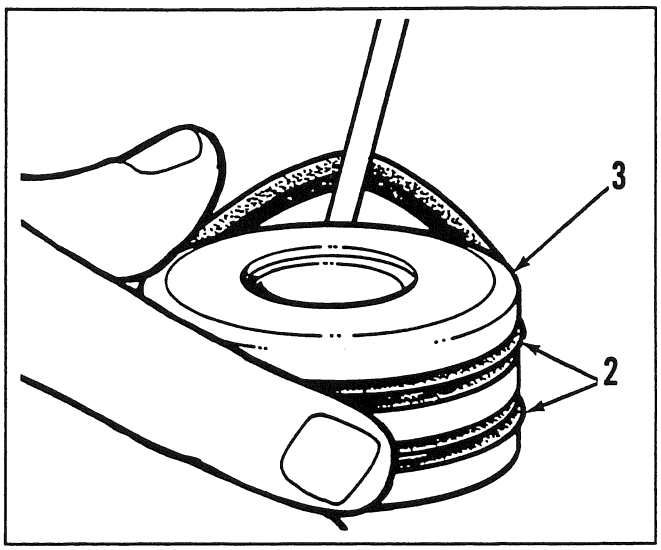


Fig. 20



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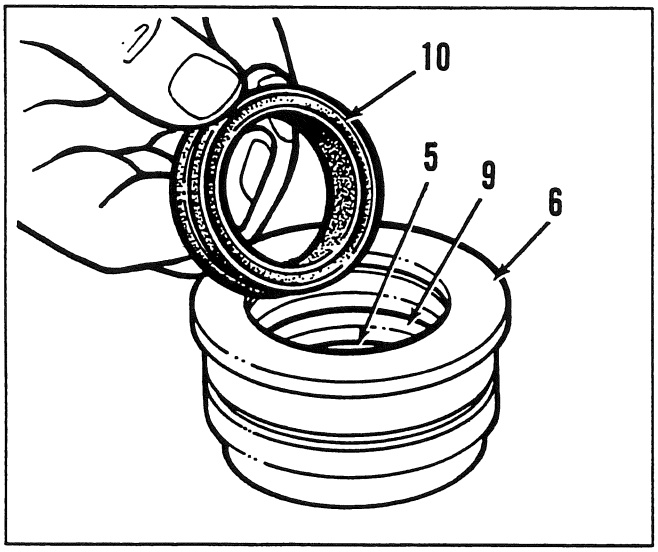

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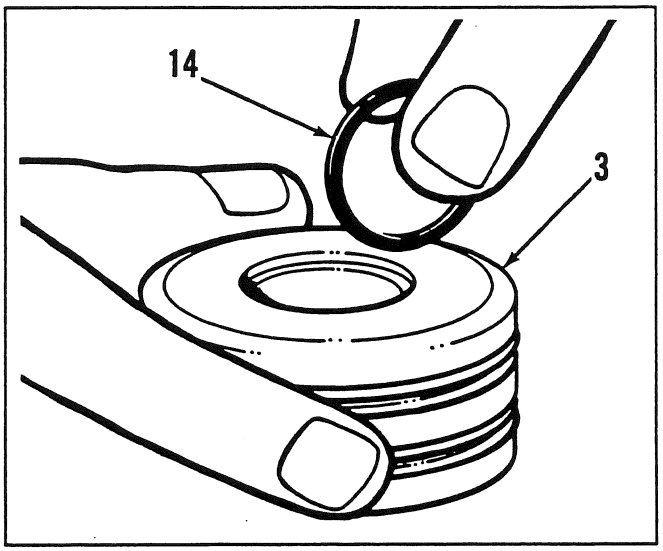


Fig. 24

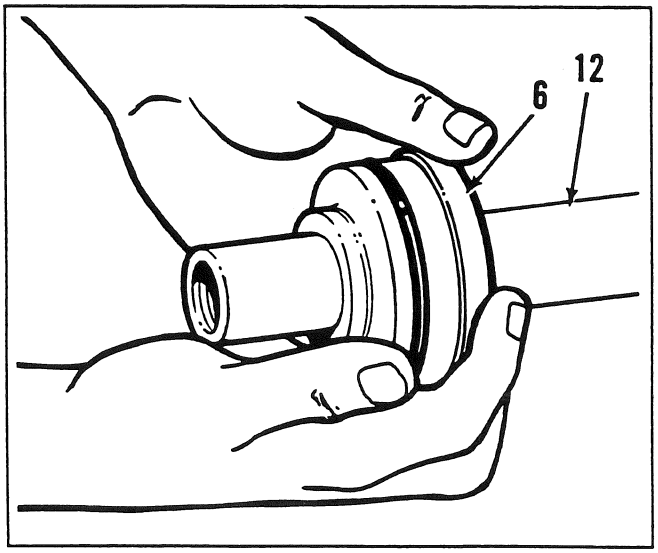


Fig. 22

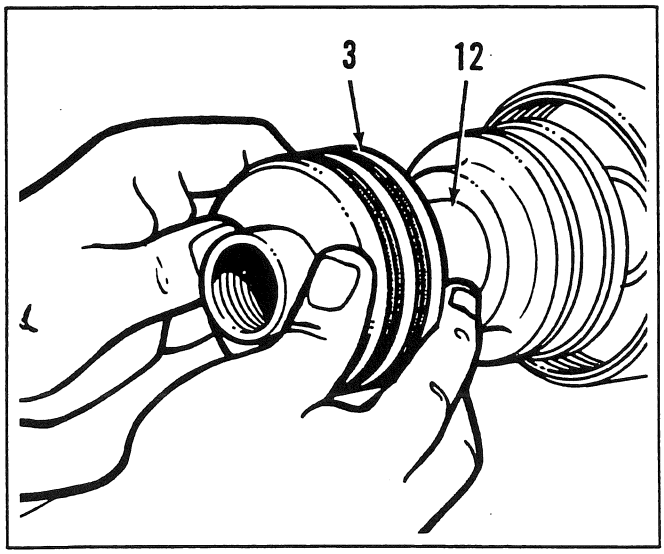


Fig. 25

Hydraulic Cylinder - Assembly continued

Fig. 20
Lubricate and install a new 90 durometer O ring (7) and back-up ring (8) in the gland (6) outer groove.

NOTE: *Install only a 90 durometer O ring. Do not install any other type of O ring.*

Fig. 21
Lubricate and install a new wear ring (5), buffer ring (9) and rod seal (10) in the gland (6). Note that the rod seal lip must point toward the small diameter end of the gland.

NOTE: *Due to the type of material and position of the buffer ring and rod seal, Champion recommends that you use the appropriate special tool listed in the front of this sub-section for installation.*

NOTE: *You may have to remove a small piece from the wear ring to help installation.*

Fig. 22
Carefully install the gland (6) on the piston rod (12). Note that the small diameter end of the gland must point toward the threaded end of the rod.

Fig. 23
Lubricate and install new seals (2) on the piston (3). Note that the seal lips must point toward the ends of the piston. Allow a short time for the seals to return to their original shape.

NOTE: *Pistons for the windrow eliminator, moveable point blade lift and circle shift, and the Models 780/780A leaning wheel and steering hydraulic cylinders have one piston seal and one wear ring. The moveable point lock cylinder has two piston seals and one wear ring.*

Fig. 24
Lubricate and install a new O ring (14) in the piston (3) counterbore.

Fig. 25
Carefully install the piston (3) on the piston rod (12).

Hydraulic Cylinder - Assembly continued

Fig. 26
Thoroughly clean the piston retaining bolt (1) and piston rod (12) with a solvent such as 'Varsol'. Dry using moisture-free compressed air. Ensure all threads are free of dirt, oil and grease.

NOTE: *Never substitute the piston retaining bolt with a bolt of a lower grade.*

Fig. 27
Apply threadlocking compound P/N **45472** evenly to 3/4 of the bolt thread engagement. Ensure the root areas are covered. Immediately install the piston retaining bolt (1). Take care not to displace the O ring (14). Tighten the bolt to the specified torque (see **Torque Guide** found in the front of this sub-section).

NOTE: *For hydraulic cylinder pistons retained by a nut, do not apply threadlocking compound. Install a new nut and tighten to the specified torque (see **Torque Guide** found in the front of this sub-section).*

Fig. 28
Lubricate the edge of the cylinder barrel (4). Carefully install the piston rod assembly.

Fig. 29
Thoroughly clean the cylinder barrel (4) and cylinder nut (13) with a solvent such as 'Varsol'. Dry using moisture-free compressed air. Ensure all threads are free of dirt, oil and grease.

Fig. 30
Apply threadlocking compound P/N **45472** evenly to 3/4 of the barrel thread engagement. Ensure the root areas are covered. Install the cylinder nut (13) and tighten to the specified torque (see **Torque Guide** found in the front of this sub-section). The hydraulic cylinder overhaul is now complete. Pressure check the cylinder at one end using a portable hydraulic power supply to 2700 psi (186 bar). Hold at that pressure to ensure there are no leaks. Repeat pressure check at the other end. Install the cylinder. Road test the grader before returning it to service.

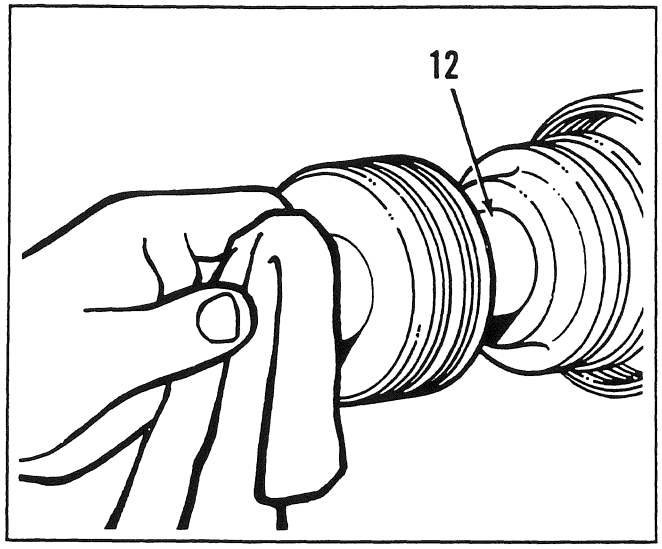
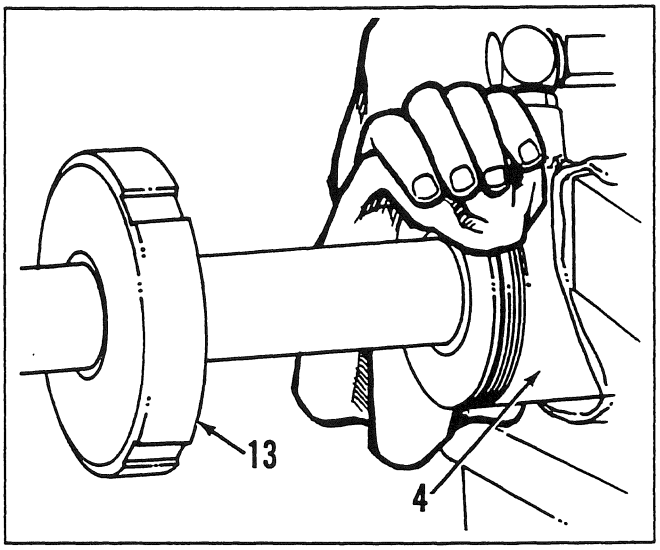


Fig. 26



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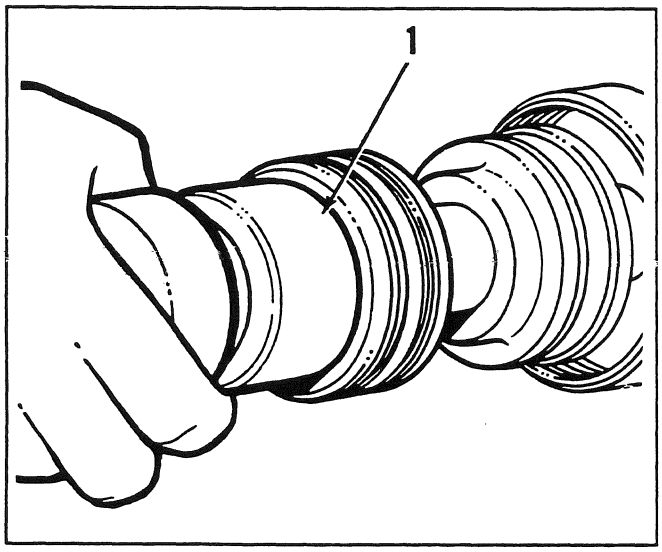


Fig. 27

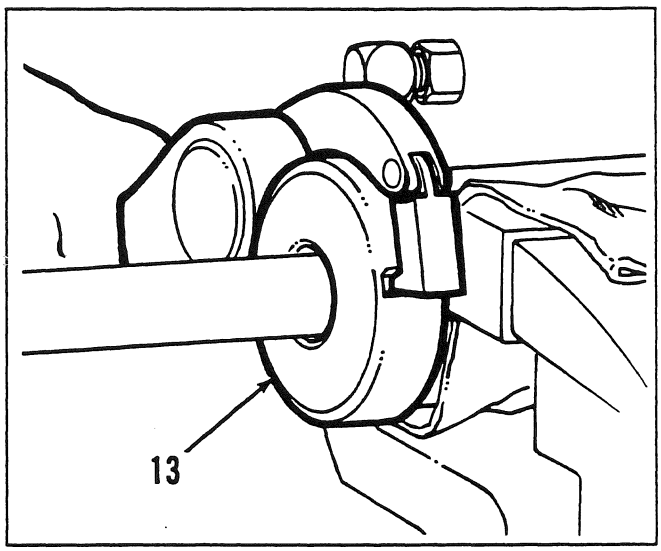


Fig. 30

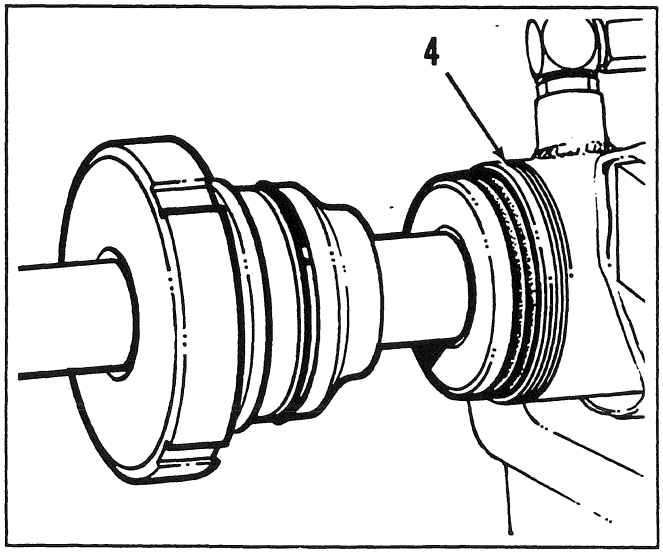


Fig. 28

SECTION 4J
HYDRAULICS
Power Tilt Lock Valves

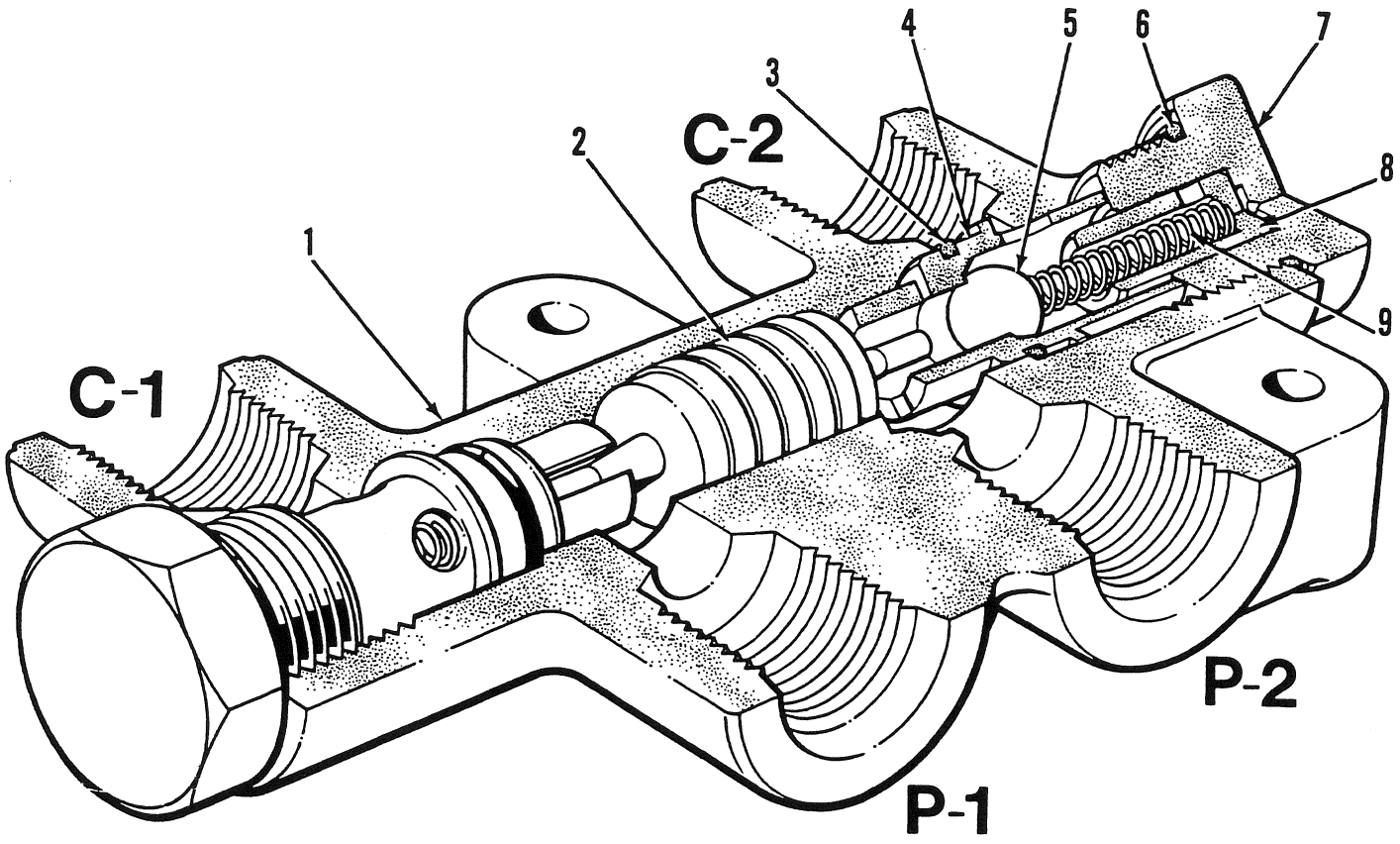


Fig. 1J Power Tilt Lock Valve

Item	Description	Item	Description	Item	Description
1	Valve body	4	Check valve seat	7	O ring cap
2	Pilot piston	5	Check ball	8	Spring seat
3	O ring	6	O ring	9	Spring

Key to Fig. 1J

Power Tilt Lock Valve - Description (Fig. 1J)

The power tilt lock valve is a double pilot operated check valve. Two lock valves are used in the moldboard power tilt hydraulic circuit of Models 720 through 780A. The valves prevent moldboard twist caused by internal leakage in one cylinder and not the other. They are not installed on Models 710/710A as only one tilt cylinder is used.

Hydraulic fluid directed to one end of the cylinder pushes the check ball (5) off the check valve seat (4). At the same time, the pilot piston (2) moves to the left, which unseats the other check ball and allows hydraulic fluid to flow out of the cylinder. When you operate the cylinder in the opposite direction, the sequence is reversed.

When the manifold control valve section is in neutral, both check valves are closed. This effectively locks hydraulic fluid in both ends of the cylinder.

Power Tilt Lock Valve - Removal and Disassembly

Fig. 2

Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Remove the tubes and hoses from the valve body (1) and clean up any oil leakage. Cap the tubes, hoses and fittings to prevent contamination.

Fig. 3

Remove the bolts retaining the valve body (1) to the circle outside diameter. Remove the power tilt lock valve assembly.

Fig. 4

Install the valve body (1) in a vise with soft jaws. Do not overtighten the vise. Remove the O ring cap (7). Remove the spring seat (8) and spring (9). Remove and discard the O ring (6).

Fig. 5

Remove the check ball (5) from the valve body (1).

Fig. 6

Remove the check valve seat (4) from the valve body (1). Remove and discard the O ring (3).

Fig. 7

Remove the pilot piston (2) from the valve body (1). Repeat steps **Fig. 4** through **Fig. 6** for the other end of the lock valve. Inspect the valve body bores and pilot piston for scoring, binding or wear. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

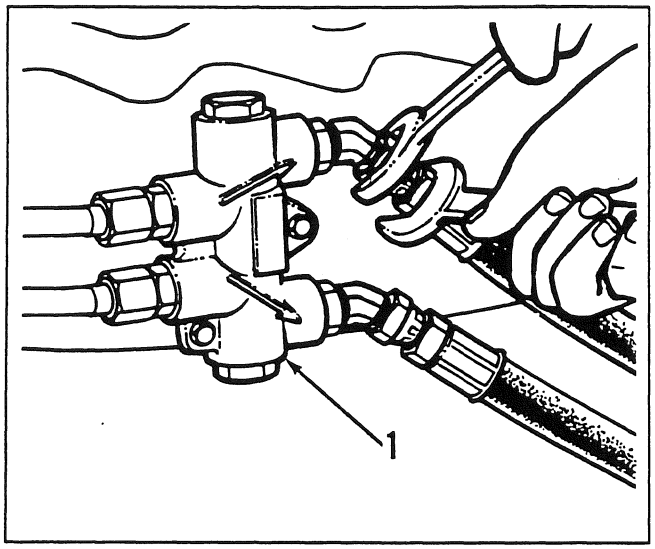


Fig. 2

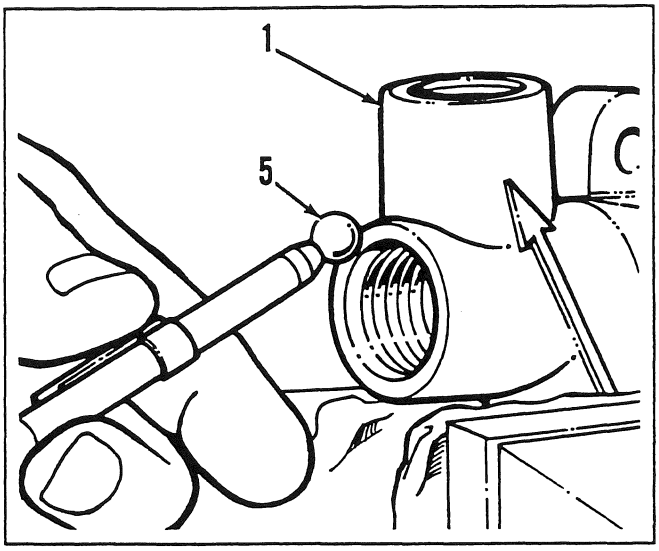


Fig. 5

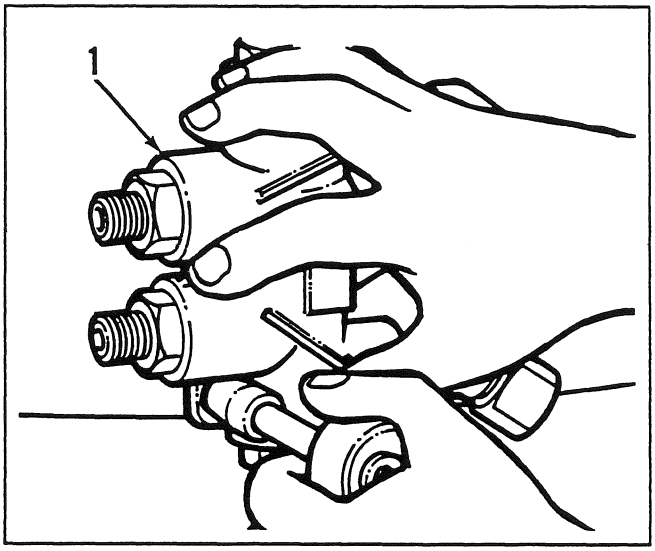


Fig. 3

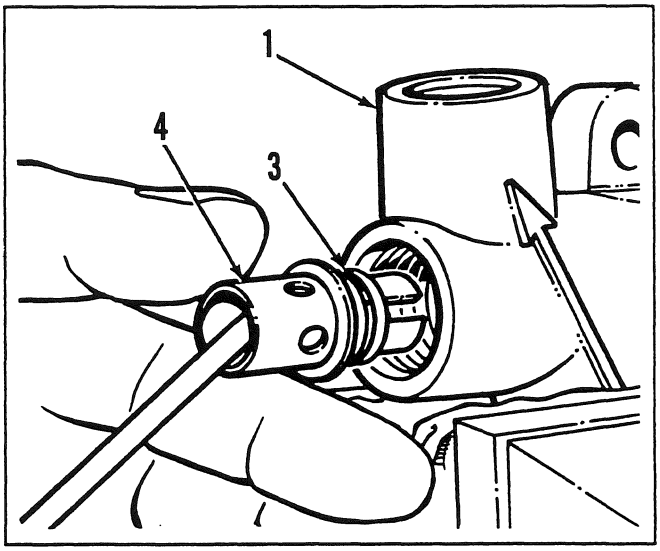


Fig. 6

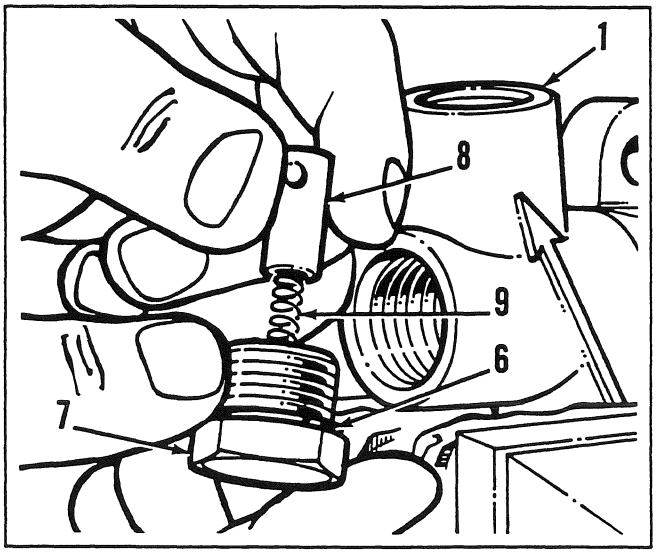


Fig. 4

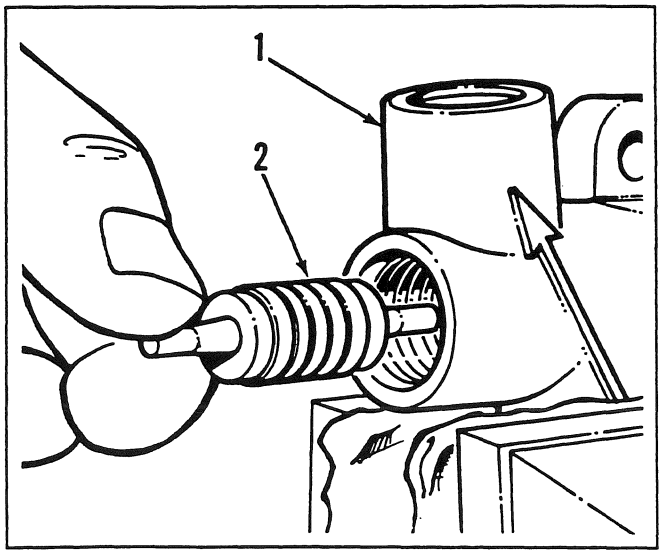


Fig. 7

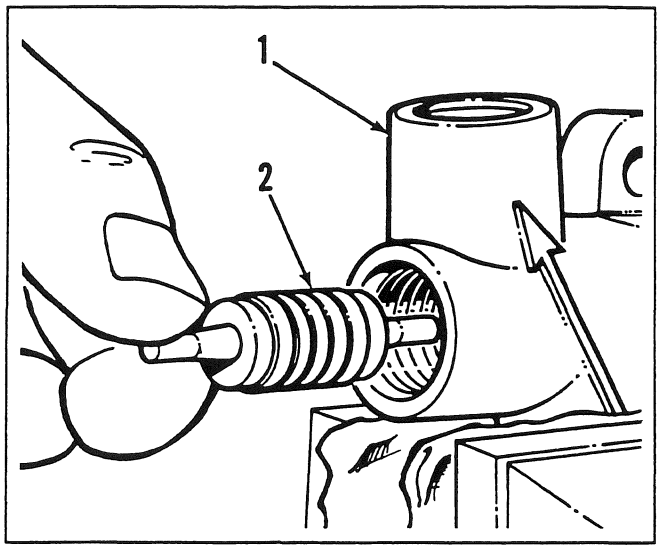


Fig. 8

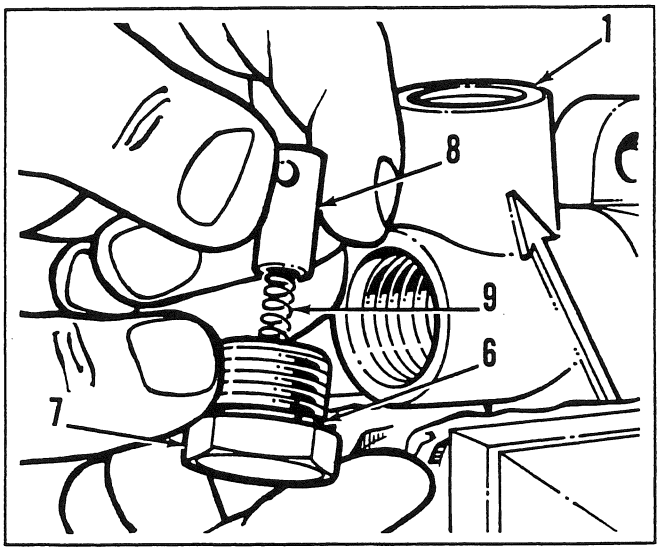


Fig. 11

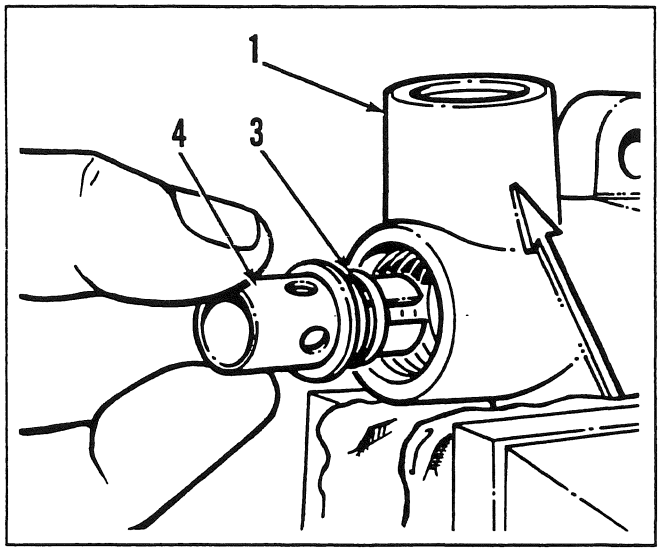


Fig. 9

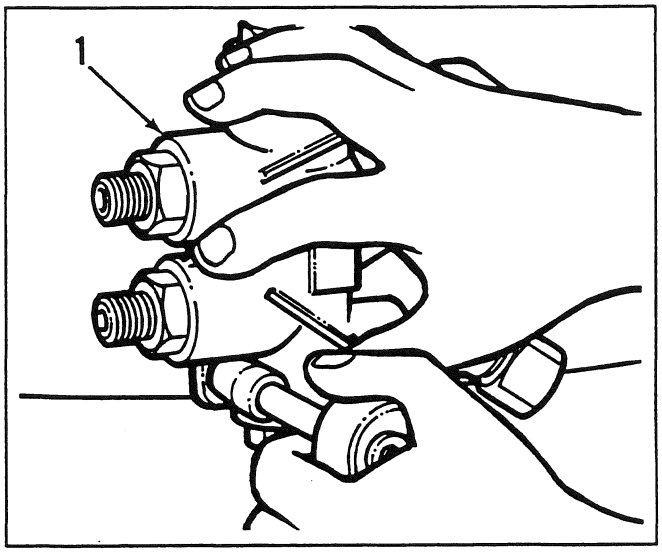


Fig. 12

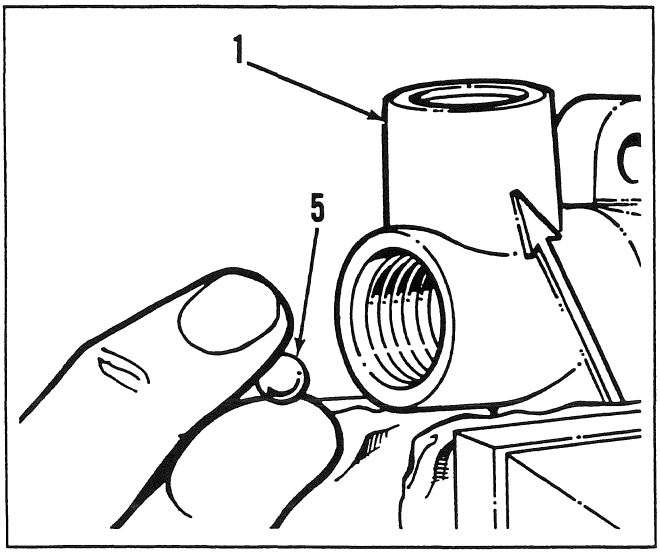


Fig. 10

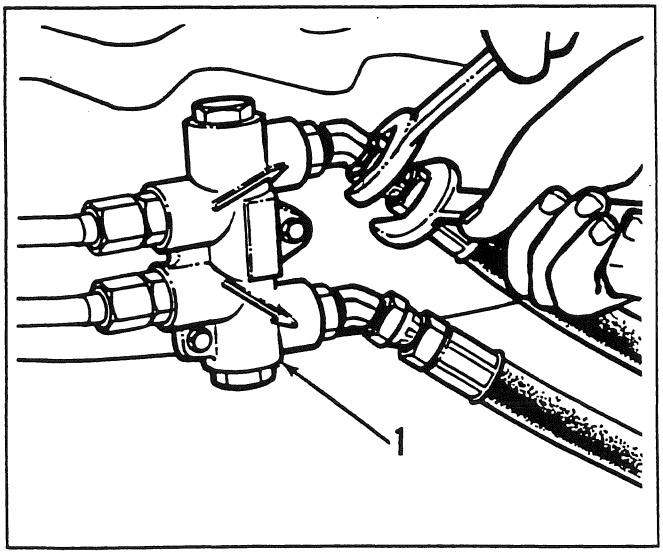


Fig. 13

Power Tilt Lock Valve - Assembly and Installation

Fig. 8
Install the pilot piston (2) into the valve body (1).

Fig. 9
Lubricate and install a new O ring (3) onto the check valve seat (4). Install the check valve seat into the valve body (1).

Fig. 10
Install the check ball (5) into the valve body (1).

Fig. 11
Lubricate and install a new O ring (6) onto the O ring cap (7). Install the O ring cap, spring (9) and spring seat (8) into the valve body (1). Repeat steps **Fig. 9** through **Fig. 11** for the other end of the lock valve.

Fig. 12
Retain the valve body (1) to the circle outside diameter with the bolts.

Fig. 13
Connect all hoses and tubes to the valve body (1). Tighten the fittings. Test the operation of the power tilt cylinders and check for leaks. It may take several cycles of operation to purge the hydraulic system of air.

Counterbalance Valve - Description (Fig. 1K)

The counterbalance valve is a double pilot operated check valve installed in the blade lift, leaning wheel and moveable point lock cylinder hydraulic circuits. It is used to lock hydraulic fluid in the cylinders and prevents cylinder cavitation, blade lift or moveable lock "creep" and leaning wheel cylinder "drift".

Hydraulic fluid directed to one end of the cylinder pushes the check poppet (8) against the spring (11). Hydraulic fluid is then free to flow into the cylinder. Hydraulic fluid at the other end of the cylinder is locked in and pressure builds back to the pilot piston (3). The pilot piston pushes against the pilot poppet (9) which moves off its seat. Hydraulic fluid is then free to flow from the other end of the cylinder. Both the check poppet and pilot poppet are tapered to enable smooth, accurate hydraulic control of these circuits.

Two thermal relief valves (13) are incorporated in the counterbalance valve to vent high oil pressures, created by thermal expansion, from the cylinders to the manifold valve ports. Champion advises that you do not disassemble or adjust the thermal relief valves.

*NOTE: Refer to your 700 Series Parts Manual P/N **L 3008** for the specific blade lift, leaning wheel and moveable point lock cylinder hydraulic circuit counterbalance valves installed on your grader.*

Counterbalance Valve - Removal and Disassembly

Fig. 2

Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Loosen the hose and tube fittings slowly and carefully to release any accumulated pressure in the cylinder(s). Remove the hoses and tubes from the valve body (15) and clean up any oil leakage. Cap the hoses, tubes and fittings to prevent contamination.

Fig. 3

Remove the bolts, nuts and lockwashers retaining the valve body (15) to the blade lift cylinder bracket or grader frame. Remove the counterbalance valve assembly.

Fig. 4

Install the valve body (15) in a vise with soft jaws. Do not overtighten the vise. Remove the end caps (12) containing the check valve assemblies (2). Remove and discard the O rings (1).

Fig. 5

Remove the check valve seats (7) from the valve body (15). Remove and discard the O ring (6) and split ring (5) from the seats. Note the positions of the O ring and split ring.

Fig. 6

Remove the pilot piston (3) from the valve body (15). Remove and discard the O ring (4). Repeat steps **Fig. 4** through **Fig. 6** for the other end of the lock valve. Inspect all components for damage or wear. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

Counterbalance Valve - Assembly and Installation

Fig. 7

Lubricate and install a new O ring (4) onto the pilot piston (3). Install the pilot piston into the valve body (15).

SECTION 4K
HYDRAULICS
Counterbalance Valves

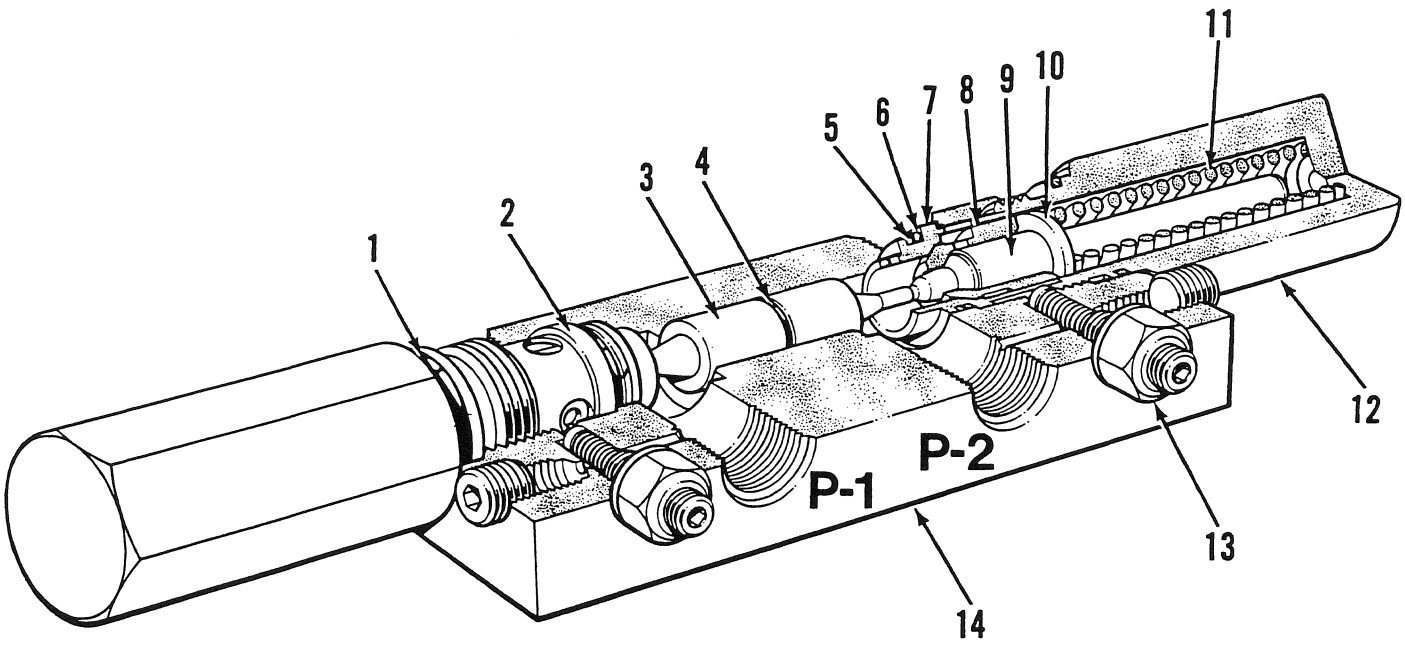


Fig. 1K Counterbalance Valve

Item	Description	Item	Description	Item	Description
1	O ring	6	O ring	11	Spring
2	Check valve assembly	7	Check valve seat	12	End cap
3	Pilot piston	8	Check poppet	13	Thermal relief valve assembly
4	O ring	9	Pilot poppet	14	Valve body
5	Split ring	10	Spring seat		

Key to Fig. 1K

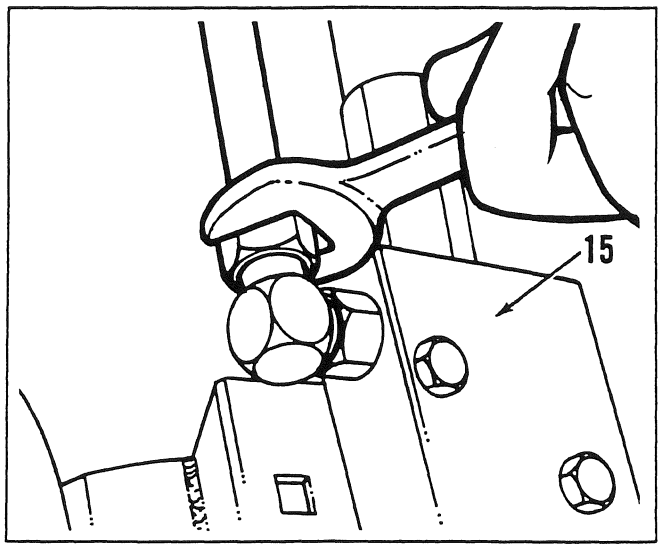


Fig. 2

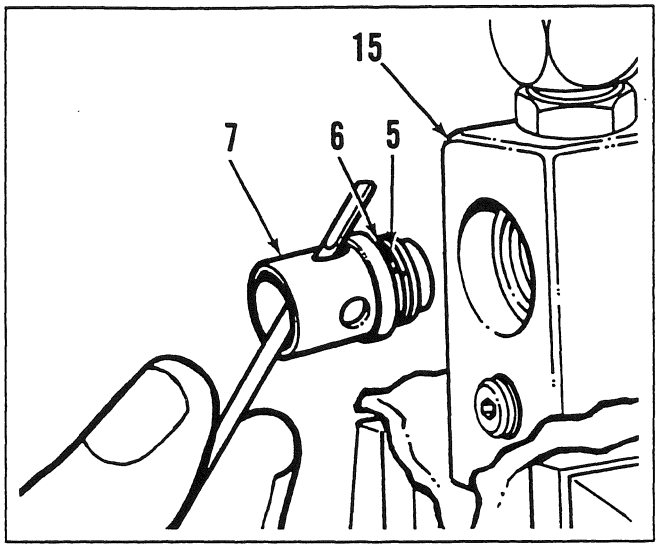


Fig. 5

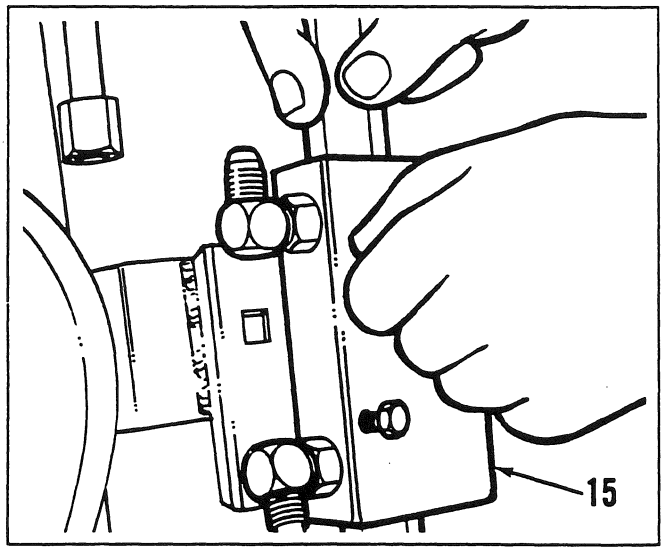
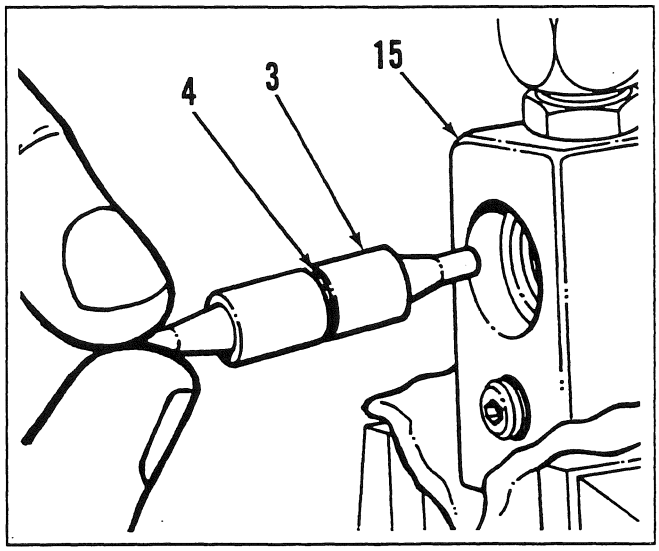


Fig. 3



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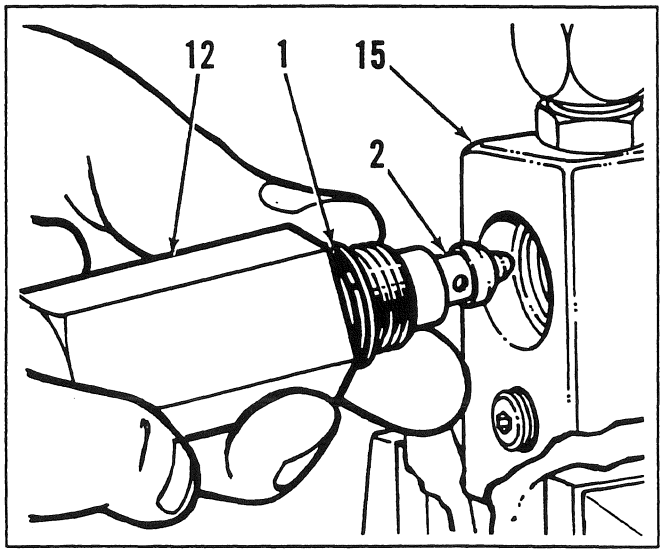

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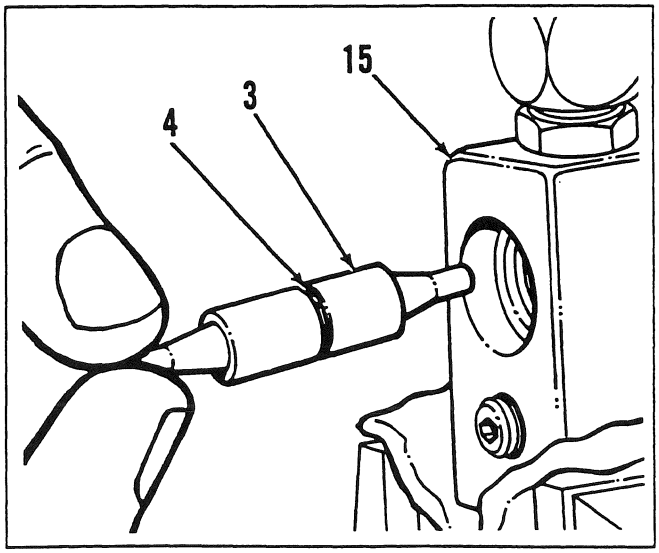


Fig. 7

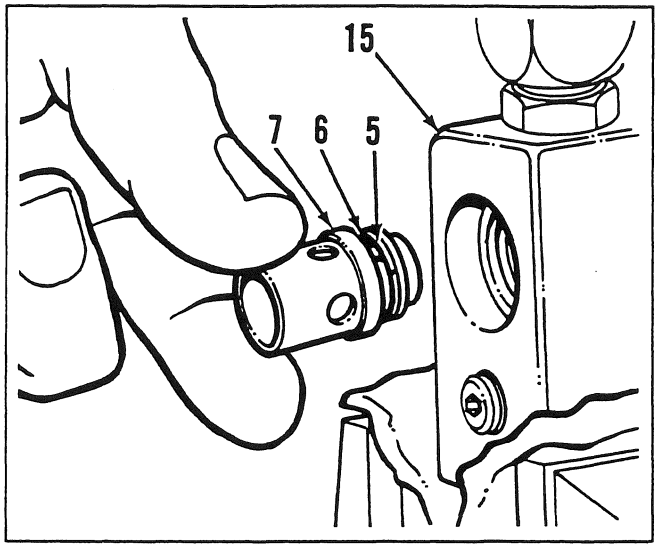


Fig. 8

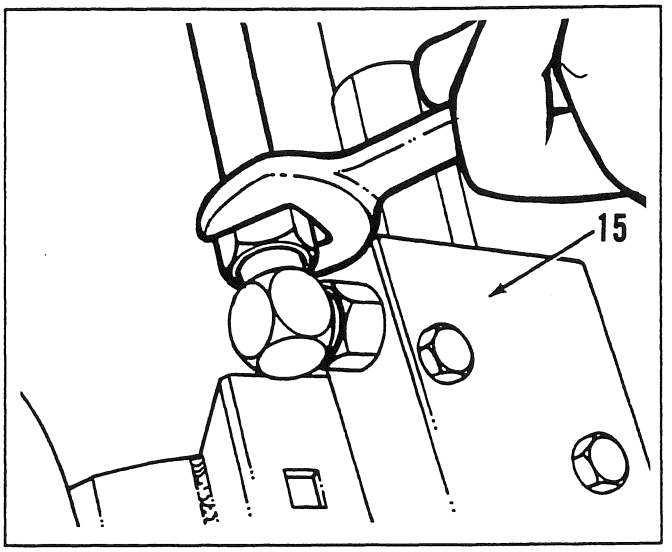


Fig. 11

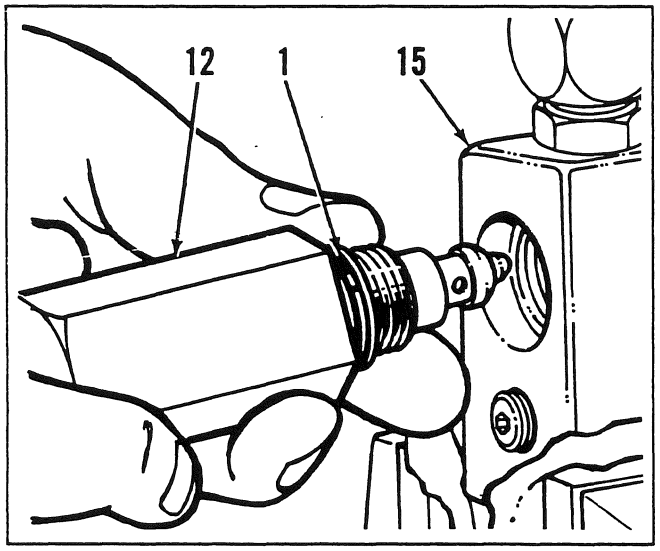


Fig. 9

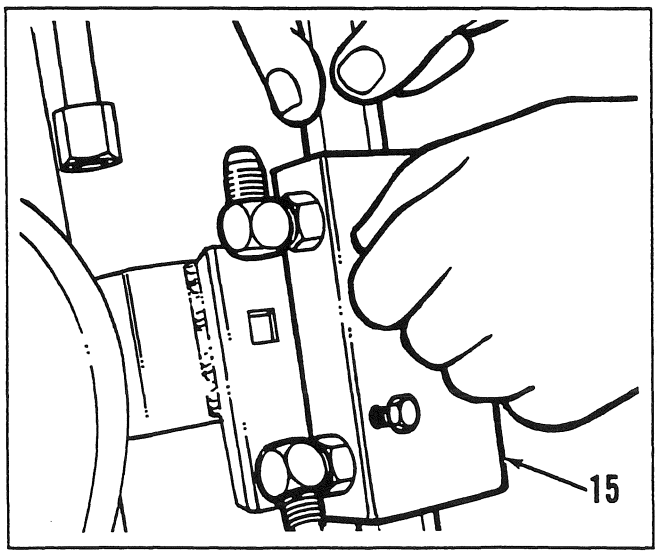


Fig. 10

*NOTE: Champion recommends installing parts contained in seal kit P/N **23712** for counterbalance valves P/N **34951**. Install parts contained in seal kit P/N **37215** for counterbalance valves P/N **27314**. Refer to the Champion Service Parts Kit Booklet P/N **L 21000** or 700 Series Parts Manual P/N **L 3008**.*

Counterbalance Valve - Assembly and Installation continued

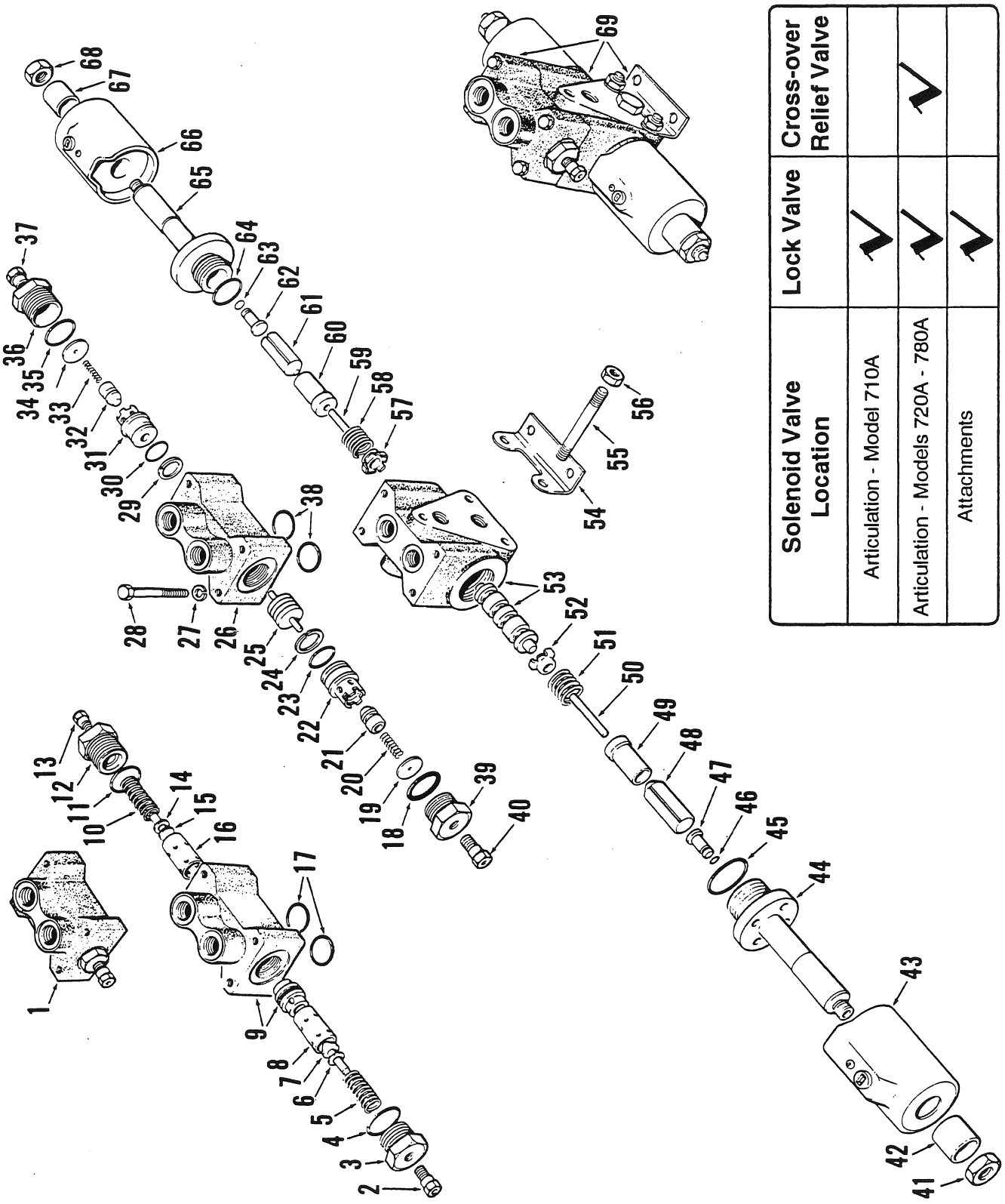
Fig. 8
Lubricate and install a new O ring (6) and split ring (5) onto the check valve seats (7). Install the seats into the valve body (15). Ensure you install the split rings on the pilot piston side of the check valve seat.

Fig. 9
Lubricate and install new O rings (1) onto the end caps (12). Install the end caps containing the check valve assemblies into the valve body (15). Repeat steps **Fig. 7** through **Fig. 9** for the other side of the counterbalance valve.

Fig. 10
Retain the valve body (15) to the blade lift cylinder bracket or grader frame with the bolts, nuts and lockwashers.

Fig. 11
Connect all hoses and tubes to the valve body (15). Tighten the fittings. Test the operation of the blade lift cylinders, moveable point lock cylinder, or wheel lean cylinders and check for leaks. It may take several cycles of operation to purge the hydraulic system of air.

SECTION 4L
HYDRAULICS
Solenoid Valves



Solenoid Valve Location	Lock Valve	Cross-over Relief Valve
Articulation - Model 710A	✓	
Articulation - Models 720A - 780A	✓	✓
Attachments	✓	

Fig. 1L Solenoid Valve

Item	Description	Item	Description	Item	Description
1	Cross-over relief valve	25	Shuttle spool	49	Plug
2	Thermal relief valve	26	Lock valve body	50	Pin
3	Plug	27	Lockwasher	51	Spring
4	O ring	28	Bolt	52	Spring retainer
5	Spring	29	Back-up ring	53	Directional spool and body (matched set)
6	Shim	30	O ring		
7	Poppet	31	Cage	54	Foot
8	Stop	32	Check	55	Tie rod
9	Cross-over relief valve body sub-assembly	33	Spring	56	Nut
		34	Washer	57	Spring retainer
10	Spring	35	O ring	58	Spring
11	O ring	36	Plug	59	Pin
12	Plug	37	Thermal relief valve	60	Plug
13	Thermal relief valve	38	O rings	61	Plunger
14	Shim	39	Plug	62	Standard flush button (manual override)
15	Poppet	40	Thermal relief valve		
16	Stop	41	Nut	63	O ring
17	O rings	42	Sleeve	64	O ring
18	O ring	43	Solenoid coil	65	Tube assembly
19	Washer	44	Tube assembly	66	Solenoid coil
20	Spring	45	O ring	67	Spacer
21	Check	46	O ring	68	Nut
22	Cage	47	Standard flush button (manual override)	69	Solenoid valve assembly
23	O ring				
24	Back-up ring	48	Plunger		

Key to Fig. 1L

Graders S/N **16224**, **16245** to **19983**, **19986** to **19995**, **19997** to **20004**, **20006** to **20103**, **20105** and **20107** to **20119**; U.S. S/N **2021-2** to **2658-2**, are equipped with solenoid valves with 1/2 in. SAE O ring pressure ports. Graders S/N **19982**, **19984**, **19985**, **19996**, **20005**, **20104**, **20106**, **20120** and up are equipped with solenoid valves with 5/8 in. SAE O ring pressure ports. Only the directional spool and body (53) has changed. Champion recommends upgrading earlier machines and installing directional spool and bodies with the larger port sizes whenever possible.

Starting at grader S/N **20719**, the external thermal relief valves (2) and (13) were replaced by internal thermal relief valves. The internal thermal relief valves are non-adjustable and require different internal porting in the directional control lock and cross-over relief sections. Do not mix them with external thermal relief valve components.

Solenoid Valve - Removal

Fig. 2
Place the grader in the SERVICE POSITION. Refer to the procedure on page (ii) in the front of this Shop Manual section. Solenoid valves are used on articulated graders and for the operation of some attachments. Thoroughly clean the area where the solenoid valve is located. Identify all hoses and tubes to prevent confusion during assembly. Disconnect the hoses, tubes and wires. Cap the fittings and ports to prevent contamination. Remove the solenoid valve assembly (69) from the grader.

Fig. 5
Remove the nut (41) and sleeve (42) from the tube assembly (44). Remove the solenoid coil (43).

Solenoid Valve (All Models) - Disassembly

Fig. 3
Remove the nuts (56) and tie rods (55) securing the mounting feet (54). Remove the mounting feet. Secure the valve body in a vise with soft jaws. Do not overtighten the vise. Remove the bolts (28) and lockwashers (27) retaining the cross-over relief valve (1). Remove the cross-over relief valve from the solenoid valve body (53).

Fig. 6
Remove the tube assembly (44) from the solenoid valve body (53). Remove and discard the O ring (45).

Fig. 4
Remove and discard the O rings (38) from the recesses in the solenoid valve body (53).

Fig. 7
Remove the pin (50) from the tube assembly (44).

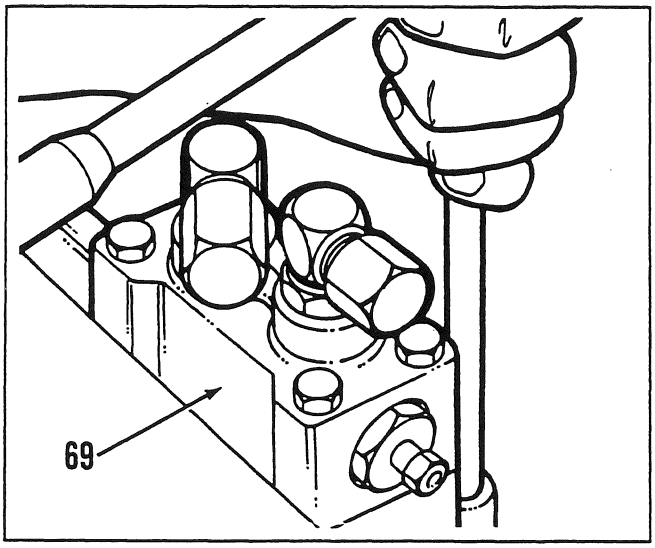


Fig. 2

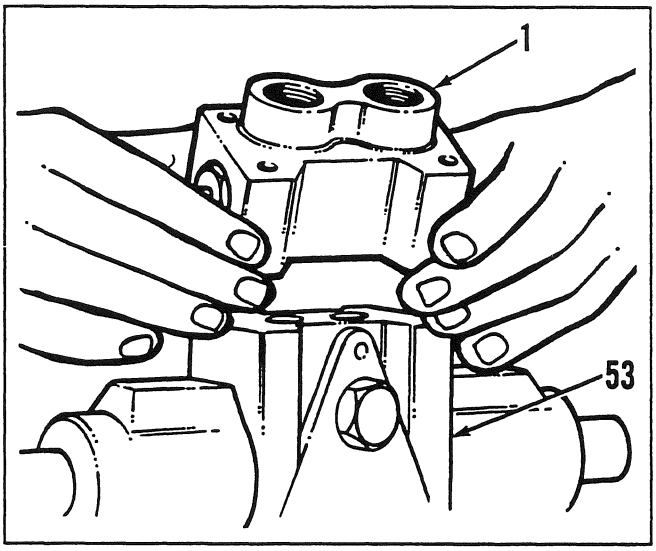


Fig. 3

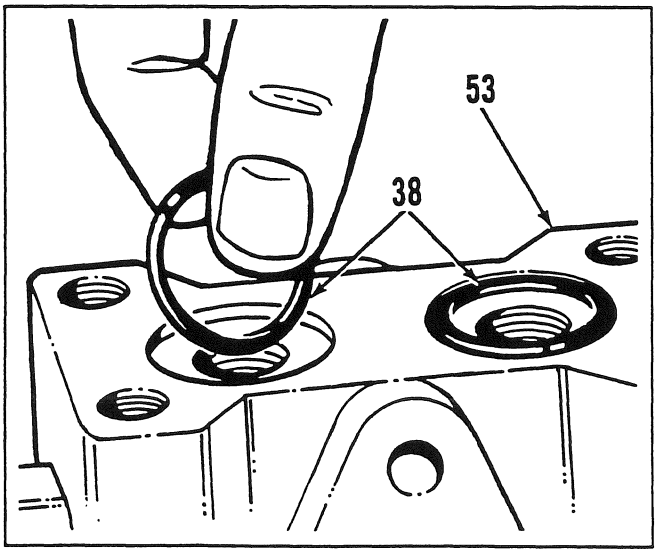


Fig. 4

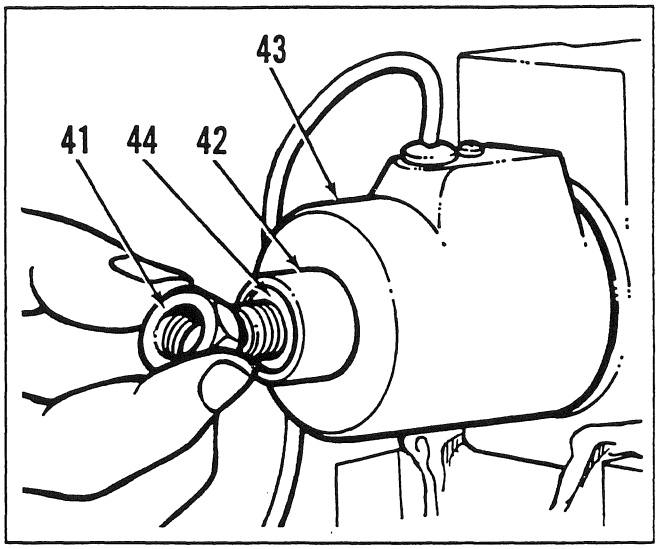


Fig. 5

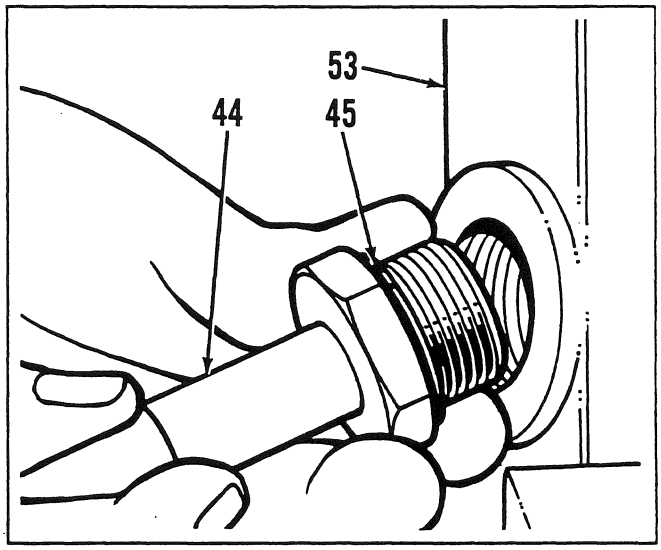
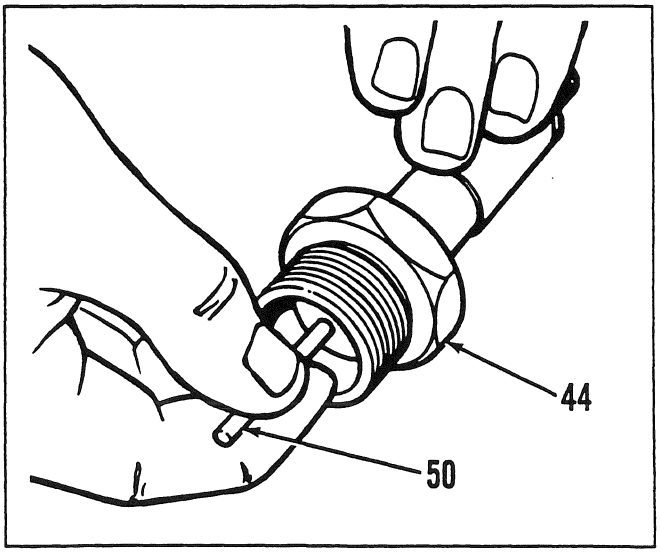


Fig. 6



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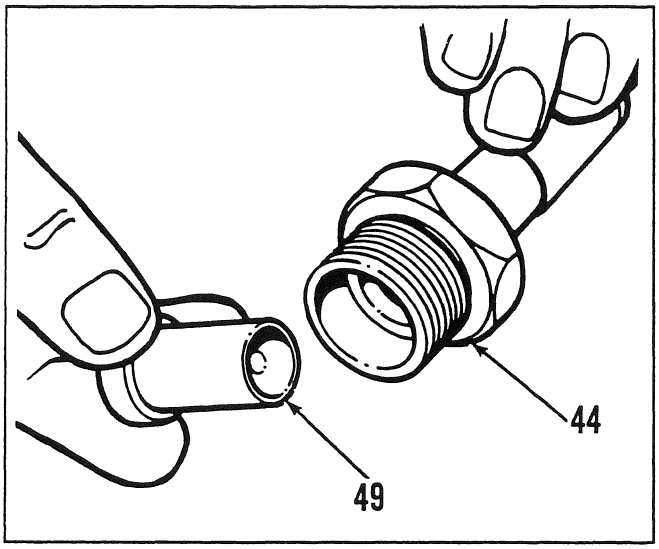


Fig. 8

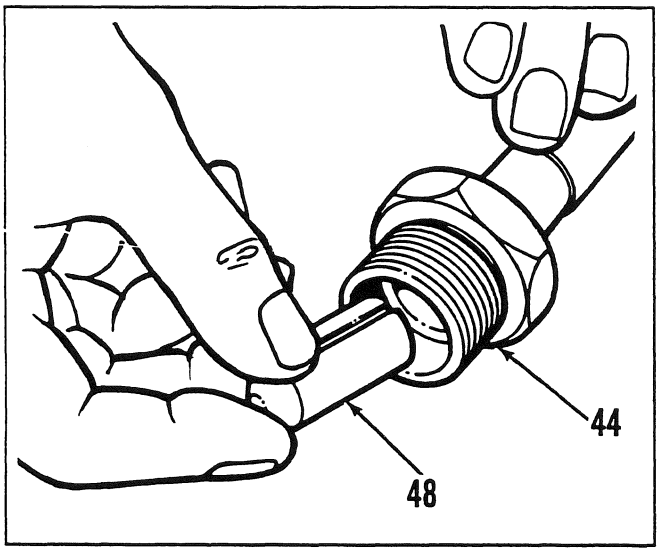
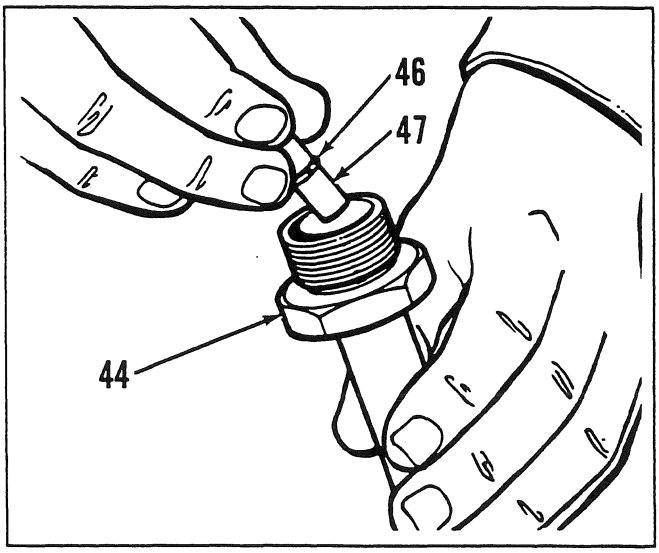


Fig. 9



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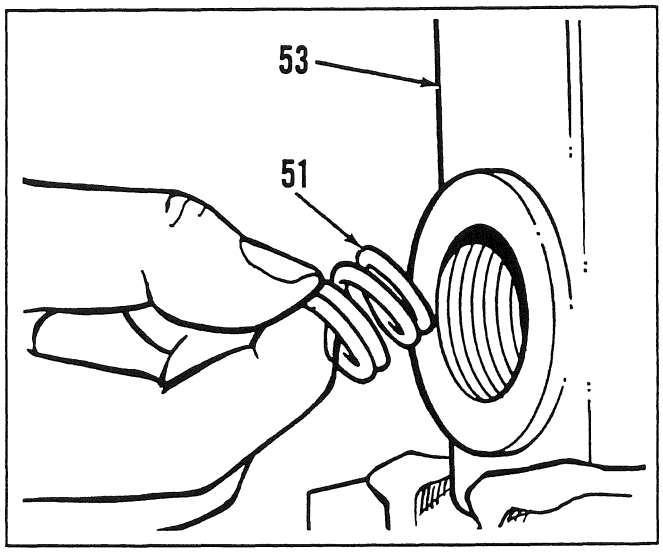


Fig. 11

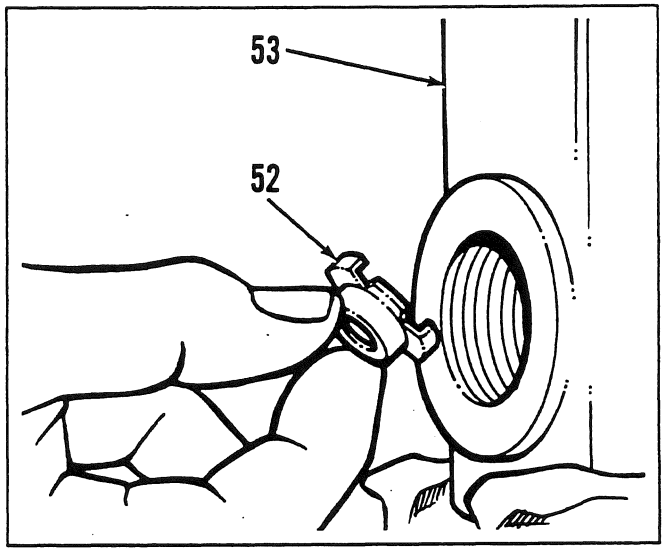


Fig. 12

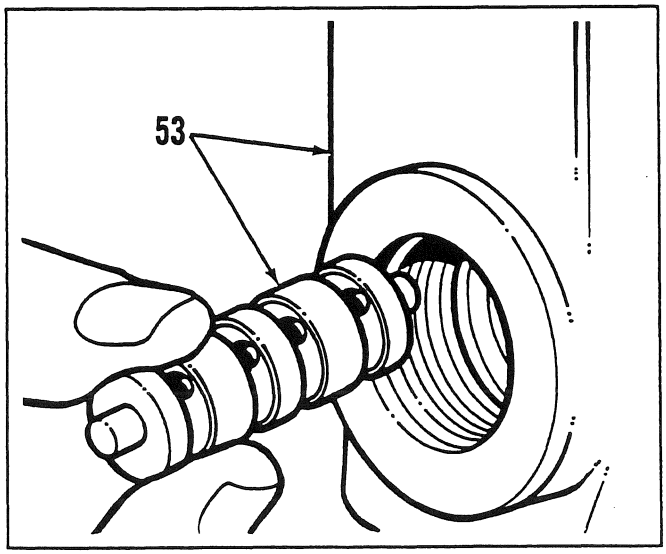


Fig. 13

Solenoid Valve (All Models) - Disassembly

continued

Fig. 8

Remove the plug (49) from the tube assembly (44).

Fig. 9

Remove the plunger (48) from the tube assembly (44).

Fig. 10

Remove the standard flush button (manual override) (47) from the tube assembly (44). Remove and discard the O ring (46).

Fig. 11

Remove the spring (51) from the solenoid valve body (53).

Fig. 12

Remove the spring retainer (52) from the solenoid valve body (53). Repeat steps **Fig. 5** through **Fig. 12** for the solenoid cartridge on the other side of the valve body.

Fig. 13

Remove the directional spool (53) from the solenoid valve body (53). Thoroughly clean the directional spool and valve body. Inspect the directional spool and valve body for serviceability. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

NOTE: *The directional spool and valve body are a matched set and cannot be separately interchanged with another directional spool or valve body.*

Solenoid Valve (All Models) - Assembly

Fig. 14
Lubricate the directional spool (53) and solenoid valve body (53) bore with system oil. Carefully install the directional spool into the valve body and centralize it in the bore.

Fig. 15
Install the spring retainer (52) into the solenoid valve body (53).

Fig. 16
Install the spring (51) into the solenoid valve body (53).

Fig. 17
Lubricate and install a new O ring (46) onto the standard flush button (manual override) (47). Lubricate and install the flush button into the tube assembly (44). The flanged end of the standard flush button (manual override) must point toward the solenoid valve body (53) when the tube assembly is installed.

Fig. 18
Lubricate and install the plunger (48) into the tube assembly (44). The conical end of the plunger must point toward the solenoid valve body (53) when the tube assembly is installed.

Fig. 19
Lubricate and install the plug (49) into the tube assembly (44). The flanged end of the plug must point toward the solenoid valve body (53) when the tube assembly is installed.

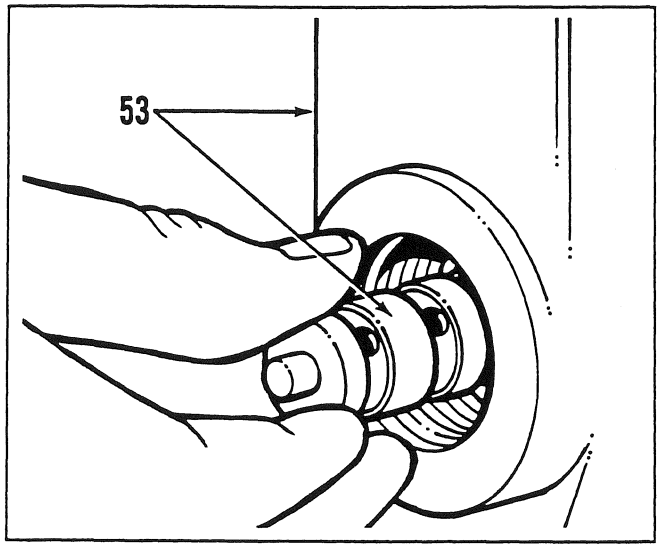


Fig. 14

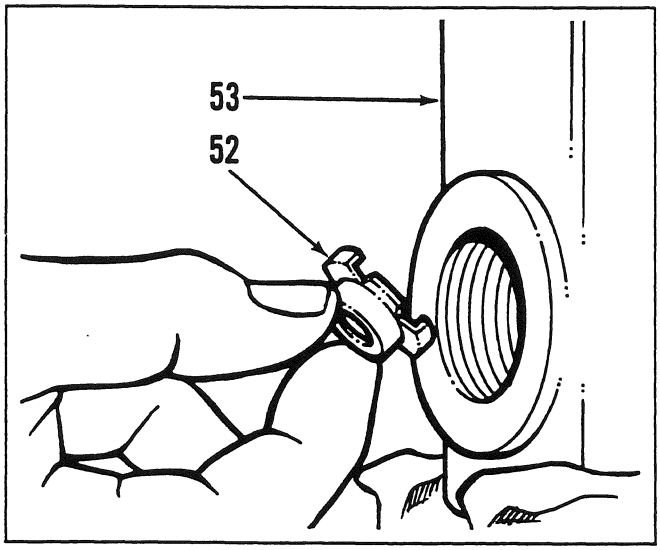


Fig. 15

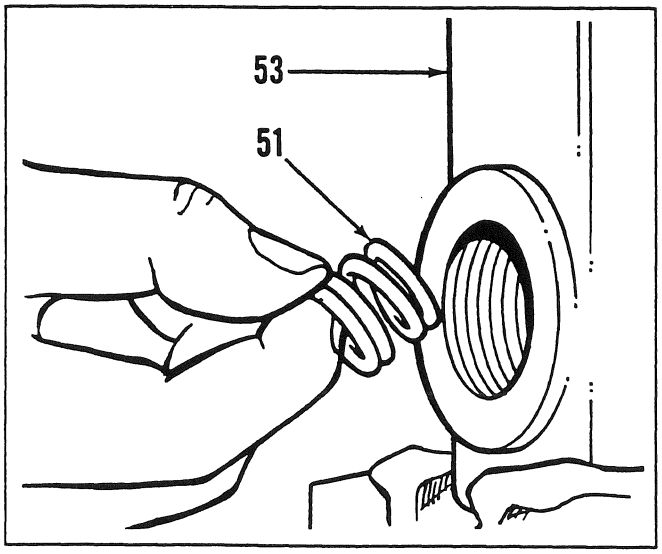


Fig. 16

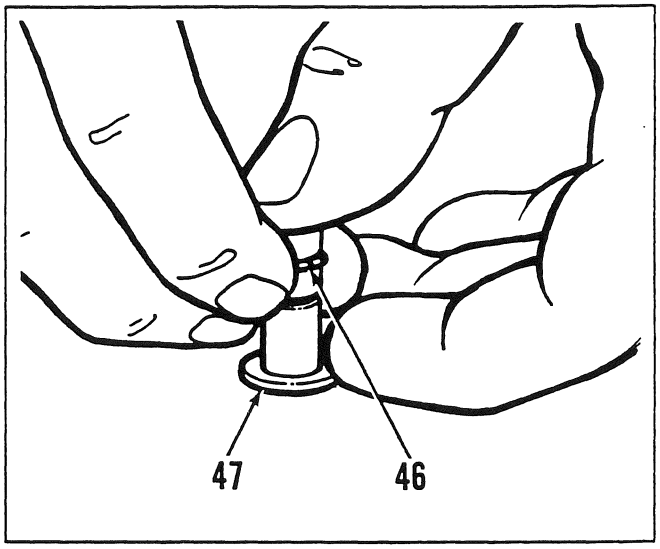


Fig. 17

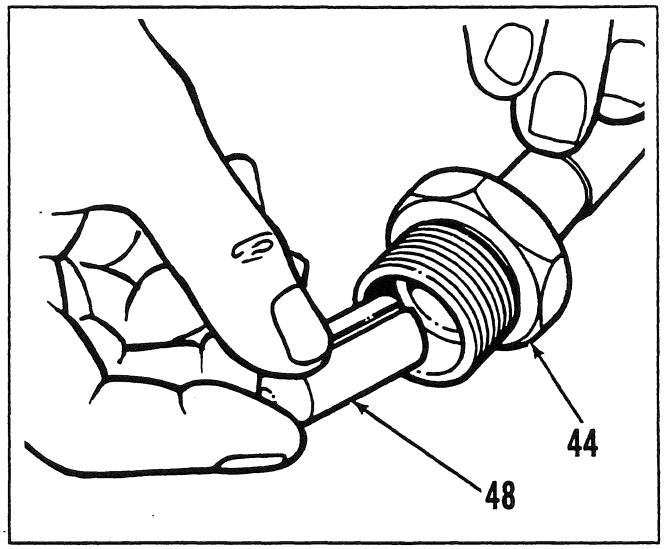


Fig. 18

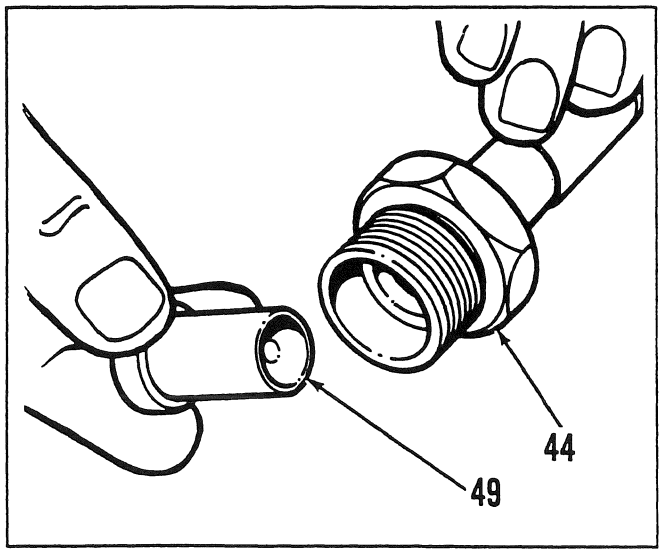
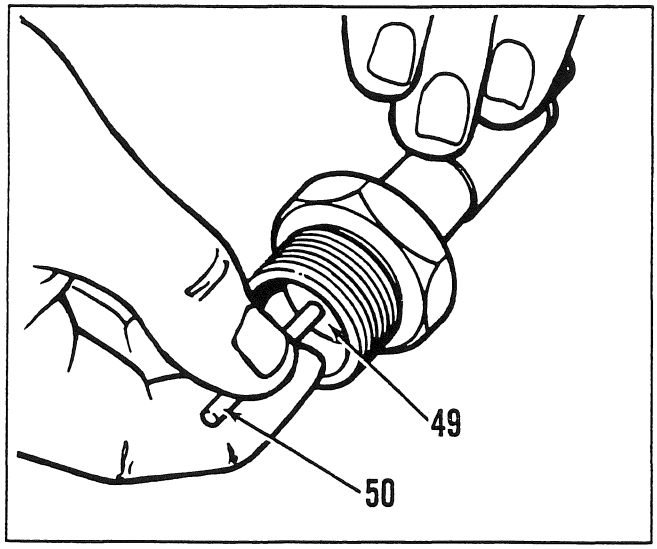


Fig. 19



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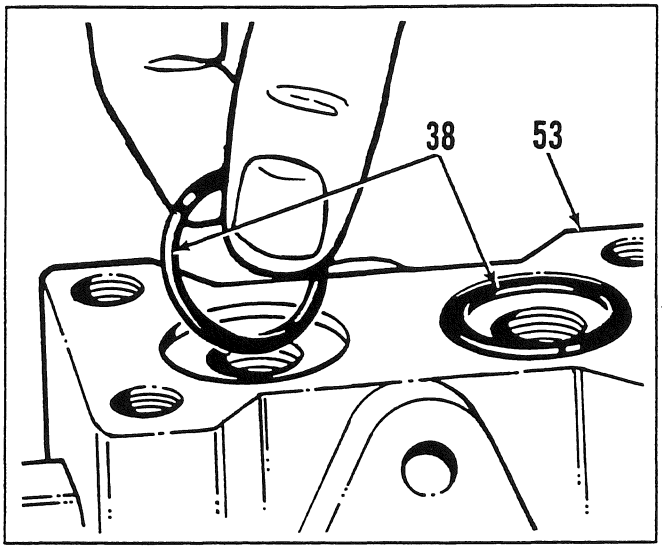


Fig. 23

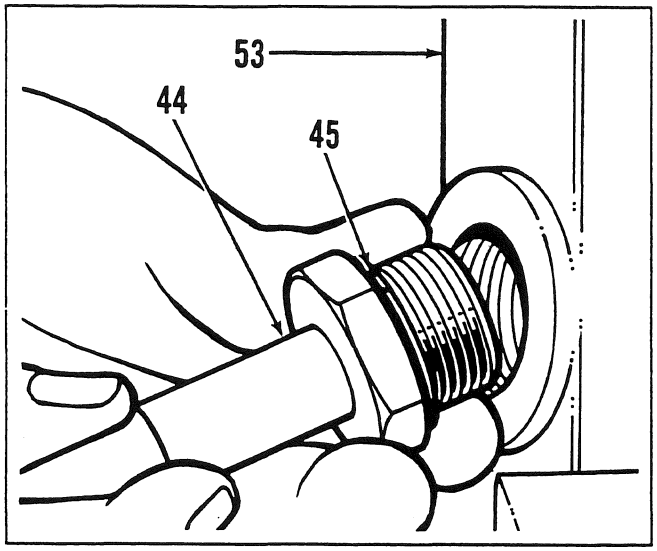


Fig. 21

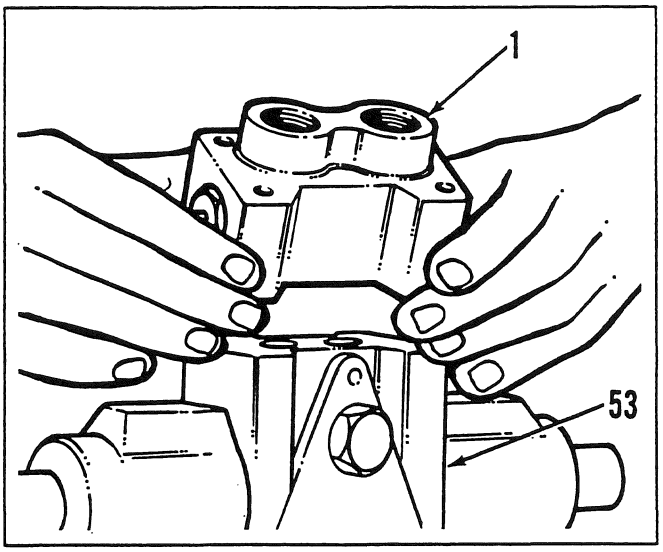


Fig. 24

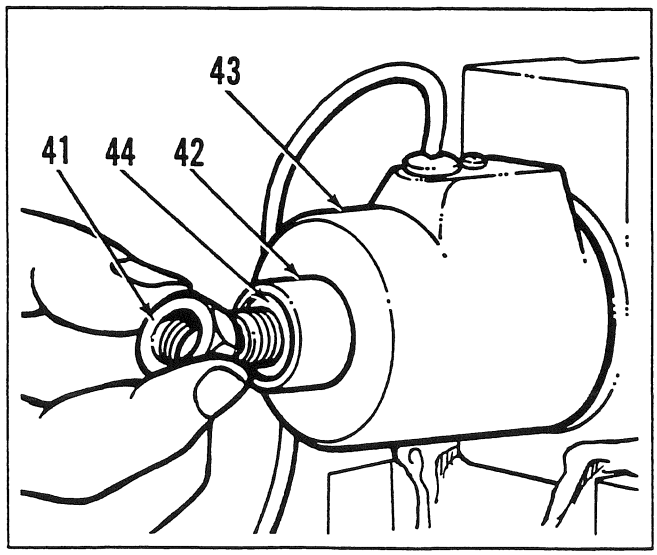


Fig. 22

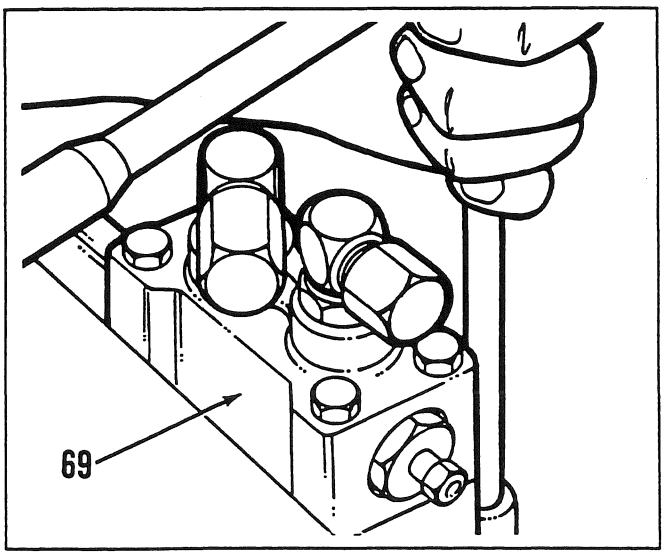


Fig. 25

Solenoid Valve (All Models) - Assembly
continued

Fig. 20
Lubricate and install the pin (50) into the bore of the plug (49).

Fig. 21
Lubricate and install a new O ring (45) onto the tube assembly (44). Install the tube assembly into the solenoid valve body (53). Tighten the tube assembly to the specified torque.

Fig. 22
Install the solenoid coil (43), sleeve (42) and nut (41) onto the tube assembly (44). Tighten the nuts to the specified torque. Repeat step **Fig. 15** through **Fig. 22** for the solenoid cartridge on the other side of the valve body.

Fig. 23
Lubricate and install two new O rings (38) in the recesses of the solenoid valve body (53).

Fig. 24
Carefully install the cross-over relief valve (1) and secure with the four bolts (28) and lockwashers (27). Install the mounting feet (54) on the solenoid valve body (53) and retain with the tie rods (55) and nuts (56). The nuts must be torque-tightened in three increments: 50 lbf·in. (6,0 N·m; 0,6 kgf·m), 90 lbf·in. (10 N·m; 1,0 kgf·m), and 115 lbf·in. (13 N·m; 1,3 kgf·m).

NOTE: *Torque-tighten one side at a time. Do not overtorque; possible bore distortion may cause spool binding or valve leakage.*

Solenoid Valve - Installation

Fig. 25
Install the solenoid valve assembly (69) onto the grader. Connect the hoses, tubes and wires to the solenoid valve. Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and test the function controlled by the solenoid valve. Shut down the engine. Check the hydraulic fluid level and for leaks.

Cross-over Relief Valve (Articulation Solenoid Valve, Models 720A - 740A) - Disassembly

Fig. 26

Refer to **Solenoid Valve (All Models) - Removal** and remove the cross-over relief valve (1) from the solenoid valve body (53). Remove the plug (3), thermal relief valve (2) and spring (5) from the cross-over relief valve body sub assembly (9). Remove and discard the O ring (4).

Fig. 27

Remove the poppet (7), shims (6) and stop (8) from the cross-over relief valve body sub-assembly (9).

Fig. 28

Repeat steps **Fig. 26** and **Fig. 27** for the thermal relief on the other side of the cross-over relief valve body sub-assembly (9). Use a hammer and soft metal drift to gently force the seat (9) out of the valve body. Remove and discard the O ring and back-up rings. Thoroughly clean the seat and valve body. Inspect the seat and valve body for serviceability. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

NOTE: *The seat and cross-over relief valve body are a matched set and cannot be separately interchanged with another seat or cross-over relief valve body.*

Cross-over Relief Valve (Articulation Solenoid Valve, Models 720A - 740A) - Assembly

Fig. 29

Lubricate and install a new O ring and back-up rings onto the seat (9). Lubricate and carefully install the seat in the cross-over relief valve body bore.

Fig. 30

Lubricate and install the stop (8), poppet (7) and shims (6) into the cross-over relief valve body sub-assembly (9).

Fig. 31

Lubricate and install a new O ring (4) onto the plug (3). Install the spring (5), plug and thermal relief valve (2) into the cross-over relief valve body sub-assembly (9). Repeat steps **Fig. 30** and **Fig. 31** for the thermal relief on the other side of the valve body. Install the solenoid valve assembly (69) onto the grader. Connect the hoses, tubes and wires to the solenoid valve. Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and test the function controlled by the solenoid valve. Shut down the engine. Check the hydraulic fluid level and for leaks.

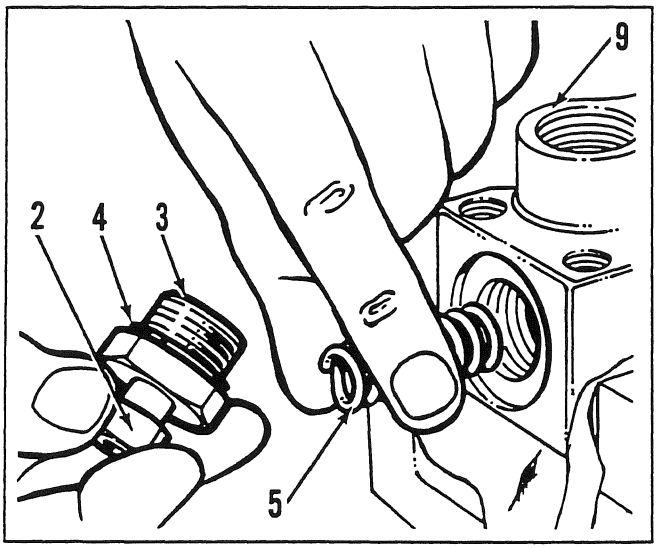


Fig. 26

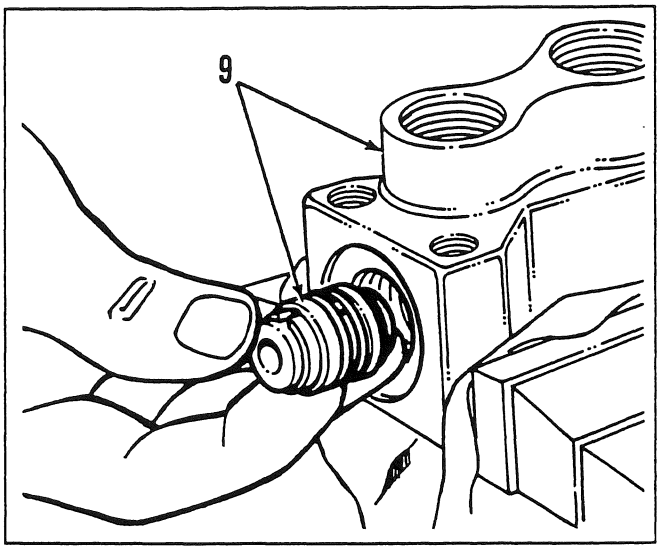


Fig. 29

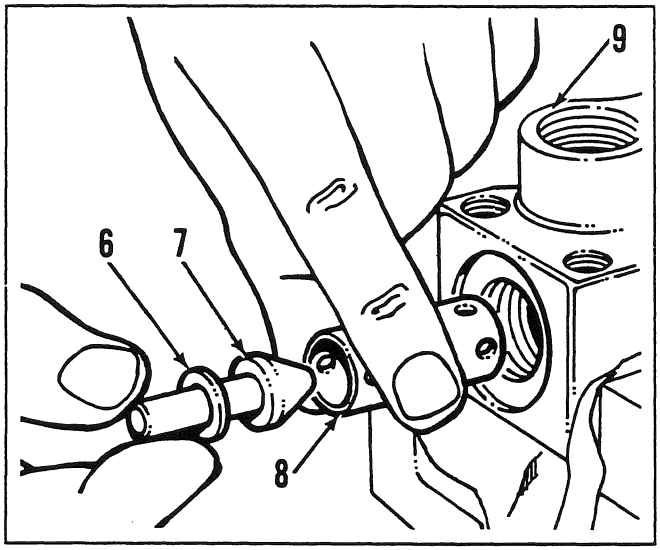


Fig. 27

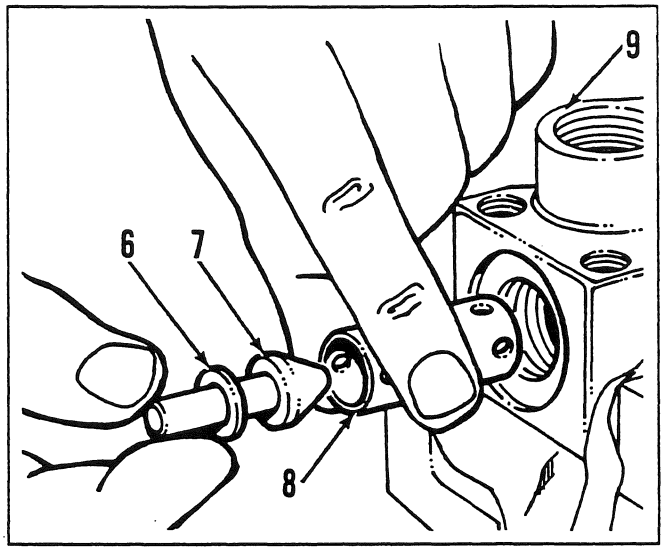
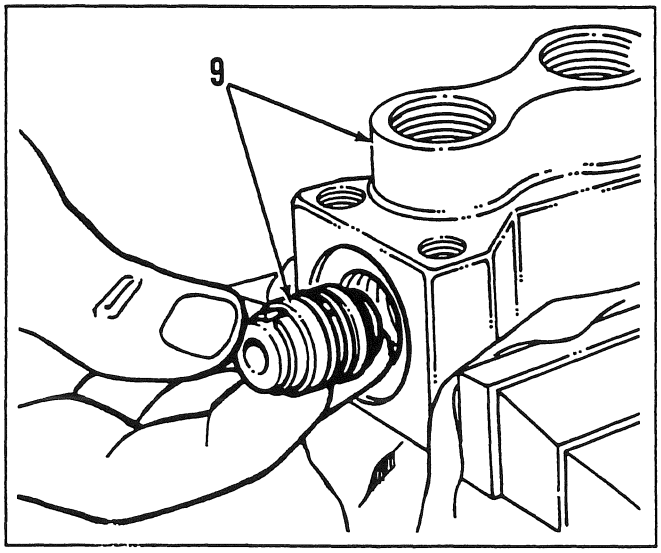


Fig. 30



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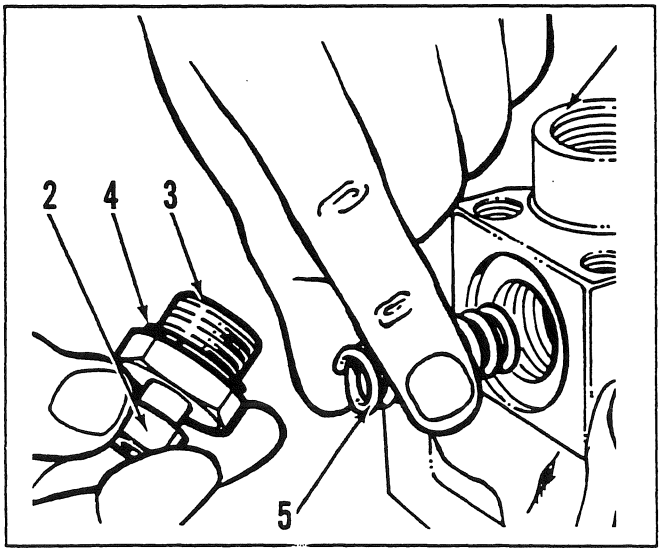
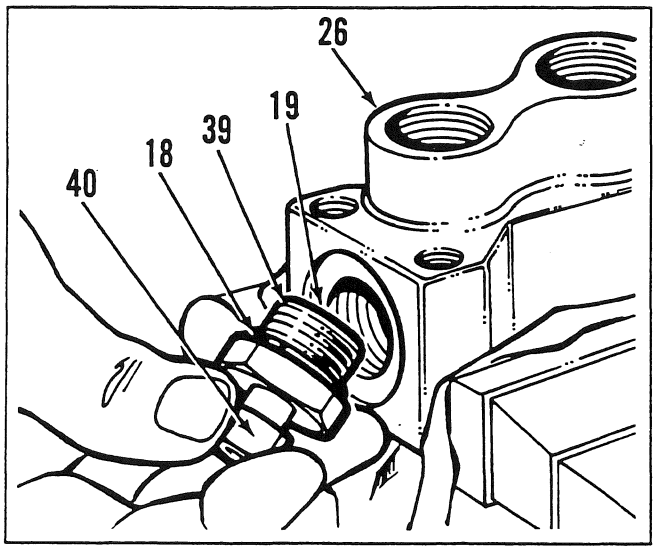


Fig. 31



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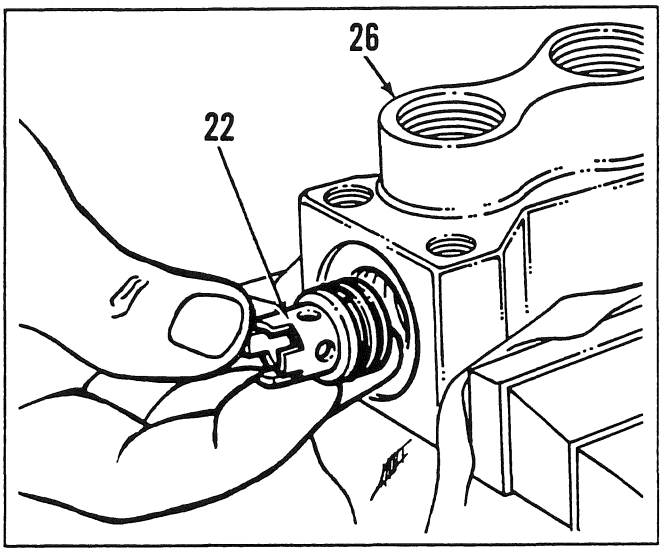

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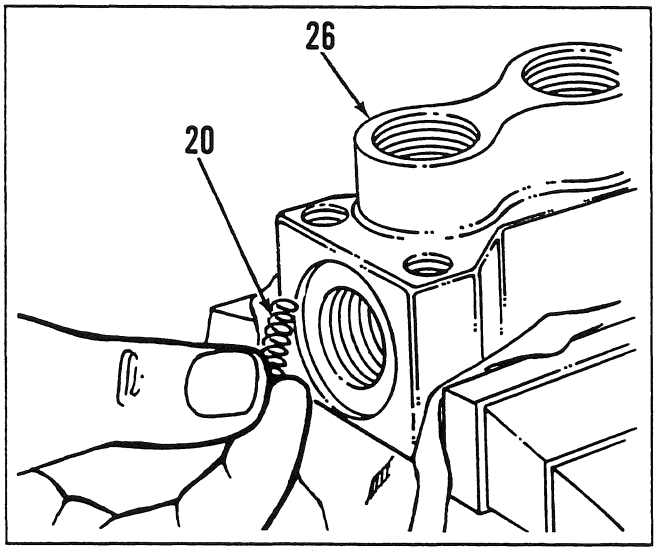

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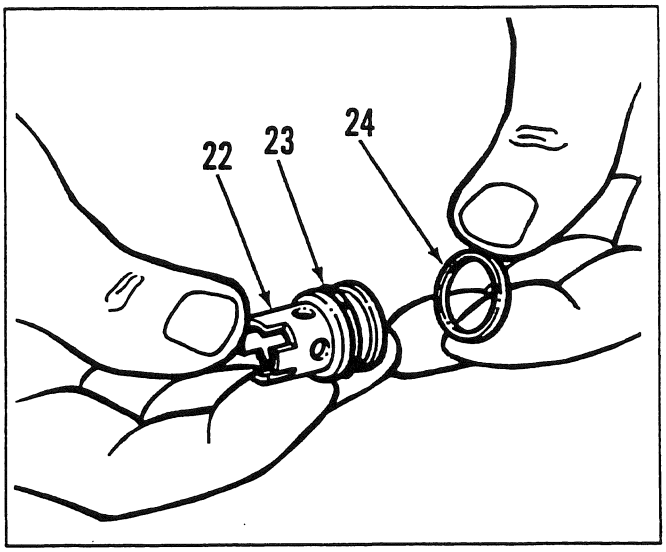


Fig. 36

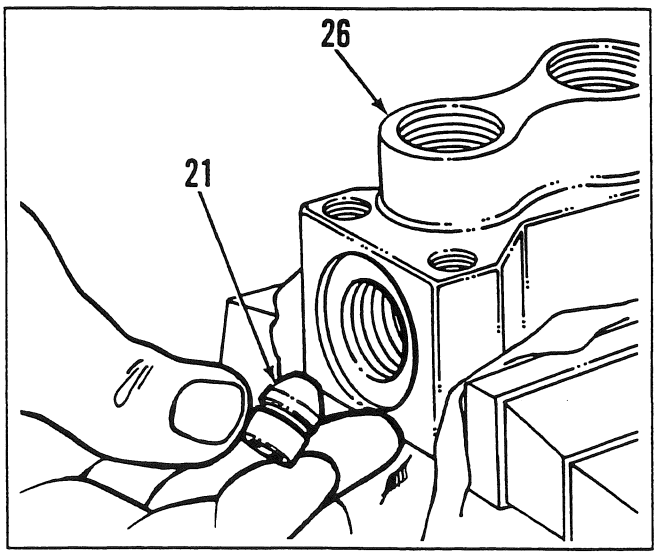


Fig. 34

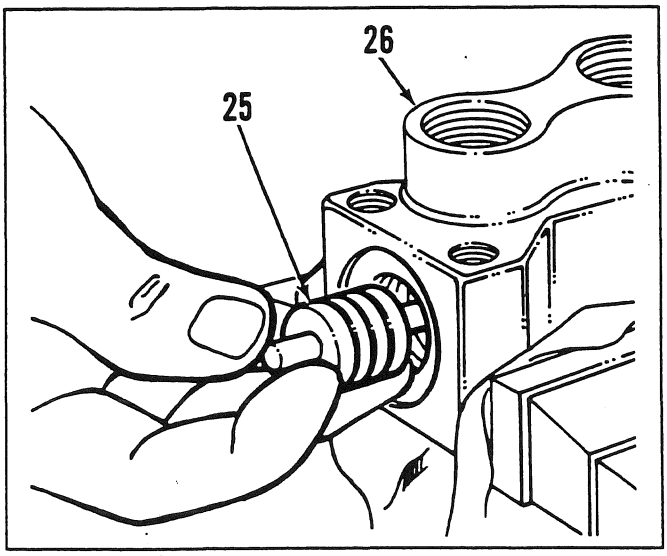


Fig. 37

Cross-over Relief Valve (Articulation Solenoid Valve, Model 710A, Attachment Solenoid Valves, All Models) - Disassembly

Fig. 32
Refer to **Solenoid Valve (All Models) - Removal** and remove the cross-over relief valve (1) from the solenoid valve body (53). Remove the plug (39), thermal relief valve (40) and washer (19) from the lock valve body (26). Remove and discard the O ring (18).

Fig. 33
Remove the spring (20) from the lock valve body (26).

Fig. 34
Remove the check (21) from the lock valve body (26).

Fig. 35
Remove the cage (22) from the lock valve body (26). Repeat steps **Fig. 32** through **Fig. 35** for the thermal relief on the other side of the lock valve body.

NOTE: *The checks, cages and lock valve body are a matched set and cannot be separately interchanged with another check, cage or lock valve body.*

Fig. 36
Remove and discard the O ring (23) and back-up ring (24) from the cage (22). Note the position of the O ring and back-up ring.

Fig. 37
Use a hammer and soft metal drift to gently force the shuttle spool (25) out of the lock valve body (26). Thoroughly clean the shuttle spool and lock valve body. Inspect the shuttle spool and lock valve body for serviceability. Refer to **Cleaning and Inspection** found at the front of this Shop Manual section.

NOTE: *There are two different shuttle spool designs, one for the articulation solenoid valve and one for the attachment solenoid valve. The articulation shuttle spool has larger diameter ends than the attachment shuttle spool.*

Cross-over Relief Valve (Articulation Solenoid Valve, Model 710A, Attachment Solenoid Valves, All Models) - Assembly

Fig. 38
Lubricate and install the shuttle spool (25) into the lock valve body (26).

Fig. 39
Lubricate and install a new O ring (23) and back-up ring (24) into their appropriate positions in the cage (22) groove.

Fig. 40
Lubricate and carefully install the cage (22) into the lock valve body (26).

Fig. 41
Install the check (21) into the lock valve body (26).

Fig. 42
Install the spring (20) into the lock valve body (26).

Fig. 43
Lubricate and install a new O ring (18) onto the plug (39). Install the washer (19), plug and thermal relief valve (40) into the lock valve body (26). Repeat steps **Fig. 39** through **Fig. 43** for the thermal relief on the other side of the lock valve body. Install the solenoid valve (69) onto the grader. Connect the hoses, tubes and wires to the solenoid valve. Perform the daily pre-start checks detailed in the 700 Series Operator's Manual. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and test the function controlled by the solenoid valve. Shut down the engine. Check the hydraulic fluid level and for leaks.

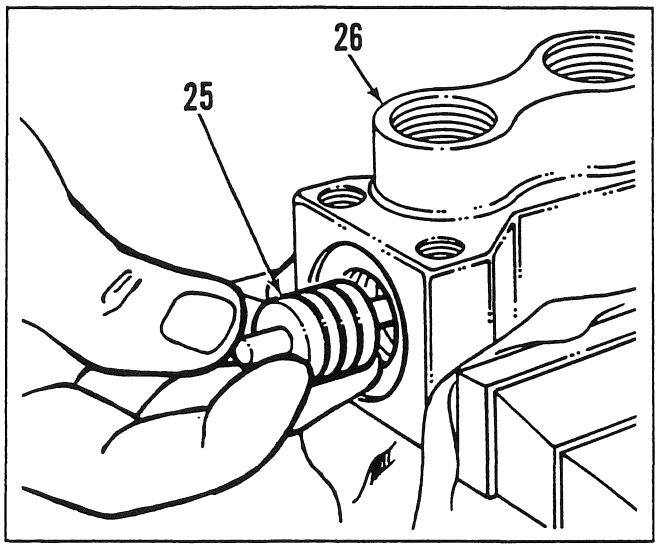


Fig. 38

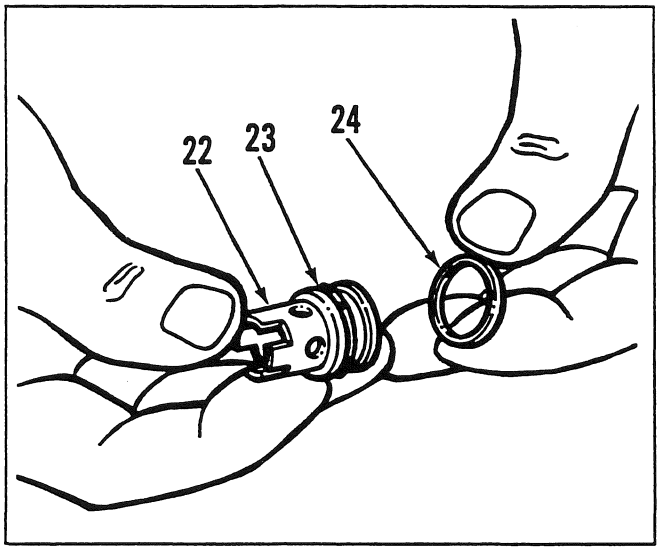


Fig. 39

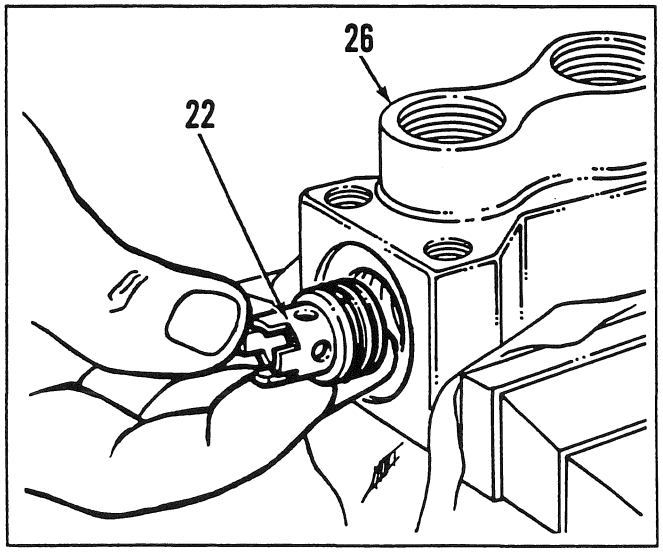


Fig. 40

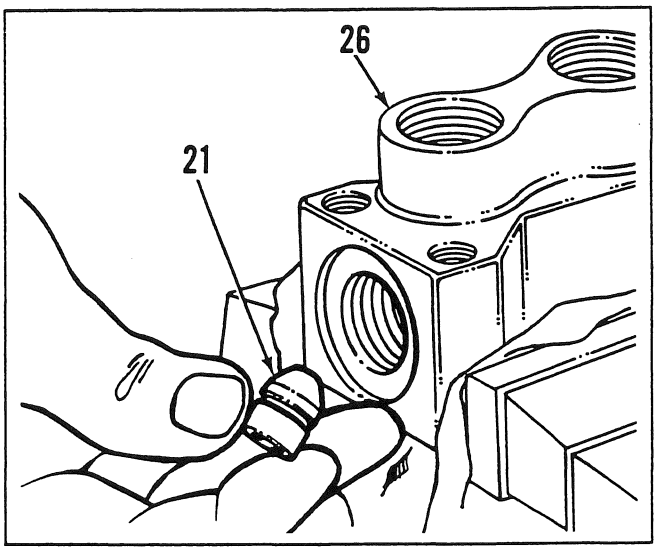


Fig. 41

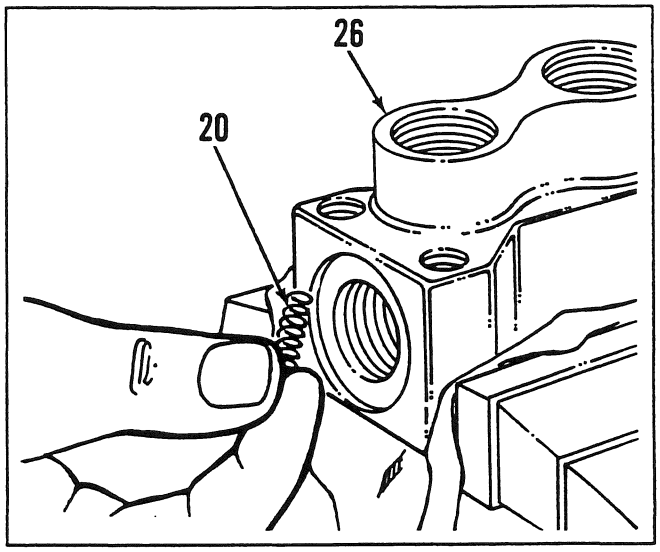


Fig. 42

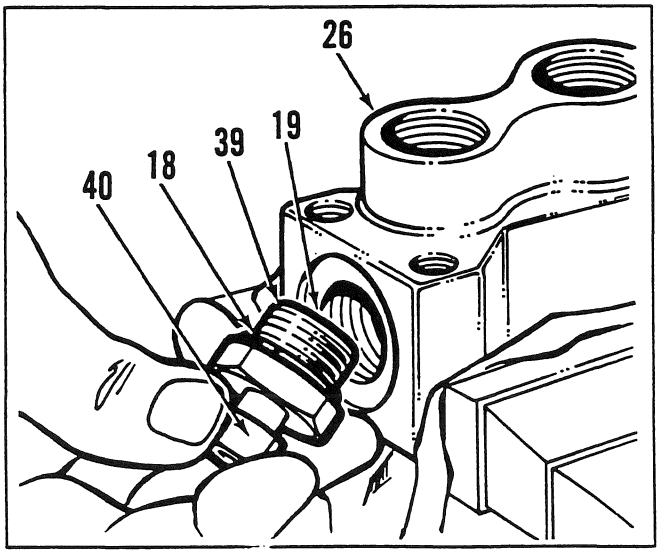


Fig. 43

Installing Hydraulic Power Beyond Function for Snow Wing Attachments and Other Auxiliary Hydraulic Power

This information applies to graders S/N **19236** and up; plus any earlier machines upgraded with hydraulic manifold valve P/N **48435** and P/N **48555**. When installing Champion front mounted and rear mounted snow wings or other attachments needing auxiliary hydraulic assistance, you can install a power beyond function on the right-hand manifold valve.

Hydraulic power beyond is taken from the right-hand manifold valve because auxiliary hydraulic assistance needed for articulation is taken from the left-hand main hydraulic system. It is important to install the hoses **and** power beyond plug P/N **49202** as shown in **Fig. 44** otherwise damage to hydraulic components could result.

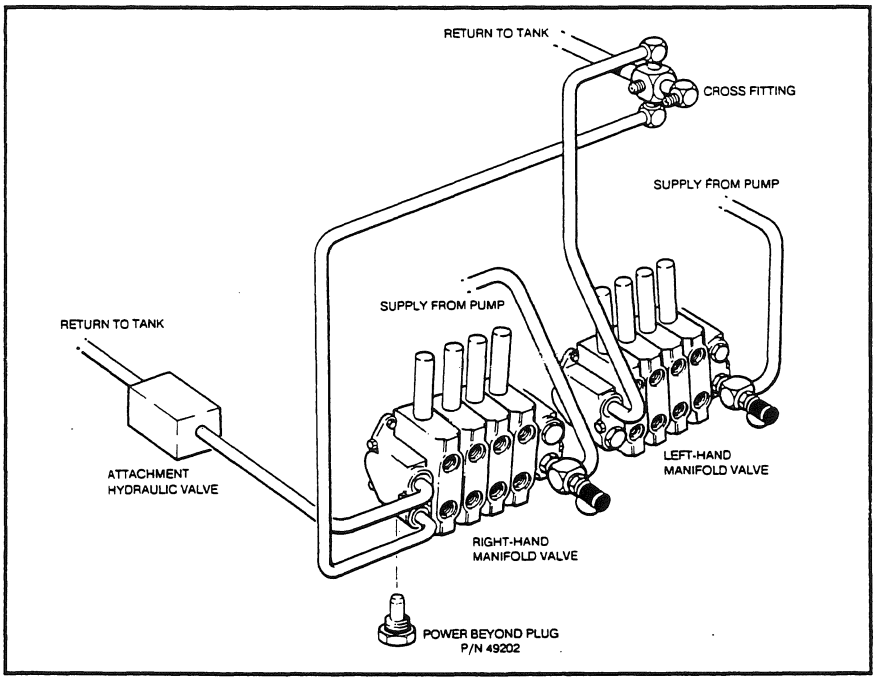


Fig. 44

When the power beyond plug is installed, ensure the existing drain hose is connected to the lower port of the manifold valve outlet section as shown in **Fig. 44**. This allows normal leakage within the manifold valve to return to tank. Without this hose, pressure may build up inside the valve and cause damage. The attachment hose must be connected to the upper port of the manifold valve outlet section.

Note that the left-hand manifold valve does not change. The right-hand manifold valve supplies oil flow for the power beyond function.

NOTE: *The terms left-hand and right-hand indicate the directions when in the operator's cab looking toward the front of the grader.*

SECTION 4M
HYDRAULICS
Accumulators

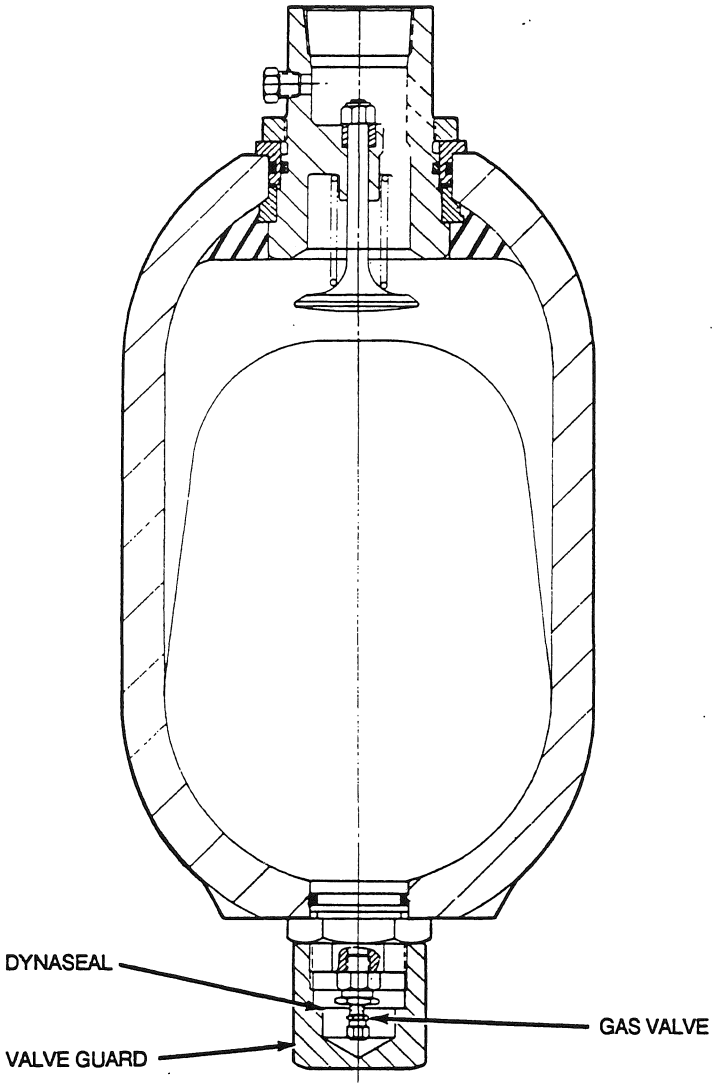


Fig. 1M Cross-section of Typical Bladder-type Accumulator

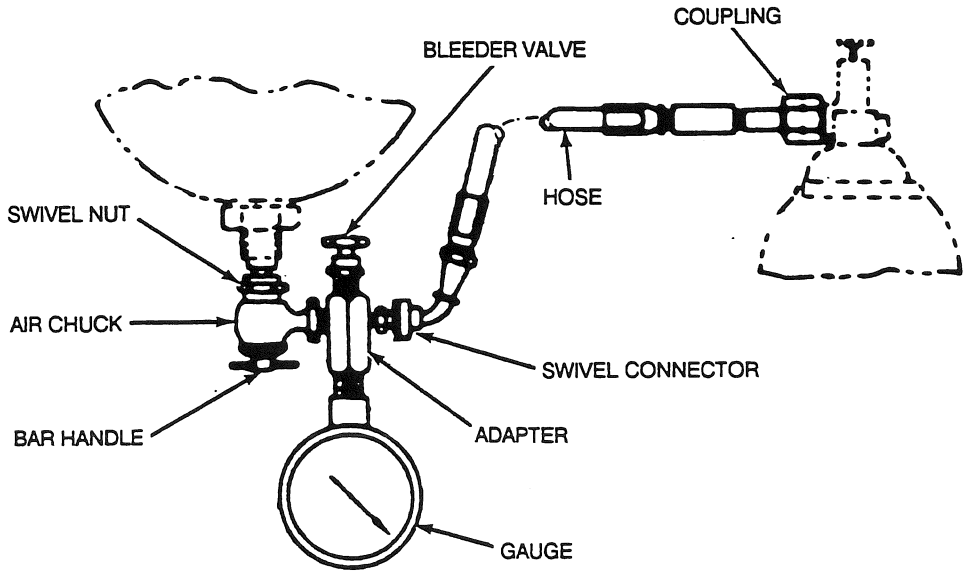


Fig. 2M Charging Kit P/N **16042** for Bladder-type Accumulators

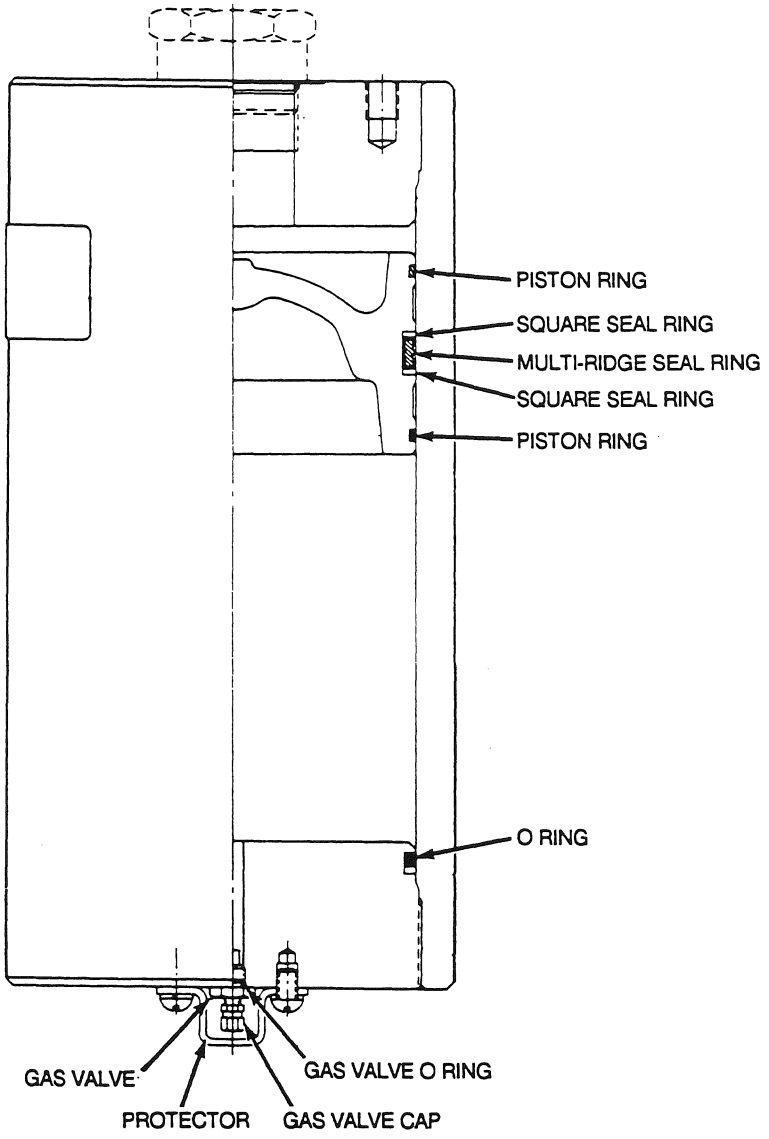


Fig. 3M Cross-section of Typical Piston-type Accumulator

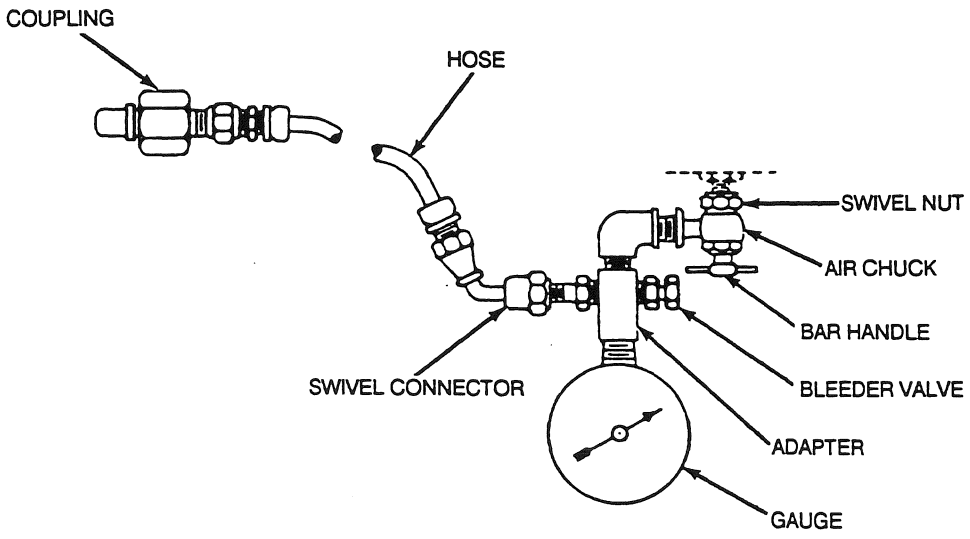


Fig. 4M Charging Kit P/N **56475** and Gauge P/N **56474** for Piston-type Accumulators

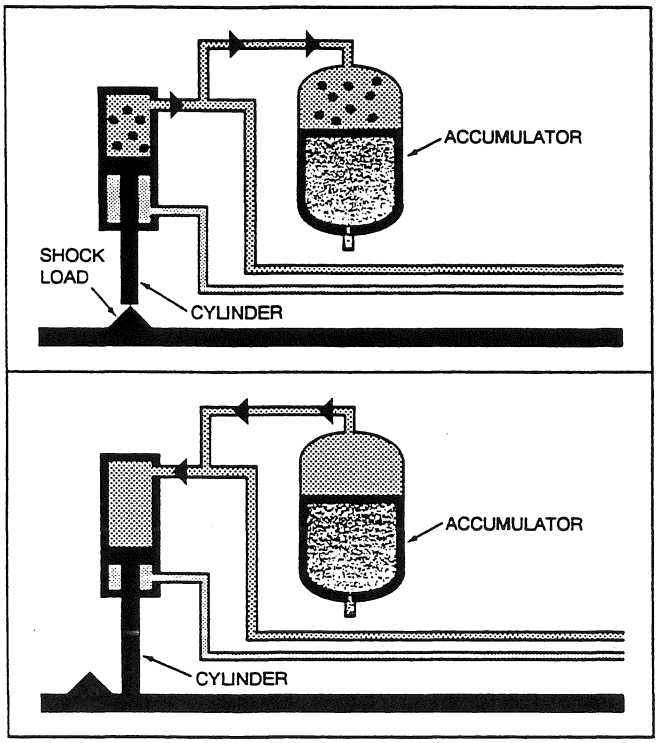
Accumulators - Description and Operation

Bladder-type or piston-type accumulators can be either a standard or optional feature, depending on your grader model. They are used in the blade lift, circle shift and oil disc brakes hydraulic circuits.

Both types of accumulators contain a precharged amount of nitrogen gas. The nitrogen absorbs shock loads in the hydraulic circuit. For blade lift and circle shift hydraulic circuits, shock loads can be caused by higher than normal pressure developing in the piston end of the cylinder. If this pressure is greater than the precharge pressure in the accumulator, hydraulic oil flows from the piston end of the cylinder into the accumulator. The cylinder then retracts.

After the shock load, the pressure at the piston end of the cylinder reduces. When the precharge pressure in the accumulator exceeds the pressure in the cylinder, hydraulic oil flows out of the accumulator and into the cylinder. The cylinder then extends to its position before experiencing the shock load.

In oil disc brake applications, accumulators are used to assist braking power. Refer to **Section 13, Oil Disc Brakes and Tandems** in this Shop Manual.



Preventive Maintenance

Check accumulators once a month for precharge pressure and signs of damage. Also, check the precharge pressure if an accumulator relieves too easily or requires excessive force to relieve. If you notice a continuous change in the precharge pressure of piston-type accumulators, you must replace the seals. A seal kit P/N **56473** is available. Champion recommends installing all the seals supplied in the kit at the same time.

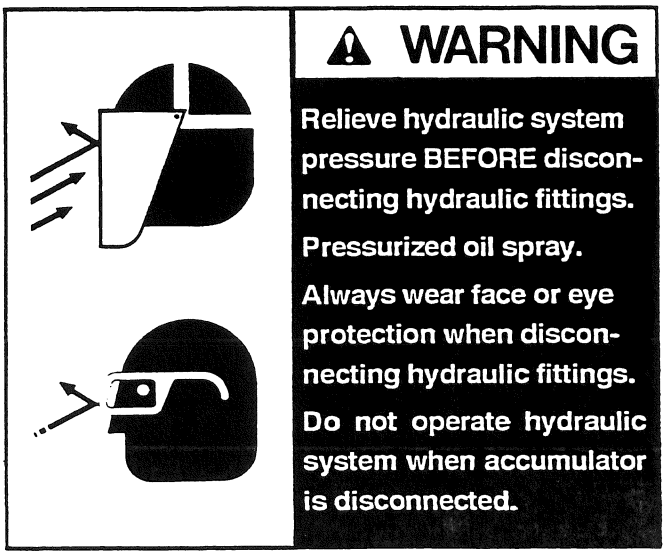
Checking the Precharge Pressure

Checking the precharge pressure in bladder-type and piston-type accumulators is a similar procedure. For bladder-type accumulators, use charging kit P/N **16042**. For piston-type accumulators, use charging kit P/N **56475** and gauge P/N **56474**. Apply a light coating of thread sealing compound P/N **19167** onto the gauge connector threads. Install the gauge into the adapter.

NOTE: *Accumulators should be at operating temperature when checking the precharge pressure and during the charging procedure.*

1. Place the grader in the SERVICE POSITION. Remove the hydraulic tank filler cap to release any pressure and replace the cap loosely.

2. Remove the hydraulic hose from the accumulator. Cap the hose and fitting to prevent contamination.



3. Before installing the charging kit, turn the bar handle counter-clockwise and fully retract the air chuck stem. Install the air chuck onto the accumulator gas valve and secure with the swivel nut. Close the bleeder valve.

4. Turn the bar handle clockwise until the air chuck stem depresses the core in the accumulator gas valve. Check the precharge reading on the gauge. Refer to **Accumulator Precharge and Maximum Operating Pressures** listed below. Significant temperature differences can occur between the charging temperature and operating temperature. Adjust the precharge pressure using the appropriate correction factor listed in the **Accumulator Precharge Adjustment Chart** listed below.

- For example, if the precharge temperature is 90°F (33°C) and the expected accumulator operating temperature is 40°F (4°C), the accumulator precharge pressure should be increased by a factor of 1.10, i.e. 400 psi x 1.10 = 440 psi.

- If you anticipate operating temperatures below 30°F (-1°C), make the following correction. For every 10°F drop below 30°F (-1°C), increase the precharge pressure by using the formula:
Precharge minus (precharge multiplied by 520/530)

Accumulator Precharge and Maximum Operating Pressures

Accumulator Location	Accumulator Part No.	Accumulator Precharge Pressure	Accumulator Max. Operating Pressure
Circle shift cylinder	14007 37048 45807 54913	700 psi (48 bar) for all accumulator part numbers in this application	3,000 psi (207 bar) for all accumulator part numbers in this application
Blade lift cylinder Fixed point blade lift Moveable point blade lift	37048 45807 54913 54913	400 psi (28 bar) 400 psi (28 bar) 400 psi (28 bar) 700 psi (48 bar)	3,000 psi (207 bar) for all accumulator part numbers in this application
Oil disc brakes	24410 45810 45811 54790	500 psi (34 bar) for all accumulator part numbers in this application	2,000 psi (138 bar) for all accumulator part numbers in this application

Accumulator Precharge Adjustment Chart

Operating Temperature (°F) \ Charging Temperature (°F)	30	40	50	60	70	80	90	100	110	120
30	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18
40	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16
50	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14
60	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12
70	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.09
80	0.91	0.93	0.95	0.96	0.98	1.00	1.02	1.04	1.06	1.07
90	0.89	0.91	0.93	0.95	0.96	0.98	1.00	1.02	1.04	1.05
100	0.88	0.89	0.91	0.93	0.95	0.96	0.98	1.00	1.02	1.04
110	0.86	0.88	0.89	0.91	0.93	0.95	0.96	0.98	1.00	1.02
120	0.84	0.86	0.88	0.90	0.91	0.93	0.95	0.97	0.98	1.00

- For example, at 10°F (-12°C), increase the precharge pressure for a 400 psi accumulator as follows:

  400 - (400 x 520) x 2 (i.e. 30° less 2 x 10°)
  530)
  = 400 - (392.5) x 2
  = 15
  Precharge pressure = 400 + 15
  = 415 psi

5. Piston-type accumulator precharge pressure can rise if oil gathers on the gas side of the piston. Also, precharge pressure can fall if gas leaks into the oil side of the piston or out pass the gas end seals.

6. If the precharge reading is below the specified pressure (corrected according to temperature differences), you must charge the accumulator.

Charging the Accumulator

⚠ WARNING

Pressurized gas.
Do not use oxygen.
Explosion could occur causing severe personal injury or property damage.

1. Connect the hose coupling to a nitrogen bottle.

NOTE: *Do not loop or twist the hose as it will stiffen when gas pressure is released from the nitrogen bottle.*

2. Connect the swivel connector to the adapter and hand tighten to prevent gas leaks. Slowly open the nitrogen bottle valve. Close the valve occasionally to allow the gauge to stabilize and show an accurate reading. When you reach the correct precharge pressure, close the nitrogen bottle valve.

- You can use the bleeder valve to exhaust gas that exceeds the correct precharge pressure.

⚠ CAUTION

Do not reduce precharge by depressing the valve core of piston-type accumulators. High pressure may rupture the rubber valve seat. Slowly remove the gas valve until gas begins to escape through bleed hole in the valve threads. The hole is a safety feature. It warns of stored pressure whenever the gas valve is being removed. Install a new O ring each time you remove the gas valve.

3. Before removing the charging kit, turn the bar handle counter-clockwise and fully retract the air chuck stem. Open the bleeder valve to relieve any gas pressure remaining in the charging kit and hose.

4. Prevent the charging kit from turning and loosen the air chuck swivel nut. Remove the charging kit. Use soapy water or fresh system oil to check the accumulator gas valve for leaks.

- Bladder-type accumulators only: If the accumulator gas valve core is leaking, depress it quickly once or twice. You may have to tighten the gas valve core or replace it if leakage persists. Install the Dynaseal. Install the valve guard to finger tightness. Use a wrench and tighten the valve guard another half turn.

- Piston-type accumulators only: Install the accumulator gas valve cap and protector.

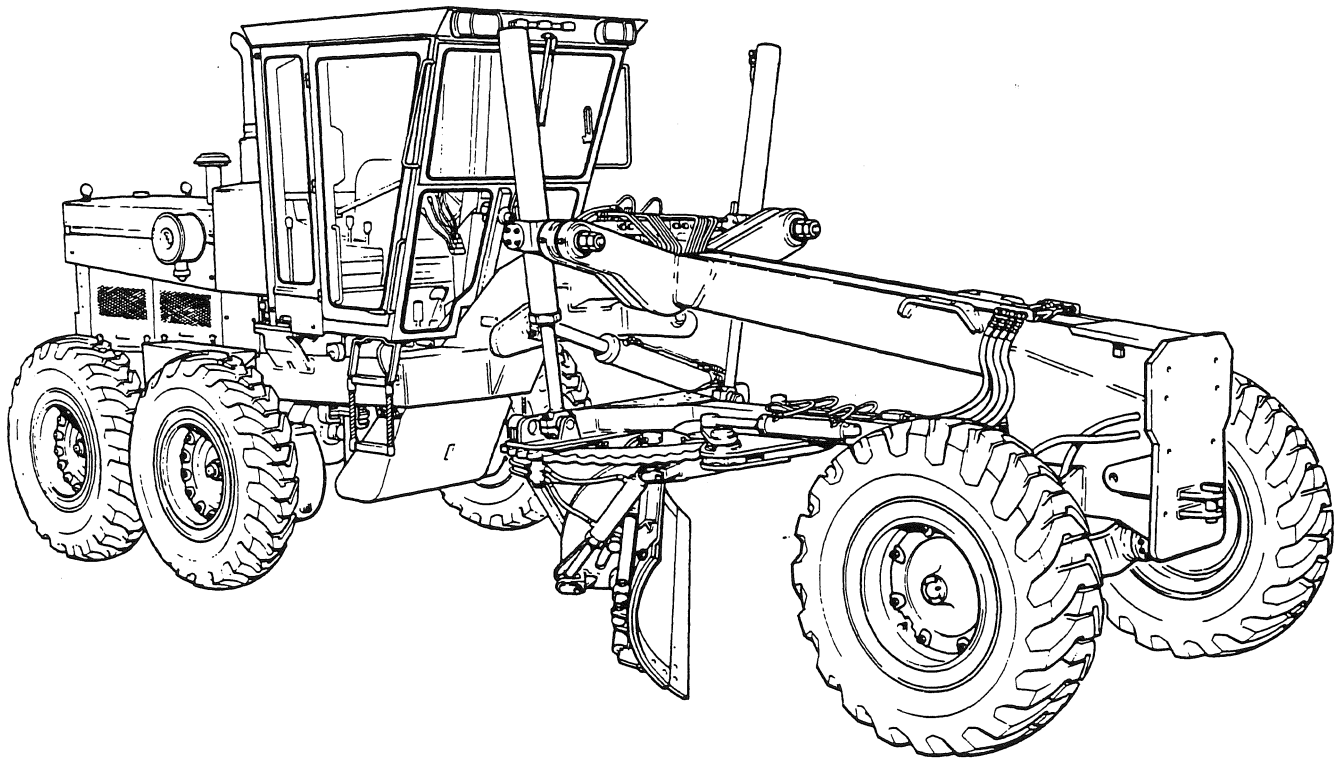
5. Remove the caps and install the hydraulic hose onto the accumulator fitting.

6. Make a visual check around the grader. Signal your intention to start the engine. Start the engine when it is safe to do so and test the accumulator function.

7. If you test the blade lift cylinders, lower the moldboard to the ground. Shut down the engine. Check the hydraulic fluid level. If you see any oil leaks, check and tighten all connections. If leakage persists, disassemble the accumulator and replace any faulty parts. The accumulator precharge check and charging procedure is now complete.

SECTION 5

STEERING UNIT AND COLUMN



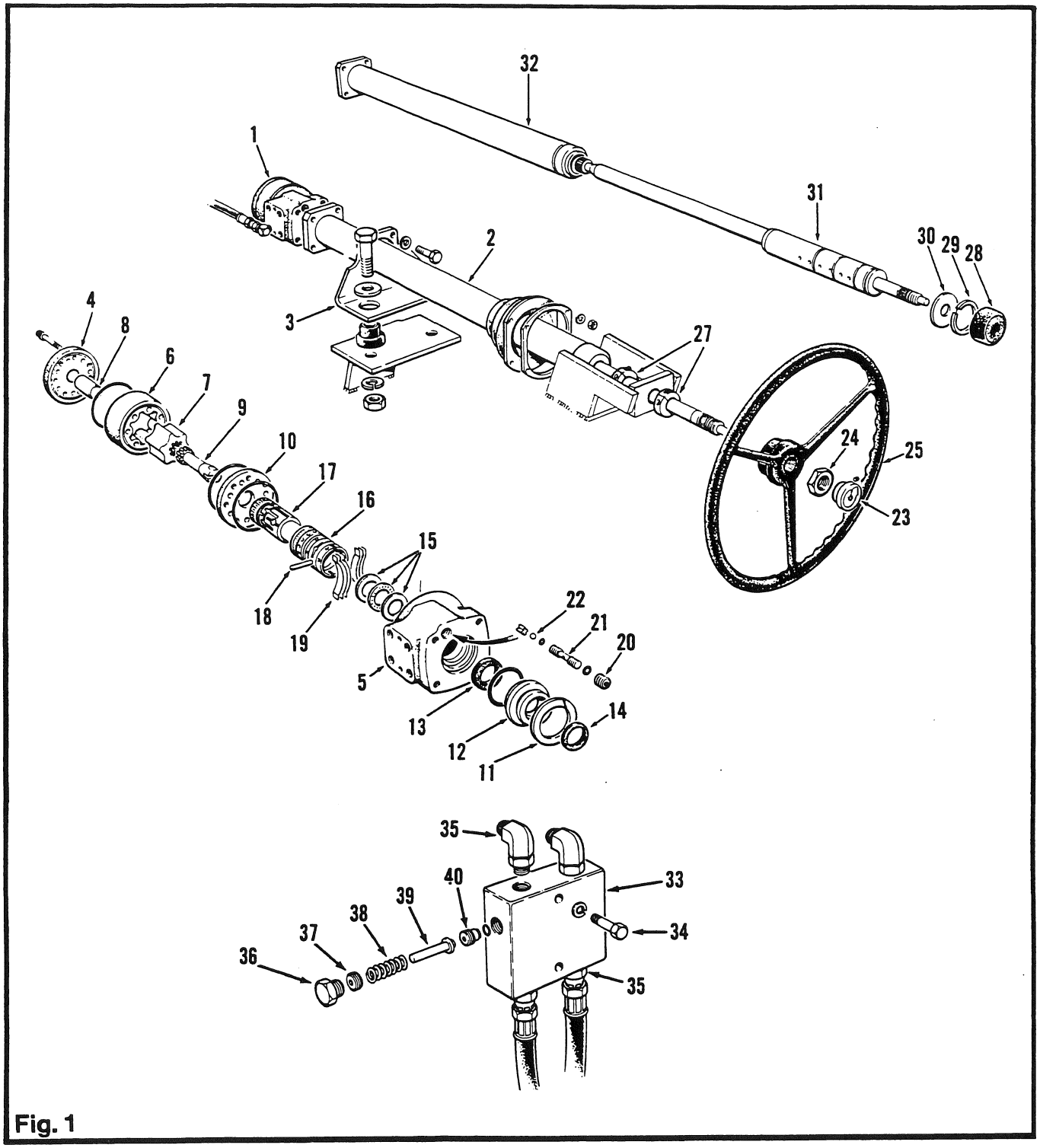

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Fig. 1

INDEX (Fig. 1) PAGE

KEY TO FIG. 1

item	description	item	description	item	description
1	Steering Unit	15	thrust bearing	29	retaining ring
2	Steering Column Assy.	16	control sleeve	30	thrust washer
3	bracket	17	control spool	31	shaft
4	end cap	18	drive pin	32	tube
5	housing	19	centering spring	33	Cushion Valve
6	meter gear housing	20	set screw	34	capscrew
7	meter gear	21	check ball seat	35	O ring fittings
8	spacer	22	check ball	36	O ring plugs
9	drive coupling	23	brass knob	37	adjusting screws
10	spacer disc	24	steering wheel nut	38	springs
11	retaining ring	25	steering wheel	39	poppets
12	seal gland	26	pedestal cover*	40	seat
13	quad ring seal	27	clamping collars		
14	oil seal	28	dust cap	*	Not Shown

GENERAL

Make sure the work area is clean and safe before starting any service procedure. A clean work area will reduce the chance of foreign matter entering the system.

You must use extreme care and practice maximum cleanliness when overhauling steering system components.

The steering unit is a precision component and can be easily damaged by very small contaminants or by the effects of thermal expansion.

Make sure proper tools are available and in good working order. You will require a safe lifting device and normal shop tools.

DESCRIPTION AND OPERATION

The steering system of your Champion Motor Grader is fully hydraulic. There is no mechanical connection between the steering wheel and the front axle.

When the engine is running, the steering pump, located at the rear of the grader, supplies oil flow to power the circuit.

The steering unit meters and directs the oil to the steering cylinders on the front axle.

The steering cylinders provide the necessary force to move the steering linkage and turn the front wheels.

The cushion valve acts as a shock absorber, protecting the system from sudden, high pressure surges by allowing oil to flow from the high pressure side of the circuit to the low pressure side. It is located in the nose of the main frame, above the steering cylinders.

The steering system also provides oil flow to the brake and clutch boosters. (see Section 6)

TORQUE GUIDE

application	torque		
Steering Wheel Retainer Nut	17 N.m	1.7 kg.m	150 lbf-in.
Column to Steering Unit	32 N.m	3.2 kg.m	280 lbf-in.
End Cap	17 N.m	1.7 kg.m	150 lbf-in.
Set Screw for Check Ball	17 N.m	1.7 kg.m	150 lbf-in.

TROUBLESHOOTING:

PROBLEM	CAUSE	REMEDY
Hard Steering. **Slow Steering.** **No Power Assist.**	Worn Pump. Malfunctioning flow divider valve. Malfunctioning relief valve.	Replace the pump. Repair or replace the flow divider valve. Repair or replace the relief valve.
Wander - Grader will not hold a straight line.	Air in the system. Severe wear in the steering unit. Worn or damaged steering linkage. Worn steering cylinder(s).	Check for leaks, low oil level, cavitating pump. Repair or replace the steering unit. Repair the steering linkage. Repair the steering cylinder(s).
Slip - Slow movement of the steering wheel does not cause the front wheels to move.	Worn steering cylinder(s). Worn steering unit meter.	Repair the steering cylinders. Repair or replace the steering unit.
Free Wheeling - Steering wheel turns freely with no feeling of pressure and no movement in the front wheels.	Defective steering column. Lack of oil in the steering unit after service. Lack of flow to the steering unit.	Repair the column. Wait for the steering unit to fill with oil after starting. Check for low oil level, or leaks.
Binding, Steering Wheel does not centralize.	Steering column damaged or misaligned. Serious contamination.	Repair the steering column. Clean the steering unit and purge the system.
Steering Wheel oscillates or turns by itself.	Steering unit improperly assembled, timing wrong. Lines connected improperly. Broken centering springs.	Assemble the unit correctly. Reconnect the lines. Repair steering unit.
Front Wheels turn opposite to Steering Wheel.	Lines from steering unit to cylinders are connected in reverse.	Reconnect the lines.

STEERING UNIT

Removal

1. Be sure to clean all dirt and flaking paint from the outside of the steering unit before disconnecting the hoses. (Fig. 2)

2. Disconnect the hoses from the steering unit (1). (Fig. 3) Plug the hose fittings and the ports of the steering unit to prevent contamination of the system.

3. Remove the capscrews that fasten the steering unit (1) to the steering column (2) and bracket (3). (Fig. 4) Remove the steering unit (1) from the grader.

Disassembly

1. Place the control section of the steering unit into a vise with the metering end up. Tighten the vise only enough to hold the unit in place. (Fig. 5)

2. Remove the capscrews retaining the end cap (4) and lift it off the housing (6). (Fig. 6)

3. Carefully lift off the meter housing (6), meter gear (7), spacer (8) drive coupling (9) and spacer disc (10) and set them aside. Discard the three O rings. (Fig. 7)

STEERING UNIT

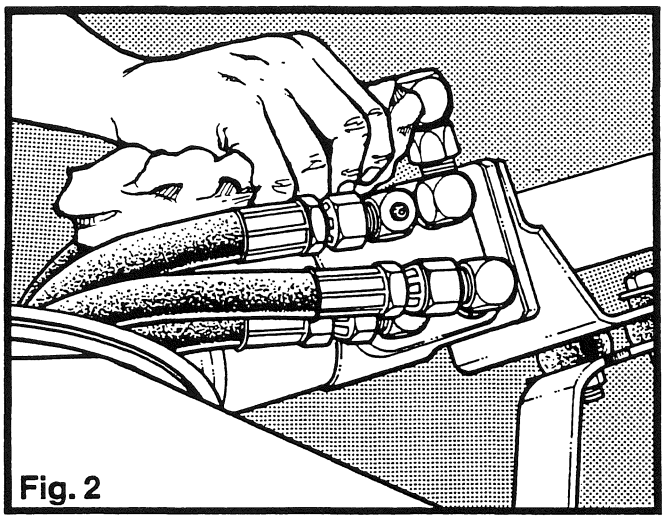


Fig. 2

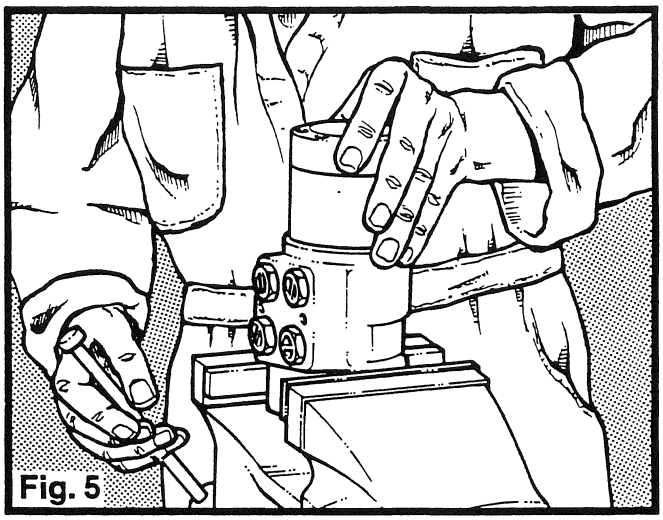


Fig. 5

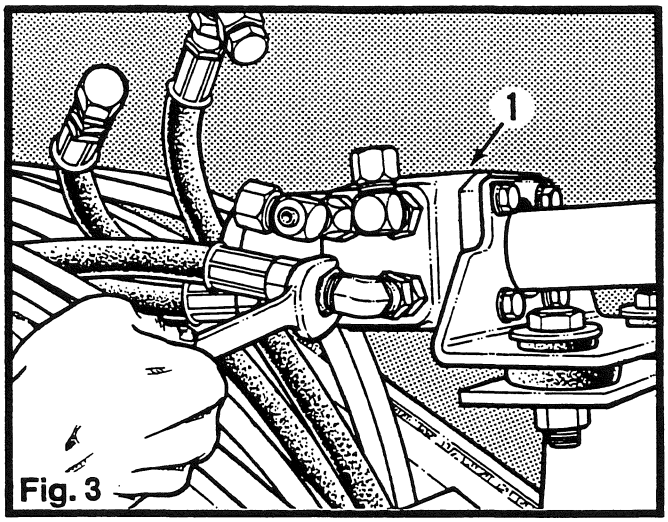


Fig. 3

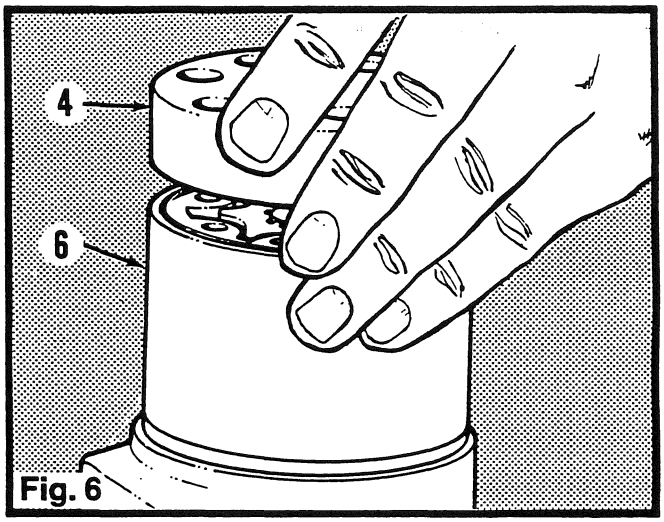


Fig. 6

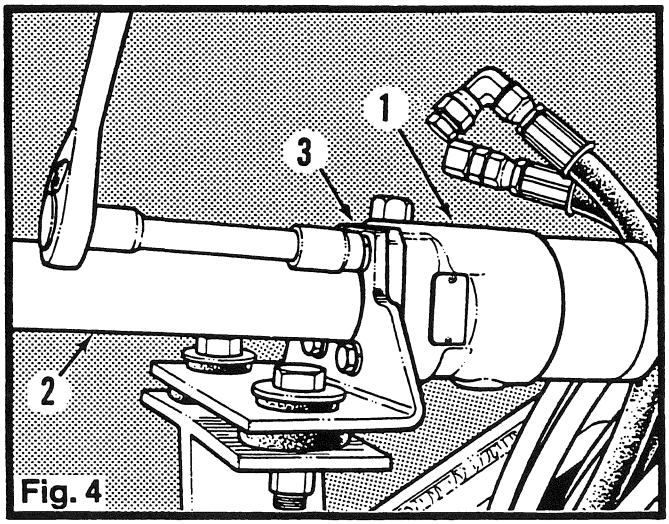


Fig. 4

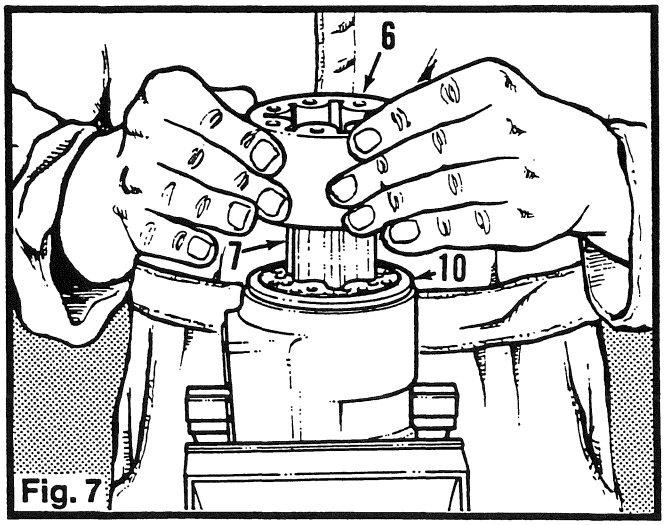


Fig. 7

STEERING UNIT

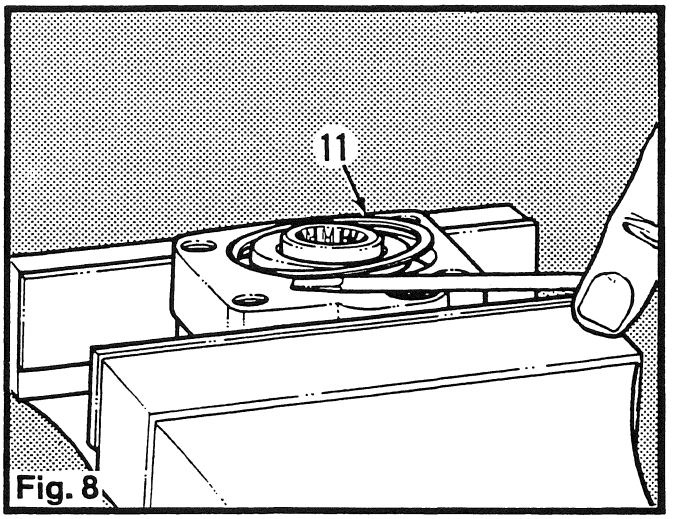


Fig. 8

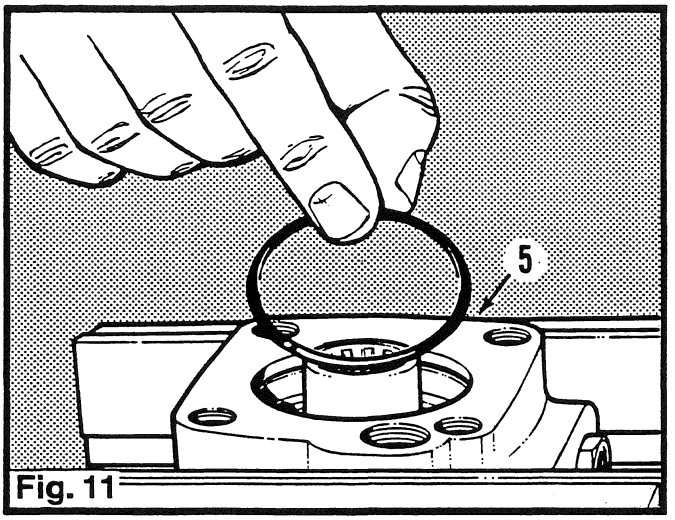


Fig. 11

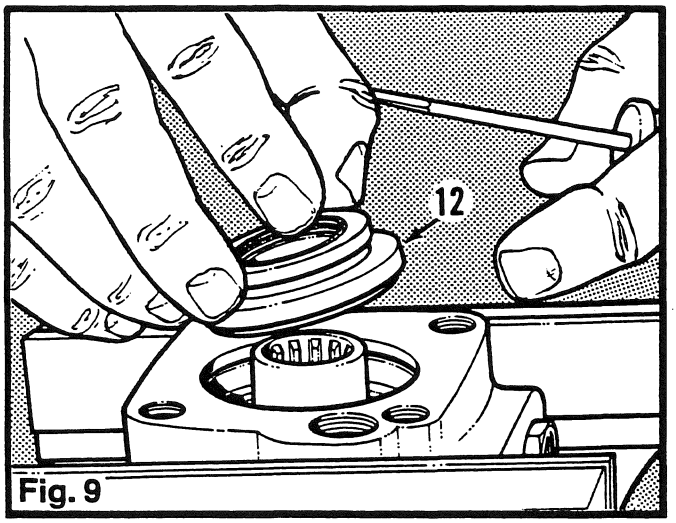


Fig. 9

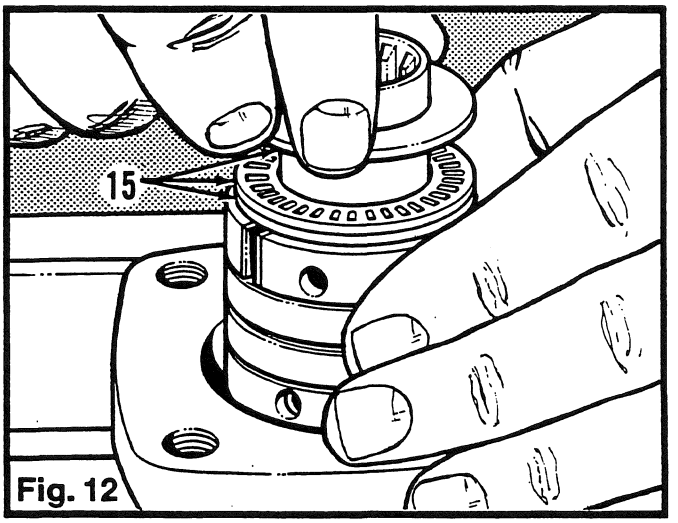


Fig. 12

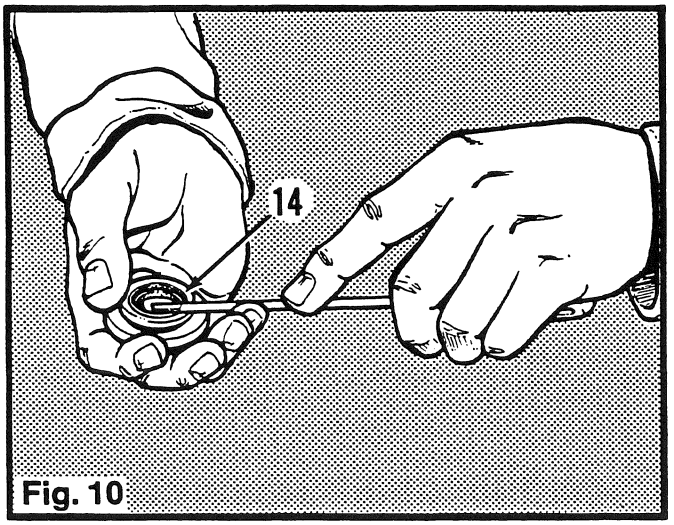


Fig. 10

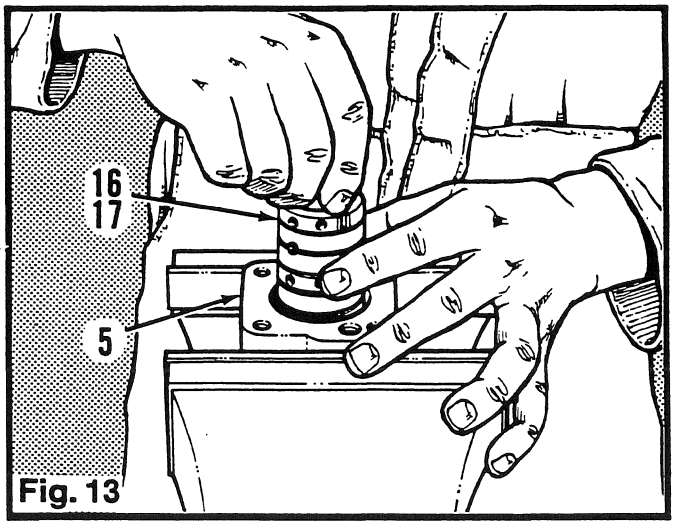


Fig. 13

STEERING UNIT

Disassembly (cont.)

4. Turn the assembly over and remove the retainer ring (11). (Fig. 8)

5. Remove the seal gland (12). (Fig. 9)

6. Remove and discard the quad ring (13) and oil seal (14). (Fig. 10)

7. Remove the O ring from the housing (5) and discard it. (Fig. 11)

8. Remove the thrust bearing (15). (Fig. 12)

9. Loosen the jaws of the vise. Rotate the control assembly (16, 17) while pulling it from the housing (5). (Fig. 13) Take care not to force the components.

IMPORTANT

The tolerances of the control assembly and housing are very close and the heat of your hand can cause enough expansion to make these components tight. If the components do get tight, set them on the bench for a couple of minutes to cool off. Apply more lubricant, and try again.

STEERING UNIT

Disassembly (cont.)

10. Remove the pin (18). (Fig. 14)

11. Carefully separate the control sleeve (16) and control spool (17). (Fig. 15)

12. Compress and remove the centering springs (19). (Fig. 16)

13. Remove the set screw (20) and the check ball seat (21). (Fig. 17)

14. Discard the O rings. (Fig. 18)

15. Remove the check ball (22). (Fig. 19)

STEERING UNIT

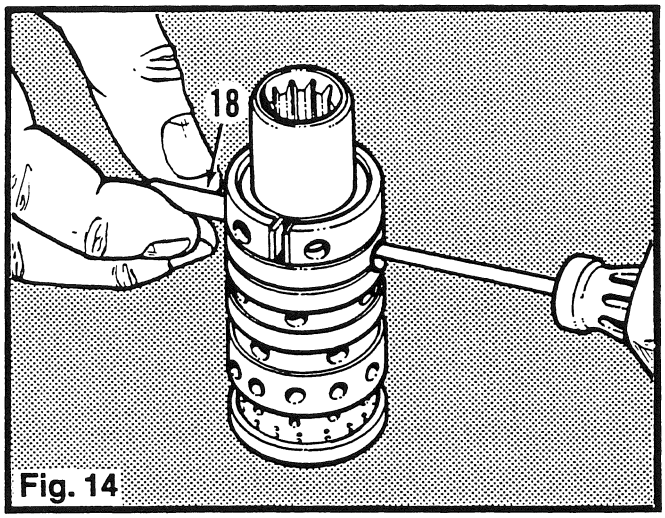


Fig. 14

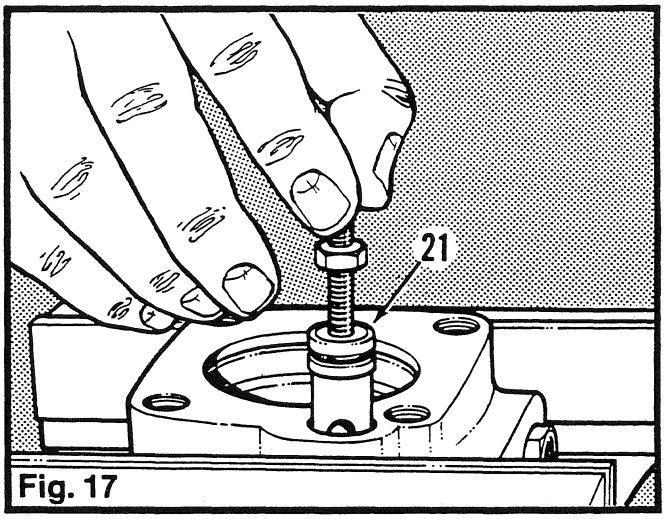


Fig. 17

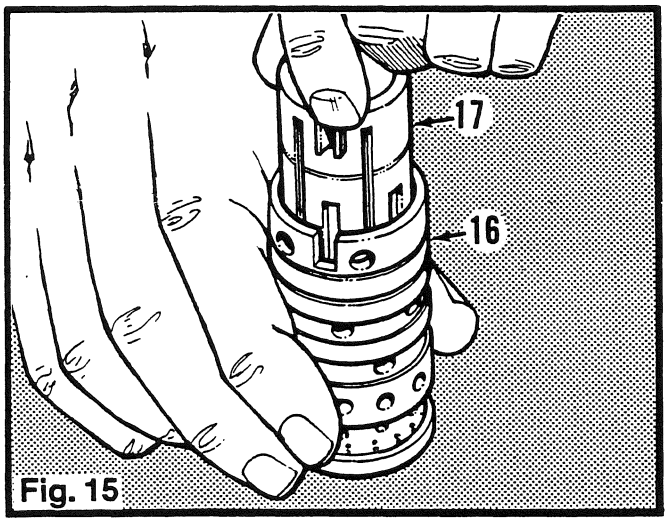


Fig. 15

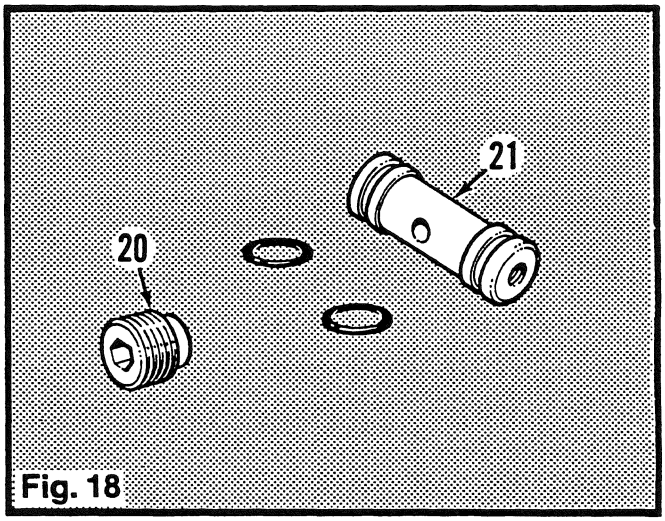


Fig. 18

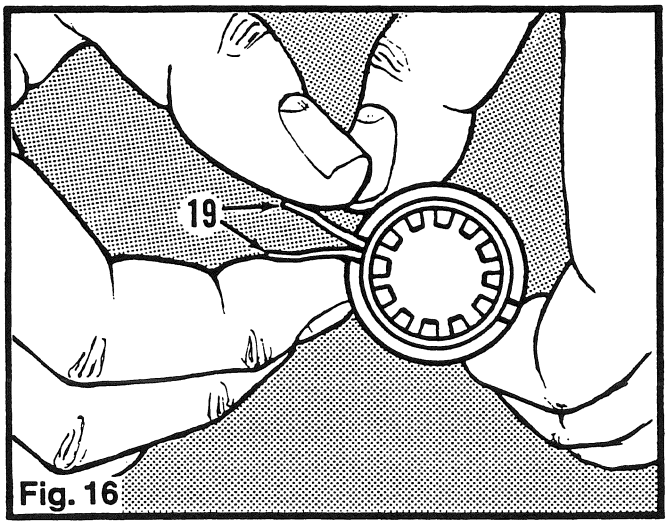


Fig. 16

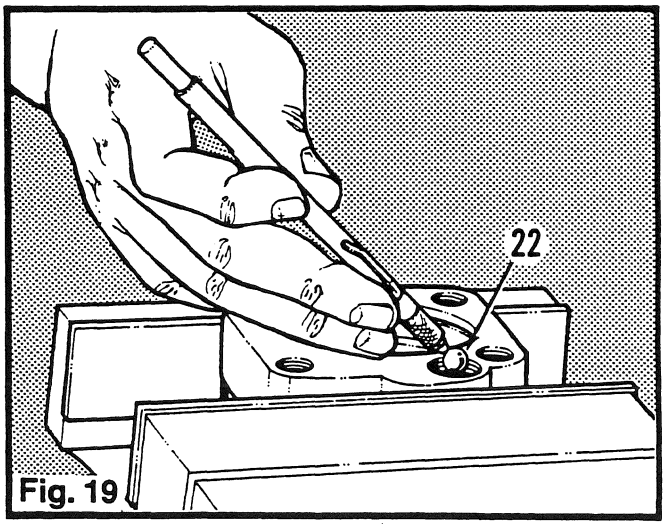


Fig. 19

STEERING UNIT

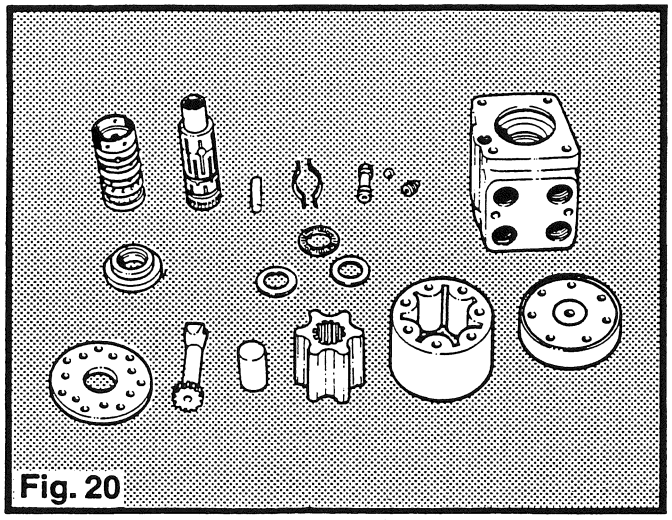


Fig. 20

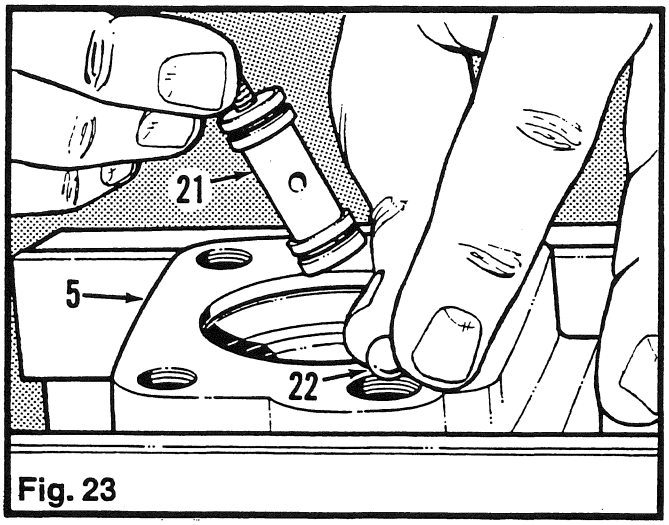


Fig. 23

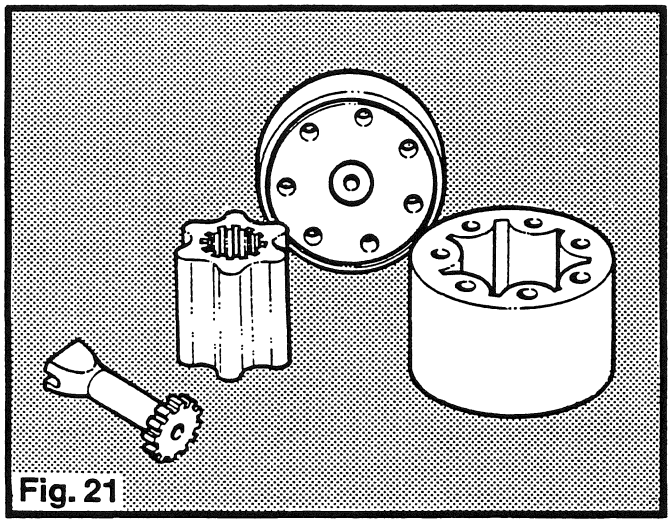


Fig. 21

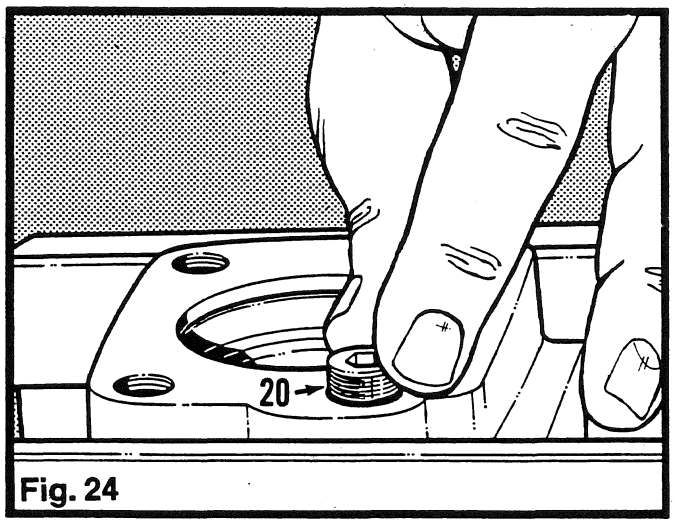


Fig. 24

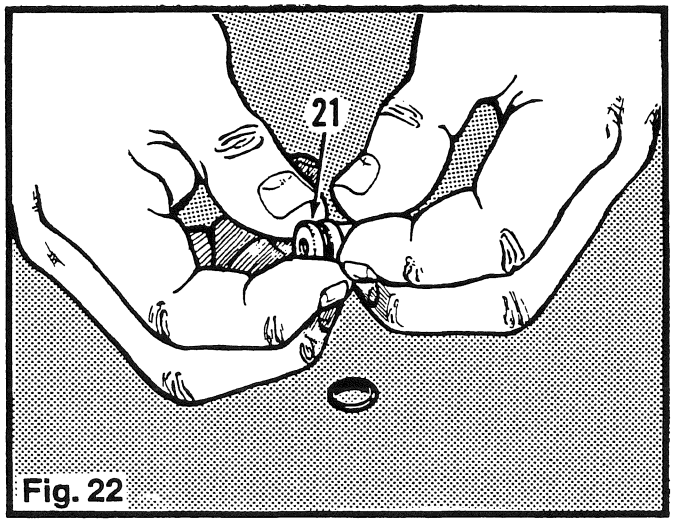


Fig. 22

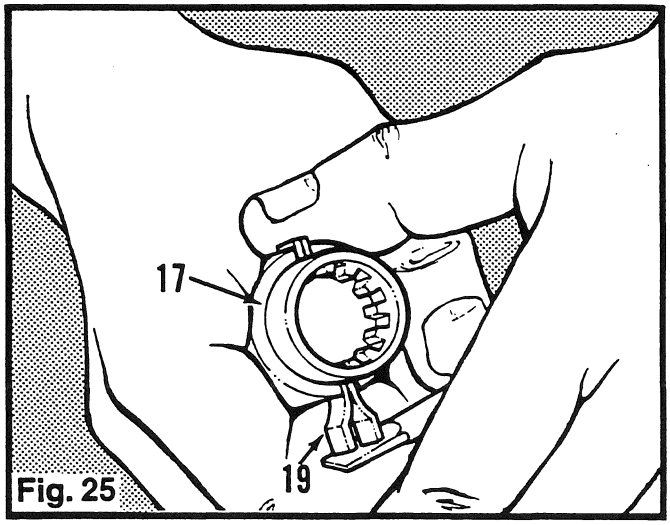


Fig. 25

STEERING UNIT

Inspection

Wash all of the components in solvent, dry them with compressed air and set them in a clean dry place. (Fig. 20)

Inspect each part for scoring, wear or pitting. Remember that the control assembly components are matched and if one is damaged, all must be replaced.

You can dress the mating surfaces of the body components and the meter gear using 600 grit paper laid on a flat surface or an equivalent stone. (Fig. 21) After 6-10 strokes, wash the components thoroughly in solvent and dry them with compressed air. After inspection, dip them in oil and set them aside. Discard all seals and "O" rings.

Use extreme care and practice maximum cleanliness when assembling the steering unit.

Assembly

1. Lubricate new O rings and install them on the check ball seat (21). (Fig. 22)

2. Install the check ball (22) and seat (21) in the housing (5). This will be easier if you install a machine screw in the end of the seat. (Fig. 23)

3. Install the set screw (20). (Fig. 24)

4. Install the centering springs (19) into the control spool (17). (Fig. 25)

   Remember, the fit of the control components is critical and can be affected just by the heat from your hands.

STEERING UNIT

Assembly (cont.)

4. Apply lubricant to the spool (**17**) and rotate it as you install it in the control sleeve (**16**). (Fig. 26) Remember, the fit of the control components is critical and can be affected just by the heat from your hands.

5. Compress the centering springs (**19**) into their slot. (Fig. 27)

6. Install the drive pin (**18**). (Fig. 28)

7. Apply lubricant to the control assembly (**16,17**). Rotate the control assembly as you install it in the control housing (**5**). (Fig. 29)

IMPORTANT

Do not force the control assembly. If the components jam during installation, you may permanently damage them.

8. Install the thrust bearing (**15**). (Fig. 30)

9. Lubricate a new O ring and install it. (Fig. 31)

STEERING UNIT

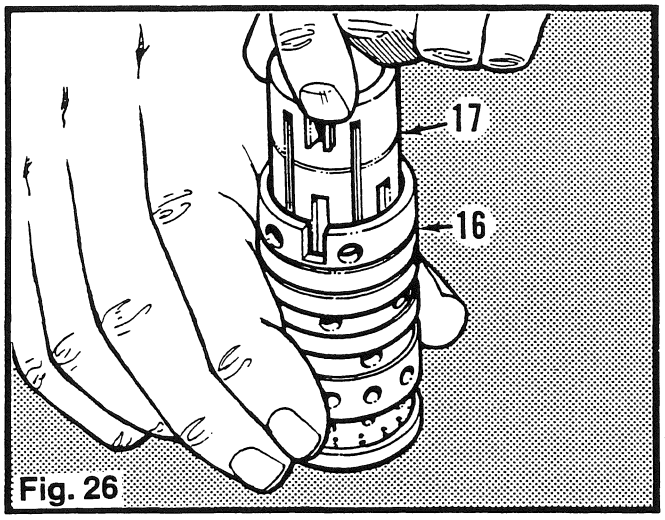


Fig. 26

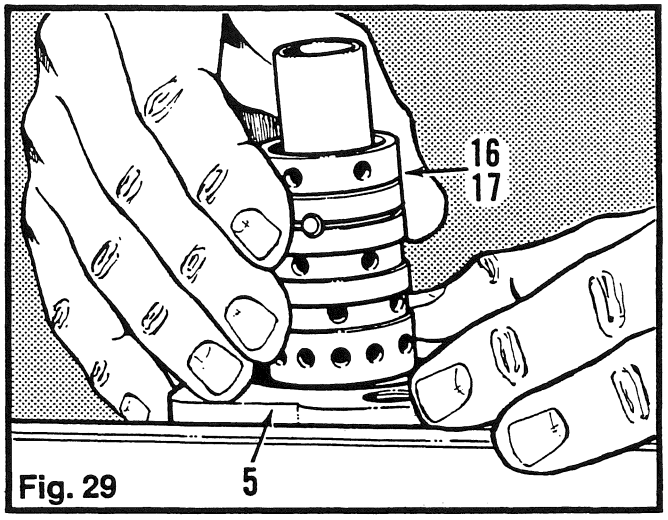


Fig. 29

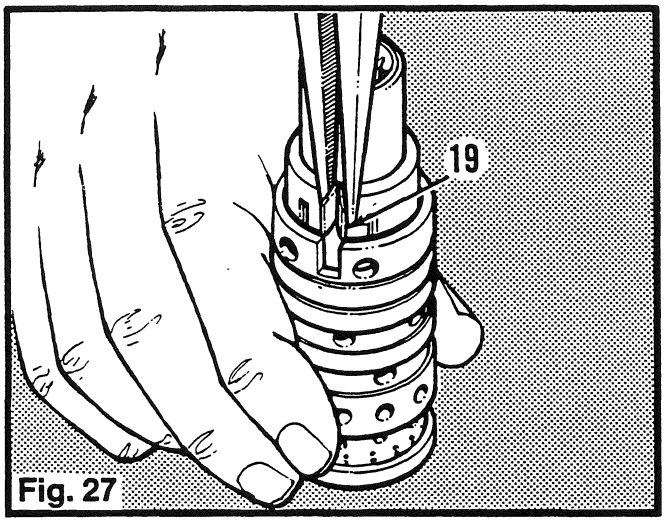


Fig. 27

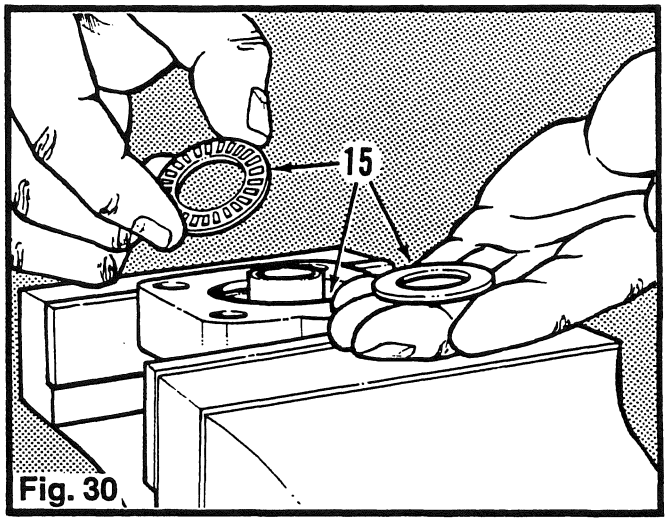


Fig. 30

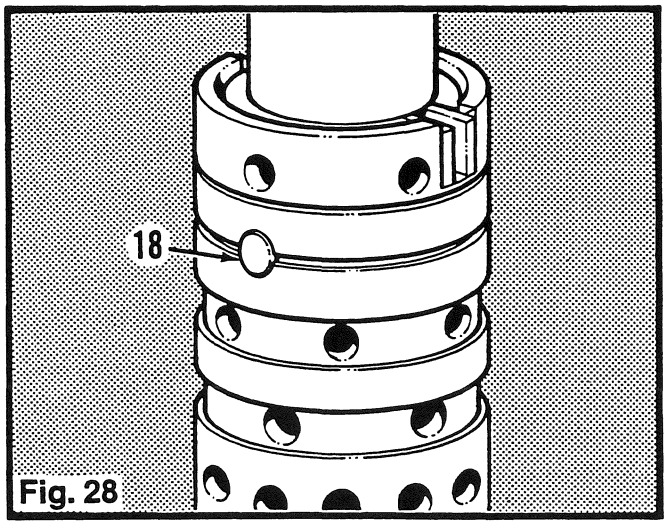


Fig. 28

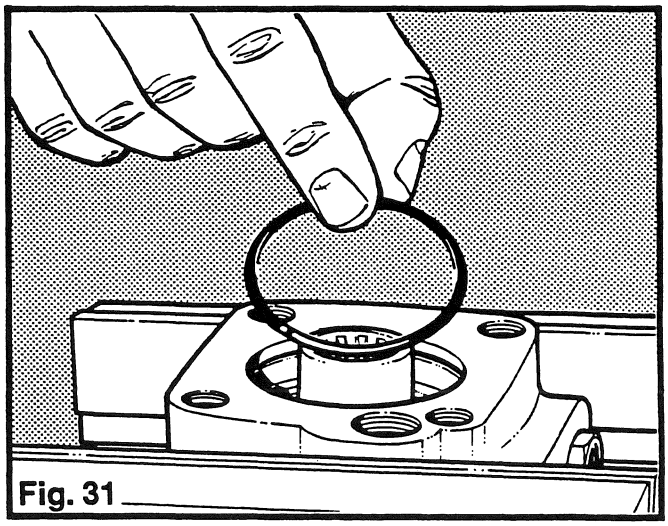


Fig. 31

STEERING UNIT

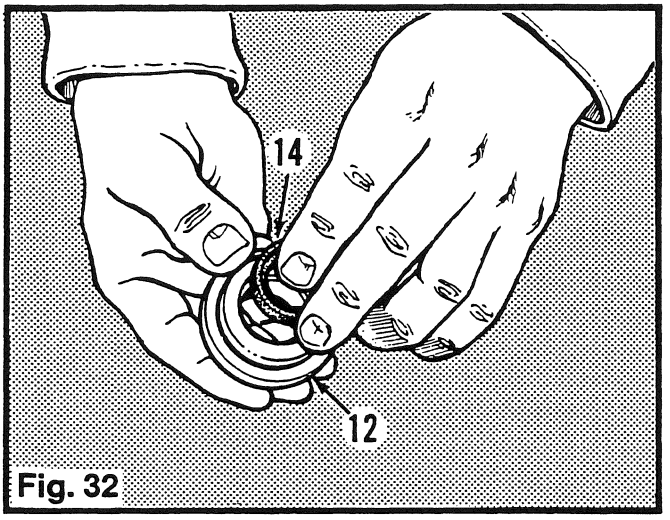


Fig. 32

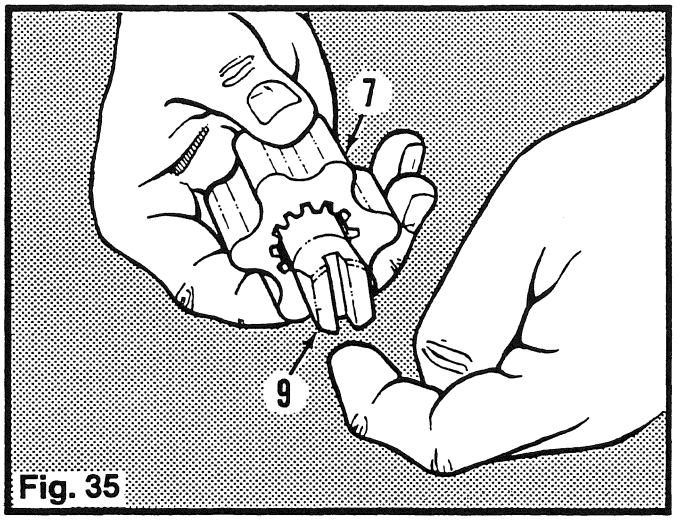


Fig. 35

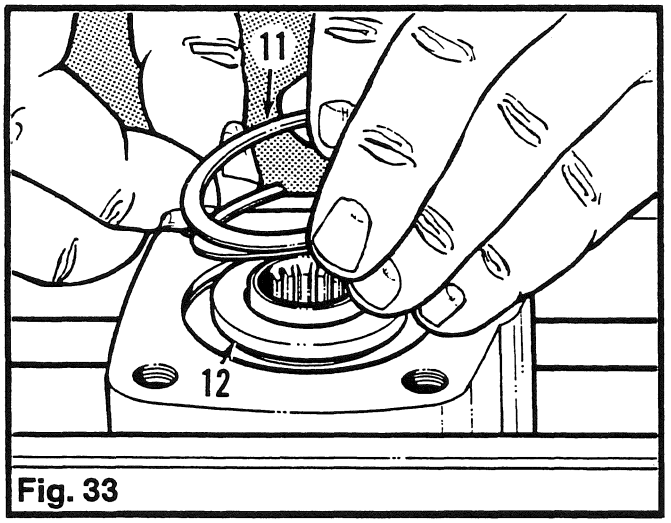


Fig. 33

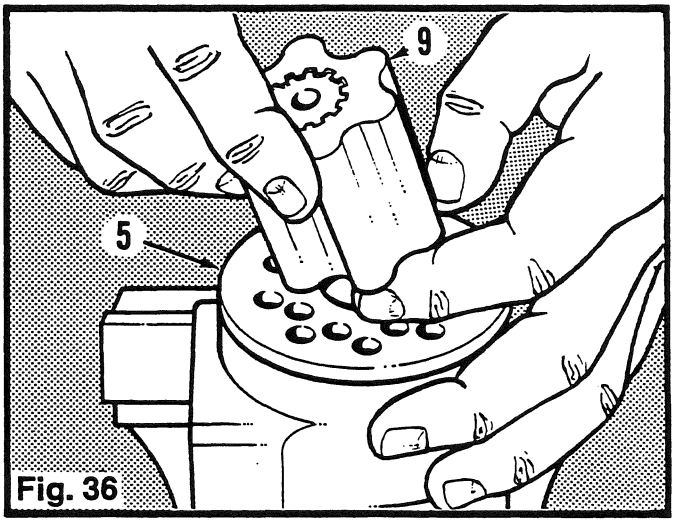


Fig. 36

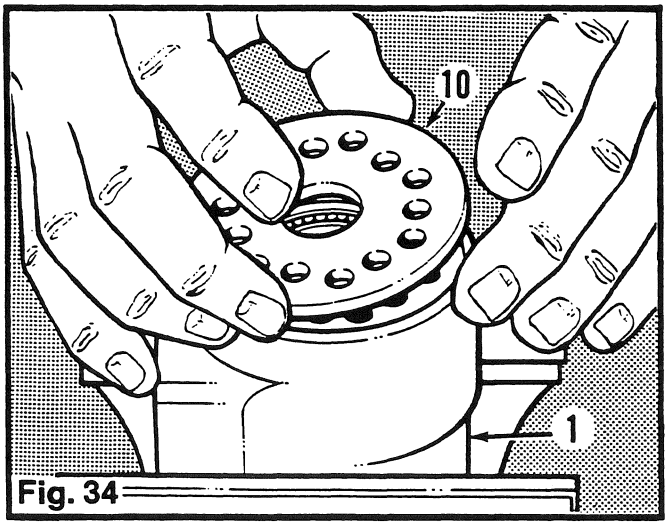


Fig. 34

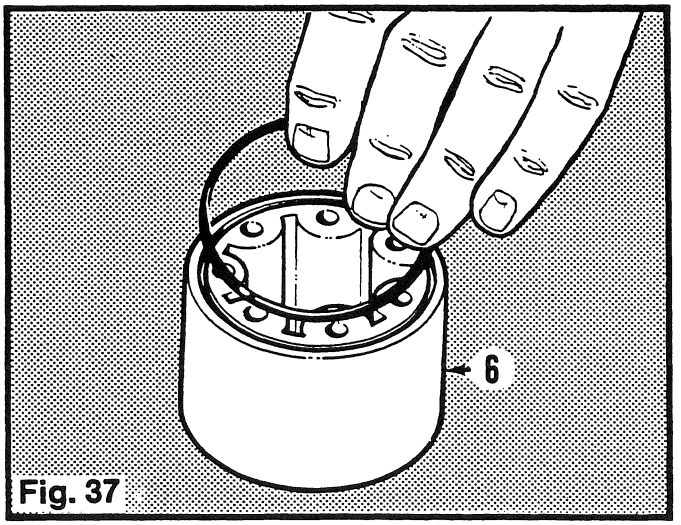


Fig. 37

STEERING UNIT

Assembly (cont.)

10. Lubricate a new oil seal (14) and quad ring seal (13) and install them in the seal gland (12). (Fig. 32)

11. Install the seal gland (12) and retainer ring (11). (Fig. 33)

12. Turn the steering unit (1) over. Lubricate a new spacer O ring and spacer disc (10) and install them. (Fig. 34)

13. Install the drive coupling (9) in the meter gear (7) so that the slot aligns with the valleys in the gear. (Fig. 35)

14. Install the coupling and gear on the housing (5) so that the drive coupling (9) engages the drive pin. (Fig. 36)

15. Lubricate a new O ring and install it on the meter gear housing (6). (Fig. 37)

STEERING UNIT

Assembly (cont.)

16. Install the meter housing (6) and align the bolt holes. (Fig. 38)

17. Install the spacer (8). (Fig. 39)

18. Lubricate a new O ring and install it on the end cap (4). Install the end cap (4) and tighten the capscrews to the correct torque. (Fig. 40)

19. Install plugs into the O ring ports to prevent contamination.

Installation

1. Install the steering unit (1) on the end of the steering column. (Fig. 41)

2. Install the capscrews that fasten the steering unit (1) to steering column (2) and bracket (3). Tighten the capscrews to the recommended torque. (Fig. 42)

3. Connect the hoses to the steering unit (1). (Fig. 43)

IMPORTANT

Always road test the grader before returning it to service. Check the hydraulic oil level and add oil as required. Carefully inspect the system for leaks and repair where necessary.

STEERING UNIT

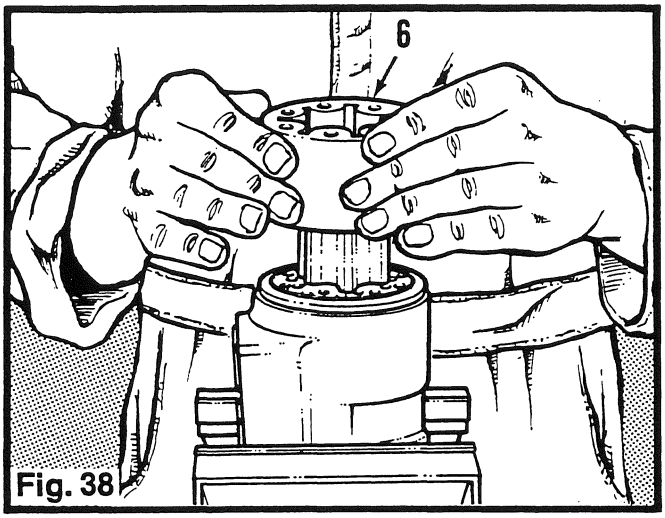


Fig. 38

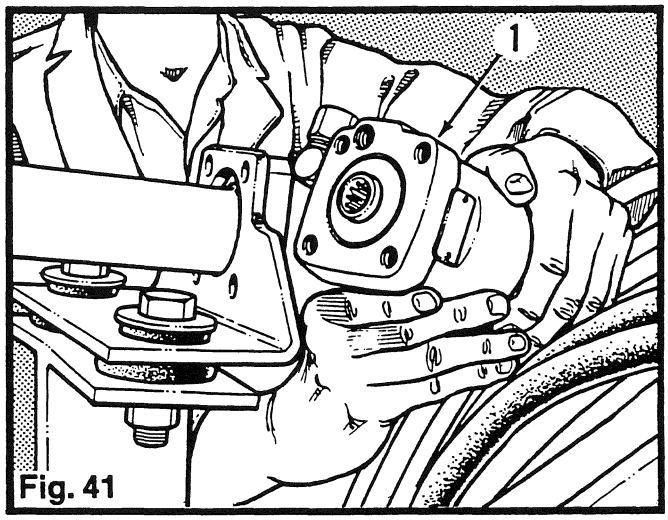


Fig. 41

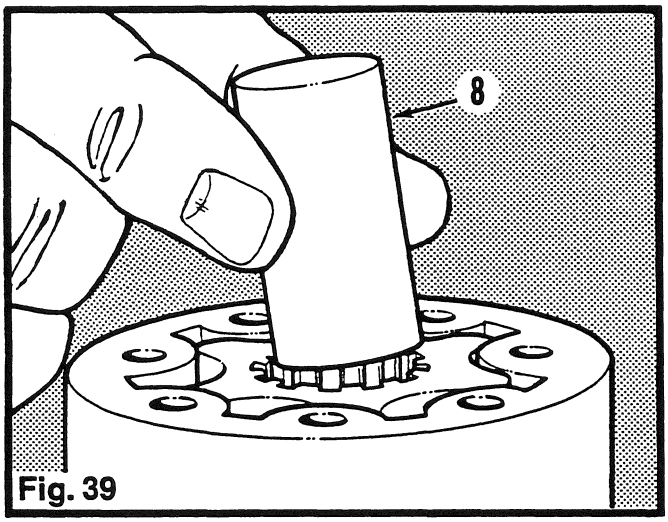
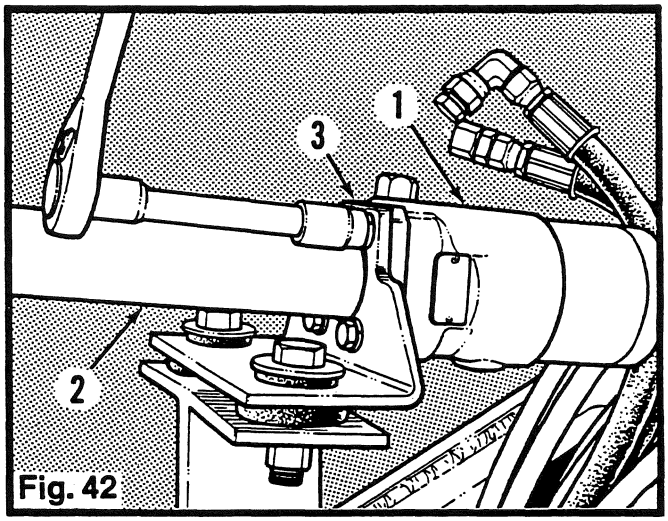


Fig. 39



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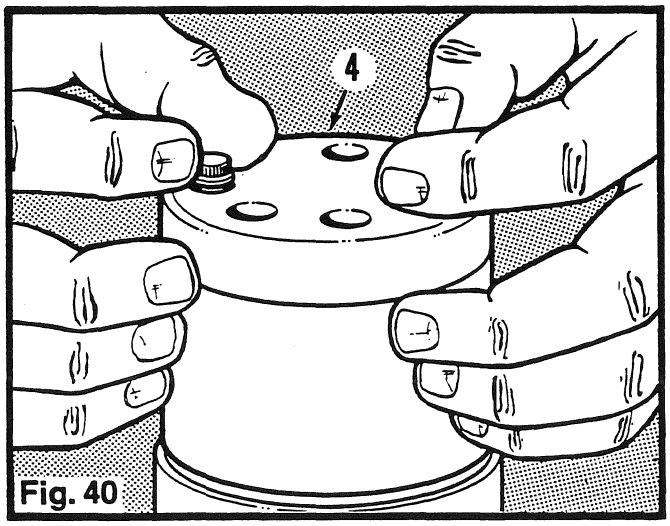


Fig. 40

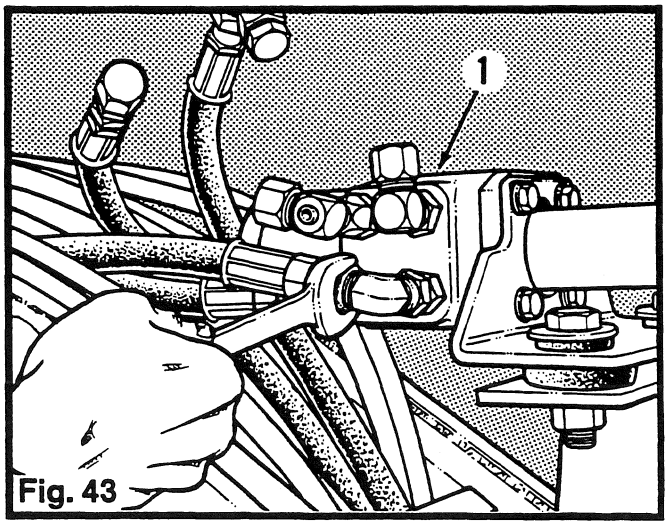


Fig. 43

STEERING COLUMN

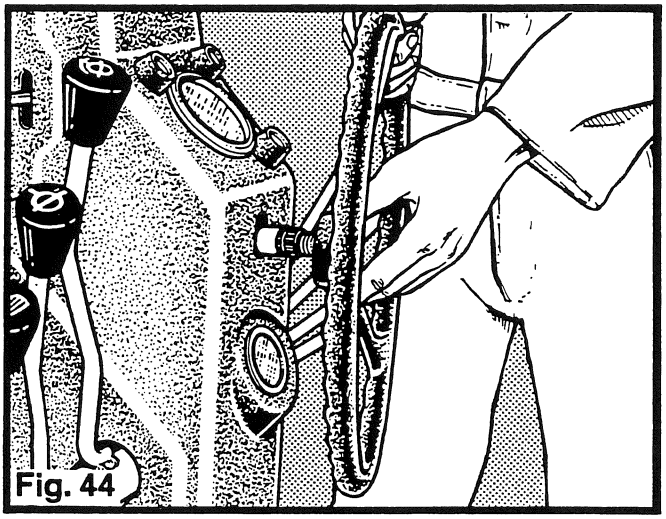


Fig. 44

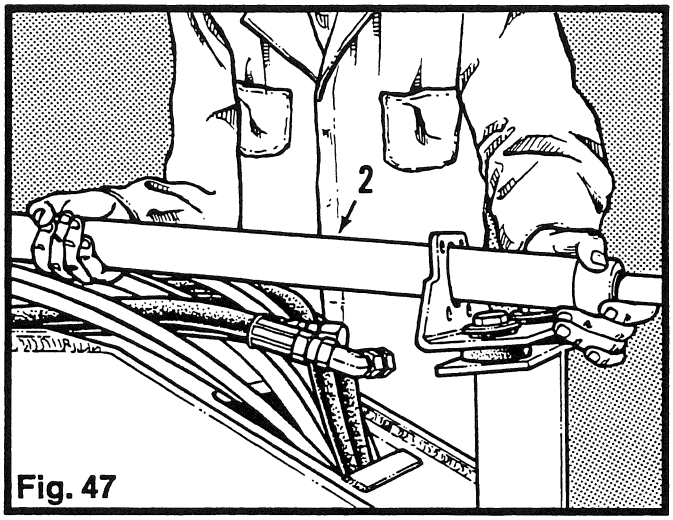


Fig. 47

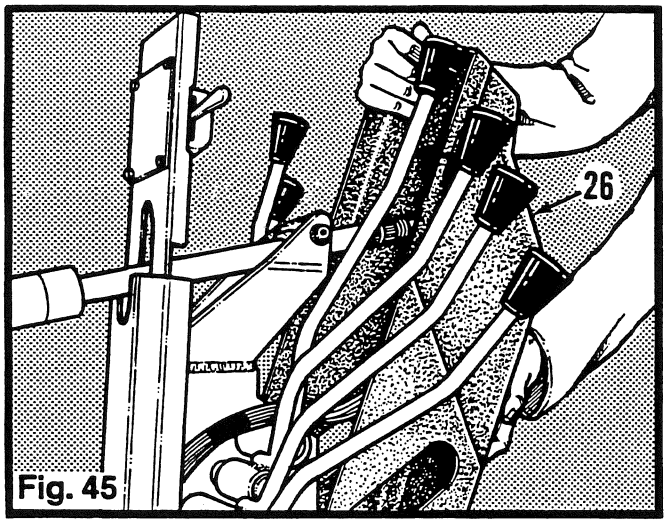


Fig. 45

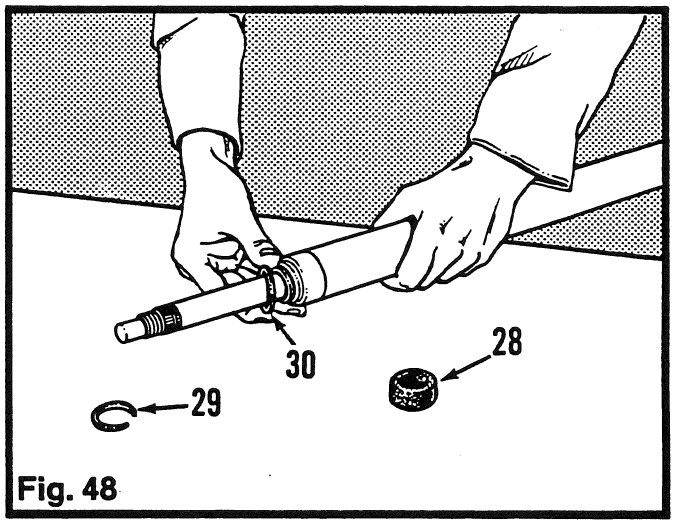
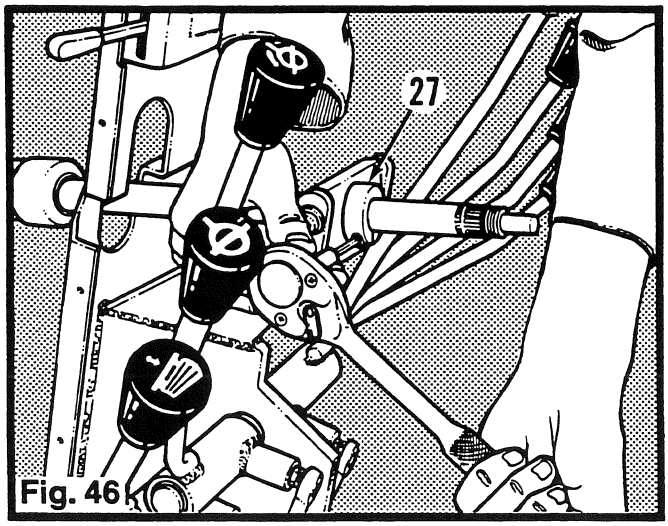


Fig. 48



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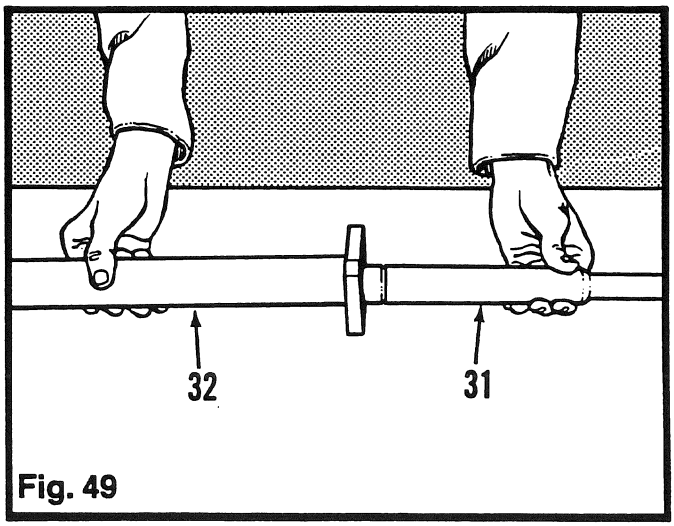


Fig. 49

STEERING COLUMN

Removal

1. Remove the steering unit (1). (see page 3)

2. Remove the brass knob (23) and steering wheel nut. (Fig. 44) Remove the steering wheel.

4. Remove the pedestal cover (26). (Fig. 45)

5. Remove the clamping collars (27). (Fig. 46)

6. Remove the steering column (2) from the grader. (Fig. 47)

Disassembly

1. Remove the dust cap (28). Release the retaining ring (29) and remove the thrust washer (30). (Fig. 48)

2. Remove the shaft assembly (31) from the tube (32) by pushing it in the direction of the flange. (Fig. 49)

Assembly and Installation

To assemble and install the steering column, reverse the above procedures. See page 15 to install the steering unit.

CUSHION VALVE

Removal

1. Disconnect the two hydraulic hoses from the steering cylinders. (Fig. 50) Plug the fittings and cylinder ports to prevent contamination. Identify the hoses to prevent confusion during reassembly.

2. Disconnect the top hydraulic tubes. (Fig. 51) Plug the fittings and ports to prevent contamination.

3. Remove the two capscrews that fasten the cushion valve (**33**) to the frame. Remove the cushion valve (**33**). (Fig. 52)

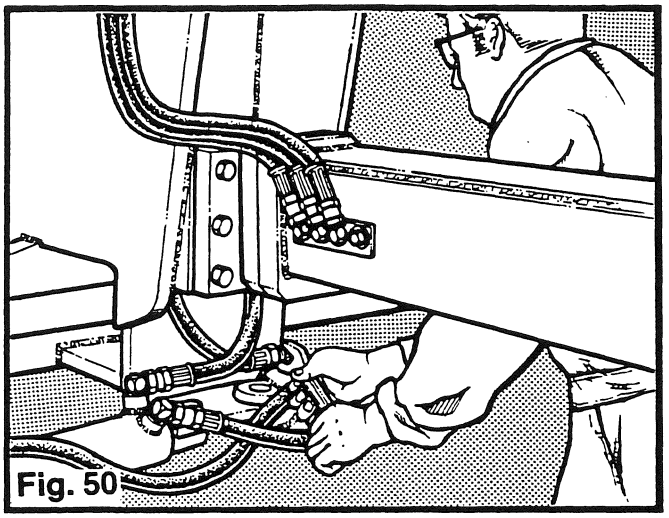
Disassembly

1. Place the valve into a vise with soft jaws. Remove the O ring fittings (**35**) and hoses. (Fig. 53)

2. Remove the O ring plugs (**36**). (Fig. 54)

3. Use an Allen wrench to remove the adjusting screws (**37**). (Fig. 55)

CUSHION VALVE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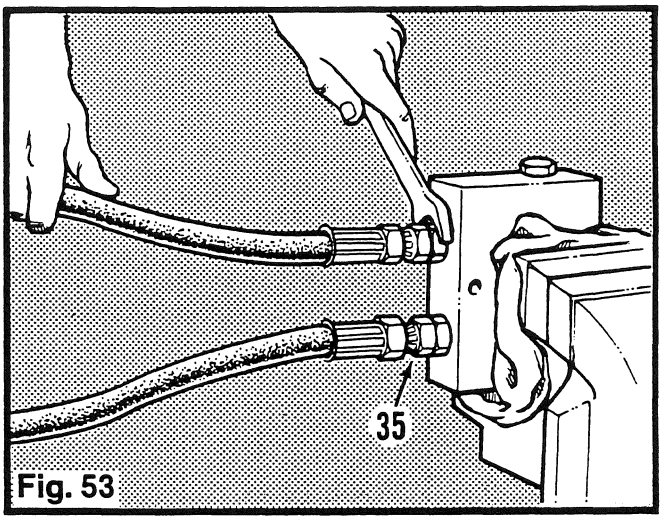

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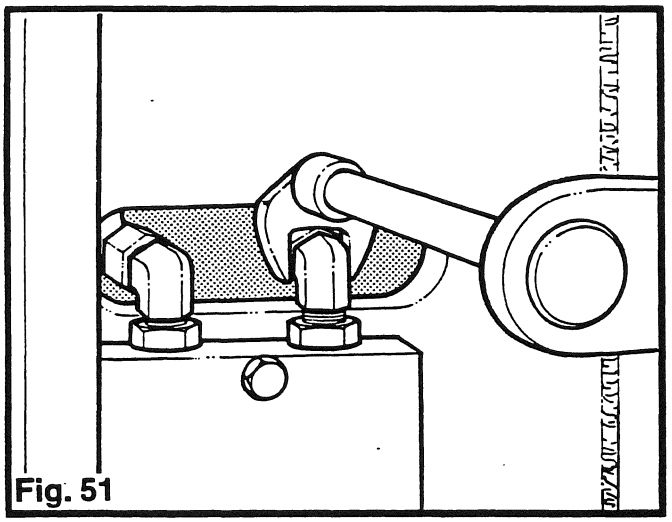
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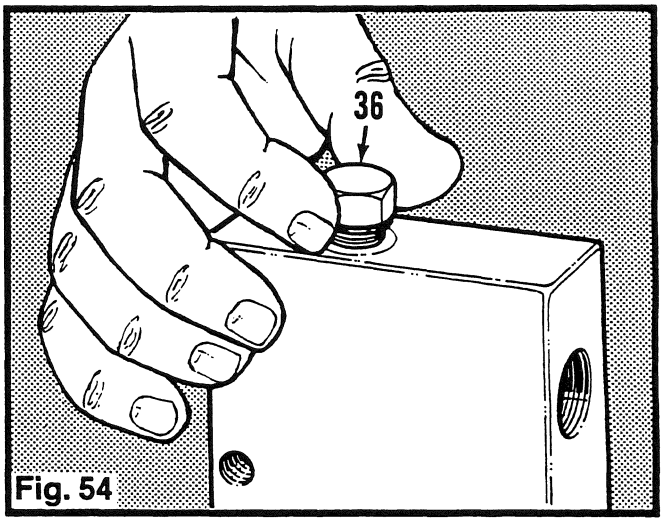


Fig. 54

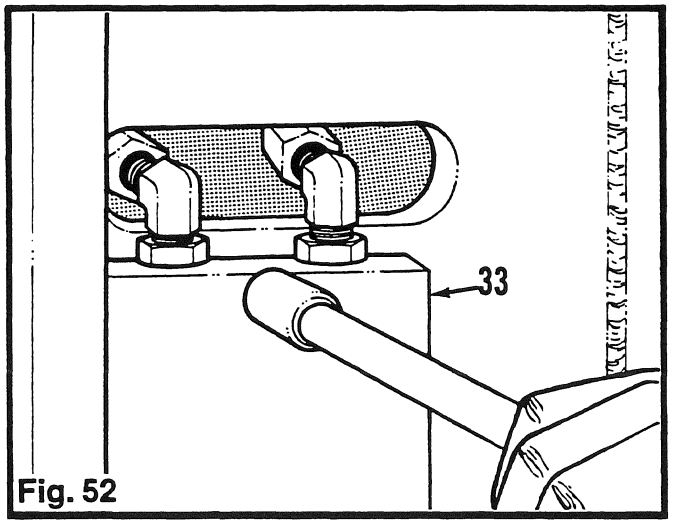


Fig. 52

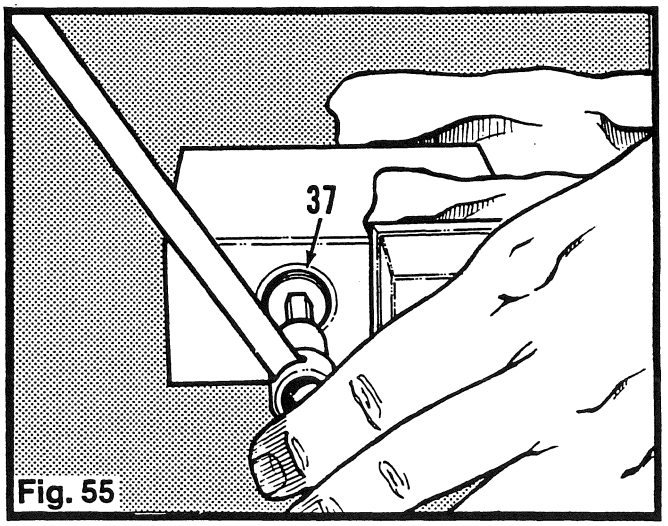


Fig. 55

CUSHION VALVE

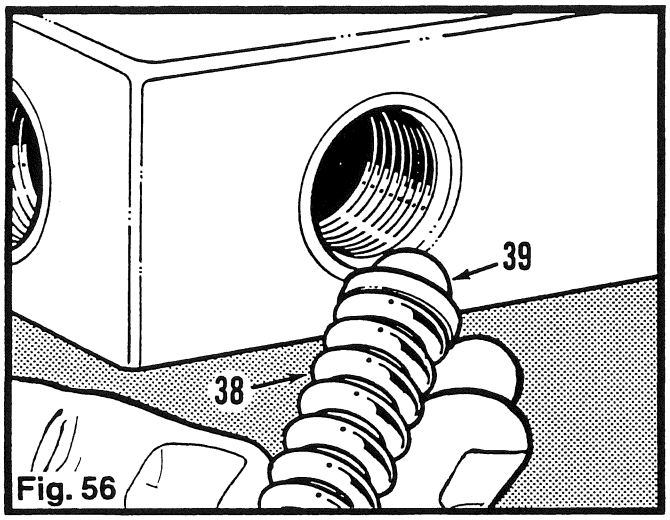


Fig. 56

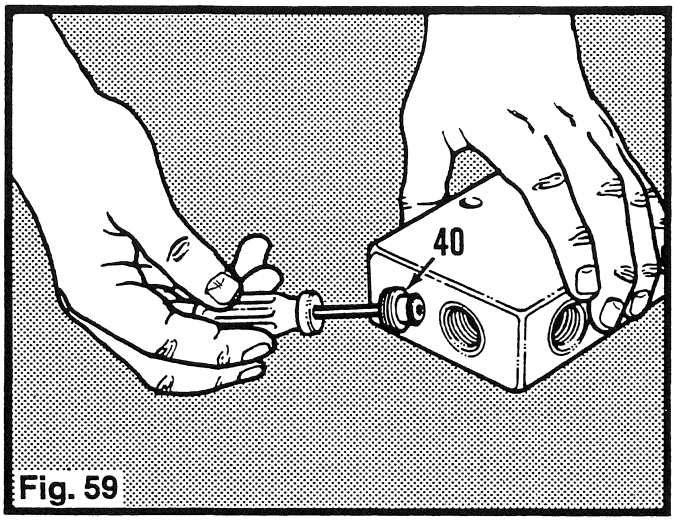


Fig. 59

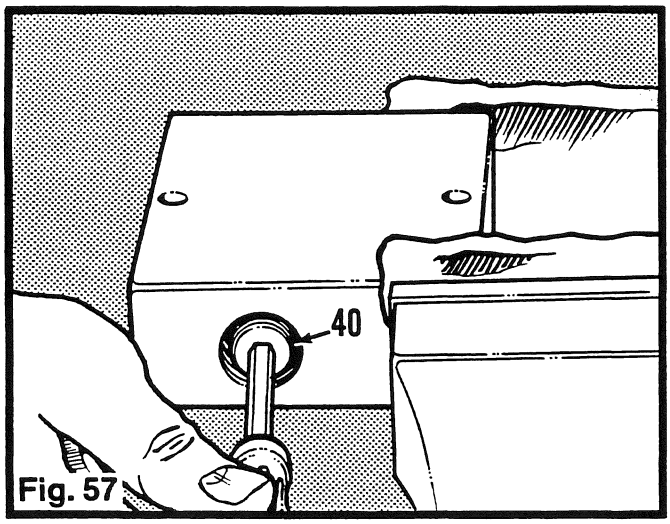


Fig. 57

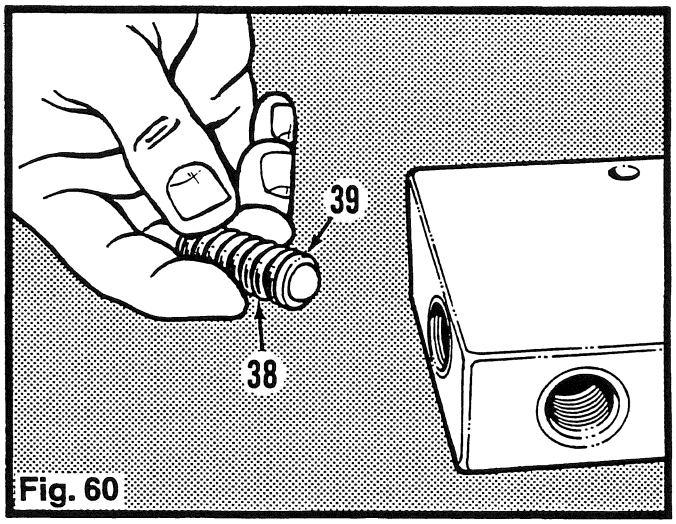
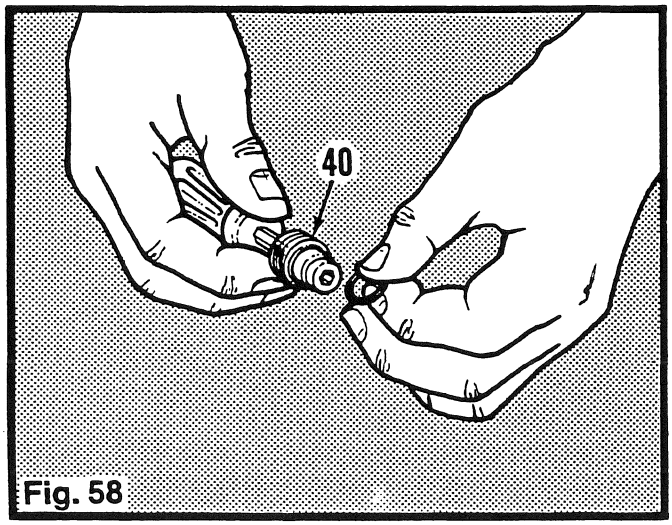


Fig. 60



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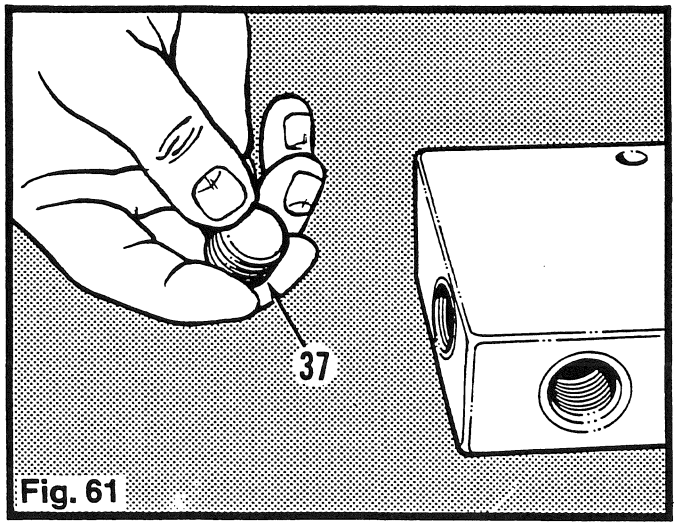


Fig. 61

CUSHION VALVE

Disassembly (cont.)

4. Remove the springs (**38**) and poppets (**39**). (Fig. 56)

5. Remove the seat (**40**). (Fig. 57)

6. Discard all O rings. Inspect all components for damage or wear. Wash them with solvent and dry them with compressed air.

Assembly

7. Install a new O ring on the seat (**40**). (Fig. 58)

8. Install the seat (**40**) in the housing and tighten it to the specification in the torque table. (Fig. 59)

9. Install the poppet (**39**) and spring (**38**). (Fig. 60)

10. Install the adjusting screw (**37**). (Fig. 61) Repeat this assembly procedure for the opposite side of the valve.

CUSHION VALVE

Adjustment

1. Install a plug in the port on one side of the valve (33) and attach a hydraulic power supply, such as a portable press to the other port. (Fig. 62)

2. Build pressure with the press until the valve begins to relieve oil to the opposite port. (Fig. 63)

3. Turn the adjusting screw until the valve relieves oil at 5515 kPa (800 psi). Repeat this operation for the opposite side. (Fig. 64)

Installation

1. Install new O rings on the fittings (35) and install the fittings to finger tightness. Install the two hoses. (Fig. 65)

2. Remove the plugs from the hydraulic tubes and connect them to the valve (33).

3. Fasten the valve (33) to the frame with the two capscrews (34). Tighten the capscrews to the specified torque. (Fig. 66)

4. Connect the hoses to the steering cylinders. Fully tighten the O ring fittings (35) at the valve. (Fig. 67)

IMPORTANT

Always road test the grader before returning it to service. Check the hydraulic oil level and add oil as required. Carefully inspect the system for leaks and repair where necessary.

CUSHION VALVE

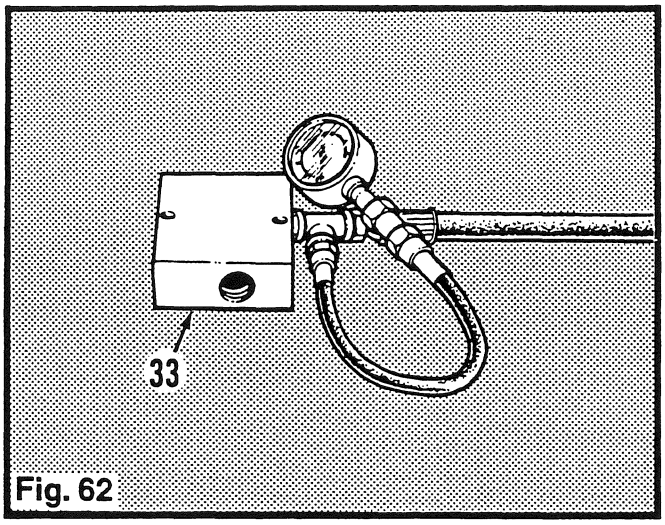


Fig. 62

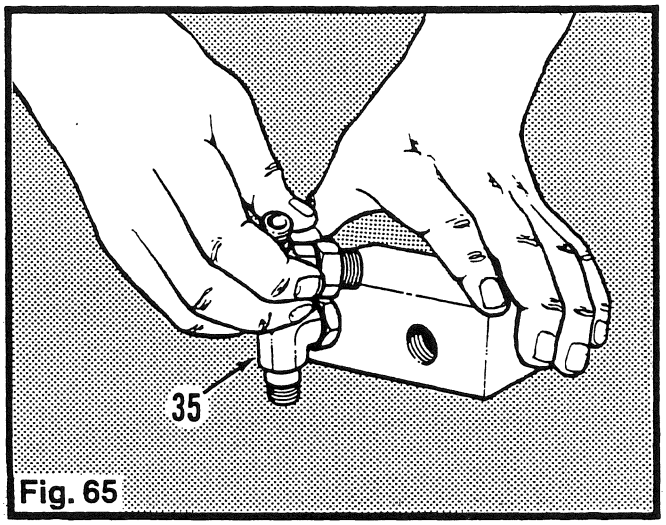


Fig. 65

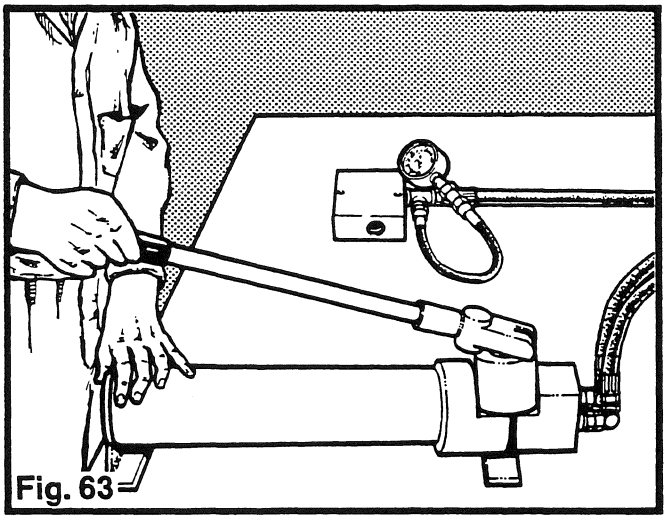


Fig. 63

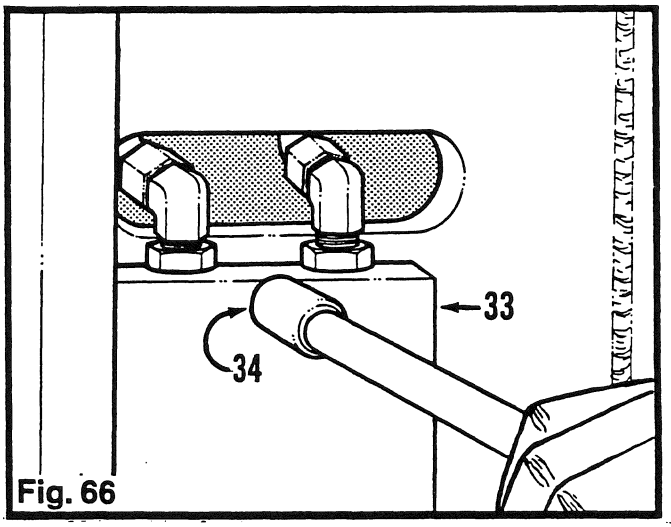


Fig. 66

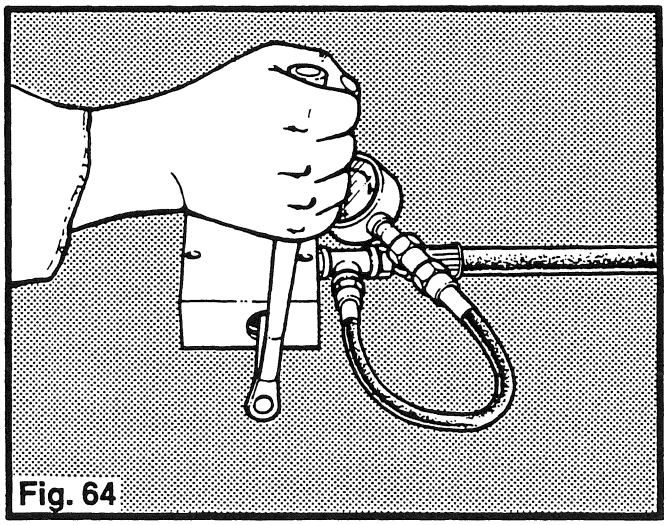


Fig. 64

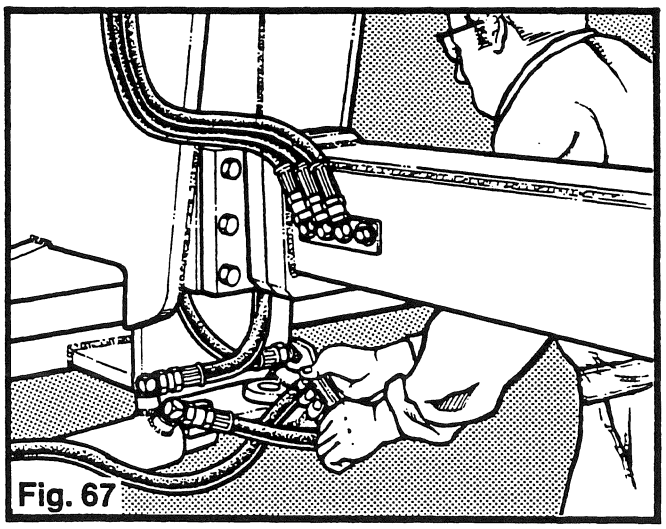
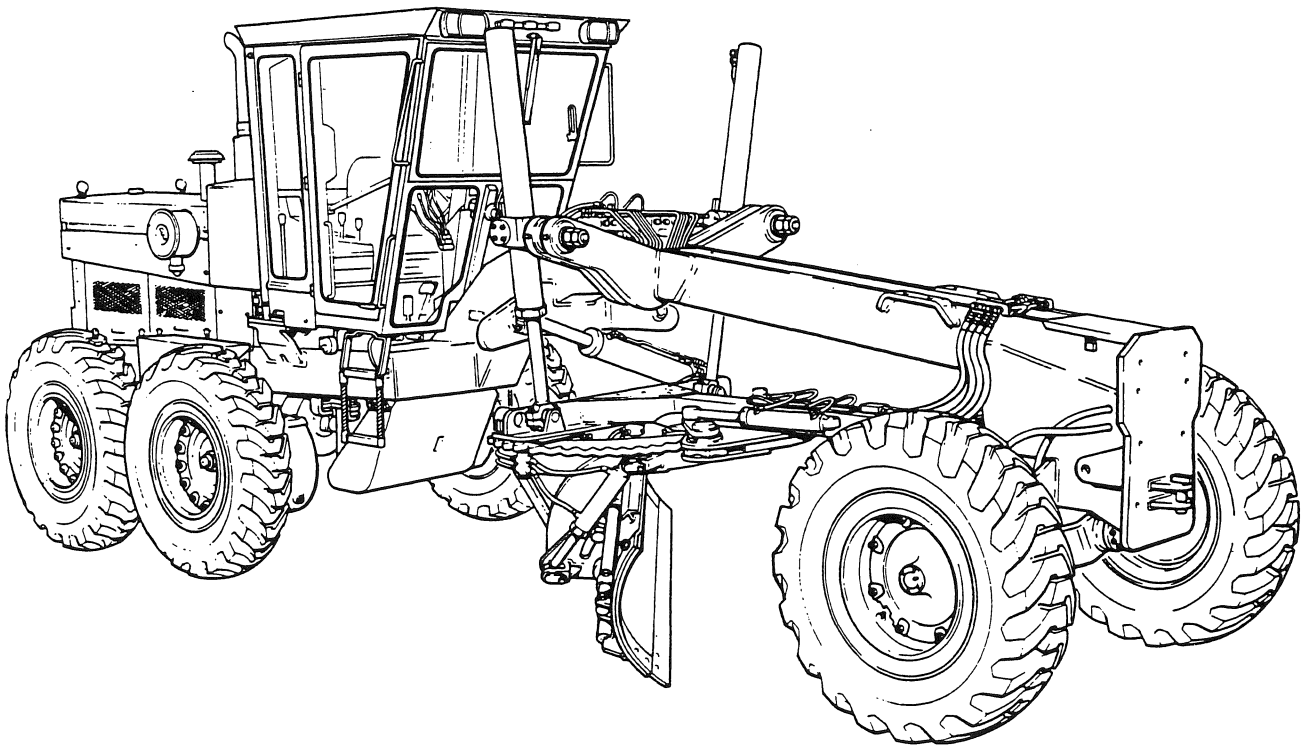


Fig. 67

SECTION 6

CLUTCH MASTER CYLINDER



MASTER CYLINDER AND BOOSTER ASSEMBLY

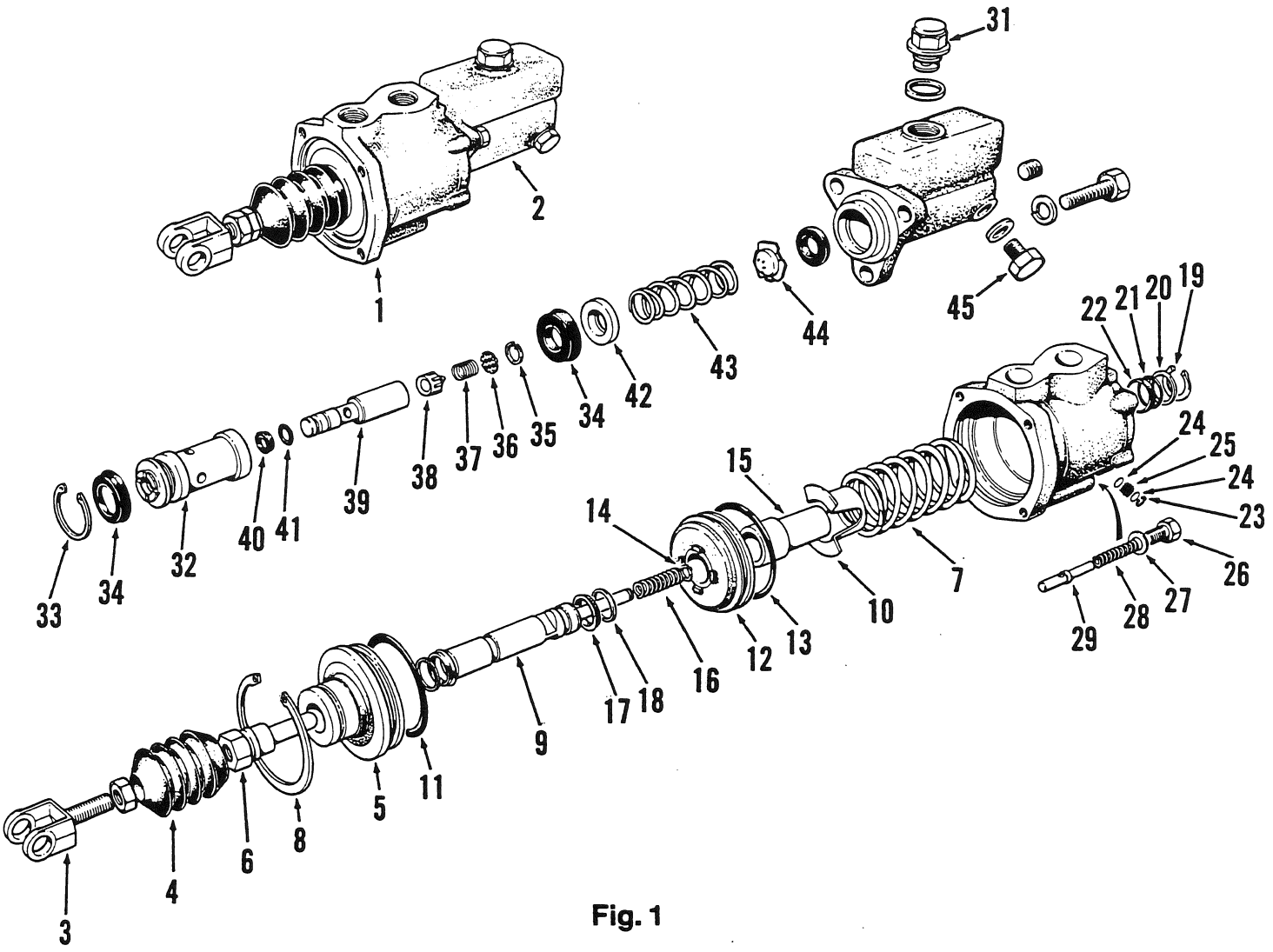


Fig. 1

KEY TO FIG. 1		
item description	item description	item description
1 booster	17 seals	33 snap ring
2 master cylinder	18 back-up washers	34 piston cup seals
3 yoke	19 snap ring	35 retaining ring
4 boot	20 back-up ring	36 retainer
5 end cover	21 back-up washer	37 return spring
6 push rod	22 seal	38 check valve assembly
7 return spring	23 snap ring	39 reaction piston
8 snap ring	24 strainers	40 seal
9 valve piston	25 hair filter	41 O ring
10 spring retainer	26 plug	42 retainer
11 O ring	27 washer	43 spring
12 piston	28 spring	44 residual check valve
13 O ring	29 plunger	45 plugs
14 retaining ring	30 O ring fittings	46 sending unit
15 connector	31 reservoir cap	47 fitting
16 inner return spring	32 piston	

INDEX

NOTE

The following Section applies to graders with serial no.s 8512 to 15858 and U.S. serial no.s 101-2 to 1786-2. It can be used as a guide for servicing graders serial no. 15859 and after and U.S. serial no. 1787-2 and after.

GENERAL

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chance of foreign matter entering the hydraulic system.

Make sure proper tools are available and in good working order. You will require normal shop tools to service the master cylinder and booster assemblies.

DESCRIPTION AND OPERATION

Both the brake and the clutch circuits incorporate master cylinders equipped with hydraulic boosters. The boosters receive oil from the steering circuit (see Section 5). The master cylinders used in the brake and clutch circuits are essentially the same.

If the grader is equipped with the Mark III cab, the master cylinder assemblies are located beneath the cab. Graders equipped with previous model cabs have the master cylinder assemblies mounted in front of the cab.

MASTER CYLINDER AND BOOSTER ASSEMBLY

REMOVAL

CAUTION

Wear eye protection when working on the master cylinders. Brake fluid can harm your eyes.

Removal from the Grader

1. Remove the hydraulic hoses from the fittings on top of the booster (1). (Fig. 2) Install plugs in the hoses to prevent dirt from entering the system.

2. Remove the lines and hoses from the master cylinder (2). (Fig. 3) Drain the remaining fluid into a suitable container.

3. Disconnect the linkage from the yoke (3).

4. Remove the capscrews that fasten the booster and master cylinder assembly to the grader. Remove the assembly. (Fig. 4)

BOOSTER

Booster - Disassembly

1. Allow any oil remaining in the booster (1) to drain out.

2. Slide the boot (4) out of the groove in the end cover (5) and remove it, along with the push rod (6) and yoke (3). (Fig. 5)

3. Place the booster (1) in a vise. Remove the capscrews retaining the master cylinder (2) to the booster. Remove the master cylinder and set it aside. (Fig. 6)

4. Turn the assembly over in the vise. (Fig. 7)

BOOSTER

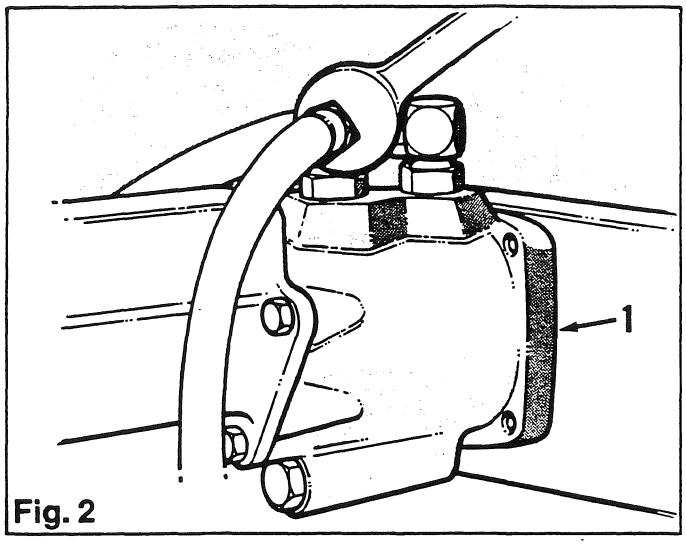


Fig. 2

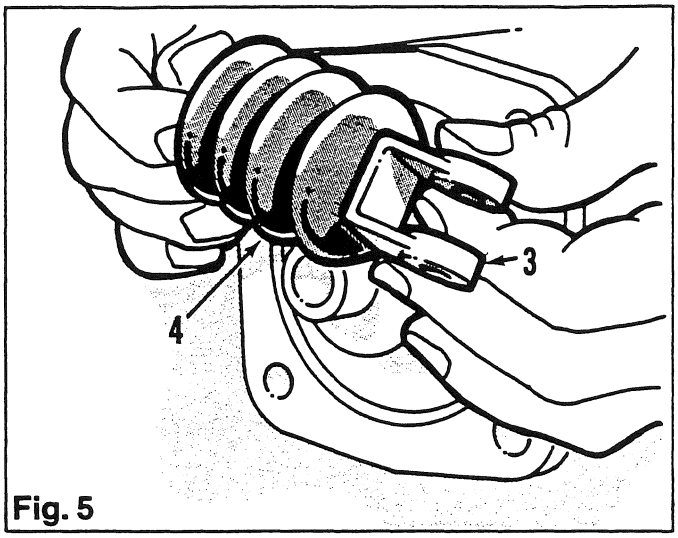


Fig. 5

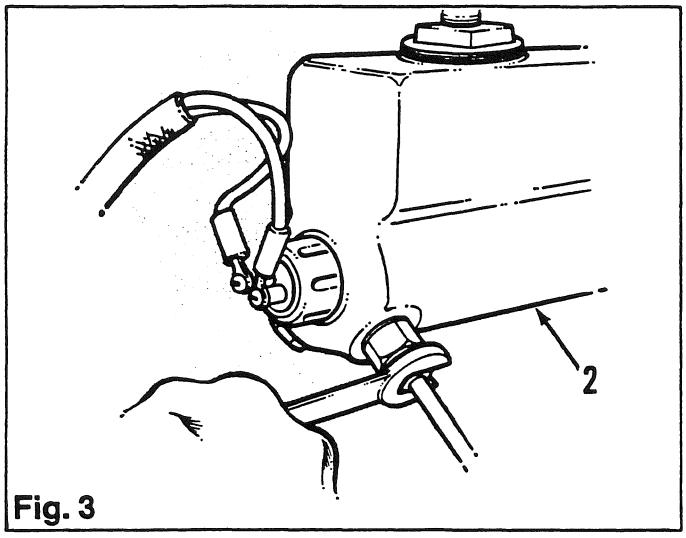


Fig. 3

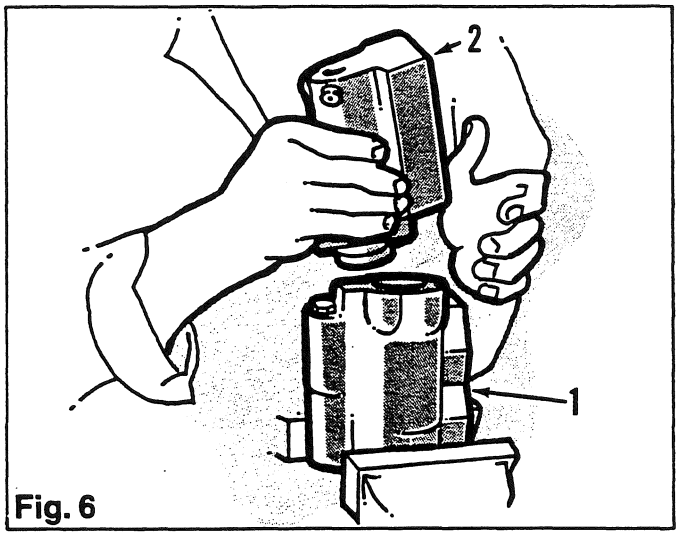
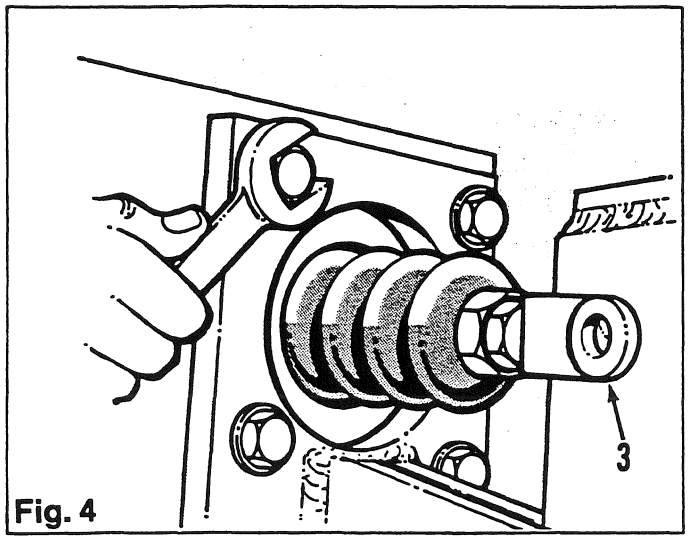


Fig. 6



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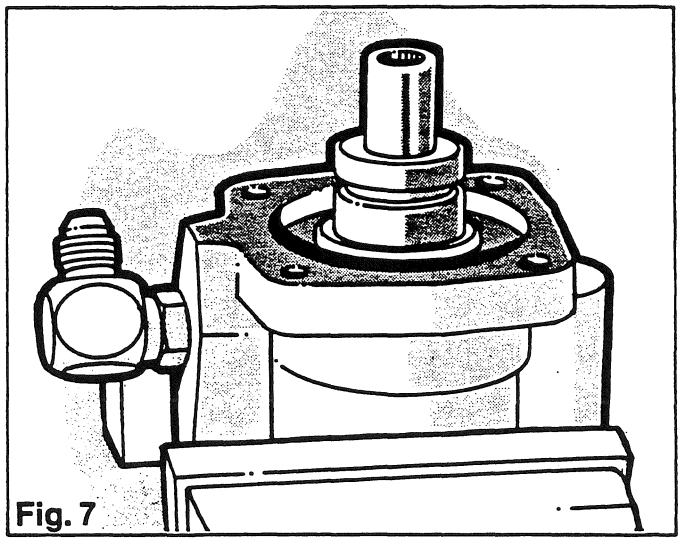


Fig. 7

BOOSTER

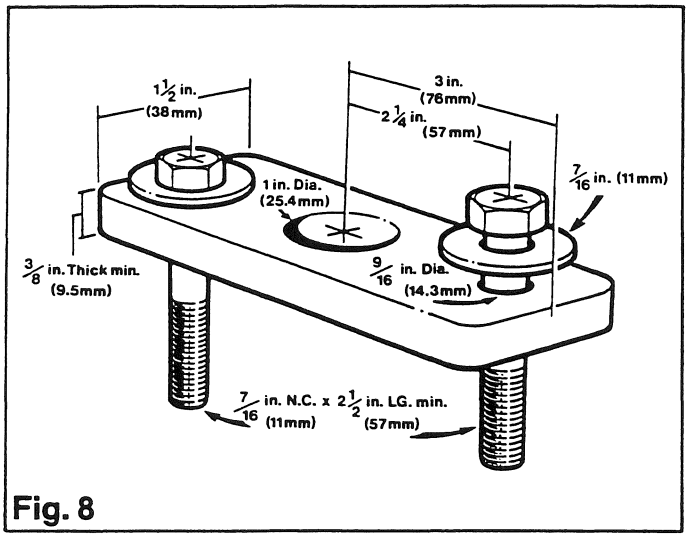
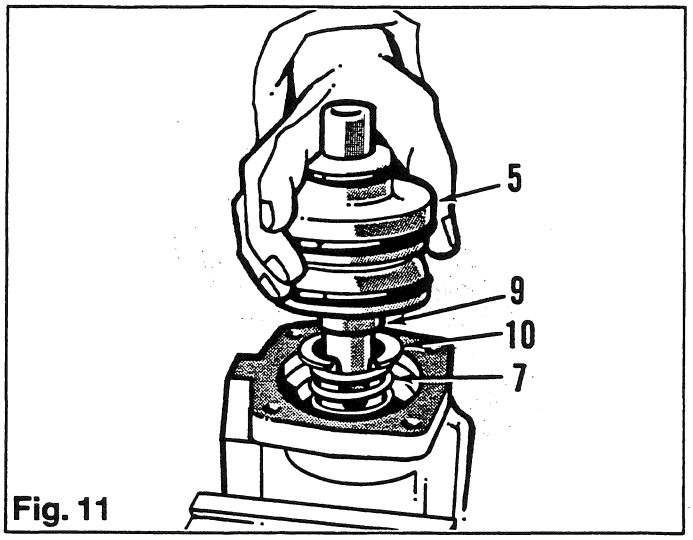


Fig. 8



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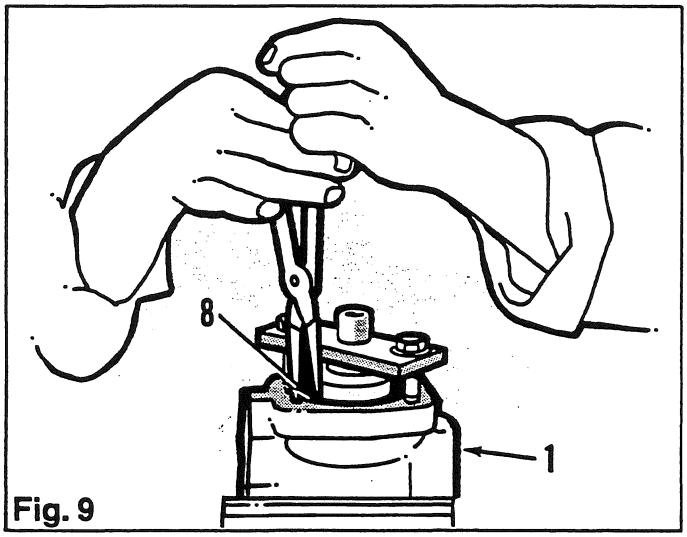

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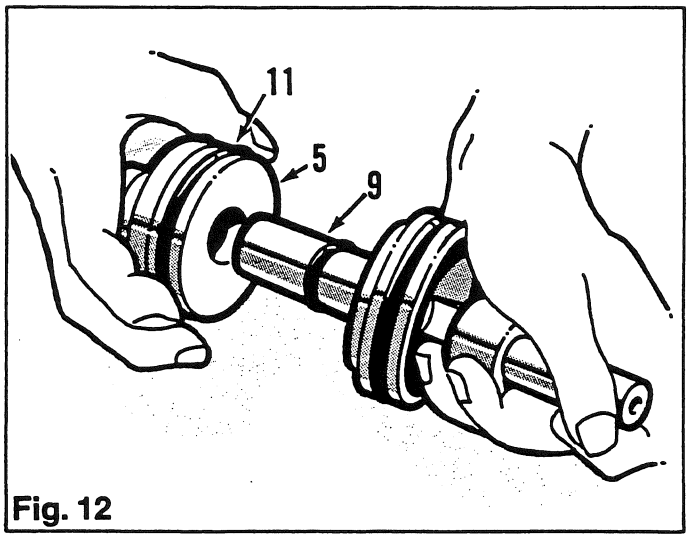

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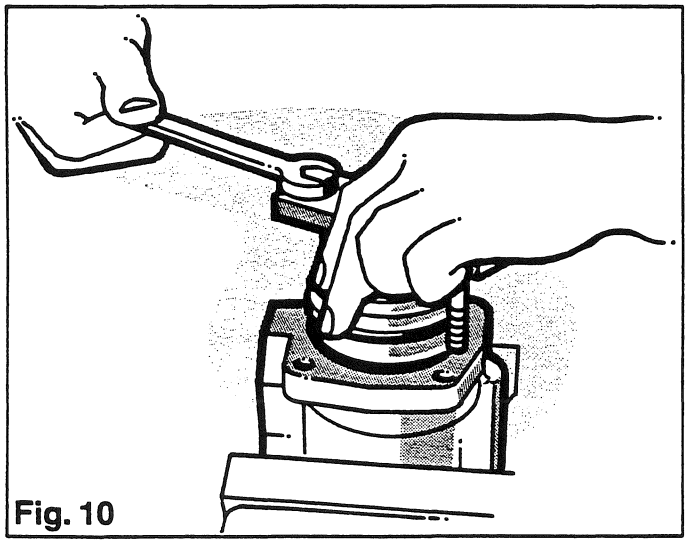


Fig. 10

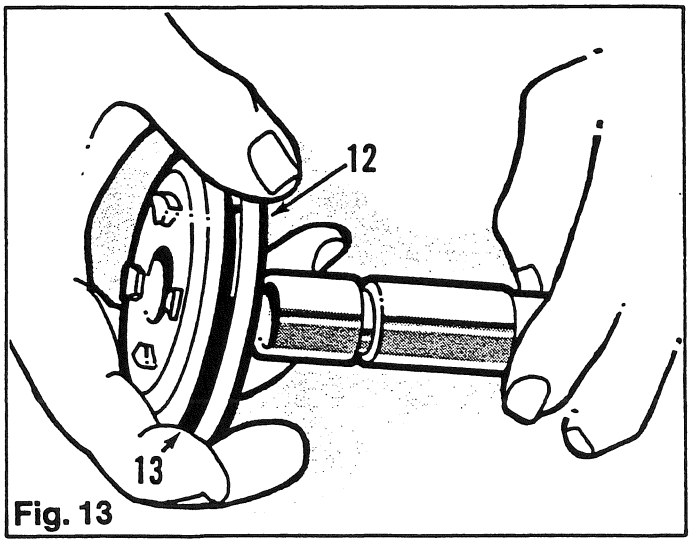


Fig. 13

BOOSTER

Disassembly (cont.)

5. If you do not already have one, make a tool according to the illustration in Fig. 8.

6. Install the tool on the booster (1) as shown in Fig. 9. It will compress the return spring (7) slightly while you remove the snap ring (8).

7. Carefully loosen the capscrews to release the spring tension. Remove the tool. (Fig. 10)

8. Remove the end cover (5), valve piston (9) assembly, return spring (7) and spring retainer (10). (Fig. 11)

9. Remove the end cover (5) from the valve piston (9) and discard the O ring (11). (Fig. 12)

10. Remove the piston (12) and discard the O ring (13). (Fig. 13)

BOOSTER

Disassembly (cont.)

11. Remove the retaining ring (14), the connector (15) and the inner return spring (16). (Fig. 14)

12. Use a screwdriver or similar tool to pry the seals (17) and back-up washers (18) from the valve piston (9). (Fig. 15)

13. Turn the housing on its end and remove the snap ring (19), back-up ring (20) back-up washer (21) and seal (22). (Fig. 16)

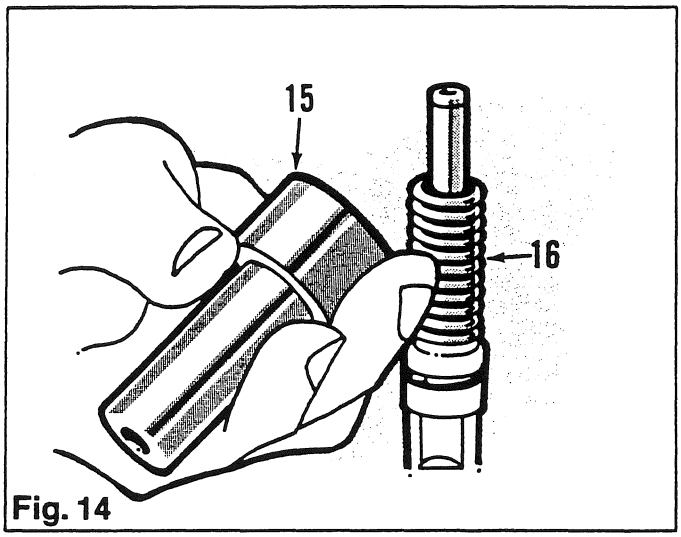
14. Remove the snap ring (23), strainers (24) and hair filter (25) from the housing. (Fig. 17)

15. Remove the plug (26), washer (27), spring (28) and plunger (29) from the housing. (Fig. 18)

16. Remove the O ring fittings (30) from the housing. (Fig. 19)

Discard all seals O rings and snap rings. Wash all components in solvent and dry them with compressed air. Check all surfaces for damage or wear.

BOOSTER



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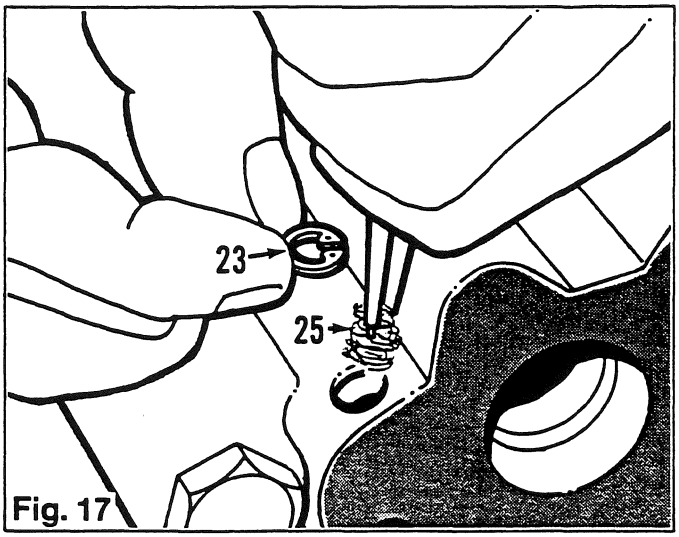

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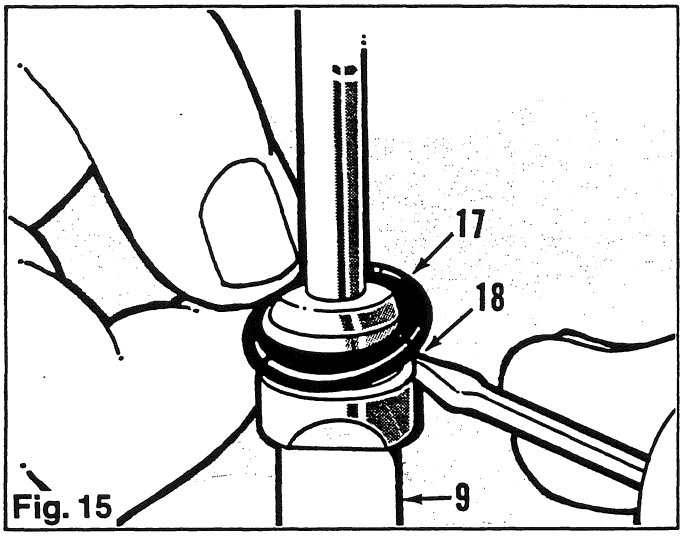

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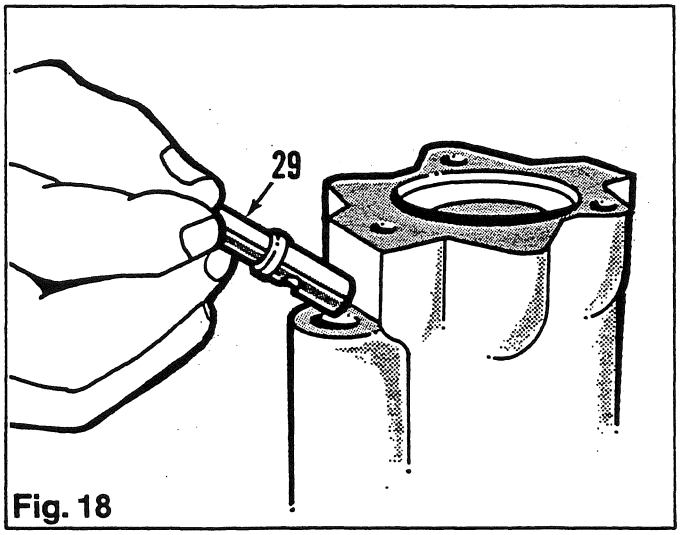

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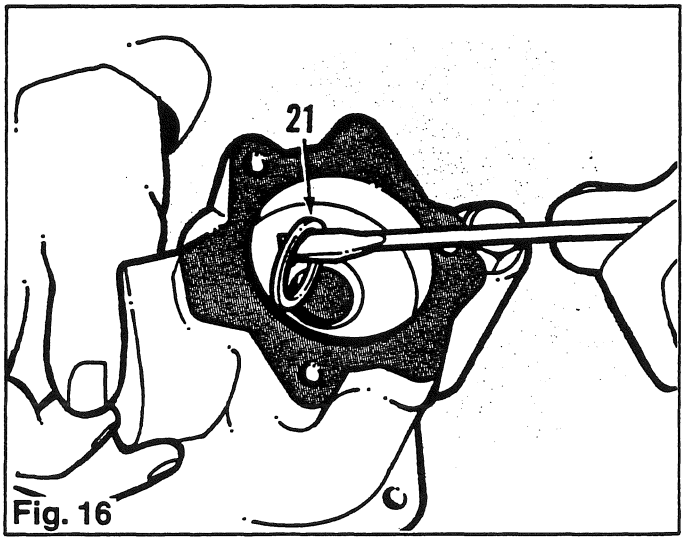

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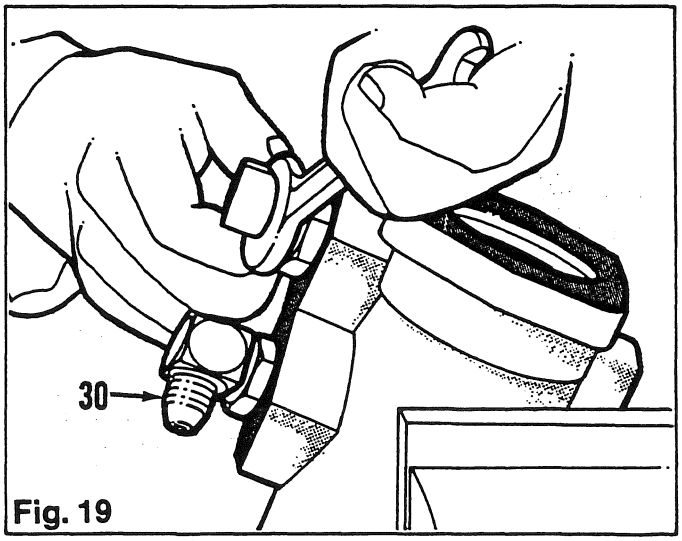
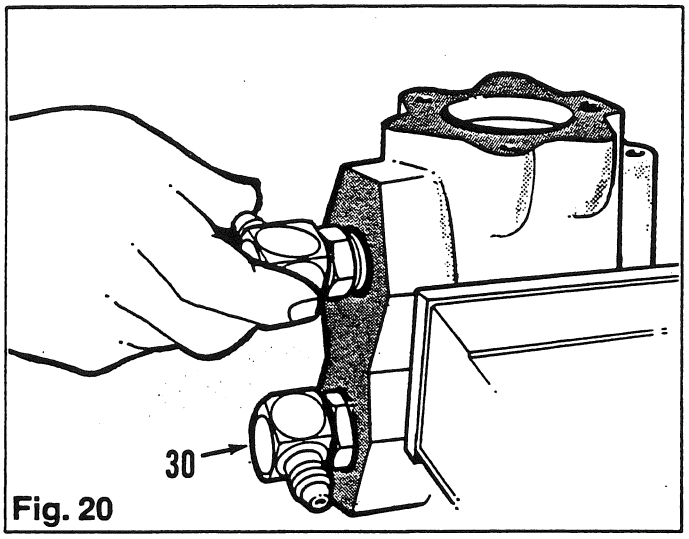


Fig. 19

BOOSTER



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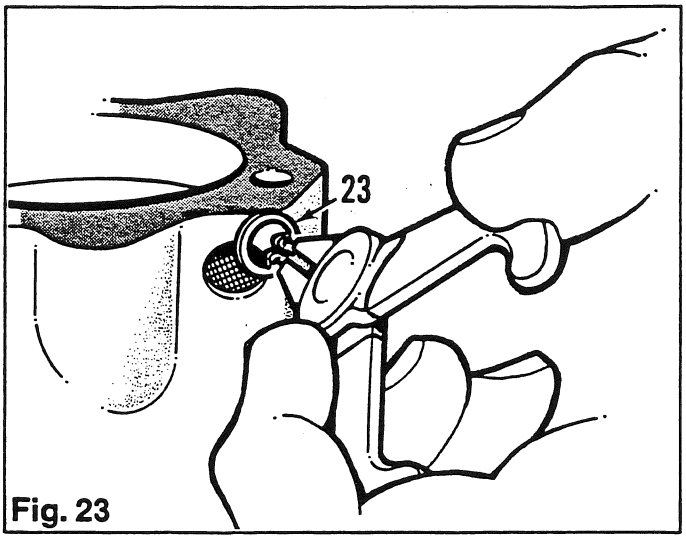


Fig. 23

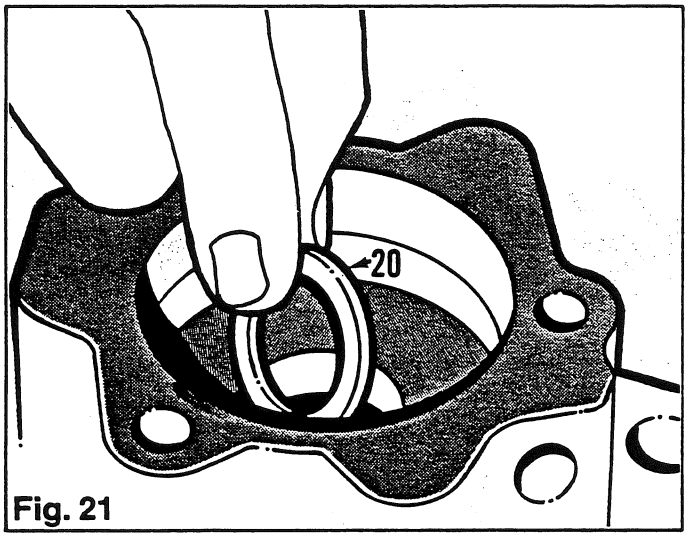
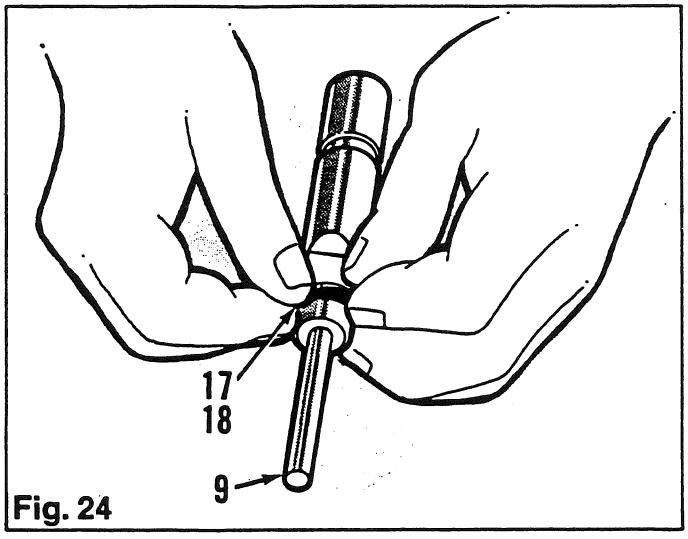


Fig. 21



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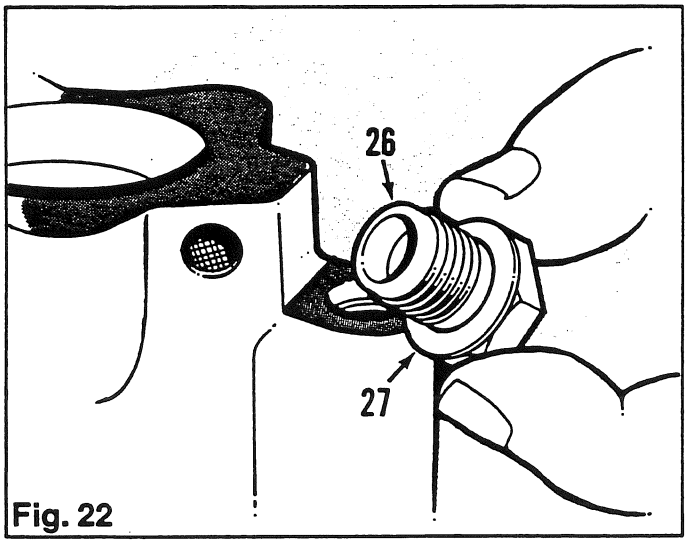

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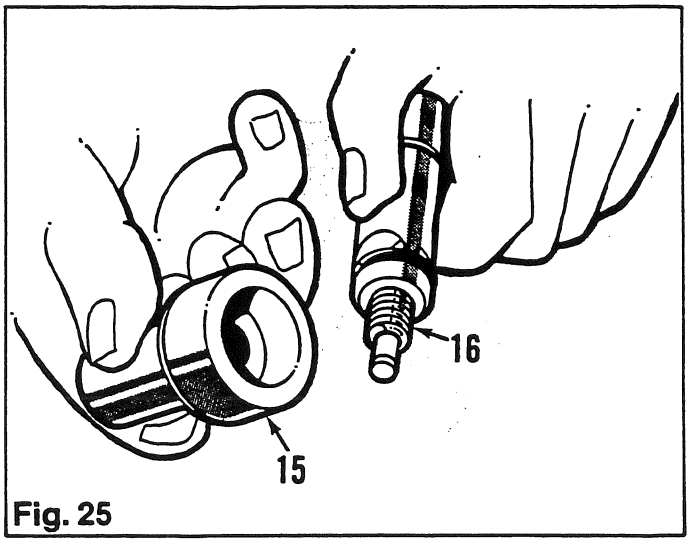


Fig. 25

BOOSTER

Assembly

1. Re-install the O ring fittings (30). (Fig. 20)

2. Install the seal (22), back-up washer (21) back-up ring (20) and snap ring (19) into the housing. (Fig. 21)

3. Install the plunger (29) and spring (28). Retain them with a new copper washer (27) and plug (26). (Fig. 22)

4. Install a new hair filter (25) complete with the strainers (24) and retain it with a new snap ring (23). (Fig. 23)

5. Lubricate and install a new seal (17) and back-up washer (18) onto the spring end of the valve piston (9). (Fig. 24)

6. Install the inner return spring (16) and connector (15) and retain them with a new retaining ring (14). (Fig. 25)

BOOSTER

Assembly (cont.)

7. Lubricate a new O ring (13) and install it on the piston (12). (Fig. 26)

8. Lubricate the piston (12) and install it on the valve piston (9). (Fig. 27)

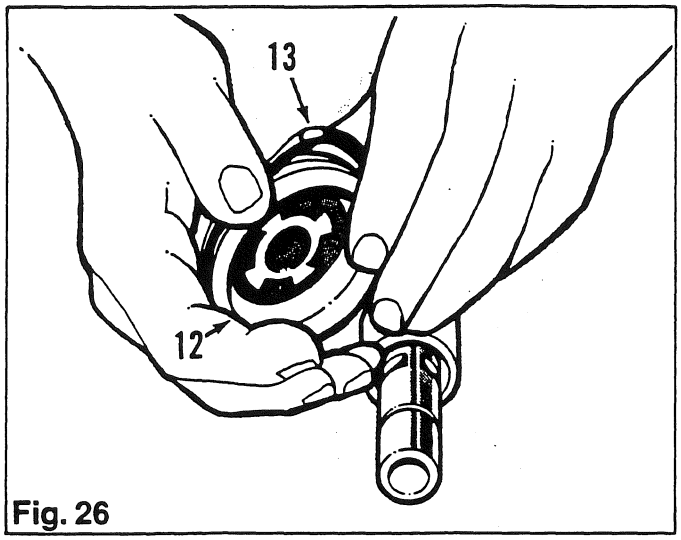
9. Install the other valve piston seal (17) and back-up washer (18). (Fig. 28)

10. Install the return spring (7) and spring retainer (10) in the housing, followed by the valve piston assembly. (Fig. 29)

11. Lubricate a new "O" ring (11) and install it in the end cover (5). (Fig. 30)

12. Install the end cover (5) over the valve piston (9) and install the assembly tool. (Fig. 31)

BOOSTER



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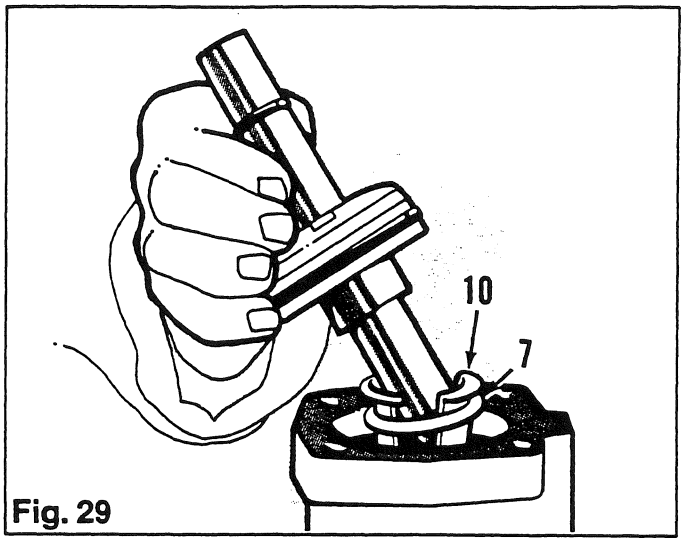

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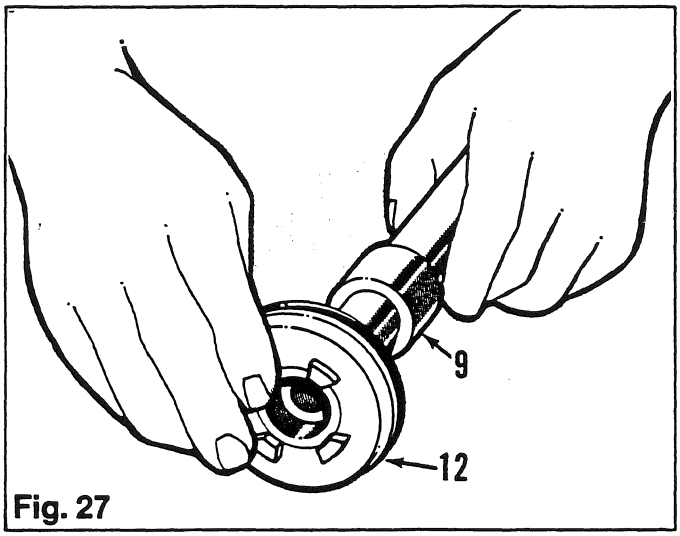

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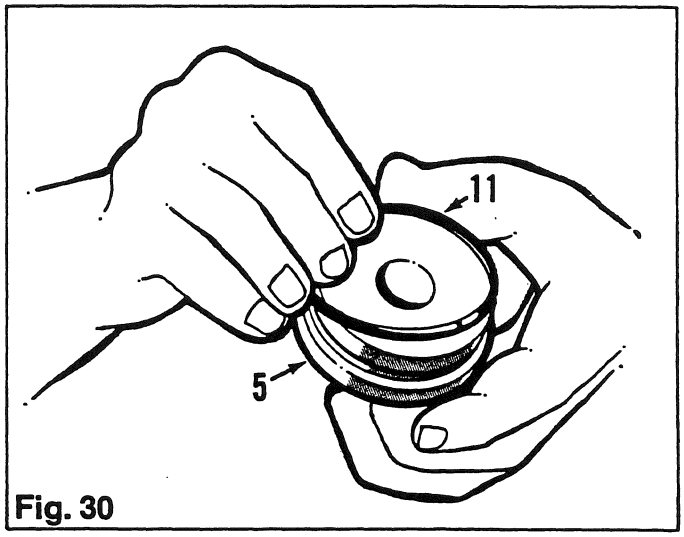


Fig. 30

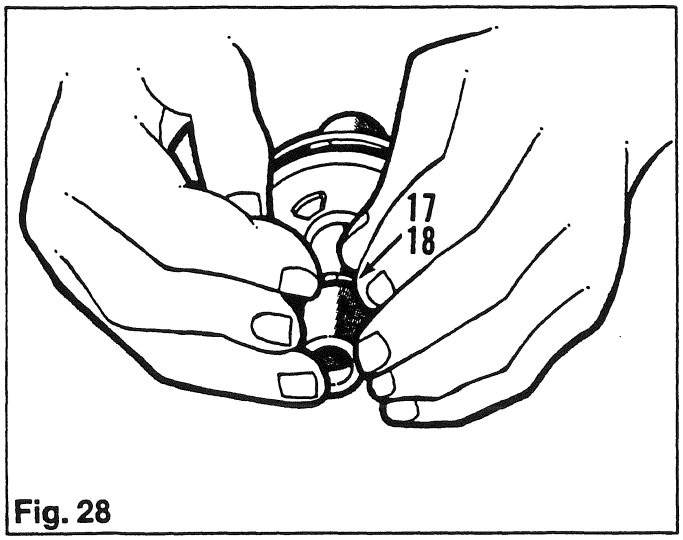


Fig. 28

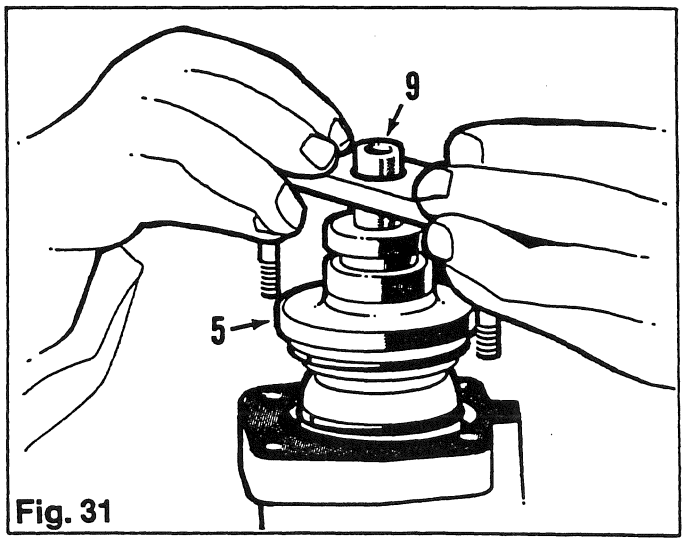


Fig. 31

BOOSTER

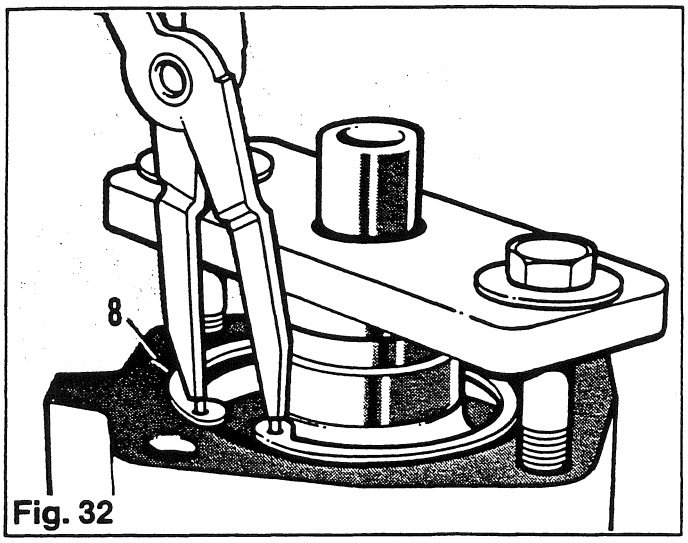


Fig. 32

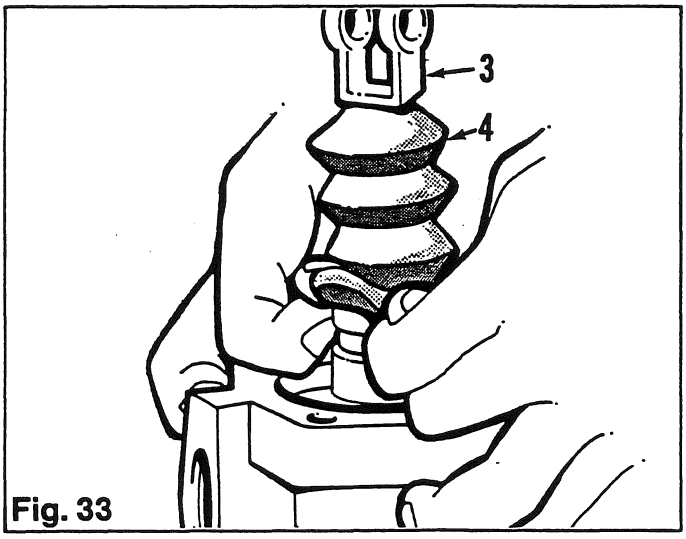


Fig. 33

MASTER CYLINDER

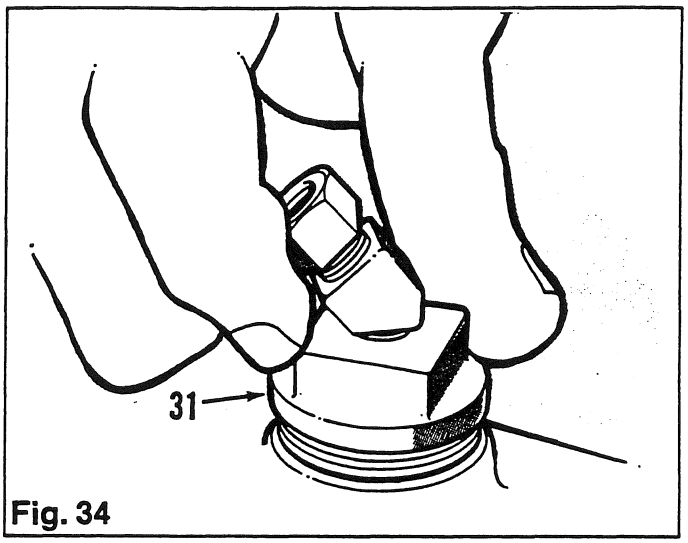


Fig. 34

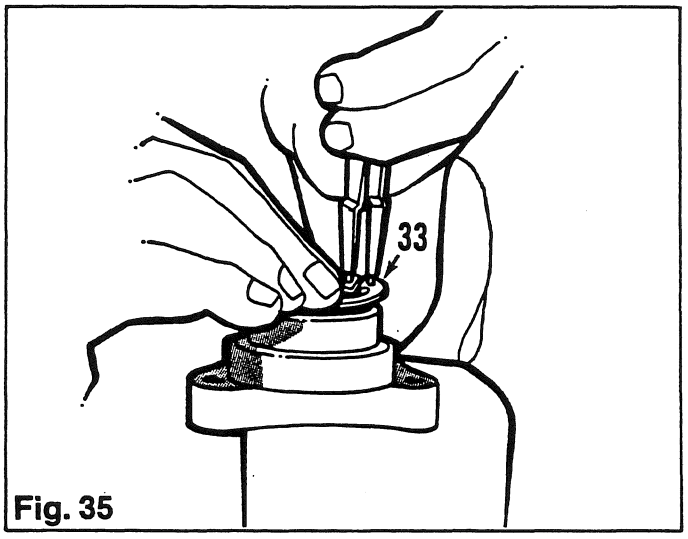


Fig. 35

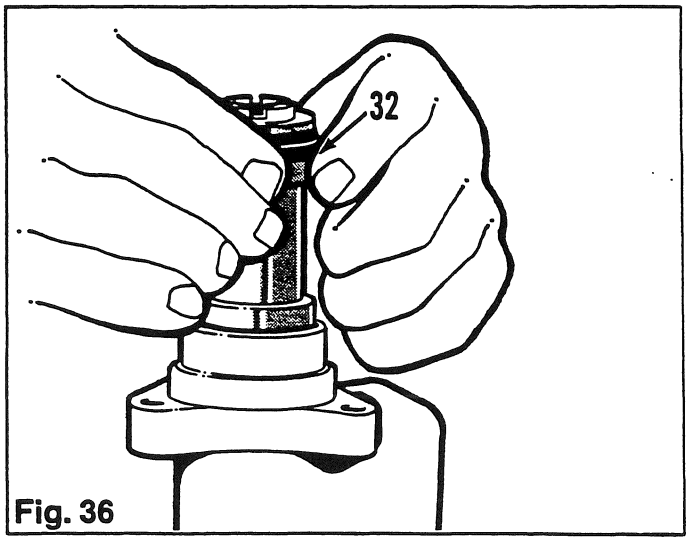


Fig. 36

BOOSTER

Assembly (cont.)

13. Tighten the capscrews until the tool compresses the return spring (7). Install the snap ring (8) and remove the assembly tool. (Fig. 32)

14. Install the push rod (6), boot (4) and adjusting yoke (3) on the front of the booster cylinder. (Fig. 33) The booster is now ready for installation on the master cylinder.

MASTER CYLINDER

Disassembly

1. Remove the master cylinder reservoir cap (31). Empty any fluid into a suitable container. (Fig. 34)

2. Compress the piston (32) slightly. Remove the snap ring (33). (Fig. 35)

3. Release the spring tension slowly and remove the piston assembly. (Fig. 36)

MASTER CYLINDER

Disassembly (cont.)

4. Remove and discard the piston cup seals (**34**). (Fig. 37)

5. Remove the retaining ring (**35**), retainer (**36**), return spring (**37**) and check valve assembly (**38**). (Fig. 38)

6. Remove the reaction piston (**39**). Discard the seal (**40**) and O ring (**41**). (Fig. 39)

7. Remove the retainer (**42**) and spring (**43**). (Fig. 40)

8. Discard the residual check valve (**44**). (Fig. 41)

9. Remove the remaining plugs (**45**), sending unit (**46**) and fitting (**47**) from the cylinder. (Fig. 42)

Thoroughly clean the pistons and housing with alcohol and dry them with compressed air. Ensure that no residue is present on any of the parts. You can remove scratches or light scores from the cylinder with a hone. Be sure to clean the cylinder thoroughly after using the hone.

MASTER CYLINDER

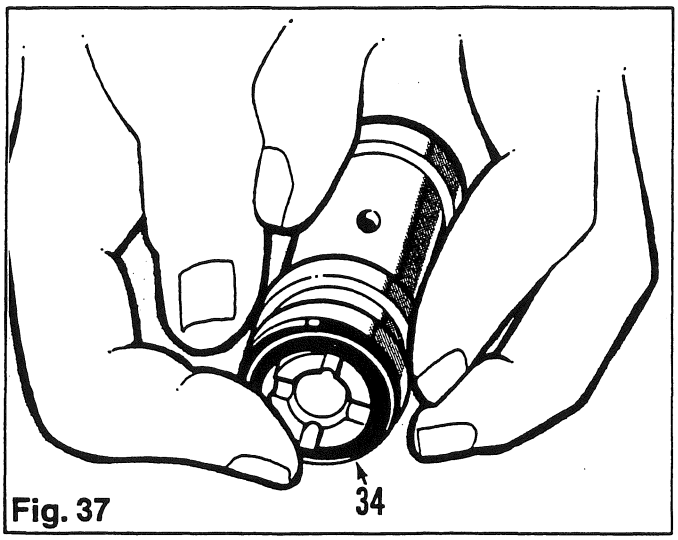


Fig. 37

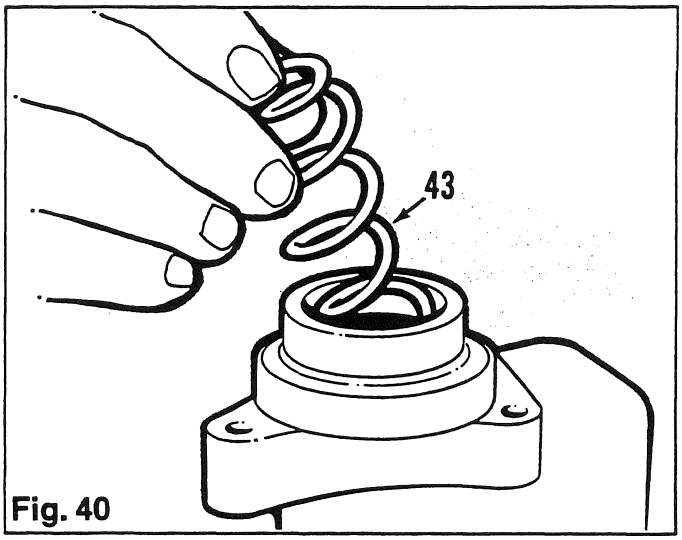


Fig. 40

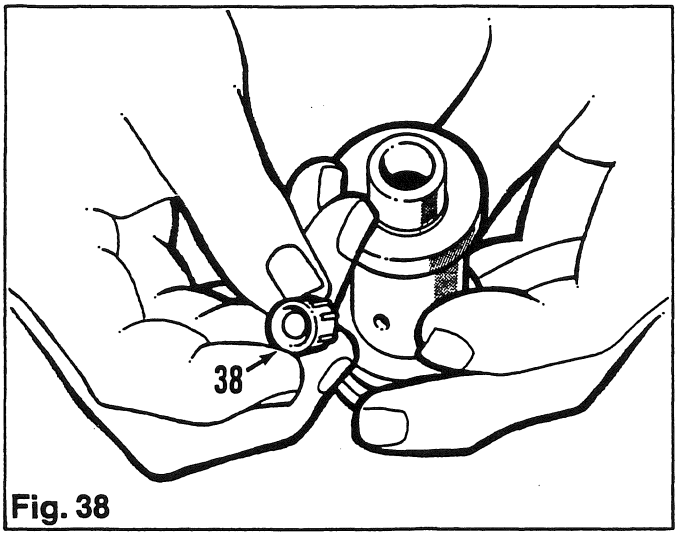


Fig. 38

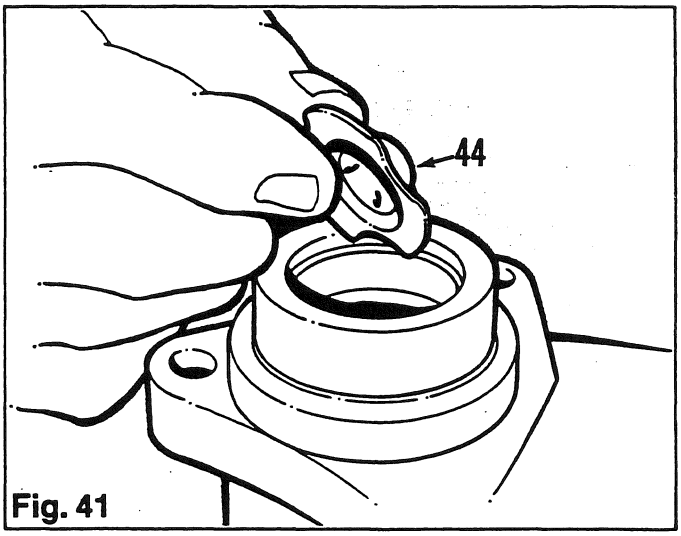


Fig. 41

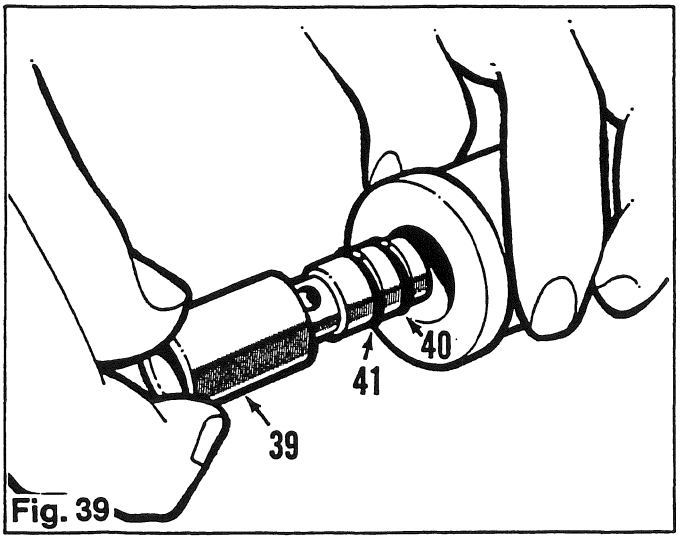


Fig. 39

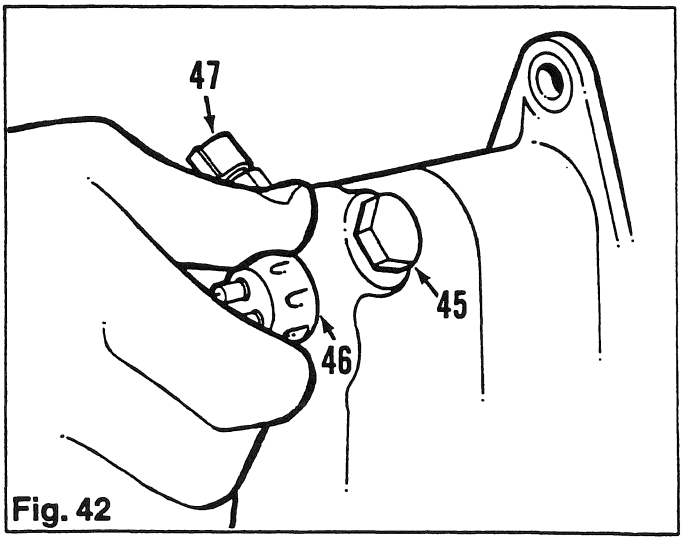


Fig. 42

MASTER CYLINDER

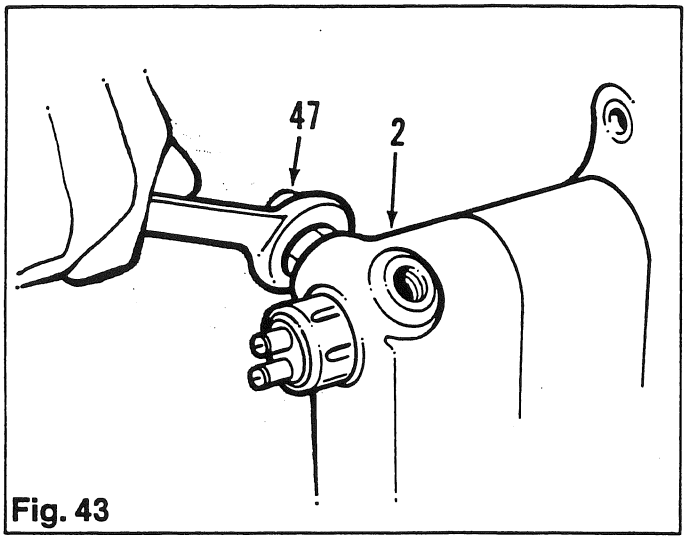
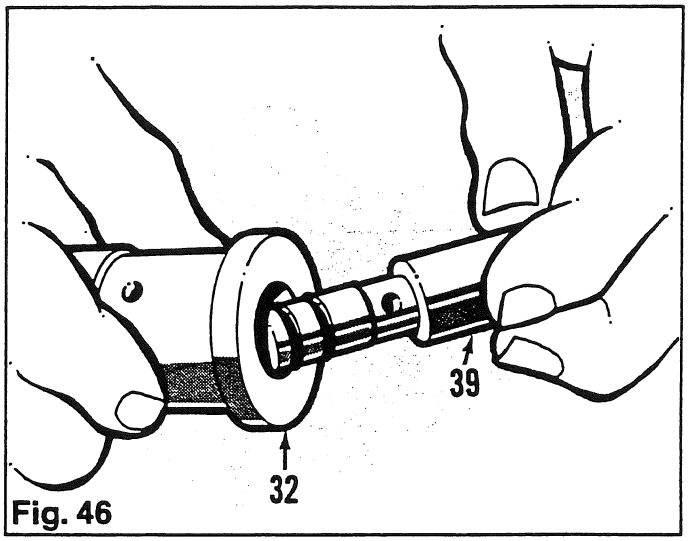


Fig. 43



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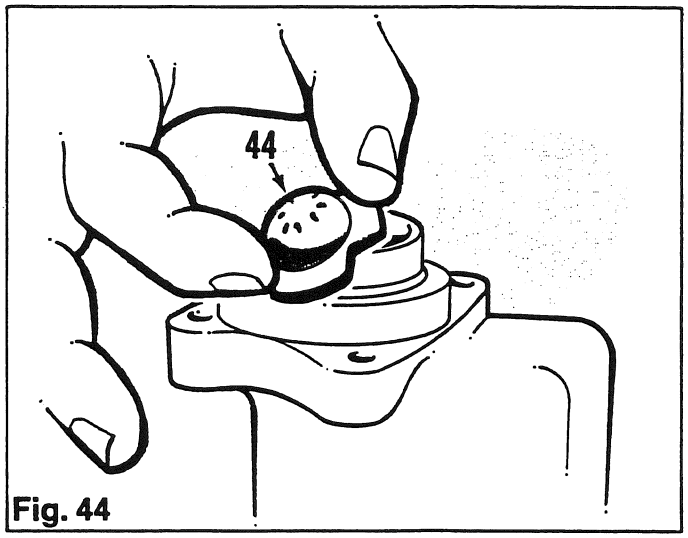

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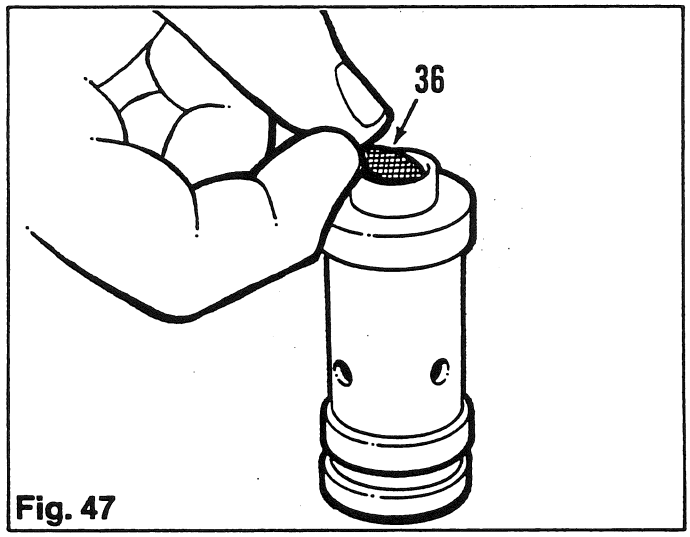

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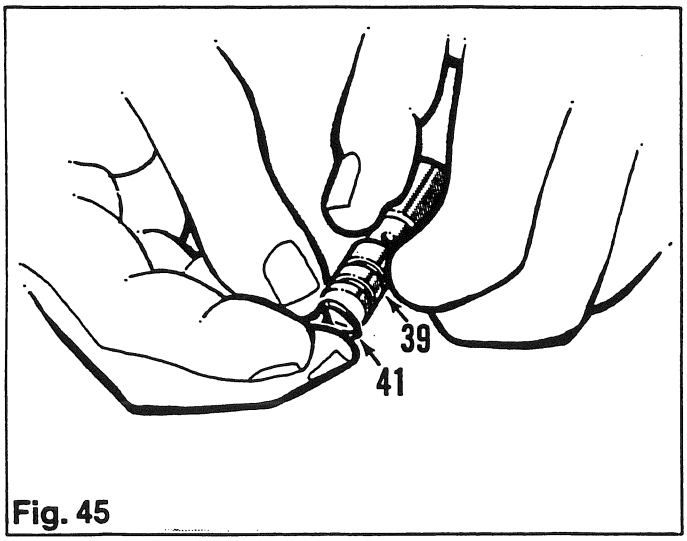

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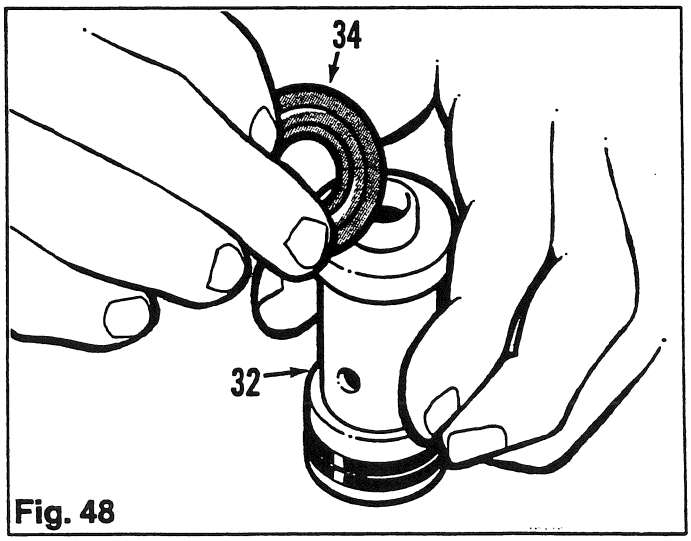


Fig. 48

MASTER CYLINDER

Assembly

1. Install the plugs (45) and fittings (47) in the cylinder body (2). (Fig. 43)

2. If you are working on a brake master cylinder, install the residual check valve (44). **Do Not** use the residual check valve in a clutch master cylinder. (Fig. 44)

3. Apply clean brake fluid to a new seal (40) and O ring (41). Install them on the reaction piston (39). (Fig. 45)

4. Install the reaction piston (39) into the main piston (32). (Fig. 46)

5. Install the check valve assembly (38), spring (37), retainer (36) and snap ring (35). (Fig. 47)

6. Apply clean brake fluid to new cups (34) and install them on the piston (32). (Fig. 48)

MASTER CYLINDER

Assembly (cont.)

7. Carefully install the piston assembly into the cylinder body. (Fig. 49)

8. Compress the spring (43) and retain the piston (32) with a new snap ring (33). (Fig. 50) Install the reservoir cap.

9. Fasten the master cylinder (2) to the booster (1) with the three capscrews. (Fig. 51) The master cylinder and booster assembly is now ready for installation to the grader.

INSTALLATION

Installation to the Grader

1. Install the master cylinder and booster assembly on the grader.

2. Connect the linkage to the yoke (3). (Fig. 52)

3. Connect the lines and hoses to the master cylinder (2). (Fig. 53)

4. Connect the hydraulic hoses to the fittings on top of the booster (1). (Fig. 54)

Fill the brake fluid reservoir located on the back side of the cab with clean, fresh brake fluid (see your 700 Series Operator's Manual). Purge the brake system of air using the procedure as detailed in the Brake section of this manual.

Check the oil level in the hydraulic tank as described in the 700 Series Operator's Manual. Add fresh oil as necessary.

MASTER CYLINDER

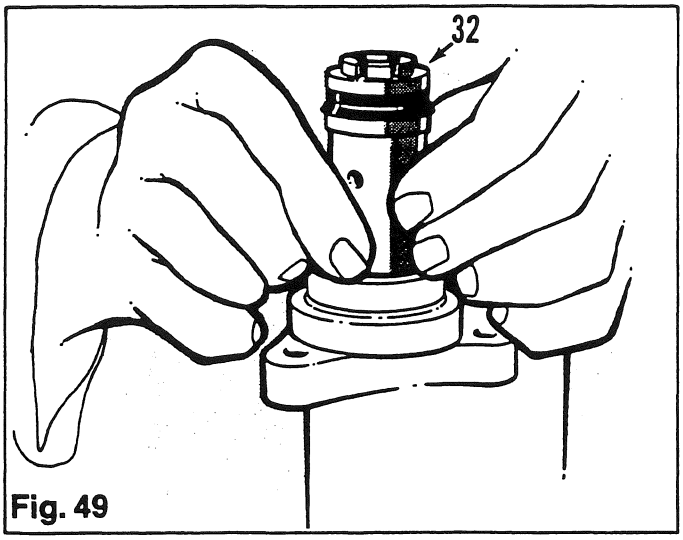


Fig. 49

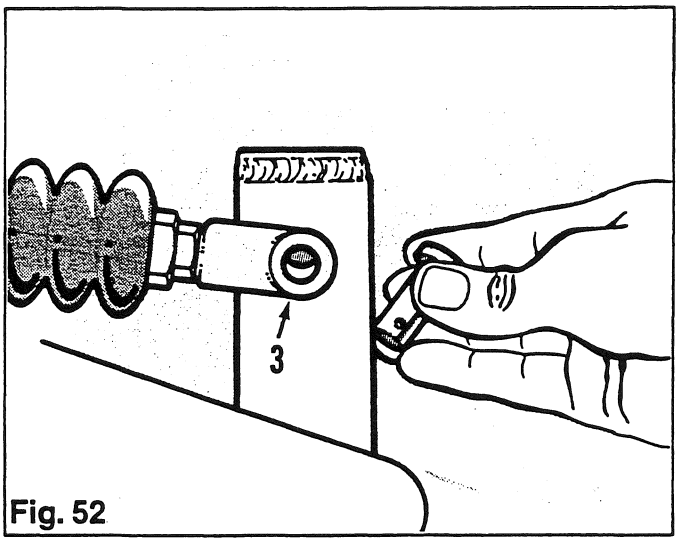


Fig. 52

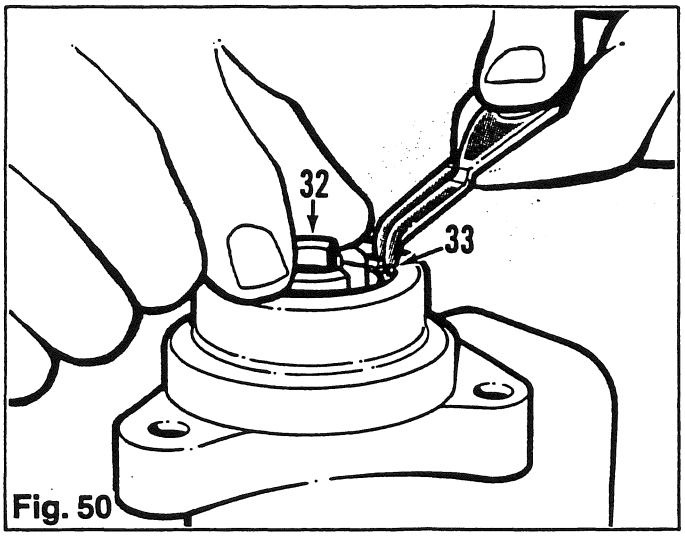


Fig. 50

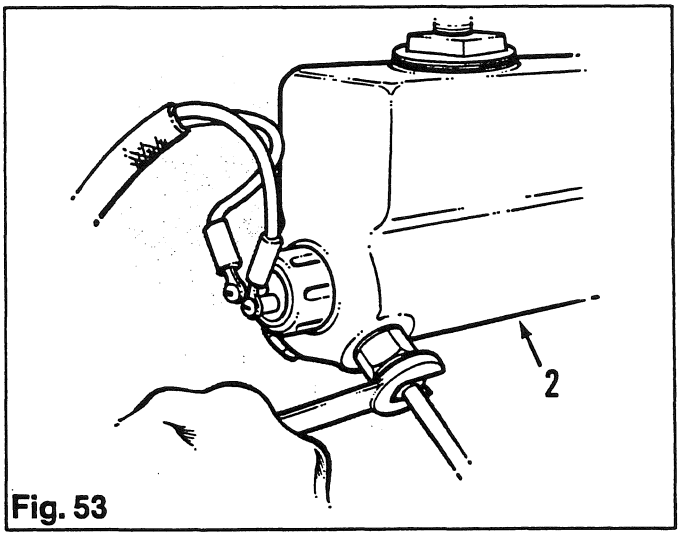


Fig. 53

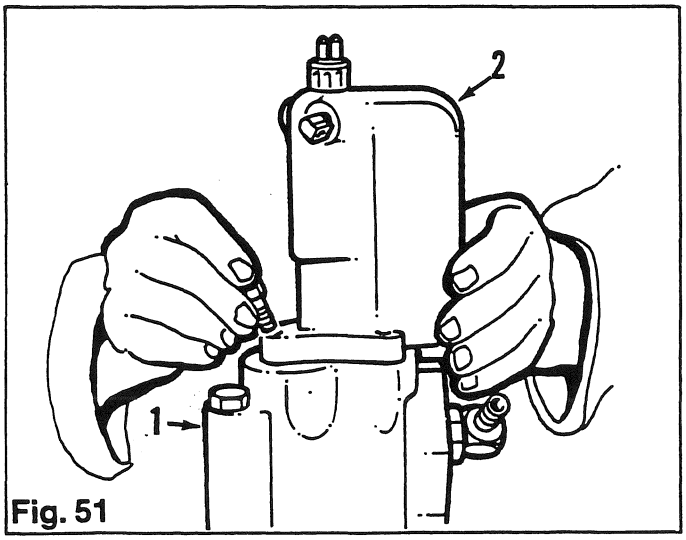


Fig. 51

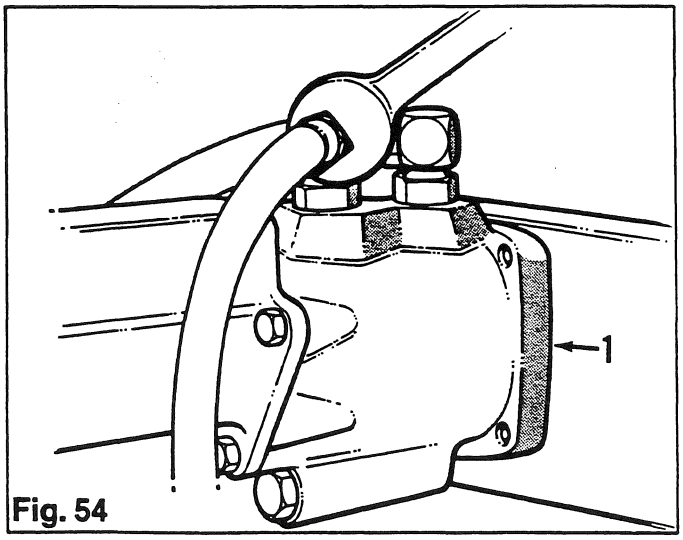
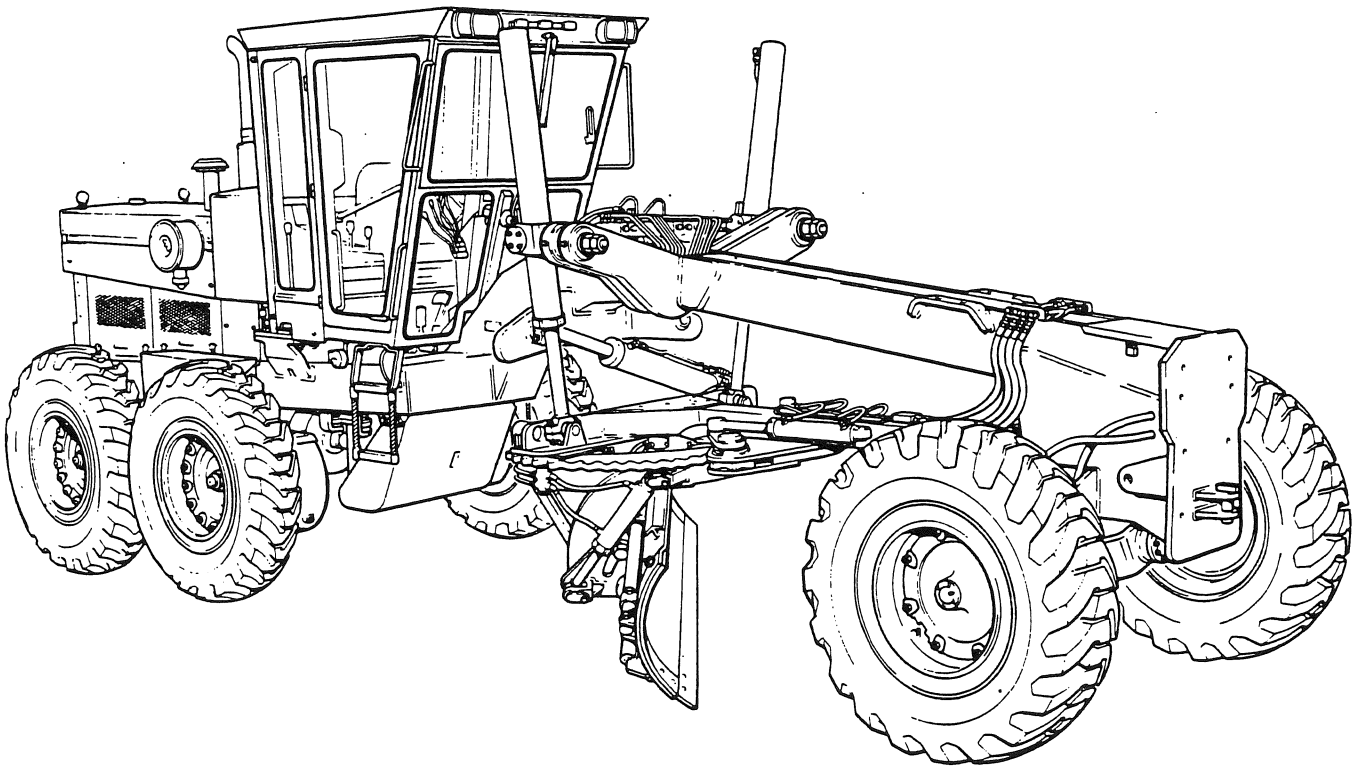


Fig. 54

SECTION 7

ENGINE CLUTCHES



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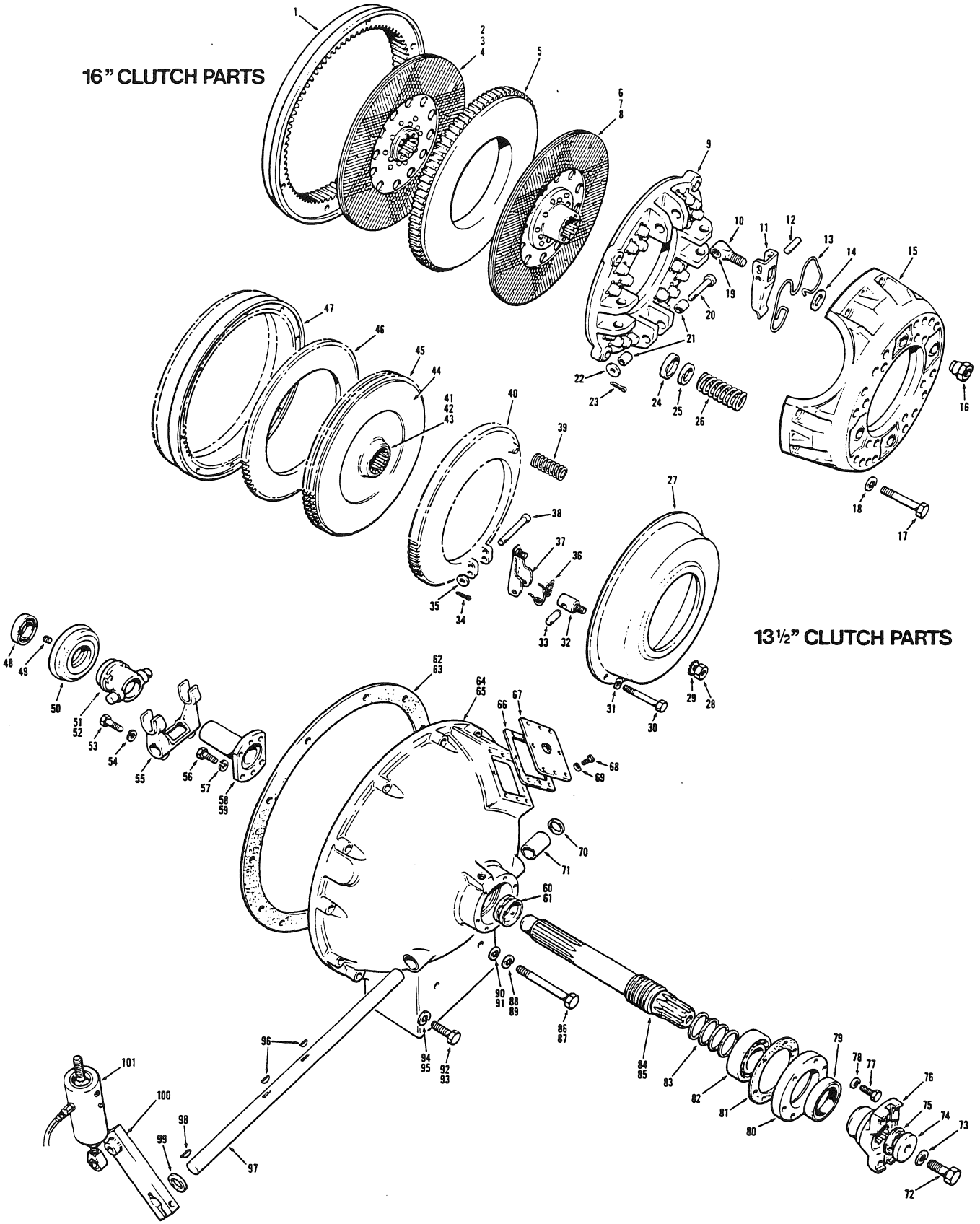


Fig. 1

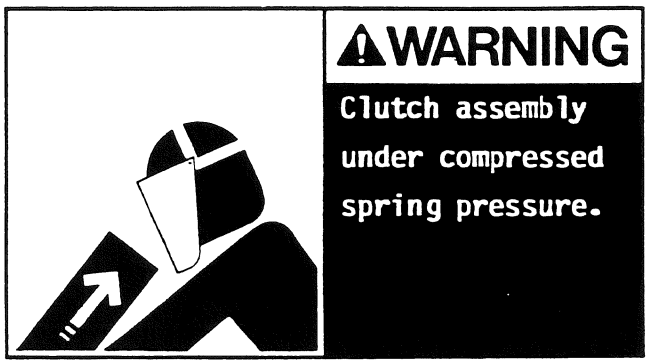
Item	Description	Item	Description	Item	Description
1	Drive ring	42	Washer	73	Lockwasher
2	Driven member	43	Rivet	74	Retaining washer
3	Cork lining	44	Inner disc	75	Gasket
4	Rivet	45	Outer disc	76	Yoke
5	Spacer	46	Outer disc	77	Capscrew
6	Driven member	47	Drive ring	78	Lockwasher
7	Cork lining	48	Pilot bearing	79	Outer seal
8	Rivet	49	Orifice pipe plug	80	Seal housing
9	Pressure plate	50	Release bearing	81	Gasket
10	Eye bolt assembly	51	Sleeve - 13½ inch clutch	82	Bearing
11	Release Lever	52	Sleeve - 16 inch clutch	83	Seal ring
12	Pivot pin	53	Capscrew	84	Shaft - 13½ inch clutch
13	Anti-rattle spring	54	Lockwasher	85	Shaft - 16 inch clutch
14	Washer	55	Yoke	86	Capscrews - 13½ inch clutch
15	Backing plate	56	Capscrew	87	Capscrews - 16 inch clutch
16	Adjusting nut	57	Lockwasher	88	Lockwashers - 13½ inch clutch
17	Capscrew	58	Release guide - 13½ inch clutch	89	Lockwashers - 16 inch clutch
18	Lockwasher	59	Release guide - 16 inch clutch	90	Seal washers - 13½ inch clutch
19	Needle bearing	60	Sleeve - 13½ inch clutch	91	Seal washers - 16 inch clutch
20	Lever pin	61	Sleeve - 16 inch clutch	92	Capscrews - 13½ inch clutch
21	Needle bearing	62	Gasket - 13½ inch clutch	93	Capscrews - 16 inch clutch
22	Washer	63	Gasket - 16 inch clutch	94	Lockwashers - 13½ inch clutch
23	Cotter pin	64	Clutch housing - 13½ inch clutch	95	Lockwashers - 16 inch clutch
24	Retainer washer	65	Clutch housing - 16 inch clutch	96	Keys
25	Insulating washer	66	Gasket	97	Shaft
26	Spring	67	Cover	98	Keys
27	Backing plate	68	Capscrew	99	Oil seal
28	Jam nut	69	Lockwasher	100	Cross shaft arm
29	Washer	70	Oil seal	101	Slave cylinder assy.
30	Capscrew	71	Bushing		
31	Lockwasher	72	Capscrew		
32	Pivot block				
33	Pivot pin				
34	Cotter pin				
35	Washer				
36	Anti-rattle spring				
37	Lever assembly				
38	Lever pin				
39	Spring				
40	Pressure plate				
41	Splined hub				

Key to Fig. 1

General

Make sure proper tools are available and in good working order. You will require a safe lifting device; the appropriate drifts and shop tools.

The clutch assemblies should only be serviced by qualified service personnel.



Refer to the 700 Series Parts Manual when ordering replacement parts. Refer to Lubrication Specifications detailed in the front of this manual for the recommended transmission oil and brake fluid.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH PROPER STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances appear in Metric (SI), Imperial and U.S. quantities. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

Description and Operation

Champion motor graders are equipped with a multi-plate, wet-type clutch.

The inching clutch pedal needs to be used only when starting or stopping the grader or when changing direction. A major advantage of the clutch is that it allows the operator to start the grader moving under heavy loads without stalling or putting undue strain on the rest of the drive train. Another plus is its superior inching and feathering capabilities. The operator may use the clutch to ease the grader into tight areas and maintain precise control at low speed operations.

On the 16 inch clutch, the clutch pedal is connected to the assembly by the hydraulic circuit and slave cylinder. When the pedal is depressed, brake fluid causes the piston in the slave cylinder to be extended, causing the cross shaft to turn. This pushes the clutch yoke against the release bearing. The release bearing moves the clutch fingers, which pull the pressure plate back, thereby releasing the clutch driven members.

Oil enters the clutch housing through an orifice and is divided to provide lubrication and cooling to the clutch components. Oil is bled off the main inlet flow to provide lubrication, through a 3/32 inch (2,4 mm) drilling, to the clutch shaft bearing. Four piston rings prevent the oil from passing between the shaft and the housing and direct through cross drillings to the center of the shaft where the oil passageways carry it to the distrubution orifices. Oil flows over the friction surfaces, cools them and lubricates the bearings throughout the assembly. Oil leaves the assembly through a drain in the clutch housing and flows back to the transmission.

16 inch clutches are on grader models 740, 740A, 760, 760A, 780 and 780A.

The 13½ inch clutch functions like the 16 inch clutch but differs in design features. Instead of two friction plates and spacers, three are used to increase driving torque. The spacer closest to the flywheel takes the wear normally put on the flywheel. This means the flywheel should never require refacing.

Oil is used to cool the plates and lubricate the bearings. The lubricating oil from the transmission lube circuit enters through an orifice. Some oil flows through the 3/32 inch (2,4 mm) drilling to the clutch shaft bearing; the remainder goes down the 3/8 inch (9,5 mm) rifle drilling in the clutch shaft to two cross bores and then out to cool the plates and driven members. The pilot bearing and release bearing are splash lubricated. All oil drains back to the clutch sump and then returns to the transmission sump.

13½ inch clutches are on grader models 710, 710A, 720, 720A, 730 and 730A.

Cleaning and Inspection

Cleaning - Bearings and Small Parts

You are recommended to wear cotton gloves when handling bearings. This prevents transfer of skin acids and perspiration onto bearing races.

Immerse bearings and small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the part using moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin the bearing when drying. Make sure all oil passages are unblocked. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages for wear, nicks or chipping. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - Seals

Replace all seals. Handle seals carefully; particularly when being installed. Cutting, scratching or curling of the sealing lips seriously reduces efficiency. Lubricate all sealing lips with system oil.

Apply a thin coating of sealant, Champion part number **19200** onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O-rings before installation.

Inspection - Disc Teeth and Shafts

If non-destructive detection equipment is available, use the process to check parts. Examine the teeth of all drive members, disc and drive rings for wear, pitting, chipping, nicks, cracks and scores. Inspect the pilot shaft for signs of wear or damage. Check and clean the oil passageways.

Cleaning and Inspection (continued)

Inspection - Clutch Housing

To inspect the clutch housing, ensure the housing is thoroughly clean and all mating surfaces and bearing bores are free from nicks and burrs. Check for evidence that would cause subsequent oil leaks.

Check the backing plate circumference for damage due to improper installation into the drive ring. Replace the backing plate if the edges have been damaged, pushed up or if the mounting holes are out of alignment.

The lever adjusting screws should be replaced if they show wear caused by the release bearing.

Inspection - 13½ Inch Clutches

With a commercially available spring tester, check the pressure springs for loss of pressure or heat set. Replace the springs if they have taken a heat set or if the spring pressure is below 170 lbs. (77.1 kg) at a compressed length of 1.81" (46,0 mm).

Replace the drive ring, if evidence of damage or wear has occured. Excessive damage or wear may cause drag problems. The discs must slide freely in the drive ring.

Check the pivot blocks for wear at the bottom of the slotted hole. If wear has occured, replace the pivot block. The pivot roller must roll within the slot and therefore must not be restricted by wear in the pivot block causing the levers not to work properly.

Check the friction face of the pressure plate for dish warpage, nicks or excessive marks (discoloration).

When reconditioning the pressure plate for a 13½ inch clutch assembly the dimension from the pressure plate face to the center of the lever pin holes in the boss should not be less than 1.636" (41,6 mm).

The pressure plate friction face must be ground to 32 RMS. Grinding must be followed with a one minute polishing operation using 300 grit emery cloth in a circumferential direction to create a surface **texture** which is compatible with the friction material.

Cleaning and Inspection (continued)

The friction face must be flat within .005" (0,13 mm) TIR and parallel with the plane of the 3 pin holes within .003" (0,08mm).

Check for wear in the lever bosses of the pressure plate caused by contact of the pivot rollers. Also check to see if the teeth on the outside diameter are worn, replace the pressure plate if either situation has occured.

When reconditioning the outer steel discs for 13½ inch clutch assembly, the minimum thickness of any plate after grinding is .232" (5,9 mm). The plate must be ground to a 32 RMS finish and then followed with a one minute polishing operation in a circumferential direction using 300 grit emery cloth to create a surface **texture** compatible with the friction material. The discs must be flat within .005" (0,13 mm) TIR.

The minimum disc pack thickness after rebuilding and machining is 1.051" (26,7 mm). Replace the inner disc assemblies when the facing material is worn to the bottom of the grooves. Alternate the inner and outer discs during reassembly. To retain the disc packs, place hardened flat washers on the cavity side of the splined hub, install the rivets with the heads on the same side.

Then install hardened flat washers on the rivets on the other side of the splined hub. Using the special rivet tool, Champion part number **45567**, roll the end of the rivet. **DO NOT** peen the end of the rivet.

Inspection - 16 Inch Clutches

With a commercially available spring tester, check the pressure springs for loss of pressure or heat set. Replace the springs if they have taken a heat set or if spring pressure is below 220 lbs. (99,8 kg) at a compressed length of 2.06" (52,4 mm).

Replace the drive ring, if evidence of damage or wear has occured. Excessive damage or wear may cause drag problems. The spacer disc must slide free in the drive ring.

Check the friction face of the pressure plate for dish warpage, nicks or excessive heat marks (discoloration).

When reconditioning the pressure plate for a 16 inch clutch assembly the dimension from the pressure plate face to the center of the lever pin holes in the boss should not be less than 1.591" (40.4 mm).

Cleaning and Inspection (continued)

Pressure plate friction faces must be ground to 32 RMS in a circumferential direction to create a surface texture compatible with the friction material.

The friction face must be flat within .005" (0,13 mm) TIR and parallel with the plane of the 4 pin holes within .003" (0,08 mm).

NOTES

When new driven members are being used, it is recommended to soak them for a minimum of 12 hours in Champion approved transmission fluid.

When using the flywheel or a decompression fixture as a setup stand, the surface MUST be smooth and flat within .002" TIR for accurate lever heights.

Torque Guide

Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 32	Release guide capscrews	27,1	2,8	20
Fig. No. 36	Seal housing capscrews	20,4	2,1	15
Fig. No. 37	Yoke retaining capscrews	230,5	23,5	170
Fig. No. 44	13½" Clutch housing capscrews (short)	47,5	4,8	35
Fig. No. 44	13½" Clutch housing capscrews (long)	47,5	4,8	35
Fig. No. 44	16" Clutch housing capscrews (short)	47,5	4,8	35
Fig. No. 44	16" Clutch housing capscrews (long)	47,5	4,8	35
Fig. No. 82	Pivot block jam nuts	54,2-61,0	5,5-6,2	40-45
Fig. No. 83	Lever adjusting nuts	27,1-33,9	2,8-3,5	20-25

Special Tools

The following tools are recommended when overhauling the 13½ inch and 16 inch clutches. The tools help to remove and install precision-machined parts.

Champion Tool Part Number	Description
5629	Clutch Repair Pilot Shaft
45567	Rivet Tool - Long solid anvil

Engine Clutch Housing - Removal

Fig. 2
Descriptive procedures for the clutch housing removal, disassembly, reassembly and installation will be the same for all models, including the 13½ inch and 16 inch clutch assemblies.

Park the grader on level ground. Place the transmission mode lever in **Neutral.** Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **Service Position.** Begin by removing the covering panels over the filters, all side panels and the intermediate panels.

Fig. 3
Remove the muffler clamp, the support brace and the muffler. Cap the turbo exhaust outlet.

Fig. 4
Remove the fuel return line. Cap the fitting and the open port. The fuel level must be below the port.

Fig. 5
Disconnect the leads from the back-up lights, if so equipped.

Fig. 6
Remove the clamp and air intake pipe, cap the filter inlet port.

Fig. 7
Remove the capscrews retaining the engine hood and lift the hood off the grader.

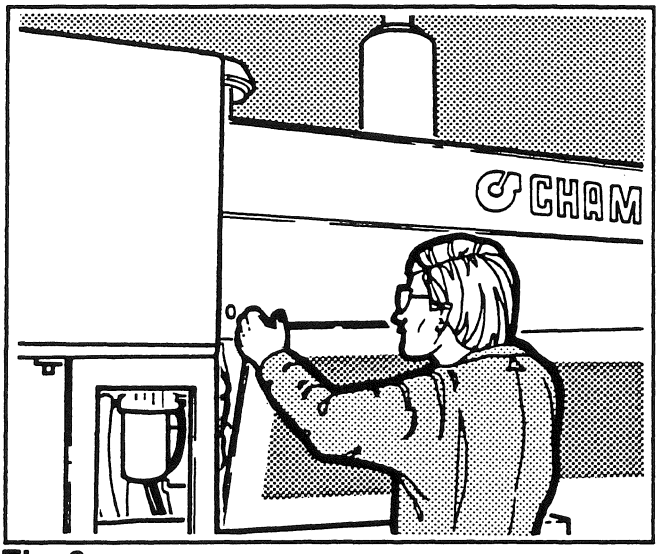
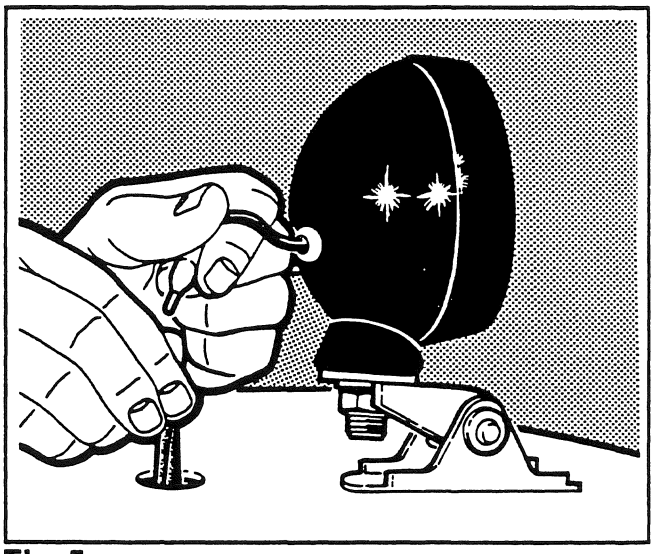


Fig. 2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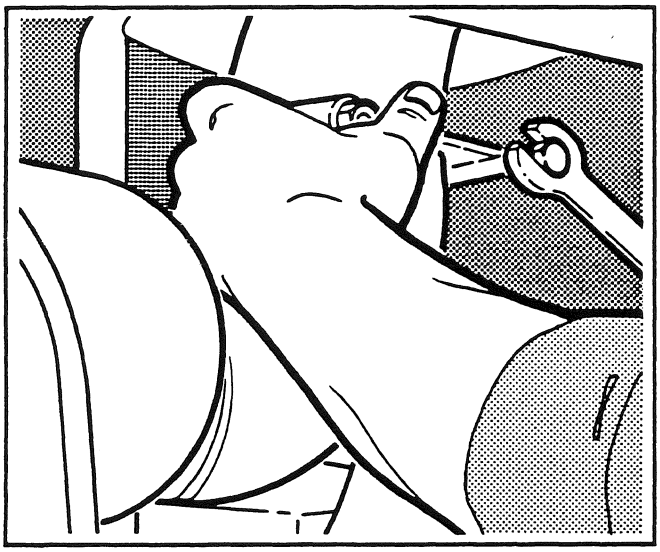
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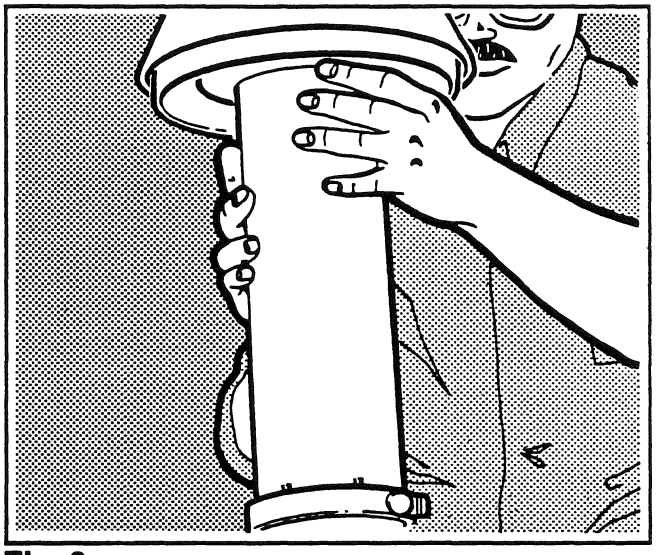
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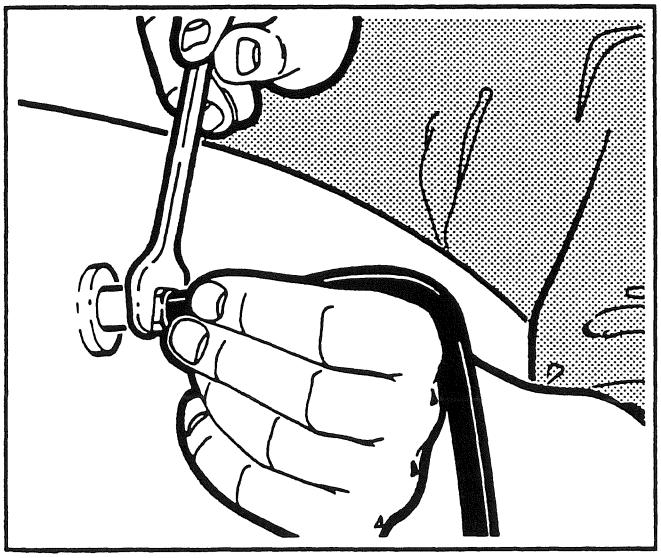
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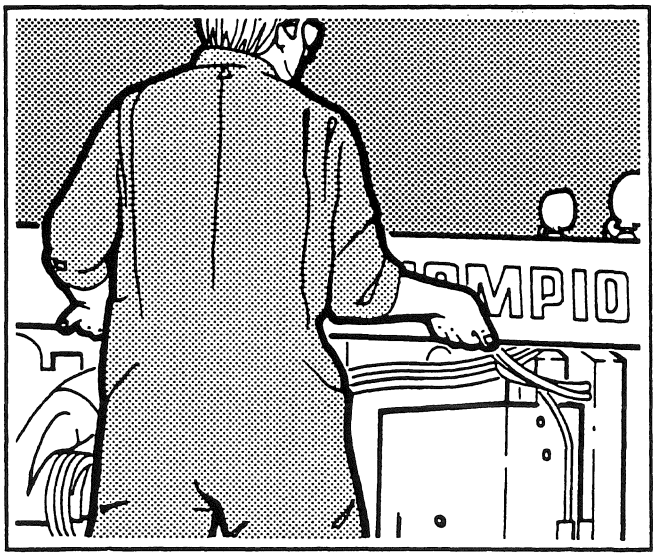

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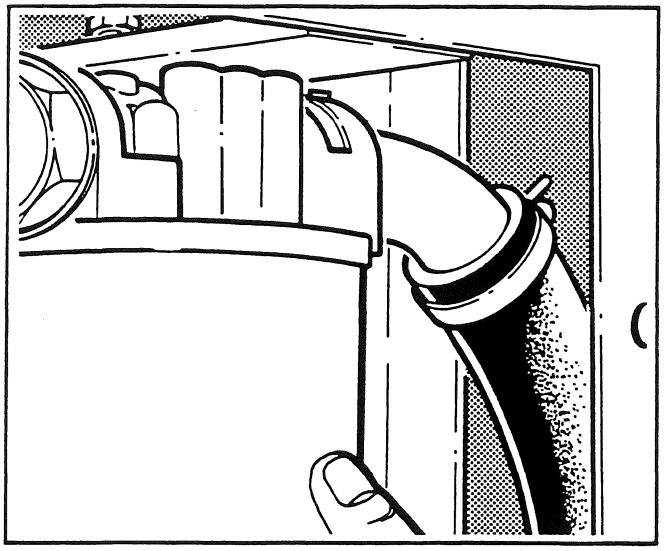

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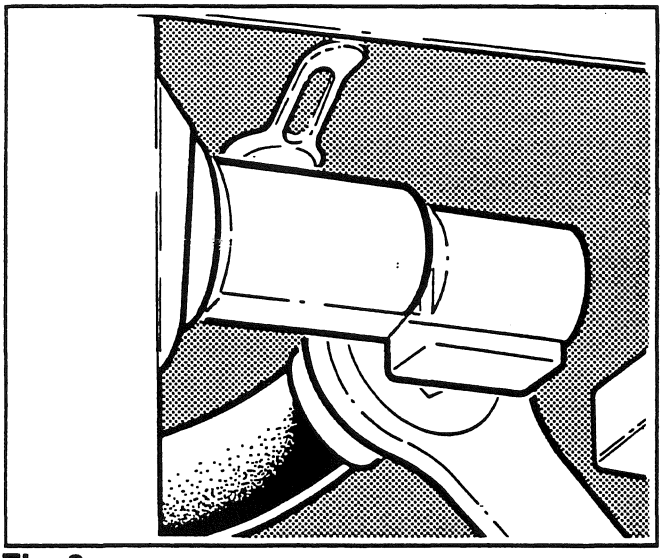

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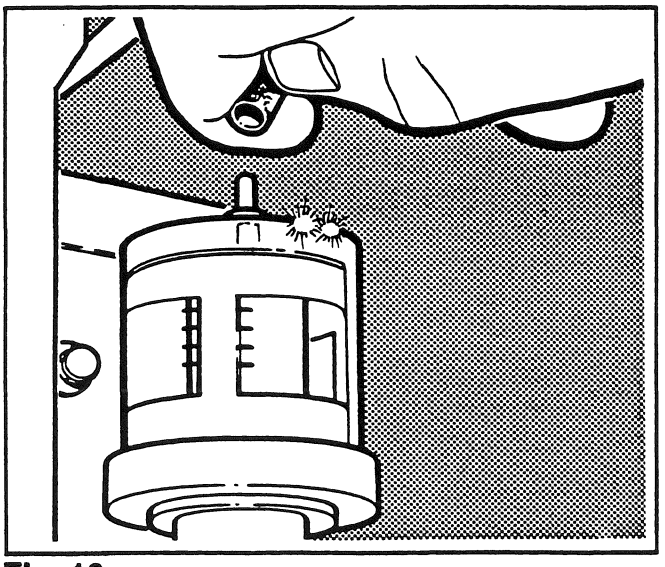

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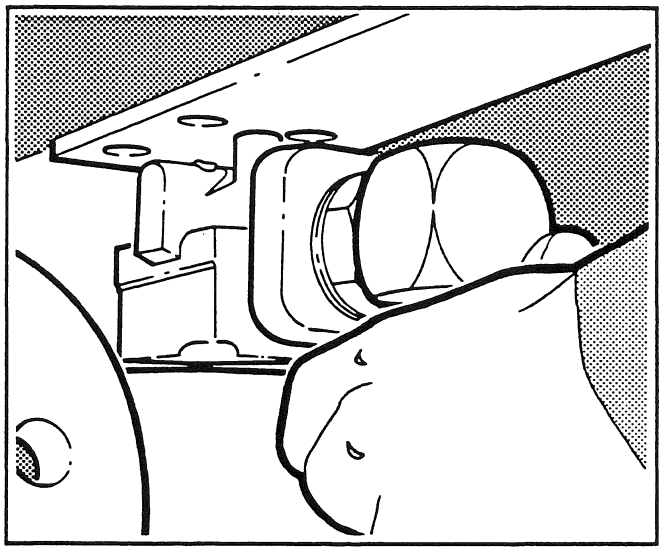

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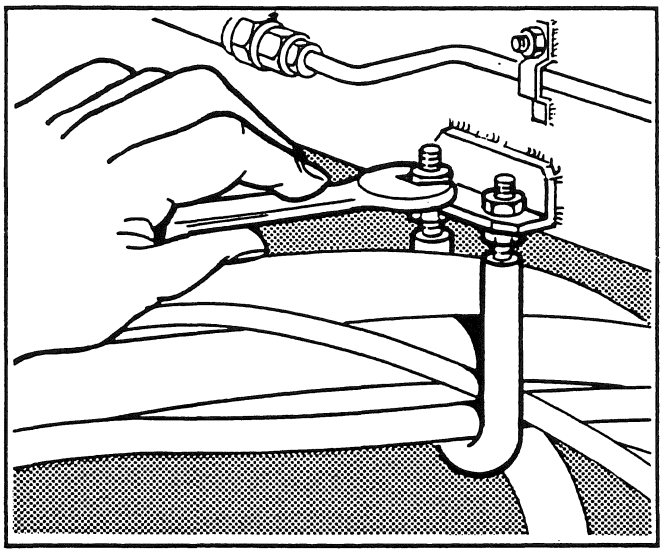

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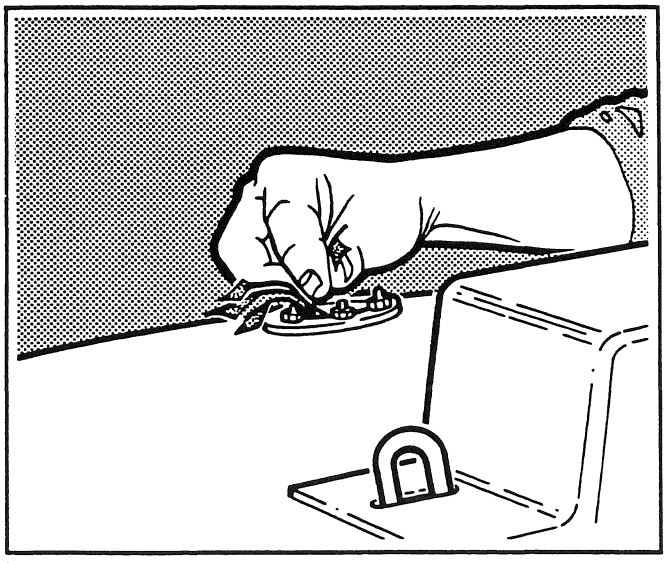


Fig. 13

Removal (continued)

Fig. 8
Remove the hydraulic filter at the bracket.

Fig. 9
Shut off the fuel supply and remove the fuel supply line. Cap the hose fitting.

Fig. 10
Remove the hose to the air filter restriction indicator.

Fig. 11
Remove the transmission filter from the fuel tank stand bracket.

Fig. 12
Remove the hose supporting bracket.

Fig. 13
Identify the electrical wires and disconnect them from the fuel tank sending unit.

Removal (continue)

Fig. 14
Remove the air duct from the turbo charger and cap the turbo charger and duct.

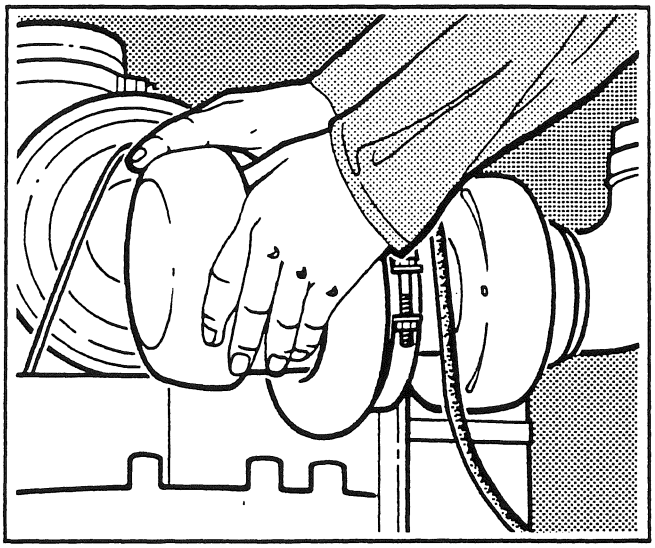
Fig. 15
Remove the capscrews retaining the fuel tank stand to the frame. Use a safe lifting device and remove the fuel tank, stand and air cleaner assembly.

Fig. 16
Disconnect the upper driveshaft. Ensure that the universal joint bearings **DO NOT** fall off during this procedure. Remove the driveshaft.

Fig. 17
Remove the clutch housing drain line and cap the open port and hose.

Fig. 18
Identify and remove the vent hose on the clutch housing to avoid confusion during reassembly. Cap the open port and hose. Identify and remove the clutch lubrication oil supply hose and cap the open port.

Fig. 19
Remove the bracket securing the slave cylinder to the clutch housing. Remove the capscrew and the clutch cross shaft arm (100) off the shaft (97). Move the slave cylinder (101) to a safe location out of the way.



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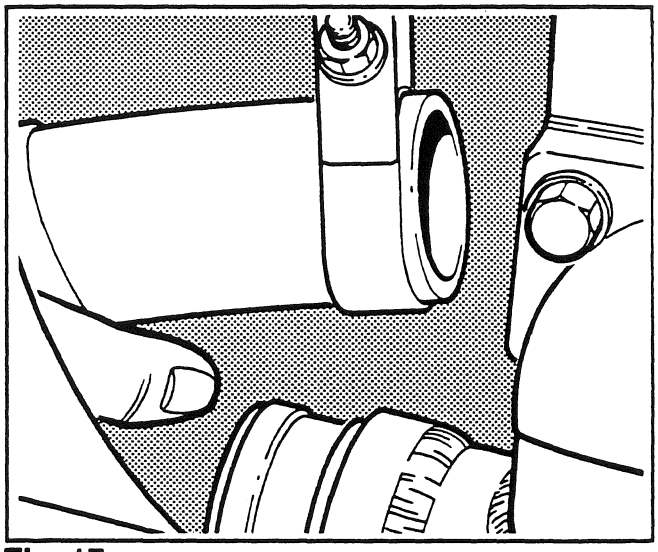

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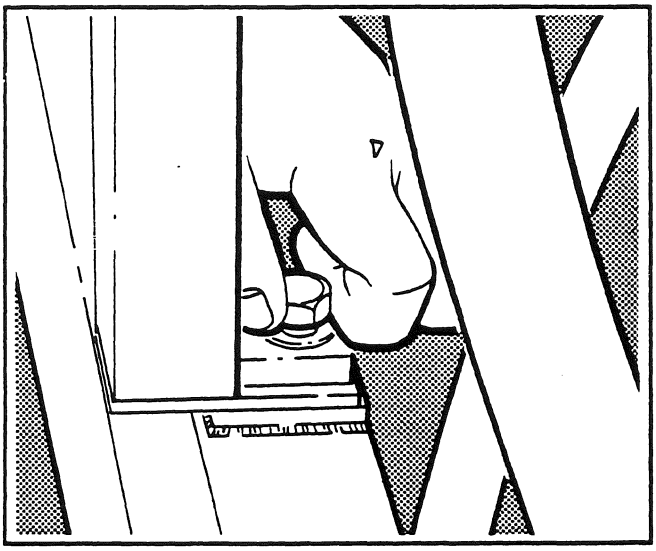

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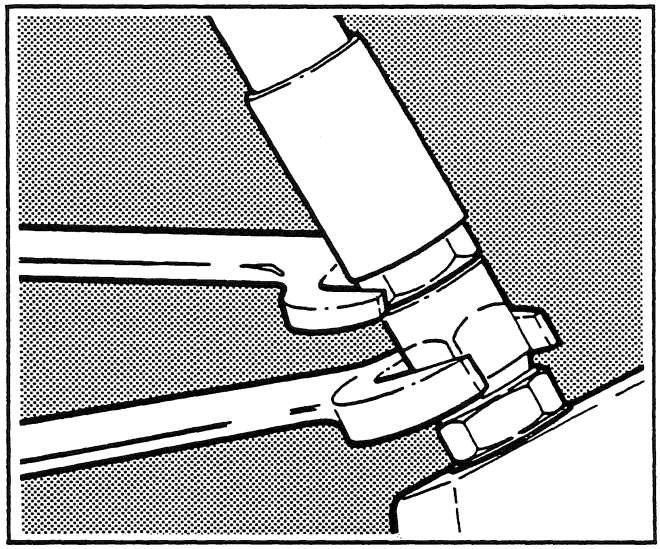

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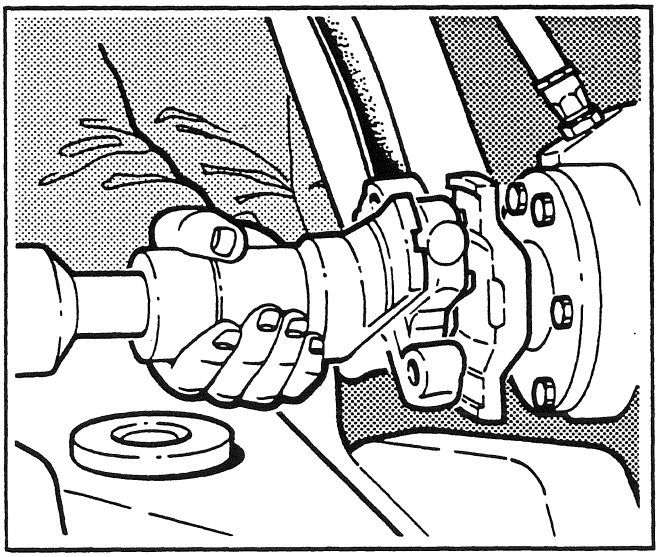

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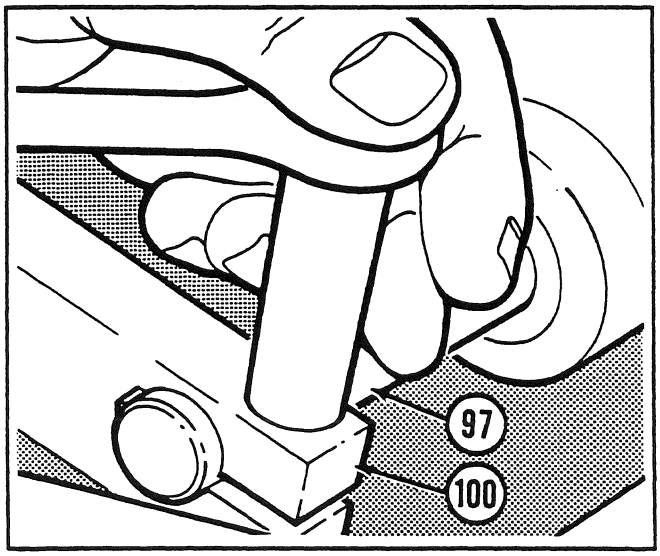

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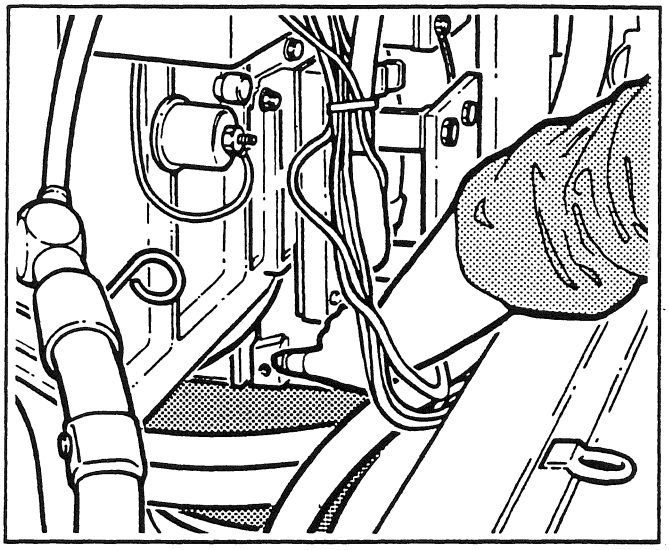

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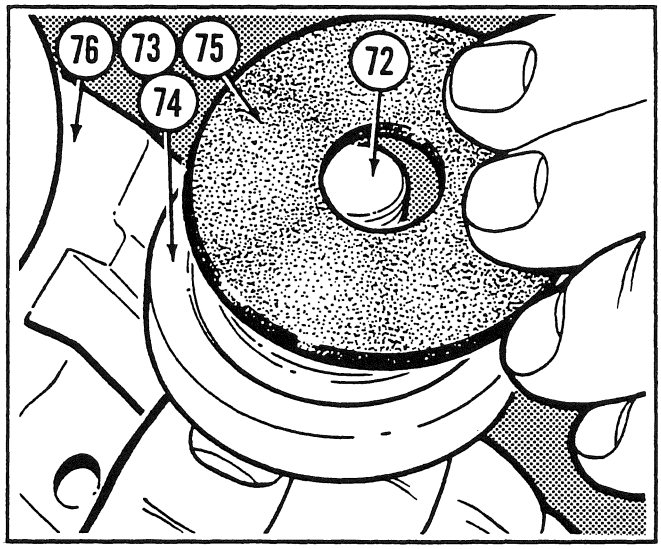

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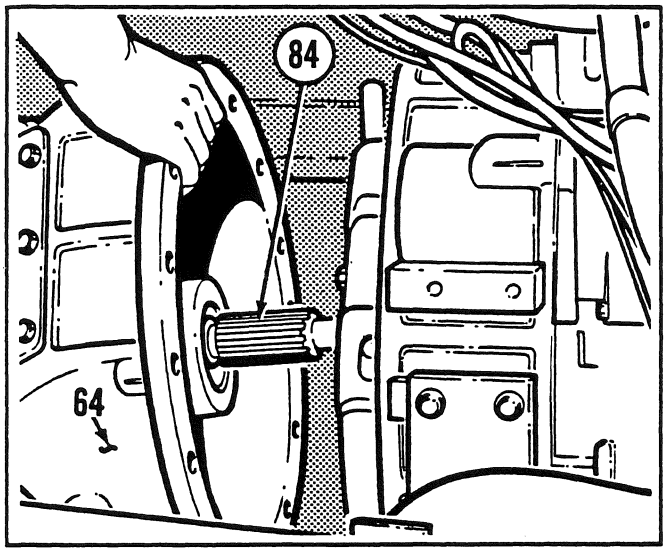

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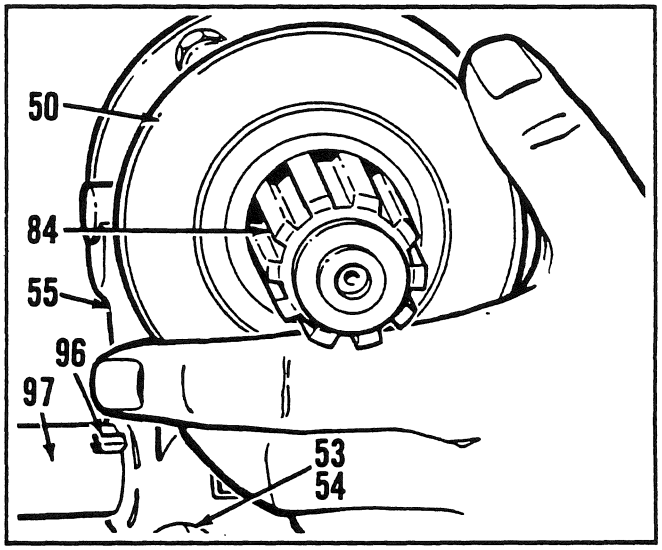

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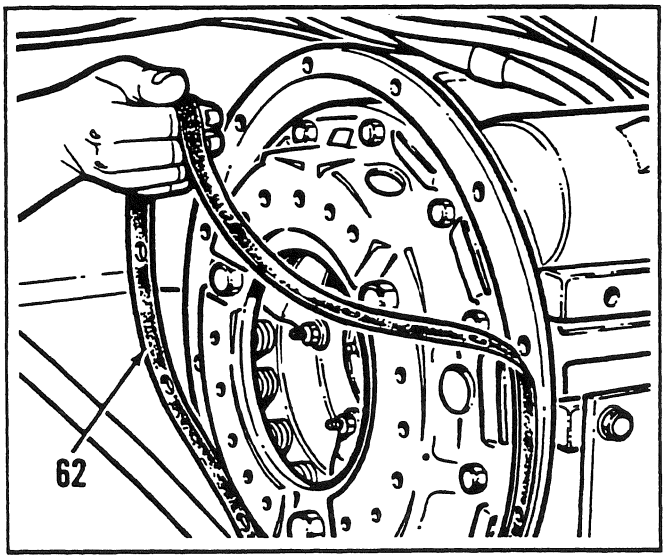


Fig. 22

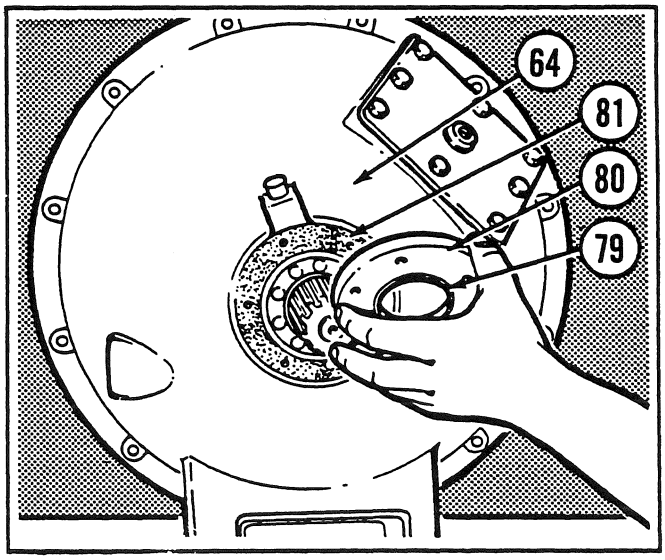


Fig. 25

Removal (continued)

Fig. 20
On the 13½ inch clutch, remove the socket head capscrews retaining the drain manifold to the clutch housing.

Fig. 21
Remove the capscrews (86), (92). Use a pry bar to carefully separate the clutch housing (64) from the engine. Disengage the pilot shaft (84) from the friction pack hub. Remove the clutch housing (64) and place it on a clean work bench.

NOTE

Champion oil clutch assembly housings are made of aluminum. DO NOT torque capscrews beyond the values recommended in this Shop Manual section.

Engine Clutch Housing - Disassembly

Fig. 22
Remove and discard the clutch housing gasket (62).

Disassembly (continued)

Fig. 23
Place the clutch housing (64) in a vise with soft jaws. Be careful not to damage the lip of the housing in the vise. From the back of the housing remove the capscrew (72), Lockwasher (73), retaining washer (74), gasket (75) and the drive yoke (76).

Fig. 24
Pull the release bearing (50) and the sleeve assembly (51) off the pilot shaft (84) and out of the housing (64). Remove the capscrews (53) and lockwasher (54) retaining the yoke (55). Use a hammer and a soft metal drift to move the yoke along the shaft (97) enough to expose the keys (96). Remove the keys from the slots in the shaft. Remove the cross shaft from the housing (64) and slide the yoke off the shaft.

Fig. 25
Remove the capscrews (77) and lockwashers (78) retaining the seal housing (80). Remove the seal housing and discard the gasket (81). Place the seal housing on a appropriate support and remove and discard the seal (79).

Disassembly (continued)

Fig. 26
Remove the bearing (82) from the clutch housing (64) by alternately inserting an appropriate soft metal drift into the two ¼ inch (6,4 mm) holes on the inside of the housing. Force the bearing and pilot shaft assembly (84) out of the clutch housing.

Fig. 27
Cap and remove the fitting from the back of the housing (64).

Fig. 28
Remove the capscrews (56) and lockwashers (57) retaining the bearing guide (58) in the housing (64) and remove the bearing guide.

Fig. 29
Place the pilot shaft (84) upright on a clean workbench, remove the sealing rings (83), the bearing (82) and the pipe plug (49). Inspect the bearing and discard if necessary. Examine the shaft splines for signs of damage or wear. Also clean the lubrication passages in the shaft.

Fig. 30
Examine the sleeve (60) in the clutch housing bore (64). If it is worn or damaged, it must be replaced. When the sleeve is being replaced, cool the new sleeve in a freezer or with dry ice, then place the sleeve into position. Remove and discard the cross shaft oil seals (70), (99). Inspect the bushings (71), if they must be removed, use a hammer and the approriate drift to force them out of the housing (64).

Fig. 31
Support the release bearing (50) with a vise and use a soft metal drift to remove the sleeve (51). Inspect the release bearing and sleeve, replace them if necessary.

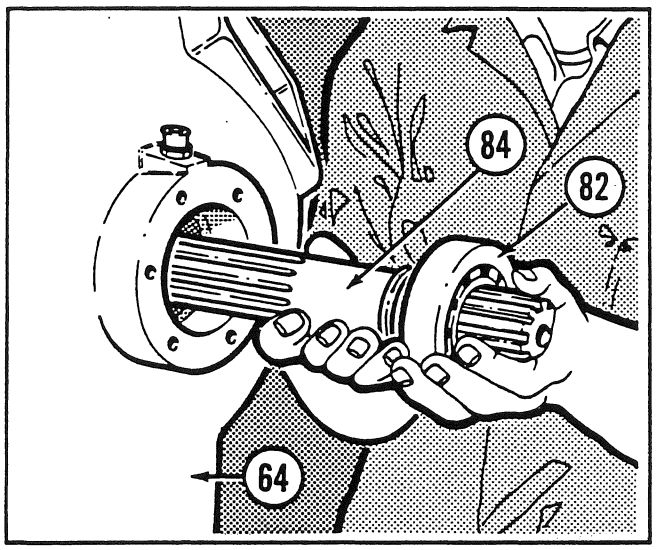


Fig. 26

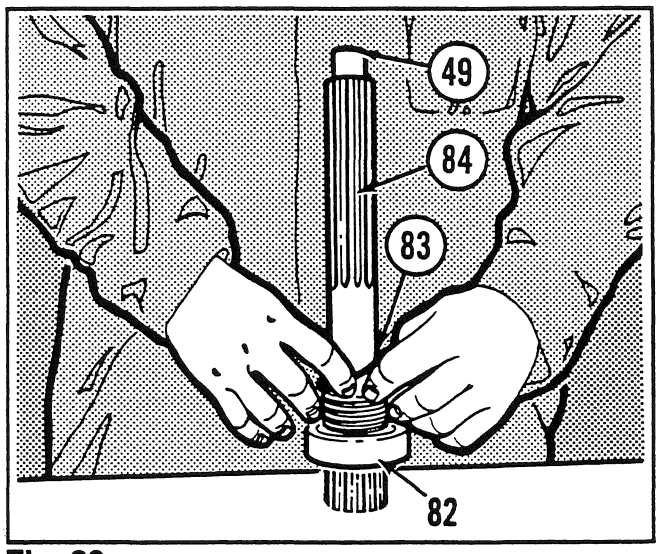


Fig. 29

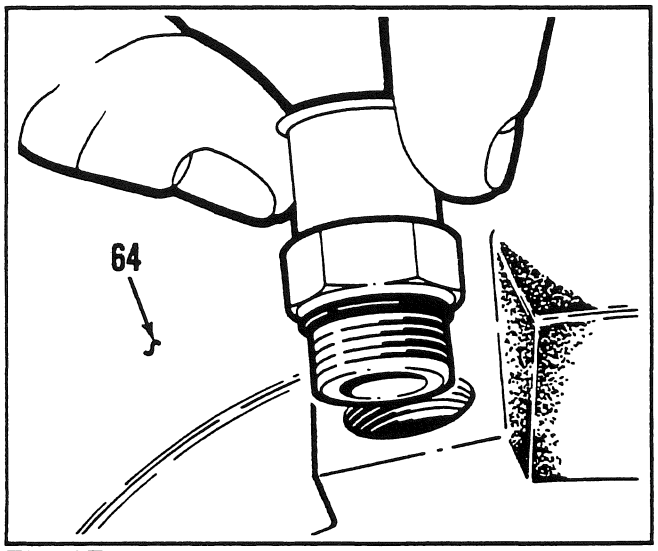


Fig. 27

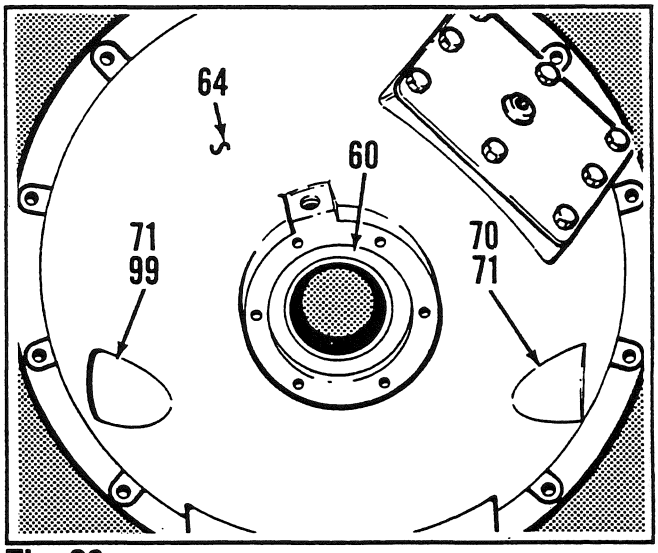
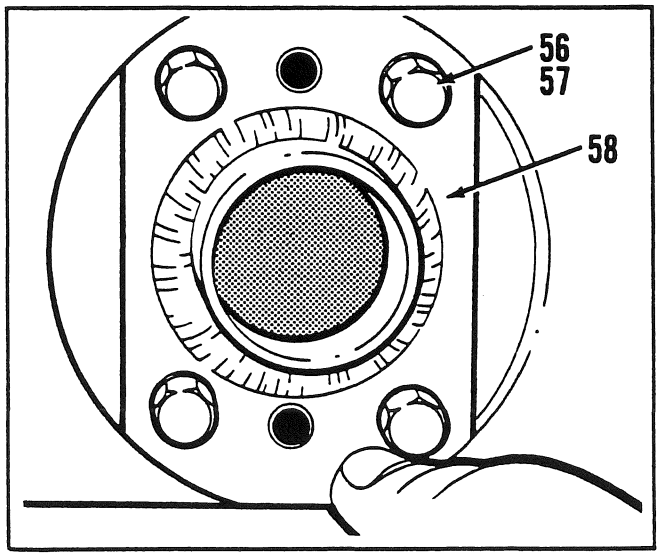


Fig. 30



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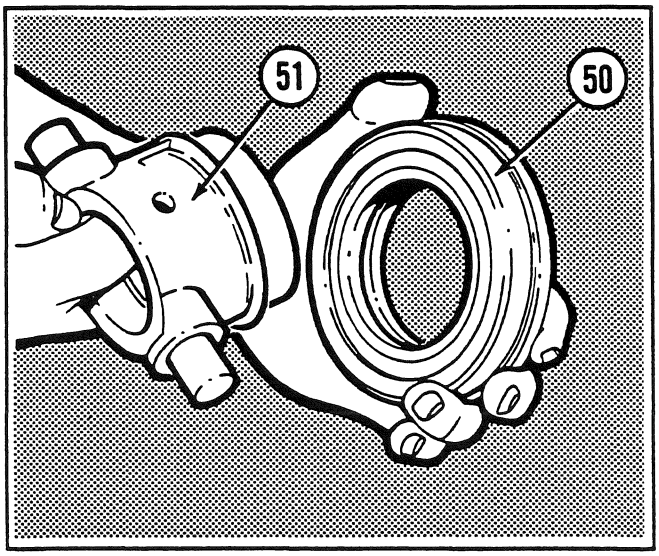


Fig. 31

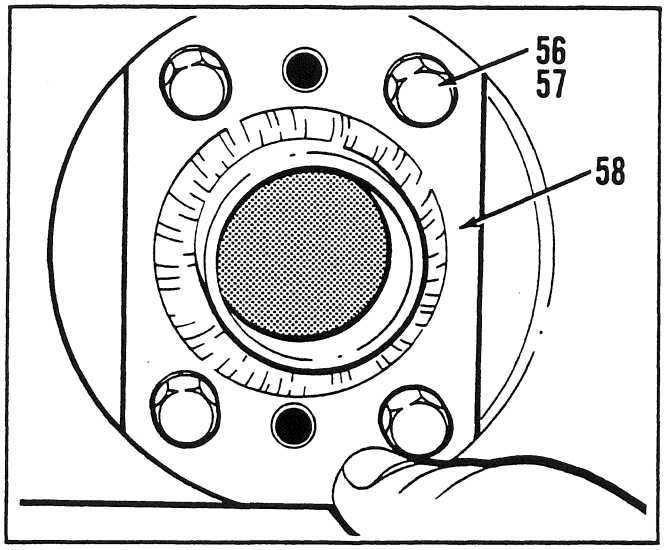


Fig. 32

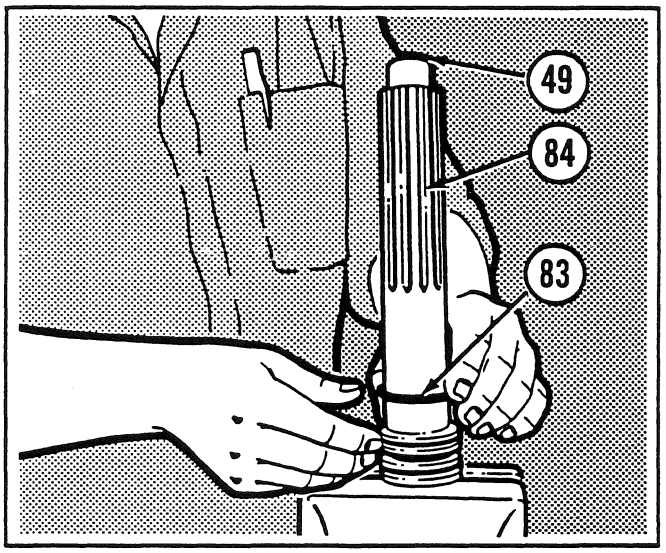


Fig. 33

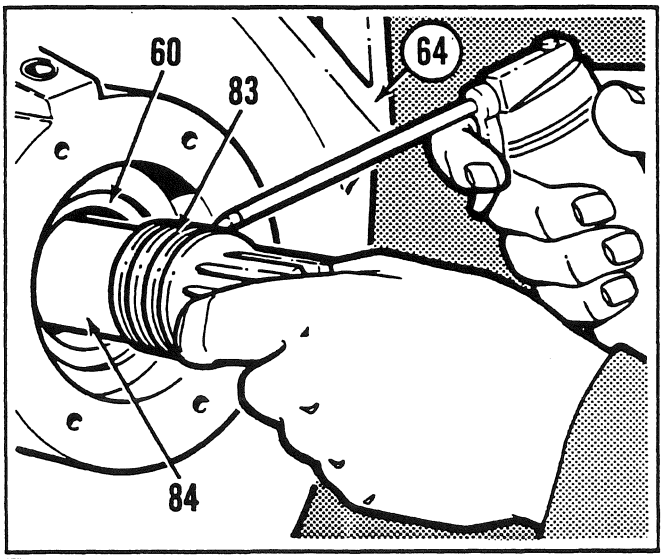


Fig. 34

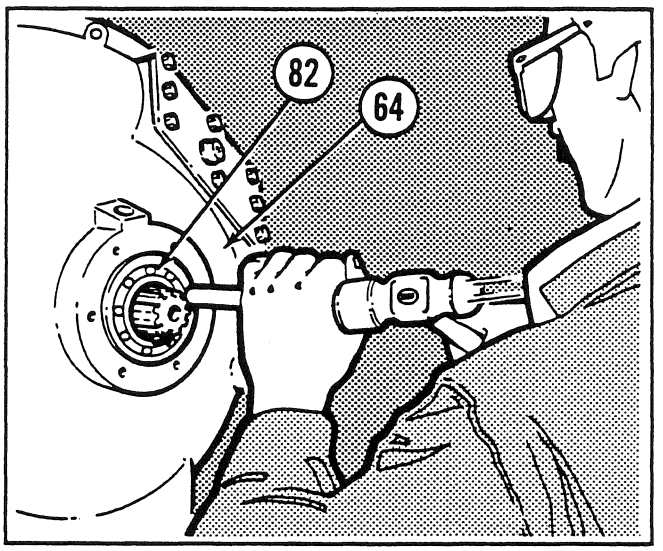


Fig. 35

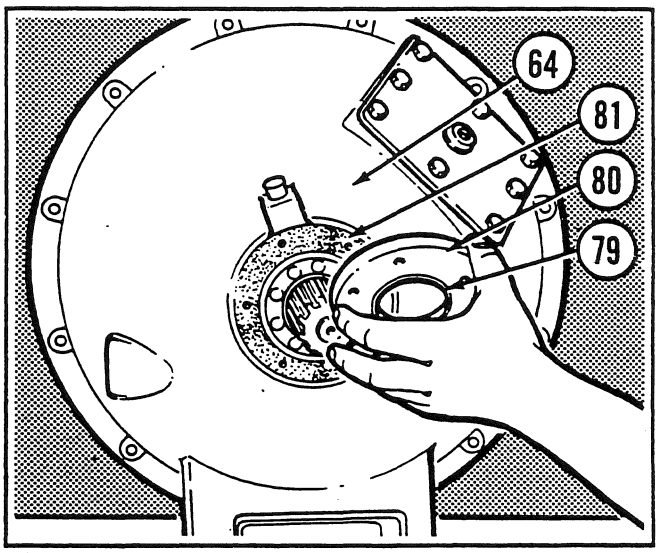


Fig. 36

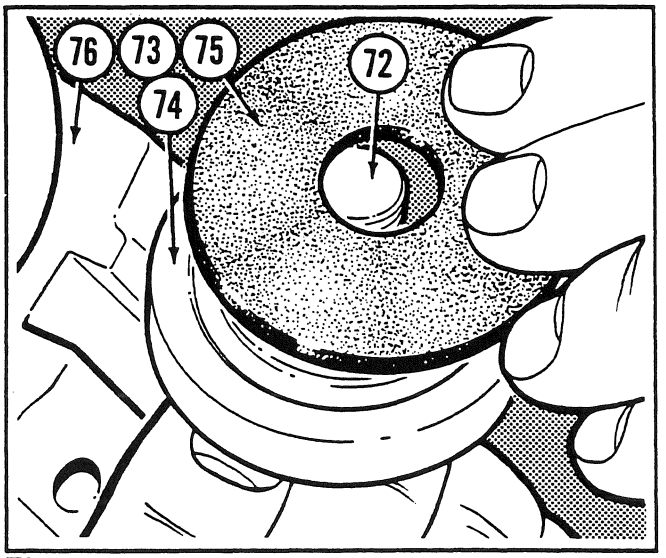


Fig. 37

Engine Clutch Housing - Reassembly

Fig. 32
Mount the bearing guide (58) in the housing (64) and ensure that it is properly seated into the counterbore of the housing. Retain the guide with the lockwashers (57) and capscrews (56) and tighten them to the specified torque.

Fig. 33
Place the pilot shaft (84) upright in a vise with soft jaws. Install the orifice pipe plug (49) into the end of shaft. Install and alternate the position of the end gaps of the four sealing rings (83) on the shaft.

Fig. 34
Lubricate the sealing rings (83) and carefully insert the shaft (84) into the housing (64). Be careful not to damage the rings during this procedure, as they fit loosely. Ensure that the shaft rotates freely, and the rings are completely seated in the sleeve (60).

Fig. 35
Lubricate the roller bearing (82) and install it into the housing (64) with a hammer and a soft metal drift.

Fig. 36
Place the seal housing (80) on an appropriate support and gently tap the new outer seal (79) into place. Install a new gasket (81) on the seal housing and mount the housing and gasket assembly on the clutch housing (64). Retain the seal housing with the capscrews (77), lockwashers (78) and tighten them to the specified torque.

Fig. 37
Lubricate the outer seal (79) with transmission fluid and install the drive yoke (76). Install the gasket (75), the retaining washer (74) and the lockwasher (73) and retain them with the capscrew (72). Tighten the capscrew to the specified torque.

Reassembly (continued)

Fig. 38
Remove the cap from the fitting and install the fitting into the clutch housing (64).

Fig. 39
Use an appropriate installation drift and install the cross shaft bushings (71) in the housing (64) if required. Lubricate and install new oil seals (70), (99) into the housing with an appropriate installation drift.

Fig. 40
Before installing the cross shaft (97) in the clutch housing (64), smooth any rough edges around the key slots with emery paper. This will ensure that the oil seals are not damaged when the cross shaft is installed. Lubricate the oil seals (70) and install the cross shaft into the clutch housing. Align the holes in the yoke (55) with the cross shaft and slide the yoke onto the shaft. Use a brass drift and hammer to install the woodruff keys (96) into the key slots on the shaft. Slide the yoke into place on the shaft over the woodruff keys. Secure the yoke into position on the cross shaft with the lockwashers (54) and the capscrews (53) to finger tightness only to retain the yoke in position.

Fig. 41
Note the lubrication groove in the release bearing (50) and the lubrication hole in the sleeve (51). Align the groove and the hole to ensure proper lubrication. Install the bearing in the sleeve with a soft faced hammer.

Fig. 42
Install the sleeve (51) and the release bearing (50) with the lubrication hole at the top. Engage the trunnions in the yoke (55). Once the sleeve (51) and bearing assembly (50) is firmly seated and correctly aligned, secure the yoke (55) to the cross shaft (97) by tightening the capscrews (53) to the recommended torque.

Engine Clutch Housing - Installation

Fig. 43
When working on the 13½ inch clutch, apply gasket eliminator, Champion part number **25303** to the manifold drain opening. Install a new gasket (62), (63) on the mounting surface of the clutch housing.

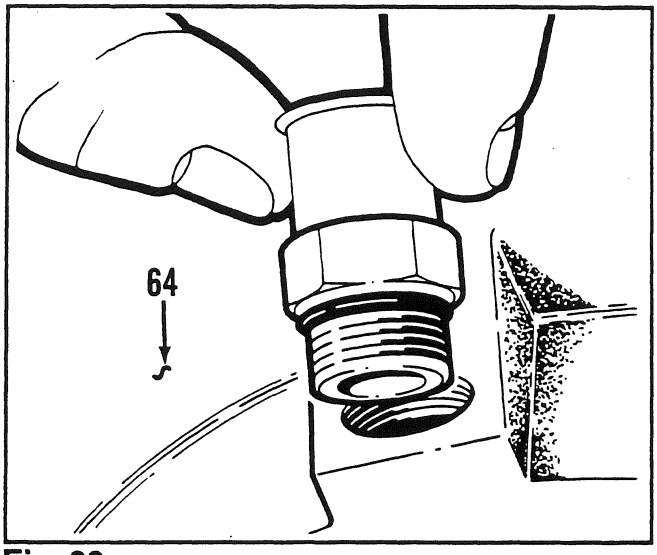


Fig. 38

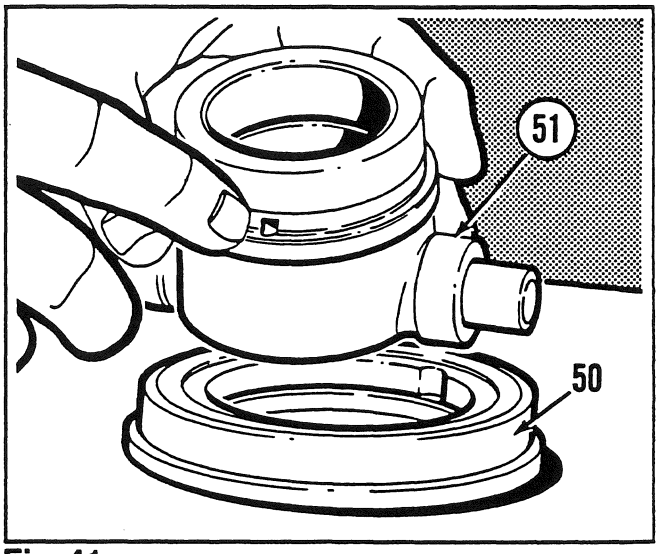
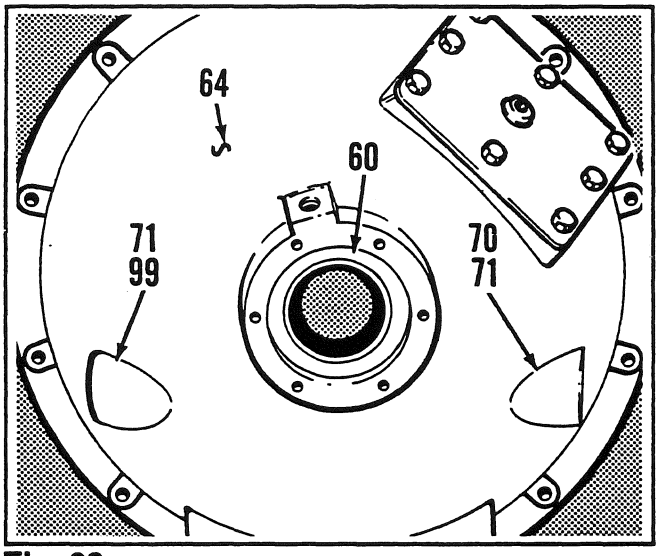


Fig. 41



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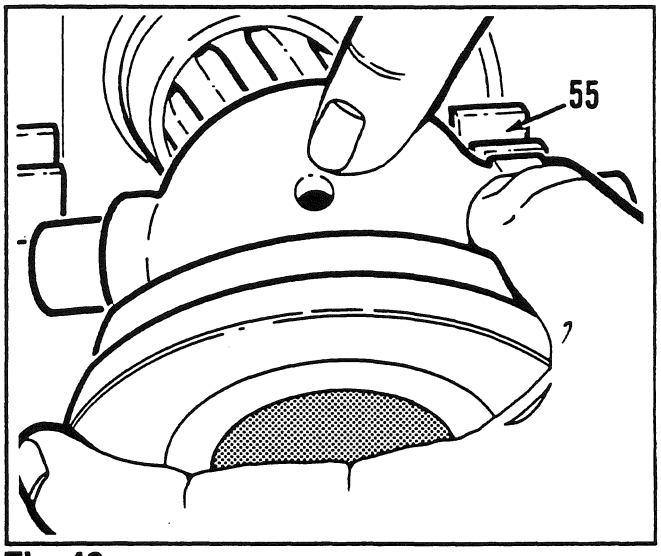


Fig. 42

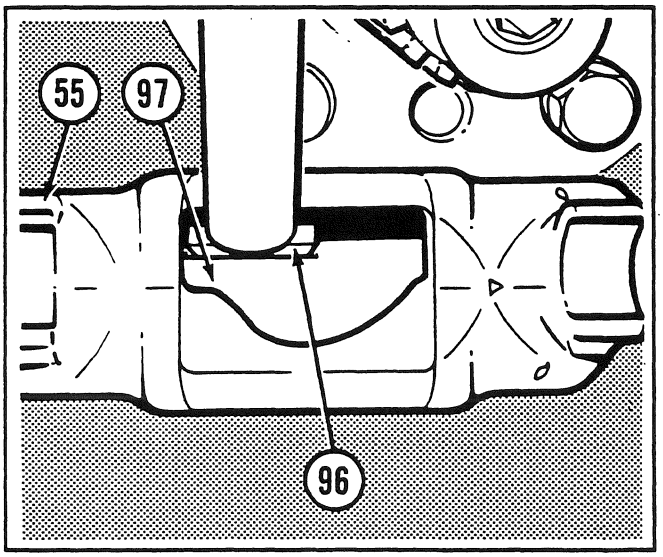


Fig. 40

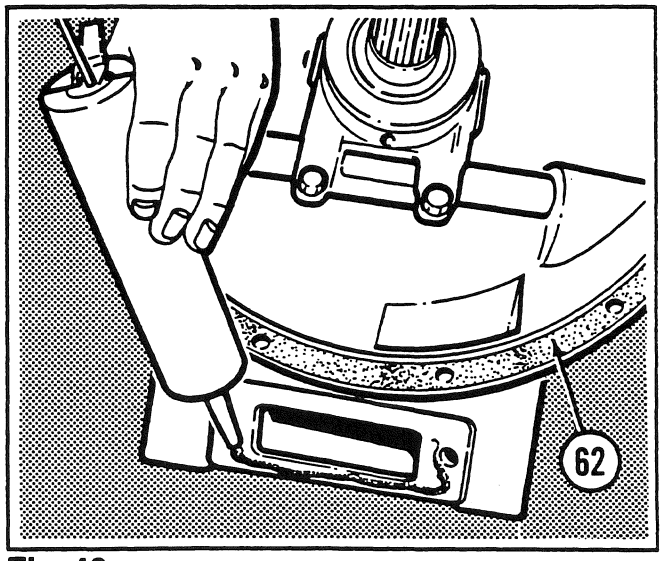


Fig. 43

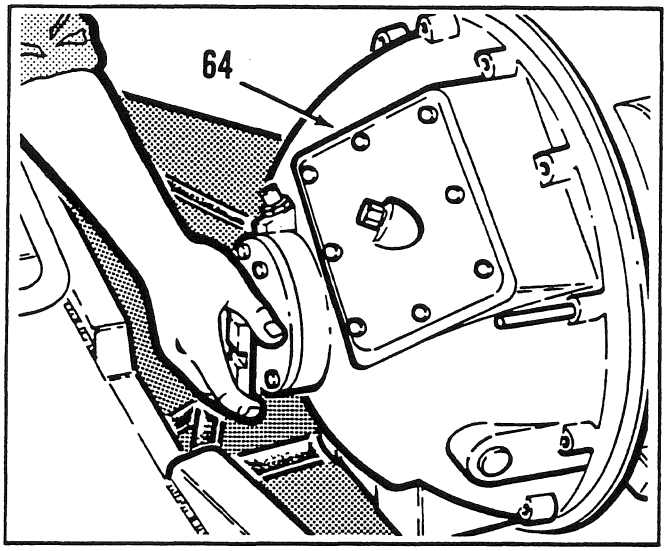


Fig. 44

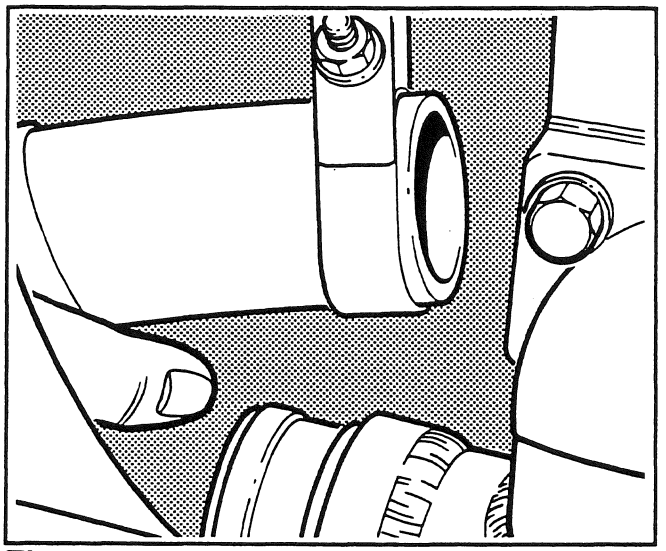


Fig. 47

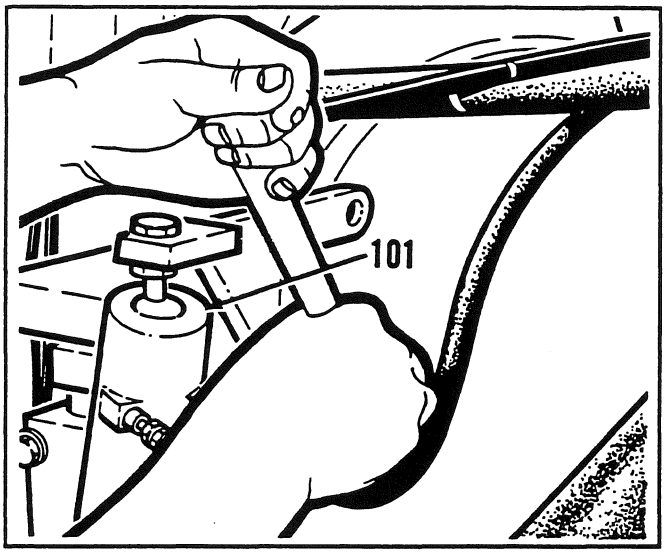


Fig. 45

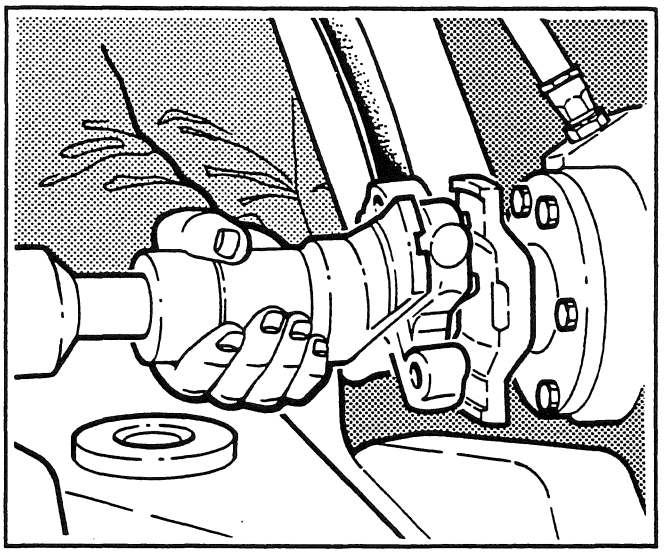


Fig. 48

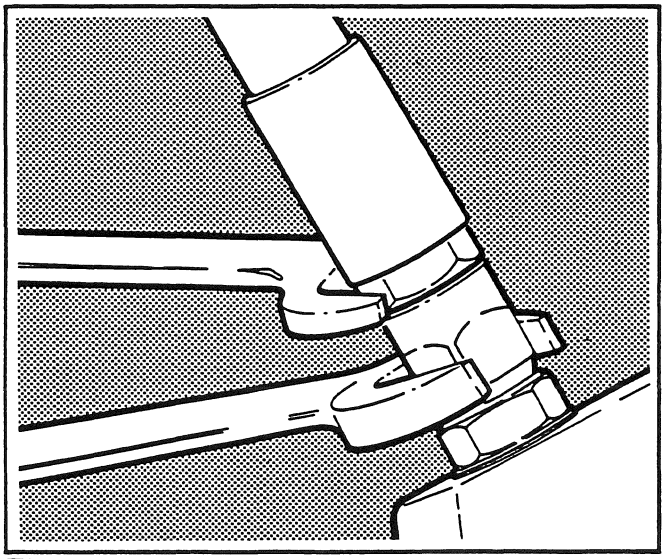


Fig. 46

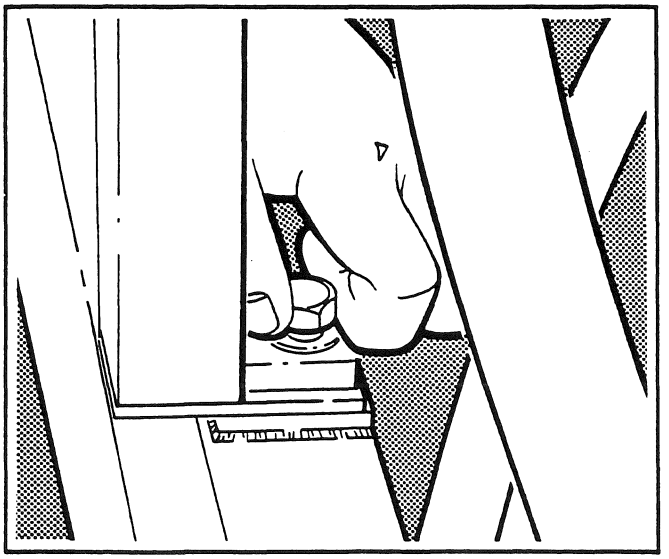


Fig. 49

Installation (continued)

Fig. 44
Install two threaded dowel pins in the flywheel housing at the nine o'clock and three o'clock positions. Slide the clutch housing (64) into position. During this procedure move the pilot shaft (84) gently to make sure that it engages the splines of the friction pack hub. Once the clutch housing is firmly in place, install the capscrews (86), (92) and lockwashers (88), (94). On the two lower capscrews (86) use new seal washers (90), (91). Remove the dowel pins and install the capscrews.

Fig. 45
Install the slave cylinder (101) and mounting bracket. Install the remaining clutch housing capscrews and tighten them in a diagonal sequence to the recommended torque. Ensure the woodruff key is on the shaft.

Fig. 46
Uncap and install the lubrication pressure line and the clutch housing vent line.

Fig. 47
Install the clutch housing drain line. Remove the caps from the hose and port.

Fig. 48
Inspect the universal joints and slip joint on the upper drive shaft. Check to see that the universal joints are aligned. Place the female end towards the clutch housing. Install the capscrews and tighten them. Grease both universal joints and slip joint.

Fig. 49
Use a safe lifting device and install the fuel tank, stand and the air cleaner assembly onto the frame. Retain the stand to the frame.

Installation (continued)

Fig. 50
Remove the caps and fit the the air duct onto the turbo charger inlet and secure it with the clamp. Ensure a tight and secure installation.

Fig. 51
Reconnect the fuel supply line and open the fuel feed petcock located on the rear of the fuel tank sump.

Fig. 52
Install the hydraulic filter to the fuel tank stand.

Fig. 53
Install the vacuum line to the air filter restriction indicator.

Fig. 54
Install the transmission filter to the fuel tank stand.

Fig. 55
Install the hose supporting bracket.

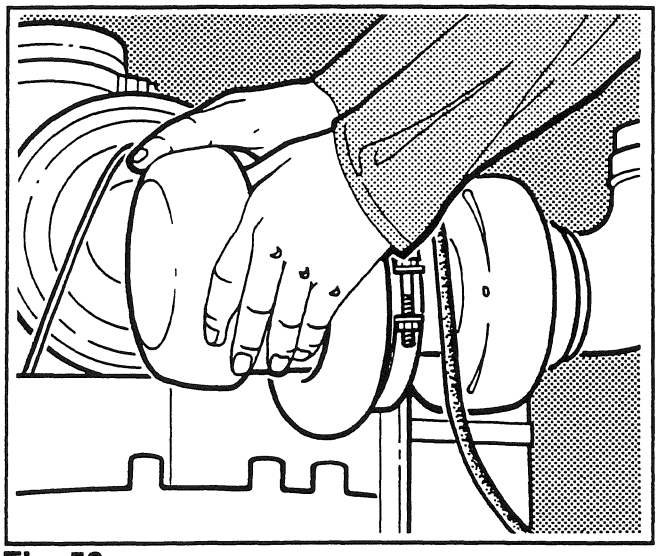


Fig. 50

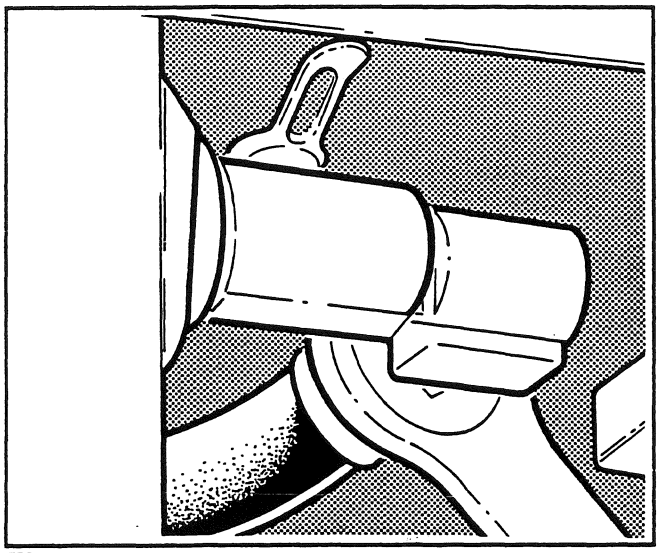


Fig. 51

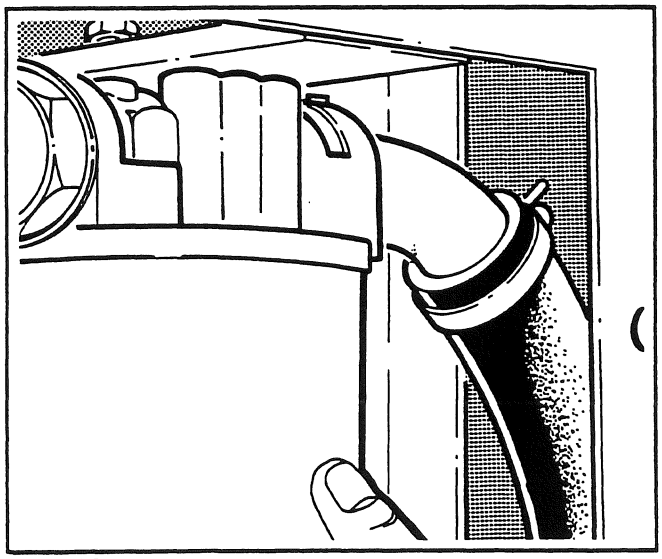


Fig. 52

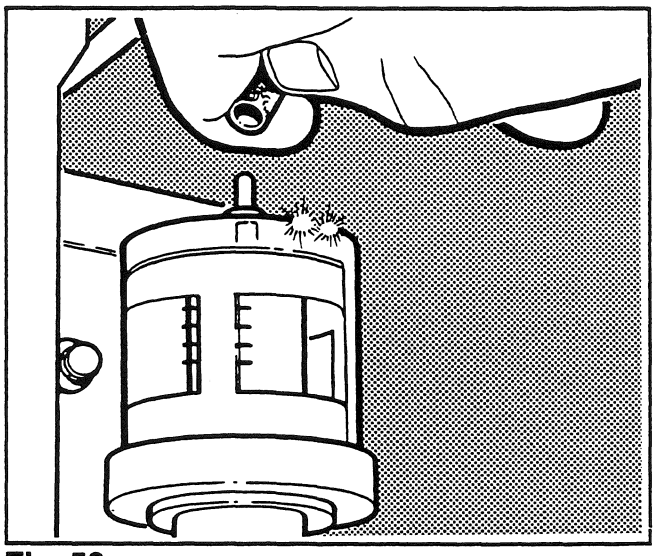


Fig. 53

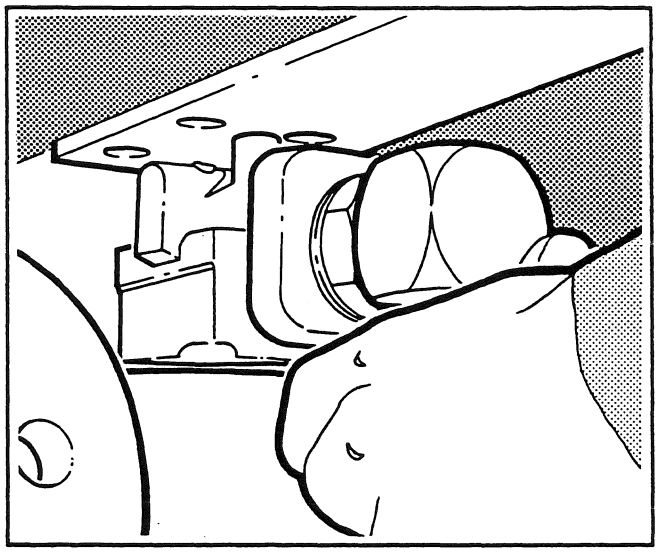
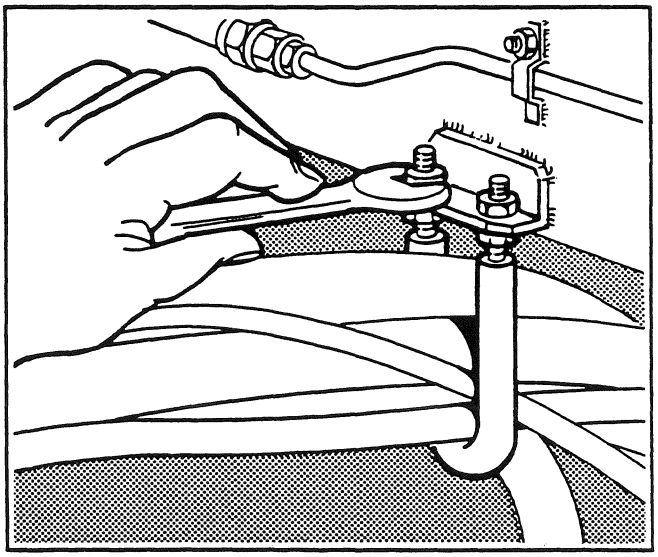


Fig. 54



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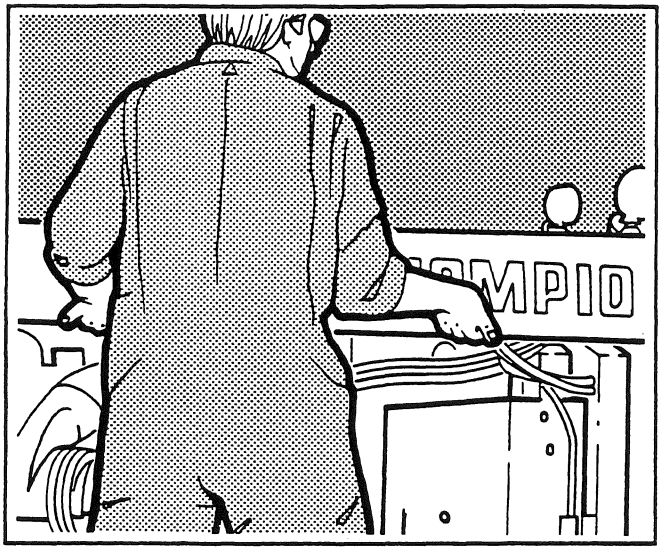

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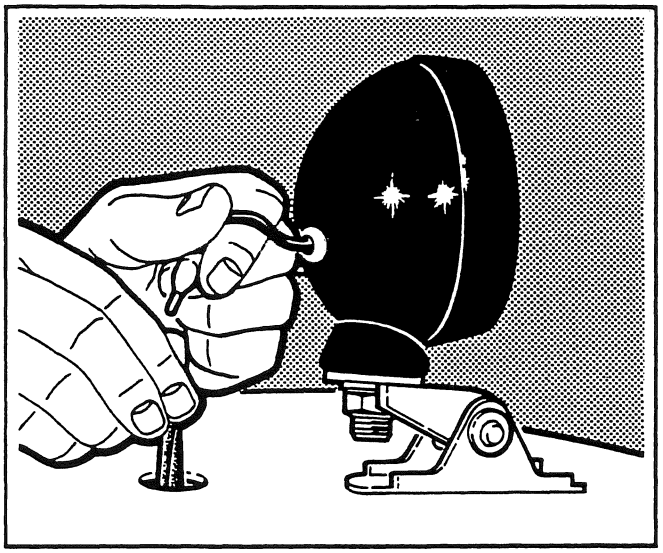


Fig. 57

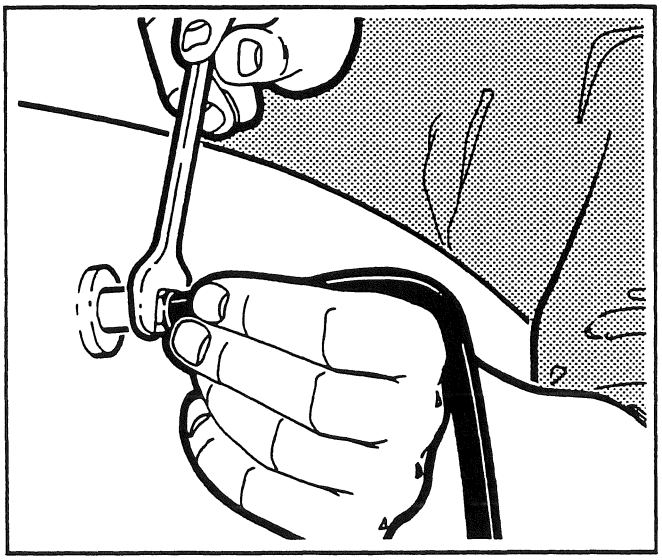


Fig. 58

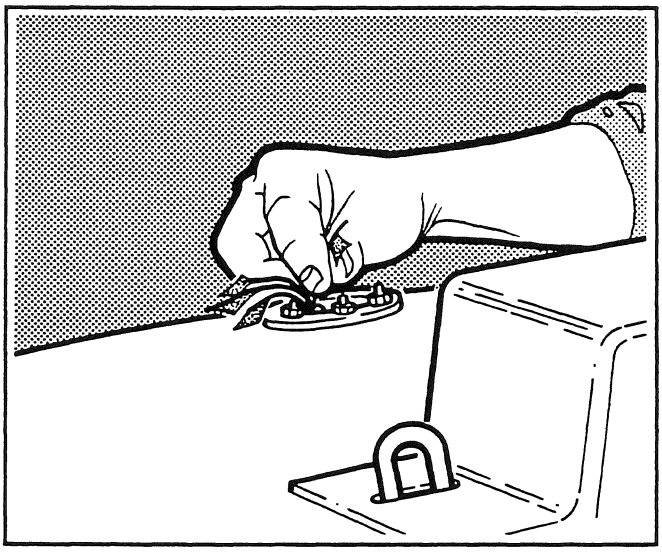


Fig. 59

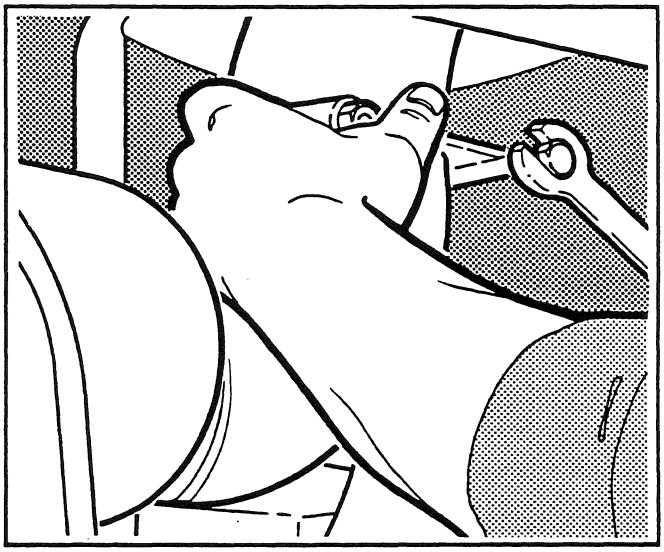


Fig. 60

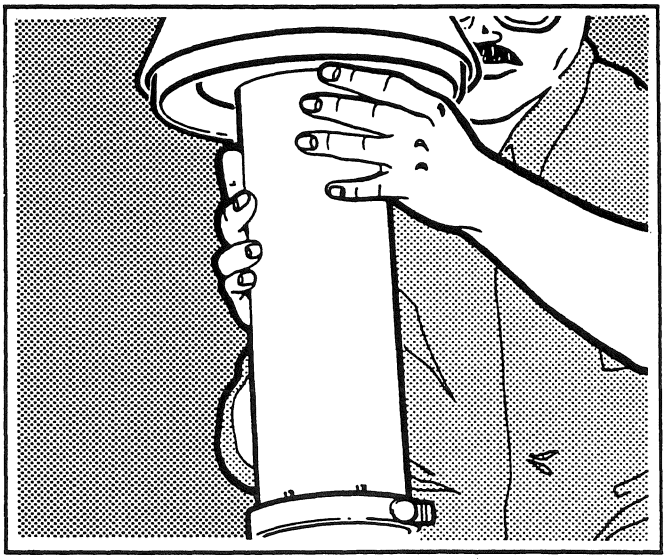


Fig. 61

Installation (continued)

Fig. 56
Lightly tap underneath the engine hood to seat it properly in position. Install the hood and secure with the capscrews, lockwashers and plain washers.

Fig. 57
Reconnect the back-up lights, if so equipped.

Fig. 58
Uncap the fitting and fuel return line and reconnect it to the fuel tank.

Fig. 59
Reconnect the fuel level sending wires at the top of the tank.

Fig. 60
Uncap the turbocharger and install the muffler and direct the exhaust outlet towards the rear of the grader. Install the muffler brace and clamp.

Fig. 61
Uncap the air intake port and install the intake pipe, secure the pipe by tightening the clamp.

Installation (continued)

Fig. 62
Check all connections. Ensure that it is safe to start the grader, turn the isolation switch **"ON"**. Start the grader and with the mode lever in **Neutral**, the oil level should be at the middle of the sight glass.

Fig. 63
With the engine off and the isolation switch **"OFF"**, install and secure all side panels.

Adjustment of the Slave Cylinder

With the engine shut down adjustments are required for proper engine clutch operation and longevity. On the 16 inch clutch, a power-assist feature requires the engine be idling when bleeding air from the slave cylinder. Put the grader into the **Service Position.**

Fig. 64
Ensure the clutch master cylinder fluid is at the full level. Replace the cap.

Fig. 65
With an assistant slowly depressing the clutch pedal, open the bleeder screw on the slave cylinder (101). Close the bleeder screw before the clutch pedal is released. Continue the bleeding procedure until all the air bubbles are discharged. Check the reservior level, add fluid recommended in the Operator's Manual.

Fig. 66
16 inch clutch assemblies must have the engine shut down and the isolation switch **"OFF"**. Loosen the jam nut on the slave cylinder (101) and rotate the cross shaft until the release bearing contacts the release levers. The distance traveled by the cross shaft arm must equal 1/8 inch (3,7 mm). If required, rotate the piston shank to move the cross shaft arm until the specified travel is achieved. Tighten the jam nut. Adjustments can also be accomplished at the top of the slave cylinder. For the 13½ inch clutch the distance traveled by the cross shaft arm must be between .040 in. and .100 in. (1,02 mm and 2,54 mm).

Fig. 67
Check the pedal free play. The starting point of the clutch disengagement should be 1/3 of the pedal travel. On the 13½ inch clutch the linkage rod between the arm and the master cylinder must have a +.031"/-.000"(0,8 mm/0,0 mm) clearance.

NOTE

Clutch settings can be checked by applying the parking brake, blocking the tires and ensuring the area is well ventilated. Indicate you are starting the grader, turn the isolation switch "ON" and ensure the transmission is in "Neutral". Start the engine. Select the highest gear. Fully depress the clutch and brake pedals, shift the mode lever to "Forward". If a lunging motion occurs the clutch is not fully releasing. Shift the mode lever to "Neutral". Shut down the engine and repeat the adjustment procedures.

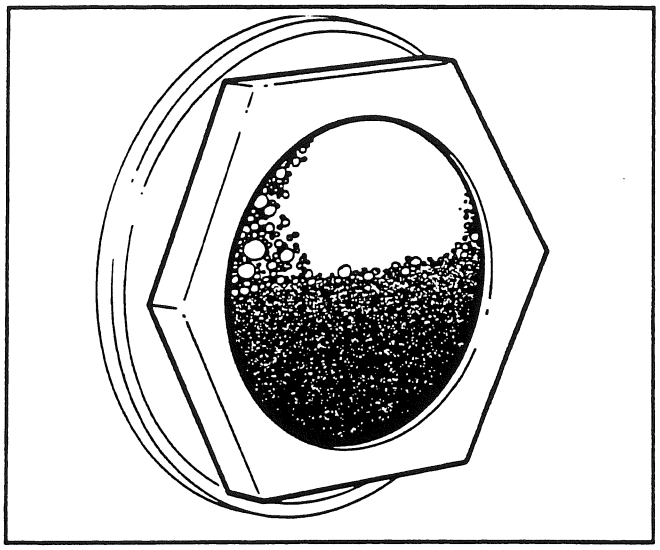


Fig. 62

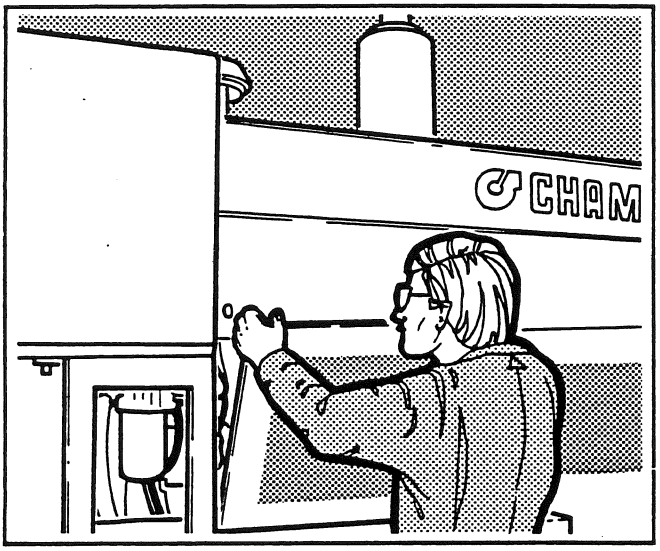


Fig. 63

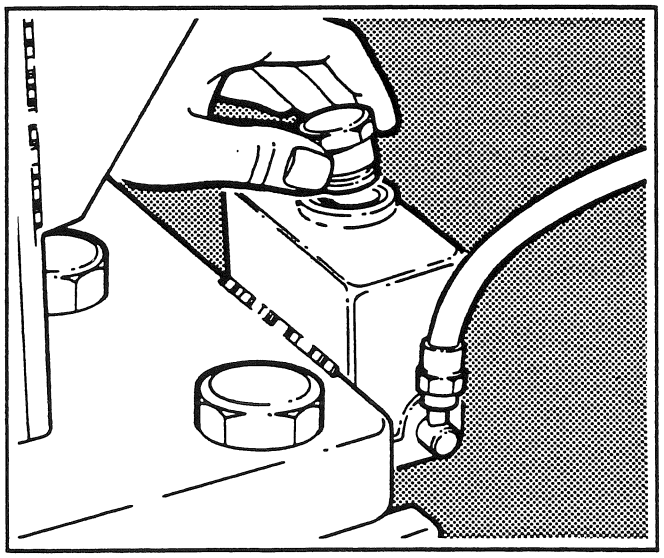


Fig. 64

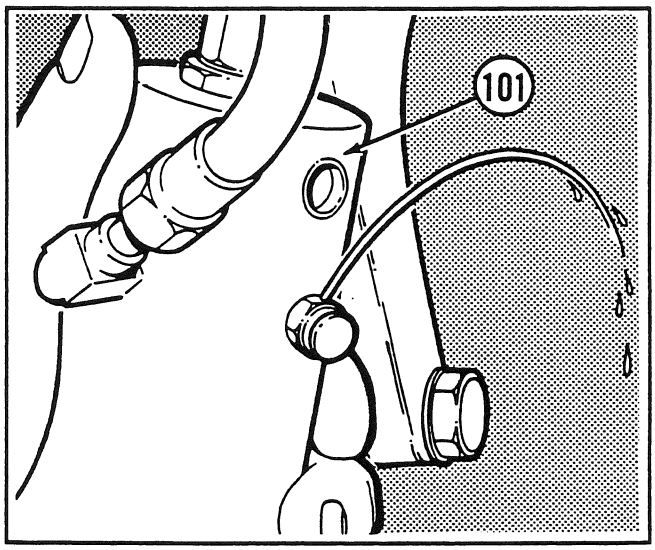


Fig. 65

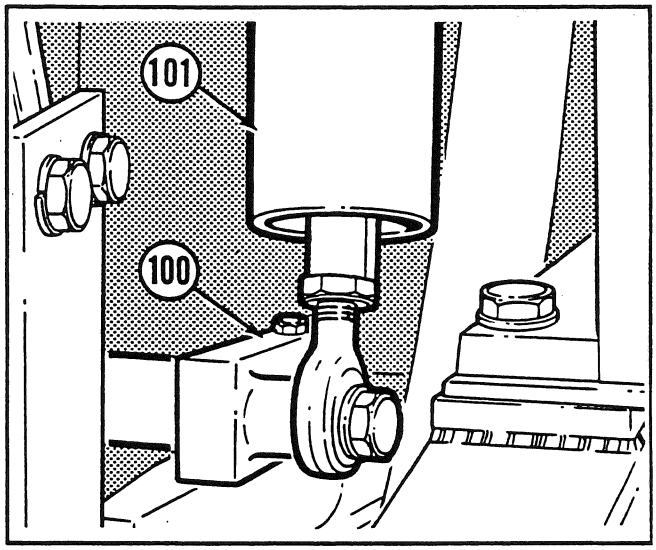


Fig. 66

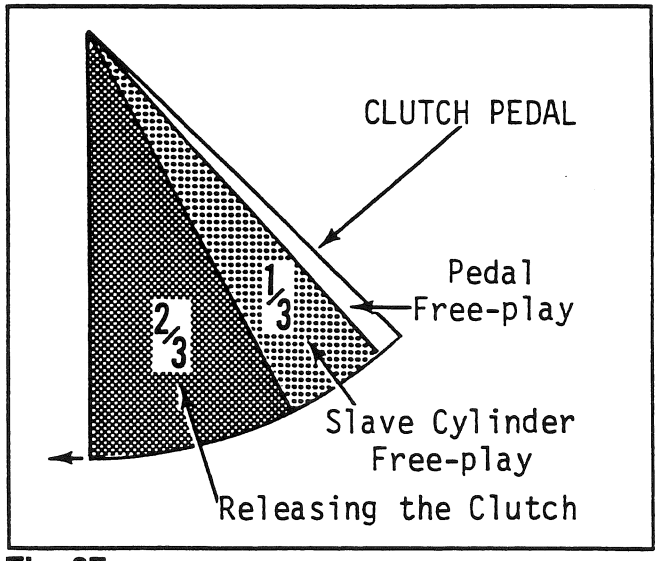


Fig. 67

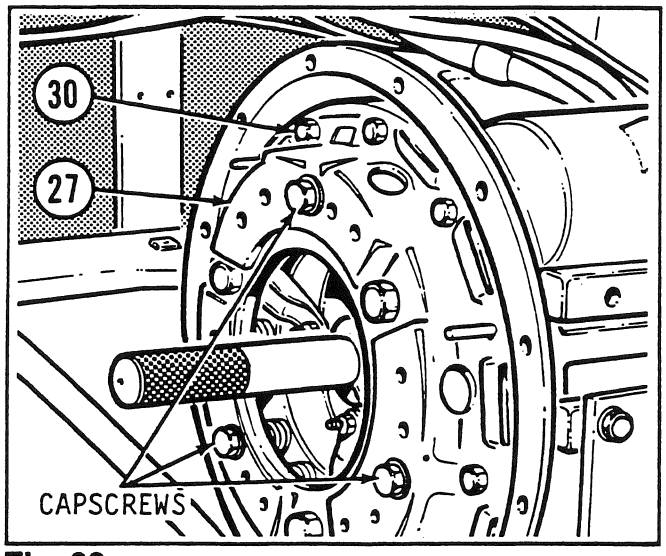


Fig. 68

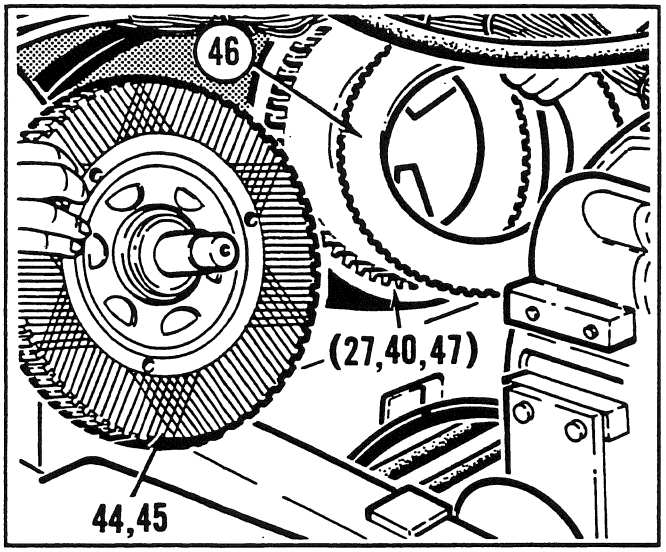


Fig. 69

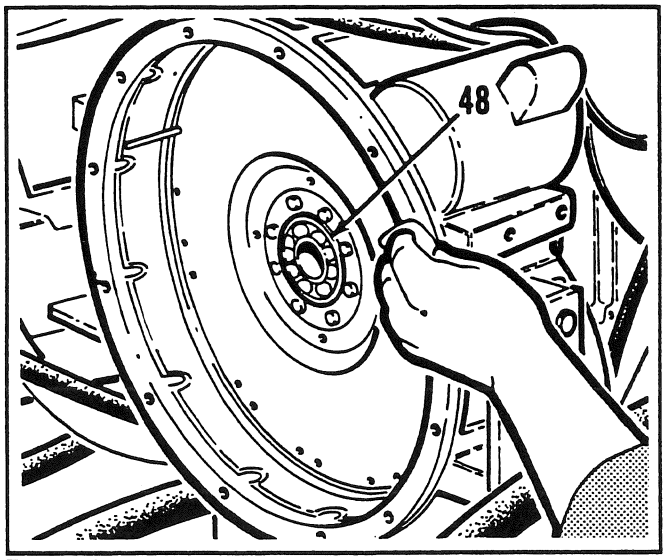


Fig. 70

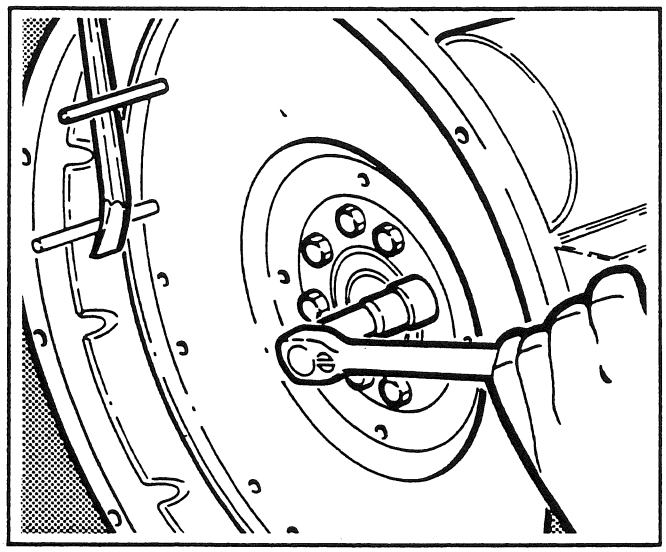


Fig. 71

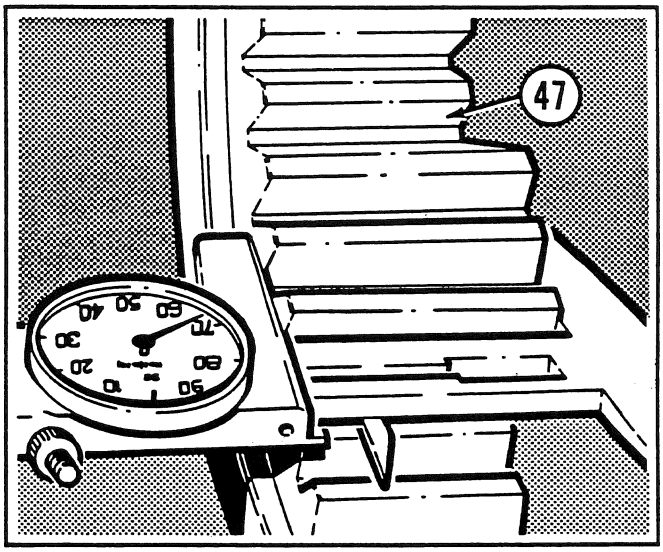


Fig. 72

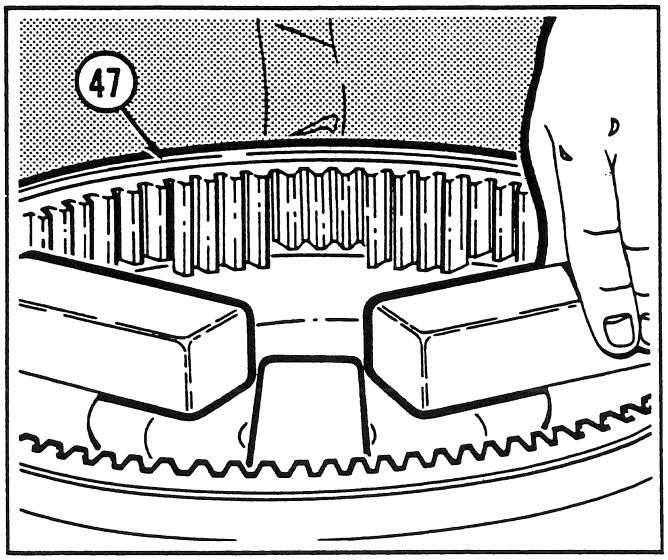


Fig. 73

13½ Inch Clutch - Disassembly

Fig. 68
Park the grader on level ground and place the machine in the **Service Position.** Shift the transmission into **Neutral.** Refer to the beginning of this Shop Manual section to remove the clutch housing. Insert the clutch pilot shaft tool, Champion part number **5629** into the friction pack hub. Using three capscrews and washers, retain the backing plate (27) to the pressure plate (40). Remove two backing plate capscrews (30) at the ten and two o'clock positions and replace them with threaded dowel pins. Remove the remaining capscrews (30) **evenly**, so that the backing plate does not warp or distort.

Fig. 69 (See "WARNING" Page 1)
With an assistant, remove the clutch assembly (items 27, 40 and 47). Withdraw the pilot shaft tool and the friction pack (44), (45). Also remove the steel outer disc.

Fig. 70
Inspect the pilot bearing (48). Examine the flywheel exterior face for damage. Also refer to the Engine Manual for flywheel information. Clean and inpect the Engine - Clutch Housing mounting surface.

Fig. 71
For the 13½ inch clutch the flywheel can be used as a set-up stand. Move the two dowel pins closer together. Use a pry bar between the pins to prevent the flywheel from rotating. Loosen the metric capscrews in a diagonal sequence. Refer to the Engine Manual for removal procedures. The backing plate is a stamped steel component. When using the flywheel as a fixture, you **MUST** retain the backing plate with twelve capscrews to the flywheel. Without retaining the backing plate, the stress on these components will make it impossible to set the release lever height accurately. You **MUST** tighten or loosen these capscrews evenly in sequence (Fig. 74 instructions).

Fig. 72
Determine the setup block thickness. Measure the inner thickness of the drive ring (47), subtract the design constant measurement of .724" +/-.001" (18.4 mm). The remainder will be the measurement required to machine the setup blocks from square bar stock 1½" by 5½" long (38,1 x 127,0 mm).

Fig. 73
Place the flywheel onto a plywood board on a workbench. Place the drive ring (47) onto the flywheel and align the capscrew holes. Place the setup blocks on the flywheel surface with the smaller ends perpendicular to the drive ring teeth. Place these blocks where each of the release levers (37) will be.

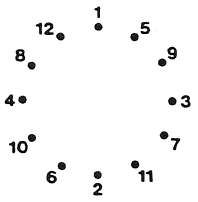
13½ Inch Clutch - Disassembly (continued)

Fig. 74

NOTE

The pressure plate, the backing plate and the drive ring all have stamped markings. These three components MUST be correctly aligned when reassembled.

Retain the backing plate (27) to the flywheel by installing twelve 3/8" dia. by 3-3/4" long capscrews and tighten them in the sequence as shown.



Remove the three capscrews and washers retaining the backing plate (27) to the pressure plate (40). Remove the three locknuts (28) and washers (29) securing the lever arms (37).

Fig. 75 (See "WARNING" Page 1)

Loosen the twelve 3/8" x 3-3/4" capscrews in sequence (Fig. 74 instructions). Remove the twelve capscrews, the backing plate (27) and the springs (39).

Fig. 76

Place the pressure plate (40) onto a plywood board on a workbench. Remove and discard the cotter pin (34). Remove the washer (35) and the lever pin (38). Note the direction of the lever pins during removal. Lift the lever assembly (37) from the pressure plate (40). From the lever assembly (37), remove the pivot pin (33), the pivot block (32) and anti-rattle spring (36).

Fig. 77

Place the lever (37) in a vise, use soft jaws. Remove the adjusting screw and jam nut from the lever (37). Examine all components for wear or damage, refer to **Cleaning and Inspection.**

13½ Inch Clutch - Reassembly

Fig. 78

Install the pivot pin (33), pivot block (32) and the anti-rattle spring (36) into the release lever. Place the pressure plate (40) onto a plywood board on a workbench and install the lever assembly. Install the lever pin (38) from the direction it was removed. Install the washer (35) and new cotter pin (34) to retain the pin. Install the adjusting screw and jam nut on the lever (37). **DO NOT** thread the adjusting screws all the way in the lever arms. The adjusting screws are held in the lever by a thread interference fit and jam nut and may become loose if they are turned counter-clockwise.

Fig. 79

With the flywheel, drive ring (47) and setup block set on a workbench, place the pressure plate on top of the block spacers. Position the spacers directly under the release levers (37). Install the springs (39) and the backing plate (27). Ensure that the springs are properly seated on the backing plate. Install twelve 3/8" x 3-3/4" capscrews and draw the backing plate down to install the pivot blocks (32).

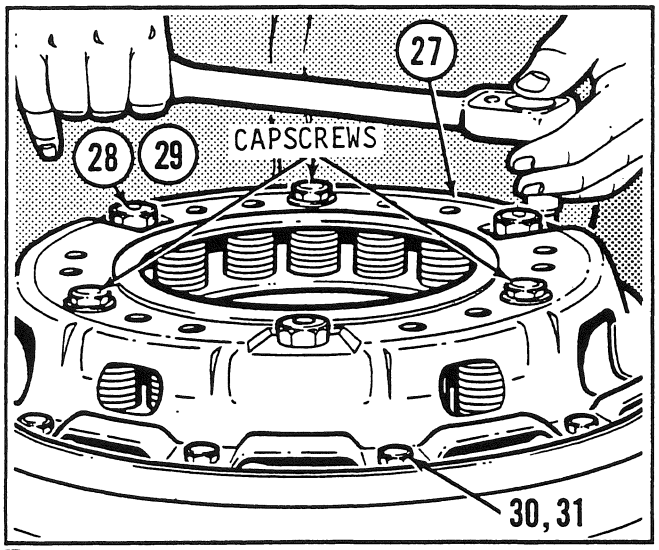


Fig. 74

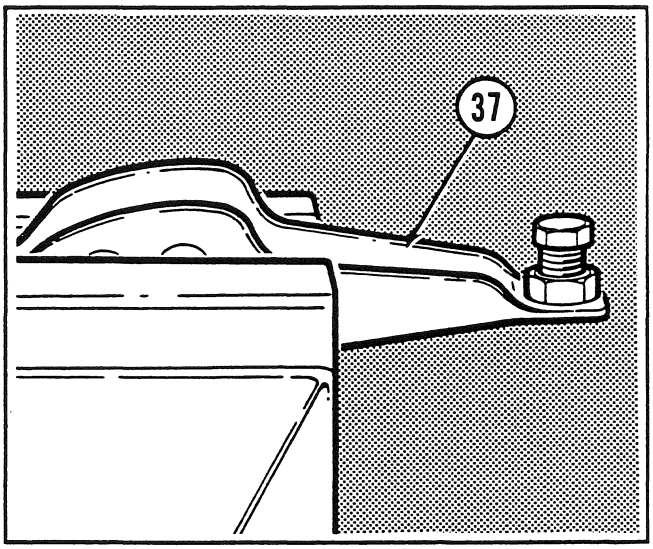
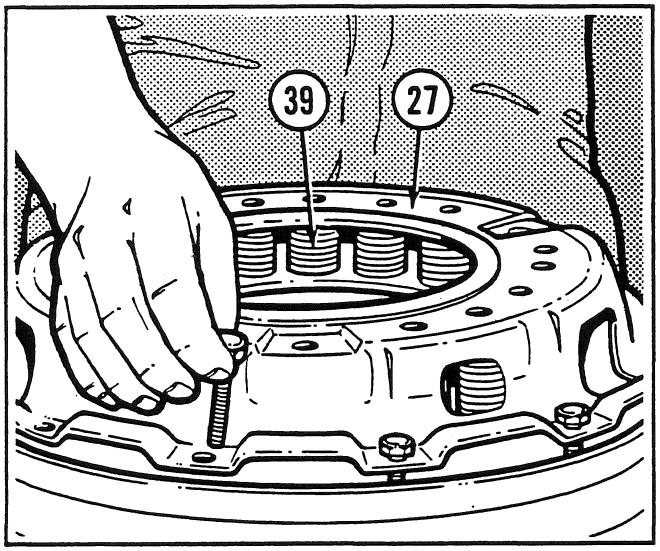


Fig. 77



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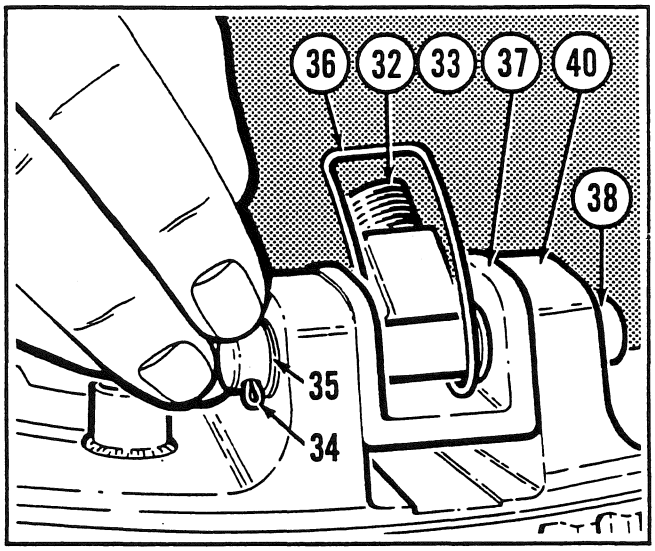

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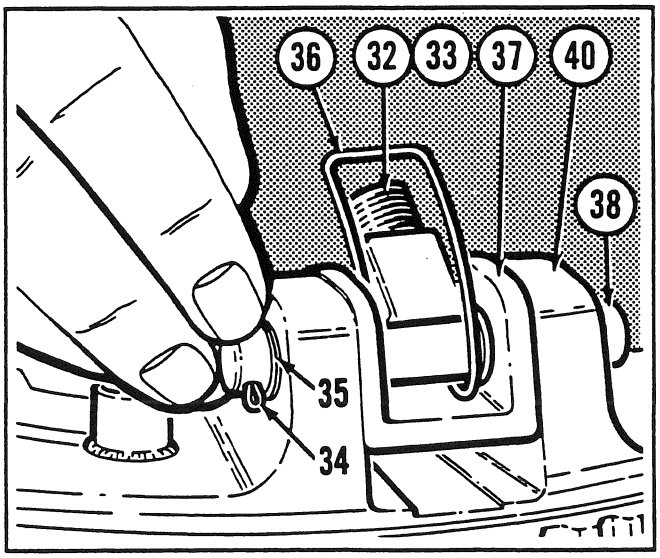

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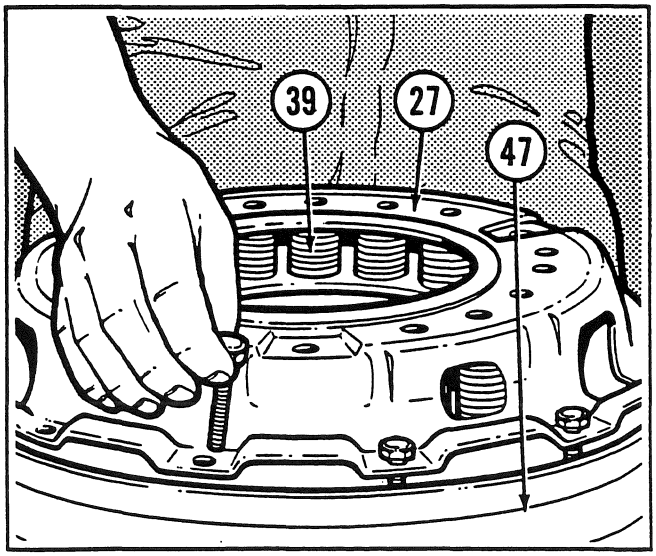

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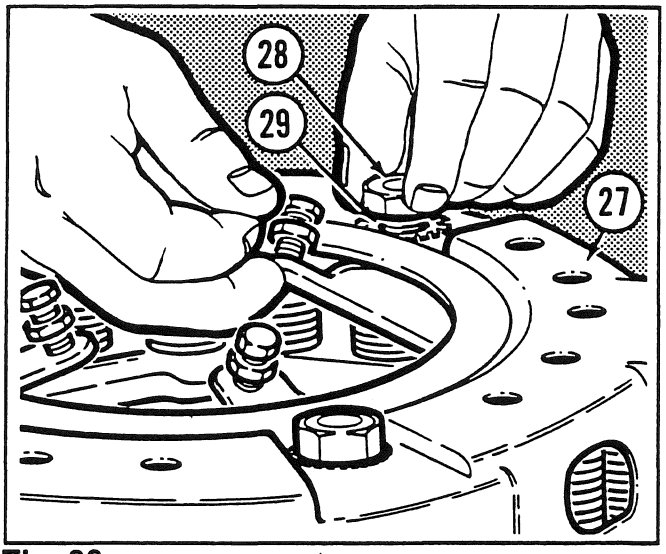

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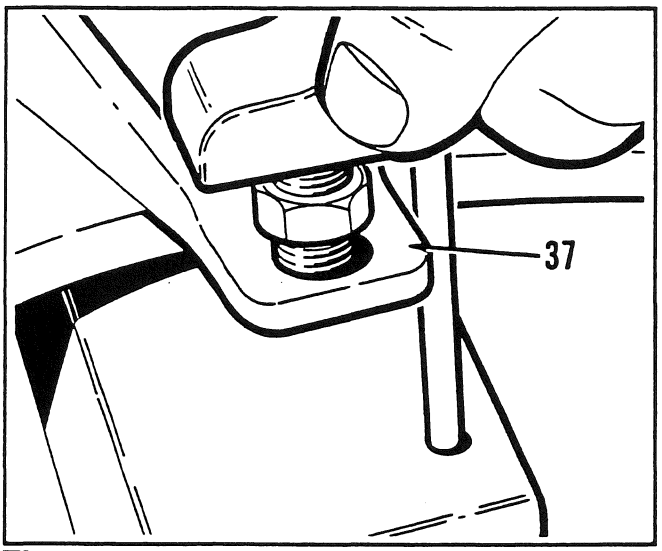

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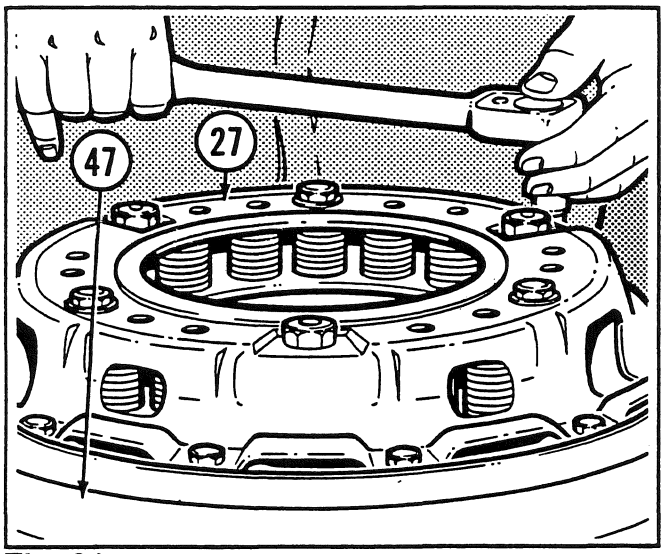

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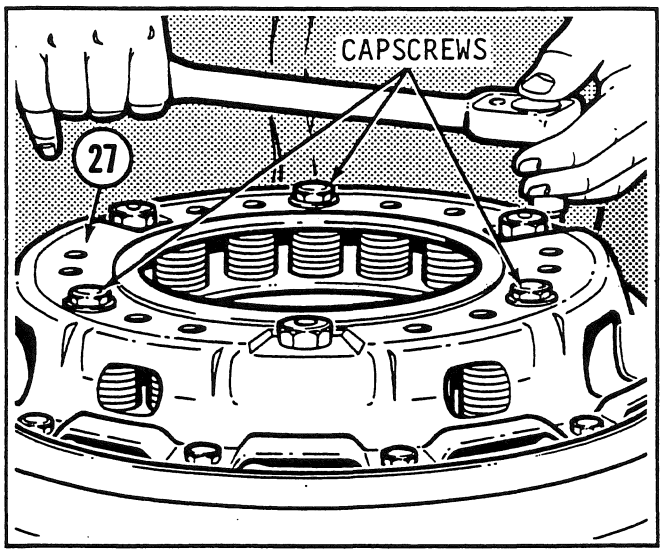

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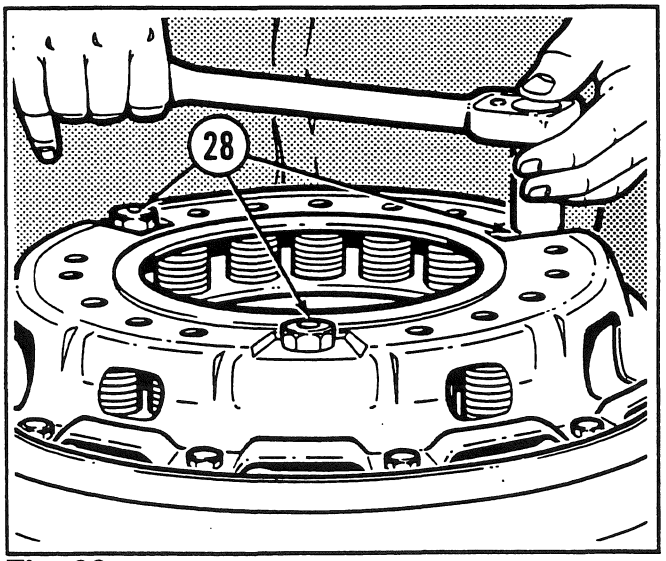

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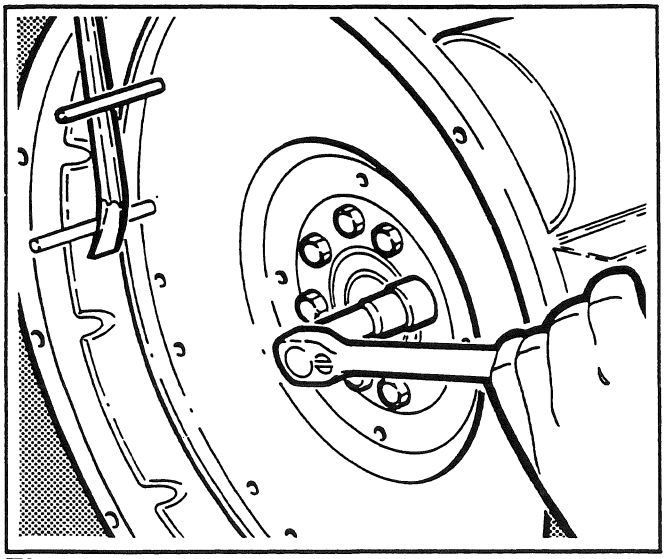


Fig. 85

13½ Inch Clutch - Reassembly (continued)

Fig. 80
If the lever pivot block is not positioned correctly, damage will occur to the lever assembly components. Install the lockwasher (29) and jam nut (28) to finger tightness. Ensure the lever pivot blocks (32) are **seated** correctly in the corresponding backing plate (27) holes.

Fig. 81
Tighten the twelve 3-3/4 in. long capscrews evenly in sequence (Fig. 74 instructions) pull down the backing plate (27) onto the drive ring (47). Ensure the backing plate is properly positioned in the locating counterbore of the drive ring before tightening the capscrews.

Fig. 82
Tighten the three pivot block jam nuts (28) to the specified torque.

Fig. 83
Using a depth micrometer, measure the perpendicular distance from the top of the setup block to the top of the adjustment screw. The three levers (37) must be of equal height within .020" and set at 2.162" +/-.015 (54,9mm). Tighten the jam nut to the specified torque to retain the lever adjusting screw. Recheck the lever heights.

Fig. 84

NOTE

The pressure plate, back plate and the drive ring as an assembly must be dynamically balanced within 1.3 oz. inch before putting the clutch into service.

Install the three retaining capscrews and washers. Retain the backing plate (27) to the pressure plate (40). Carefully loosen the twelve 3-3/4 in. long capscrews evenly in sequence (Fig. 74 instructions). **DO NOT** allow the backing plate to warp or distort during this procedure.

Fig. 85
Install the flywheel and tighten the retaining metric capscrews in the sesequence and torque recommended in the Engine Manufacturer's manual.

13½ Inch Clutch - Reassembly (continued)

Fig. 86
Move the threaded dowel pins to the ten and two o'clock positions in the flywheel housing and install the drive ring (47). Install the steel outer disc (46), hold it against the flywheel.

Fig. 87
When installing the friction pack, the cavity of the splined hub must face towards the flywheel.

Fig. 88
Place the friction pack on the clutch pilot shaft tool, Champion part number **5629**, align the splines. Hold the drive ring (47) in place so that the outer disc (46) does not drop out of position. Install the clutch pilot shaft tool into the pilot bearing (48). Align the teeth of the drive ring.

Fig. 89
Align the stamp mark on the drive ring (47) with the mark on the backing plate (27) and install the clutch assembly on the supporting dowel pins. Install the capscrews (30) and lockwashers (31) to retain the clutch assembly to the flywheel and check to see that the steel outer disc (46) has not dropped out of place. Remove the dowel pins and replace them with the remaining capscrews. Tighten the twelve capscrews evenly in sequence (Fig. 74 instructions) to the recommended torque.

Make certain that the backing plate is properly positioned in the locating counterbore of the drive ring.

Remember to remove the three retaining capscrews.

Remove the pilot shaft tool from the clutch assembly.

Reinstallation of the 13½ inch clutch is now complete. Refer to instructions called **Clutch Housing - Installation** in this section for installing the clutch housing and performing slave cylinder adjustment.

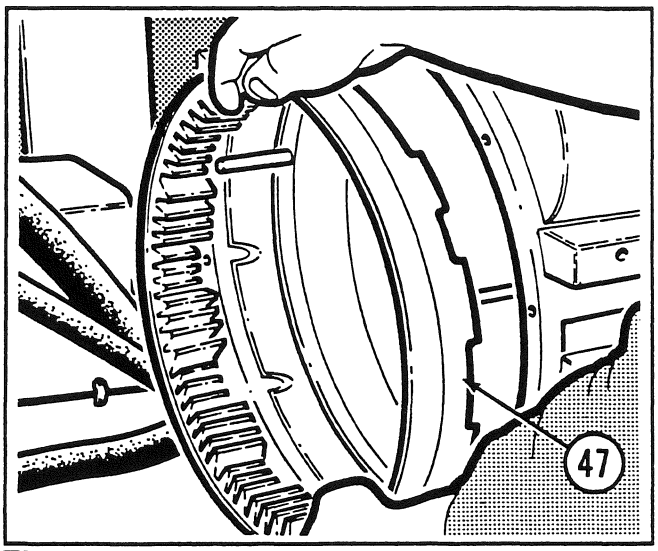


Fig. 86

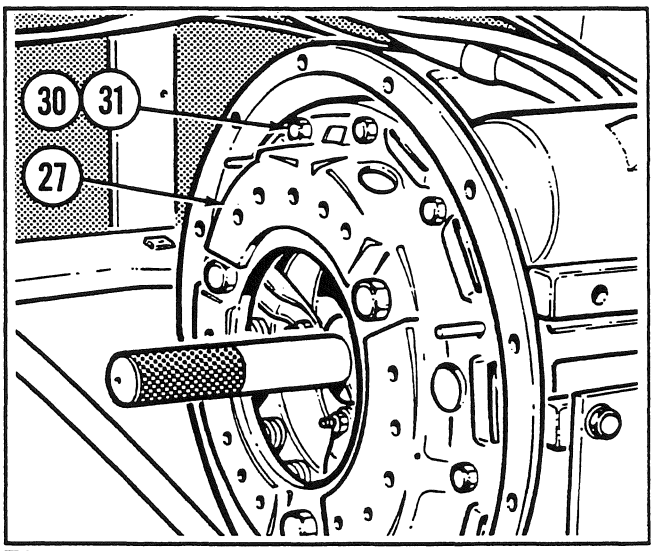


Fig. 89

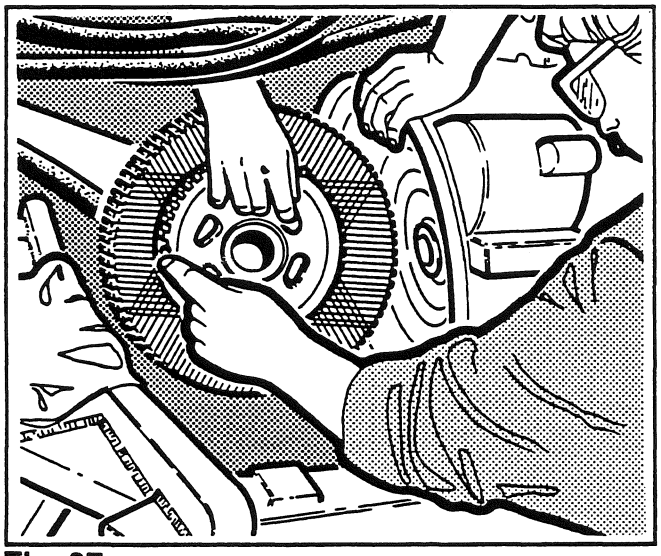
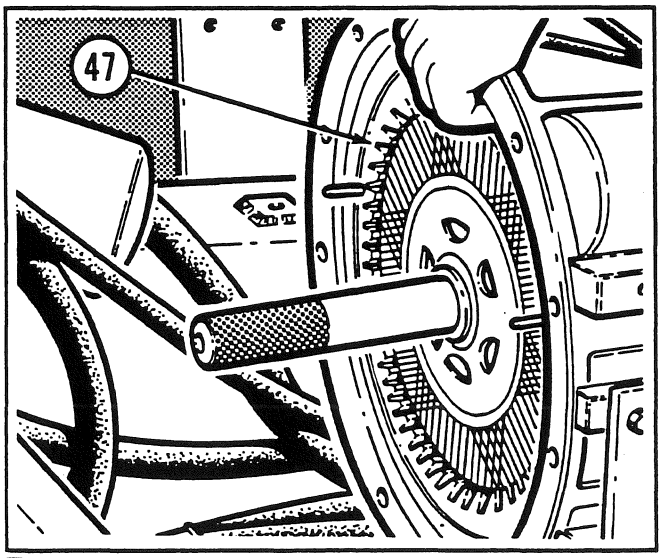


Fig. 87



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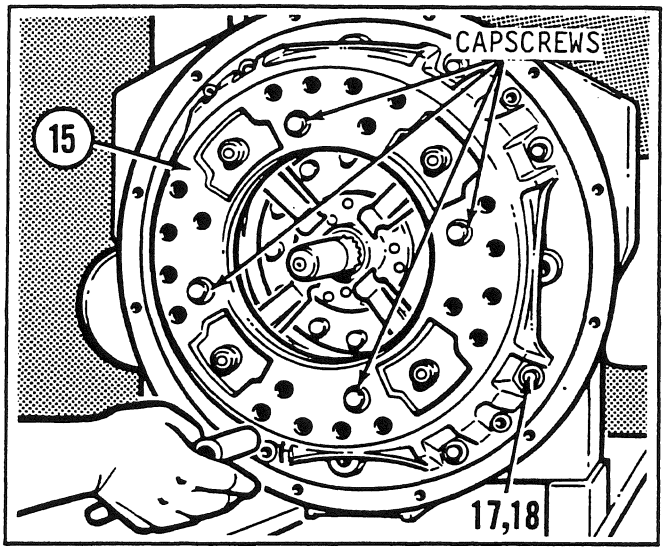
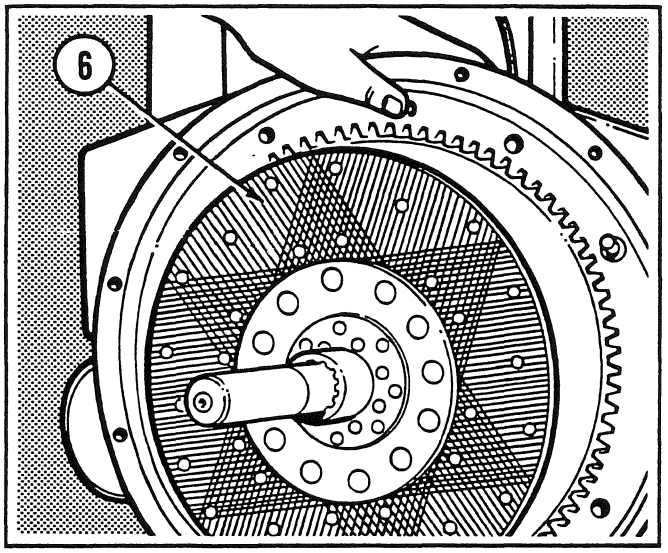


Fig. 90



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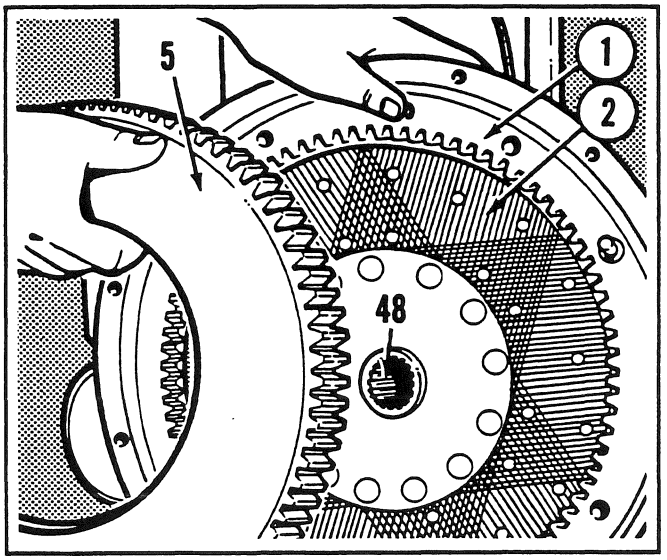

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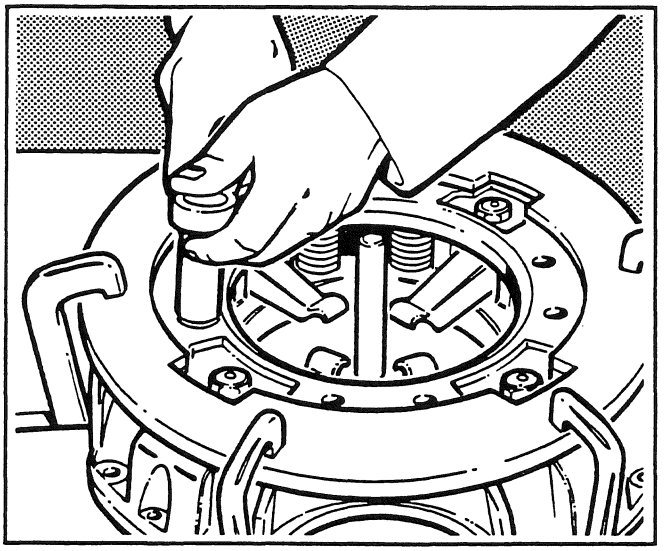
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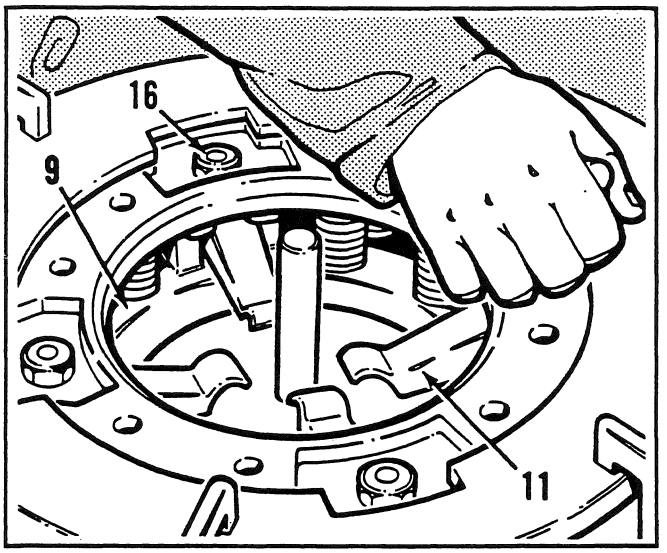


Fig. 94

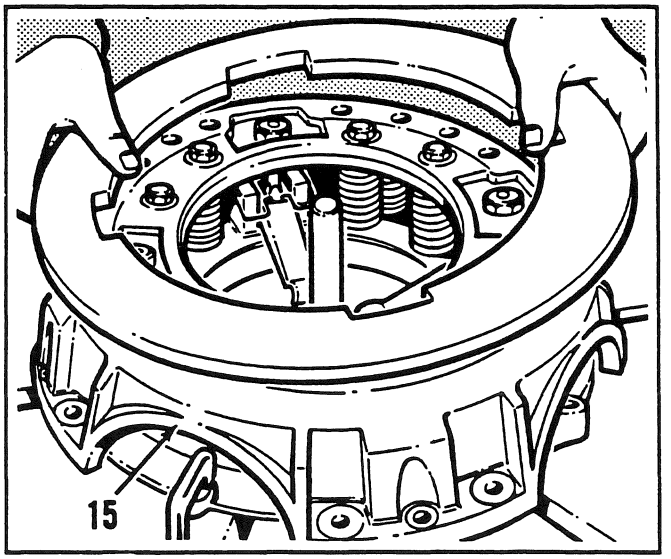


Fig. 95

16 Inch Clutch - Disassembly

Fig. 90 (See "WARNING" Page 1)
Park the grader on level ground and place the machine in the **Service Position.** Shift the transmission into **Neutral.** Refer to the beginning of this Shop Manual section to remove the clutch housing. Insert the clutch repair pilot shaft tool, Champion part number **5629** into the friction pack hub. Using four 3/8" x 2-1/2" capscrews and washers, retain the backing plate (15) to the pressure plate (9). Remove two backing plate capscrews (17) at the ten and two o'clock positions and replace them with threaded dowel pins. Remove the re-remaining capscrews (17) evenly in a diagonal sequence. With an assistant, remove the clutch assembly (items 9 and 15). Use caution, this assembly is **very heavy.**

Fig. 91
With the pilot shaft tool already inserted, remove the driven member (6).

Fig. 92
Remove the spacer (5), the driven member (2) and the drive ring (1). Inspect the pilot bearing (48). Examine the flywheel exterior face for damage. Also refer to the Engine Manual for flywheel information. Clean and inspect the Engine - Clutch Housing mounting surface.

Fig. 93 (See "WARNING" Page 1)
Using a decompression fixture, center the clutch assembly on the fixture. Place the hold down ring on the assembly. Adjust the clamps and operate the fixture to secure the assembly to the table. Remove the four 3/8" x 2-1/2" capscrews and washers.

Fig. 94
Loosen the adjusting nuts (16) until the release levers (11) almost touch the pressure plate (9). Carefully relieve the fixture pressure, making sure that the assembly is still safely clamped in place. Repeat this procedure until the pressure is completely released and the levers drop freely.

Fig. 95
Slowly release the fixture pressure completely to remove the hold down ring and fixture clamps. Remove the backing plate (15).

16 Inch Clutch - Disassembly (continued)

Fig. 96
Remove the springs (26), the insulating washers (25) and the retaining washers (24) from the pressure plate (9).

Fig. 97
Place the pressure plate (9) onto a plywood board on a workbench. Remove and discard the cotter pin (23). Remove the washer (22) and lever pin (20). Note the direction of the lever pins during removal, they **MUST** be reinstalled from the same direction. Lift the lever assembly (11) from the pressure plate (9). From the lever (11), remove the anti-rattle spring (13), the pivot pin (12) and the eye bolt (10). Repeat these procedures for the other three levers.

Fig. 98
Use a hammer and drift to remove the needle bearings (21) in the pressure plate (9). Also remove the needle bearings (19) from the eye bolts (10). Examine all components for wear or damage, refer to **Cleaning and Inspection.**

16 Inch Clutch - Reassembly

Fig. 99
Place a new or reconditioned pressure plate (9) onto a plywood board on the workbench. Lubricate and install new needle bearings (21) in the pressure plate. Install new needle bearings (19) in the eye bolts (10). The lever pin (20) makes an excellent drift for installing the needle bearings.

Fig. 100
Install the eye bolt (10) in the lever (11) with the pivot pin (12) and anti-rattle spring (13). Align the holes in the release lever with those in the pressure plate. Install the lever pin (20), washer (22) and a new cotter pin (23) to retain the pin.

Fig. 101
Place the pressure plate (9) on the decompression fixture and center it. Use four setup blocks under the pressure plate at the four lever boss positions. These setup blocks **MUST** be .474" +/-.001" (12,04mm) and all four should be of equal thickness within .001".

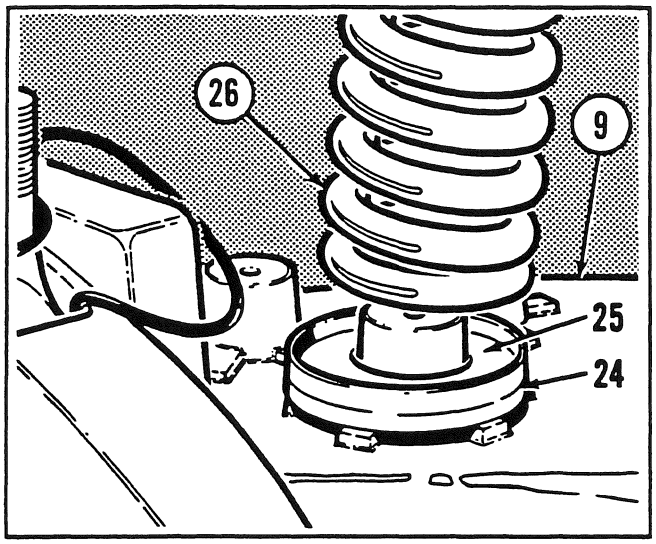
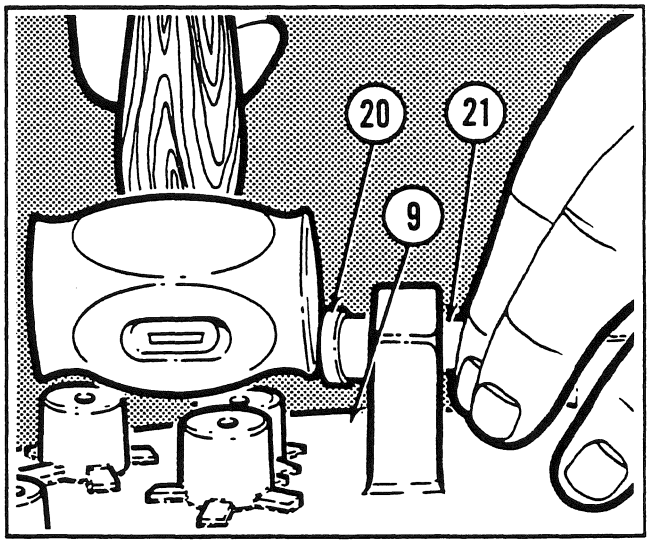


Fig. 96



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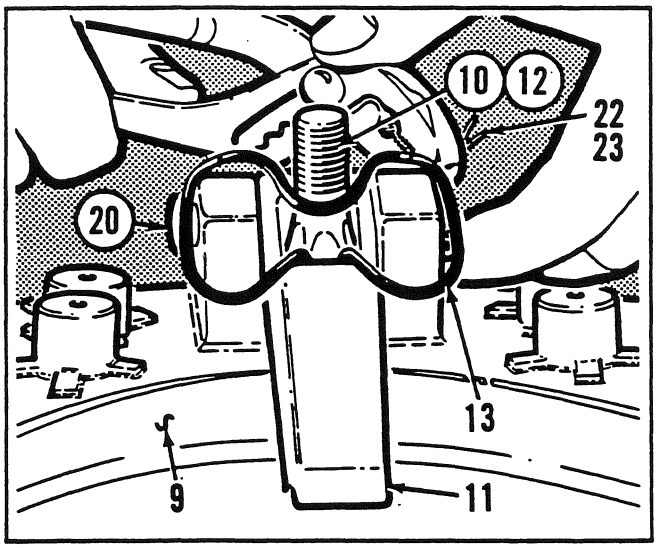

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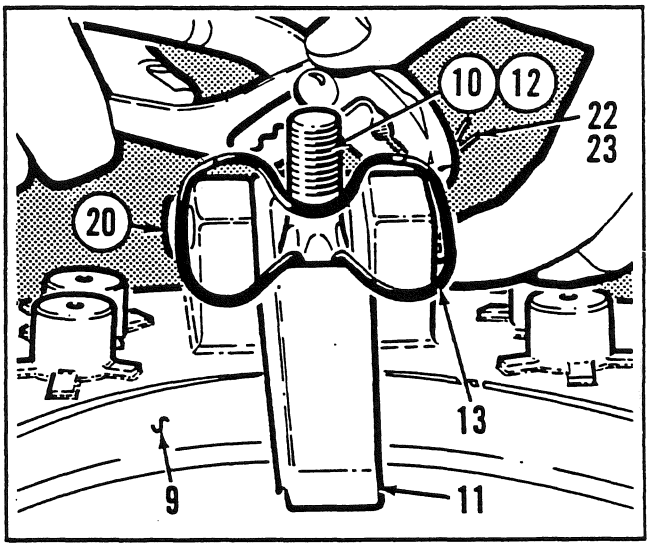

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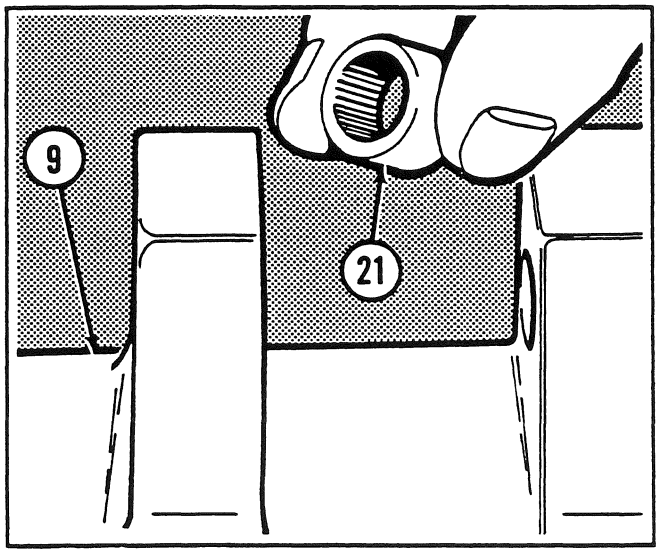


Fig. 98

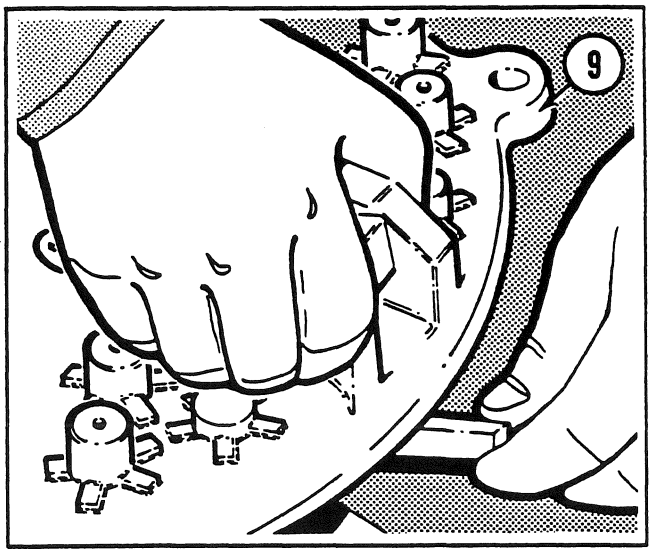


Fig. 101

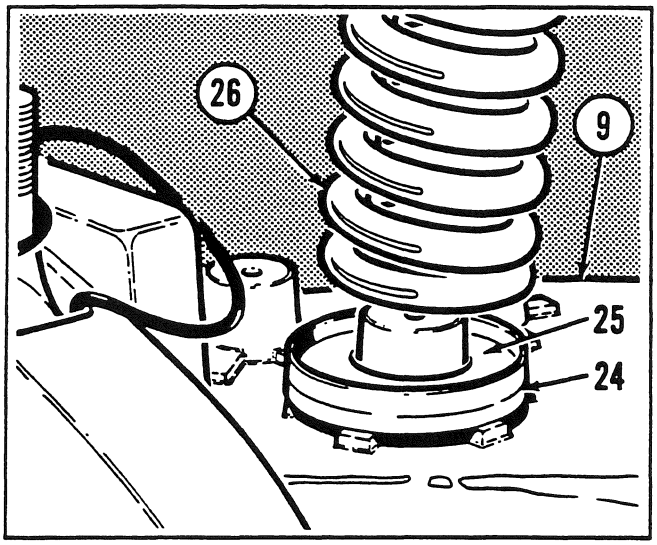
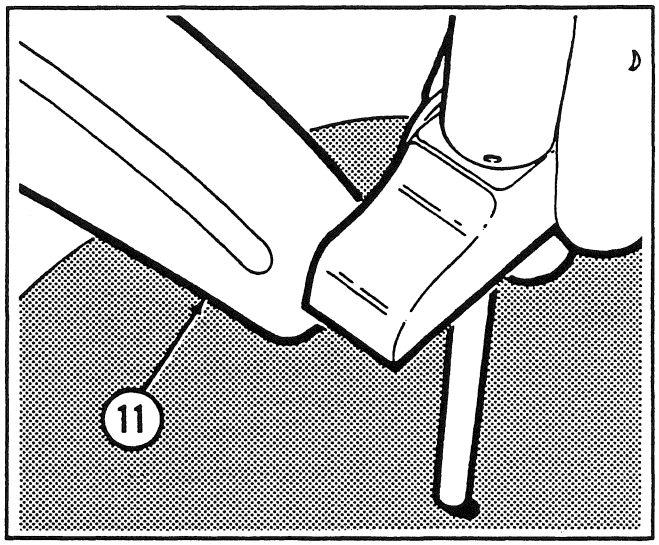


Fig. 102



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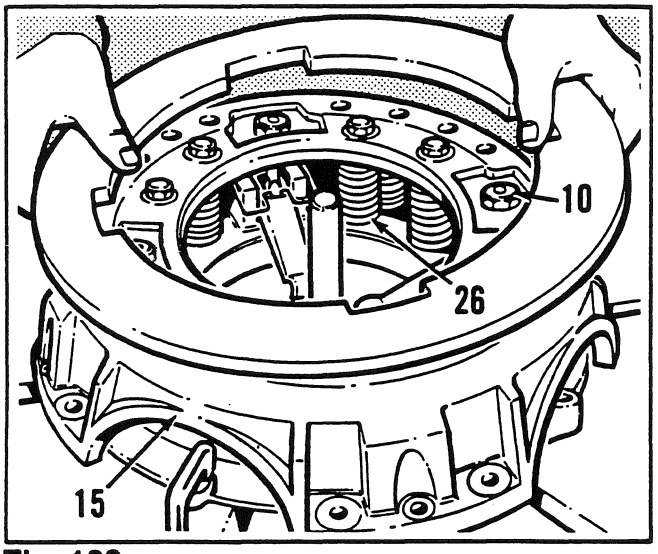
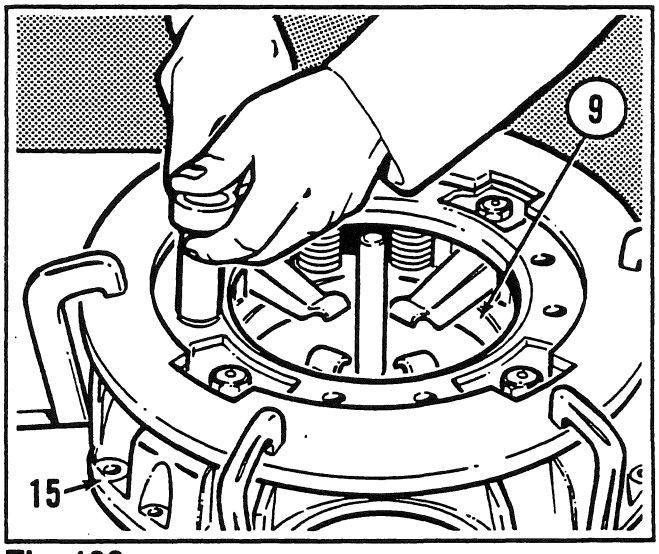


Fig. 103



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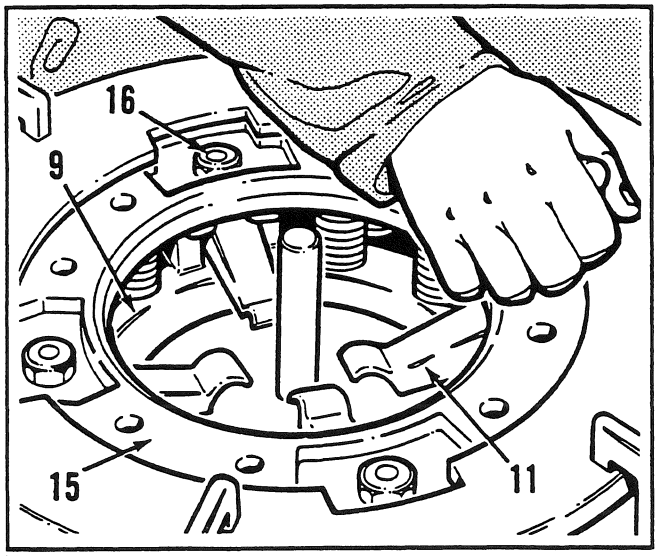

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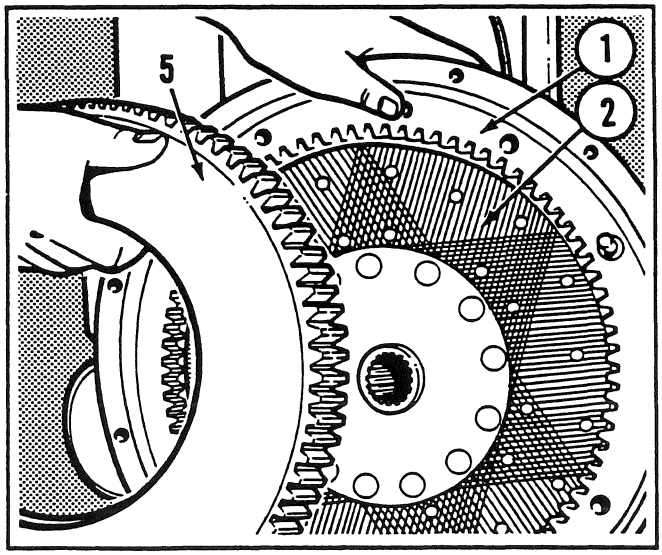


Fig. 107

16 Inch Clutch - Reassembly (continued)

Fig. 102
Install the spring retainer washers (24), the insulating washers (25) and the springs (26).

Fig. 103
Lower the backing plate (15) onto the springs (26), ensure the eye bolt holes in the backing plate align with the eye bolts (10). **Seat** the springs. Place the hold down ring on the backing plate, position the hold down clamps and compress the clutch assembly.

Fig. 104
Lift the release levers (11) to thread the adjusting nuts (16), **DO NOT** cross-thread the eye bolts. Tighten each adjusting nut until the levers almost contact the backing plate (15). Compress the backing plate until it contacts the table. A feeler gauge measure of .001 inch should not be able to fit under the backing plate. Tightening the adjusting nuts and compressing the assembly may have to be done more than once.

Fig. 105
Using a depth micrometer, measure the perpendicular distance from the top of the fixture surface to the top of the lever (11) end. The four levers **MUST** be of equal height, within .020" and **MUST** be set at 2.687" +/-.015" (68,25mm) by turning the adjusting nuts (16).

Fig. 106
Install and tighten the four retaining capscrews and washers to secure the clutch assembly (9), (15). Carefully release the pressure on the clutch assembly. Remove the hold down ring and clutch assembly. Be careful the clutch assembly is **very heavy.**

NOTE

The clutch assembly must be dynamically balanced within 1.5 oz. inch before putting the clutch into service.

Fig. 107
Install the threaded dowel pins at the ten and two o'clock positions in the flywheel housing and install the drive ring (1). Install the first driven member (2) with the hub towards the flywheel. Install the spacer (5).

16 Inch Clutch - Reassembly (continued)

Fig. 108

Install the second driven member with the hub away from the flywheel. Hold the assembly in position, insert the clutch pilot shaft tool, Champion part number **5629**, aligning the splines of the two driven members (2), (6).

Installation of the 16 inch clutch is now complete. Refer to instructions called **Clutch Housing - Installation** in this section for installing the clutch housing and performing slave cylinder adjustments.

Fig. 109

With an assistant, install the clutch assembly onto the dowel pins and slide the clutch assembly into place. Install the backing plate lockwashers (18) and capscrews (17). Remove the two dowel pins and replace them with the two remaining backing plate capscrews and tighten the them in a diagonal sequence to the recommended torque.

Remember to remove the four retaining capscrews.

Remove the pilot shaft tool from the clutch assembly and maintain the spline alignment of the two driven members.

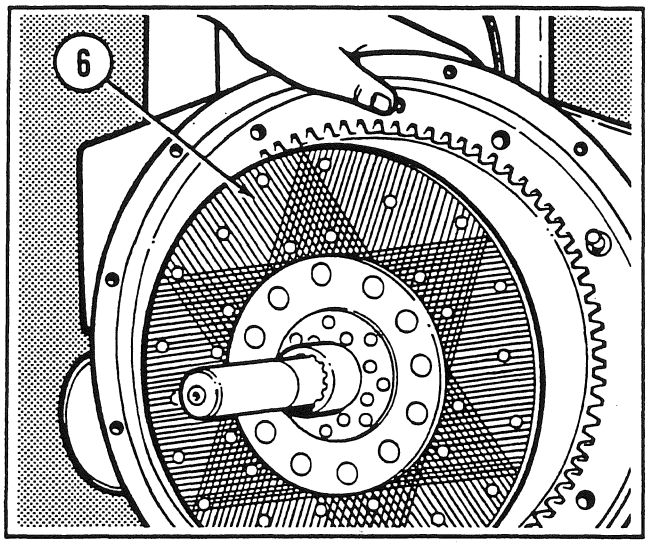


Fig. 108

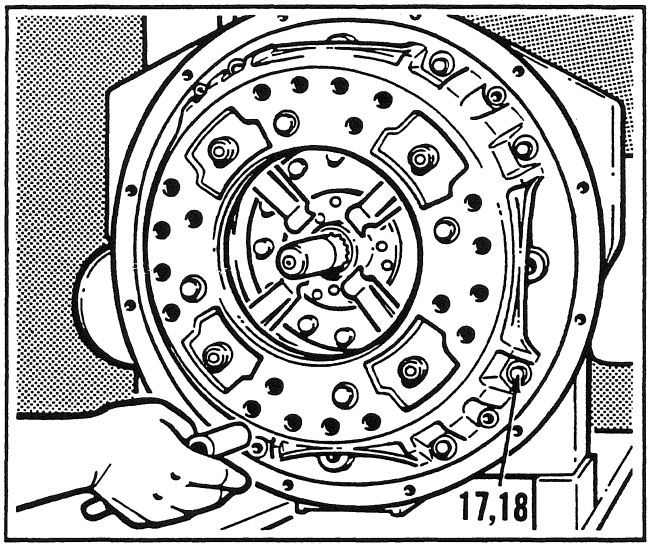
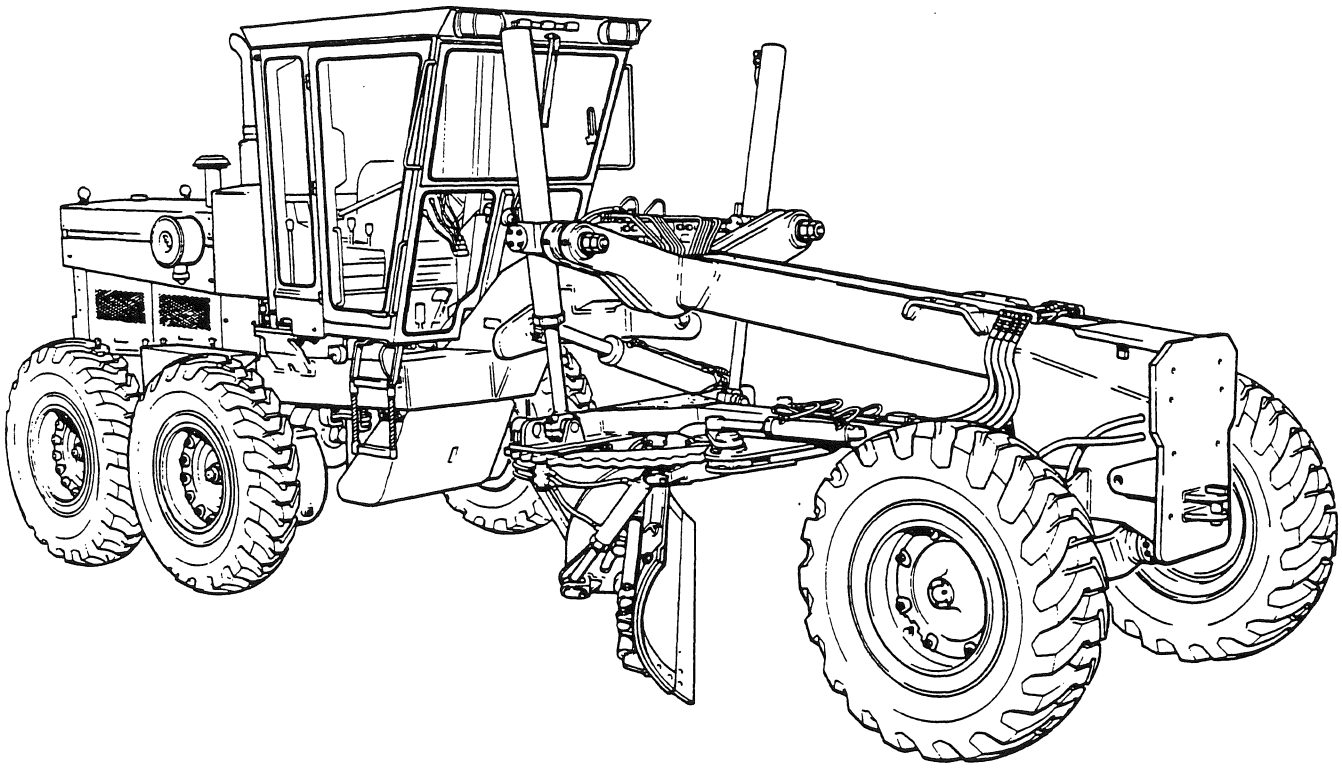


Fig. 109

SECTION 8

8400 TRANSMISSION



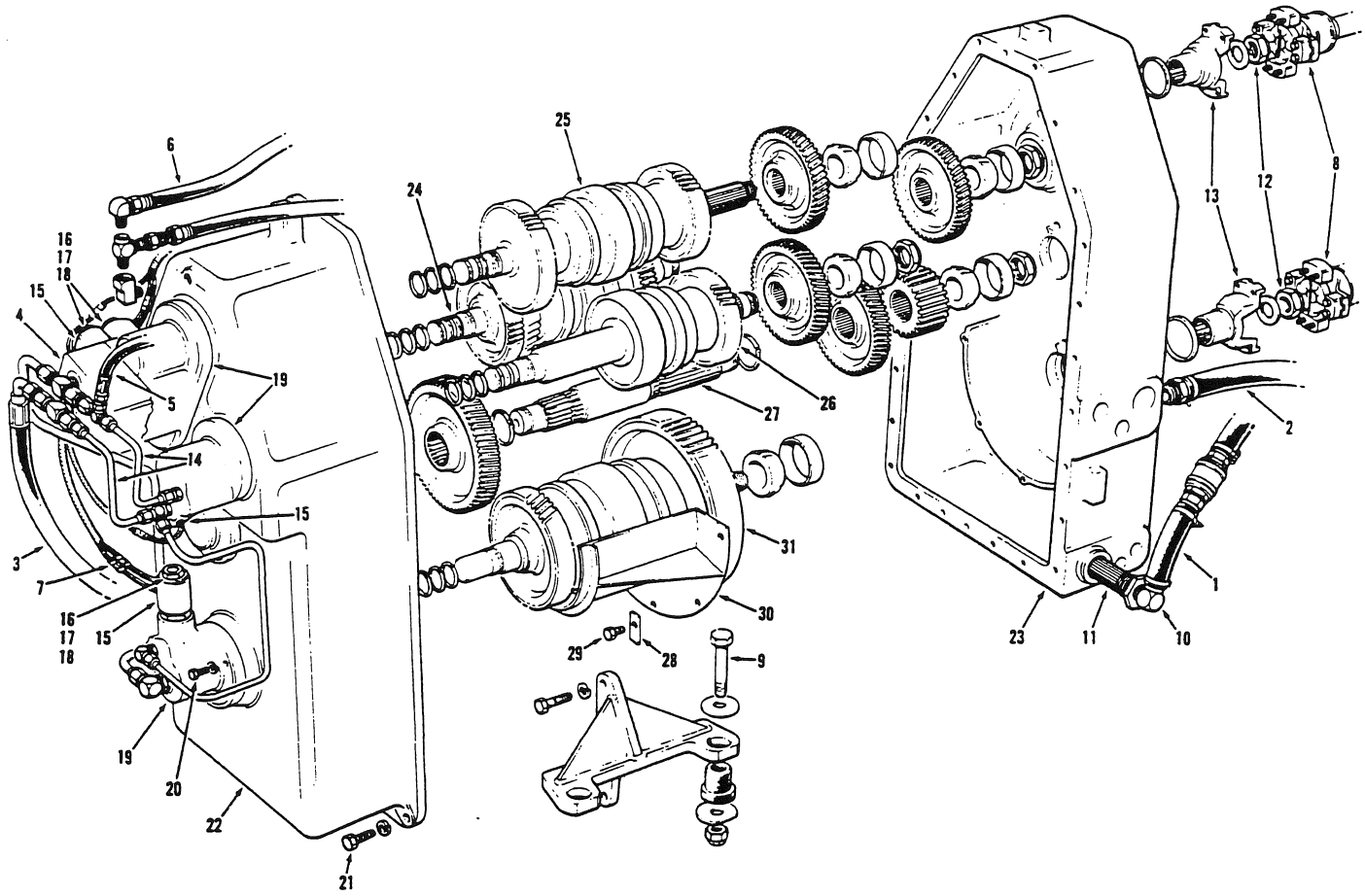


Fig. 1

1. Suction hose
2. Clutch drain hose
3. Trans. supply hose
4. Regulator valve
5. Clutch supply hose
6. Breather hose
7. Trans. wiring harness
8. Drive shafts
9. Trans. mount bolts
10. Suction fitting
11. Suction strainer
12. Nut
13. Driveshaft yoke
14. Hydraulic tube
15. Solenoid
16. Nut
17. Spacer
18. Valve cartridge
19. Control valve cap
20. Capscrews
21. Capscrews
22. Front case half
23. Rear case half
24. Intermediate clutch pack
25. Input clutch pack
26. Reverse clutch half-pack
27. Second intermediate shaft
28. Locking plates
29. Capscrews
30. Oil baffle
31. Output clutch pack

TABLE OF CONTENTS PAGE

General

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chance of foreign matter entering the hydraulic system.

Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks or proper stands; a transmission jack; shop tools and some special tools listed separately.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

THE SERVICE POSITION IS AS FOLLOWS:- PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH ADEQUATE STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS INSTALLED BEHIND THE LEFT FRONT ENGINE COVER. ON ARTICULATED MACHINES, INSTALL THE BLOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

Description

The model 8400 is an electronically controlled, full-powershift transmission. You can select eight forward gear ratios and four reverse gear ratios.

Solenoid cartridge valves mounted in the control valve caps regulate the flow of oil to the clutch packs. The controller, mounted in the cab, actuates the solenoid valves.

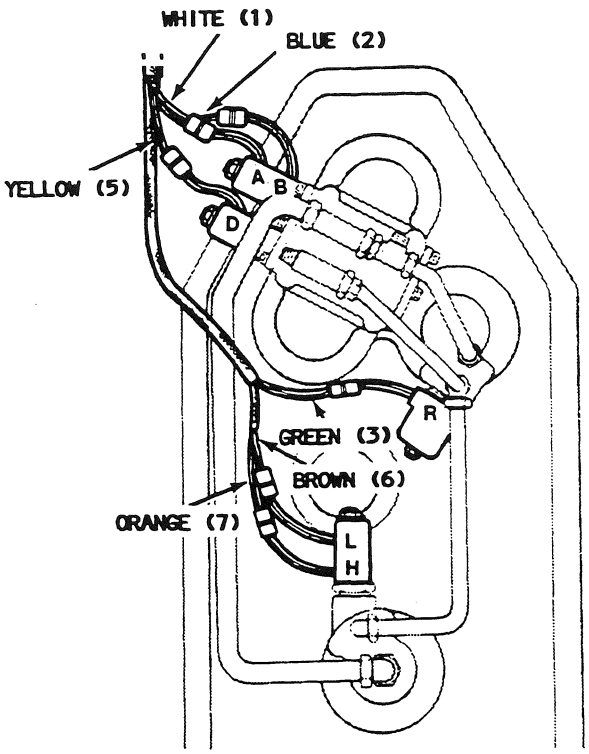
The transmission hydraulic system is separate from all other grader hydraulic systems. The transmission sump is the system oil reservoir.

The system is equipped with its own pump, cooler and filter. Bypass valves protect the system from possible blockages in the cooler or filter.

The transmission mounted regulator valve maintains a steady pressure of 1138-1275 kPa; 11,6-13,0 kg/cm^2 (165-185 psi) to operate the clutch packs. Any excess oil flows to the lubrication pressure valve, which regulates lubricating oil pressure to a maximum of 172 kPa; 1,75 kg/cm^2 (25 psi). If lubrication pressure falls below the minimum of 17,2 kPa; 0,2 kg/cm^2 (2.5 psi), a sensor activates the warning light on the operator's console.

Speed/Solenoids/Clutch Packs

Speed	Solenoids energized	Clutch Packs engaged
1	1, 6	ACL
2	2, 6	BCL
3	1, 5, 6	ADL
4	2, 5, 6	BDL
5	1, 7	ACH
6	2, 7	BCH
7	1, 5, 7	ADH
8	2, 5, 7	BDH
Neutral	None	C
-1	3, 6	RCL
-2	3, 5, 6	RDL
-3	3, 7	RCH
-4	3, 5, 7	RDH



Transmission Error Codes

The 8400 controller is constantly running a self-diagnostic program which detects electrical failures in the transmission system. Should a failure occur, the shift console display immediately alerts the operator by showing **E** for half a second, followed by a two-digit numeric code for half a second. The controller disables both shift levers and places 4he transmission in neutral. The display will alternate between **E** and the code until the operator returns the mode control lever to the neutral position.

The Error Code Table lists the error codes and their definitions. Refer to the illustration for solenoid identification. Note that solenoid pairs **1/2 (A/B)** and **6/7 (L/H)** are each contained in one cartridge. A back-up alarm short circuit display alternates between the number of the current gear and a blank. No code appears in the event of an open back-up alarm circuit.

Code	Malfunction
1.0	Electric power is below 9.5 Vdc
2.0	Open circuit, solenoid 2 (B)
2.1	Open circuit, solenoid 3 (R)
2.3	Open circuit, solenoid 6 (L)
2.4	Open circuit, solenoid 7 (H)
2.5	Open circuit, solenoid 5 (D)
2.6	Open circuit, solenoid 1 (A)
2.7	No power to solenoid circuits
3.0	Short circuit, solenoid 2 (B)
3.1	Short circuit, solenoid 3 (R)
3.3	Short circuit, solenoid 6 (L)
3.4	Short circuit, solenoid 7 (H)
3.5	Short circuit, solenoid 5 (D)
3.6	Short circuit, solenoid 1 (A)
4.0	Forward/Neutral input error
4.1	Reverse/Neutral input error
4.2	Neutral restart error

Error Code Table

Special Tools

Description	Part Number
Bearing shim tool	29858
Deep-reach socket wrench	29859

Torque Guide

Application	Torque Value lbf.ft/lbf.in.	N.m	kgf.m
Yoke locknut	150 - 200	203 - 271	21 - 28
Bearing retaining locknuts	200 - 250	271 - 339	28 - 35
Oil level check sight glass	5	6,8	0,7
Reverse control valve cartridge	30 - 40	41 - 54	4,1 - 5,5
Locknut for above	30 - 40 lbf.in.	3,4 - 4,5	0,34 - 0,46
AB, LH and D valve cartridges	30 - 40	41 - 54	4,1 - 5,5
Locknuts for above	65 - 75 lbf.in.	7,3 - 8,5	0,75 - 0,86
Control valve capscrews	30 -35	40 -47	4 - 5
Transmission case capscrews	80 - 100	108 - 135	11 - 14
Upper driveshaft - U-joint capscrews	55	74	7,6
Lower driveshaft - U-joint capscrews	80	109	11

Wear Limits - Clutch Friction Discs

Plate diameter	5-1/4 in. 133,3 mm	6-5/8 in. 168,3 mm
Minimum plate thickness	0.049 in. 1,245 mm	0.088 in. 2,235 mm

NOTE: Cross cut grooves in the friction material must be visible on both sides.

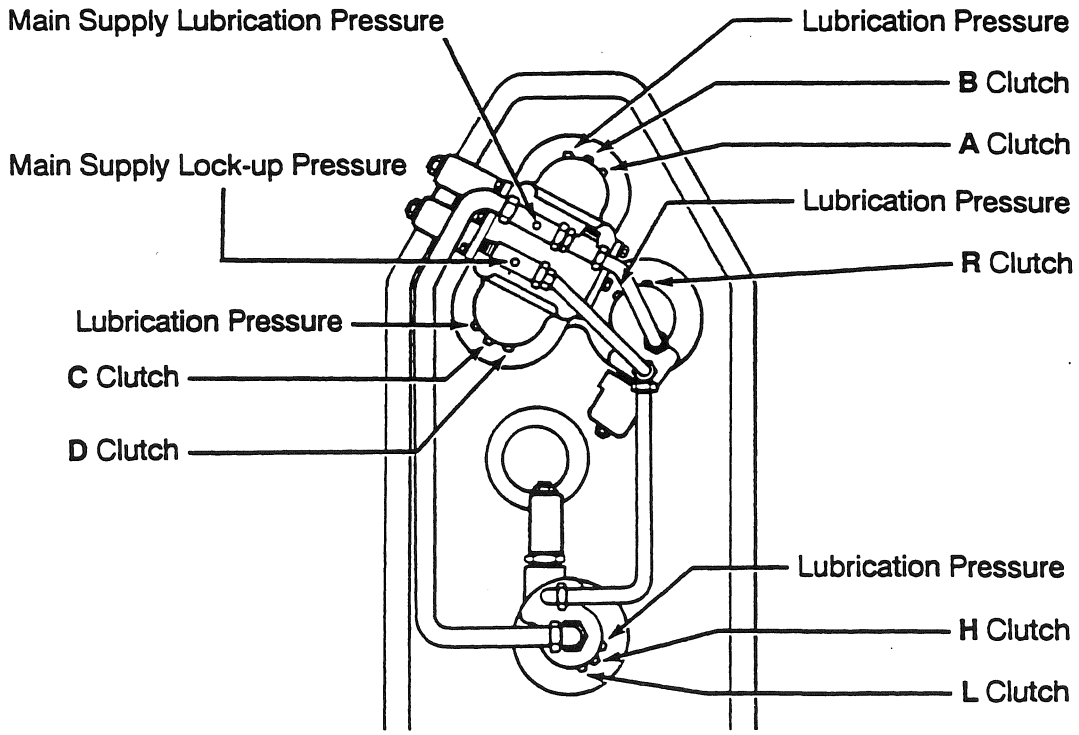
Pressure Readings

Description	psi	kPa	kg/cm²
Graders S/N 16224, 16245 to 20241, 20243, 20244, 20246 to 20249, 20251, 20252, 20254, 20255, 20257 to 20259, 20261 to 20264. U.S. 2021-2 to 2658-2 (fiber composite friction disc facing material)			
Clutch pack lock-up pressure	165 - 185	1138 - 1275	12 - 13
Graders S/N 20242, 20245, 20250, 20253, 20256, 20260, 20265 and up (bronze alloy friction disc facing material)			
Clutch pack lock-up pressure	215 - 235	1482 - 1620	15,0 - 16,5
All graders			
Maximum lock-up pressure difference between clutches	10	69	0,7
Minimum lubrication pressure at minimum engine speed	2.5	17	0,2
Minimum lubrication pressure at maximum engine speed	10	69	0,7

Flow Rates

Description	U.S. gpm	L/min
All graders		
Minimum transmission pump flow at minimum engine speed	9	34,0
Minimum transmission pump flow at maximum engine speed	30	113,5

Test Port Locations

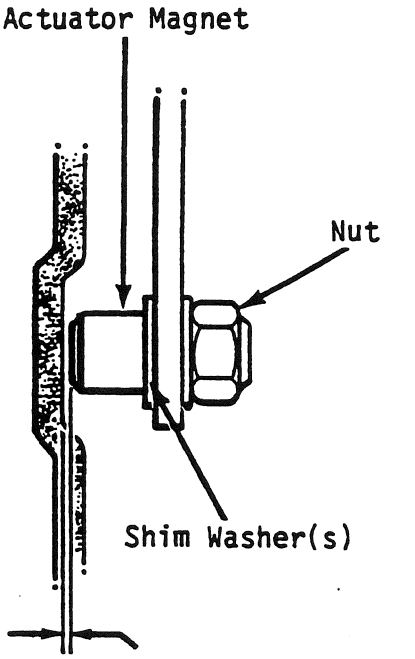


Solenoid Coil Approximate Resistance Values

Clutch Pack	Solenoid Coil	Part Number	Resistance Value (High [+] & Low [-] Tolerances)
Rev.	3	37107	8.31 (+8.56, -8.06) ohms (Ω)
AB and LH	1/2 and 6/7	37105	6.12 (+6.30, -5.94) ohms (Ω)
CD	5	37106	5.03 (+5.18, -4.88) ohms (Ω)

Resistance should be measured at a temperature of 20°C (68°F).

Transmission Controller Actuator Magnet Clearance Measurement



Magnet Clearance
0.015 in. (0,381 mm) Min.
0.070 in. (1,778 mm) Max.

SHIM SELECTION CHART (To be used only with Control Valve Caps with Counterbores)

(Effective Grader Serial Nos. 18179, 18211 and up. U.S. 2659-2 and up)

Average Measurement		Shim Part Number and Dimensions				
mm	in.	Output Shaft	Second Intermediate Shaft	First Intermediate Shaft	Input Shaft	Reverse Shaft
18,57	.731			37799 4,44 mm .175 in.		
18,54	.730					
18,52	.729					
18,49	.728					
18,46	.727			37764 4,57 mm .180 in.		
18,44	.726					
18,41	.725					
18,39	.724					
18,36	.723					
18,34	.722					
18,31	.721				37765 4,70 mm .185 in.	
18,29	.720					
18,26	.719	37798 4,70 mm .185 in.		37765 4,70 mm .185 in.		37765 4,70 mm .185 in.
18,24	.718					
18,21	.717		37765 4,70 mm .185 in.			
18,19	.716					
18,16	.715				37766 4,83 mm .190 in.	
18,14	.714	37776 4,83 mm .190 in.		37766 4,83 mm .190 in.		37766 4,83 mm .190 in.
18,11	.713		37766 4,83 mm .190 in.			
18,08	.712					
18,06	.711				37767 4,95 mm .195 in.	
18,03	.710					
18,01	.709	37777 4,95 mm .195 in.		37767 4,95 mm .195 in.		37767 4,95 mm .195 in.
17,98	.708		37767 4,95 mm .195 in.			
17,96	.707					
17,93	.706				37768 5,08 mm .200 in.	
17,91	.705					
17,88	.704	37778 5,08 mm .200 in.		37768 5,08 mm .200 in.		37768 5,08 mm .200 in.
17,86	.703		37768 5,08 mm .200 in.			
17,83	.702					
17,80	.701				37769 5,20 mm .205 in.	
17,78	.700					
17,75	.699	37779 5,20 mm .205 in.		37769 5,20 mm .205 in.		37769 5,20 mm .205 in.
17,73	.698		37769 5,20 mm .205 in.			
17,70	.697					
17,68	.696				37770 5,33 mm .210 in.	
17,65	.695					
17,63	.694	37780 5,33 mm .210 in.		37770 5,33 mm .210 in.		37770 5,33 mm .210 in.
17,60	.693		37770 5,33 mm .210 in.			
17,58	.692					
17,55	.691				37771 5,46 mm .215 in.	
17,53	.690					
17,50	.689	37781 5,46 mm .215 in.		37771 5,46 mm .215 in.		37771 5,46 mm .215 in.
17,47	.688		37771 5,46 mm .215 in.			
17,45	.687					
17,42	.686				37772 5,59 mm .220 in.	
17,40	.685					
17,37	.684	37782 5,59 mm .220 in.		37772 5,59 mm .220 in.		37772 5,59 mm .220 in.
17,35	.683		37772 5,59 mm .220 in.			
17,32	.682					
17,30	.681				37773 5,71 mm .225 in.	
17,27	.680					
17,25	.679	37783 5,71 mm .225 in.		37773 5,71 mm .225 in.		37773 5,71 mm .225 in.
17,22	.678		37773 5,71 mm .225 in.			
17,19	.677					
17,17	.676				37774 5,84 mm .230 in.	
17,14	.675					
17,11	.674	37784 5,84 mm .230 in.		37774 5,84 mm .230 in.		37774 5,84 mm .230 in.
17,09	.673		37774 5,84 mm .230 in.			
17,07	.672					
17,04	.671				37794 5,60 mm .235 in.	
17,02	.670					
16,99	.669	37796 5,60 mm .235 in.		37794 5,60 mm .235 in.		37794 5,60 mm .235 in.
16,97	.668		37794 5,60 mm .235 in.			
16,94	.667					
16,92	.666				37795 6,10 mm .240 in.	
16,89	.665					
16,86	.664					
16,84	.663		37795 6,10 mm .240 in.			
16,81	.662					
16,79	.661			37795 6,10 mm .240 in.		37795 6,10 mm .240 in.
16,76	.660					

Cleaning and Inspection

Cleaning - General

WARNING

ALKALI CLEANING SOLVENTS AND VAPORS ARE EXTREMELY HARMFUL AND CAN CAUSE SERIOUS INJURY TO EYES, LUNGS AND SKIN. ALWAYS WEAR PROTECTIVE CLOTHING, GOGGLES AND RESPIRATOR. USE UTMOST CARE WHEN HANDLING CHEMICALS.

CAUTION

YOU ARE RECOMMENDED TO WEAR COTTON GLOVES WHEN HANDLING BEARINGS. THIS PREVENTS SKIN ACIDS AND PERSPIRATION CONTAMINATING THE RACES AND ROLLING ELEMENTS.

Immerse small parts, gears and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

Cleaning - Bearings

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used. Ensure all oil passages are unblocked.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning and Inspection (Continued)

Inspection - Oil Seals, O Rings and Snap Rings

Replace all oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Apply a thin coating of 'Permatex No. 2', or equivalent, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings before installation.

Inspection - Gears and Shafts

If crack detection equipment is available, use the process to check parts. Examine teeth of all gears for wear, pitting, chipping, nicks, cracks and scores. If gear teeth show spots where the case hardening has worn through or cracked, replace the gear.

Small nicks can be removed using a suitable grinding stone. Inspect shafts for signs of bent or twisted splines and replace any deformed axles.

Check the flatness of all clutch pack reaction plates using a surface table and feeler gauges. Discard all warped plates.

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Troubleshooting

This troubleshooting program details procedures which will help you diagnose and repair most elecrical and hydraulic malfunctions.

In most cases, the last procedure that may be required is a transmission overhaul.

Make sure proper tools are available and in good working order. You will require a multimeter, pressure gauges, a flowmeter rated to at least 40 U.S. gpm (151 L/min) and normal shop tools.

Testing electrical and hydraulic systems first will normally prevent the need for a costly, time-consuming mechanical overhaul.

Troubleshooting (Continued)

Fig. 2 ELECTRICAL SYSTEM
Most electronic controller problems can be caused by a poor ground connection. **ALWAYS** check for a poor ground connection first. It could be between the cab and controller; between the cab and frame; across the articulation hinge; at the isolation switch or at the battery. On later model graders, the ground wire is in the wiring harness.

Fig. 3
When you start the engine or turn the ignition key to the **RUN** position, the controller display shows a series of codes known as the **start sequence** (refer to the 700 Series Operator's Manual). If no start sequence display appears, look for a tripped circuit breaker. Reset the circuit breaker. If all circuit breakers are normal, remove the screws retaining the console. Remove the console to expose the controller.

Fig. 4
With the ignition key in the **ON** position, look directly behind and to the left of the controller display. If you see an energized **green** light, the controller is working correctly. If you see an energized **red** light, the controller has malfunctioned and may have to be replaced. If no light is energized, power to the controller is below 9 volts. Check the power supply and ground connections to the controller.

Fig. 5
If the green light is energized but the display is blank, remove the controller and test for power at the microswitch terminal labeled **common.** There should be power if the ignition switch is in the **ON** position. If there is no power, check the continuous-duty solenoid under the console.

Fig. 6
If there is no power at the **common** terminal, make sure the mode lever is in **Neutral** and check the microswitch terminal labeled **normally open** for power.

Fig. 7
Move the mode lever to **Forward**; then **Reverse.** There should be power at the microswitch labeled **normally closed** for both modes. If there is no power, replace the microswitch.

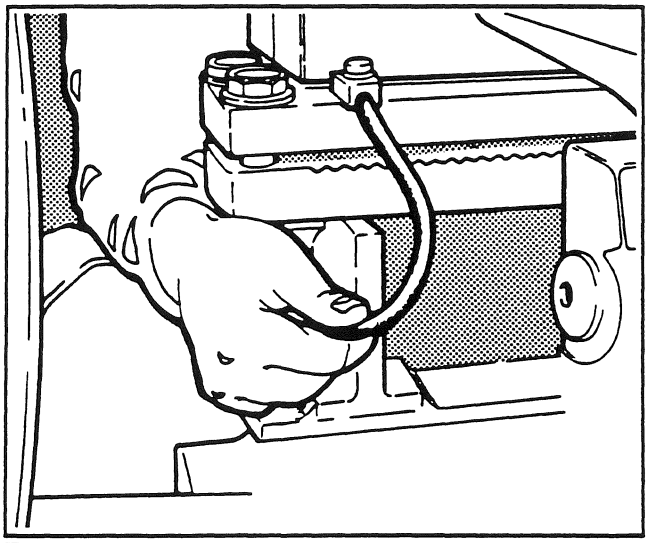


Fig. 2

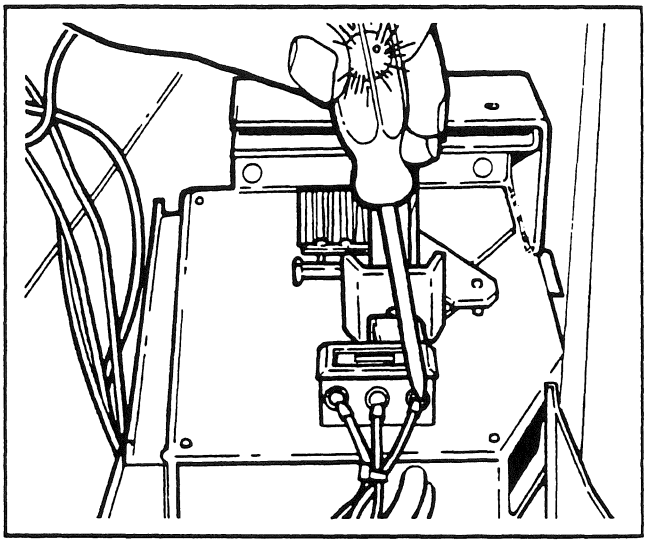


Fig. 5

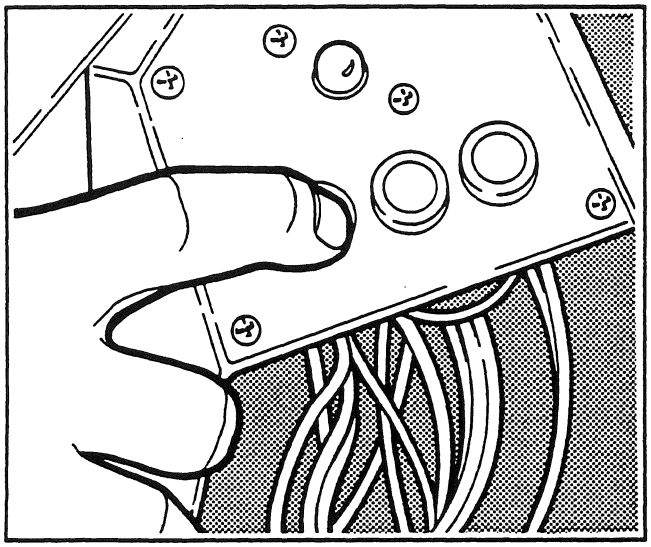


Fig. 3

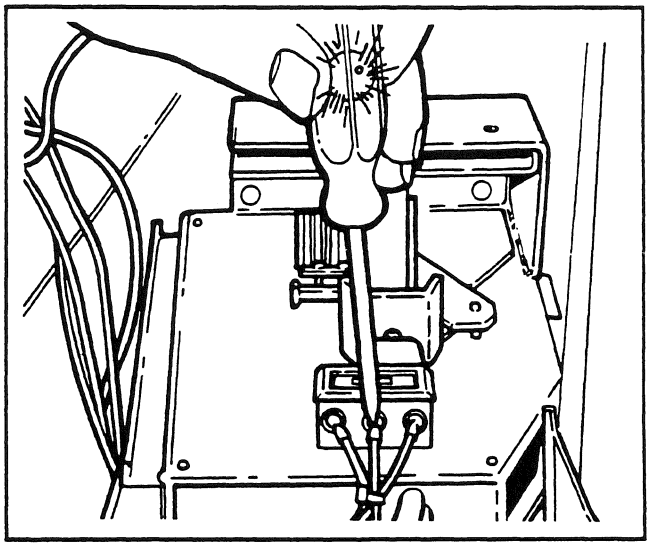


Fig. 6

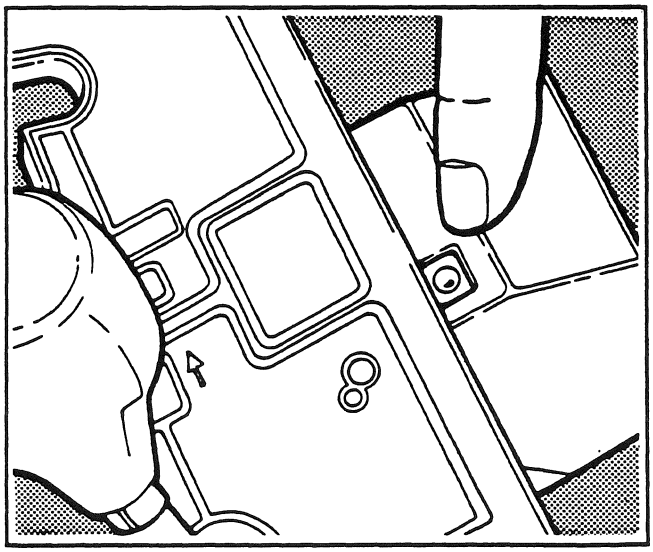


Fig. 4

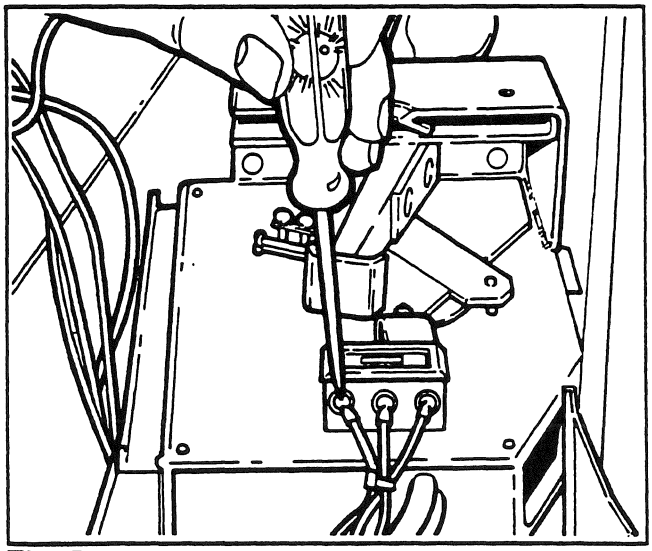


Fig. 7

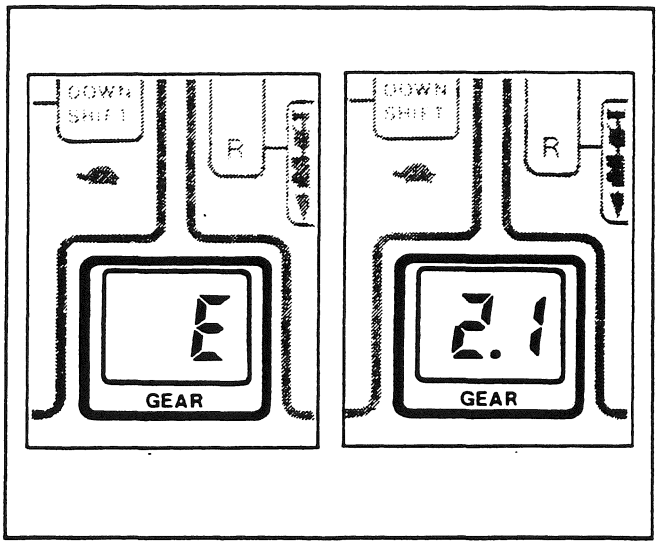


Fig. 8

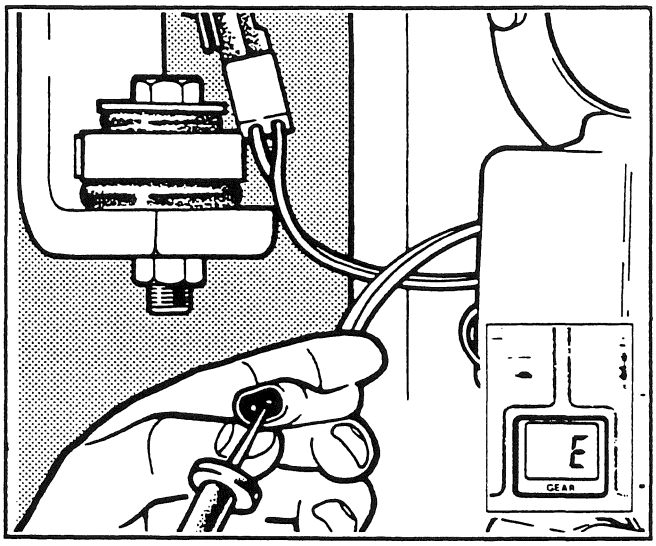


Fig. 11

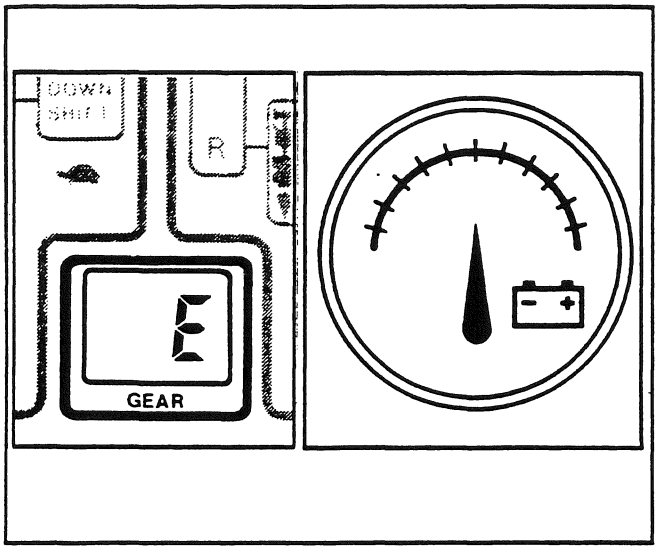


Fig. 9

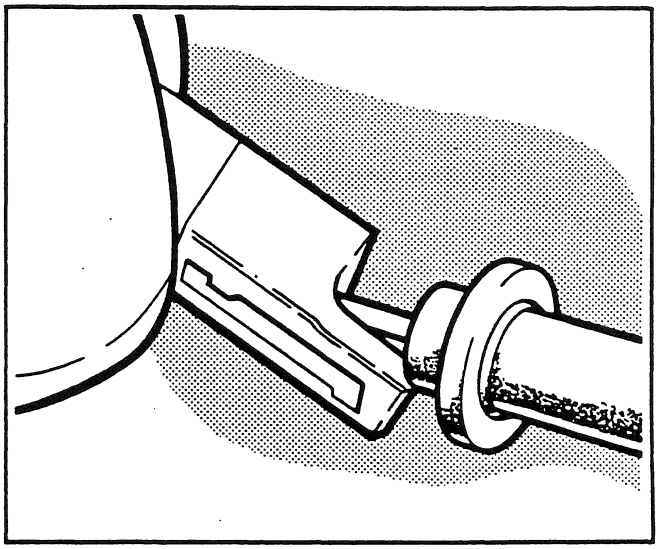


Fig. 12

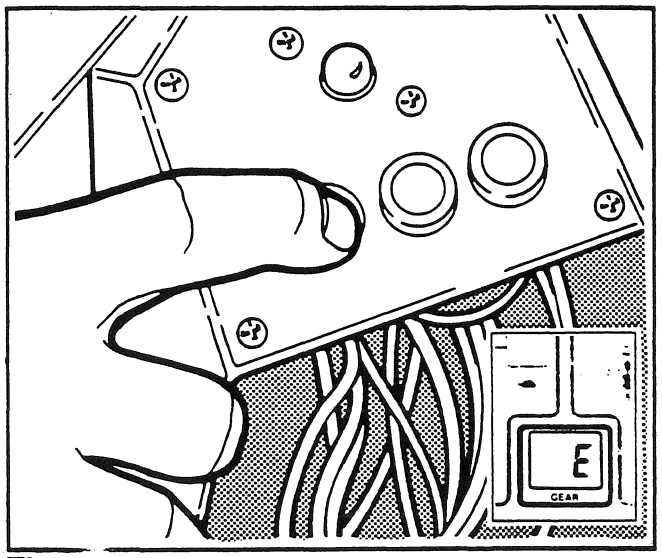


Fig.

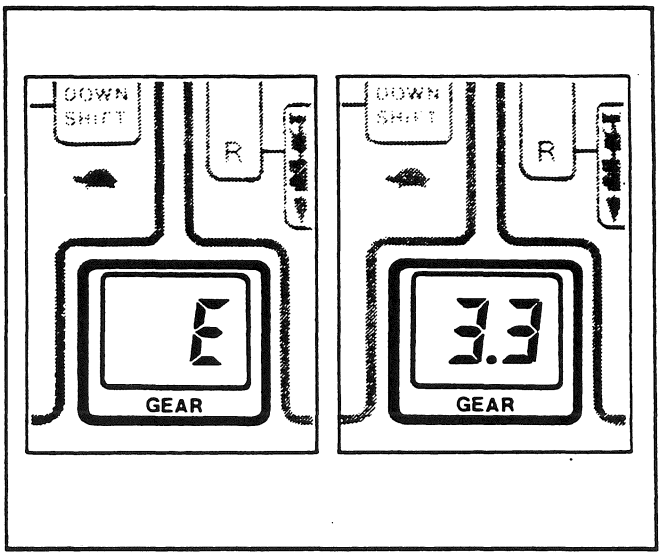


Fig. 13

Troubleshooting (Continued)

Fig. 8
The transmission controller is self-diagnostic and continuously monitors the transmission electrical system. The display indicates an error by alternately flashing **E** and a two digit code. You will find the error codes listed on Page 2 of this Shop Manual Section. Whenever an error code is displayed, the transmission automatically shift to and remains in **Neutral.** To reset the controller, move the mode lever to **Neutral.**

Fig. 9
For example, if the power supply to the controller is between 8.5 and 10 volts d.c., the error code **E 1.0** flashes. This indicates either a low state of charge in the batteries if the engine is shut down, or a faulty charging system if the engine is running. Should the power supply drop below 8.5 volts d.c., the display remains blank.

Fig. 10
Error code **E 2.7** indicates an open circuit in the power supply to all six solenoids. Check the 15 amp circuit breaker first. If the circuit breaker has not tripped, check for power at the continuous duty solenoid; the circuit breaker and at the single connector between the transmission and main power supply harness.

Fig. 11
Error codes from **2.0** to **2.6** indicate an open circuit in one of the transmission solenoids. For example, error code **E 2.3** is an open circuit in solenoid number six. Look for a broken wire or short to ground. You should also check the resistance of the solenoid against the values listed on Page 5 of this Shop Manual Section. If the resistance is high, replace the solenoid. If the resistance is normal, re-connect the solenoid to the transmission harness.

Fig. 12
Disconnect the single pin connector at the controller and check the resistance from there to the appropriate pin on the transmission harness. If the resistance is once again high, the transmission harness is faulty and should be replaced. The controller will not allow the transmission to operate with an open circuit.

Fig. 13
Short circuits are failures where electrical current by-passes the solenoids, and are indicated by error codes **3.0** to **3.6.** For example, error code **E 3.3** is a short circuit in solenoid number six. The transmission will function provided you do not select a gear that requires activation of the short circuited solenoid.

Troubleshooting (Continued)

Fig. 14
To troubleshoot a **3** series error code, disconnect the 2-pin connector at the suspect solenoid and check the resistance. If the value is below specification, replace the coil. If the resistance is normal, re-connect the solenoid. Disconnect the single connector and the controller multi-pin connector. Check the resistance between the single connector and the appropriate pin. The value should be slightly higher than that of the solenoid coil. If the resistance is far less, you must replace the transmission harness.

Fig. 15
Error codes **4.0** and **4.1** indicate **Forward/Neutral** and **Reverse/Neutral** controller input errors. When you shift from either **Forward** or **Reverse** to **Neutral**, two steps must take place:- a) the magnet on the mode lever must move away from a proximity switch; b) the microswitch must be depressed. If these two steps do not occur, the display shows one of the **4** error codes.

Fig. 16
Check for a missing or misaligned magnet. Refer to Page 5 for the correct clearance. If any adjustment is needed, add or remove washers. You can also move the magnet laterally in the slot. The same condition may also apply if the pulser lever is ignoring shift commands. Check that the magnets are present and properly adjusted.

Fig. 17
DO NOT connect any accessories, such as radios, to the transmission electrical circuit; including the continuous duty solenoid. The accessory solenoid is available to power these types of equipment.

Fig. 18
The controller electronic components are sealed in a box. Rubber boots are available for the levers to protect the microswitch from dust.

Fig. 19
Recent production units have a gasket between the controller box and the face plate to keep the digital display clean. This gasket, Champion part number **37377**, is available for installation on older units.

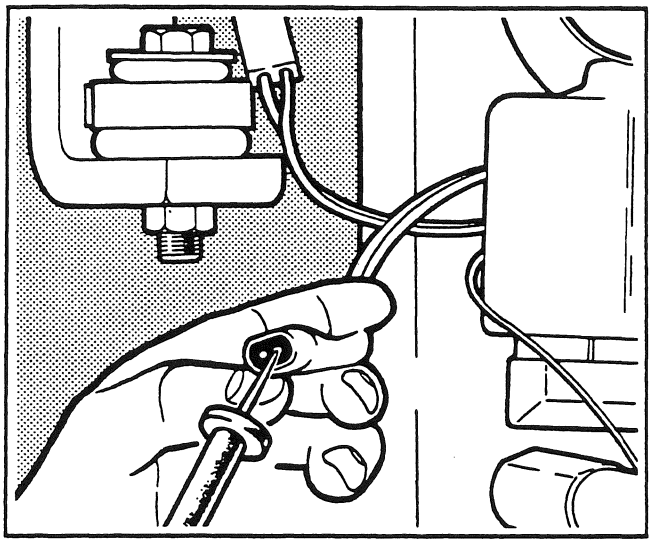


Fig. 14

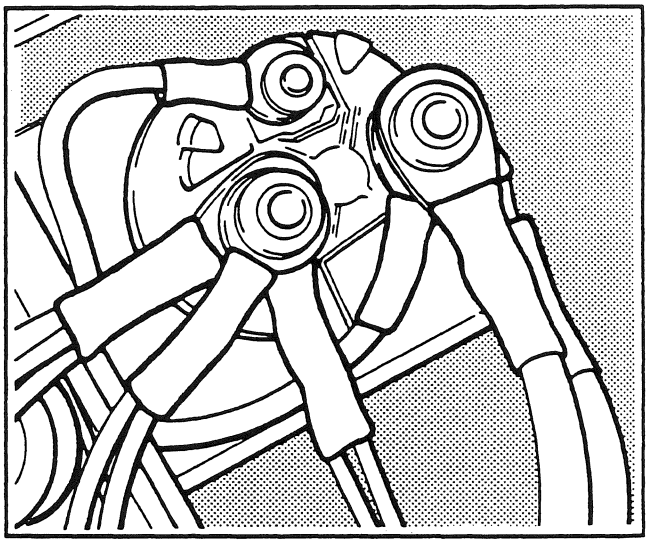
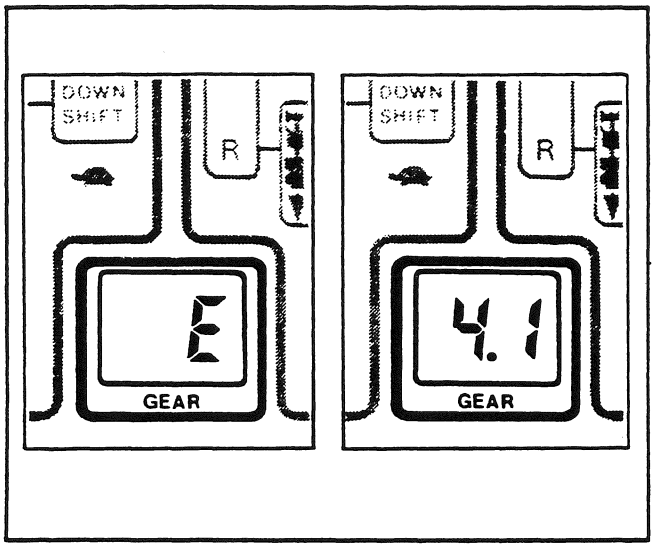


Fig. 17



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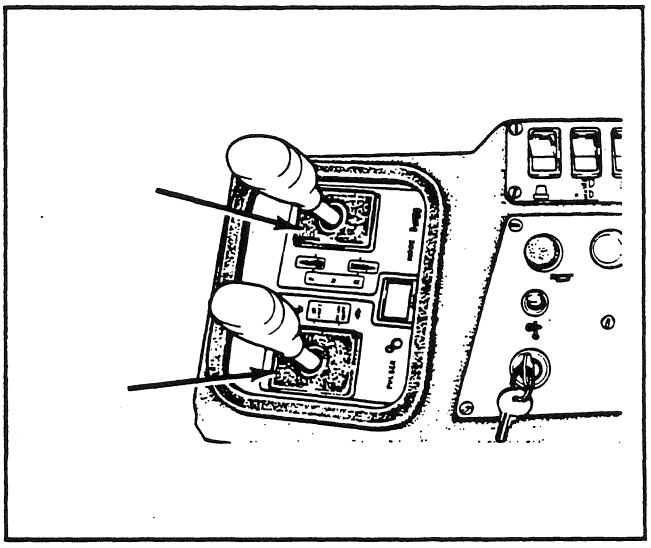

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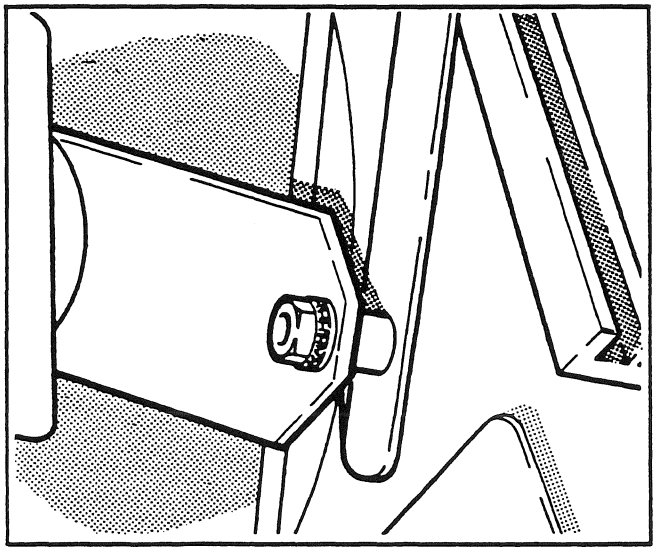

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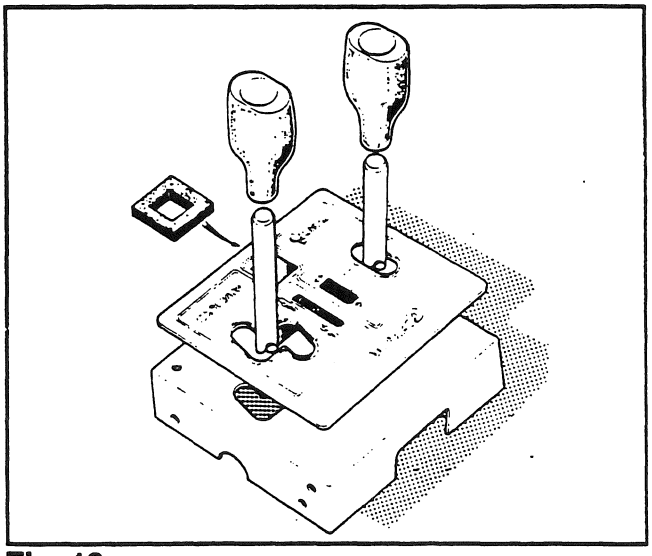

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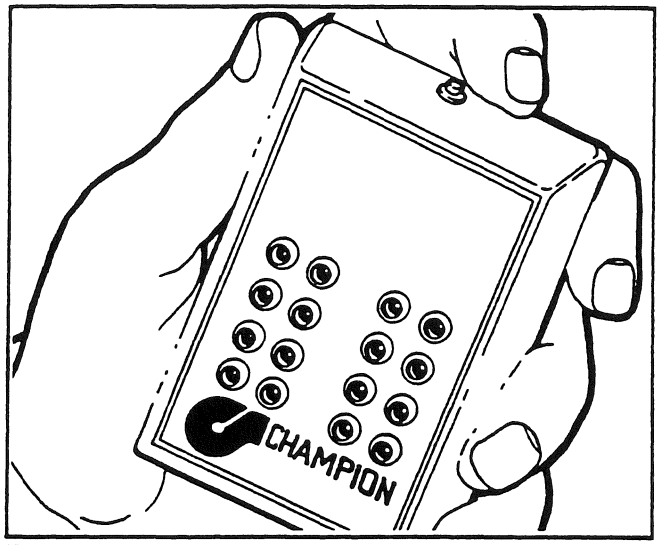
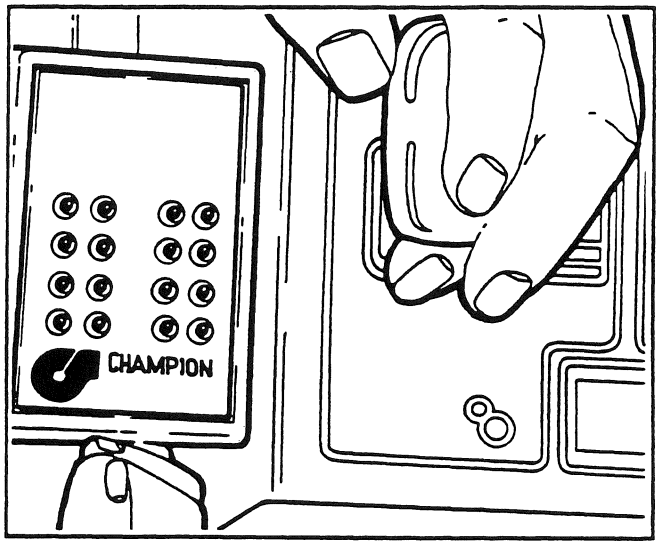


Fig. 20



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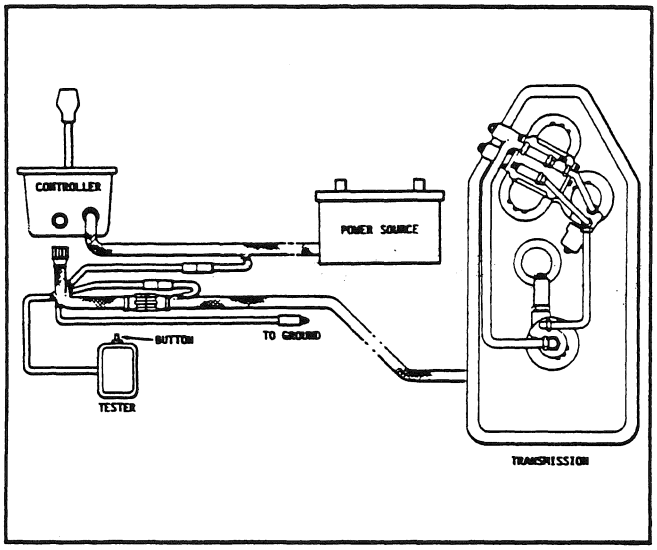

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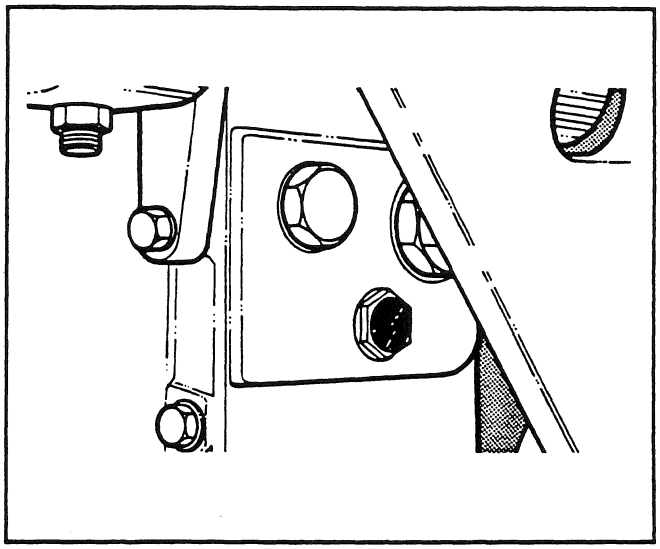


Fig. 24

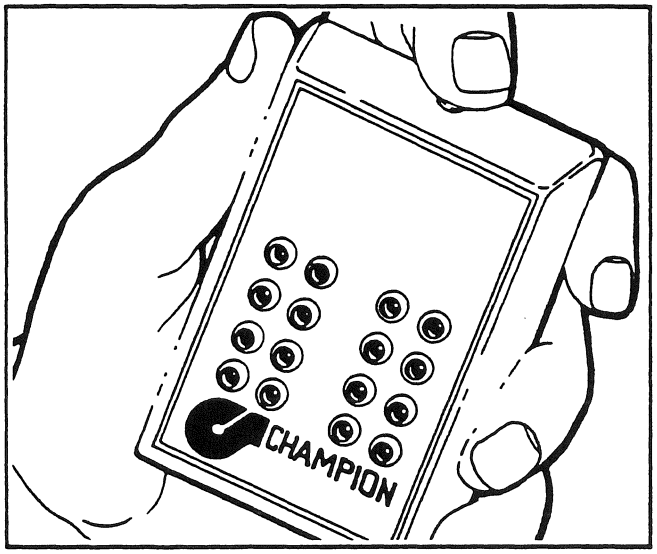


Fig. 22

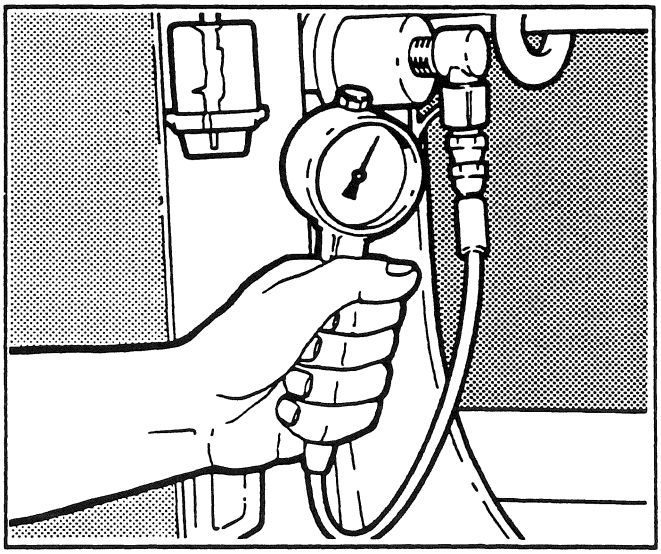


Fig. 25

Troubleshooting (Continued)

Fig. 20
The preceding electrical troubleshooting procedures should resolve most model 8400 transmission electrical faults. If you are still experiencing a transmission malfunction, there may be a hydraulic or mechanical problem. Additional to these diagnostic procedures, Champion has introduced a handheld tester that simplifies electrical troubleshooting. Using this tester, you can quickly check for open or short circuits and verify shift sequences.
NOTE: APPLIES ONLY TO S/N 16245 TO 20719.

Fig. 21
To install the tester, disconnect the transmission harness from the controller; then connect the test harness to the transmission harness. Disconnect the power supply connector and connect the tester supply between the two wires. Connect the tester ground clip to the main harness ground stud. With the mode lever in **Neutral**, turn the ignition key to the **ON** position. After the start sequence, move the mode lever to **Forward.** The controller displays **E 2.7** .

Fig. 22
Press the button on the tester: seven red light-emitting diodes (LEDs) should energize. Disregard the two upper right LEDs. Any red LED that does not energize indicates an open circuit in that solenoid. When you release the button, check for an energized green LED. An energized green LED indicates a short to ground. Turn the ignition key to the **OFF** position and rectify any indicated open or short circuits.

Fig. 23
Now connect the tester harness to the transmission controller. With the ignition switch in the **ON** position and the mode lever in **Forward**, cycle the pulser lever through the gears and check the energized green LED patterns for the correct sequences. Repeat this procedure to check the **Reverse** gears. Disregard the lower right red LED if your grader is **not** equipped with a back-up alarm or lights. Any abnormal sequences may be due to a faulty controller.

Fig. 24 HYDRAULIC SYSTEM
An important point to remember is that hydraulic oil flow rates and pressure settings **should be checked first.** This will eliminate unnecessary transmission removal and overhaul. Before starting any hydraulic troubleshooting, place the grader in the **Service Position** (refer to Page 1 of this Shop Manual Section). Before making any oil flow or pressure checks, make sure you can see transmission oil half-way up the level check sight glass, with the engine running at idle and at operating temperature.

Fig. 25
If the low lubrication pressure warning light is energized or the transmission is not operating normally, check the lock-up oil pressure reading at the transmission filter outlet. Record the pressures at idle and rated engine speed. Compare the results with the chart on Page 4 of this Shop Manual Section.

Troubleshooting (Continued)

Fig. 26
If the recorded pressure is lower than the specification on the chart, remove the transmission filter element and check for contamination. Drain the transmission oil; then check the transmission sump strainer for contamination. Refill the transmission with the correct type of oil. With the engine running at idle and at operating temperature, make sure you can see transmission oil half-way up the level check sight glass. Check all supply lines for damage or suction leaks.

Fig. 27
On graders equipped with a lock/unlock differential final drive where oil flow is at or above the recommended minimum and pressure remains low, isolate and plug the line that supplies the differential lock hydraulic circuit. Again, check the clutch pressure. If the pressure rises, there is excessive leakage in the differential lock hydraulic circuit.

Fig. 28
Remove and inspect the differential lock valve and cylinder assembly. A malfunctioning assembly may also be the cause of low lubrication oil pressure.

Fig. 29
If the low pressure problem is not corrected by these methods, check the transmission pump oil flow. Install a 40 U.S. gpm (151 L/min) in-line type flowmeter between the transmission oil cooler and filter (with the engine running at idle and at operating temperature, make sure you can see transmission oil half-way up the level check sight glass. Replenish as necessary). Record the oil flow at idle and rated engine speed. If the flow is below the specifications shown on Page 4 of this Shop Manual Section, repair or replace the transmission pump. Look for excessive wear; cavitation; erosion; contamination; scoring or defective seals.

Fig. 30
If the flow rate is normal and the pressure reading is low, remove and inspect the lock-up pressure regulator valve spring. If the spring is not collapsed or broken, adding a shim between the spring and the spool may raise the transmission pressure to specification.

Fig. 31
If the flow rate and pressure reading are normal, but the low lubrication oil warning light is energized or the transmission is not working normally, follow the procedures given in the **Hydraulic Test Sheet** detailed at the end of the Shop Manual Section and record the results. It may not be necessary to complete the entire chart. Transmission lock-up and lubrication pressures, and the differences for each clutch pack, are specified on Page 4 of this Shop Manual Section.

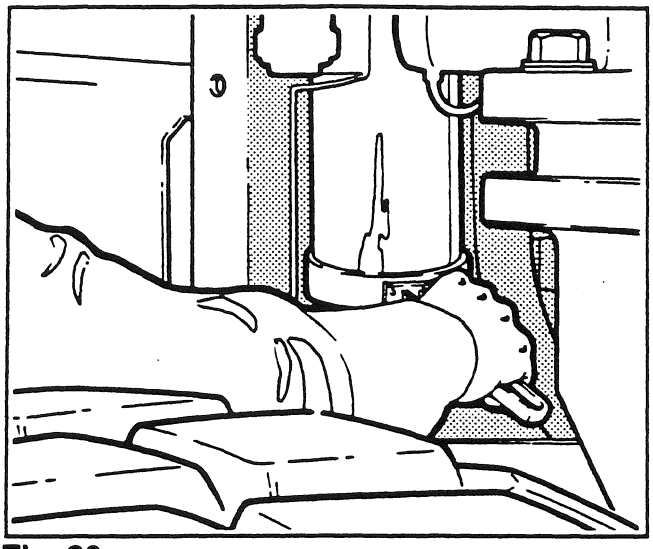


Fig. 26

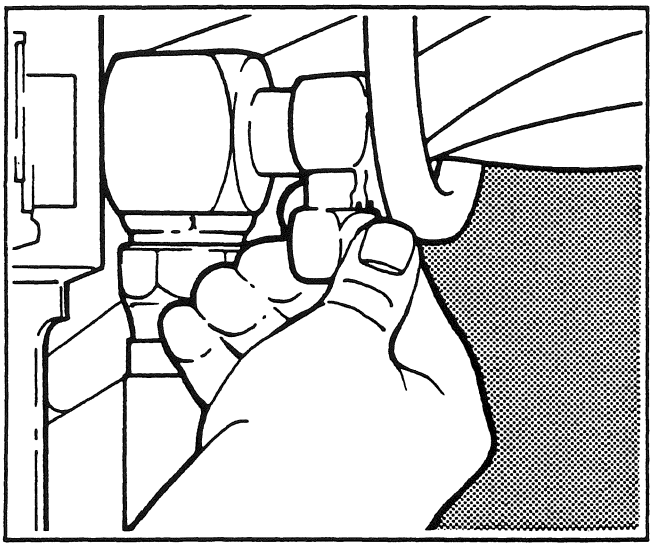


Fig. 27

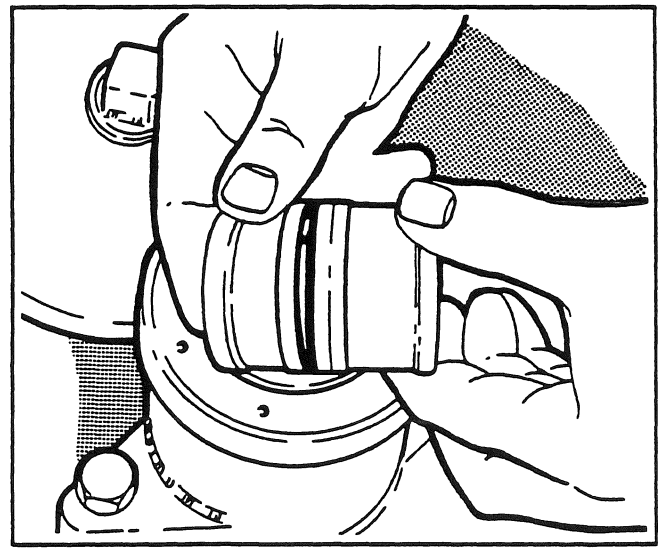


Fig. 28

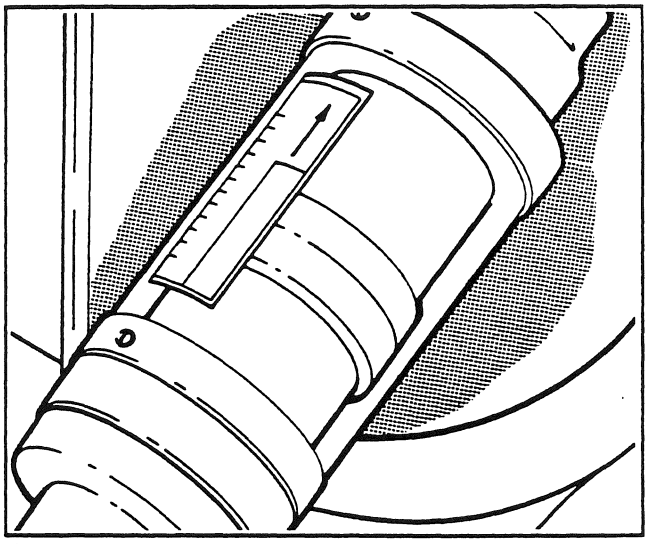


Fig. 29

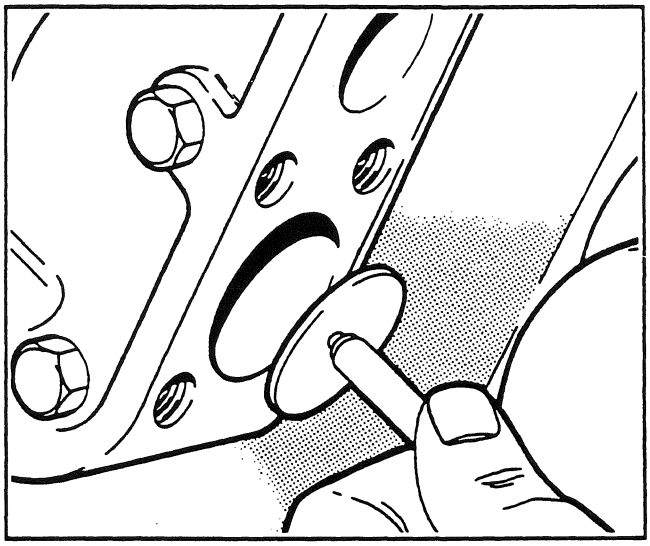


Fig. 30

700 SERIES SHOP MANUAL
8400 TRANSMISSION

HYDRAULIC TEST SHEET

(Reproduce this form as required)

Customer _____ Model _____ Hours _____ Date _____

Grader s/n _____ Trans. s/n _____ Tested by _____

"How to Use this Chart"

1. Lower attachments and moldboard, block all wheels, apply the parking brake.
2. Transmission oil must be at operating temperature.
3. Install gauges in the test ports as shown in the diagram on page 4.

⚠ WARNING

Ensure that the gauge hoses are long enough to reach beyond the grader wheels.
DO NOT work under the grader or near the wheels when the engine is running!

GEAR		CLUTCH							LUBE
		A	B	C	D	H	L	R	
forward	1								min. engine spd.
	2								max. engine spd.
	3								
	4								
	5								

Fig. 31

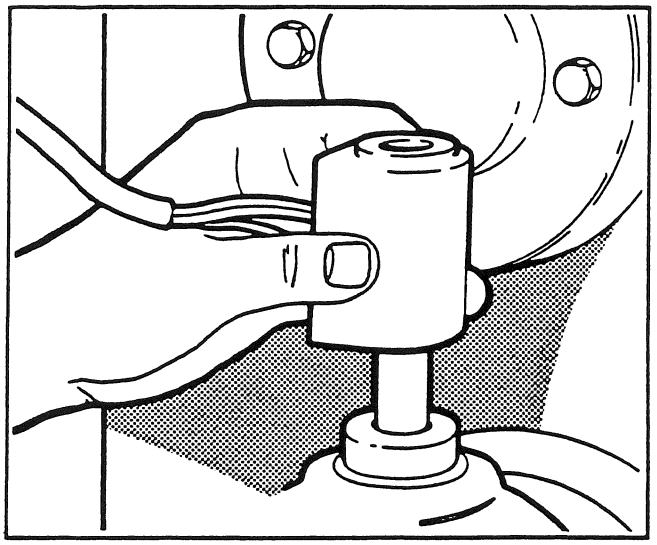


Fig. 32

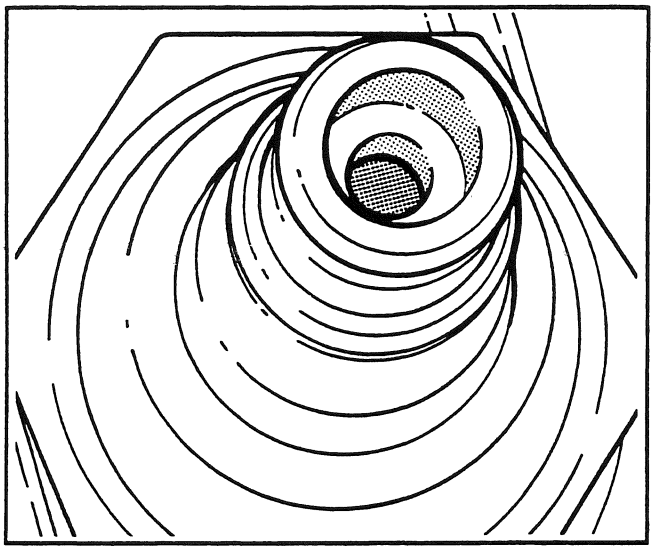


Fig. 33

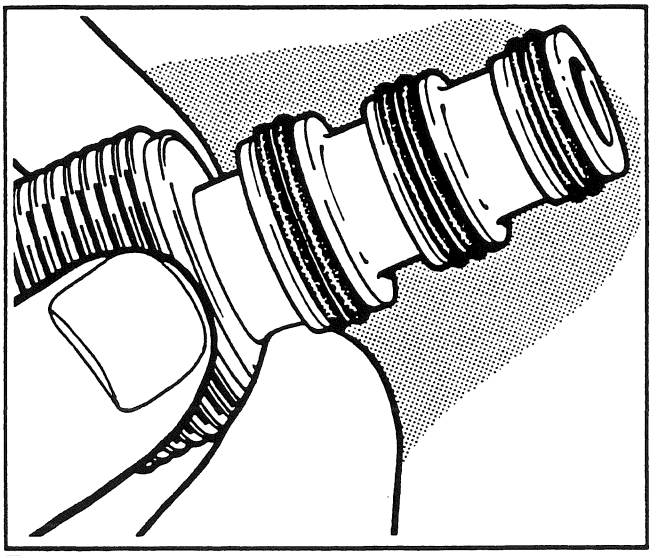


Fig. 34

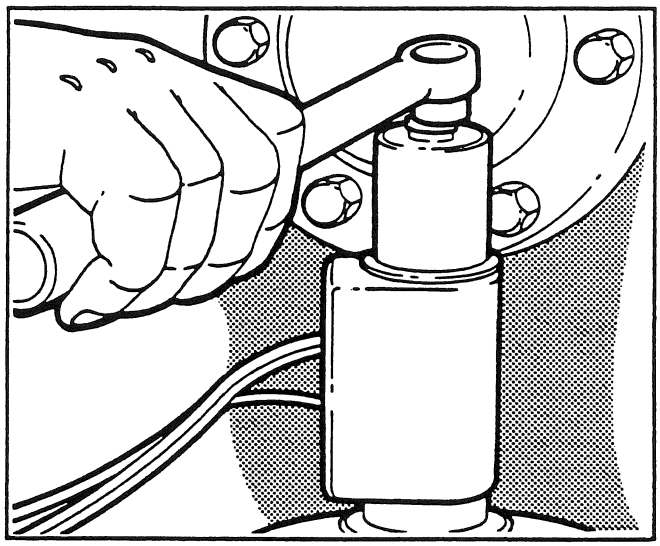


Fig. 35

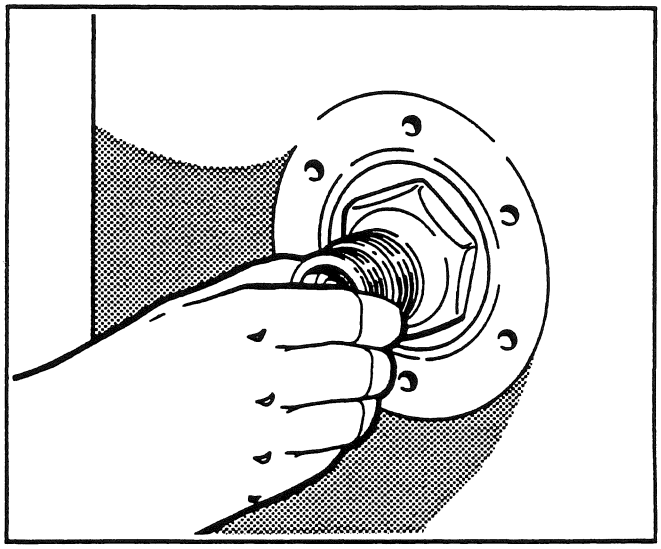


Fig. 36

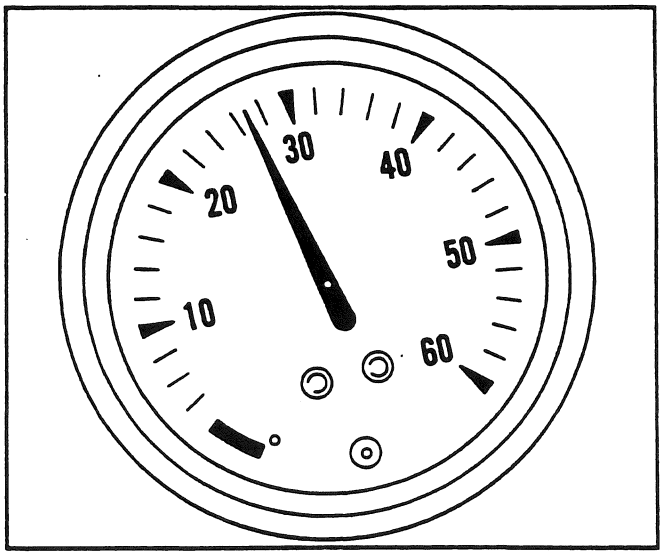


Fig. 37

Troubleshooting (Continued)

Fig. 32
If lock-up oil pressure is low in a selected clutch pack, check the mechanical operation of the appropriate solenoid valve spool. Remove the coil and cartridge from the valve bore. Inspect the coil and cartridge.

Fig. 33
With the engine shut-down, but the ignition key in the **ON** position, engage a gear that uses that valve cartridge. The valve spool should move freely.

Fig. 34
Also, check the screens around the valve for contamination. Check the O rings for damage.

Fig. 35
Install the valve cartridge and tighten the hexagon to the specified torque. If the valve fails to operate, the control valve cap bore is probably distorted. Replace the control valve cap. Tighten the nut retaining the coil to the specified torque.

Fig. 36
If lock-up oil pressure remains low at one clutch only, remove the control valve cap from that clutch. Inspect the seal rings for cracks, chips or nicks. Inspect the internal bore of the control valve cap. The seal ring grooves should be evenly worn around the inside diameter.

Fig. 37
If the low lubrication oil pressure warning light is energized, remove the sender unit and install a pressure gauge rated at 0-414 kPa; 0-4,2 kg/cm^2 (0-60 psi). Record the pressure at idle and rated engine speed. Compare the results with the specifications shown on Page 4 of this Shop Manual Section. If the flow rate is normal and pressure reading is low, adding a shim between the spring and the spool may raise the lubrication pressure to specification.

If the transmission still malfunctions with the normal flow rates and pressure readings, or lock-up flow to individual clutches is excessively high, a mechanical problem may exist within the transmission. Refer to the following pages for disassembly and assembly instructions of the model 8400 transmission and clutch packs.

Transmission - Removal

Fig. 38

WARNING

IT IS EXTREMELY IMPORTANT TO SUPPORT THE GRADER UNDER THE TANDEM CASES WITH PROPER BLOCKS OR STANDS.

Depending on the model of grader, you may need to raise the machine high enough so that the transmission sitting on the jack will clear the underside of the frame.

Fig. 39

If your grader is equipped with a transmission guard, remove it. Remove the drain plug on the lower left hand side of the transmission and drain the oil into a suitable container.

Fig. 40

Remove the suction hose (1) from the transmission.

Fig. 41

Remove the clutch drain hose (2) from the transmission.

Fig. 42

Remove the transmission supply hose (3) from the regulator valve (4). Remember to plug the open valve ports and hose fittings to prevent contamination.

Fig. 43

Remove the clutch supply hose (5).

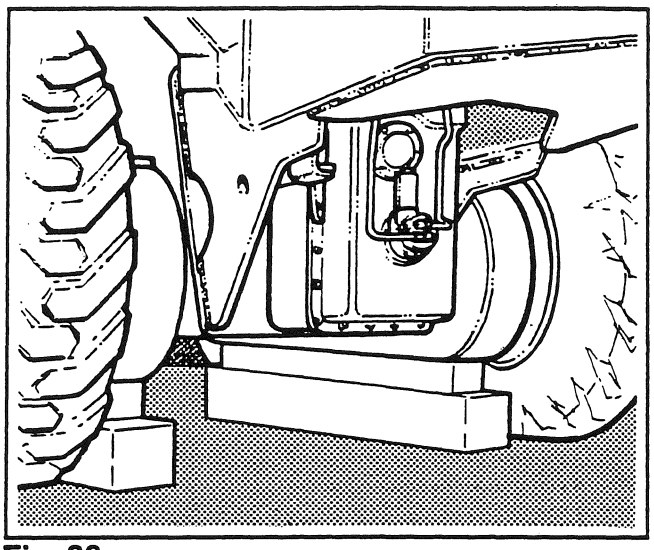
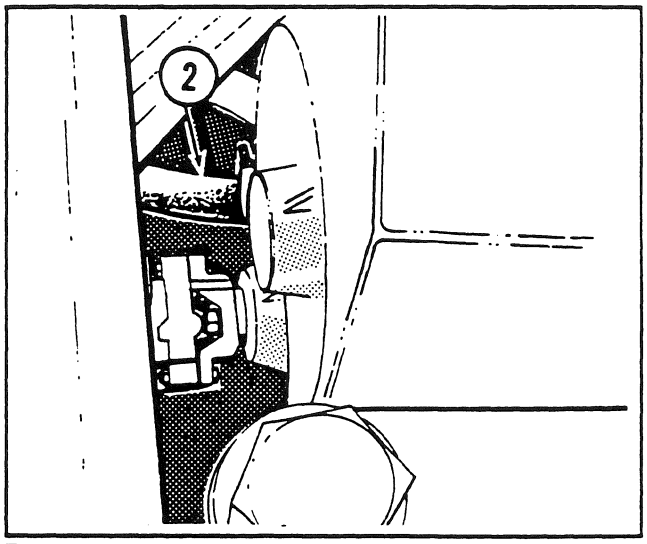


Fig. 38



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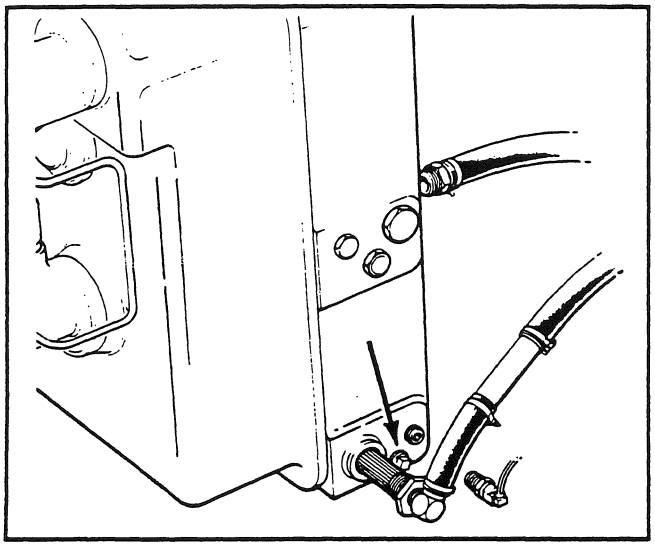


Fig. 39

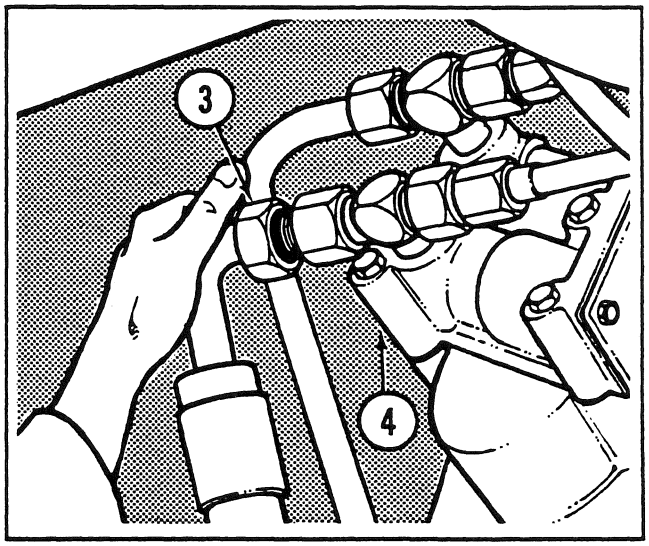


Fig. 42

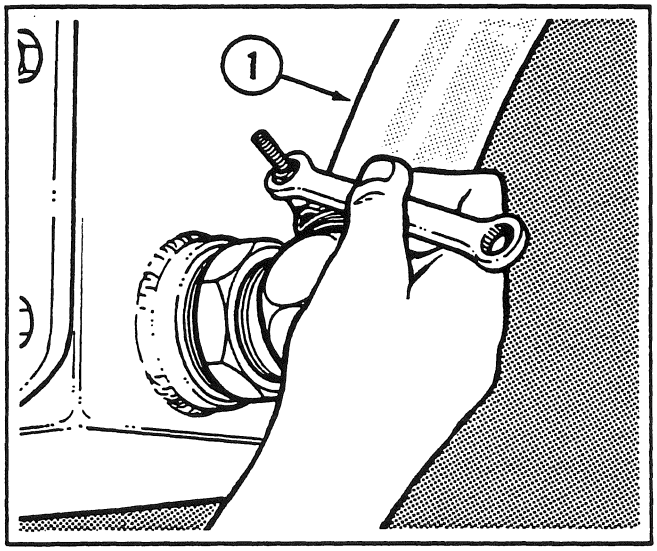
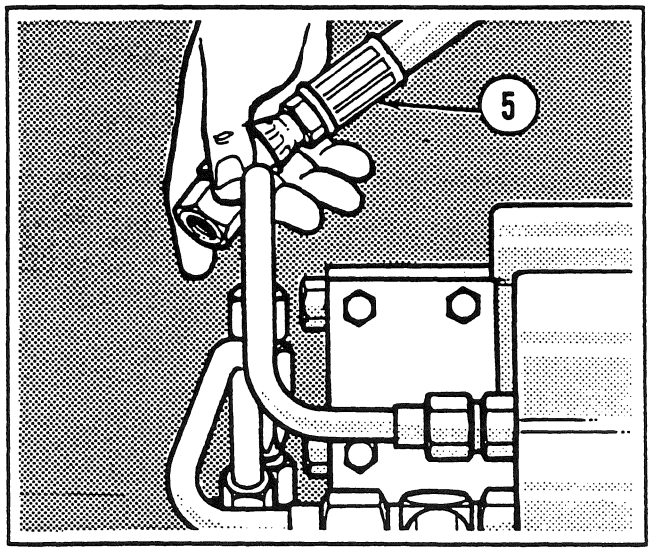


Fig. 40



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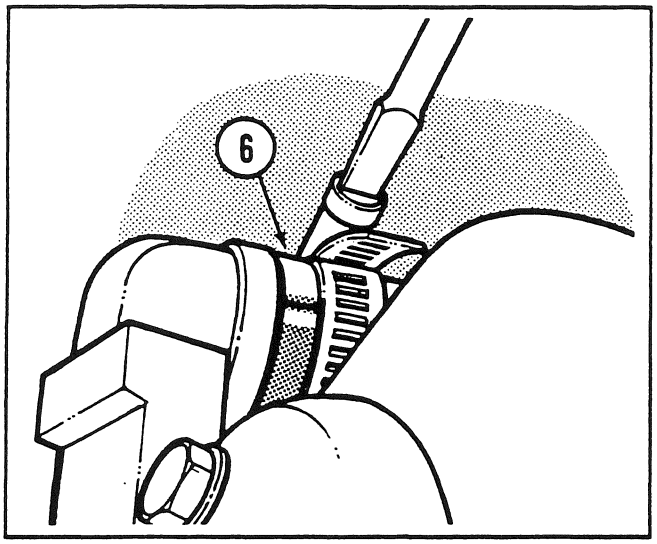


Fig. 44

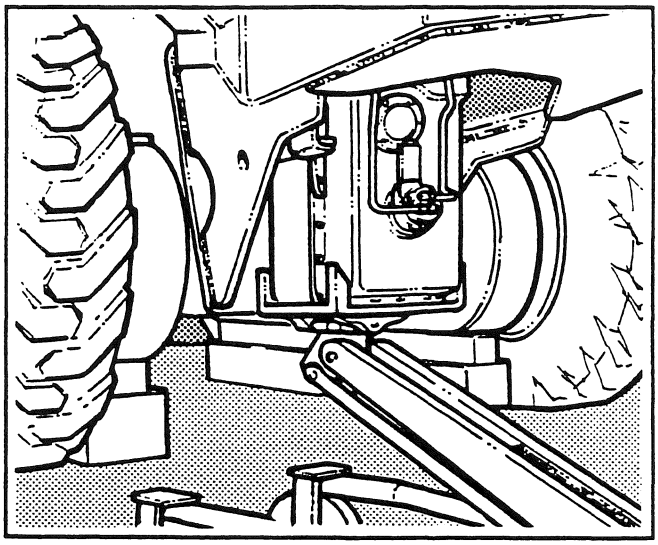
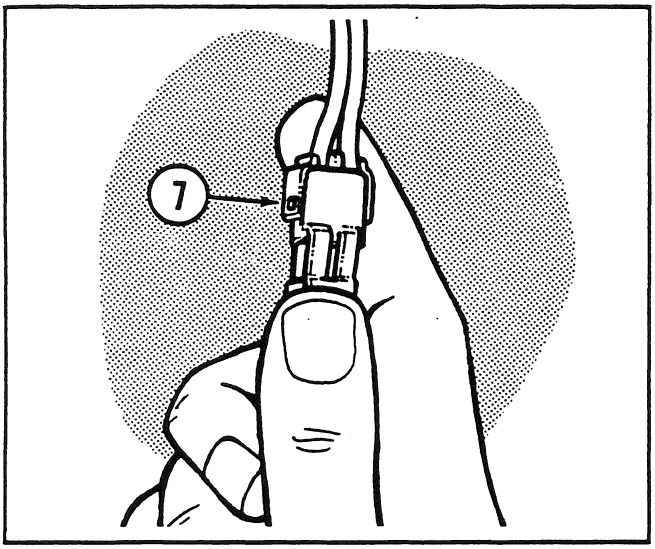


Fig. 47



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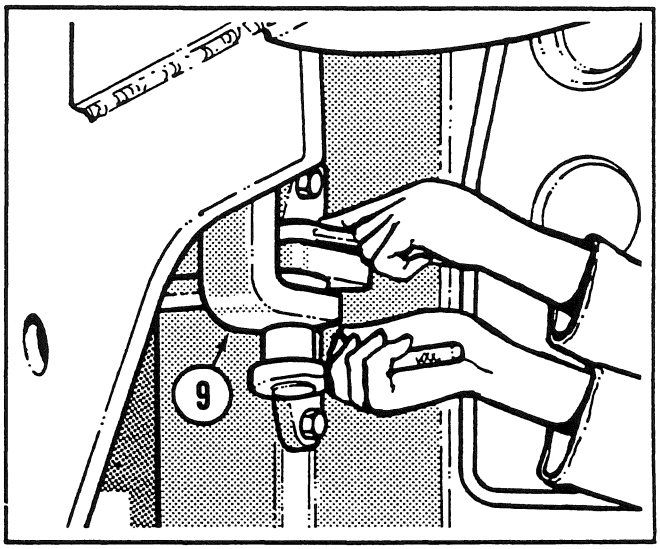

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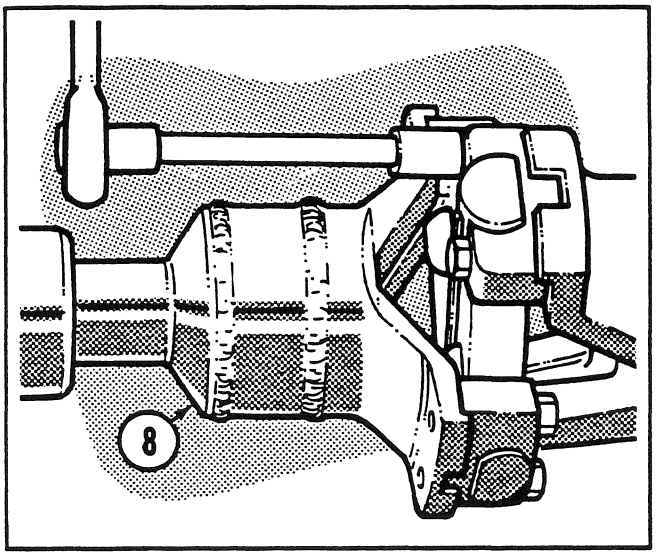

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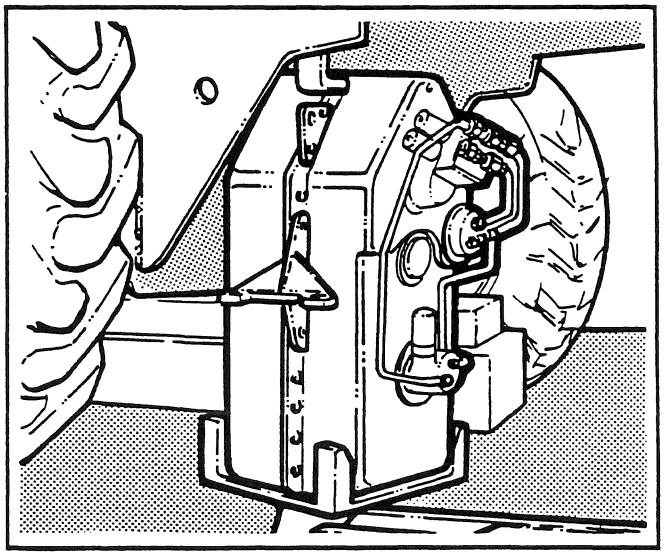


Fig. 49

Transmission - Removal (Continued)

Fig. 44
Remove the breather hose (6).

Fig. 45
Disconnect the transmission wiring harness (7). Identify the connectors to prevent confusion during assembly.

Fig. 46
Disconnect the upper and lower drive shafts (8).

Fig. 47
Use the jack to support the transmission.

Fig. 48
Remove the transmission mount bolts (9).

Fig. 49
Use the jack to lift the transmission off the mounts; then pull it forward slightly until it is clear of the mounts. Lower the transmission from the grader. Stand the transmission upright on blocks.

Transmission - Disassembly

Fig. 50
Remove the suction fitting (10) and suction strainer (11). Remove and discard the O ring.

Fig. 51
Remove the nuts (12), washers and driveshaft yokes (13) from the rear of the transmission.

Fig. 52
Rest the transmission on its back (driveshaft yoke side), using blocks to support the assembly.

Fig. 53
Remove the hydraulic tubes (14).

Fig. 54
Carefully remove the nuts (16) spacers (17) and solenoids (15).

Fig. 55
Remove the valve cartridges (18) from the control valve caps (19).

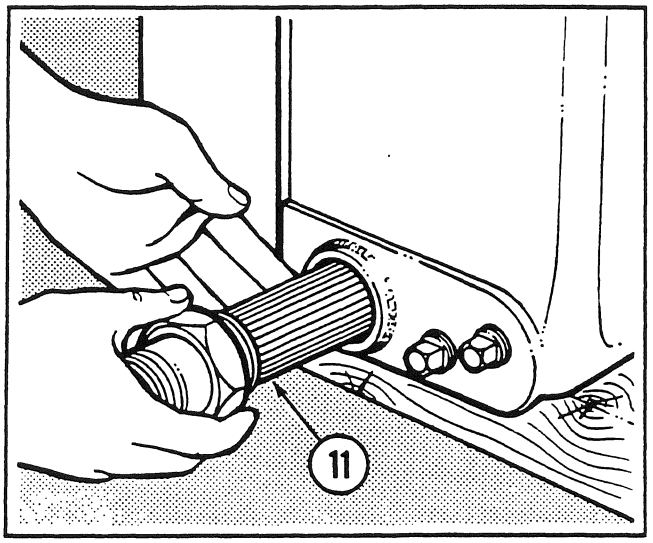


Fig. 50

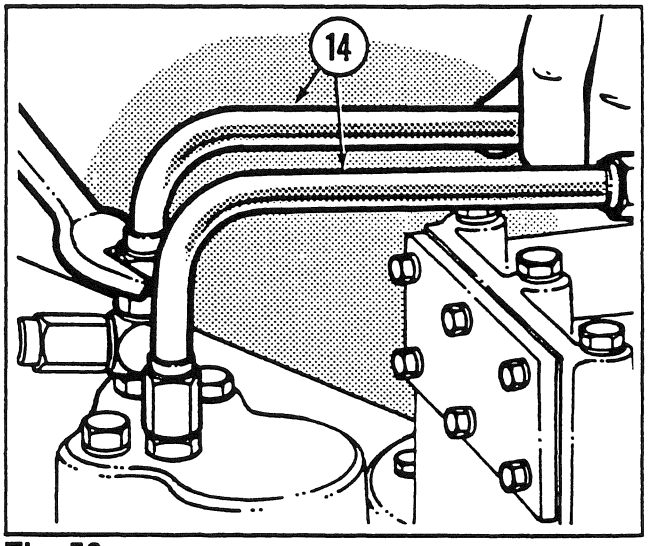


Fig. 53

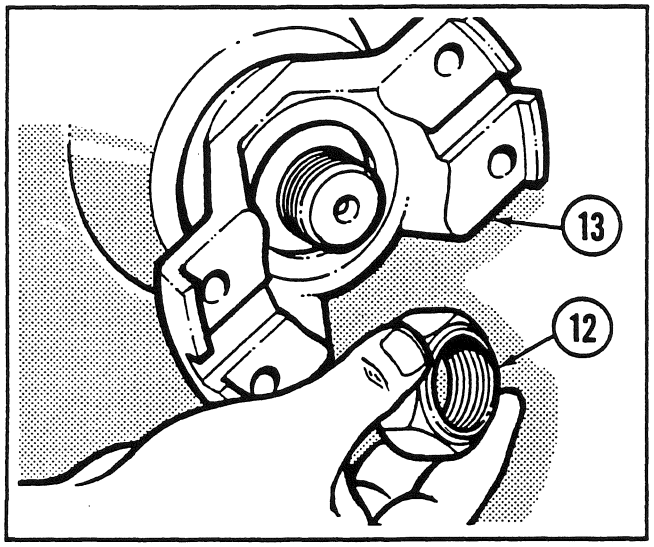


Fig. 51

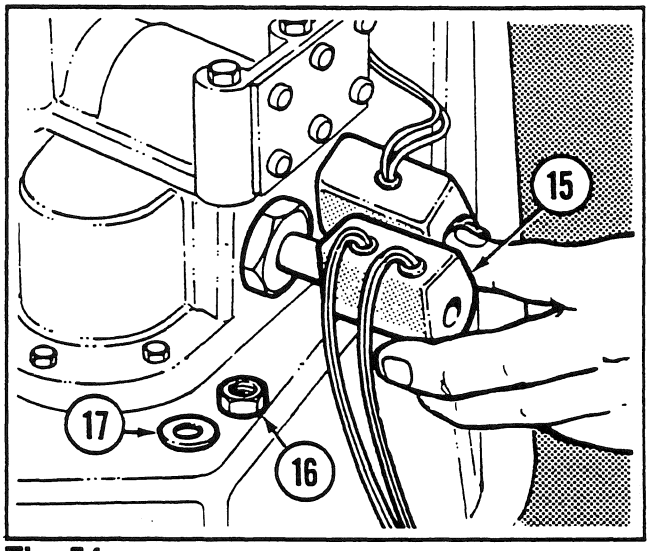


Fig. 54

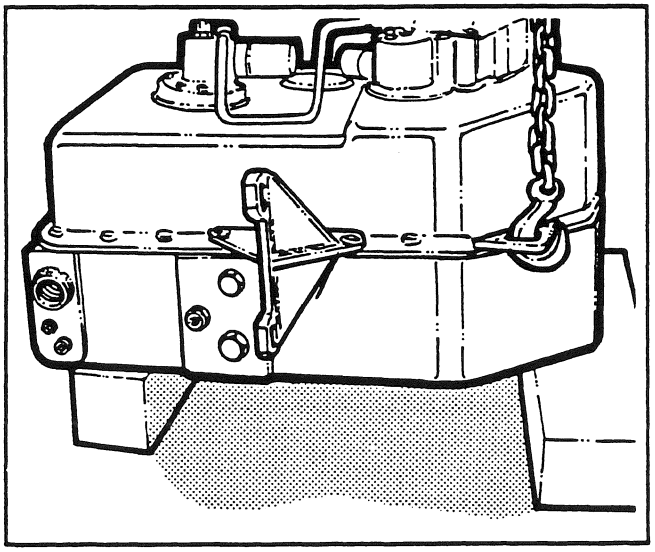


Fig. 52

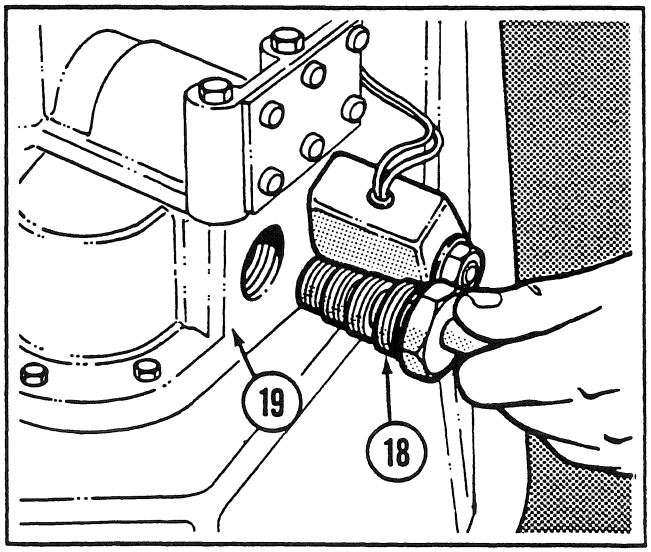


Fig. 55

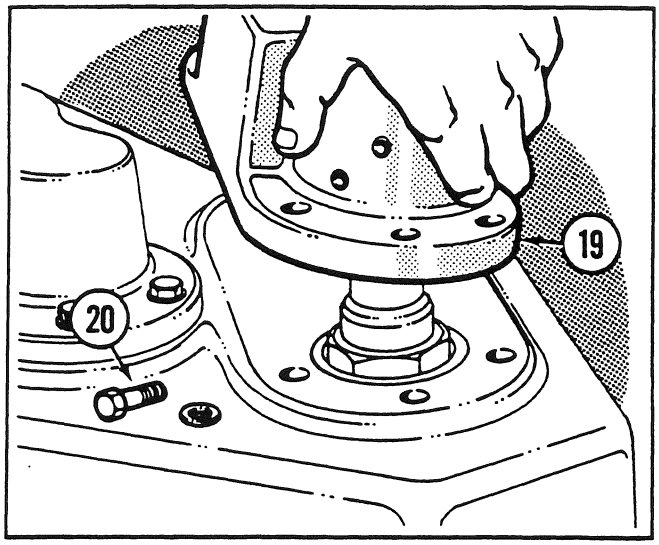


Fig. 56

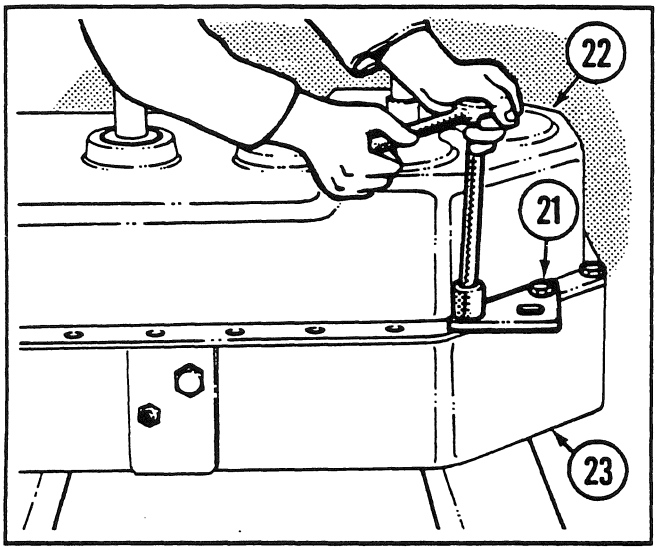
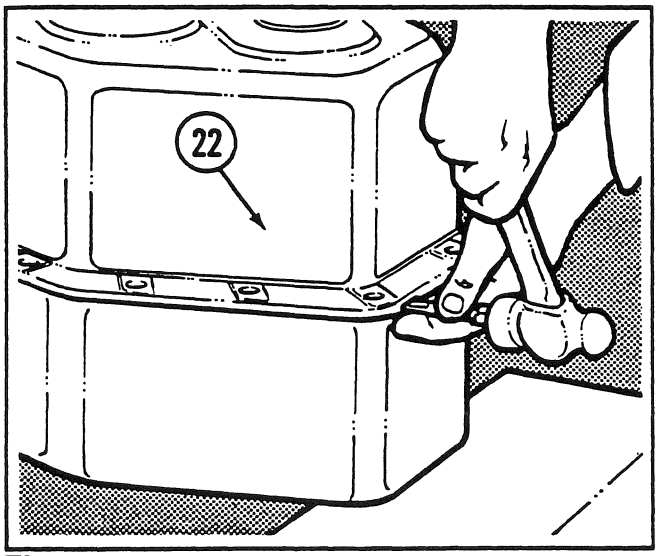


Fig. 57



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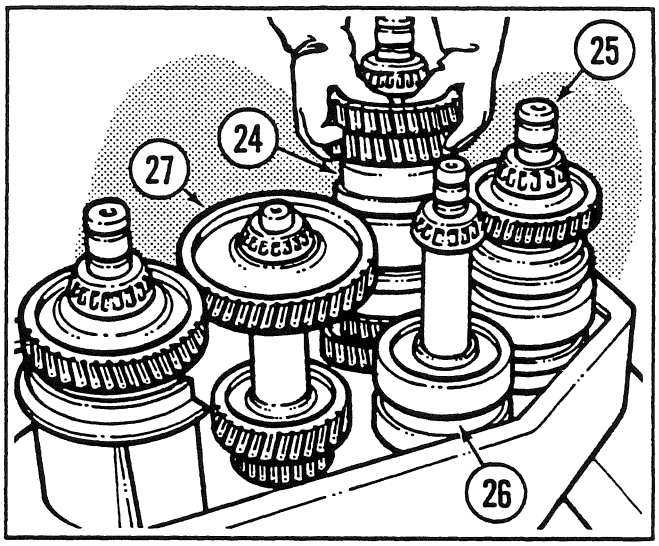

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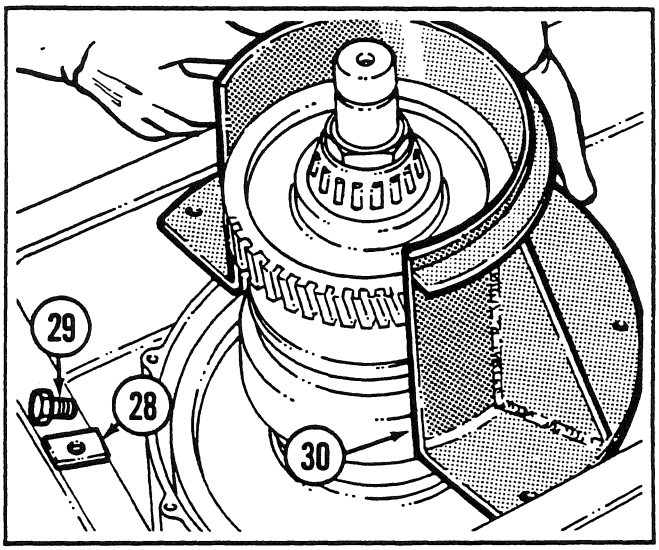

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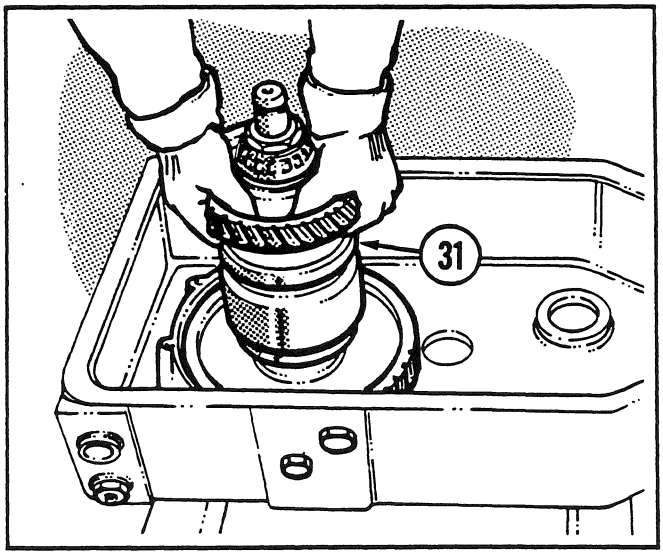


Fig. 61

Transmission - Disassembly (Continued)

Fig. 56
Remove the capscrews (20) from the control valve caps (19). Use a soft faced hammer to break the seal between the valve caps and the case. Remove the control valve caps.

Fig. 57
Remove the capscrews (21) fastening the transmission case halves (22 and 23) together.

Fig. 58
Install lifting eyes in the front case half (22) and use the lifting device to support the weight of the transmission. Insert a flat chisel into one of the slots located at either end of the case. Strike the chisel sharply with a large hammer to break the seal between the case halves. **DO NOT** attempt to use a pry-bar. Remove the front case half.

Fig. 59
Remove the clutch packs in the following order: the intermediate clutch pack (24); the input clutch pack (25); the reverse clutch half-pack (26) and, finally, the second intermediate shaft (27).

Fig. 60
Bend back the locking plates (28) securing the capscrews (29) for the oil baffle (30). Remove the capscrews and baffle. Discard the locking plates.

Fig. 61
Remove the output clutch pack (31) from the rear case half.

Clutch Pack - Disassembly

Disassembly procedures are essentially similar for all clutch packs in the 8400 transmission. Differences between clutch packs are detailed where they affect the procedure.

Fig. 62
Remove the hook-type seal rings (32) from the end of the clutch pack shaft (33).

Fig. 63
Remove the locknut (34) with the special tool listed in the front of this Shop Manual Section.

Fig. 64
Use a puller to remove the bearing cones (35) and any outer gears (36).

Fig. 65
The intermediate clutch pack (24) is not equipped with thrust bearings. For all other clutch packs, remove the outer thrust washers and bearings (37).

NOTE

The thrust bearings may have different thicknesses. Take care not to mix these parts.

Fig. 66
Remove the gear and drum assembly (38).

Fig. 67
For all clutch packs except the intermediate clutch pack, remove the needle roller bearings (39) and spacer (40). Examine the bearings for excessive wear or damage.

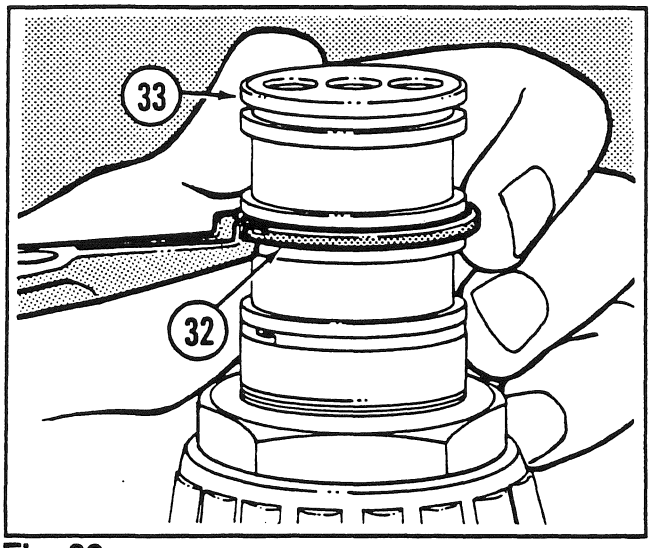


Fig. 62

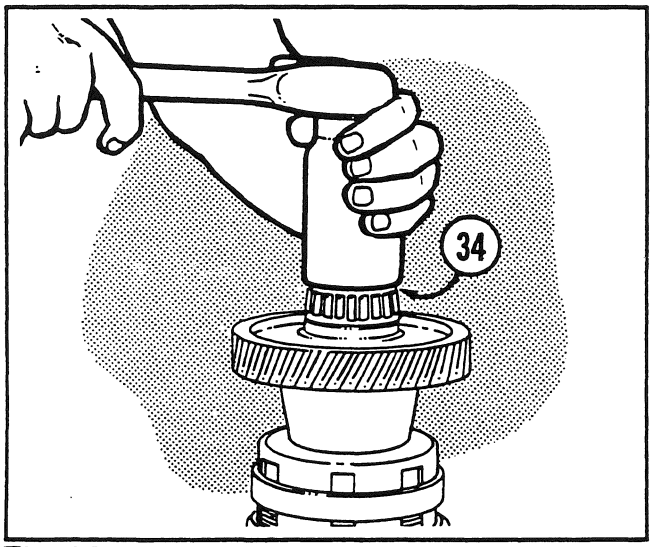


Fig. 63

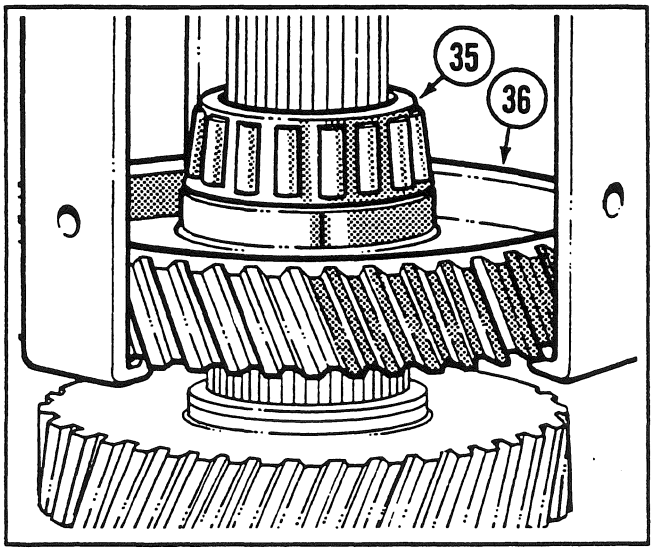
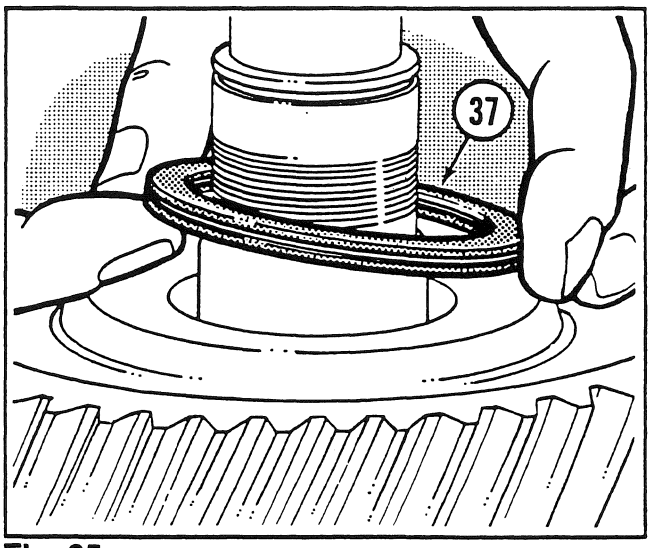


Fig. 64



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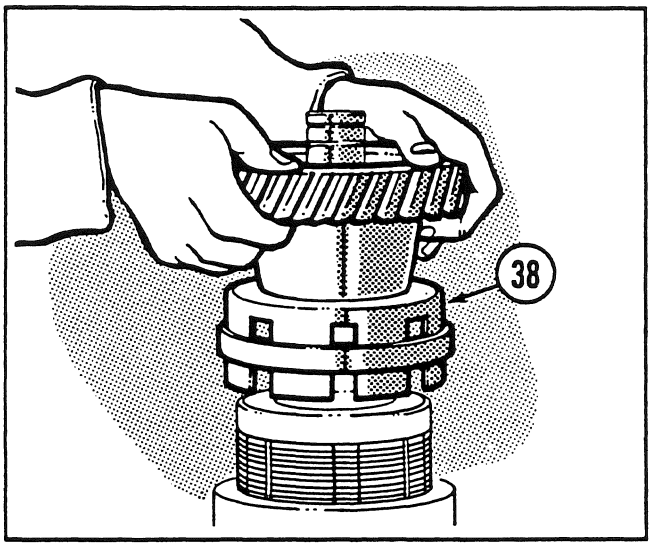

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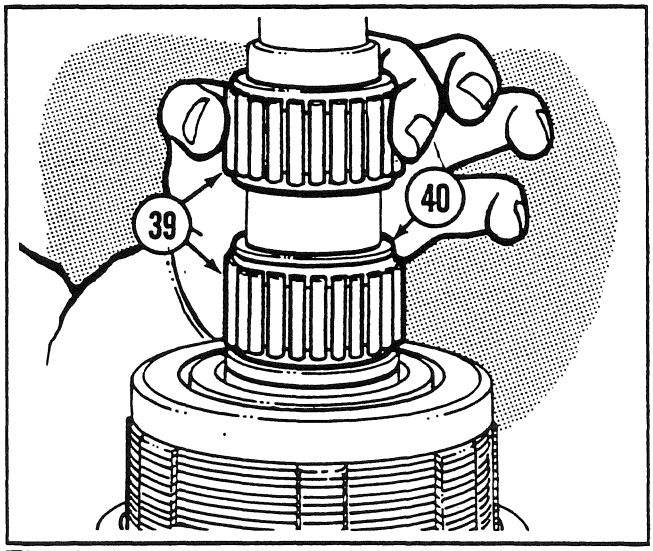

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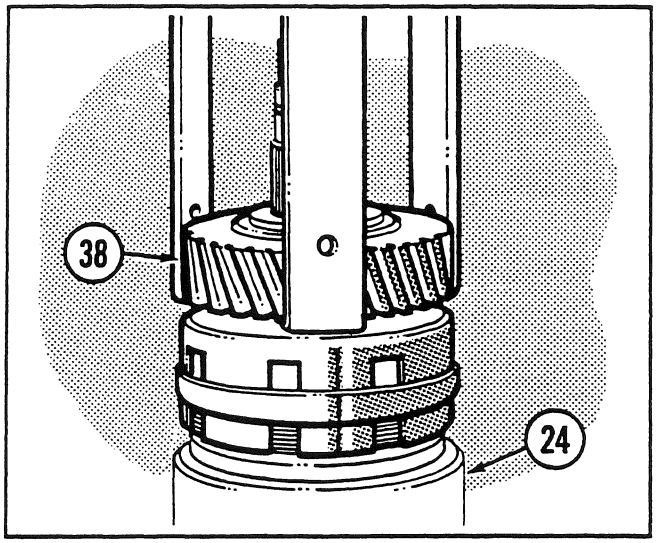

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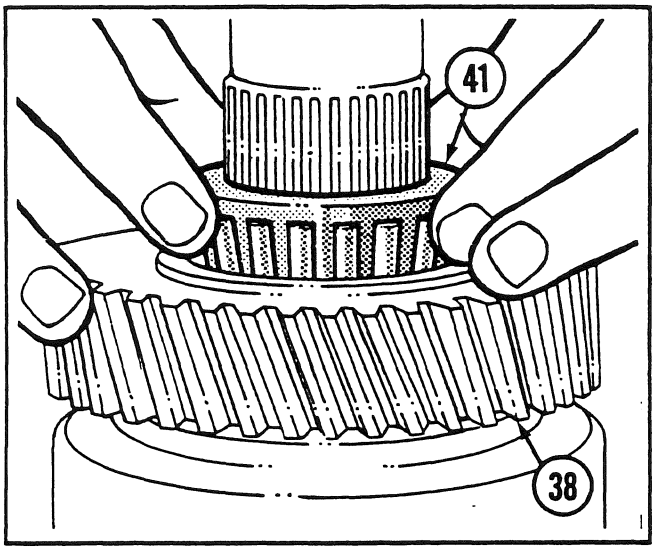
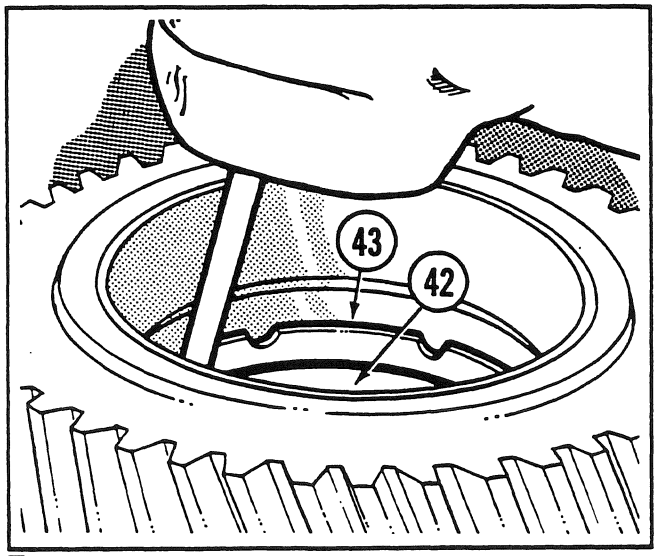


Fig. 69



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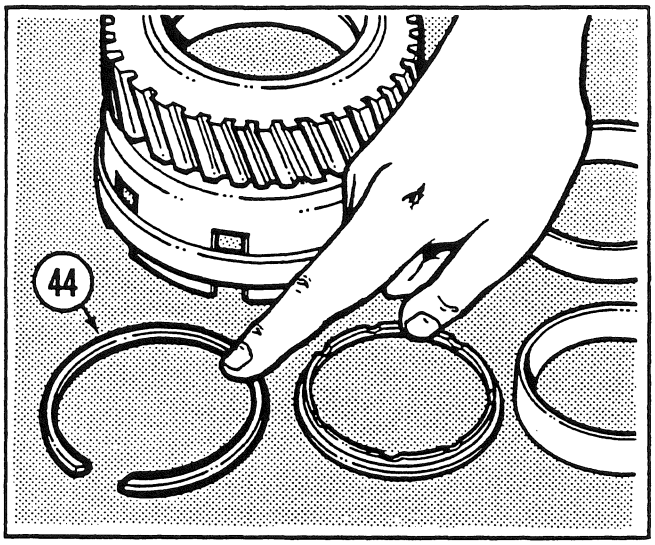

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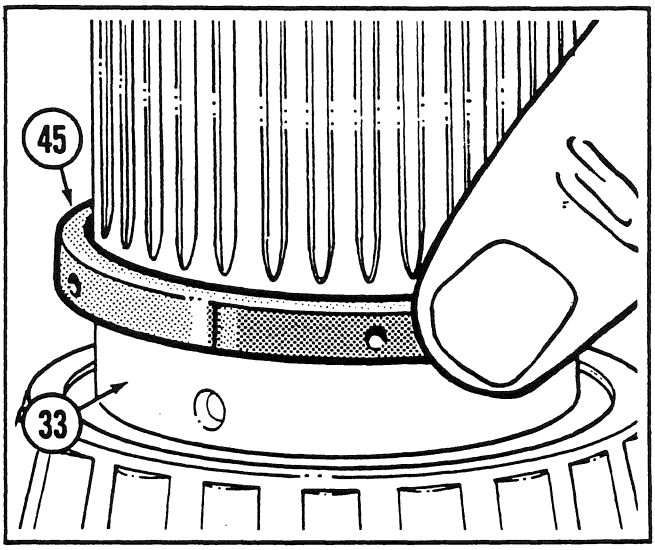

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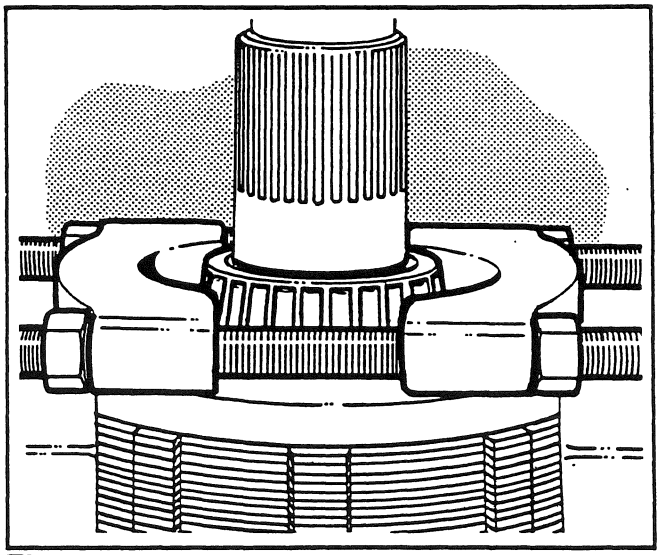


Fig. 73

Clutch Pack - Disassembly (Continued)

Fig. 68
If you are working on the intermediate clutch pack (24), use a puller to remove the gear and drum assembly (38).

Fig. 69
You may need to remove the outer bearing cone (41) before you can fully remove the gear and drum assembly (38).

Fig. 70
Use a soft metal drift to force one bearing cup (42) out of the gear and hub assembly. Remove the cup spacer (43).

Fig. 71
Remove and discard the snap ring (44) and force the other bearing cup (42) out of the gear.

Fig. 72
Remove the bearing cone spacer (45) from the shaft (33).

Fig. 73
Use a suitable bearing separation device to remove the remaining bearing cone from the shaft. Examine the bearings for excessive wear or damage.

Clutch Pack - Disassembly (Continued)

Fig. 74
Remove the inner thrust bearing and washers (46) from all clutch packs except the intermediate clutch pack.

Fig. 75
Remove the spacer.

Fig. 76
The spacer (47) for the output clutch pack is different.

Fig. 77
Remove and discard the retainer snap ring (48) from all clutch packs except the output clutch pack.

Fig. 78
If you are working on the output clutch pack (31), remove the retainer capscrews (49).

Fig. 79
Remove the retainer half-rings (50) from the hub assembly. It may be necessary to depress the hub assembly against return spring pressure to remove the half-rings.

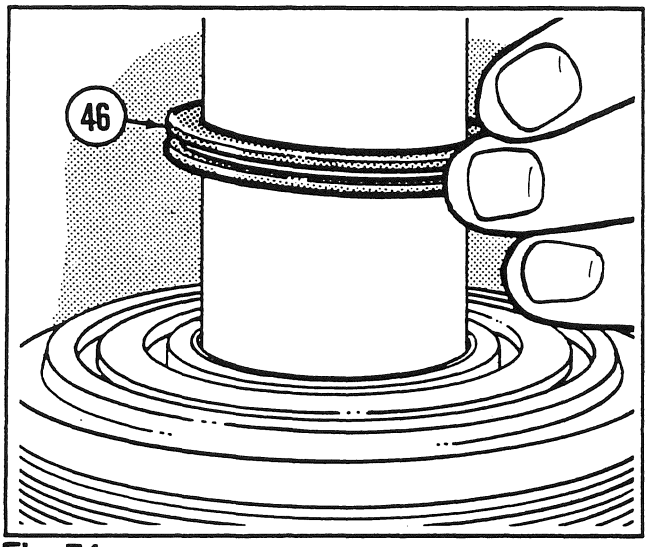


Fig. 74

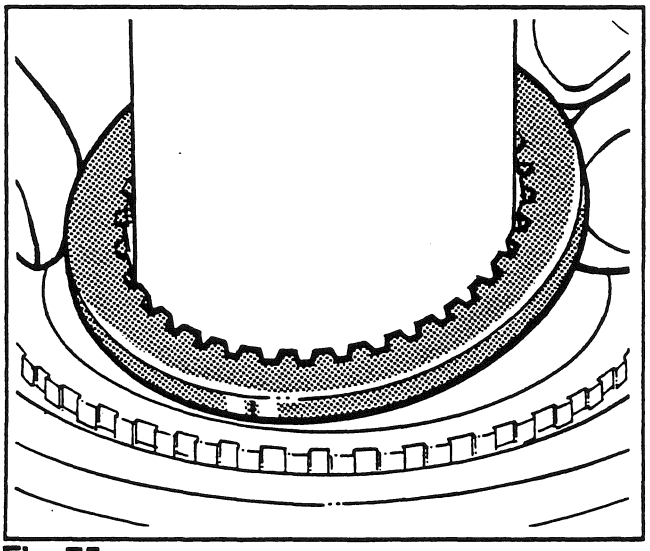
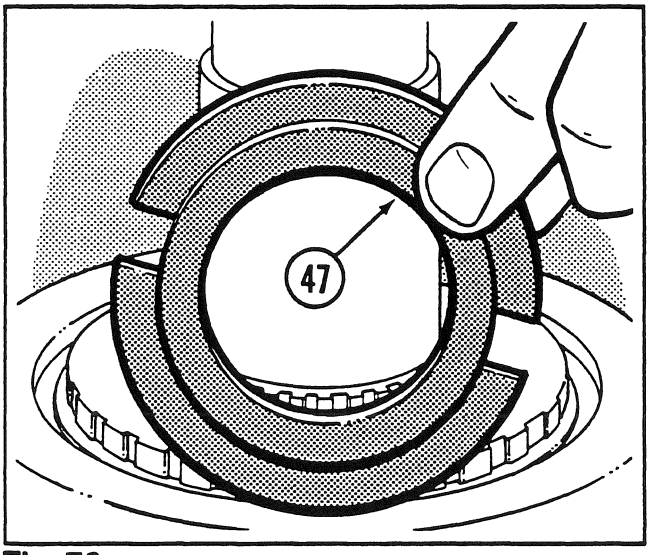


Fig. 75



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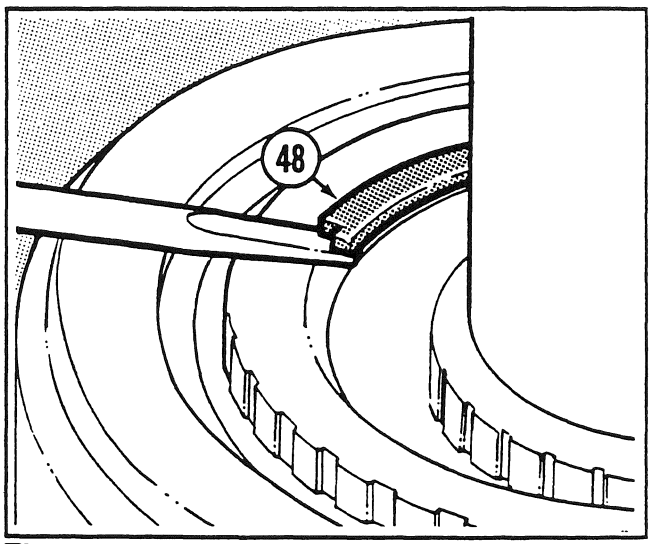

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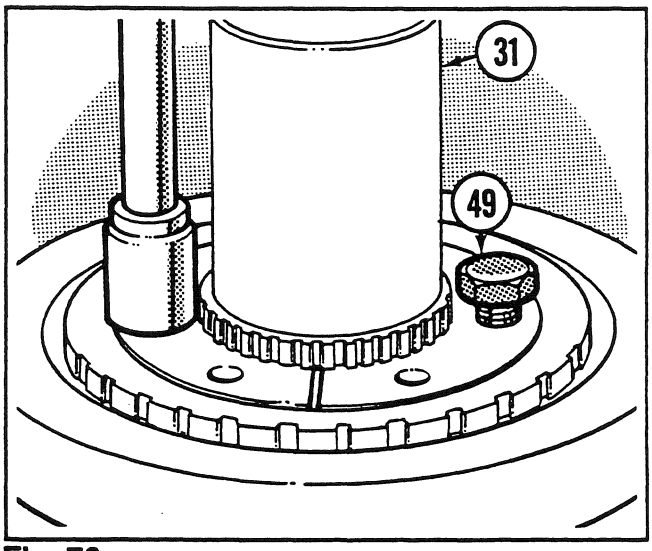

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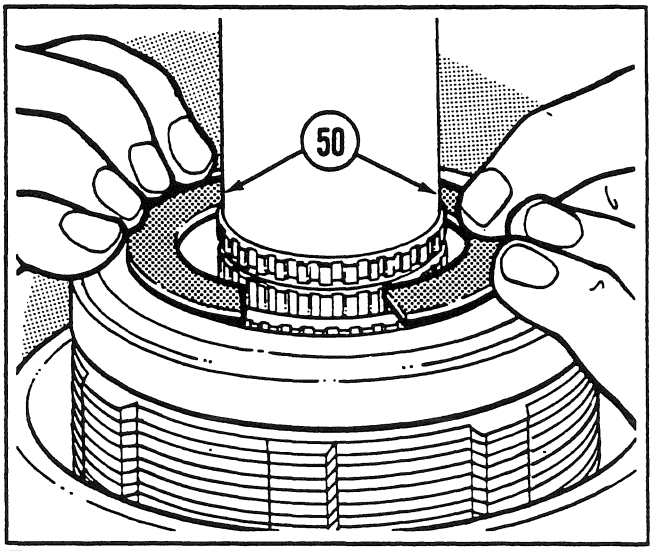

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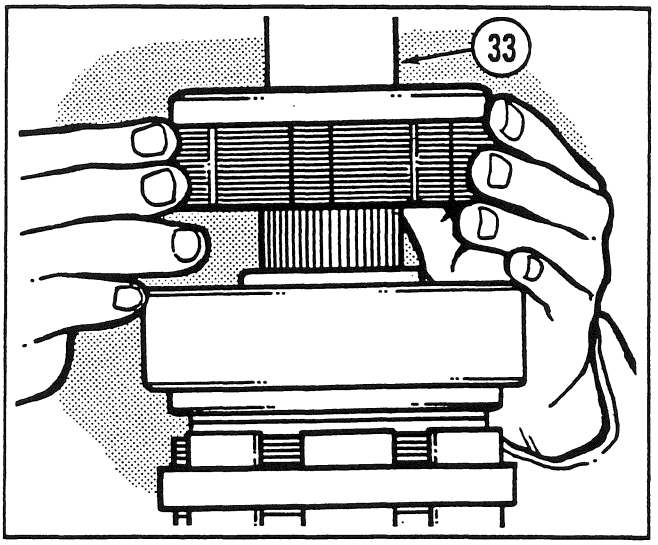

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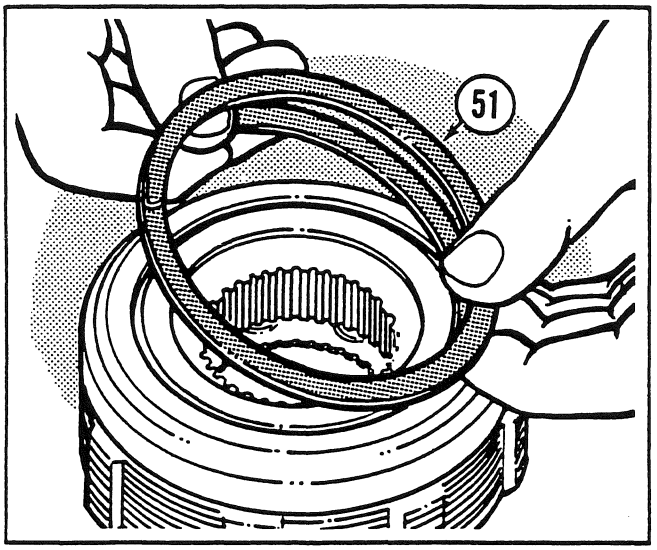

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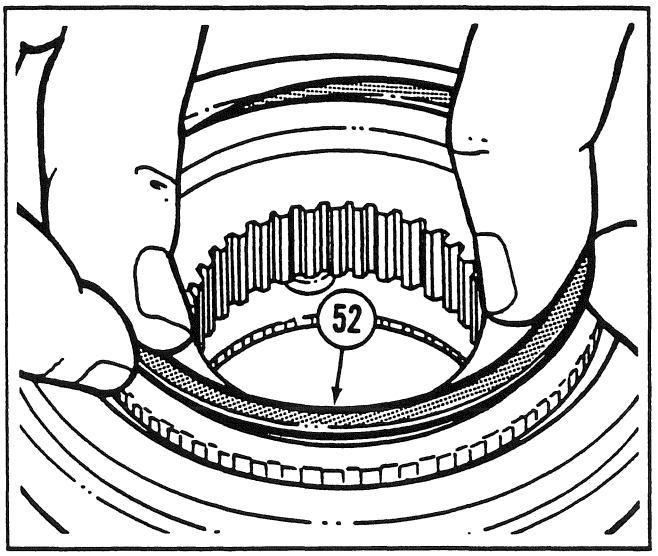

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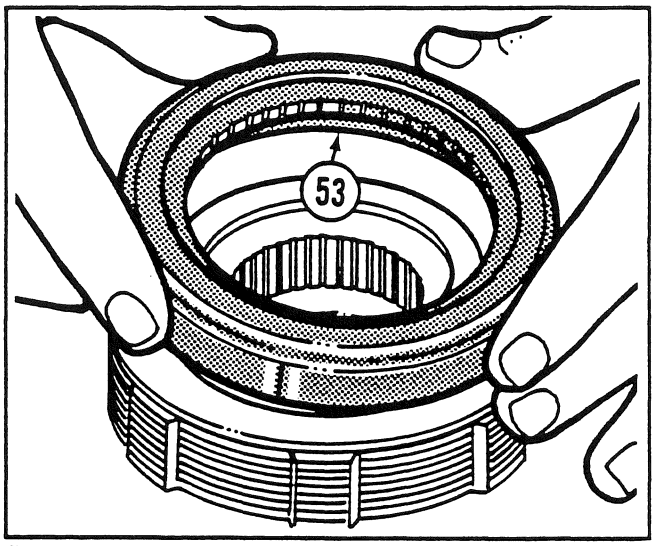

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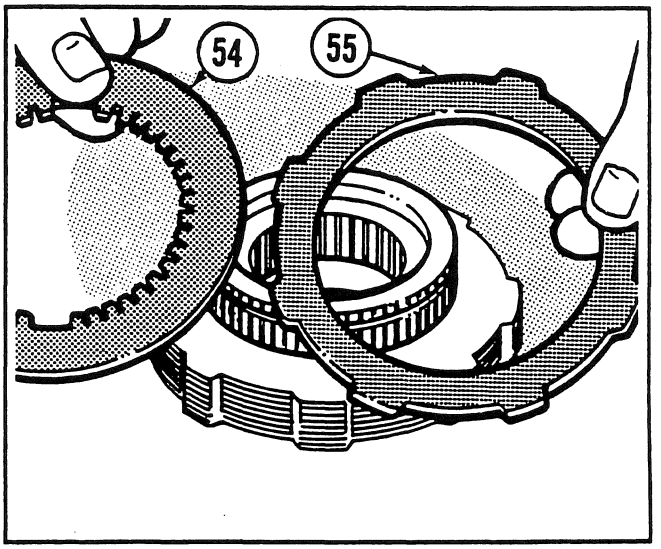

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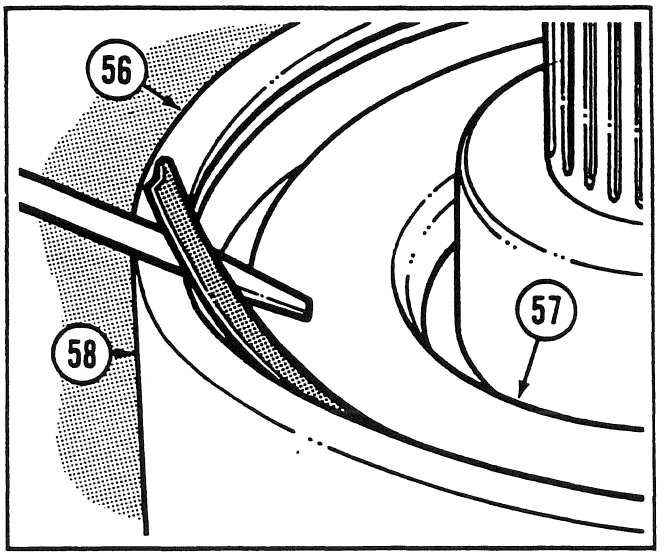


Fig. 85

Clutch Pack - Disassembly (Continued)

Fig. 80
Lift the hub assembly off the shaft (33).

Fig. 81
Remove and discard the spiral lock ring (51).

Fig. 82
Remove and discard the snap ring (52).

Fig. 83
Remove the backing plate (53). Identify all backing plates to prevent confusion. **The backing plates are not interchangeable!**

Fig. 84
Remove the friction discs (54) and reaction plates (55) from the hub assembly and separate them. Discard the friction discs if they are less than the minimum thicknesses shown on Page 3 of this Shop Manual Section; of if the oil grooves are not visible on both sides. If you reuse the same friction discs and reaction plates, assemble the parts in the same order as disassembly.

Fig. 85
Before proceding further, you will have to repeat the procedures described in **Fig. 62** through **Fig. 84** to disassemble the opposite side of the clutch pack (all except the reverse clutch half-pack). When you have removed the opposite hub assembly, you can begin disassembly of the piston housing (56) and force piston (57). Remove and discard the snap ring (58).

Clutch Pack - Disassembly (Continued)

Fig. 86
Use a soft-faced mallet to push the piston housing (56) off the force piston (57).

Fig. 87
Remove the force piston (57) and piston housing (56) from the shaft (33). Remove and discard the seal ring.

Fig. 88
Remove and discard the snap ring (59) from the accelerator piston (60).

Fig. 89
Remove and discard all hook-type seal rings (61).

Fig. 90
Remove the accelerator piston (60).

Fig. 91
Remove the disc valve (63) and reinforcing disc (64).

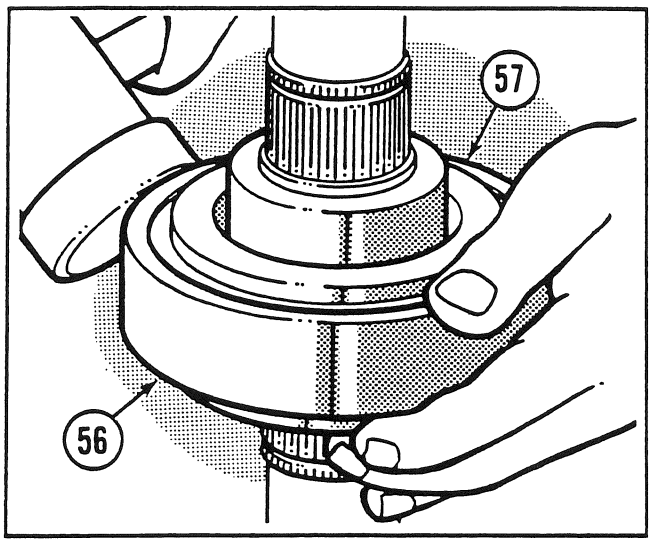
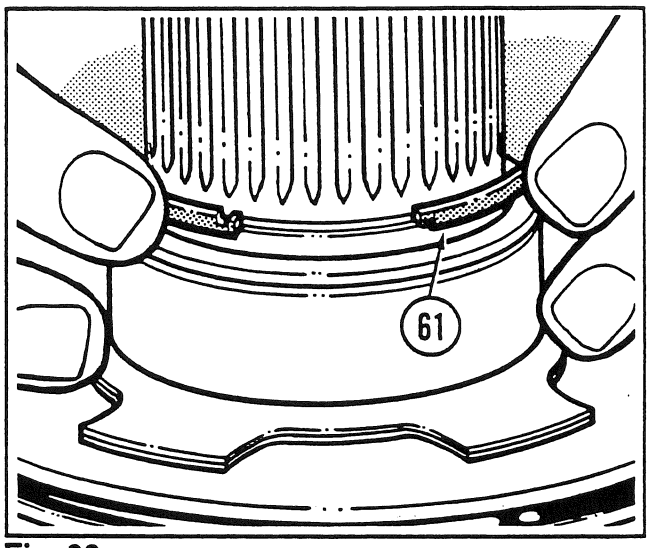


Fig. 86



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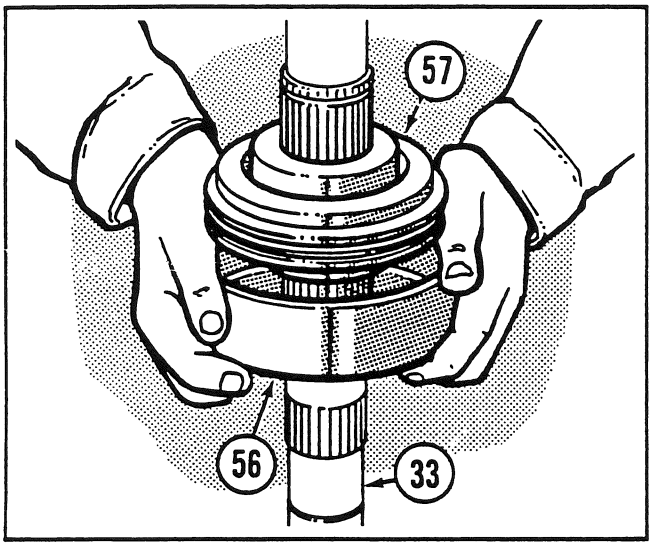

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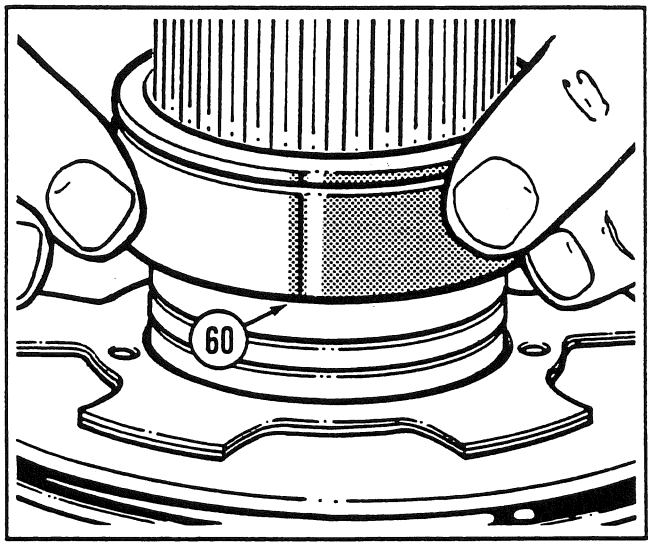
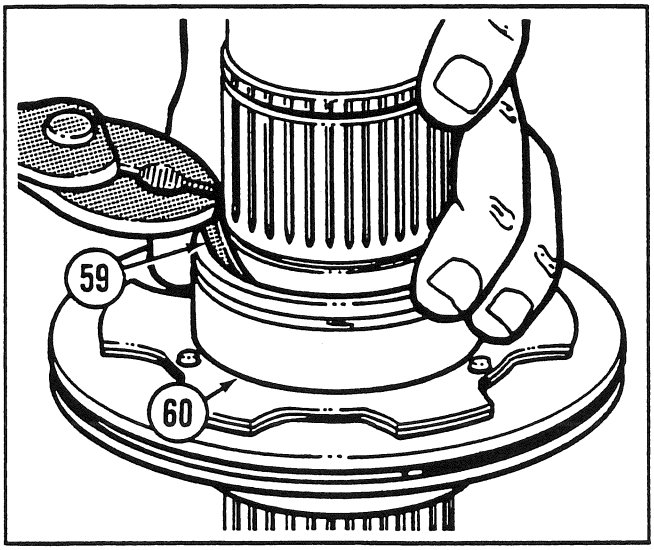


Fig. 90



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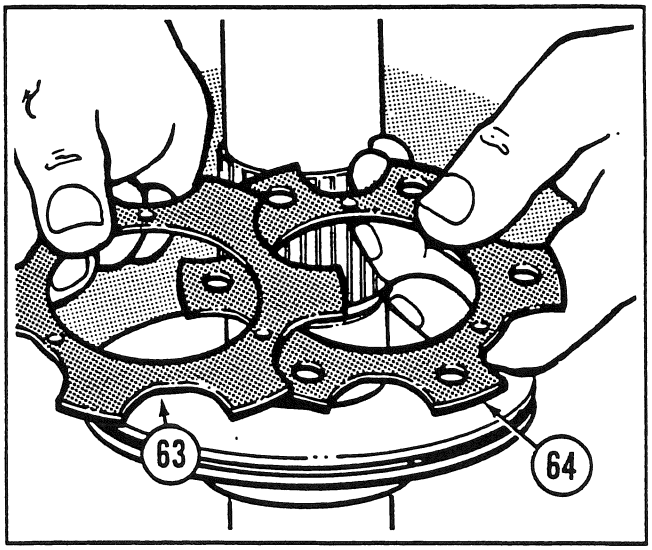

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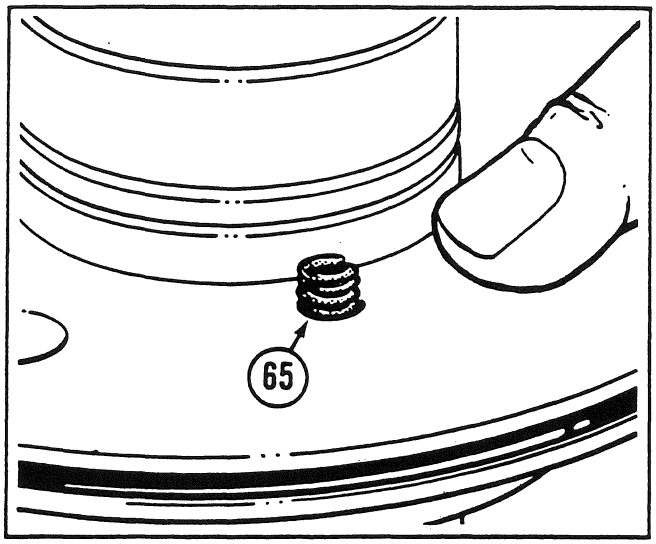

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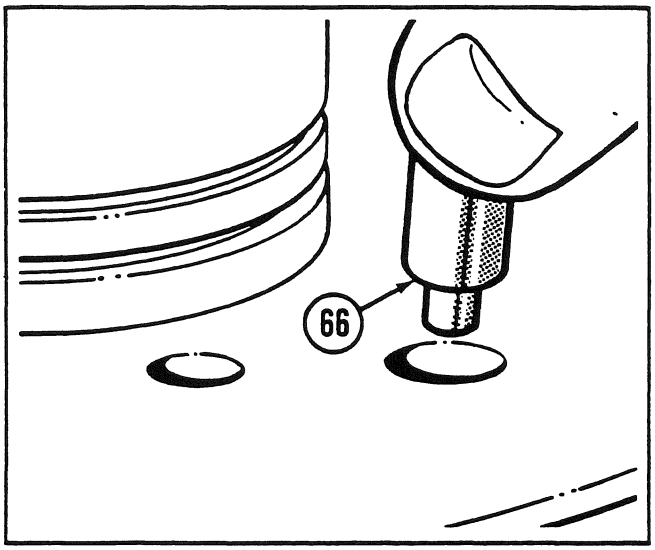

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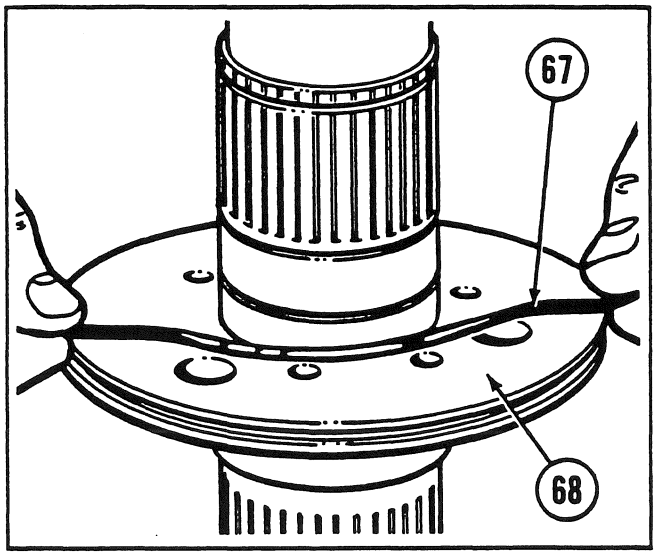

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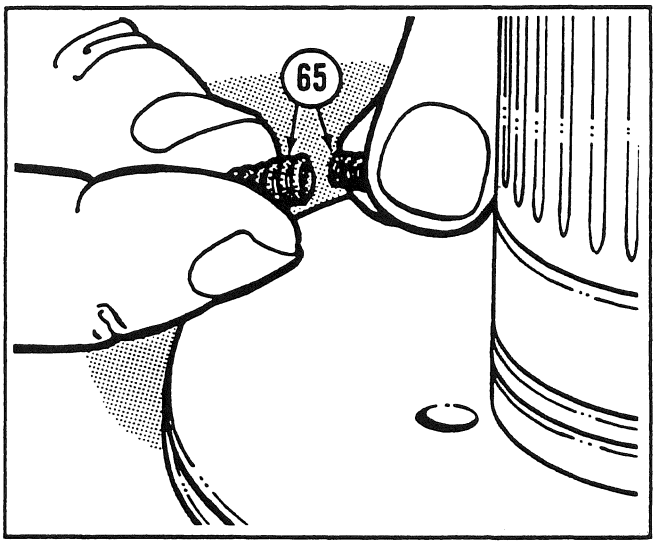

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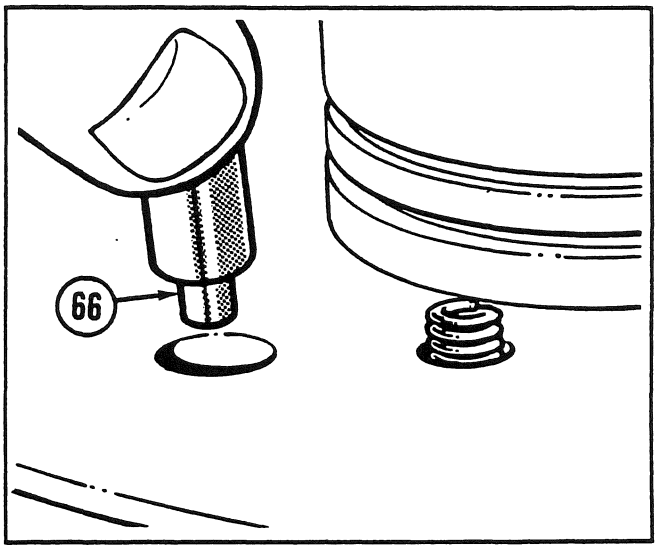

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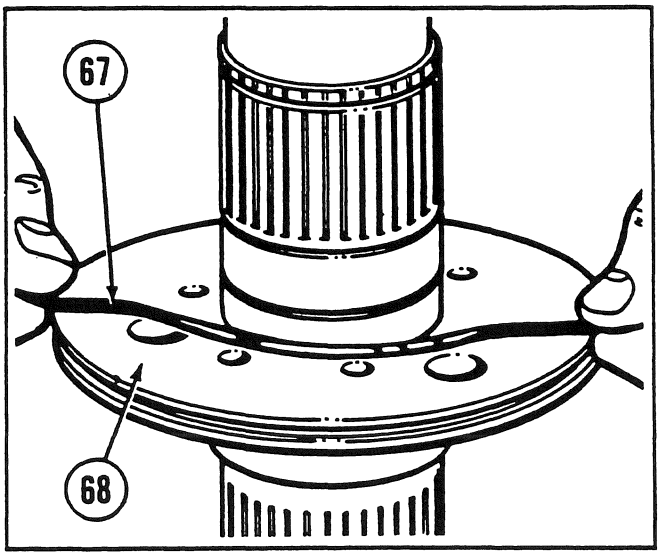


Fig. 97

Clutch Pack - Disassembly (Continued)

Fig. 92
Remove the inner and outer springs (65).

Fig. 93
Remove the three dowel pins (66) from the separator plate of all clutch packs except the reverse clutch half-pack. The reverse clutch half-pack has fixed dowel pins.

Fig. 94
Remove and discard the O ring (67) from the separator plate (68). **DO NOT** attempt to remove the separator plate from the shaft.

Clutch Pack - Assembly

Fig. 95
Install the inner and outer springs (65).

Fig. 96
Install the dowel pins (66) in the separator plate of all clutch packs except the reverse clutch half-pack.

Fig. 97
Lubricate and install a new O ring (67) into the separator plate (68) groove. Coat the O ring with a thick layer of petroleum jelly.

Following disassembly of the transmission and clutch packs, refer to **Cleaning and Inspection** detailed on pages 7 and 8 of this Shop Manual Section. Thoroughly clean and inspect all parts before assembling the transmission and clutch packs.

Clutch Pack - Assembly (Continued)

Fig. 98
Install the reinforcing disc (64), followed by the disc valve (63). Align the holes in the discs with the dowel pins (66).

Fig. 99
Install new hook-type seal rings (61) on the shaft.

Fig. 100
Install a new hook-type seal ring on the accelerator piston (60) and install the piston on the shaft (33).

Fig. 101
Install a new snap ring (59) retaining the accelerator piston (60).

Fig. 102
Lubricate and install a new seal ring (69) on the force piston (57) - or in the case of the reverse clutch half-pack, the piston return housing.

Fig. 103
Fill the entire snap ring groove of the piston housing (56) with soft copper wire or petroleum jelly. This will prevent the groove from cutting the separator plate O ring.

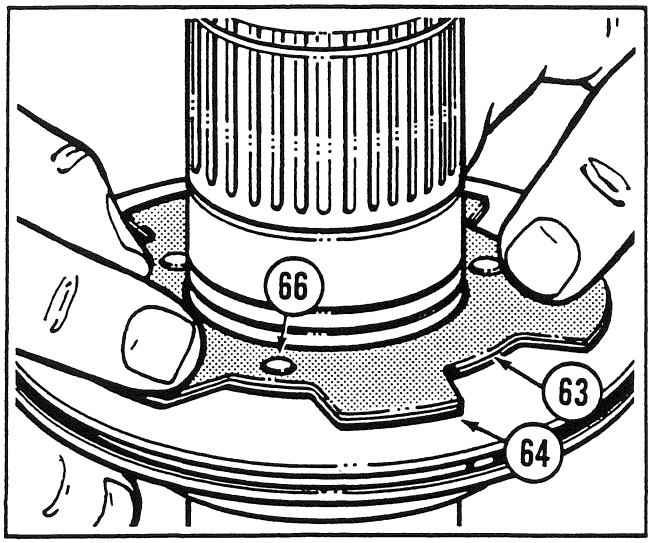


Fig. 98

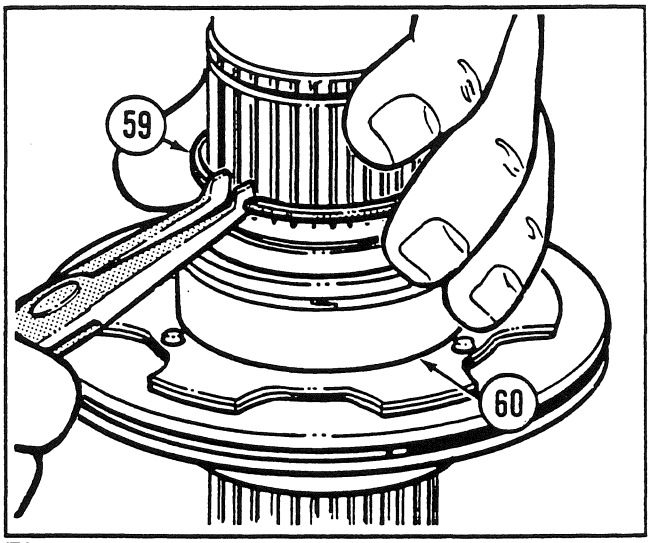
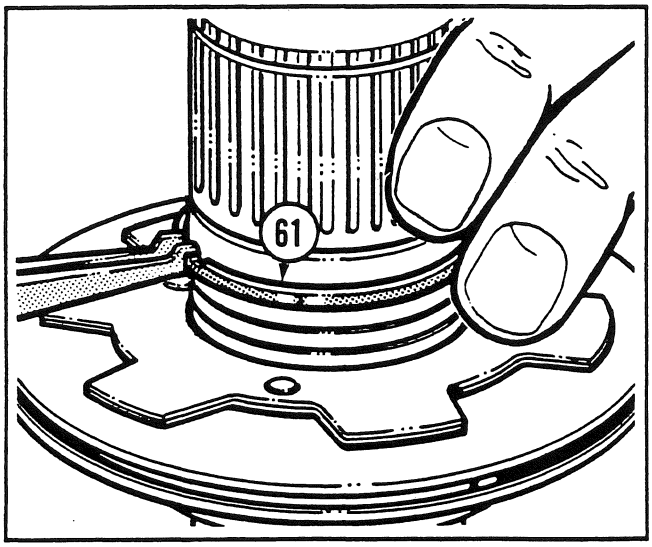


Fig. 101



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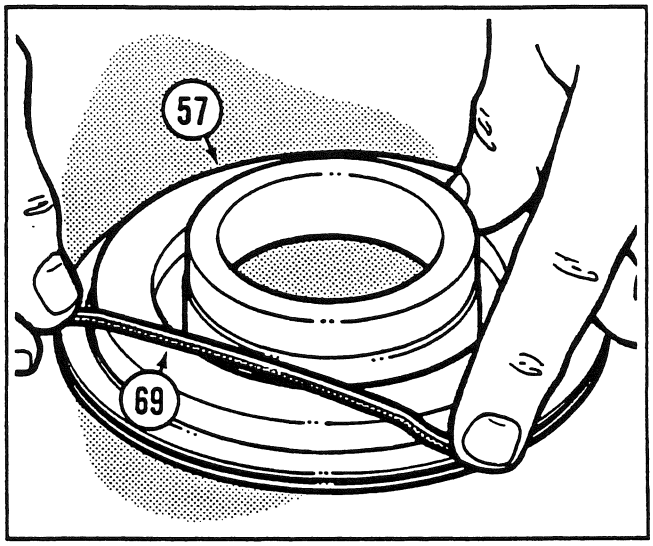

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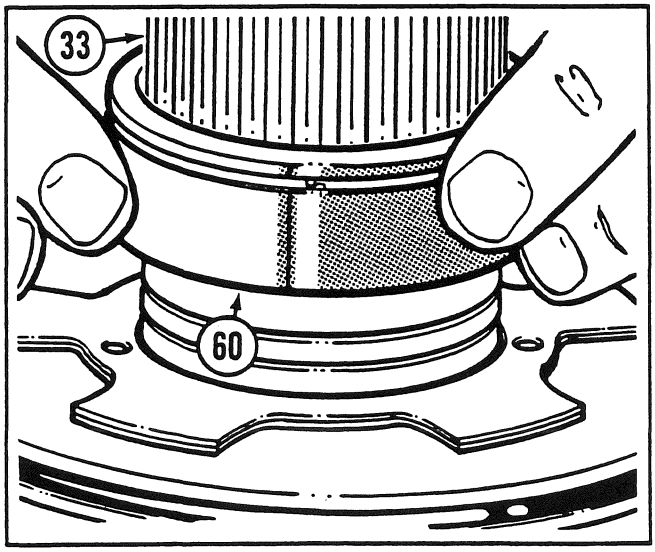

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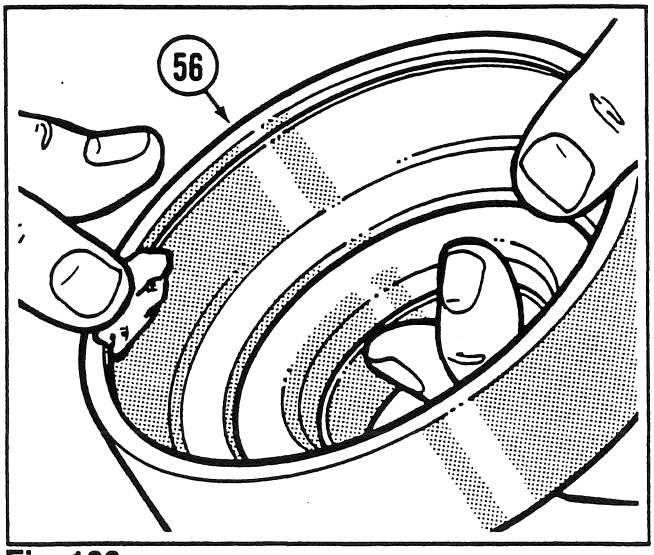
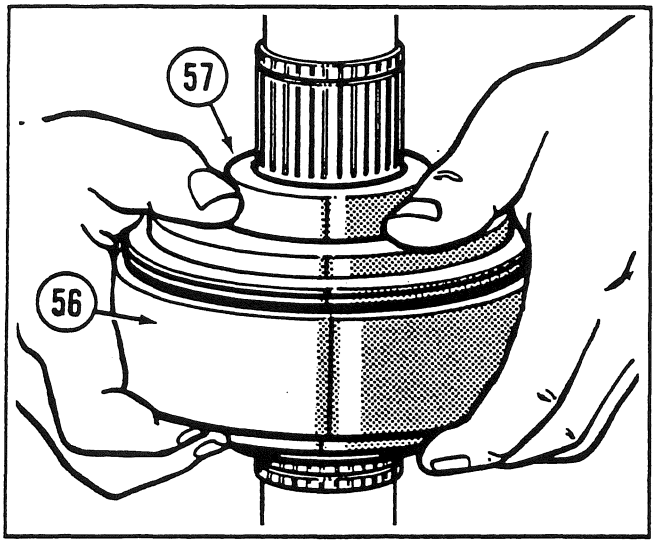


Fig. 103



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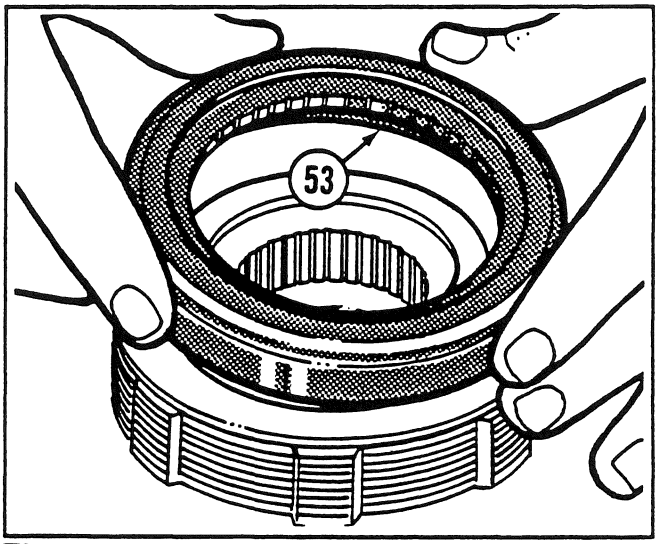

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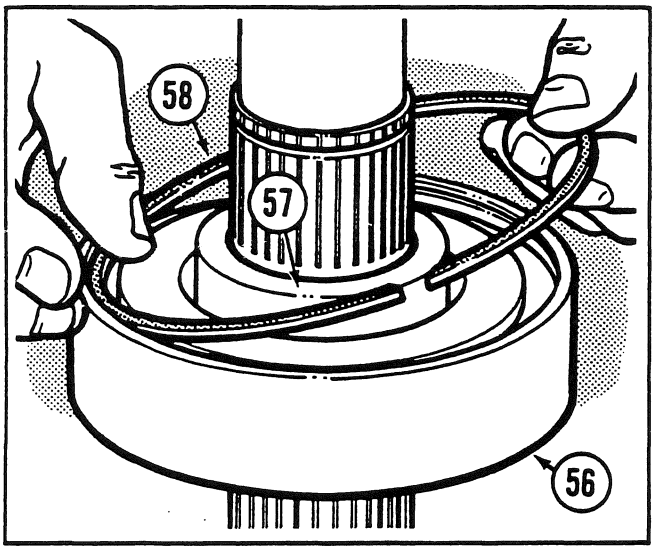

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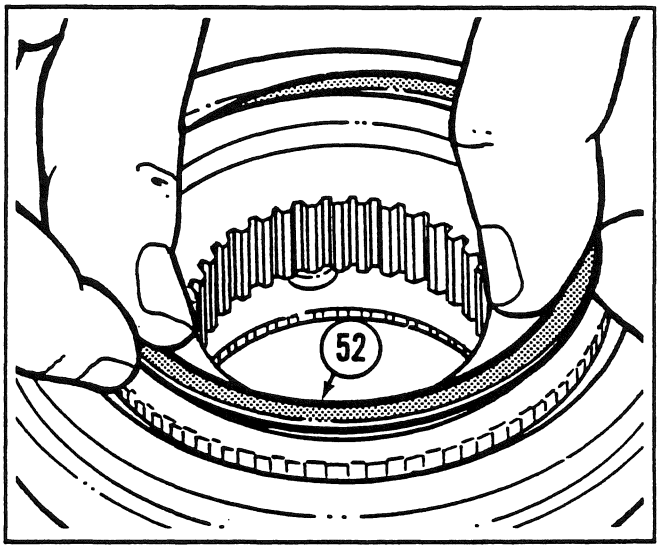

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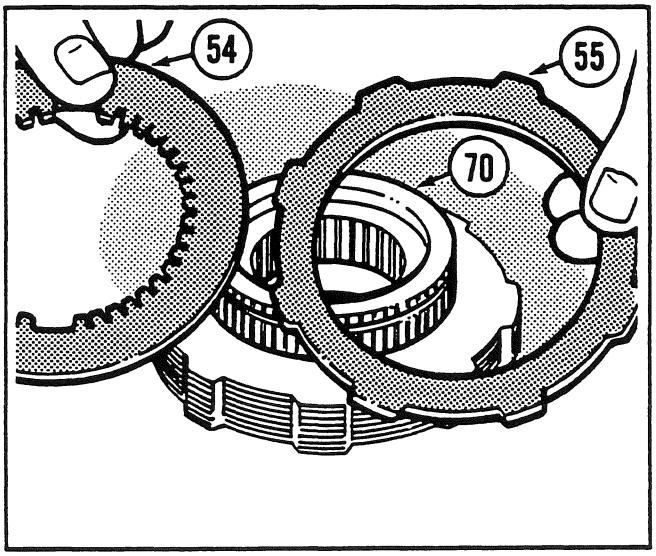

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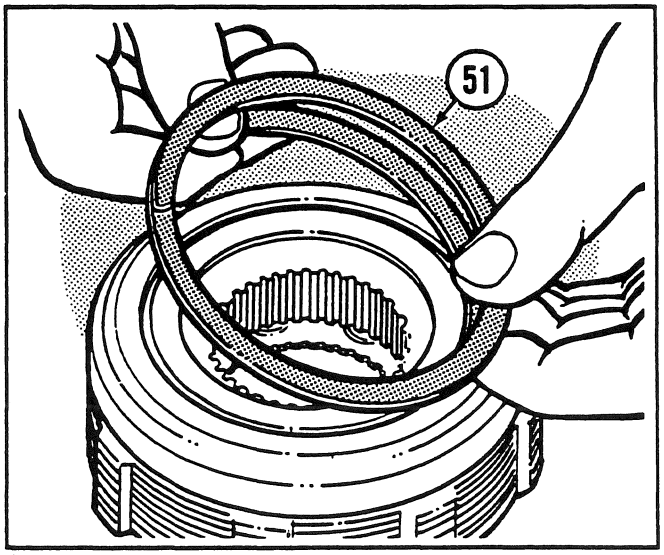


Fig. 109

Clutch Pack - Assembly (Continued)

Fig. 104
Install the piston housing (56) and force piston (57) on the shaft. **Ease** the lip of the housing past the separator plate O ring. **DO NOT FORCE** the housing past the hook-type seal rings on the shaft or accelerator piston. Allow the chamfers on the housing to compress the seal rings.

Fig. 105
Once the force piston (57) clears the snap ring groove in the piston housing (56), you can remove any copper wire you may have installed in the snap ring groove. Install a new snap ring (58). If you are working on a reverse clutch half-pack, install a new snap ring in the shaft to secure the piston return housing.

Fig. 106
Lubricate internal-spline friction discs and external-tang reaction plates in system oil. Install a friction disc (54) on the hub assembly (70), followed by a reaction plate. Install internal-spline and external-tang discs alternately. The last or top disc should have internal splines. Refer to the 700 Series Parts Manual for the exact number of discs and plates for each clutch pack assembly.

Fig. 107
Install the backing plate (53) on the hub assembly. Take care not to confuse the backing plates from different clutch packs. **The backing plates are not interchangeable!**

Fig. 108
Install a new internal snap ring (52).

Fig. 109
Install a new external spiral lock ring (51).

Clutch Pack - Assembly (Continued)

Fig. 110
Install the hub and disc assembly on the shaft (33).

Fig. 111
Install the retainer ring halves (50).

Fig. 112
On all clutch packs except the output clutch pack, secure the retainer ring halves with a new snap ring (48).

Fig. 113
If you are working on an output clutch pack (31), install the retainer ring halves (50). Install the retainer capscrews (49) and secure to finger tightness.

Fig. 114
Install the spacer on all clutch packs. If you are working on an output clutch pack, you may have to align the heads of the retainer capscrews with the slots in the spacer (47).

Fig. 115
For all clutch packs except the intermediate clutch pack, install the inner thrust bearing and washers (46). Refer to the 700 Series Parts Manual to select the exact thrust bearing size you need.

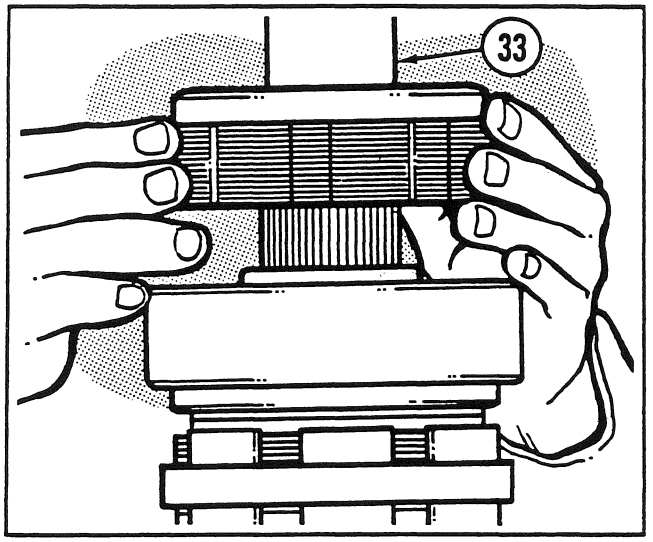
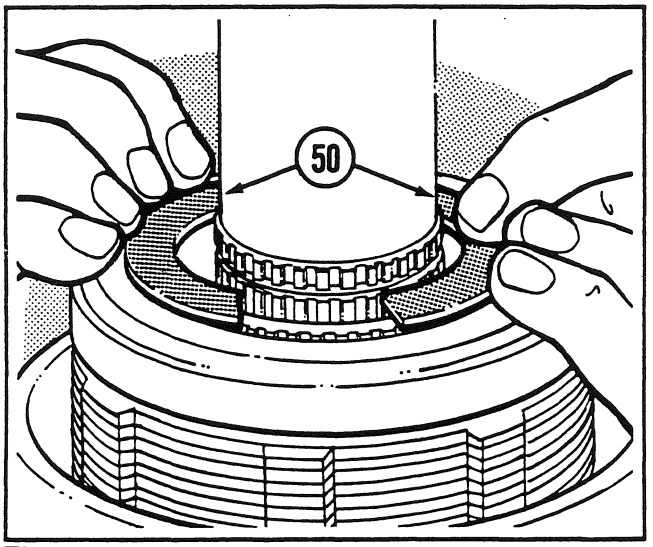


Fig. 110



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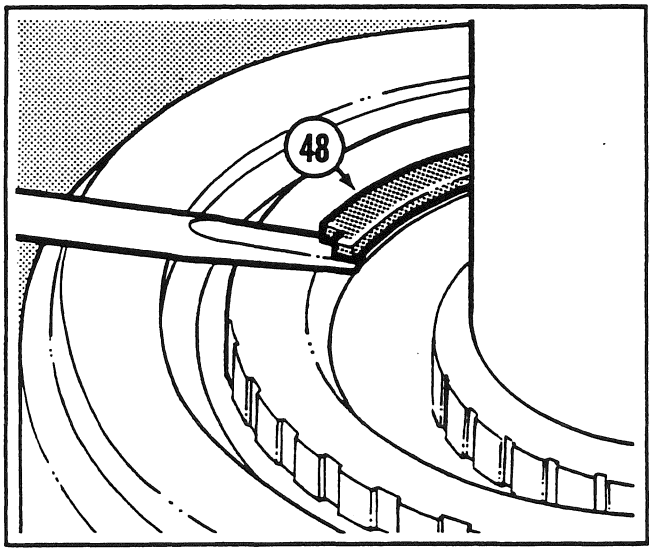

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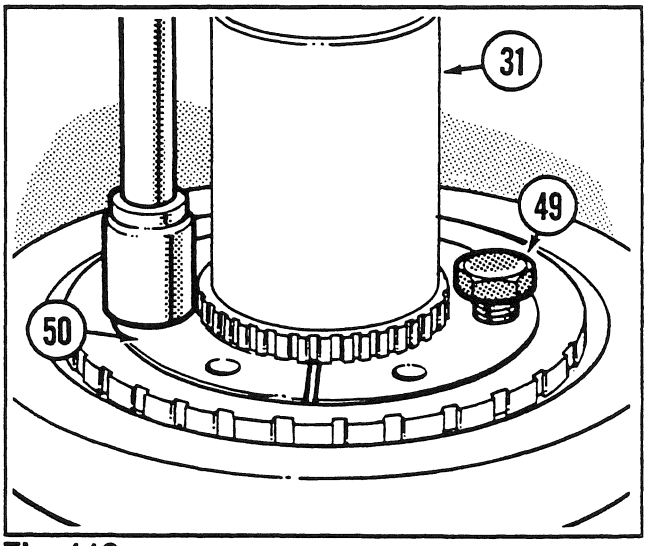

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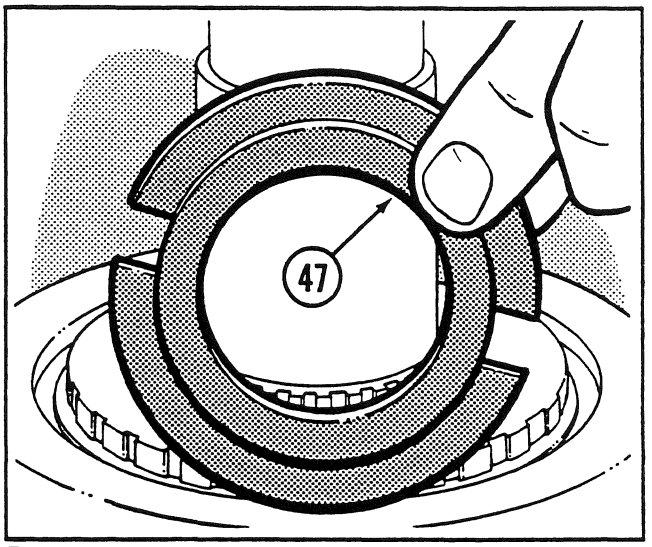

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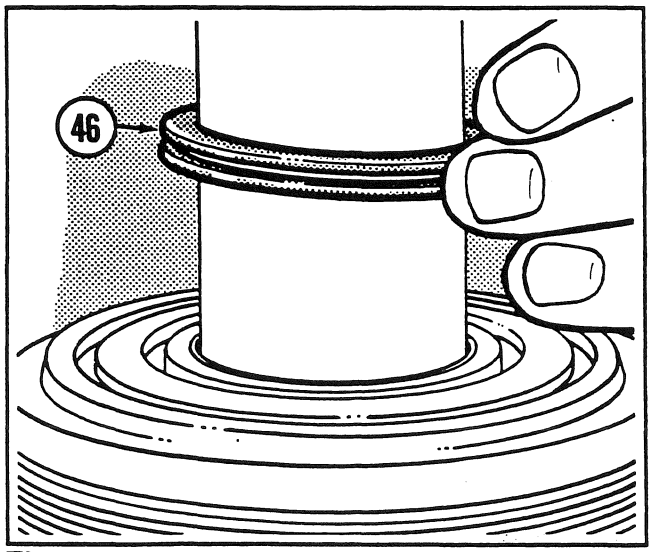

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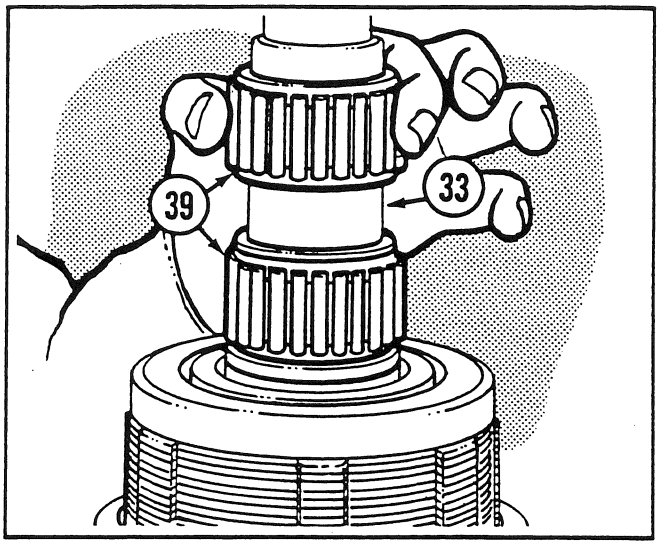

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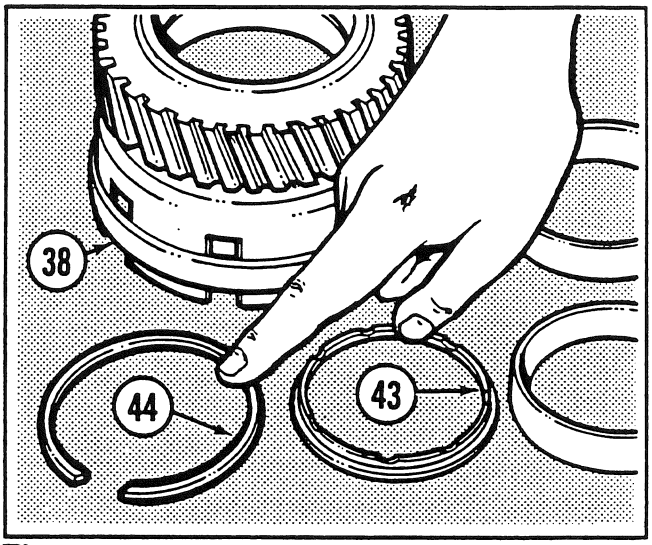
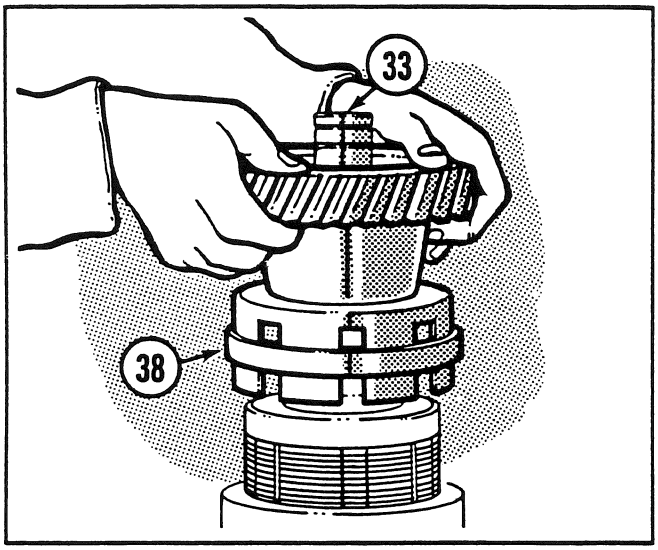


Fig. 119



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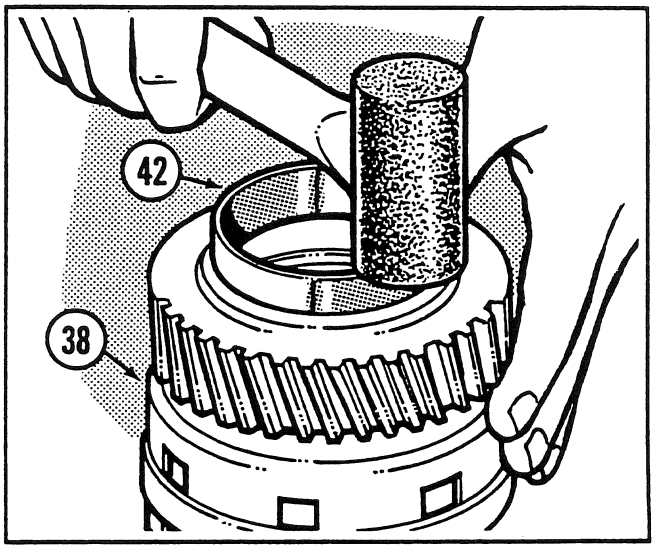

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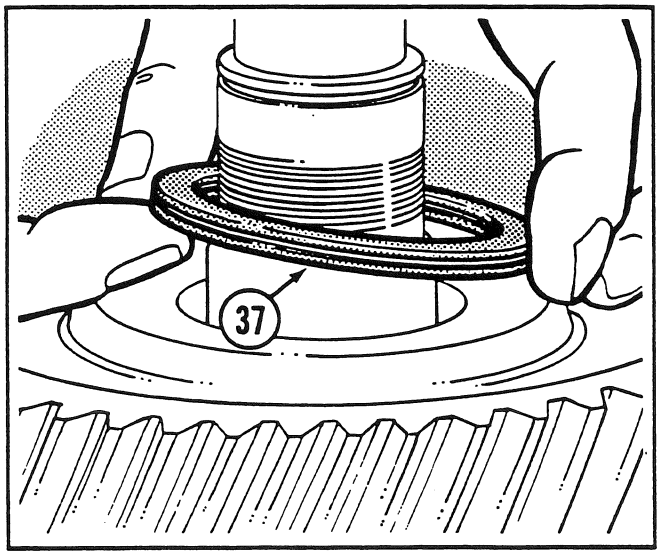

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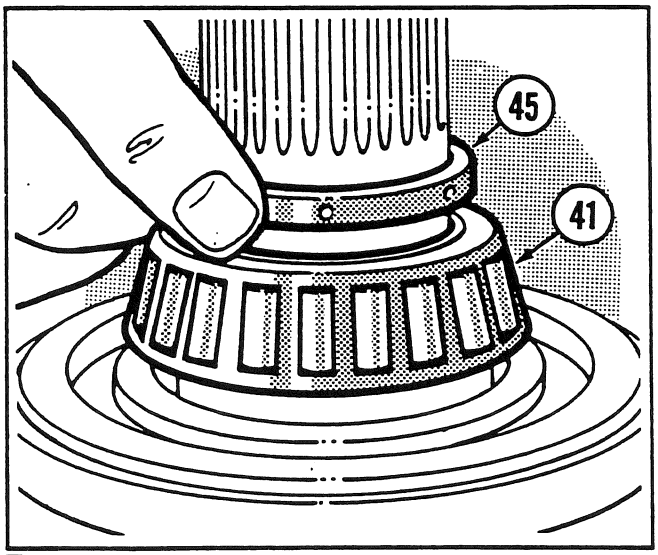


Fig. 121

Clutch Pack - Assembly (Continued)

Fig. 116
Install the needle roller bearings (39) on the shaft (33).

Fig. 117
Install the gear and drum assembly (38) on the shaft (33), taking care to engage the tangs of the reaction plates with the slots in the drum.

Fig. 118
Install the outer thrust bearing and washers (37). Refer to the 700 Series Parts Manual to select the exact thrust bearing size you need.

Fig. 119
If you are working on the intermediate clutch pack, install a new snap ring (44) and the cup spacer (43) in the gear and drum assembly (38). Make sure that the spacer is on the drum side of the snap ring.

Fig. 120
Use dry ice, a soft-faced hammer or soft metal drift to install the inner and outer bearing cups (42) in the gear and drum assembly (38).

Fig. 121

CAUTION

WHEN INSTALLING A BEARING CONE, ALWAYS USE A SUITABLE SOFT METAL TUBULAR DRIFT HAVING THE SAME DIAMETER AS THE CONE INNER RACE.

Lubricate the bearing cone (41). Use the hydraulic press and suitable drift to install the bearing cone. The bearing is easire to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Install the cone spacer (45) on the shaft.

Clutch Pack - Assembly (Continued)

Fig. 122
Install the gear and drum assembly (38) for the intermediate clutch pack, taking care to align the tangs of the reaction plates with the slots in the drum.

Fig. 123

CAUTION

WHEN INSTALLING A BEARING CONE, ALWAYS USE A SUITABLE SOFT METAL TUBULAR DRIFT HAVING THE SAME DIAMETER AS THE CONE INNER RACE.

Lubricate the bearing cone (41). Use the hydraulic press and suitable drift to install the bearing cone. The bearing is easire to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F).

Fig. 124
Apply anti-seize lubricant ('Rocol' J 166, or equivalent) to the splines of the shaft (33). Install any splined gears (36). Use a press to install the gears firmly against the clutch pack assembly.

Fig. 125

CAUTION

WHEN INSTALLING A BEARING CONE, ALWAYS USE A SUITABLE SOFT METAL TUBULAR DRIFT HAVING THE SAME DIAMETER AS THE CONE INNER RACE.

Lubricate the shaft bearing cones. Use the hydraulic press and suitable drift to install the bearing cone. The bearing is easire to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F).

Fig. 126
Install the locknut (34) and tighten to the specified torque using the special tool listed in the front of this Shop Manual Section.

Fig. 127
Install the bearing cups (71) in the bearing bores.

The clutch pack overhaul is now complete. For all clutch packs except the reverse clutch half-pack, repeat the procedures described in **Fig. 106** through **Fig. 124** to assemble the opposite side of the shaft assembly.

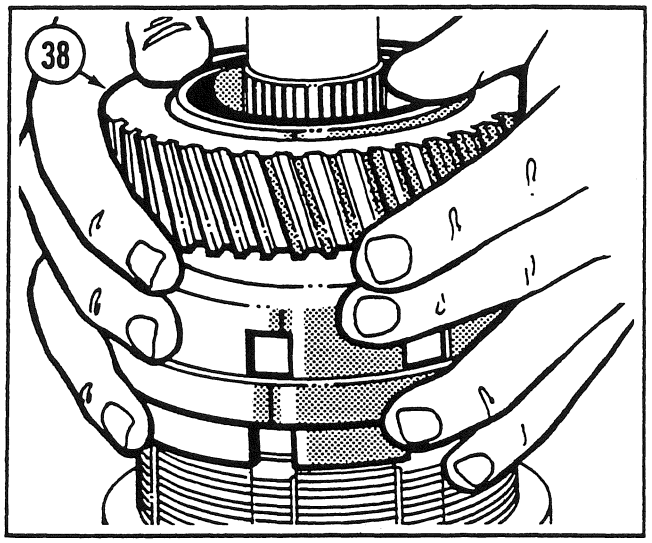
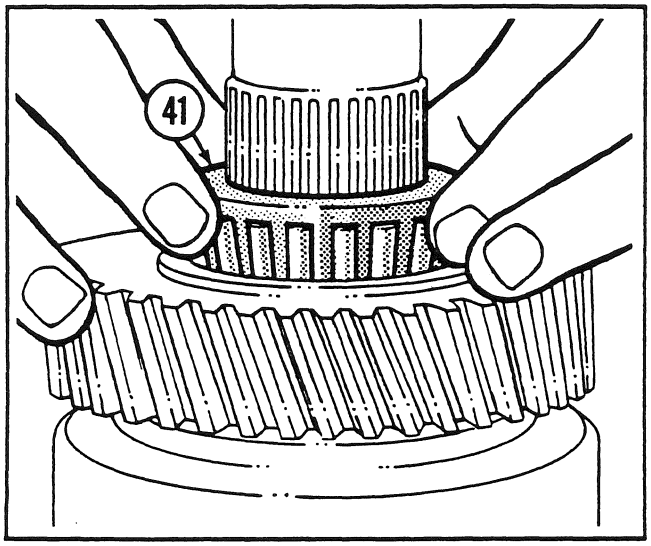


Fig. 122



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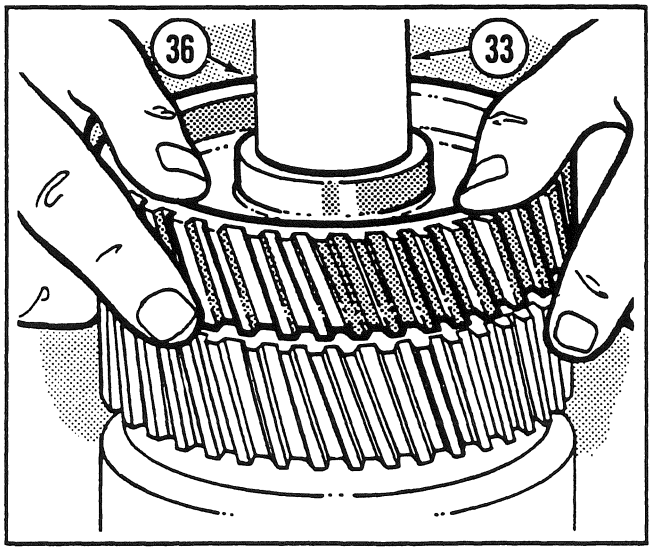

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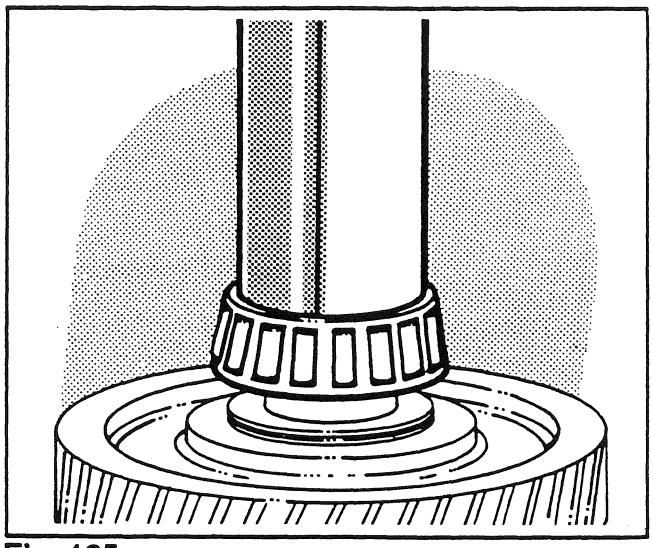
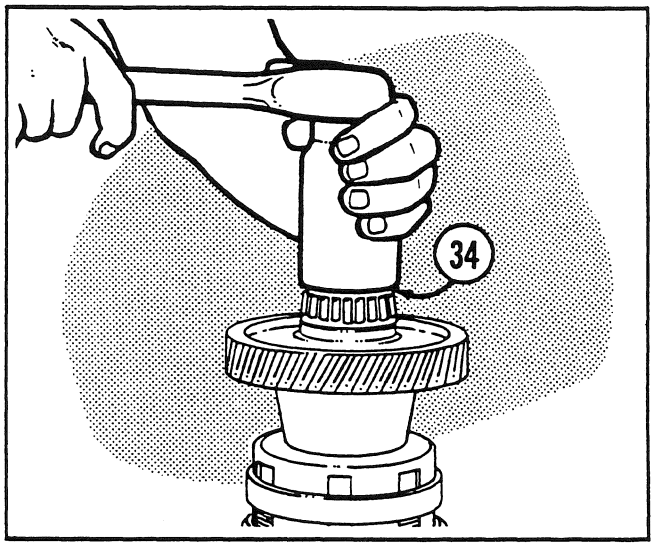


Fig. 125



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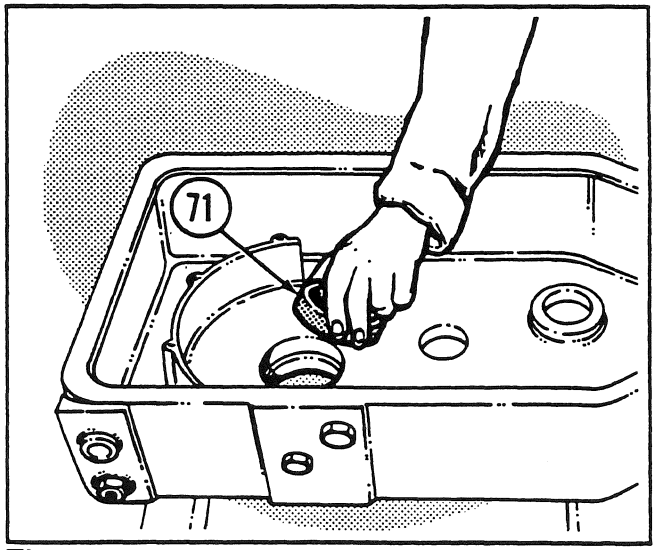

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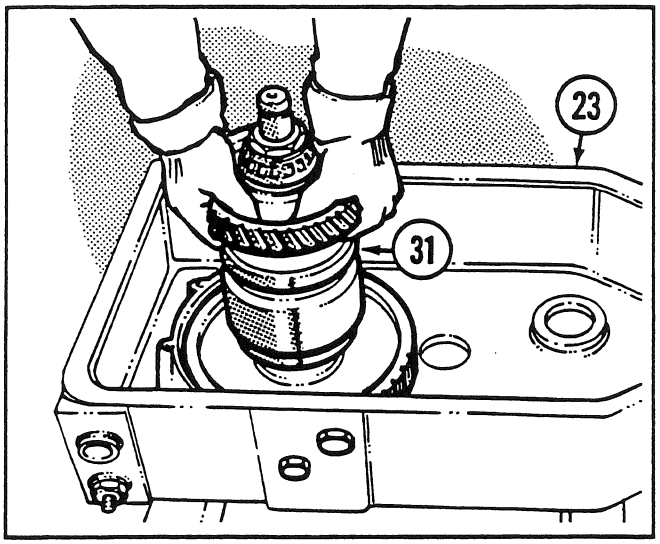

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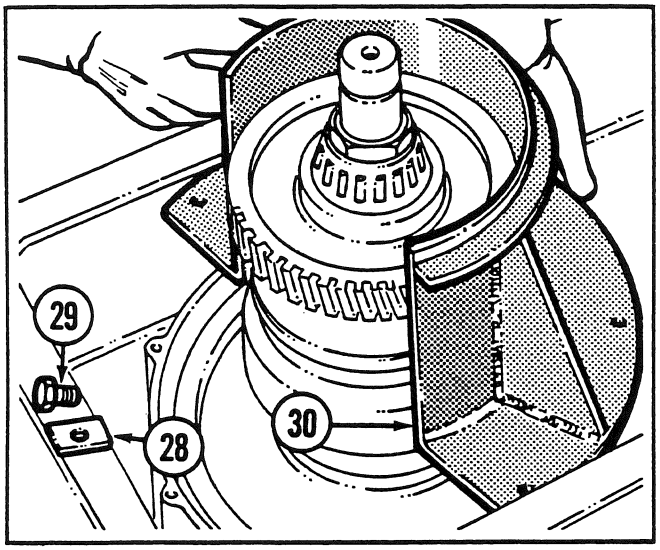

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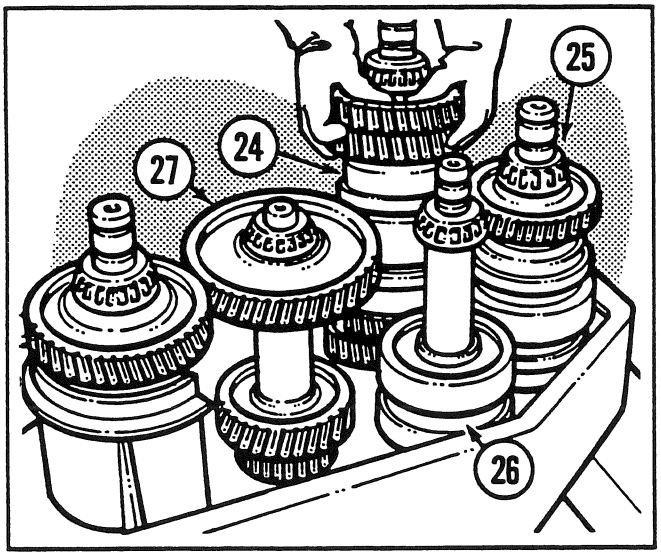

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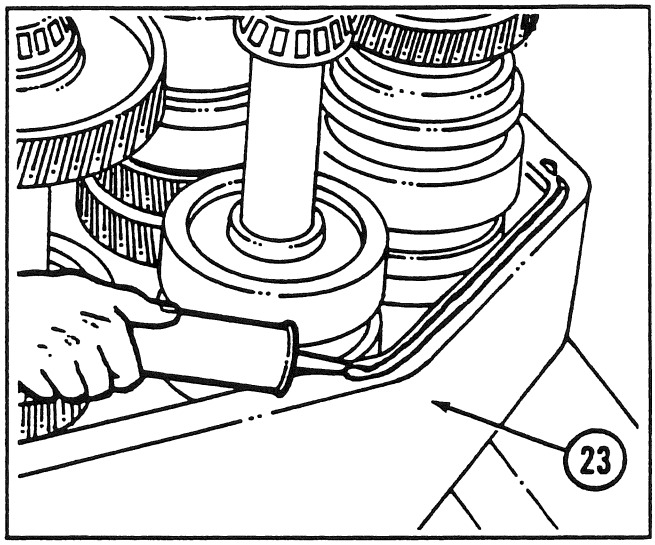

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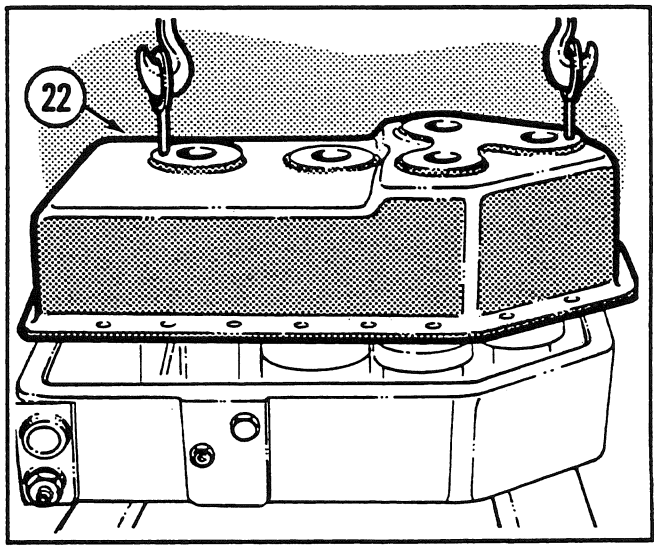


Fig. 132

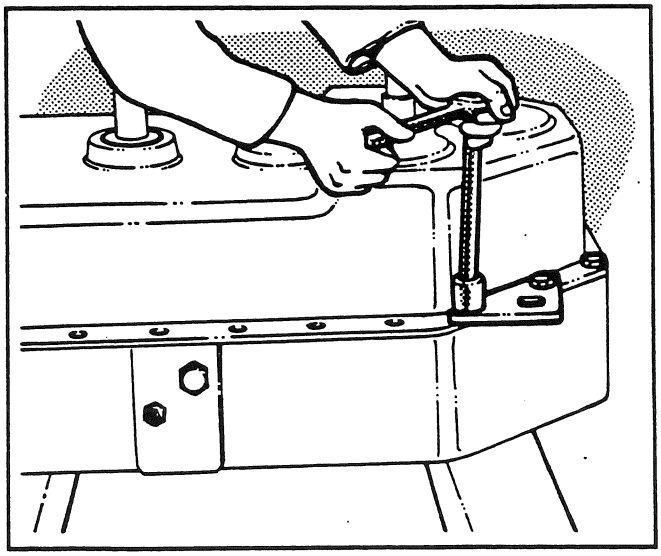


Fig. 133

Transmission - Assembly

Fig. 128
Install the yoke end of the output clutch pack (31) in the rear case half (23).

Fig. 129
Install the oil baffle (30). Install the capscrews (29) and new locking plates (28). Tighten the capscrews. Bend the locking plates over the capscrew heads and edge of the oil baffle.

Fig. 130
Install the clutch packs in the following order: the second intermediate shaft (27); the reverse clutch halfpack (26); the input clutch pack (25) and the intermediate clutch pack (24). The seal ring end of each shaft should be pointing up.

Fig. 131
Use 'Loctite Liquid Chisel', or equivalent, to clean the flange mating surfaces of both case halves, the mating surfaces of the control valve caps, second intermediate cap and regulator valve. Apply a bead of gasket eliminator, Champion part number 25303, 'Loctite' 515 or equivalent, to the flange mating surface of the rear case half (23).

Fig. 132
Carefully install the front case half (22).

Fig. 133
Install the capscrews, together with the transmission mounts and lifting eyes. Tighten the capscrews to the specified torque.

Transmission Assembly (Continued)

Fig. 134
The 8400 transmission uses shims in each shaft bearing bore to control proper end-float. The proper end-float is **0.002 in. to 0.006 in. (0,051 mm to 0,152 mm).** You must determine the correct shim thickness for **each** shaft. Install the special tool, part number **29858,** and secure with two capscrews. Torque-tighten the capscrews evenly to 20 lbf.in. (2,3 N.m; 0,23 kgf.m).

Fig. 135
Use the special tool, part number **29859,** to rotate the shaft assembly in both directions. This ensures that the tapered roller bearing is fully seated.

Fig. 136
Torque-tighten the capscrews evenly to 40 lbf.in. (4,5 N.m; 0,46 kgf.m) and repeat the rotating step in **Fig. 135.** Torque-tighten the capscrews evenly to 60 lbf.in. (6,8 N.m; 0,69 kgf.m) and repeat the rotating step in **Fig. 135.** Check the final torque and repeat this procedure as necessary to reach the final torque value. **These torque values are critical to the final outcome of the procedure, so follow them exactly!**

Fig. 137
Use a depth micrometer and measure through each of the four small holes in the special shim tool to the surface of the transmission case. Calculate and record the average measurement.

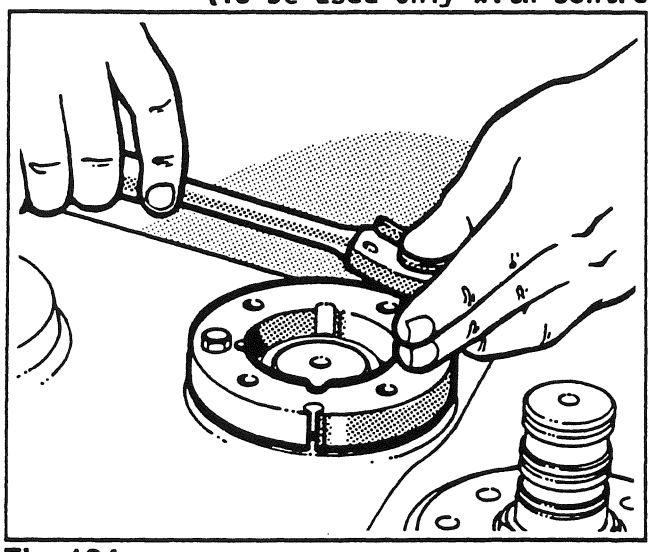
Fig. 138
Measure the depth of the cap counterbore in four places. Calculate and record the average measurement.

Fig. 139
Subtract **Fig. 138** average measurement from **Fig. 137** average measurement. Find this total in the **Average Measurement** column of the **SHIM SELECTION CHART** (refer to your grader serial number). Find the column for the shaft you are working on. Find the part number and thickness of the shim in that column opposite the **Average Measurement.** Use a micrometer to check the shim thickness. Compare with the chart before installation. Install the shim with the chamfered edge away from the bearing. Install the cap. If in doubt, repeat the shim selection procedure. **Remember,** improper end-float can cause bearing damage!

NOTE

DO NOT use the new caps with old (thinner) shims. Use only one shim for each bearing bore. NEVER use two thinner shims to equal the thickness of the required shim.

8400 TRANSMISSION
(To be used only with Control Valve Caps with Counterbores)



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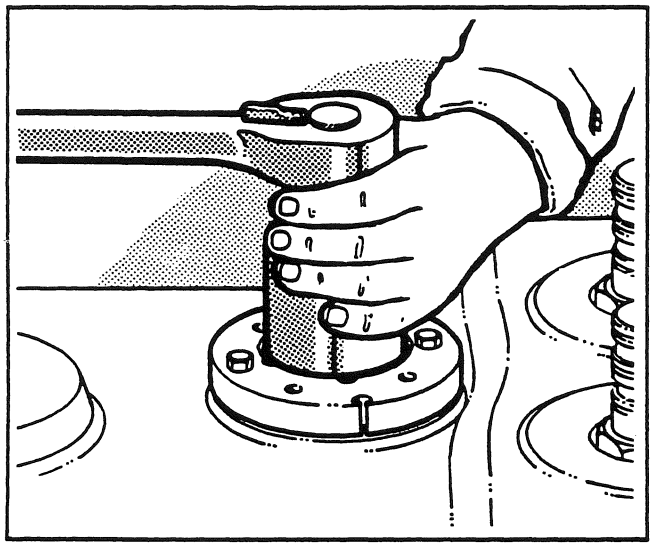

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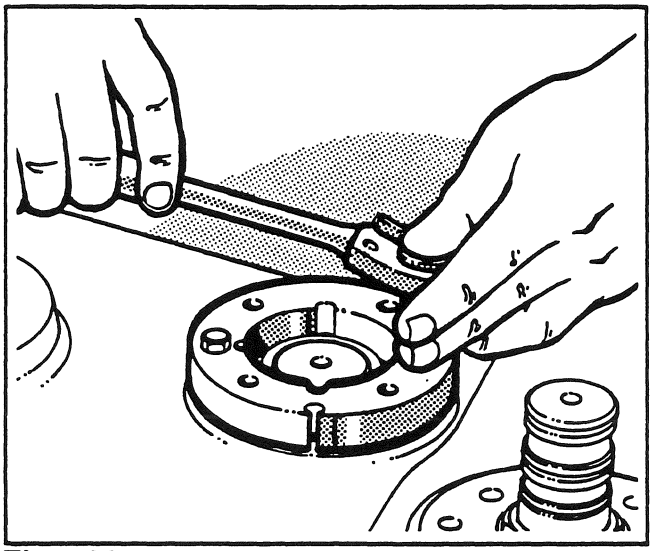
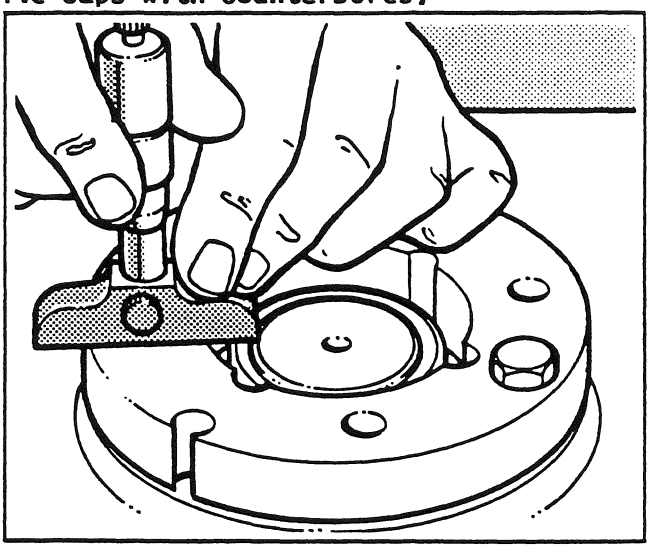


Fig. 136



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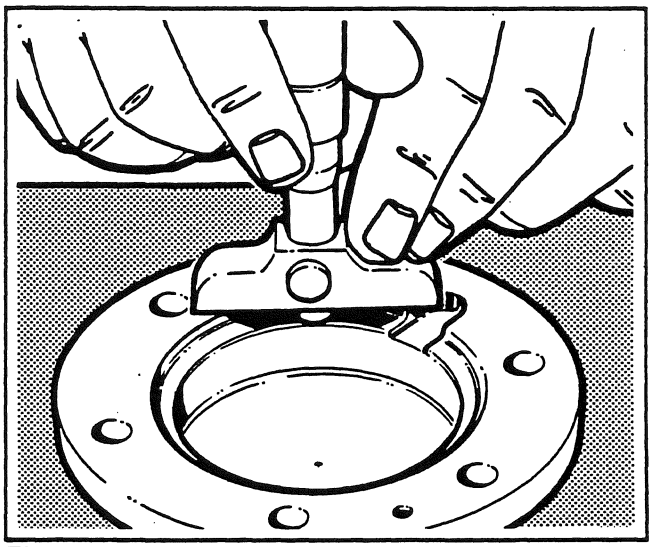

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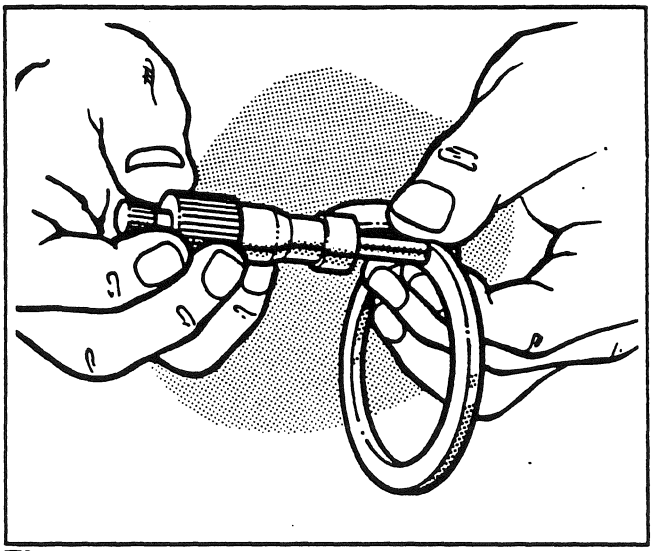

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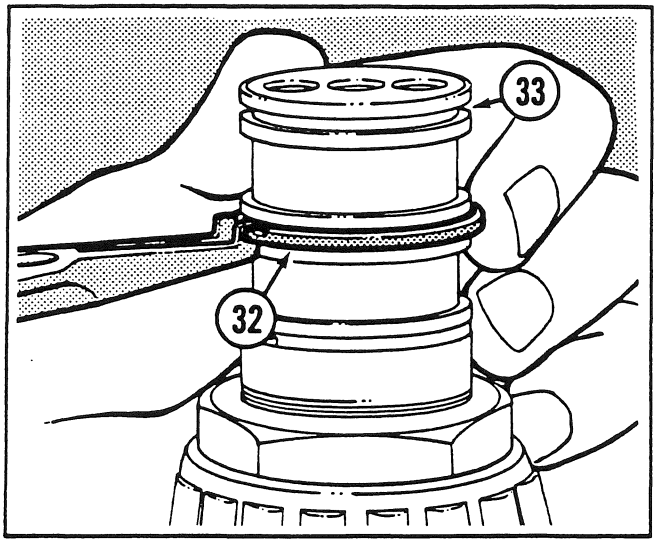

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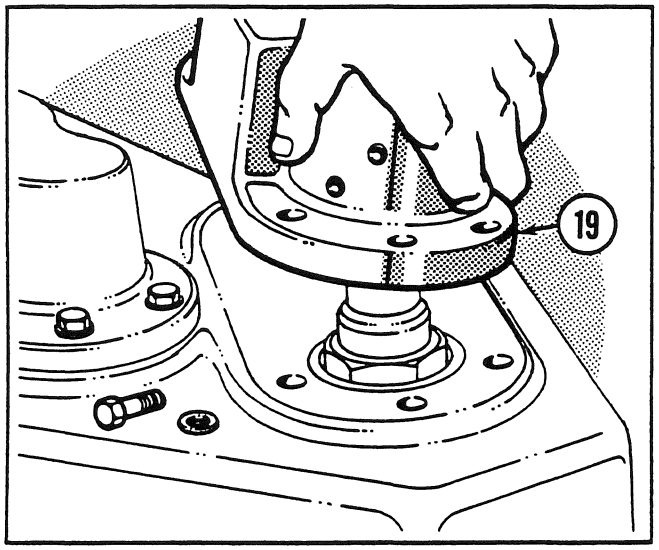

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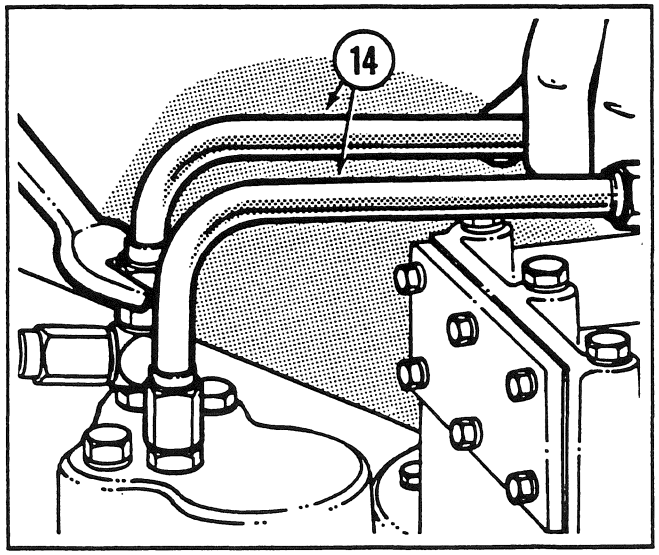

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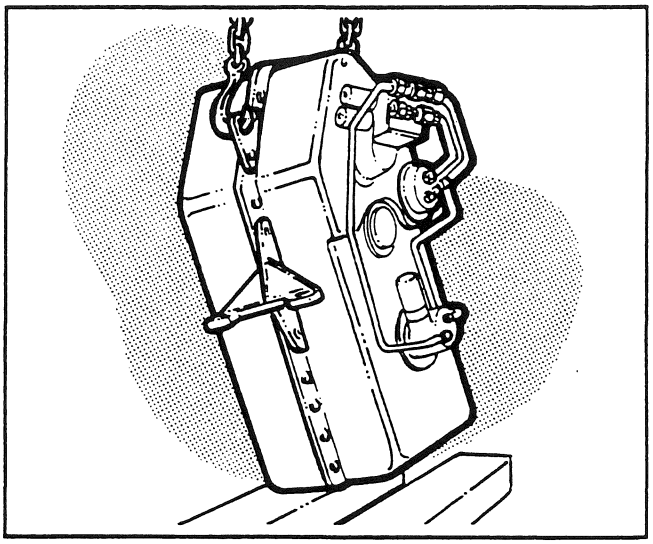


Fig. 143

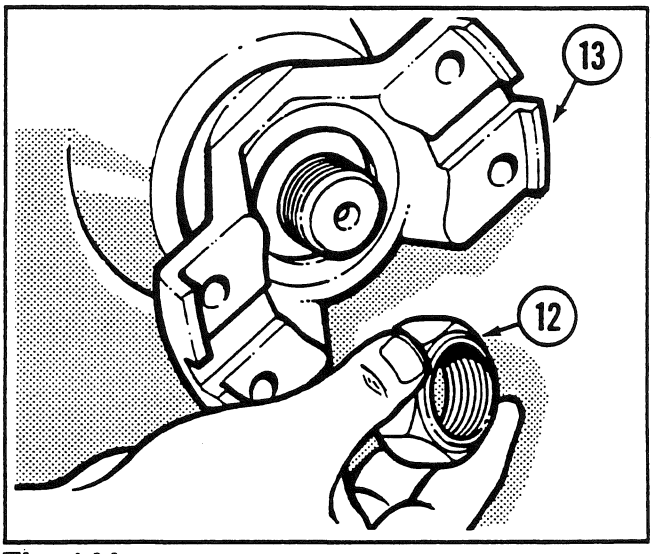


Fig. 144

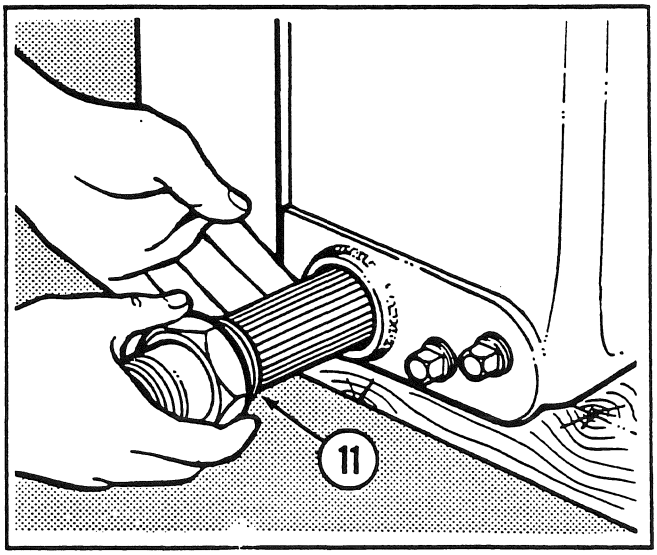


Fig. 145

Transmission - Installation

Fig. 140
Install new hook-type seal rings (32) on the valve end of all shafts.

Fig. 141
Apply a bead of gasket eliminator, Champion part number **25303**, 'Loctite' 515 or equivalent, to the mating surfaces of the control valve caps, second intermediate cap (19) and regulator valve (4). Centralize the seal rings on the shafts and install the control valve caps. **Take care not to damage the seal rings!** Install the second intermediate cap. Tighten the capscrews evenly. Finally, tighten the capscrews to the specified torque. Install the solenoids, spacers and nuts. **Be sure to tighten to the specified torque to avoid damaging the components!**

Fig. 142
Install the hydraulic tubes (14).

Fig. 143
Raise the transmission into an upright position.

Fig. 144
Apply a bead of gasket eliminator, Champion part number **25303**, 'Loctite, 515 or equivalent, to the bearing face of both driveshaft yokes (13) and install them. Install the washers and locknuts (12). Tighten the locknuts to the specified torque.

Fig. 145
Lubricate and install a new suction strainer O ring. Press the suction strainer bypass valve and check for free return spring action. Clean and install the suction strainer (11) and fitting (10).

Transmission - Installation (Continued)

Fig. 146
Place the model 8400 transmission on a jack and maneuver it under the grader. Raise the transmission carefully into position. Make sure that the mounts are properly aligned.

Fig. 147
Install and tighten the transmission mount bolts (9).

Fig. 148
Connect the upper and lower drive shafts (8). Tighten the capscrews to the specified torque.

Fig. 149
Connect the breather hose (6).

Fig. 150
Connect the clutch supply hose (5).

Fig. 151
Connect the transmission supply hose (3) to the regulator valve (4).

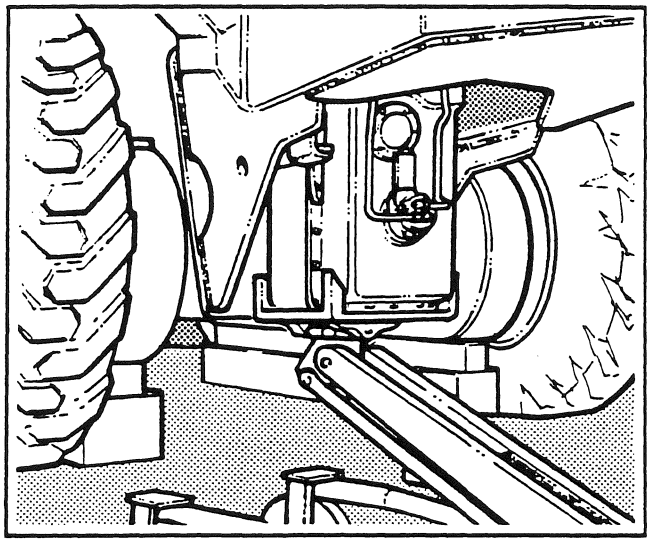


Fig. 146

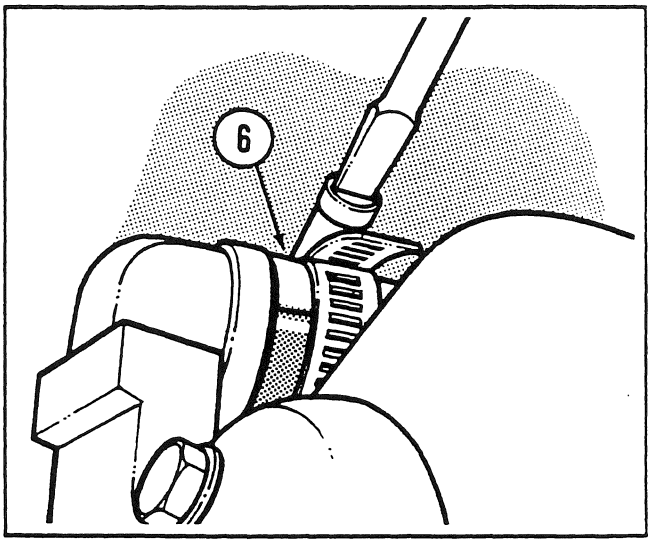


Fig. 149

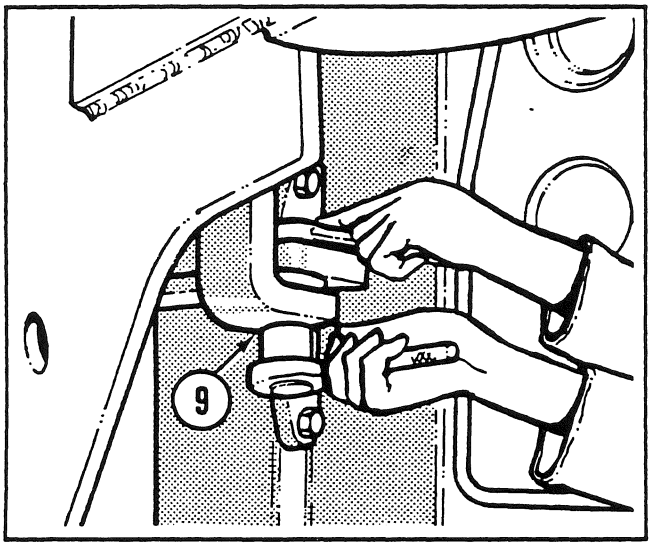


Fig. 147

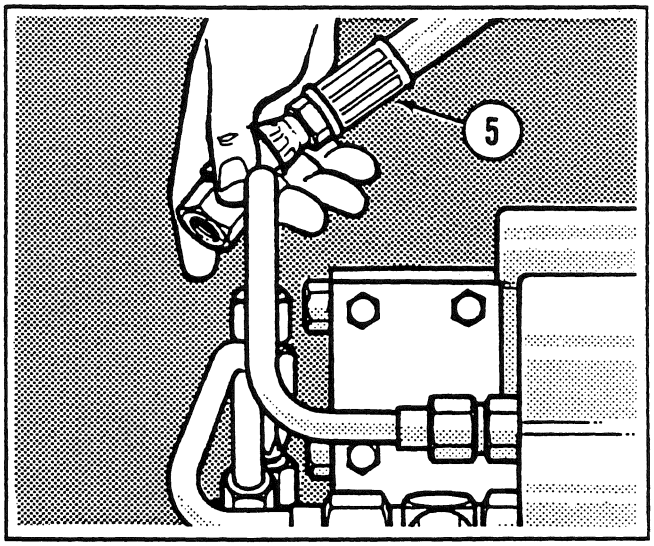


Fig. 150

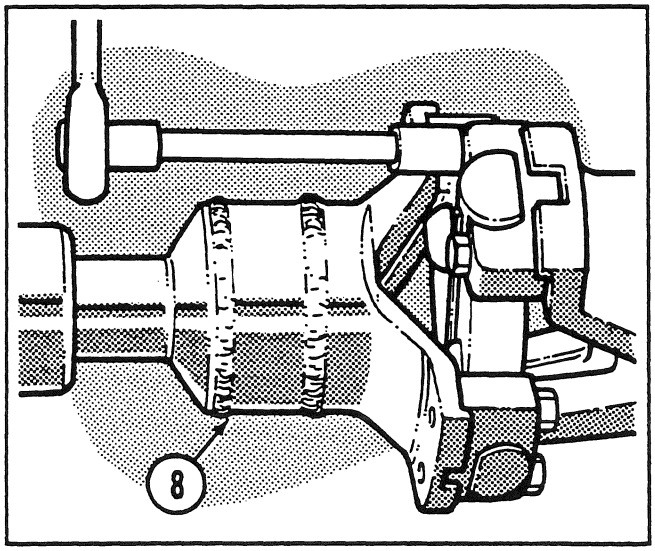


Fig. 148

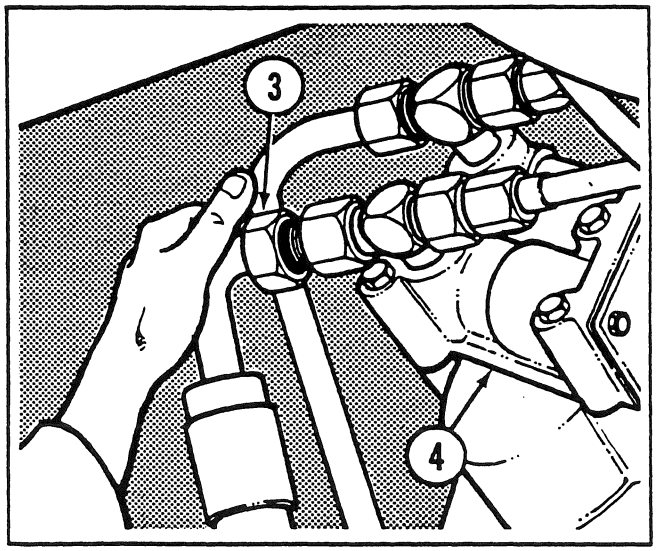


Fig. 151

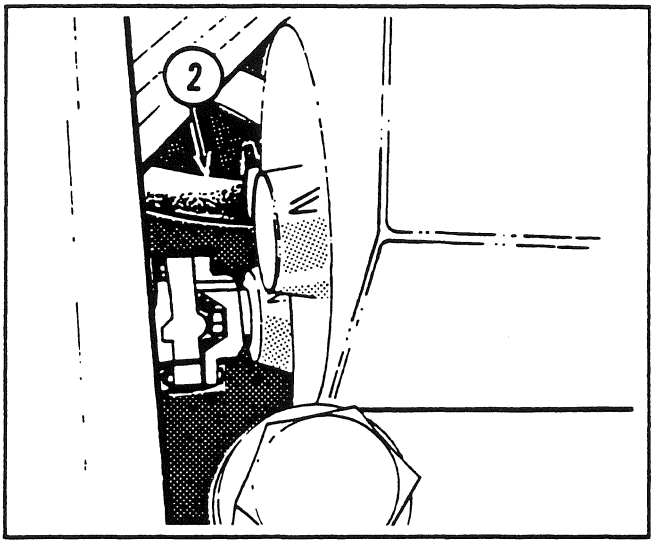


Fig. 152

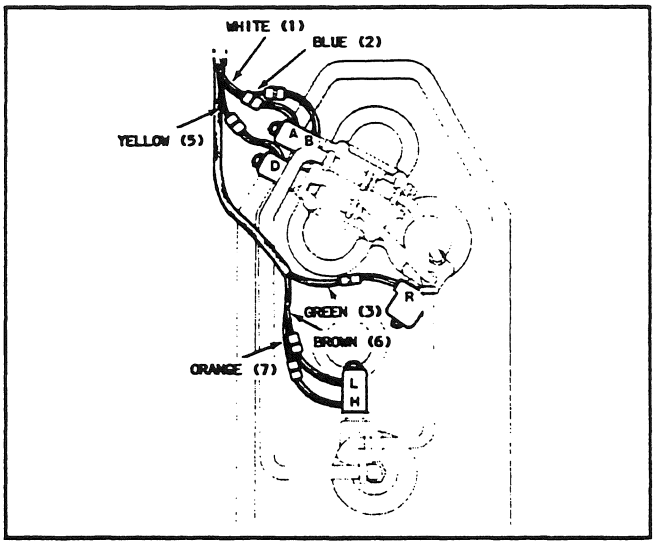


Fig. 155

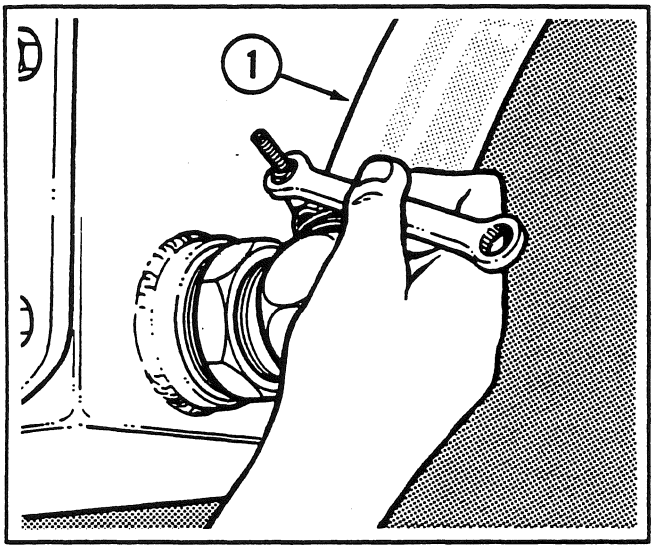


Fig. 153

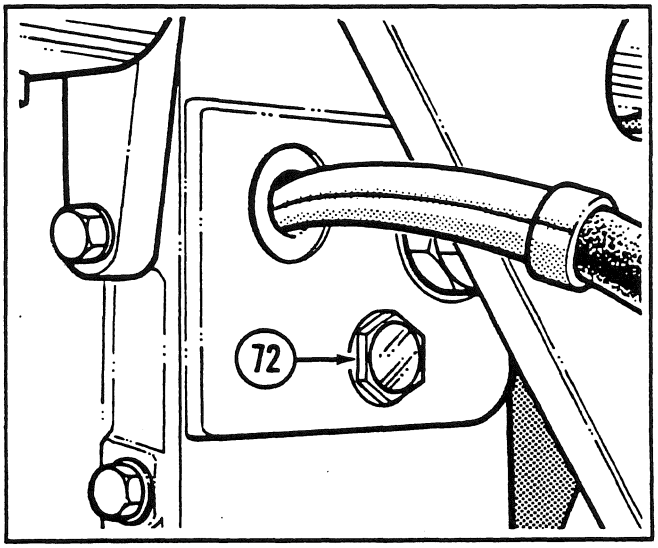


Fig. 156

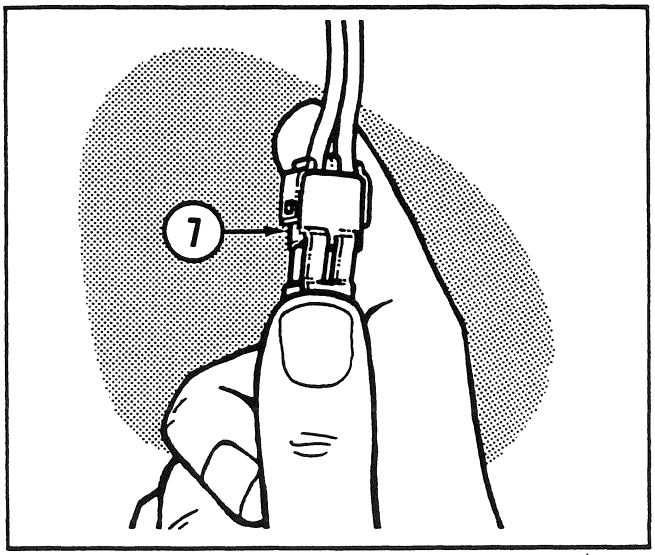


Fig. 154

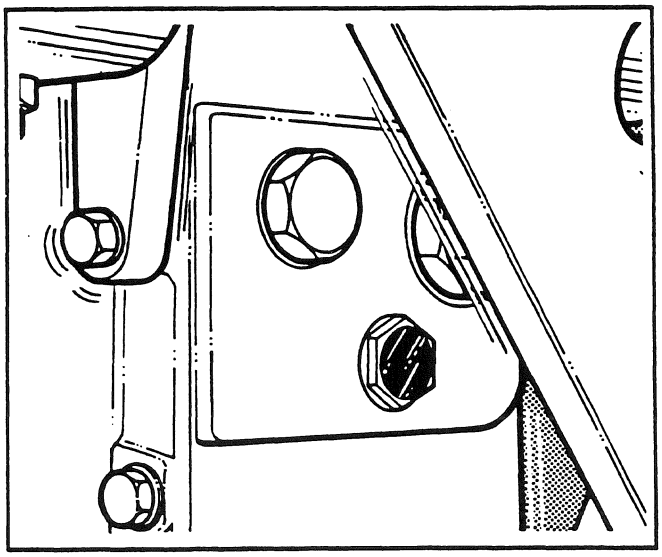


Fig. 157

Transmission - Installation (Continued)

Fig. 152
Connect the clutch drain hose (2).

Fig. 153
Connect the suction hose (1).

Fig. 154
Connect the transmission wiring harness (7). The harness consists of six color-coded or number-coded wires. Use the colors or numbers to make sure the wires are properly connected.

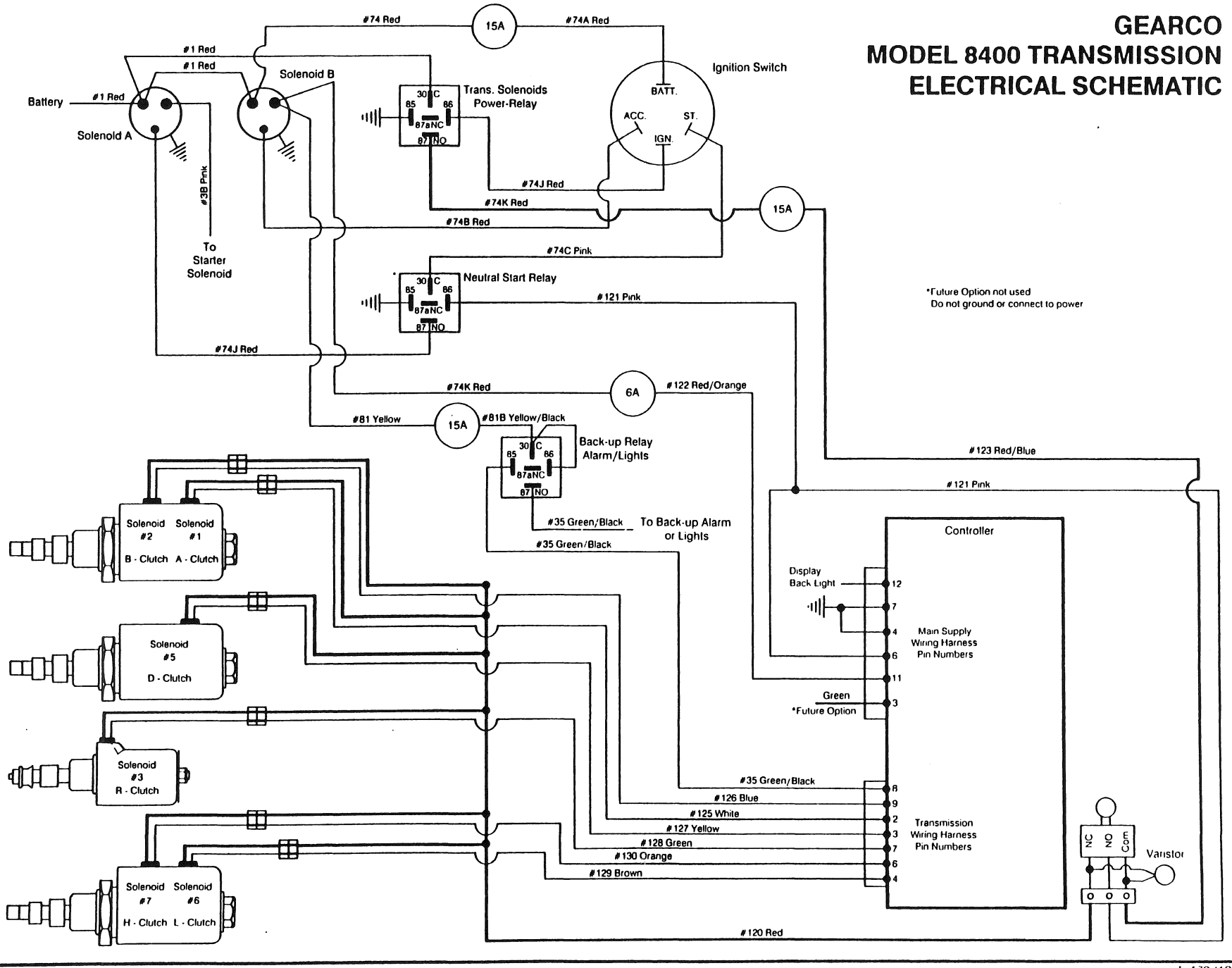
Fig. 155
Verify the positions of the wires by comparing them to the connection diagram on page 2 of this Shop Manual Section.

Fig. 156
Install a new transmission filter element. Refill the transmission with the lubricant recommended in the Lubrication Specifications at the front of this Shop Manual.

Fig. 157
Park the grader on level ground. With the engine running at idle and at operating temperature, make sure you can see transmission oil half-way up the level check sight glass.

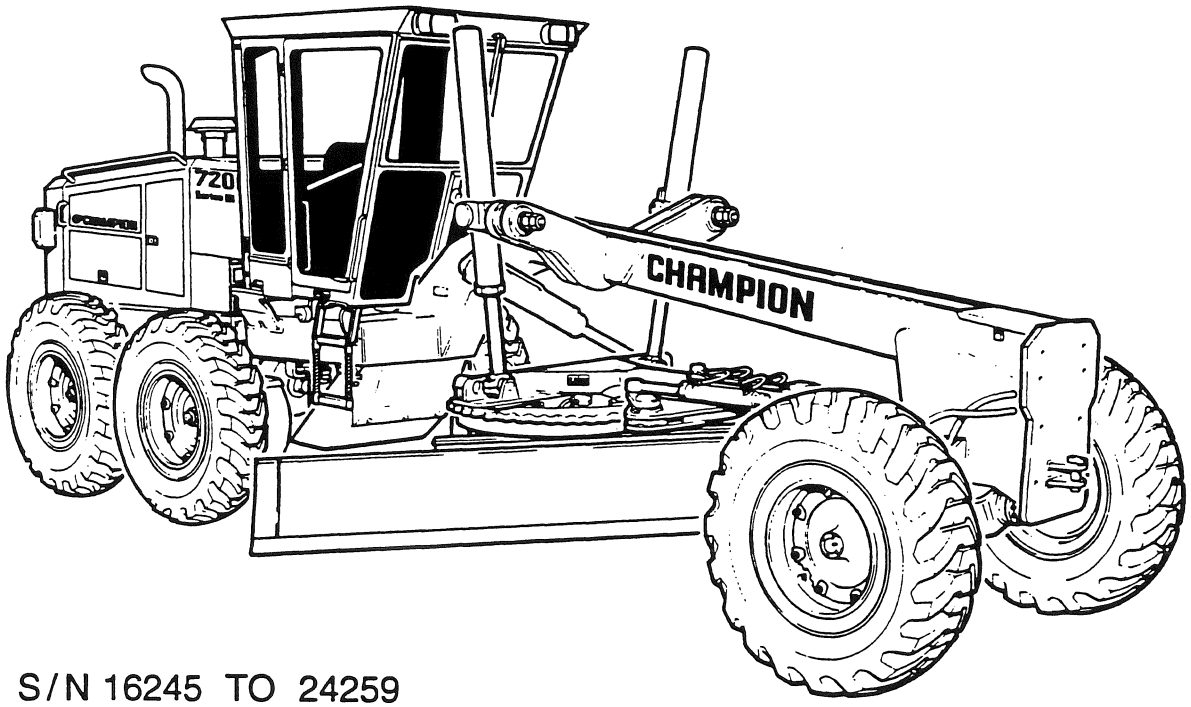
Road test the grader to make sure that the transmission functions properly. Check all connections for leaks. When you are satisfied that everything is working properly, install the transmission guard.

GEARCO
MODEL 8400 TRANSMISSION
ELECTRICAL SCHEMATIC



CHAMPION
MOTOR GRADERS

8400 Electrical Troubleshooting Guide



S/N 16245 TO 24259

L-2009-02 (08/91)

Error Code Table

CODE	MALFUNCTION	CODE	MALFUNCTION
1.0	Electric power is below 9.5 Vdc	3.0	Short circuit, solenoid 2 (B)
		3.1	Short circuit, solenoid 3 (R)
2.0	Open circuit, solenoid 2 (B)	3.3	Short circuit, solenoid 6 (L)
2.1	Open circuit, solenoid 3 (R)	3.4	Short circuit, solenoid 7 (H)
2.3	Open circuit, solenoid 6 (L)	3.5	Short circuit, solenoid 5 (D)
2.4	Open circuit, solenoid 7 (H)	3.6	Short circuit, solenoid 1 (A)
2.5	Open circuit, solenoid 5 (D)		
2.6	Open circuit, solenoid 1 (A)	4.0	Forward/Neutral input error
		4.1	Reverse/Neutral input error
2.7	No power to solenoid circuits		
		4.2*	Controller restart error
		4.4**	Forward/Reverse input error

All Error Codes are common between 1.7, 1.8, 2.7 and 6.0 software except:

* Found only in 1.8 AND 2.7 software

** Found only in 2.7 software

This guide only applies to 12Vdc running electrical systems. The transmission controller and solenoids installed in graders with 24Vdc start but 12Vdc charging systems operate on 12Vdc.

Please consult Champion for information about graders equipped with a total 24Vdc electrical system.

NOTE: The information contained in this 8400 Electrical Trouble Shooting Guide is for reference only. Refer to the Champion 700 Series Shop Manual for proper safety and service procedures BEFORE performing any service procedure.

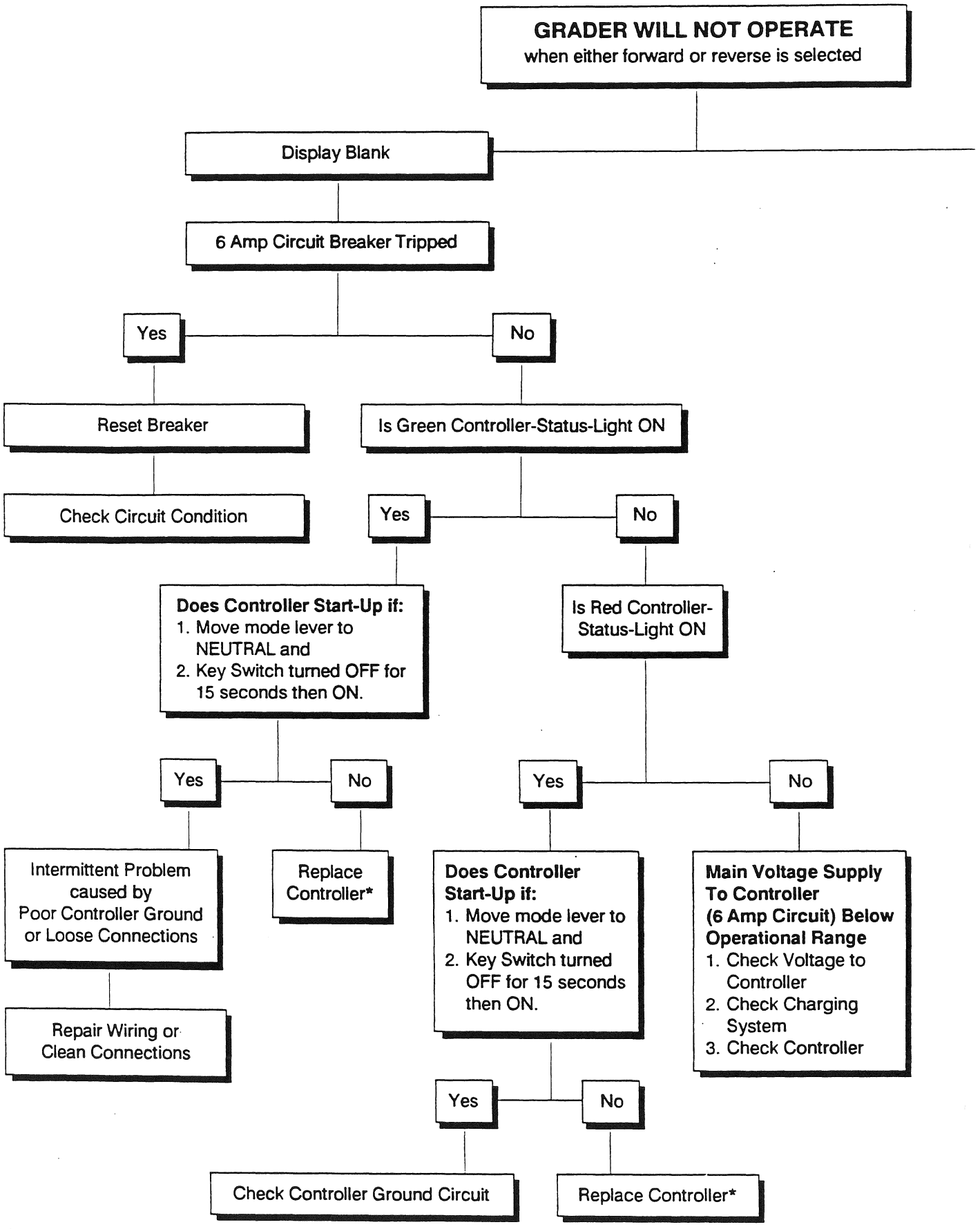
Champion Road Machinery cannot anticipate all circumstances that may arise. Thus this chart is only a guide to trouble shooting the 8400 Electrical System.

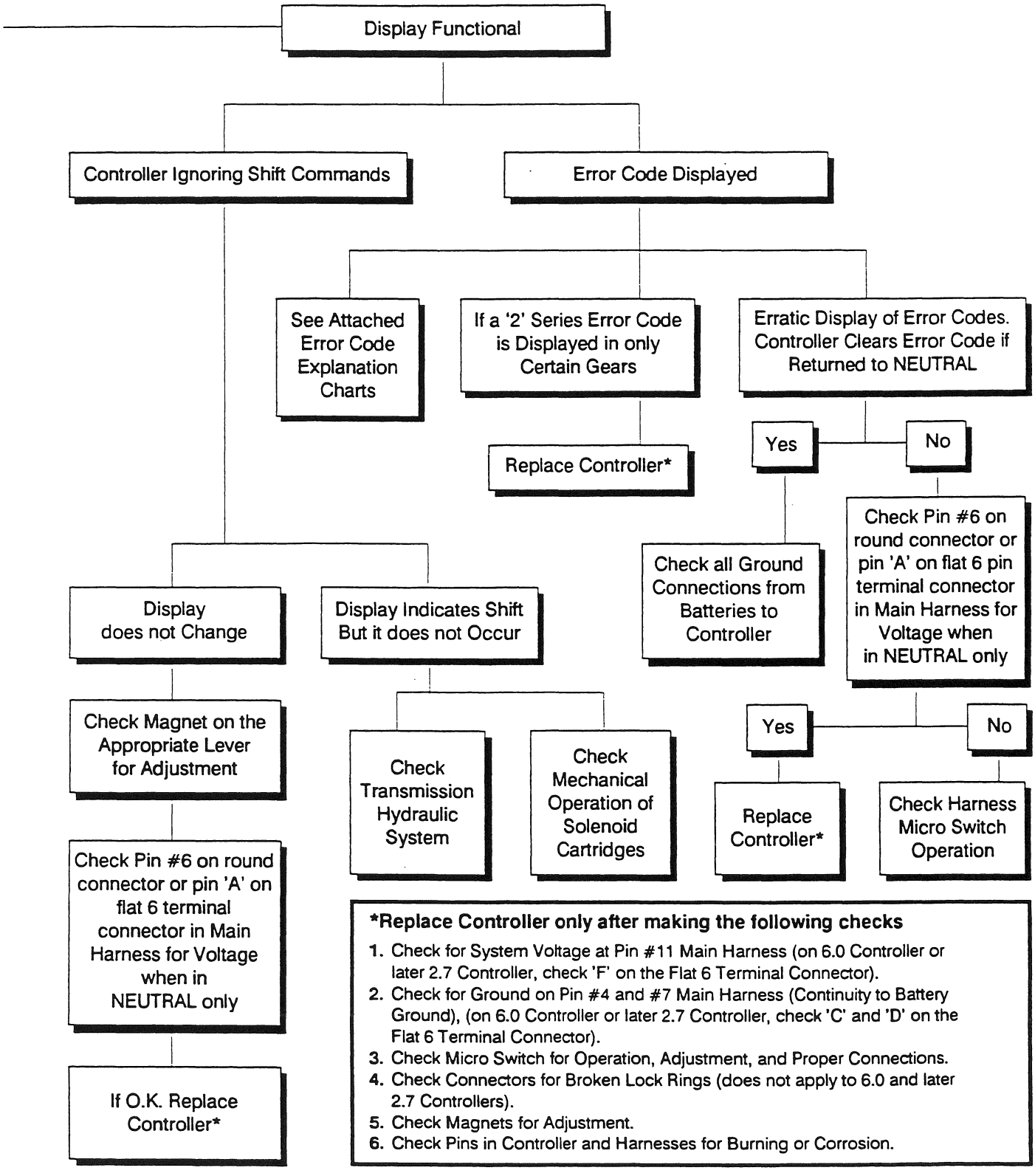
Error Code Explanation Chart

CODE SERIES	DESCRIPTION
1.0	**Low system voltage** Check: - Applied voltage at Controller (pin #11on round connector or pin 'F' on flat 6 terminal connector) - Charging system - For proper grounding of Controiler
2.0 - 2.6	**Open circuit or short to ground in applicable Solenoid circuit** *Check for continuity at: - Solenoid coil - Solenoid wiring harness - Controller connection
2.7	**No voltage in 15 amp circuit (Transmission Solenoid)** Check for continuity at: - Circuit breaker - Transmission relay - Normally closed terminals on micro switch when in Forward or Reverse - At each Solenoid - At Transmission harness connector to Controller
3.0 - 3.6	**Short circuit in applicable Solenoid circuit** Check: - Solenoid coil resistance - Solenoid wiring harness and coil resistance - Controller connection for corrosion
4.0 - 4.1	**Forward or Reverse input error** Check: - Neutral start micro switch operation - Magnets for proper clearance and adjustment
4.2	**Neutral input error** - F-N-R lever was left in gear when unit was shut off, or shifted during start-up sequence, or controller experienced a momentary power or ground loss - Shift F-N-R lever to Neutral - Check power supply to pin #11 on main supply harness on round connector or pin 'F' on flat 6 terminal connector
4.4	**Internal Forward or Reverse signal switch malfunction** - Obtainable only when leaving Neutral - Replace Controller

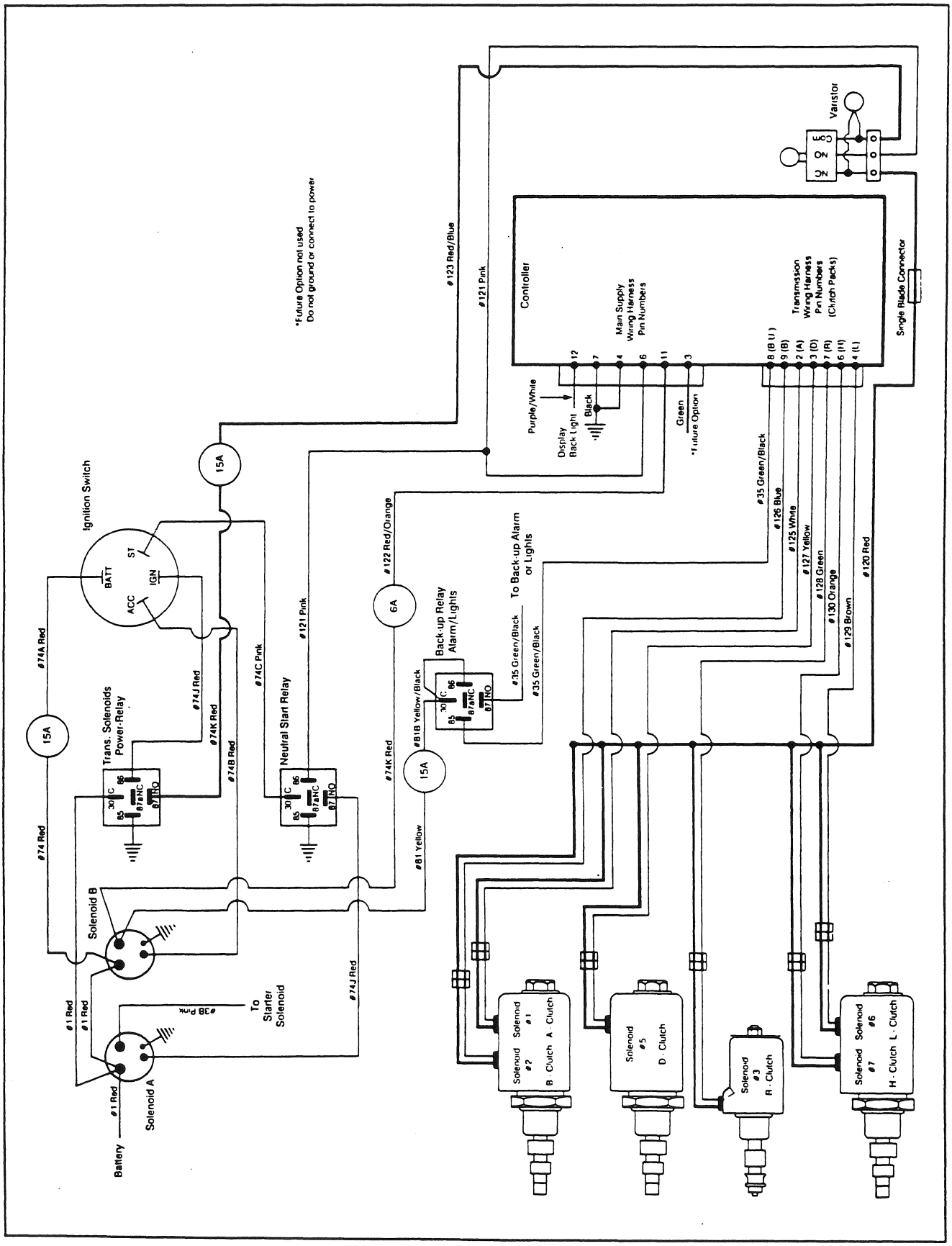
* When using an ohmmeter, ensure the battery isolation switch is turned OFF.

Grader will not Operate

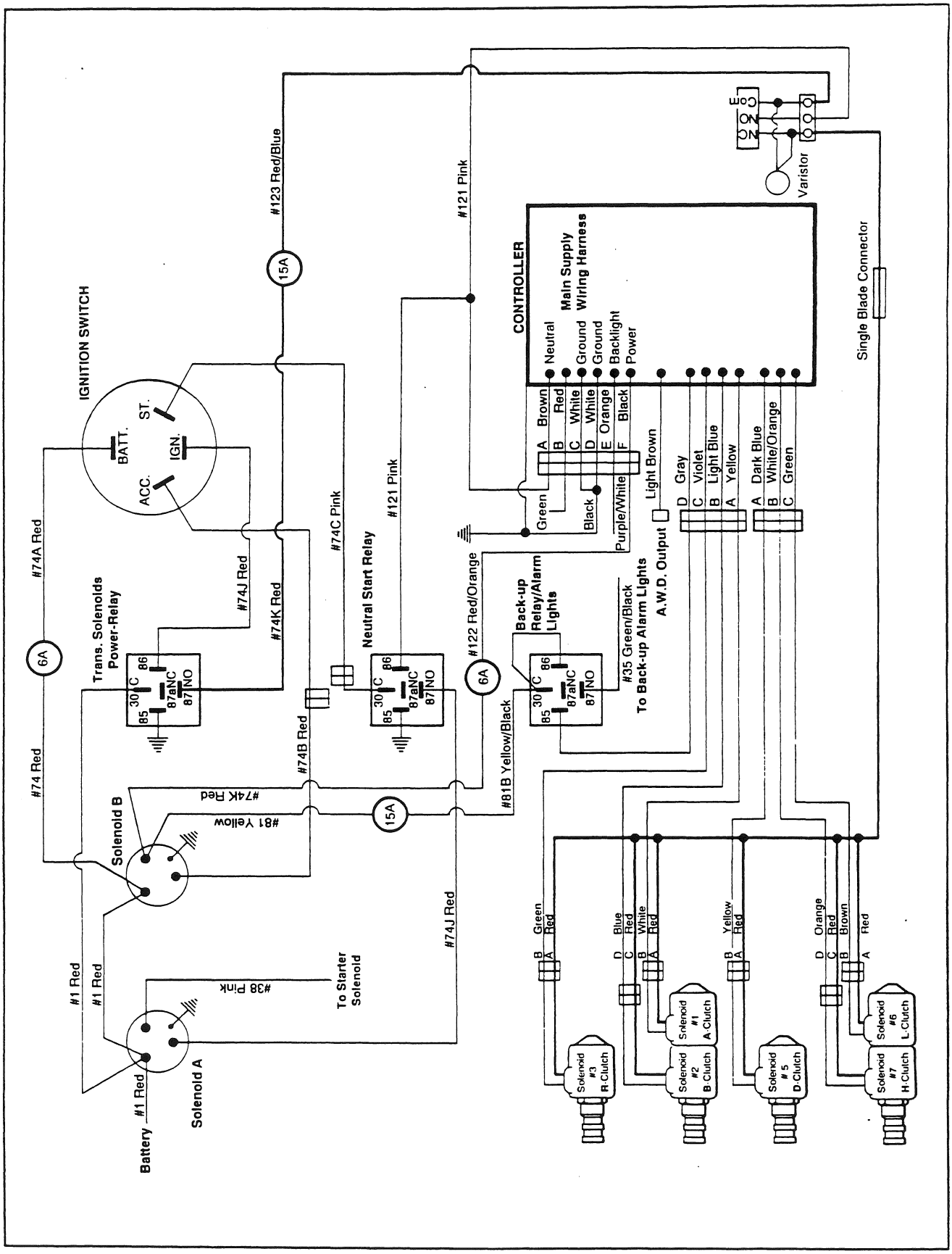



Display Functional
Controller Ignoring Shift Commands
Error Code Displayed
See Attached Error Code Explanation Charts
If a '2' Series Error Code is Displayed in only Certain Gears
Erratic Display of Error Codes. Controller Clears Error Code if Returned to NEUTRAL
Replace Controller*
Yes
No
Check all Ground Connections from Batteries to Controller
Check Pin #6 on round connector or pin 'A' on flat 6 pin terminal connector in Main Harness for Voltage when in NEUTRAL only
Yes
No
Replace Controller*
Check Harness Micro Switch Operation
Display does not Change
Display Indicates Shift But it does not Occur
Check Magnet on the Appropriate Lever for Adjustment
Check Transmission Hydraulic System
Check Mechanical Operation of Solenoid Cartridges
Check Pin #6 on round connector or pin 'A' on flat 6 terminal connector in Main Harness for Voltage when in NEUTRAL only
If O.K. Replace Controller*
*Replace Controller only after making the following checks
1. Check for System Voltage at Pin #11 Main Harness (on 6.0 Controller or later 2.7 Controller, check 'F' on the Flat 6 Terminal Connector).
2. Check for Ground on Pin #4 and #7 Main Harness (Continuity to Battery Ground), (on 6.0 Controller or later 2.7 Controller, check 'C' and 'D' on the Flat 6 Terminal Connector).
3. Check Micro Switch for Operation, Adjustment, and Proper Connections.
4. Check Connectors for Broken Lock Rings (does not apply to 6.0 and later 2.7 Controllers).
5. Check Magnets for Adjustment.
6. Check Pins in Controller and Harnesses for Burning or Corrosion.

Electrical Schematic - Gearco Model 8400 Transmission
Up to S/N 21449



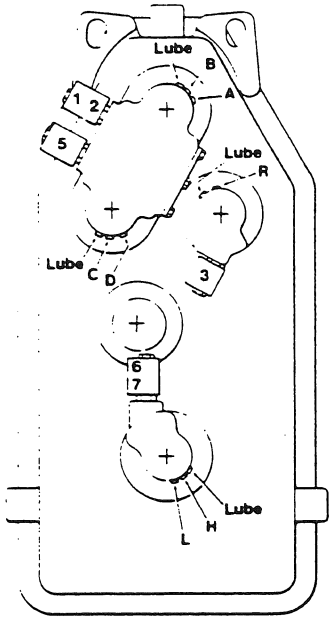
Electrical Schematic - Gearco Model 8400 Transmission
S/N 21450 TO 24259



Solenoid/Clutch Engagement

SPEED	SOLENOIDS ENERGIZED	CLUTCH ENGAGED
1	1, 6	ACL
2	2, 6	BCL
3	1, 5, 6	ADL
4	2, 5, 6	BDL
5	1, 7	ACH
6	2, 7	BCH
7	1, 5, 7	ADH
8	2, 5, 7	BDH
Neutral	None	C
-1	3, 6	RCL
-2	3, 5, 6	RDL
-3	3, 7	RCH
-4	3, 5, 7	RDH

Solenoid/Pressure Checkpoint Locations



Solenoid Coil Resistance Values - approximate (12Vdc only) Up to S/N 21449

CLUTCH PACK	SOLENOID COIL	PART NUMBER	RESISTANCE VALUE (HIGH & LOW TOLERANCES)
Rev.	3	37107	8.6 to 8.1 ohms (Ω)
AB & LH	1/2 & 6/7	37105/56211	6.3 to 5.9 ohms (Ω)
D	5	37106	5.2 to 4.9 ohms (Ω)

Resistance should be measured at a temperature of 20°C (68°F). Refer to the table in Section 8, Page 5 of the 700 Series Shop Manual. Amend the figures in the table to those shown above.

Torque Specifications - Up to S/N 21449

APPLICATION	lbf.ft	N.m
AB, LH & D Valve Cartridges	30 - 40	41 - 54
Solenoid Retaining Nuts for above	5 - 6	6,8 - 8,1
R Valve Cartridge	16 - 20	22 - 27
Solenoid Retaining Nuts for above	3 - 4	4,1 - 5,4

Solenoid Coil Resistance Values - S/N 21450 TO 24259

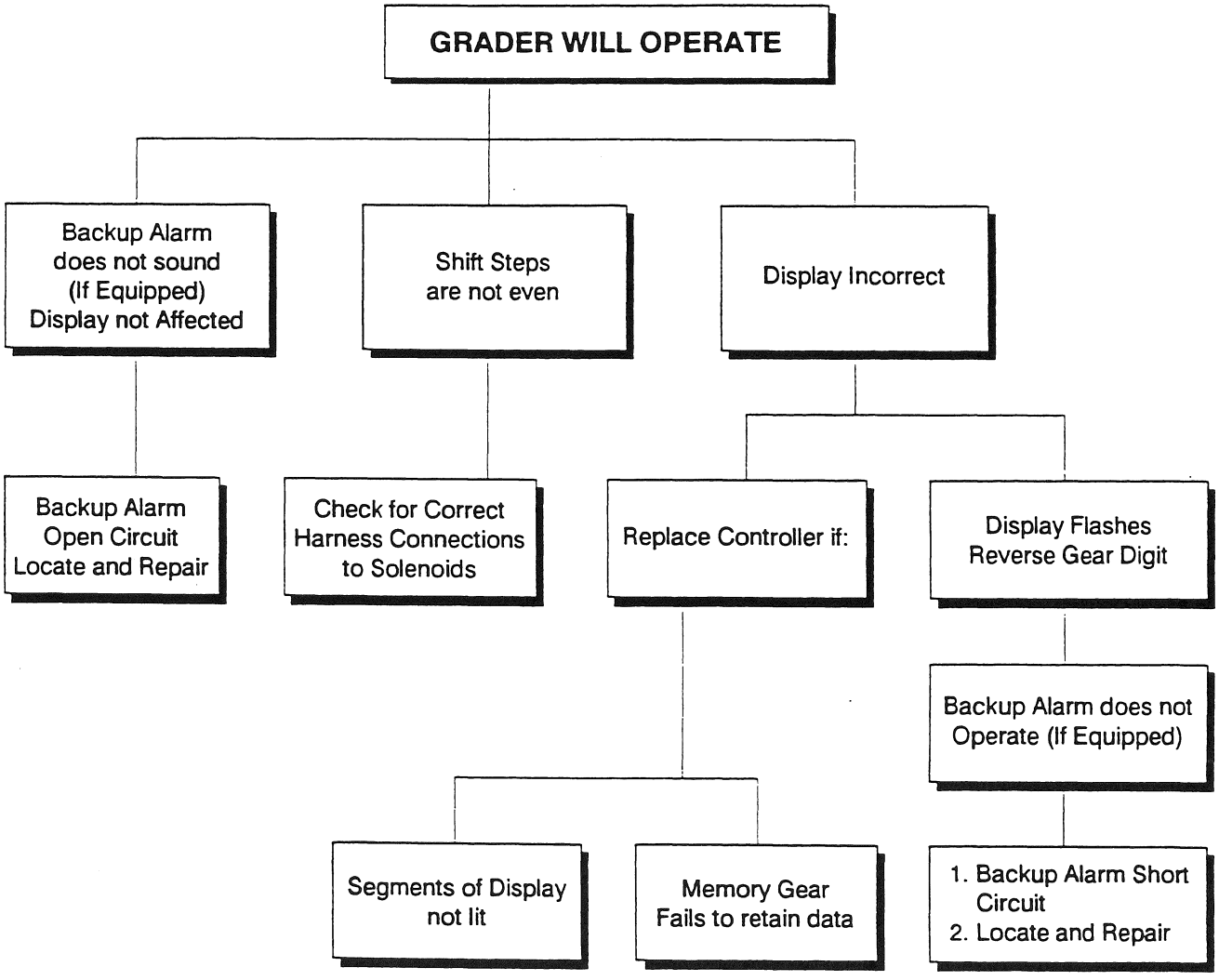
SOLENOID COIL	PART NUMBER	RESISTANCE VALUE
12 Volt	58727	7.2 (Ω)
24 Volt	58728	28.8 (Ω)

Resistance at a temperature of 20°C (68°F).

Torque Specifications - S/N 21450 TO 24259

APPLICATION	lbf.ft	N.m
Solenoid Cartridges	25	33,9
Solenoid Retaining Nut	5	6,8

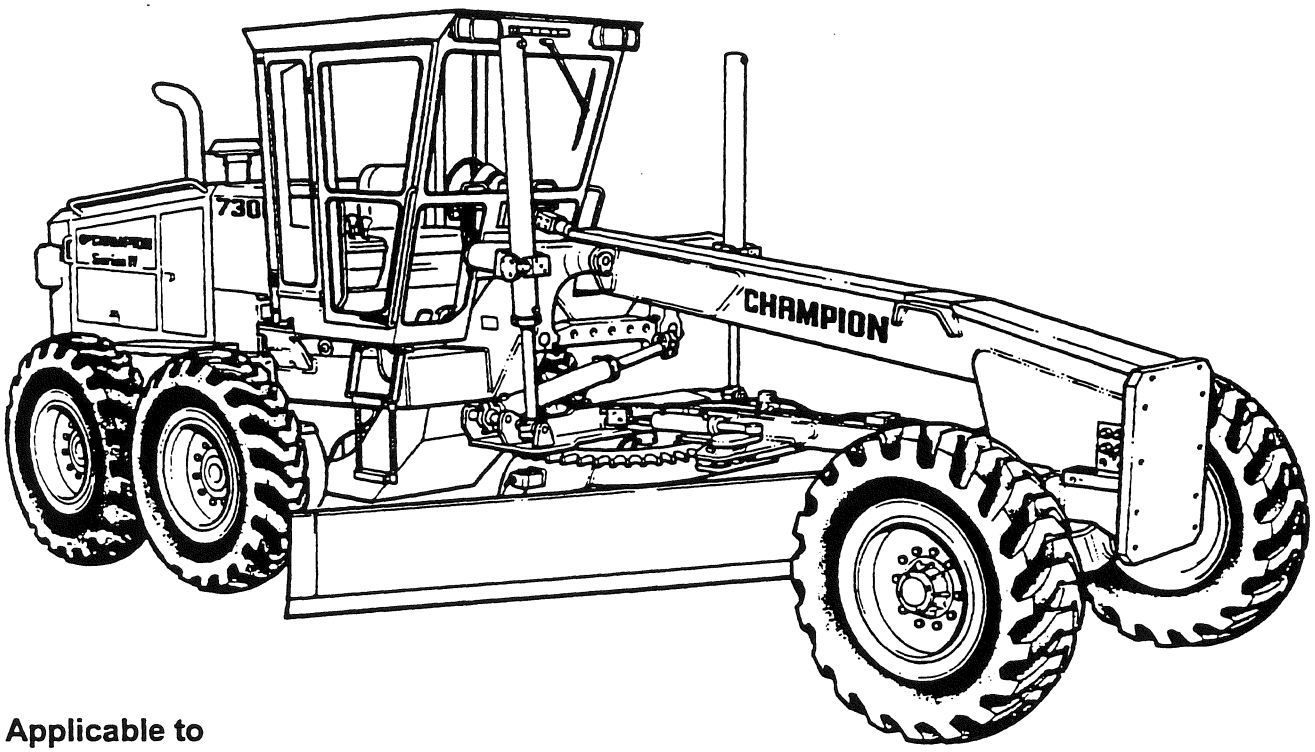
Grader will Operate



Notes

CHAMPION
ROAD MACHINERY

700 SERIES GRADER



Applicable to
Grader Serial Number 24260 & up.

Model 8400 Transmission
Electrical Troubleshooting Guide

L-2021-00 (03/95)

Error Code Table

CODE	MALFUNCTION	CODE	MALFUNCTION
1.0	Electric power is below 19.5 Vdc	3.0	Short circuit, solenoid 2 (B)
		3.1	Short circuit, solenoid 3 (R)
2.0	Open circuit, solenoid 2 (B)	3.3	Short circuit, solenoid 6 (L)
2.1	Open circuit, solenoid 3 (R)	3.4	Short circuit, solenoid 7 (H)
2.3	Open circuit, solenoid 6 (L)	3.5	Short circuit, solenoid 5 (D)
2.4	Open circuit, solenoid 7 (H)	3.6	Short circuit, solenoid 1 (A)
2.5	Open circuit, solenoid 5 (D)		
2.6	Open circuit, solenoid 1 (A)	4.0	Forward/Neutral input error
		4.1	Reverse/Neutral input error
2.7	No power to solenoid circuits		
		4.2	Controller restart error
		4.4	Forward/Reverse input error

NOTE: The information contained in this 8400 Transmission Electrical Troubleshooting Guide is for reference only. Refer to the Champion 700 Series Shop Manual for proper safety and service procedures BEFORE performing any service procedure.

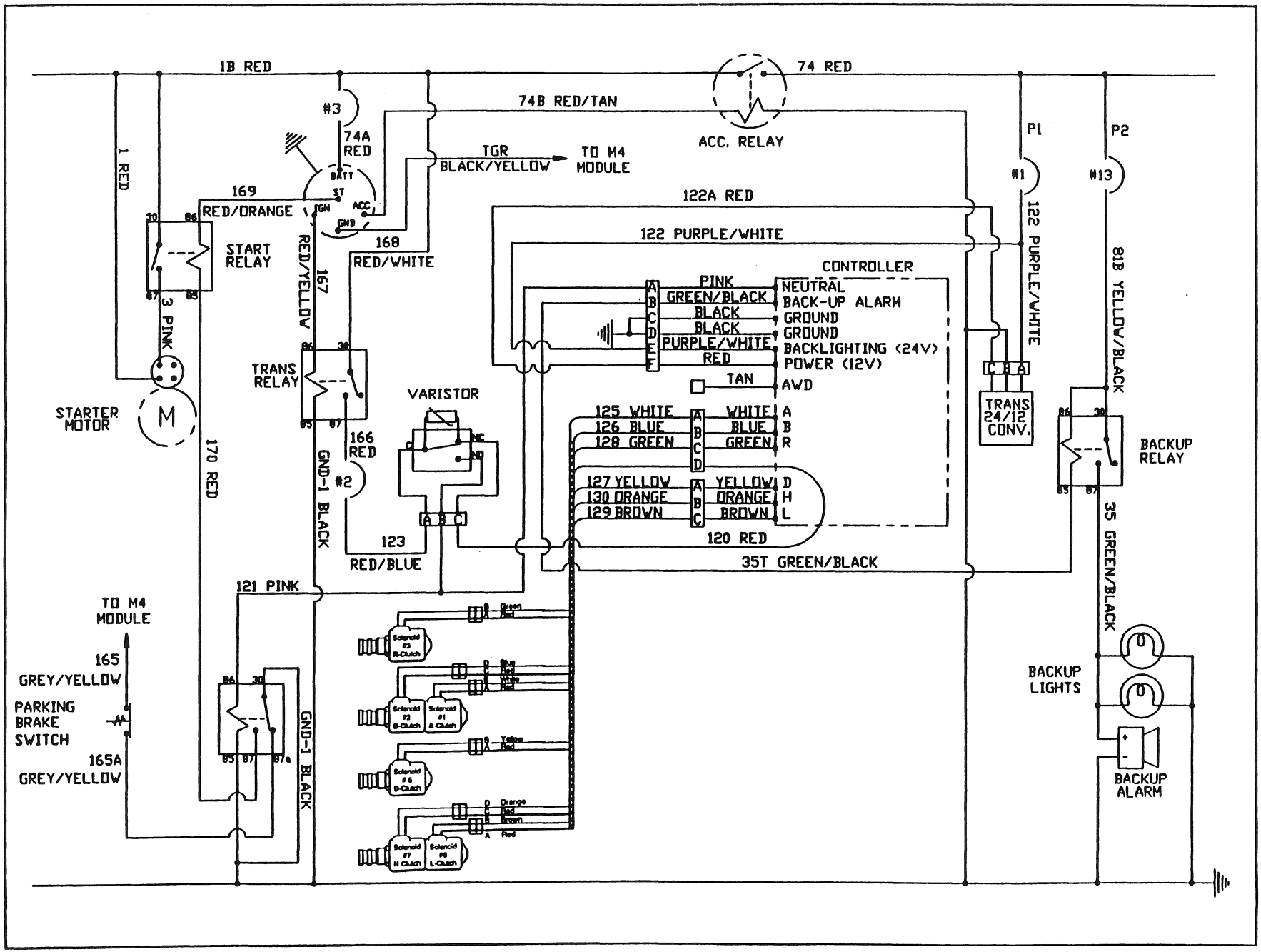
Champion Road Machinery cannot anticipate all circumstances that may arise. Use this chart only as a guide to troubleshooting the 8400 Transmission Electrical System.

Error Code Explanation Chart

CODE SERIES	DESCRIPTION
1.0	**Low system voltage** Check: - Charging system - Converter output measured at pin 'F' on 6 terminal connector (red wire 122-1) - For proper grounding of controller - High resistance at circuit breaker (transmission converter) if used
2.0 - 2.6	**Open circuit or short to ground in applicable solenoid circuit** *Check for continuity at: - Solenoid coil - Solenoid wiring harness - Harness connection
2.7	**No voltage in 5 amp circuit (transmission solenoid)** Check for continuity at: - Circuit breaker - Transmission relay - Normally closed terminals on micro switch when in Forward or Reverse - Harness connector - At each solenoid - At Transmission harness connector to controller - 3 pin connector at microswitch
3.0 - 3.6	**Short circuit in applicable solenoid circuit** Check: - Solenoid coil resistance - Solenoid wiring harness and coil resistance - Controller connection for corrosion
4.0 - 4.1	**Forward or Reverse input error** Check: - Neutral start micro switch operation - Magnets for proper clearance and adjustment
4.2	**Neutral input error** - F-N-R lever was left in gear when unit was shut off, or shifted during start-up sequence, or controller experienced a momentary power or ground loss - Shift F-N-R lever to Neutral - Check power supply pin 'F' on flat 6 terminal connector (red wire 122-1) on main supply harness - A 4.2 error code is normal with the ignition key in the accessory position
4.4	**Internal Forward or Reverse signal switch malfunction** - Obtainable only when leaving Neutral - Replace controller

* When using an ohmmeter, ensure the battery isolation switch is turned OFF.

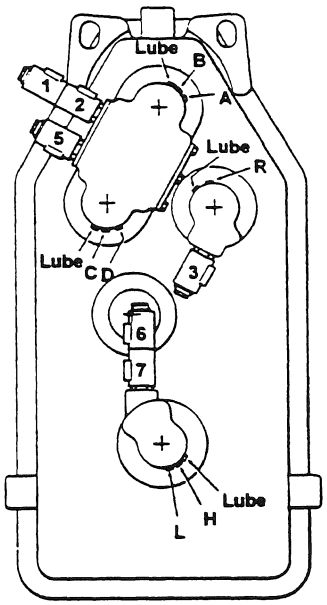
Electrical Schematic - Gearco Model 8400 Transmission



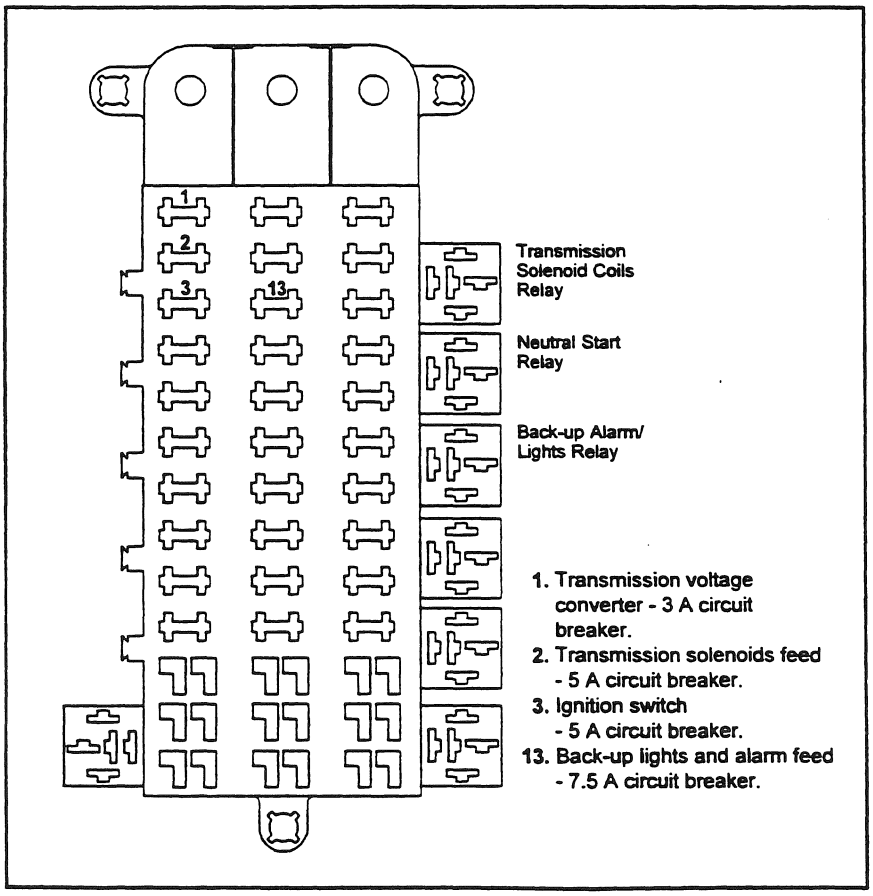
Solenoid/Clutch Engagement

SPEED	SOLENOIDS ENERGIZED	CLUTCH ENGAGED
1	1, 6	ACL
2	2, 6	BCL
3	1, 5, 6	ADL
4	2, 5, 6	BDL
5	1, 7	ACH
6	2, 7	BCH
7	1, 5, 7	ADH
8	2, 5, 7	BDH
Neutral	None	C
-1	3, 6	RCL
-2	3, 5, 6	RDL
-3	3, 7	RCH
-4	3, 5, 7	RDH

Solenoid/Pressure Checkpoint Locations



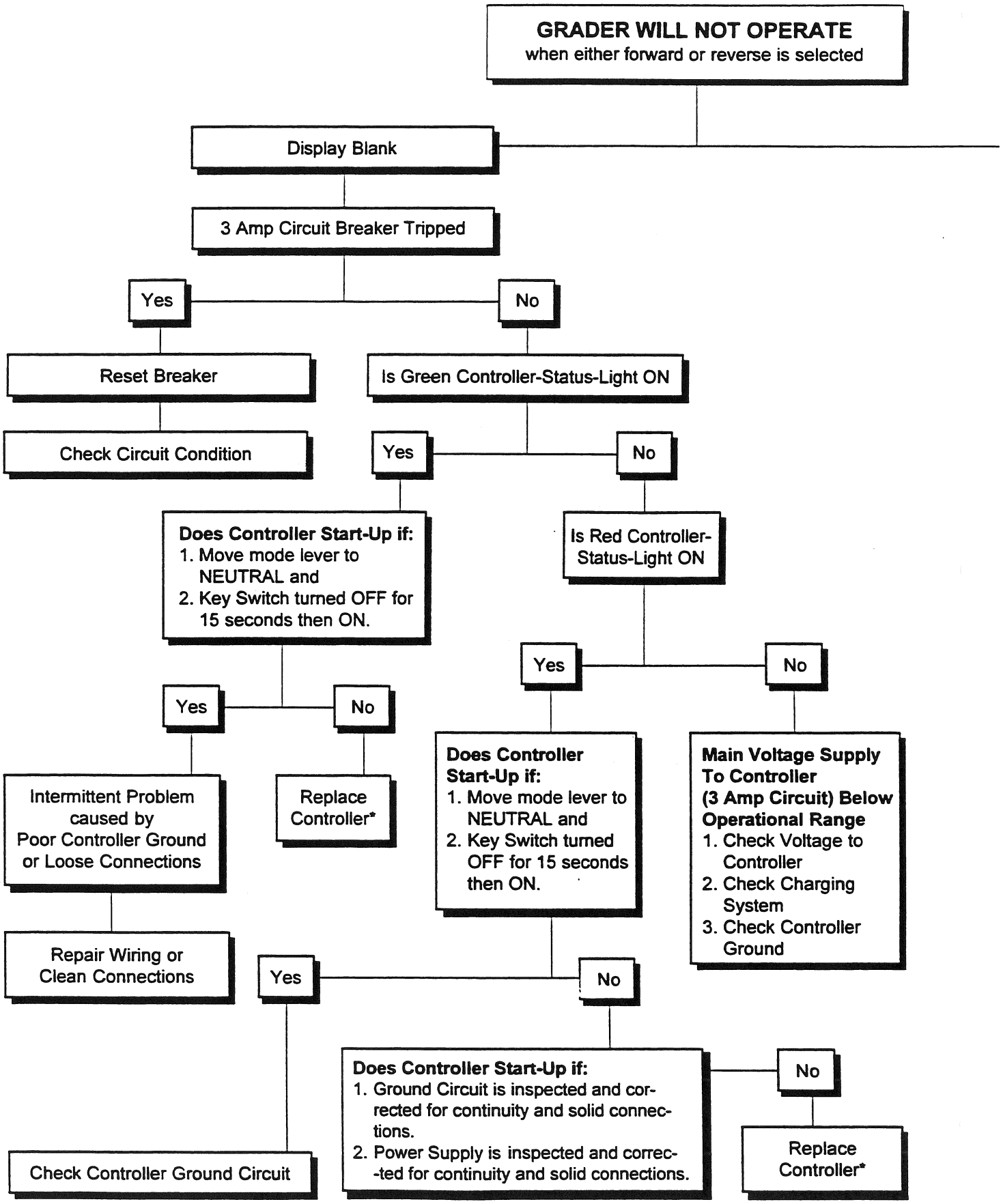
Fuse Panel

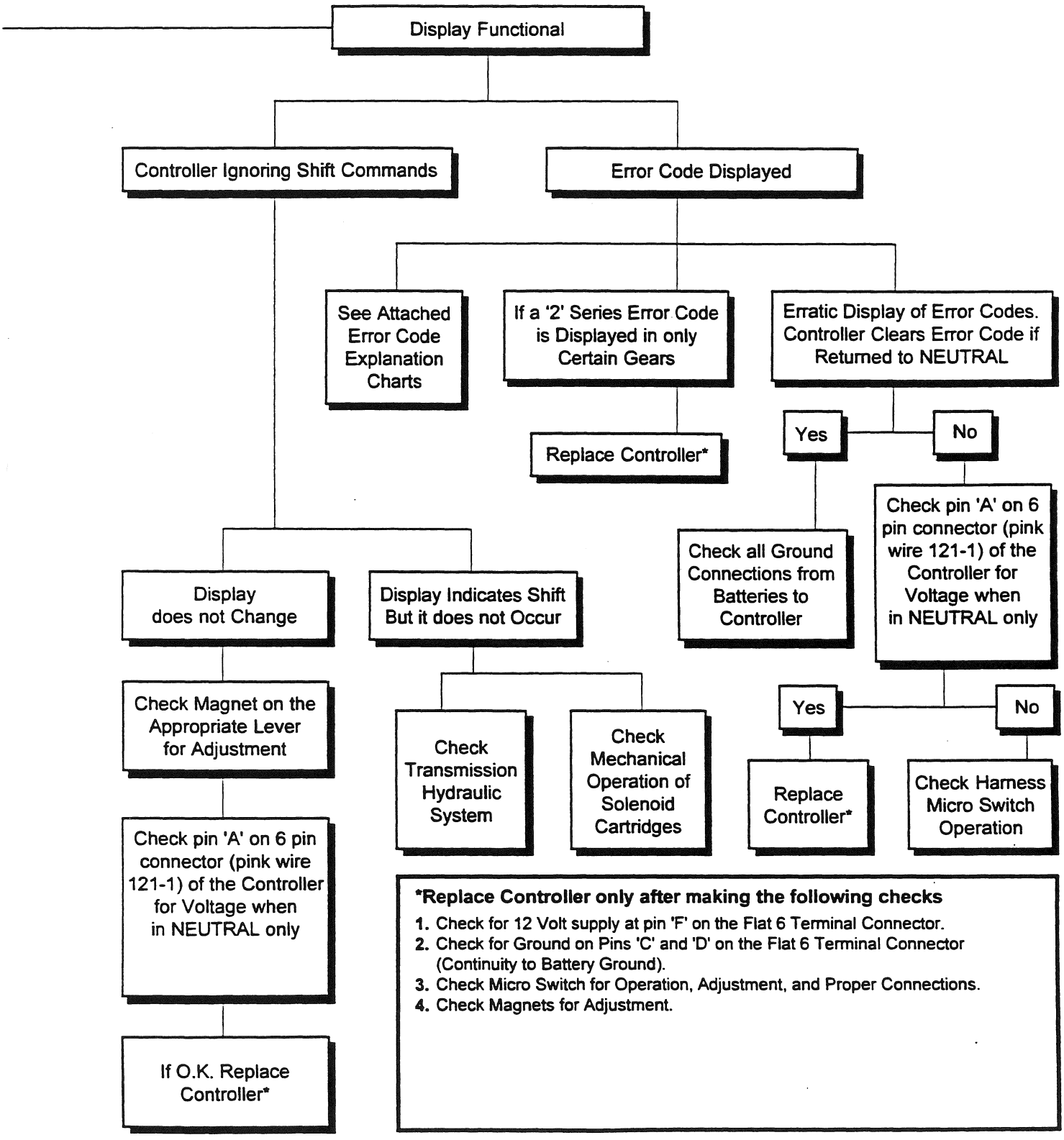


These are the fuses, circuit breakers and relays on the fuse panel that relate to the transmission and starting circuit.

The fuse panel is located inside the side console and is accessible through the removeable fuse access door or by lifting the side console cover. Thumb screws allow easy removal of both.

Grader will not Operate




Display Functional
Controller Ignoring Shift Commands
Error Code Displayed
See Attached Error Code Explanation Charts
If a '2' Series Error Code is Displayed in only Certain Gears
Erratic Display of Error Codes. Controller Clears Error Code if Returned to NEUTRAL
Replace Controller*
Yes
No
Check all Ground Connections from Batteries to Controller
Check pin 'A' on 6 pin connector (pink wire 121-1) of the Controller for Voltage when in NEUTRAL only
Display does not Change
Display Indicates Shift But it does not Occur
Check Magnet on the Appropriate Lever for Adjustment
Check Transmission Hydraulic System
Check Mechanical Operation of Solenoid Cartridges
Yes
No
Replace Controller*
Check Harness Micro Switch Operation
Check pin 'A' on 6 pin connector (pink wire 121-1) of the Controller for Voltage when in NEUTRAL only
If O.K. Replace Controller*
*Replace Controller only after making the following checks
1. Check for 12 Volt supply at pin 'F' on the Flat 6 Terminal Connector.
2. Check for Ground on Pins 'C' and 'D' on the Flat 6 Terminal Connector (Continuity to Battery Ground).
3. Check Micro Switch for Operation, Adjustment, and Proper Connections.
4. Check Magnets for Adjustment.

"Smart Shift" Memory Gear Feature - S/N 24736 & UP

The "smart shift" memory gear feature allows the operator to customize the shift patterns of the transmission in the lowest gears to the job at hand. **Table A** shows the default shift pattern before the operator uses the memory gear function.

To obtain different shift patterns, such as FORWARD 2 and REVERSE 1, you must manually shift the transmission to that gear. The memory feature remembers the selected gear that was last used in either FORWARD or REVERSE, and upon returning to that direction the controller automatically selects that gear. You only have to select the required gears in either FORWARD or REVERSE, no other programming action is needed. Refer to **Table B** for the allowable memory gear selections.

Table A

Forward Gear	Reverse Gear
1	-2
2	-2
3	-2
4	-2
5	-3
6	-3
7	-3
8	-4

Once you have obtained a valid memory gear combination, you can 'shuttle-shift' between FORWARD and REVERSE without moving the PULSER lever. However, you must still use the engine clutch.

From a gear in column **A**, you can access a gear in column **B** using the memory gear function.

Table B

Forward to Reverse		Reverse to Forward	
A	B	A	B
1	-1 -2	-1 -1 -1	1 2 3
2	-1 -2	-2	1 2 3 4 5
3	-1 -2 -3	-3 -3 -3	3 4 5
4	-2 -3	-4	5
5	-2 -3		
6	-3		
7	-3		
8	4		

If a selected combination of FORWARD and REVERSE gears is not valid (see **Table B**), the transmission controller automatically selects the closest appropriate gear.

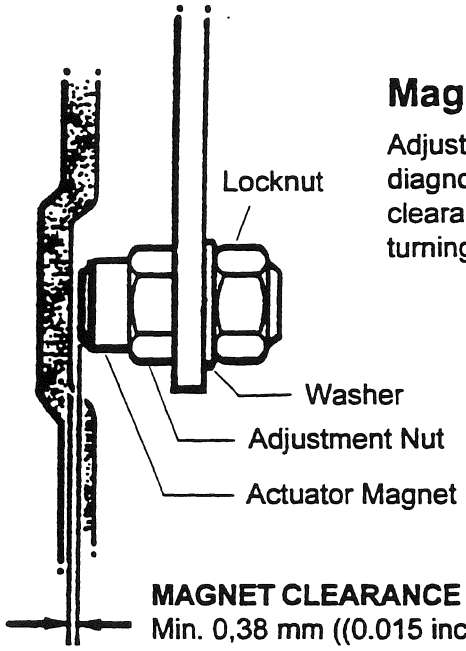
When the controller is in NEUTRAL, the LCD display always indicates the FORWARD and REVERSE gears available.

Operating the PULSER lever while in NEUTRAL cancels the memory gear function and returns the transmission shift pattern to the default settings.

You must make a complete shift sequence (i.e., F-N-R or R-N-F) to use the memory gear function. If you make an incomplete shift sequence (i.e., F-N-F or R-N-R), the transmission returns to the previous FORWARD and REVERSE gear selection.

Actuator Magnet Adjustment

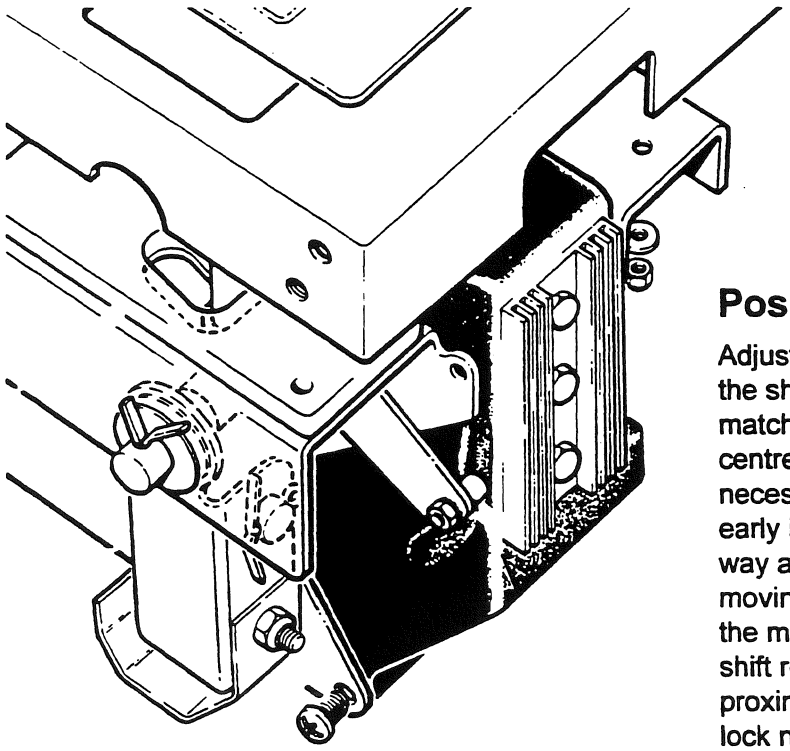
These adjustments apply to both, the Mode Lever and the Pulser Lever.



MAGNET CLEARANCE
Min. 0,38 mm ((0.015 inch)
Max. 1,78 mm (0.070 inch)

Magnet Clearance Adjustment

Adjust the magnet clearance if an error code or the diagnostic flow chart indicate a need. The magnet clearance is adjustable by loosening the lock nut and turning the adjustment nut in or out. Tighten the lock nut.



Position Adjustment

Adjust the magnet in the slot if the shift response does not match the strokes evenly from centre position. Adjustment is necessary if a lever reacts very early in its stroke moving one way and very late in its stroke moving the opposite way. Move the magnet in the slot until the shift reaction strokes are approximately equal. Loosen the lock nut to adjust the magnet's position. Tighten the lock nut.

Solenoid Coil Resistance Values

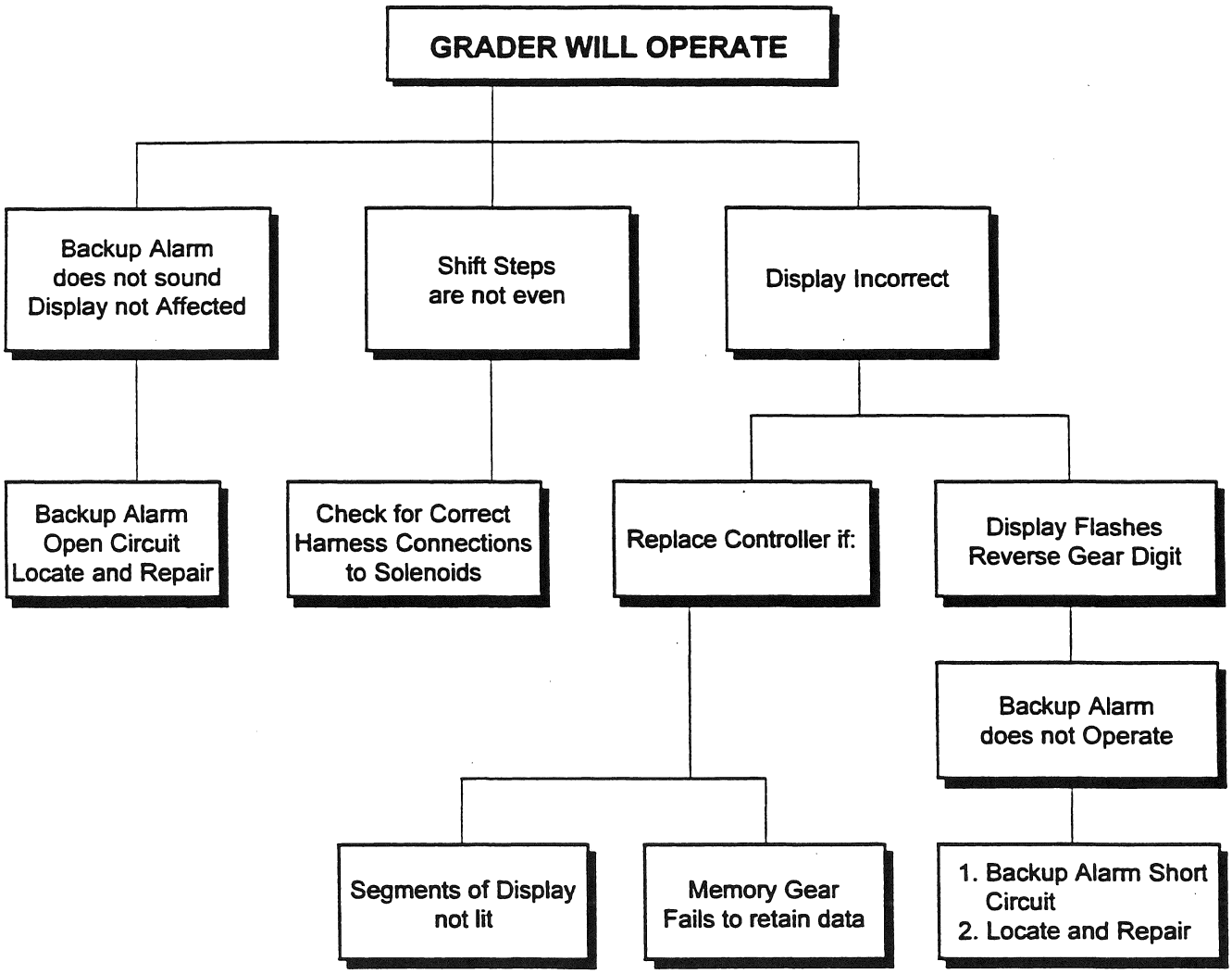
SOLENOID COIL	PART NUMBER	RESISTANCE VALUE
24 Volt	58728	28.8 (Ω) ± 5%

Resistance at a temperature of 20°C (68°F).

Torque Specifications

APPLICATION	lbf•ft	N•m
Solenoid Cartridges	25	33,9
Solenoid Retaining Nut	5	6,8

Grader will Operate



Notes

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SECTION 9

SINGLE REDUCTION FINAL DRIVE

Applicable to models: 710/710A, S/N 19482 and up
720/720A, S/N 19429,19431, 19433, 19435 to 19438, 19440, 19442 and up
730/730A, S/N 19425 and up

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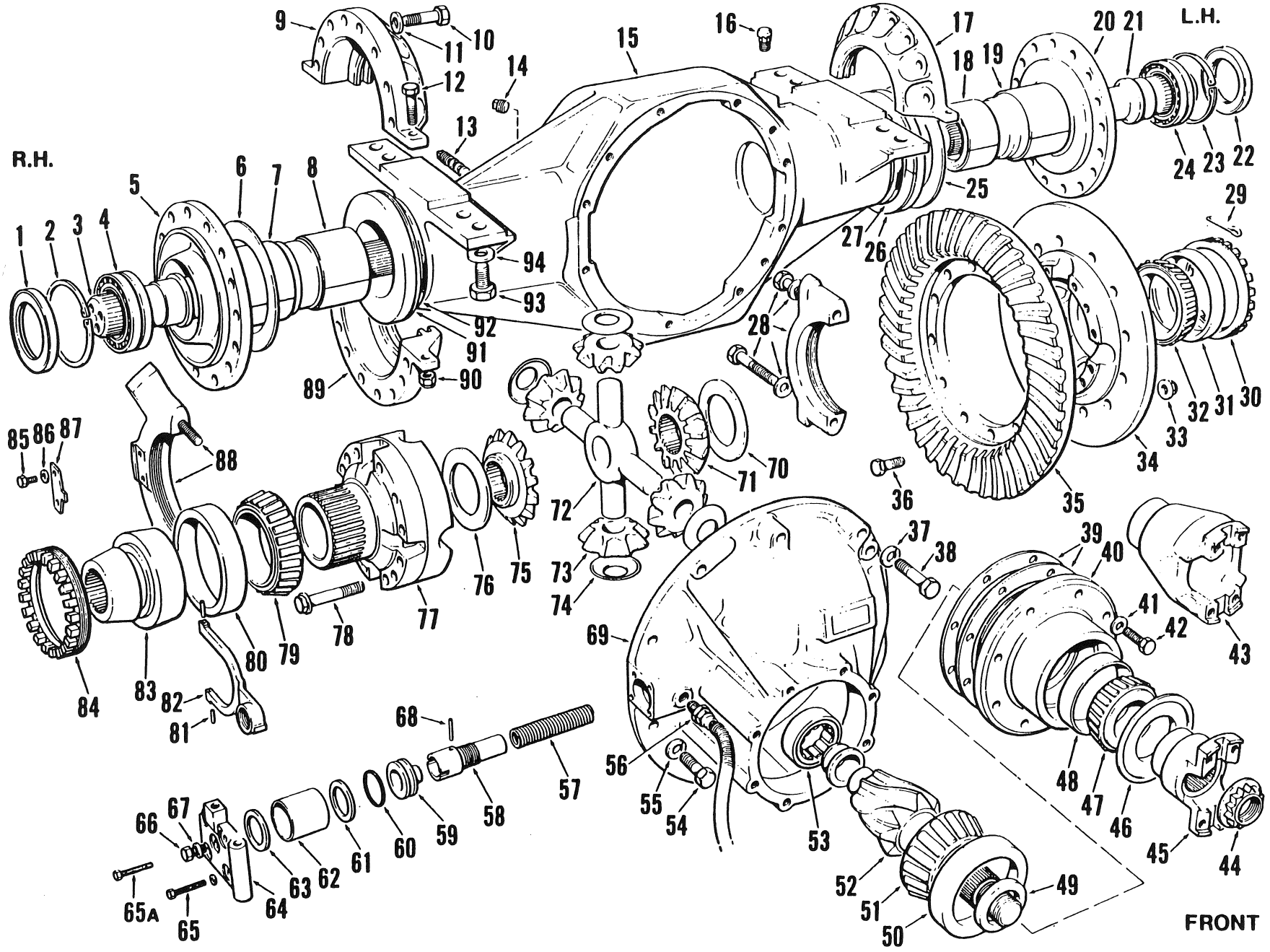


Fig. 1 710/710A, S/N **19482** and up. 720/720A, S/N **19429**,**19431**, **19433**, **19435** to **19438**, **19440**, **19442** and up

Item	Description
1	Oil seal
2	Snap ring
3	Right-hand axle shaft
4	Bearing
5	Flanged sleeve
6	Outer thrust plate
7	Outer bushing
8	Inner bushing
9	Split ring half
10	Bolt
11	Special washer
12	Bolt
13	Magnetic plug
14	Magnetic plug
15	Final drive housing
16	Breather
17	Split ring half
18	Inner bushing
19	Outer bushing
20	Flanged sleeve
21	Left-hand axle shaft
22	Oil seal
23	Snap ring
24	Bearing
25	Outer thrust plate
26	Inner thrust plate
27	Seal
28	Differential bearing cap assembly
29	Cotter pin
30	Adjusting ring
31	Bearing cup
32	Bearing cone
33	Nut
34	Differential case
35	Ring gear
36	Bolt
37	Seal washer
38	Bolt
39	Shims
40	Drive pinion bearing cage
41	Washer
42	Bolt
43	Yoke for models 720/720A
44	Nut
45	Yoke for models 710/710A
46	Oil seal
47	Bearing cone
48	Bearing cup
49	Spacer
50	Bearing cup
51	Bearing cone
52	Drive pinion
53	Drive pinion spigot bearing
54	Bolt
55	Seal washer
56	Sensor switch
57	Shifter shaft spring
58	Shifter shaft
59	Piston
60	O ring
61	Washer
62	Tube
63	Copper gasket
64	Cover
65	Bolt and lockwasher
65A	Bolt (Manual Adjusting)
66	Bolt
67	Gasket
68	Roll pin
69	Differential carrier
70	Thrust washer
71	Side gear
72	Spider
73	Pinion
74	Thrust washer
75	Side gear
76	Thrust washer
77	Differential case
78	Bolt
79	Bearing cone
80	Bearing cup
81	Roll pin
82	Fork
83	Collar
84	Adjusting ring
85	Bolt
86	Washer
87	Lock plate
88	Differential bearing cap assembly
89	Split ring half
90	Nut
91	Inner thrust plate
92	Seal
93	Bolt
94	Special washer

Key to Fig. 1 710/710A, S/N **19482** and up. 720/720A, S/N **19429,19431, 19433, 19435** to **19438, 19440, 19442** and up

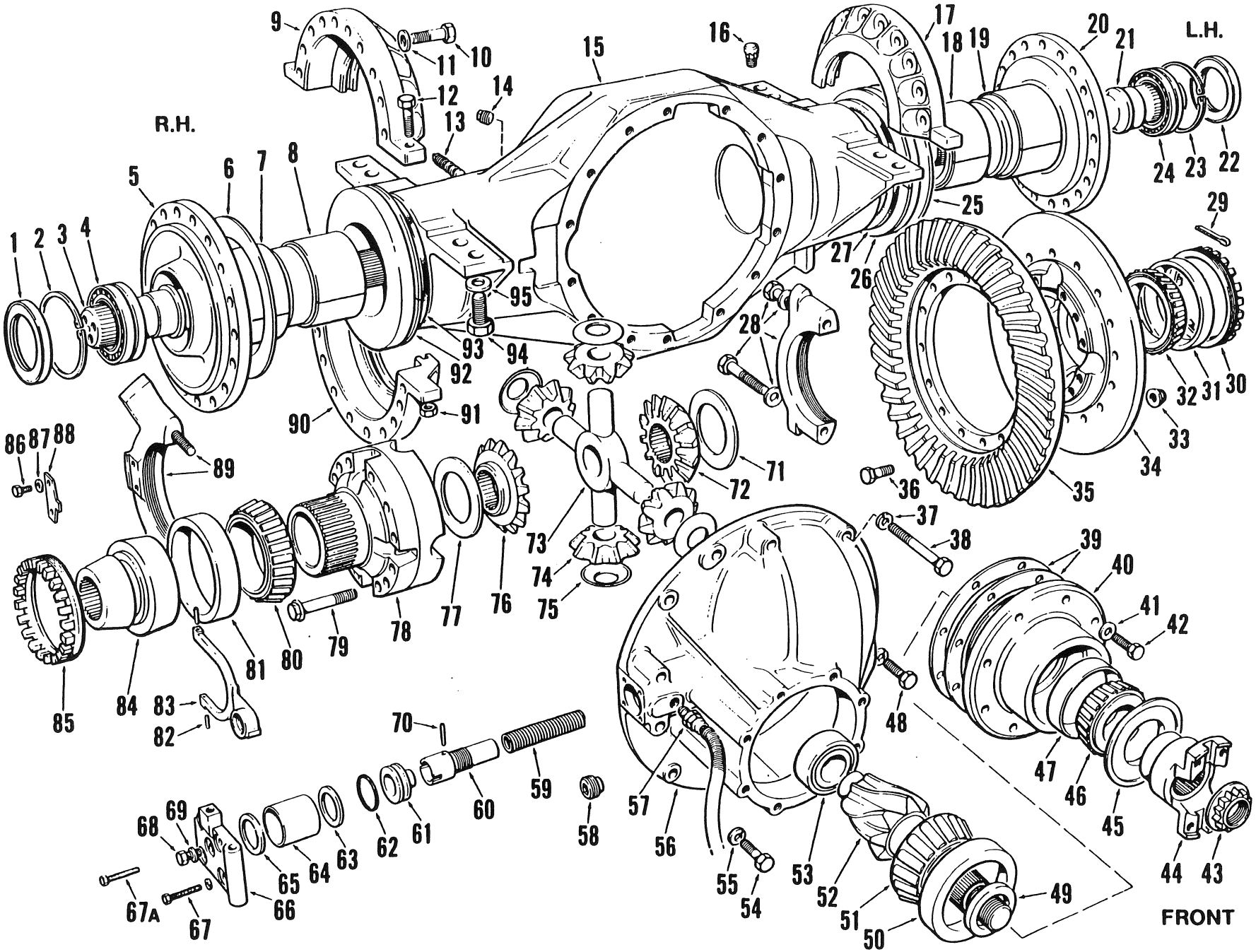
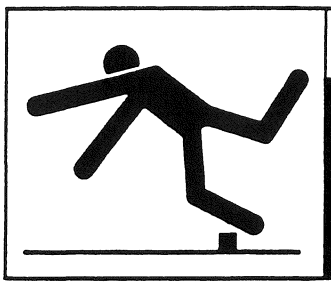


Fig. 2 730/730A, S/N **19425** and up

Item	Description
1	Oil seal
2	Snap ring
3	Right-hand axle shaft
4	Bearing
5	Flanged sleeve
6	Outer thrust plate
7	Outer bushing
8	Inner bushing
9	Split ring half
10	Bolt
11	Special washer
12	Bolt
13	Deep-reach magnetic plug
14	Magnetic plug
15	Final drive housing
16	Breather
17	Split ring half
18	Inner bushing
19	Outer bushing
20	Flanged sleeve
21	Left-hand axle shaft
22	Oil seal
23	Snap ring
24	Bearing
25	Outer thrust plate
26	Inner thrust plate
27	Seal
28	Differential bearing cap assembly
29	Cotter pin
30	Adjusting ring
31	Bearing cup
32	Bearing cone
33	Nut
34	Differential case
35	Ring gear
36	Bolt
37	Seal washer
38	Bolt
39	Shims
40	Drive pinion bearing cage
41	Washer
42	Bolt
43	Nut
44	Yoke for models 730/730A
45	Oil seal
46	Bearing cone
47	Bearing cup
48	Bolt
49	Spacer
50	Bearing cup
51	Bearing cone
52	Drive pinion
53	Drive pinion spigot bearing
54	Bolt
55	Seal washer
56	Differential carrier
57	Sensor switch
58	Plug
59	Shifter shaft spring
60	Shifter shaft
61	Piston
62	O ring
63	Washer
64	Tube
65	Copper gasket
66	Cover
67	Bolt and Lockwasher
67A	Bolt (Manual Adjusting)
68	Bolt
69	Gasket
70	Roll pin
71	Thrust washer
72	Side gear
73	Spider
74	Pinion
75	Thrust washer
76	Side gear
77	Thrust washer
78	Differential case
79	Bolt
80	Bearing cone
81	Bearing cup
82	Roll pin
83	Fork
84	Collar
85	Adjusting ring
86	Bolt
87	Washer
88	Lock plate
89	Differential bearing cap assembly
90	Split ring half
91	Nut
92	Inner thrust plate
93	Seal
94	Bolt
95	Special washer

Key to Fig. 2 730/730A, S/N **19425** and up



⚠ CAUTION

Before starting any service procedure, make sure work area is clean and safe.

General

Make sure proper shop tools are available and in good working order. You will need a safe lifting device, blocks or proper stands, a build stand (if available), a hydraulic press and special installation tools.

The differential carrier assembly is manufactured in metric dimensions. When servicing a carrier, it is important to use the correct size metric tool on the fasteners. Refer to the Torque Guide in this section.

Information in this Shop Manual section is made available courtesy of Rockwell International.

Refer to the 700 Series Parts Manual P/N **L 3008** for spare parts information.

Service Position Precaution

NOTE: Always place the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure. Refer to the SERVICE POSITION procedure on page (ii) in the front of this Shop Manual.

Description

The Gearco family of single reduction final drives combines the best features of the single reduction "No-Spin" and double reduction lock/unlock differential models.

Full floating axle shafts housed in the proven flanged sleeve concept, easily removable differential carrier and operator selectable lock/unlock differential are standard features on all models. The single reduction final drive uses a hypoid gear set for maximum durability.

The single reduction final drive forms part of the Champion modular powertrain concept. You can quickly and easily remove the tandem/final drive assembly without disturbing the rest of the powertrain.

The differential assembly is locked by transmission lock up pressure and unlocked by spring tension. A switch on the right-hand door post controls a solenoid operated valve. With the switch in the LOCKED (down) position, the solenoid energizes and allows transmission lock up pressure to the differential shift cylinder. In the UNLOCKED (up) position, the deenergized solenoid valve blocks the lock up pressure and spring tension unlocks the differential. The lock/unlock light above the switch on the door post is connected to the differential sensor switch and shows exactly what position the differential is in.

When you operate the differential lock, the shift collar moves along the axle shaft splines toward the differential case. The shift collar splines then engage with the differential case splines. This action locks the axle shaft and differential assembly together. When the carrier operates in the locked position, there is no differential action. Differential action occurs when the carrier operates in the unlocked position.

A small hose between the solenoid valve and the clutch housing vents the shift tube in the unlocked position.

Cleaning and Inspection

Cleaning

Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used. Do not use gasoline.

Use a flat-bladed tool to remove silicone sealant residue. Take care not to damage the ground surfaces.

Do not clean ground or polished parts in water, steam, alkaline solutions or a hot solution tank. However, rough parts can be cleaned in a hot solution tank with a weak alkaline solution. Parts must remain in the hot solution until completely cleaned and heated. Wash parts with water and remove all alkaline solution.

Steam clean the final drive housing exterior to remove dirt. Before steam cleaning the housing, cover all openings; for example, the air breather.

Immediately dry parts after cleaning and washing. Use soft, clean paper or cloth rags. You can also dry parts - except bearings - using moisture-free compressed air.

NOTE: *Do not dry bearings with compressed air. Spinning bearings with compressed air can damage the races and rollers.*

Apply system oil to undamaged parts that are ready for assembly. If storing parts for some time, apply a rust inhibitor to all surfaces. Wrap parts in rust inhibitor impregnated paper before storing.

Inspection

Inspect all tapered roller bearing cups and cones. Replace the bearing if you see the following defects.

a) Center of the large diameter end of the roller worn level with or below the outer surface of the roller.

b) Radius of the large diameter end of the roller worn to a sharp edge.

c) Visible roller grooves in the cup or cone inner race surfaces.

d) Deep cracks in the cup, cone inner race or roller surfaces.

e) Bright wear marks on the roller cage outer surface.

f) Etched and pitted rollers or cup and cone inner race surfaces that touch the rollers.

g) Cup and cone inner race surfaces that touch the rollers damaged by spalling and flaking.

Inspect hypoid drive pinion and ring gear for wear or damage. Replace gears that are worn or damaged. The drive pinion and ring gear are manufactured as a matched set. If either the drive pinion or ring gear needs replacing, you must install a new matched gear set.

Inspect the following differential assembly parts for wear and damage (see **Fig. 3**). Replace all worn and damaged parts.

a) Inside surfaces of both differential case halves.

b) Both sides of all thrust washers.

c) The ends of the spider (cross) trunnions.

d) Teeth and splines of both differential side gears.

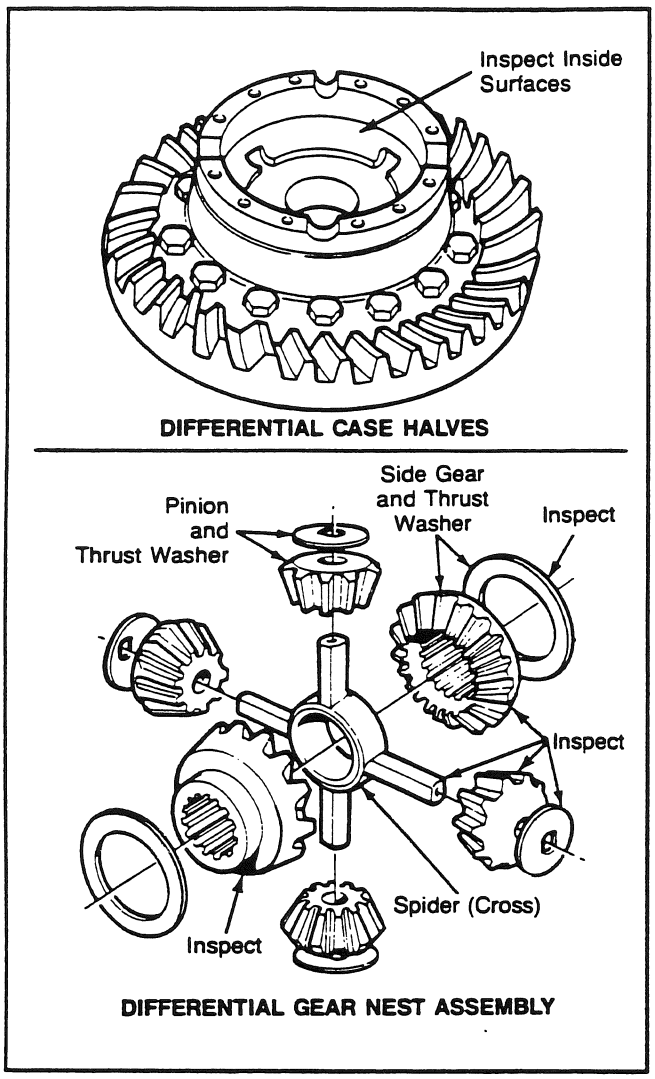


Fig. 3

e) Teeth and bore of all differential pinions.

NOTE: *Always replace thrust washers, differential side gears and pinions in sets. High stress on parts and early failures occur when new parts are used with old or worn parts.*

Inspect axle shafts for wear, cracks and worn or twisted splines. Replace any defective axle shaft.

Replace worn or damaged final drive assembly parts. Following are examples of what to check, repair or replace.

a) Replace any fasteners if the corners of the head are worn.

b) Replace damaged washers.

c) Replace all oil seals, O rings, cotter pins and snap rings.

d) Clean parts and apply new silicone sealant P/N **56427** where required when final drive is assembled (see **Fig. 4**).

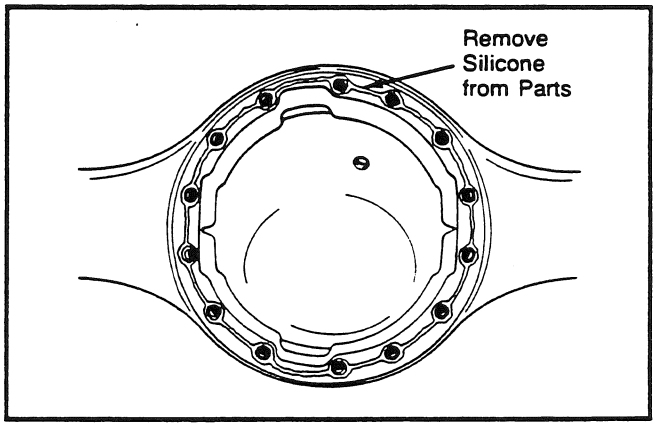


Fig. 4

e) Remove nicks, scratches and burrs from machined or ground surfaces. Use a fine file, india stone, emery cloth or crocus cloth.

f) Clean and repair threads. Use a die or tap of the correct size. You can also use a fine file.

NOTE: *Threads must be clean and undamaged to ensure correct values when fasteners are torque-tightened; also accurate adjustments.*

Lubrication

It is important to check the final drive oil level and add the correct type of lubricant. Refer to your **700 Series Operator's Manual** for complete details of capacities, change intervals, fluid types, temperature range and appropriate viscosities.

Torque Guide

Fig. No.	Application	Torque Value lbf.ft	N.m	kgf.m
39	Nut retaining yoke to drive pinion	996 - 1232	1350 - 1670	138 - 170
50	Bolts retaining drive pinion bearing cage	74 - 92	10 - 13	100 - 125
51	Nut retaining yoke to drive pinion	996 - 1232	1350 - 1670	138 - 170
52	Nuts securing ring gear and flange case half	192 - 214	26 - 30	260 - 290
58	Bolts retaining differential case halves	203 - 251	28 - 35	275 - 340
-	Bolts retaining bearing caps to carrier	479 - 597	66 - 82	650 - 810
88	Bolts retaining adjusting ring lock plate	21 - 26	28 - 35	3 - 3,5
90	Shifter shaft into fork	20 - 25	27 - 34	3 - 3,5
93	Bolts securing differential lock cylinder cover	7.4 - 8.9	10 - 12	1 - 1,2
-	Sensor switch locknut	26 - 33	35 - 45	3,5 - 4,5
96	Bolts retaining carrier to final drive housing	200 - 225	271 - 305	28 - 31
97	Bolt for differential lock in cover	44 - 55	60 - 75	6 - 7,6
97	Manual engaging bolt in cover	22 - 28	30 - 38	3 - 3,8
-	Bolts retaining split rings to tandems	260 - 290	352 - 393	36 - 40
-	Bolts retaining drive sprocket end cap	80 - 100	108 - 136	11 - 14
-	Bolts retaining final drive housing to grader frame	620 - 700	841 - 949	86 - 97
-	Bolts retaining drive shaft to yoke	70 - 80	95 - 108	10 - 11

Removing Final Drive and Tandem Assembly from Grader

1. Park the grader on level ground. Place the transmission mode lever in neutral. Centralize the circle, drawbar and moldboard assembly using the circle shift and blade lift cylinders. Shut down the engine and place the machine in the SERVICE POSITION. Refer to page (ii) in the front of this Shop Manual.

2. Place a container (capacity: 6 U.S. gallons [23 liters]) under the final drive drain plug. Remove the plug and drain the oil. Clean and install the plug.

3. Disconnect all brake lines between the rear frame and tandems. Identify the lines to prevent confusion during assembly. Immediately plug the lines and connectors to prevent dirt and moisture entering the brake fluid system. Remove any spilled brake fluid to prevent paint damage.

4. Disconnect the lower drive shaft universal joint from the final drive yoke. Secure the slip yoke and drive shaft with lockwire.

5. Disconnect the hydraulic hose at the differential lock cylinder cover. Plug the open ports. Disconnect the sensor switch wiring harness from the main wiring harness.

6. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Position the moldboard at 90° to the frame. Apply down pressure to the moldboard and lift the front wheels about 2 feet (60 cm) off the ground. Shut down the engine. Remove and retain the ignition key. Turn the battery isolation switch to the OFF position. Place a safe, adequate stand under the nose plate.

7. Open the battery box(es) and disconnect the battery cables. Remove one battery and pass the cables through the grommet.

8. Attach a safe lifting device to the rear of the grader frame. Remove the bolts and special washers retaining the final drive assembly to the frame brackets. Remove the nose plate stand. Raise the rear end of the grader clear of the final drive by pivoting on the moldboard. Roll out the final drive and

tandem assembly from under the grader. Lower the rear end of the grader onto safe, adequate stands (see **Fig. 5**).

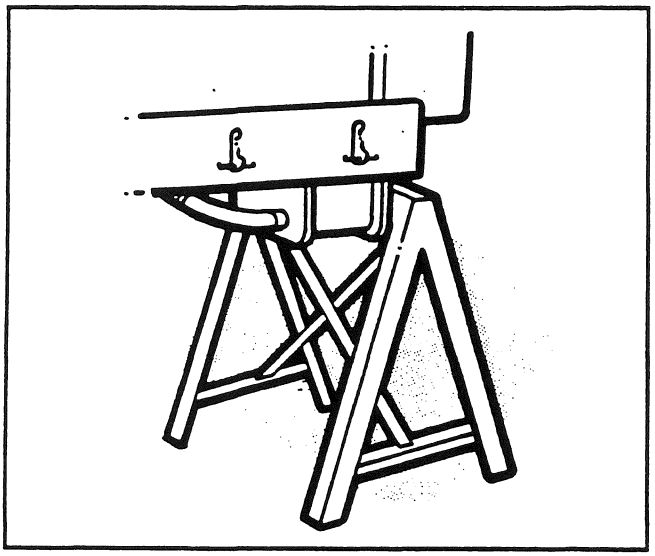


Fig. 5

9. Install chocks in front and behind the tandem tires. Place a container (capacity: 10 U.S. gallons [38 liters], oil disc brakes: 26.5 U.S. gallons [100 liters]) under the tandem drain plug. Remove the plug and drain the oil. Clean and install the drain plug.

NOTE: The differential carrier can be removed without removing the tandems or flanged sleeves.

Manual Lock/Unlock Shift Engagement

1. Before removing or installing the differential carrier or axle shafts, you must shift and hold the differential lock in the locked (engaged) position. The locked position gives enough clearance between the collar and the final drive housing to allow you to remove and install the carrier. Failure to do this can result in component damage.

2. Use the manual engaging method to lock the differential (see **Fig. 6**).

3. Remove the bolt and gasket from the hole in the center of the cover. Remove the manual engaging bolt from the top storage hole in the cover. Install the bolt and gasket into the bottom storage hole in the cover.

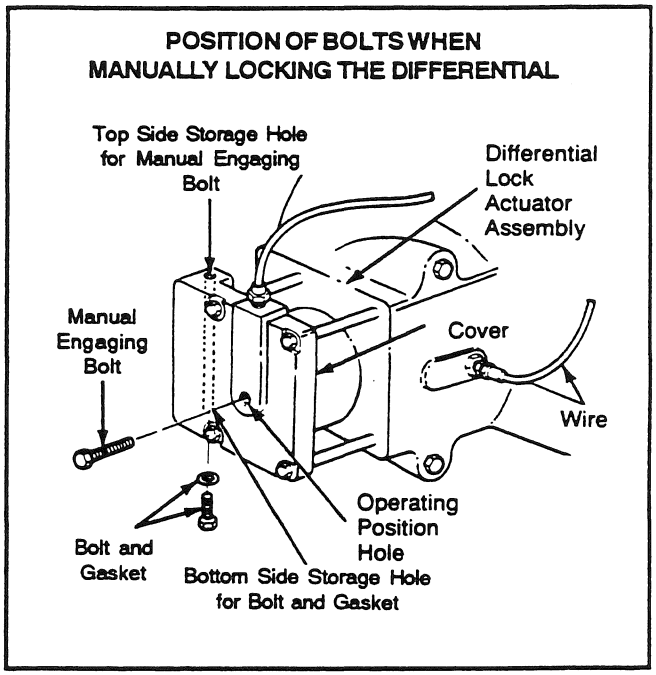


Fig. 6

4. Install the manual engaging bolt into the hole in the center of the cover. Turn the manual engaging bolt to the right until the head is approximately 1/4 inch (6 mm) from the cover. Do not turn the bolt beyond its normal stop. The bolt is now in the service position and the differential lock is completely engaged.

5. You will feel a small amount of spring resistance when turning the manual engaging bolt. If you feel a high resistance before reaching the locked (engaged) position, **stop turning the bolt.** Otherwise the cover and bolt threads will be damaged.

6. A high resistance to the bolt indicates that the splines of the collar and the differential case half are not aligned or engaged. Align the splines as follows:

   a) As you turn the manual engaging bolt, rotate the drive pinion to align the splines of the collar and differential case half.

b) Reduced spring resistance indicates the splines are engaged. Continue turning the manual engaging bolt until the head is approximately 1/4 inch (6 mm) from the cover.

Removing Tandems

1. Remove, clean and install the deep-reach magnetic plugs. If the oil and magnetic plugs are contaminated with metal particles, completely disassemble the tandem to remove defective parts.

2. If applicable, disconnect and remove the transverse brake line. Immediately plug the line and connector. Remove any spilled brake fluid to avoid paint damage.

3. Remove the bolts securing the tandem side cover plate and remove the plate. Remove all traces of silicone sealant.

4. Remove the bolts, tabwasher and end cap securing the drive sprocket to the axle shaft. Discard the tabwasher.

5. Support the final drive assembly on safe, adequate stands. Attach a safe lifting device to the tandem. Remove the bolts and lockwashers retaining the final drive assembly to the tandem.

6. Carefully remove the tandem. Remove the drive sprocket and chains from the axle shaft using a pry bar. Repeat steps 1 through 6 for the other tandem.

Removing Axle Shafts and Flanged Sleeves

1. Attach a safe lifting device to the final drive assembly and position the assembly with the differential carrier at the top. Remove the drive sprocket spacers. Remove and discard the axle shaft oil seals.

2. Remove and discard the snap rings. Remove the axle shaft and bearing assemblies from the final drive housing. Remove the bearings from the axle shafts using a hydraulic press. Place the bearings and axle shafts to one side for cleaning and inspection.

NOTE: *The right-hand axle shaft has two sets of splines. One set engages with the differential side gear. The other set engages with the differential lock collar. When removing the axle shaft, you may have to rotate the shaft slightly to align the side gear and collar splines.*

3. Remove the nuts and bolts securing the split ring halves. Separate the split ring halves and remove them from the final drive housing.

NOTE: *The split ring halves are a matched pair. Keep them temporarily bolted together during the overhaul procedure. Remove all traces of silicone sealant from the split ring flanges.*

4. Install a lifting eye in the flanged sleeve. Remove the flanged sleeve using a safe lifting device (see **Fig. 7**). Remove and discard the inner and outer thrust plates. Remove and discard the seal. Repeat this step for the other flanged sleeve.

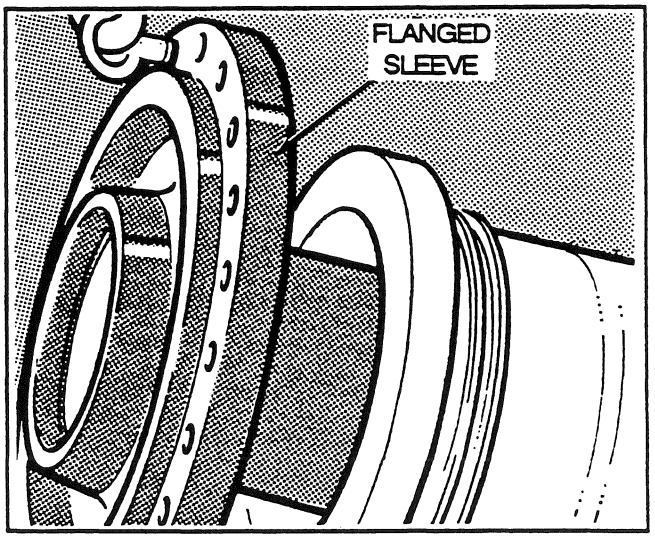


Fig. 7

Removing Differential Carrier from Final Drive Housing

1. Attach a safe lifting device to the carrier. Remove all except the top two bolts securing the carrier to the final drive housing.

2. Loosen the top two bolts and leave attached to the assembly. The bolts will hold the carrier in the housing.

3. Loosen the carrier in the housing. Use a leather mallet to hit the carrier mounting flange at several points.

NOTE: *Model SR 40 carrier housings can be loosened with puller screws. When using puller screws, clean the threaded holes before installing the screws.*

4. Remove the top two bolts after loosening the carrier.

5. Using the lifting tackle carefully remove the carrier from the housing. Use a pry bar with a round end to help separate the carrier from the housing.

NOTE: *When using a pry bar, take care not to damage the carrier or housing flange. Damage to the flanges can cause oil leaks.*

6. Use the lifting tackle and install the carrier into a build stand.

NOTE: *Before overhauling the carrier, inspect the ring gear and drive pinion gear set for damage. If the gear set is undamaged, it can be reused. Measure the gear set backlash and record the dimension (see* ***Checking Ring Gear Backlash*** *in this section). Adjust the backlash to the same dimension after installing the gear set.*

Removing Differential and Ring Gear Assembly from Carrier

1. Tap the two roll pins until they are flush with the inner face of the fork (see **Fig. 8**). Release the differential lock if it is manually engaged.

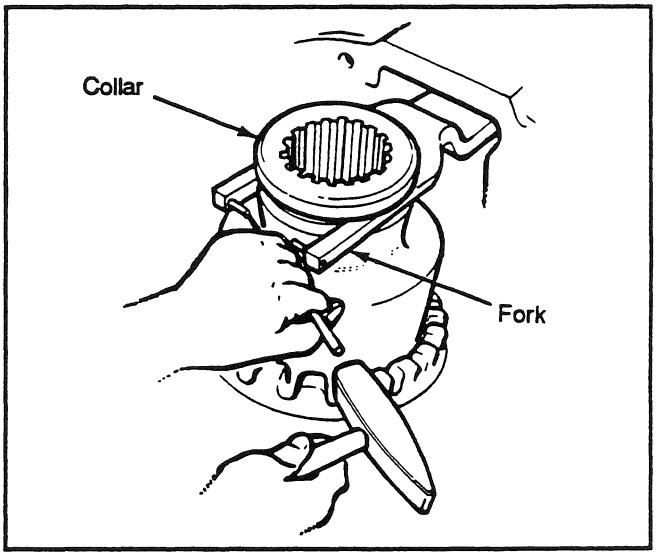


Fig. 8

2. Remove the sensor switch. Remove the four bolts and washers retaining the cover. Remove the cover and copper gasket (see **Fig. 9**). Remove the tube and piston. Remove and discard the O ring from the piston. Remove the shifter shaft from the fork. Remove the shifter shaft spring and flat washer. Remove the fork.

NOTE: *A roll pin installed in the shifter shaft is used to stop the shifter shaft spring. It is not necessary to remove the roll pin.*

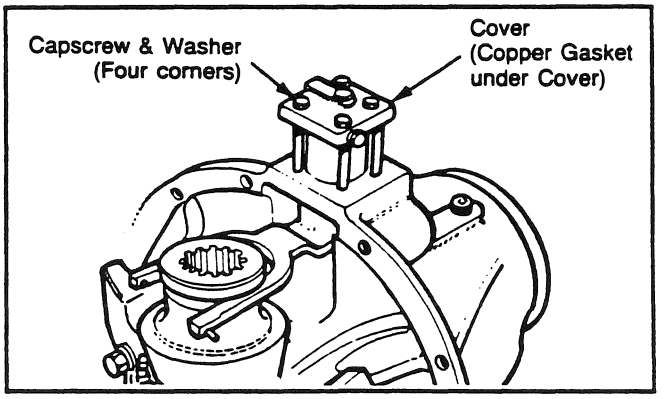


Fig. 9

3. Mark one carrier leg and differential bearing cap to correctly match the parts during assembly. Use a center punch and hammer to mark the parts (see **Fig. 10**).

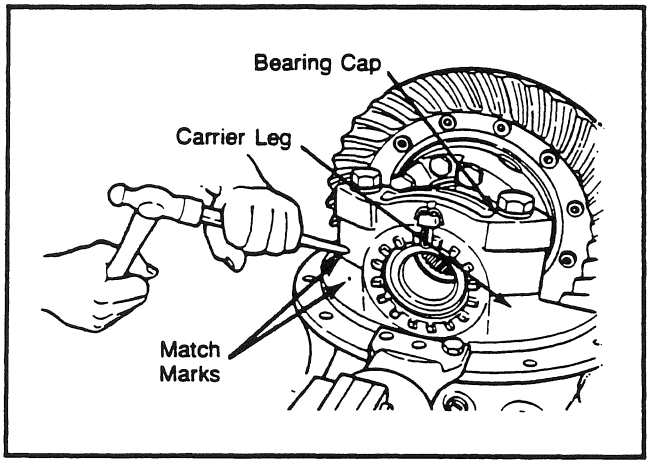


Fig. 10

4. Remove the cotter pin and lock plate retaining the two adjusting rings. Use a hammer and small drift to remove the cotter pin. Two bolts and lockwashers retain the lock plate (see **Fig. 11**).

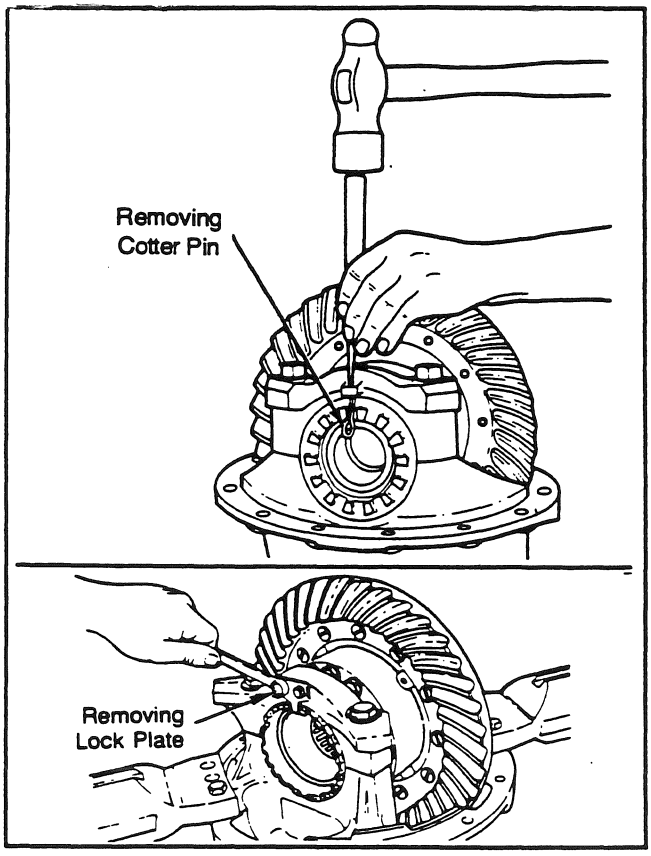


Fig. 11

5. Remove the bolts and washers retaining the two differential bearing caps to the carrier. Remove the bearing caps and adjusting rings from the carrier (see **Fig. 12**).

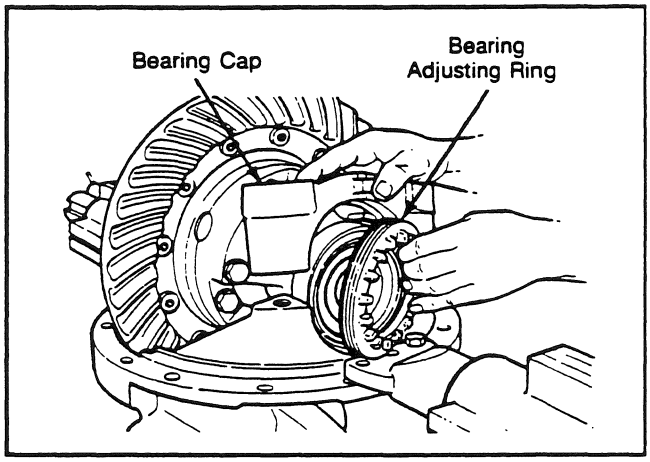


Fig. 12

6. Use safe lifting tackle to remove the differential and ring gear assembly from the carrier (see **Fig. 13**). Place the assembly on a clean workbench.

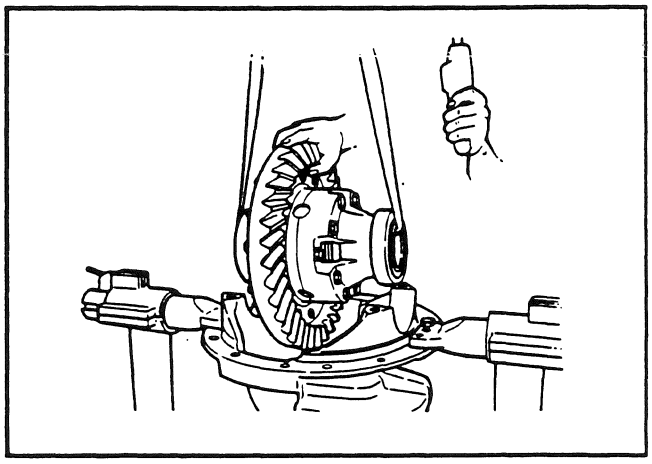


Fig. 13

Disassembly - Differential and Ring Gear Assembly

1. If the matching marks on the differential assembly case halves are not visible, mark each case half using a hammer and center punch (see **Fig. 14**). The marks show the correct positioning of the plain half and flange half during the assembly procedure. Remove the bolts and washers securing the case halves together.

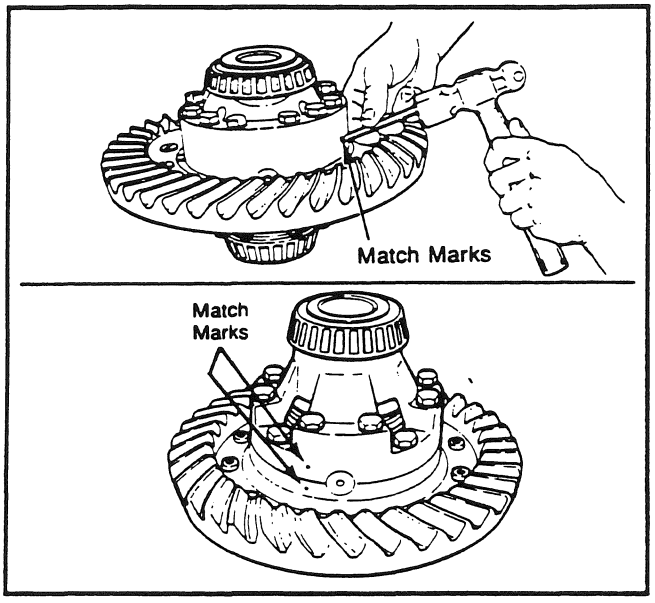


Fig. 14

2. Separate the case halves. If necessary, use a brass, plastic or leather mallet to loosen the parts. Remove the spider, four pinion gears, two side gears and six thrust washers from inside the case halves (see **Fig. 15**).

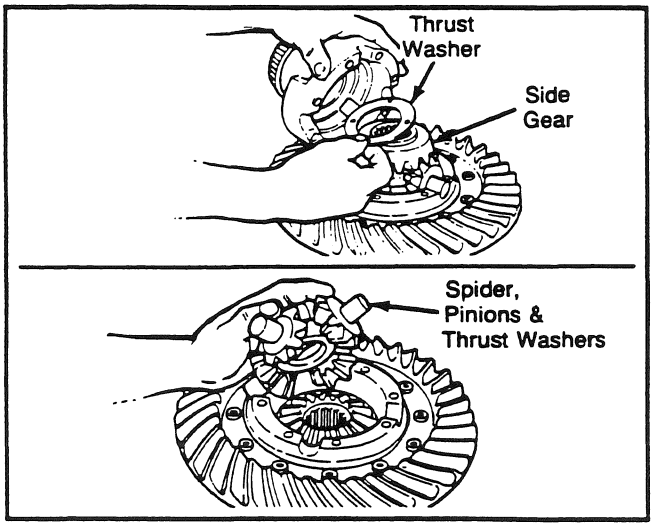


Fig. 15

3. If you are replacing the ring gear, remove the nuts and bolts retaining the gear to the flange case half. Separate the case half and ring gear using a hydraulic press. Support the assembly with wood or metal blocks under the ring gear and press the case half through the gear (see **Fig. 16**).

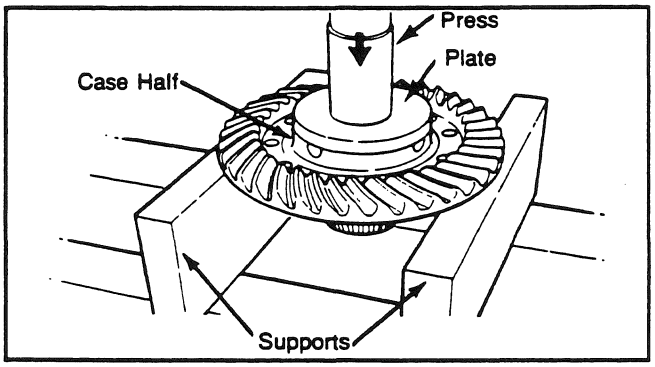


Fig. 16

4. If you are replacing the differential bearings, remove the bearing cones from the case halves. Use a bearing puller or press (see **Fig. 17**).

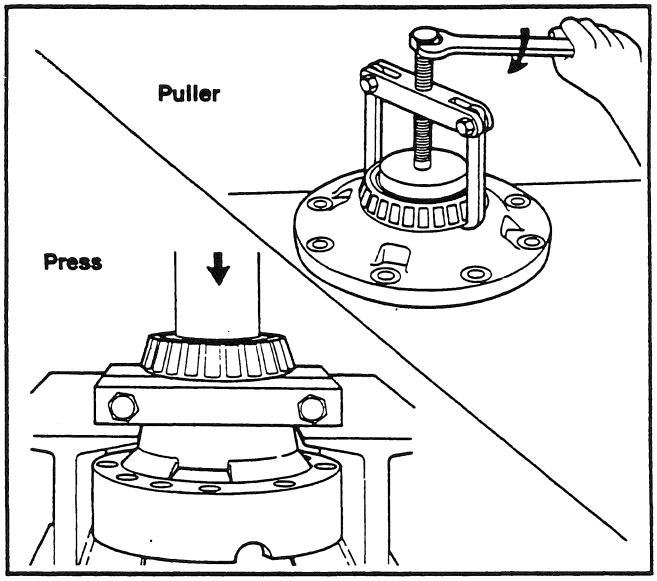


Fig. 17

Disassembly - Drive Pinion and Bearing Cage Assembly

1. Fasten a yoke bar to the input yoke (see **Fig. 18**). The bar holds the drive pinion in position when you remove the nut. Remove the nut from the drive pinion. Remove the yoke bar. Remove the yoke

from the drive pinion. Use a puller if the yoke is tight on the drive pinion (see **Fig. 19**).

NOTE: Do not use a hammer or mallet to loosen and remove the yoke. A hammer or mallet can damage parts and cause runout or alignment problems.

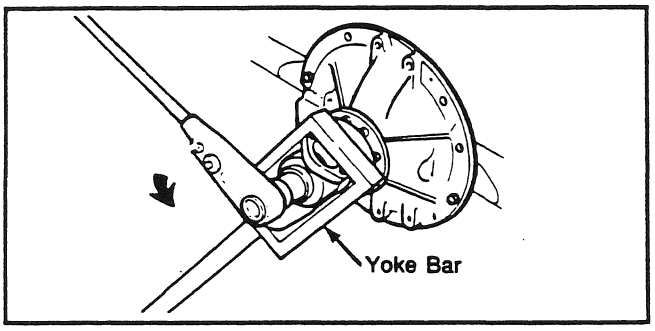


Fig. 18

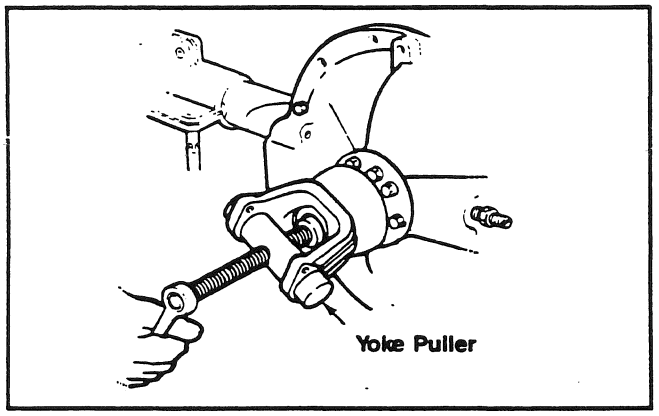


Fig. 19

2. Remove the bolts and washers retaining the bearing cage to the carrier. Remove the drive pinion, bearing cage and shims from the carrier (see **Fig. 20**).

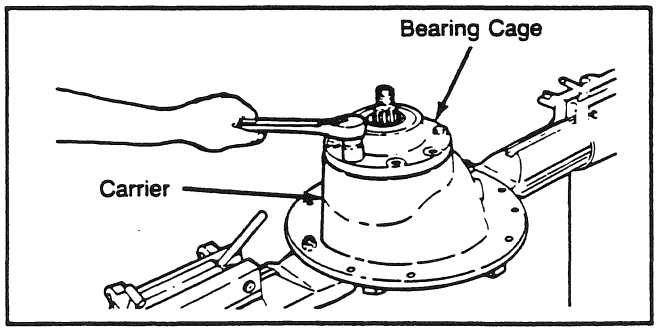
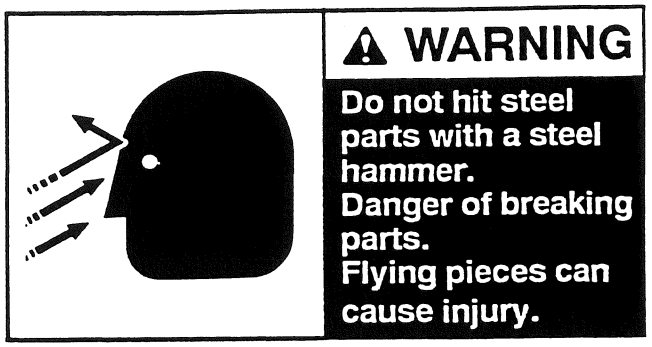


Fig. 20



3. If the bearing cage is tight in the bore, hit the cage at several points around the flange area with a leather, plastic or rubber mallet.

NOTE: Do not use a pry bar to remove the bearing cage from the carrier. A pry bar can damage the bearing cage, shims and carrier.

4. Keep any shims in good condition for use later during the assembly procedure. Before discarding any damaged shims, measure and record the total shim pack thickness. You will need to know this dimension to calculate the depth of the drive pinion when installing the gear set.

5. Place the drive pinion and bearing cage assembly in a press. The pinion shaft must be at the top. Support the bearing cage under the flange area with metal or wood blocks. Press the drive pinion through the bearing cage (see **Fig. 21**). The inner bearing cone and bearing spacer will remain on the drive pinion shaft.

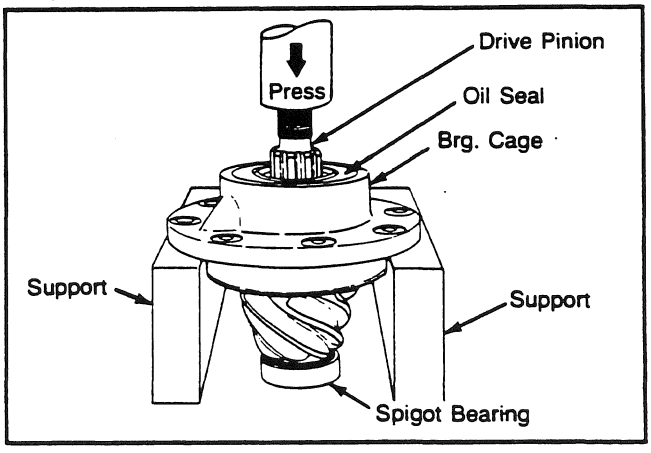


Fig. 21

6. Remove and discard the pinion oil seal (see **Fig. 22**). Be careful you do not damage the mounting surfaces or wall of the bore. Damage to the bearing cage bore can cause oil leaks.

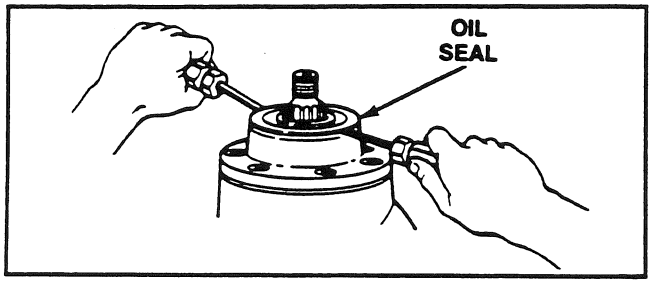


Fig. 22

7. Use a press and sleeve, bearing puller or a hammer and brass drift to remove the drive pinion inner and outer bearing cups (see **Fig. 23**). When using a press, support the bearing cage under the flange with metal or wood blocks.

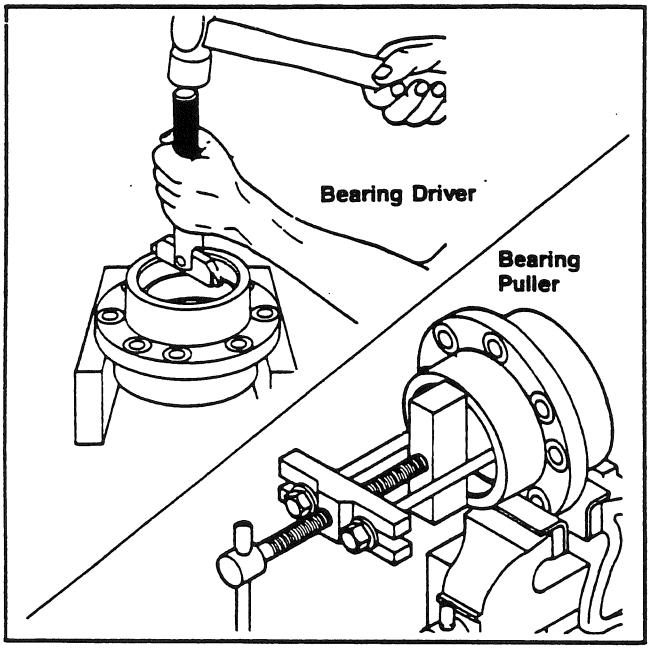


Fig. 23

8. Use a press or bearing puller to remove the drive pinion inner bearing cone. The puller must fit under the inner race of the cone for correct removal (see **Fig. 24**).

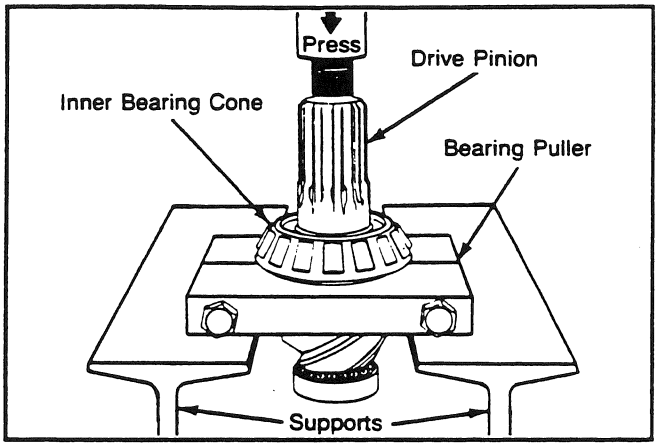


Fig. 24

9. Install the drive pinion in a vise with soft jaws to remove the drive pinion spigot bearing.

NOTE: *The spigot bearing design may differ according to your carrier assembly model.*

a) Press fit two-piece design.

b) Retained to the drive pinion by staking.

c) Retained to the drive pinion by a snap ring.

10. Remove and discard the snap ring retaining the spigot bearing to the drive pinion (see **Fig. 25**). Remove the spigot bearing from the drive pinion using a bearing puller (see **Fig. 26**). For a two-piece bearing, remove the inner race from the drive pinion using a bearing puller. Remove the outer race from the carrier using a press or hammer and brass drift (see **Fig. 27**).

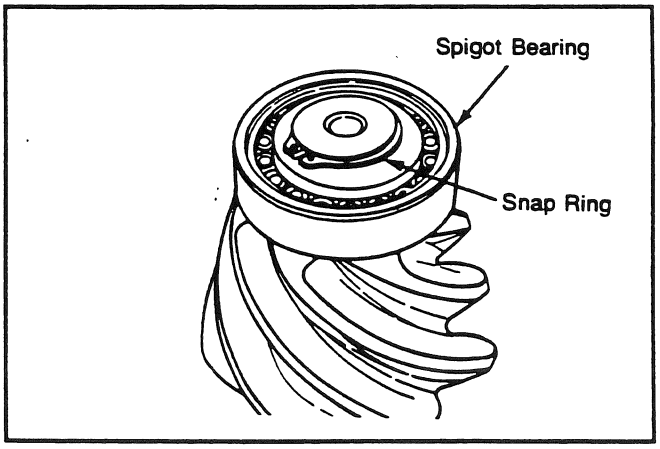


Fig. 25

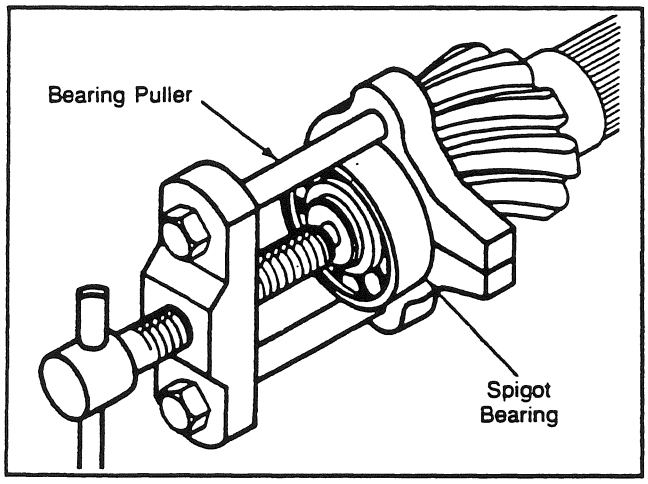


Fig. 26

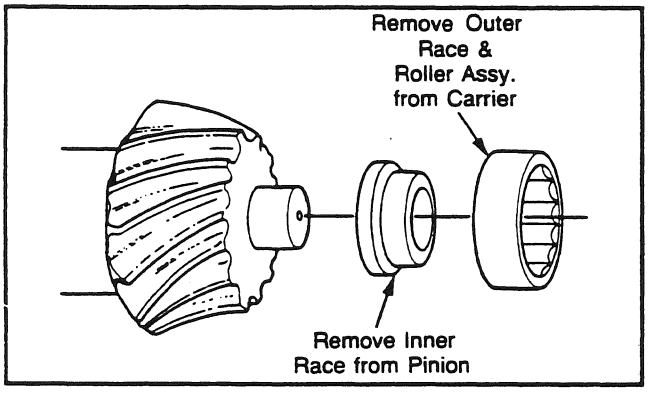


Fig. 27

Disassembly - Final Drive Housing Journal Bushings

1. Remove and discard the inner and outer bushings from the final drive housing journals (see **Fig. 28**).

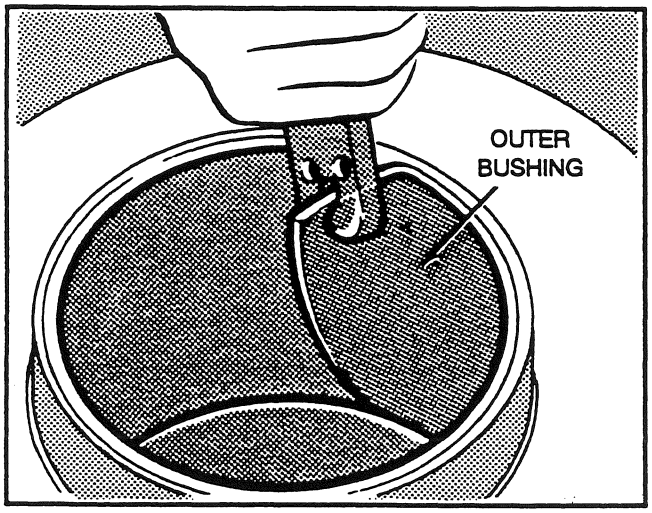


Fig. 28

Assembly - Drive Pinion, Bearings and Bearing Cage

1. Place the bearing cage in a press and support with metal or wood blocks. Lubricate the bearing cup with system oil. Use a sleeve of the correct size and press the bearing cup into the bearing cage until the cup is flat against the bottom of the bore (see **Fig. 29**). Repeat the procedure for the other bearing cup.

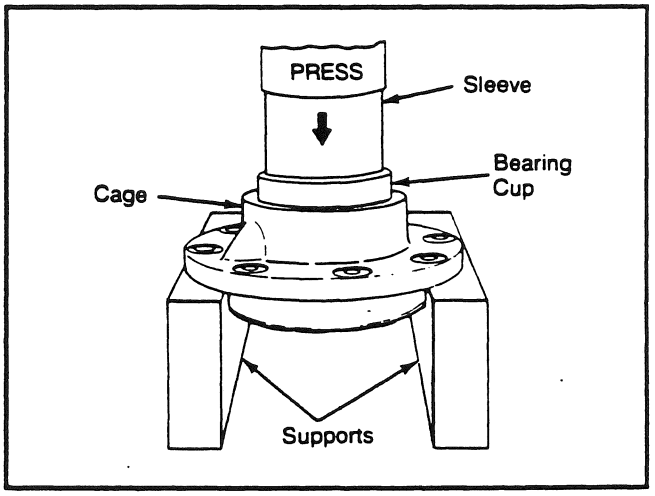


Fig. 29

2. Place the drive pinion in a press, gear head toward the bottom. Lubricate the inner bearing cone. Use a sleeve of the correct size to press the cone on the drive pinion shaft until the cone is flat against the gear head (see **Fig. 30**).

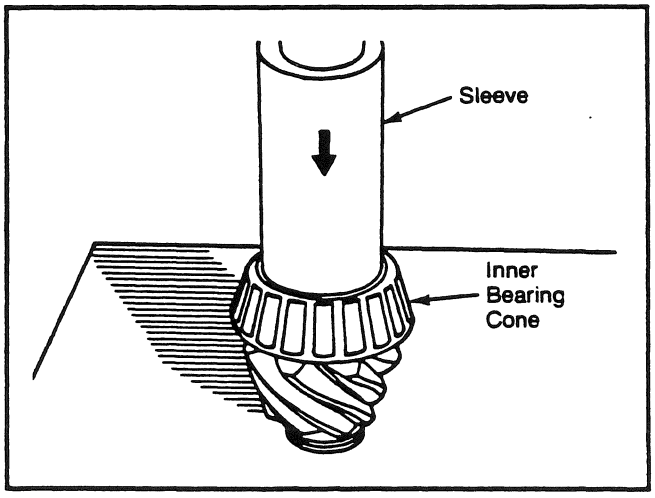


Fig. 30

3. Place the drive pinion in a press, gear head toward the top. Lubricate and install the spigot bearing.

NOTE: *The spigot bearing design may differ according to your final drive carrier model.*
a) Press fit two-piece design.
b) Retained to the drive pinion by staking.
c) Retained to the drive pinion by a snap ring.

4. Use a sleeve of the correct size and press the spigot bearing on the end of the drive pinion until the bearing is flat against the gear head (see **Fig. 31**). Install a new snap ring.

5. For spigot bearings staked to the drive pinion, there should be a minimum of five staking points. Use a two-piece staking tool, consisting of a tube and punch (see **Fig. 32**). Calculate the staking pressure as follows:

6,614 lb (3000 kg) x number of balls in tool = pounds or kilograms.

Example: 6,614 lb x 3 balls = 19,842 pounds

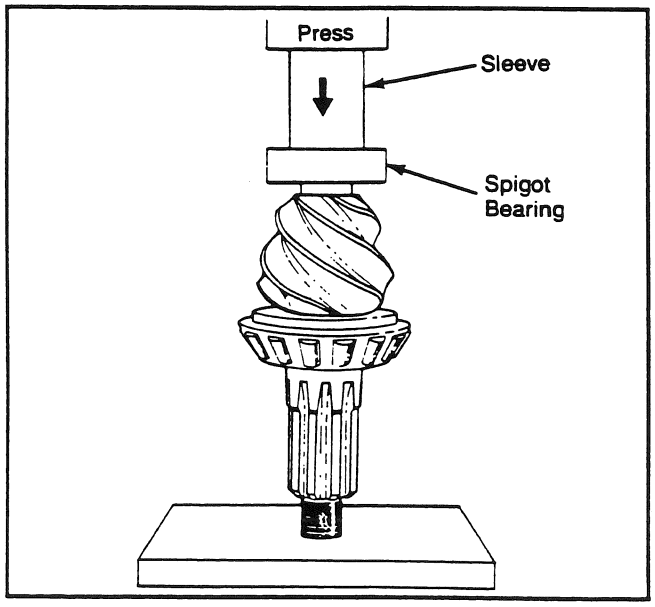


Fig. 31

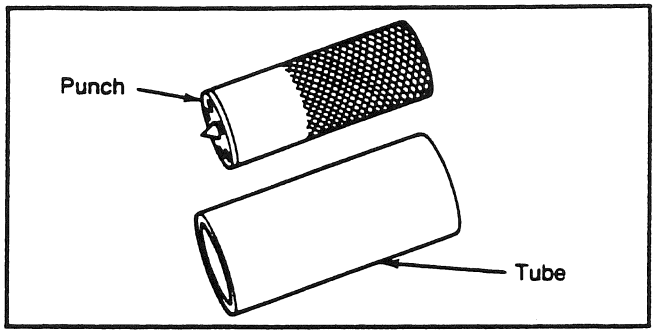


Fig. 32

6. Place the drive pinion and the tube into a press. The spigot bearing should be toward the top. Place the punch over the end of the drive pinion and spigot bearing. Apply the staking pressure previously calculated (see **Fig. 33**).

NOTE: *Do not align new staking points with the grooves in the end of the drive pinion or in old points. If the new staking points are put in the wrong areas, the spigot bearing will not be properly retained. If you use a three point punch, rotate the tool 180 degrees.*

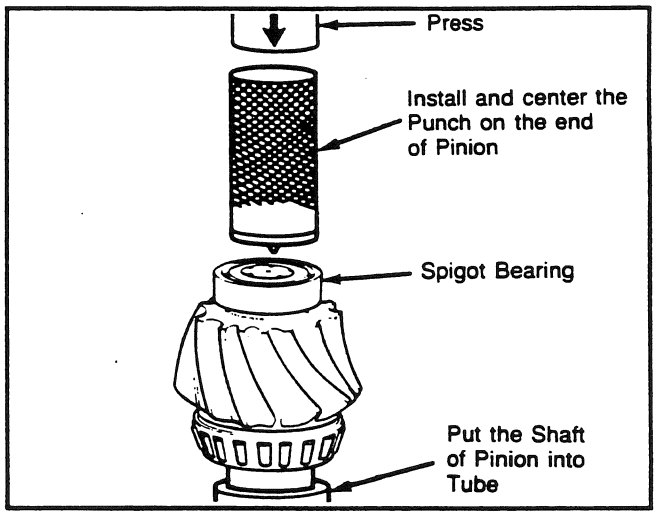


Fig. 33

7. Use a press or soft mallet to install two-piece spigot bearings. Lubricate and install the inner race of the spigot bearing onto the nose of the drive pinion. Use a sleeve of the correct size and press the race until it seats squarely against the shoulder on the nose of the drive pinion.

8. Use a press or soft mallet and sleeve of the same size as the outer race to install the race into the carrier bore. Press the race until it seats squarely against the shoulder in the bottom of the bore (see **Fig. 34**).

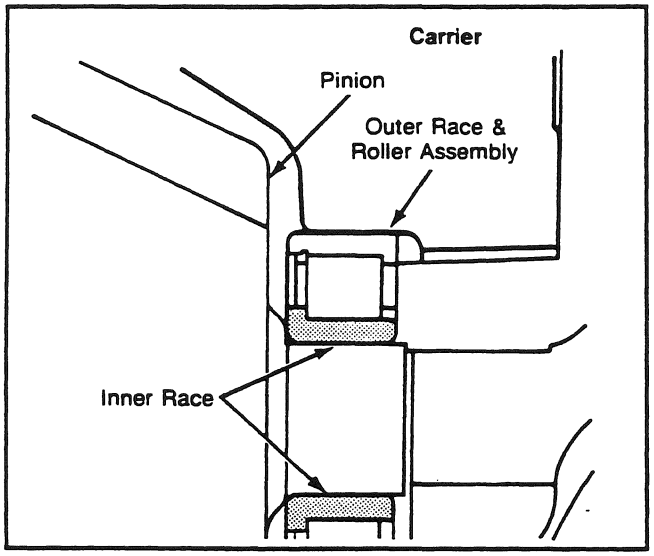


Fig. 34

9. Lubricate the drive pinion bearing cups and cones. Install the drive pinion into the bearing cage. Install the spacer on the pinion shaft against the inner bearing cone. Install the outer bearing cone on the pinion shaft against the spacer (see **Fig. 35**). Do not install the oil seal. Continue the procedure by adjusting the drive pinion bearing preload.

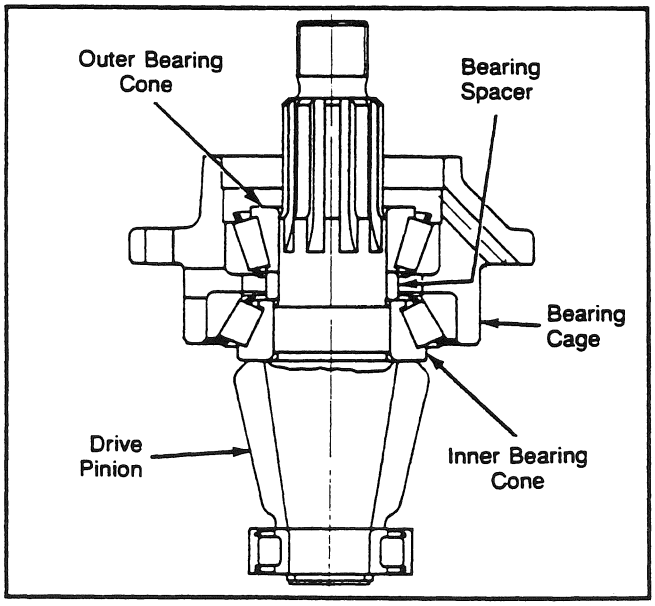


Fig. 35

Adjusting Drive Pinion Bearing Preload

Specifications:

New drive pinion bearings -
5 to 45 lbf·in. (0,06 to 0,52 kgf·m)

Used drive pinion bearings in good condition -
10 to 30 lbf·in. (0,11 to 0,35 kgf·m)

Press Method

NOTE: *If a press is not available, or the press does not have a pressure gauge, use the* ***yoke method*** *to adjust the preload.*

1. Place the drive pinion and cage assembly in a press, gear head (teeth) toward the bottom. Install a sleeve of the correct size against the outer bearing cone race (see **Fig. 36**). Apply and hold the following pressure: 50,000 lbs or 25 tons (22 680 kg or 2,7 metric tons). As you apply the pressure, turn the bearing cage several times to ensure normal bearing contact.

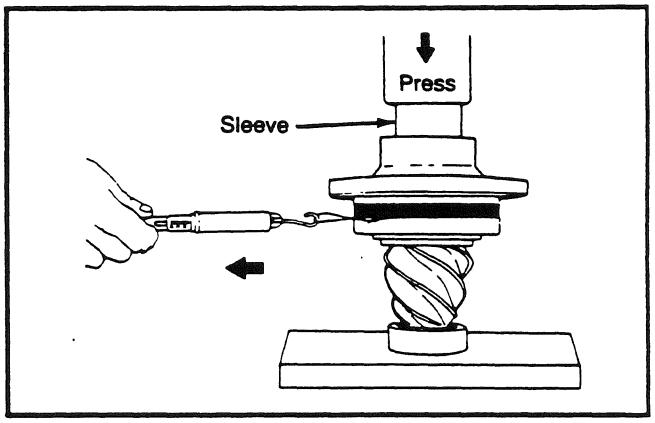


Fig. 36

2. While holding the pressure against the assembly, wind a cord around the bearing cage several times. Attach a spring scale to the end of the cord. Use the scale to pull the cord horizontally. As the bearing cage turns, read the value shown on the scale. Note the reading.

NOTE: Do not read the starting torque. Read only the torque value after the cage starts to turn. Starting torque will give a false reading.

3. See **Fig. 37** and note the radius dimension of your model final drive bearing cage.

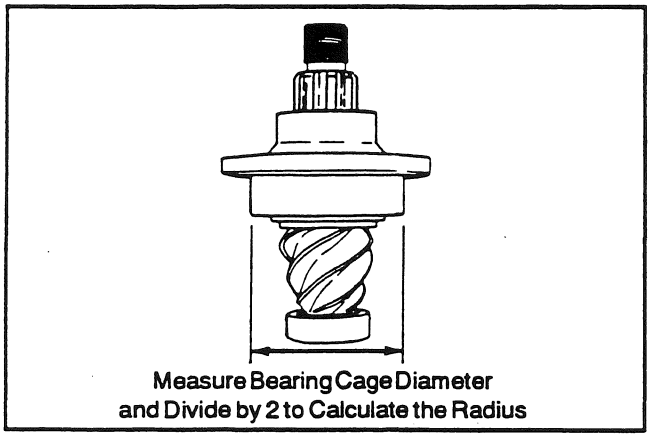


Fig. 37

4. Use the following procedure to calculate the bearing preload (torque).

Pounds pulled x Radius (inches) = lbf·in. preload

OR

Kilograms pulled x Radius (centimeters) = kgf·cm preload

Examples:
Reading from spring scale = 7.5 pounds (3,4 kg)
Radius of bearing cage = 3.31 inches (8,4 cm)

7.5 pounds x 3.31 inches = 24.8 lbf·in. preload

OR

3,4 kg x 8,4 centimeters = 28,6 kgf·cm preload

5. If the drive pinion bearing preload is not within specifications, complete this step then repeat steps 1 to 4. To increase preload, install a thinner bearing spacer. To decrease preload, install a thicker bearing spacer.

6. Check the bearing preload with the drive pinion and bearing cage assembly installed in the carrier. Follow the yoke method procedure to adjust the drive pinion bearing preload.

Yoke Method

Specification:
Torque value needed on pinion nut for correct bearing preload -
900 - 1200 lbf·ft (1220 - 1627 N·m)

1. Install the input yoke and nut on the drive pinion. The yoke must fit against the outer bearing cone. You are recommended to use the three-piece pilot tool P/N **58439** when installing the yoke. Refer to the end of this section for pilot tool details. The yoke and pinion splines are an interference fit and the pilot tool helps you correctly install the yoke. Do not use a hammer or mallet to install the yoke. Using a hammer or mallet can damage the yoke.

2. Use the three-piece pilot tool as follows (see **Fig. 38**):

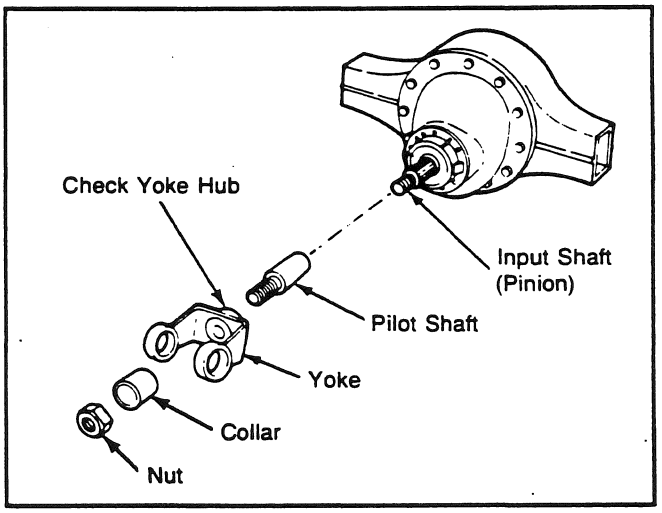


Fig. 38

a) Check all surfaces of the yoke hub for damage. Remove damaged surfaces using an india stone, emery cloth or crocus cloth.

b) Install the pilot shaft on the drive pinion splines.

c) Install the yoke over the pilot shaft. Align the yoke and drive pinion splines.

d) Install the collar on the pilot shaft and slide it against the yoke.

e) Install the nut on the pilot shaft and against the collar. Tighten the nut against the collar until the yoke is completely installed on the shaft. Sometimes a torque value of 200 lbf·ft (271 N·m; 28 kgf·m) is required to install the yoke.

NOTE: Use only the nut supplied with the three-piece pilot tool. Do not use the assembly nut.

f) Remove the nut, collar and pilot shaft from the drive pinion shaft.

g) Install the assembly nut onto the drive pinion shaft.

3. Temporarily install the drive pinion and bearing cage assembly in the carrier. Do not install shims under the bearing cage. Install the retaining bolts and tighten hand tight. Washers are not required at this time.

4. Fasten a yoke bar to the input yoke. The bar retains the drive pinion when you tighten the assembly nut. Tighten the nut to the specified torque (see **Fig. 39**). Remove the yoke bar.

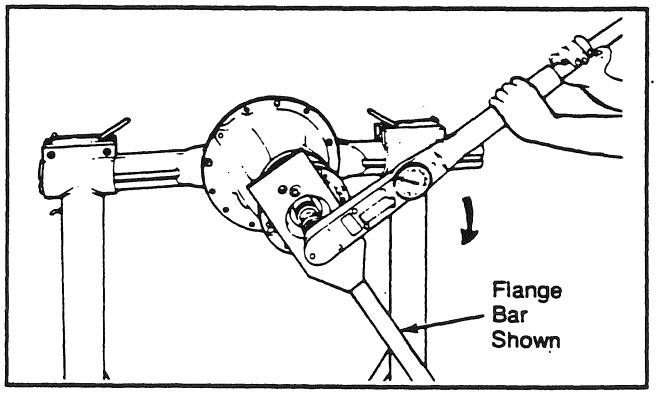


Fig. 39

5. Attach a dial indicator type torque wrench to the drive pinion nut. Turn the drive pinion and read the value shown on the dial (see **Fig. 40**). This value is the drive pinion bearing preload.

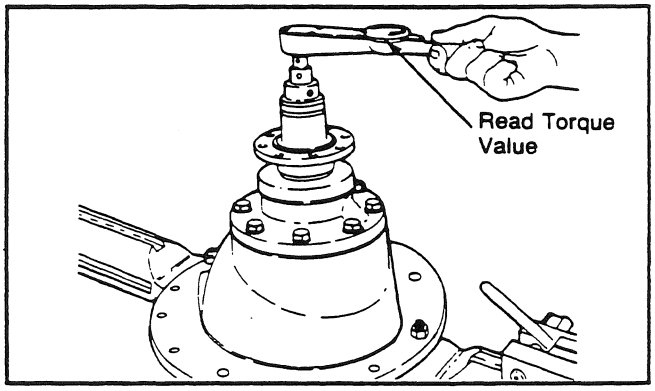


Fig. 40

6. If the drive pinion bearing preload is not within specifications, remove the drive pinion and bearing cage assembly. Complete this step, then repeat steps 1 to 5.

a) To increase preload, install a thinner bearing spacer.

b) To decrease preload, install a thicker bearing spacer.

7. After adjusting the pinion bearing preload, remove the drive pinion and bearing cage assembly.

8. Apply system oil to the outside diameter of the oil seal and the seal bore in the bearing cage. Install the seal. Make sure the seal lips are clean and free from particles that could cause a leak between the yoke and the seal. Apply wheel bearing grease to the seal lips (see **Fig. 41**).

9. Place the drive pinion and bearing cage assembly in a press; seal bore toward the top. Use a sleeve or seal driver of the correct size that fits against the metal flange of the seal. The diameter of the sleeve or seal driver **must** be larger than the diameter of the flange. Install the seal until the flange is flat against the top of the bearing cage (see **Fig. 42**).

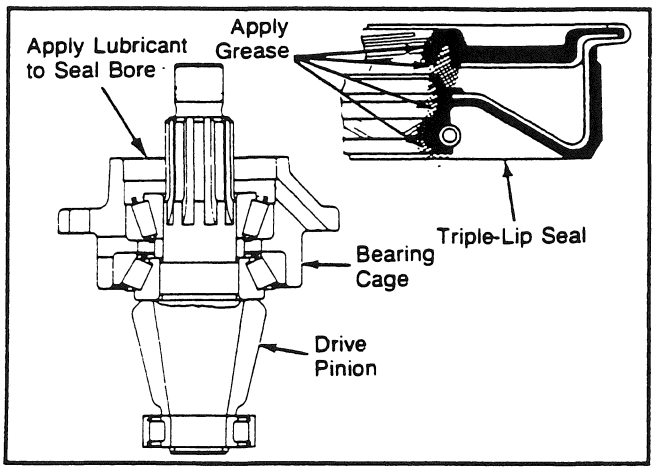


Fig. 41

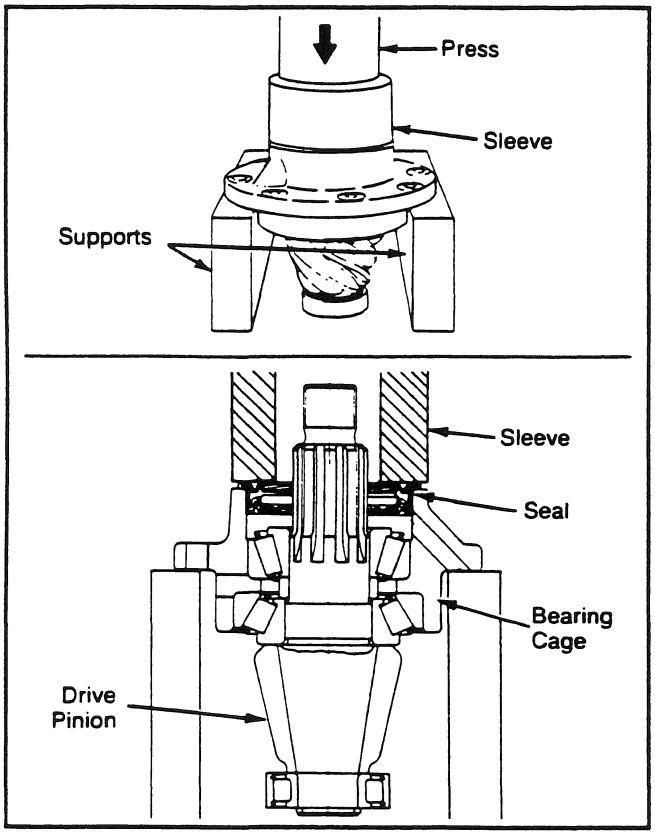


Fig. 42

If a press is not available, use a mallet and the sleeve or seal driver (see **Fig. 43**).

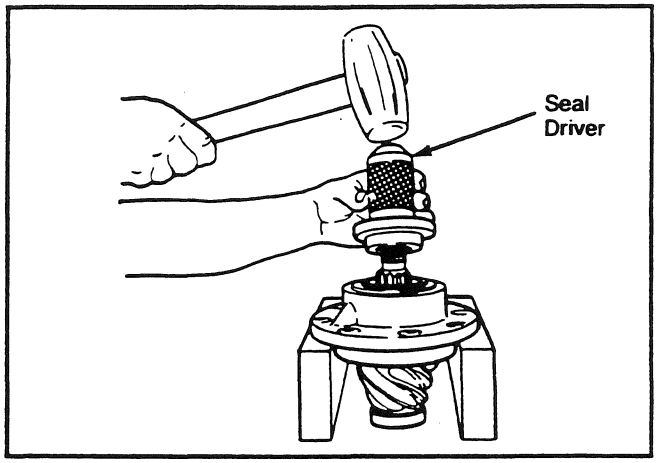


Fig. 43

10. After installing the seal, a gap of approximately 0.015 to 0.030 inch (0,38 to 0,76 mm) between the flange and bearing cage is normal (see **Fig. 44**). Check the gap with a feeler gauge at several points around the seal. The gap must be within 0.015 to 0.030 inch (0,38 to 0,76 mm). The difference between the largest and smallest gap measurement **must not** exceed 0.010 inch (0,25 mm).

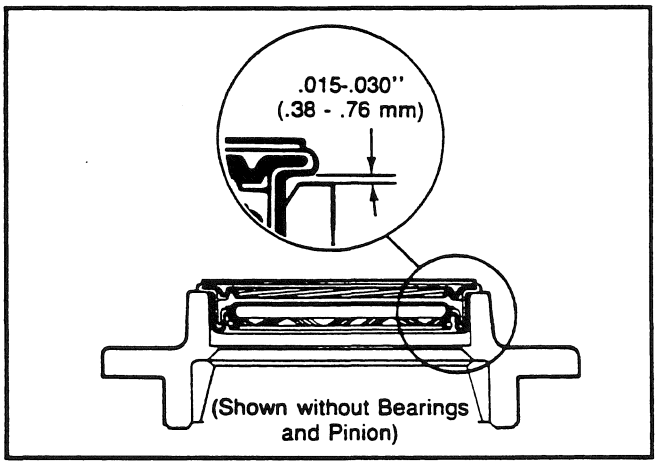


Fig. 44

Adjusting Pinion Cage Bearing Shim Pack Thickness (Pinion Depth)

NOTE: Use this procedure when installing a new ring gear and drive pinion gear set, or adjusting the drive pinion depth (see Fig. 45).

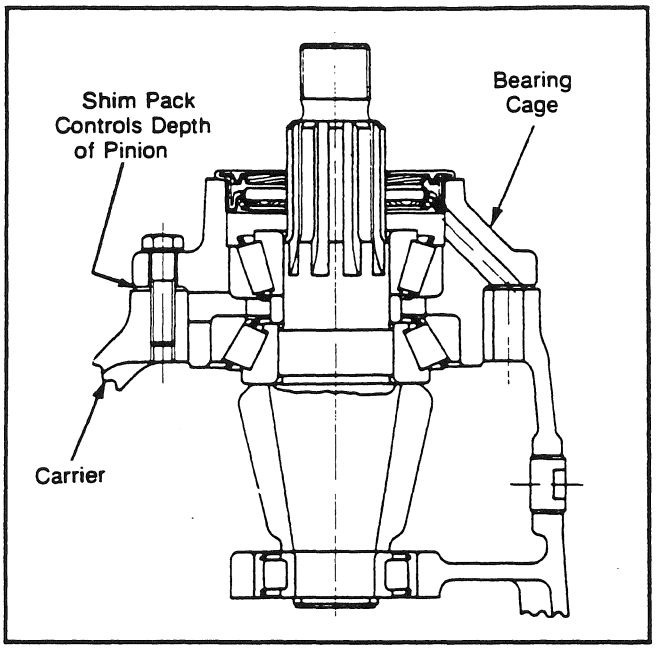


Fig. 45

1. Use a micrometer and measure the thickness of the shim pack that was removed from under the pinion bearing cage. Record the measurement for later use (see **Fig. 46**).

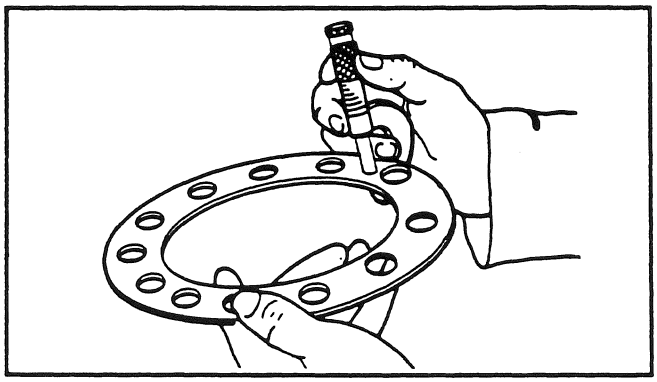


Fig. 46

2. Look at the pinion cone ("PC") variation number on the drive pinion that is being replaced. The location is on the end of the pinion gear head. Record the number for later use (see **Fig. 47**).

NOTE: *Do not use the pinion cone variation number when checking for a matched gear set. Use the number only when adjusting the pinion depth.*

NOTE: *The pinion cone variation number can be either 1,000ths of an inch or 100ths of a millimeter. See the following examples.*

PC+3, PC-3, +3 or -3 represent 0.003 inch
PC+.03, PC-.03 mm, +.03 mm or -.03 represent 0,03mm
To change inches to millimeters, multiply inches by ***25.40***
To change millimeters to inches, multiply millimeters by ***0.039***

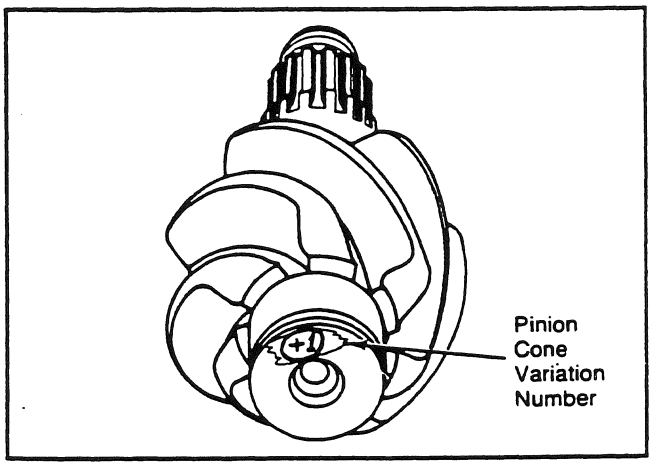


Fig. 47

3. If the old pinion cone variation number is a plus (+), subtract the number from the shim pack thickness measured in step 1. If the old pinion cone variation number is a minus (-), add the number to the shim pack thickness measured in step 1. The value calculated is the thickness of the standard shim pack, without a variation.

4. Look at the pinion cone ("PC") variation number on the new drive pinion to be installed. Record the number for later use.

5. If the new pinion cone variation number is a plus (+), add the number to the standard shim pack thickness calculated in step 3. If the new pinion cone variation number is a minus (-), subtract the number from the standard shim pack thickness calculated in step 3. The value calculated is the thickness of the new shim pack to be installed. See the examples in the following chart.

Examples:		Inches	mm
1.	Old shim pack thickness	0.030	0,76
	Old PC number, PC+2	- 0.002	- 0.05
	Standard shim pack thickness	0.028	0,71
	New PC number, PC+5	+ 0.005	+ 0.13
	New shim pack thickness	0.033	0,84
2.	Old shim pack thickness	0.030	0,76
	Old PC number, PC-2	+ 0.002	+ 0.05
	Standard shim pack thickness	0.032	0,81
	New PC number, PC-5	+ 0.005	+ 0.13
	New shim pack thickness	0.037	0,94
3.	Old shim pack thickness	0.030	0,76
	Old PC number, PC+2	- 0.002	- 0.05
	Standard shim pack thickness	0.028	0,71
	New PC number, PC-5	- 0.005	- 0.13
	New shim pack thickness	0.023	0,58
4.	Old shim pack thickness	0.030	0,76
	Old PC number, PC-2	+ 0.002	+ 0.05
	Standard shim pack thickness	0.032	0,81
	New PC number, PC-5	- 0.005	- 0.13
	New shim pack thickness	0.027	0,68

Remember: ring gears and drive pinions **must** be replaced as matched sets.

6. Install the drive pinion, bearing cage and new shim pack into the carrier.

Installing Drive Pinion and Bearing Assembly into Carrier

1. If you are installing a new ring gear and drive pinion or adjusting the drive pinion depth, calculate the shim pack thickness. Refer to the procedure in **Adjusting Pinion Bearing Cage Shim Pack Thickness (Pinion Depth)**.

2. Install the shim pack between the bearing cage and carrier. Align the oil slots in the shims with the oil slots in the bearing cage and carrier. Use guide studs to help align the shims (see **Fig. 48**). Use a minimum of three shims in a pack. If the pack is made from different thickness shims, install the thinnest shims on both sides of the pack. This ensures maximum sealing.

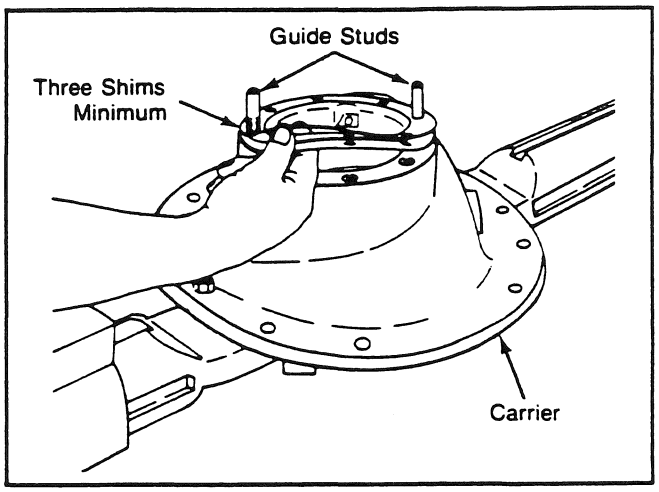


Fig. 48

3. Install the drive pinion and bearing cage assembly into the carrier (see **Fig. 49**). If necessary, use a rubber, plastic or leather mallet to hit the assembly into position.

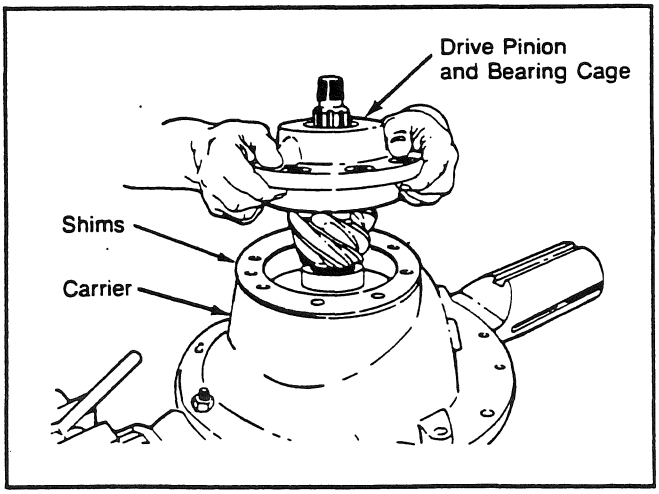


Fig. 49

4. Install the bearing cage retaining bolts and lockwashers. Tighten the bolts to the specified torque (see **Fig. 50**). Install the input yoke and nut on the drive pinion. The yoke must fit against the outer bearing cone. You are recommended to use the three-piece pilot tool P/N **58439** when installing the yoke. The yoke and pinion splines are an interference fit and the pilot tool helps you correctly install the yoke. Refer to the procedure in **Adjusting Drive Pinion Bearing Preload - Yoke Method.**

NOTE: *Do not use a hammer or mallet to install the yoke. Using a hammer or mallet can damage the yoke.*

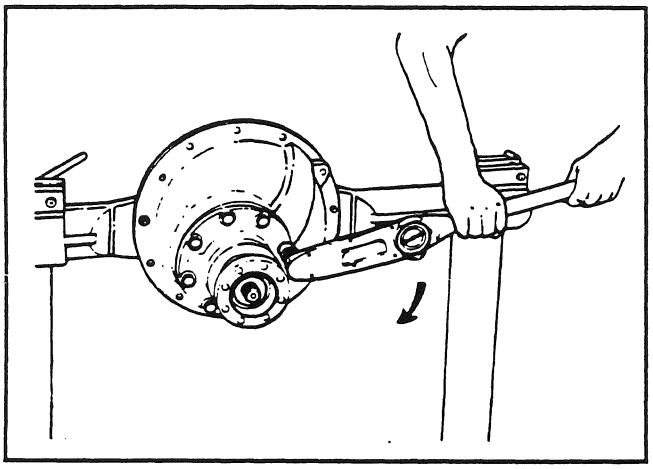


Fig. 50

5. Fasten a yoke bar to the input yoke. The bar retains the drive pinion when you tighten the assembly nut. Tighten the nut to the specified torque (see **Fig. 51**). Remove the yoke bar.

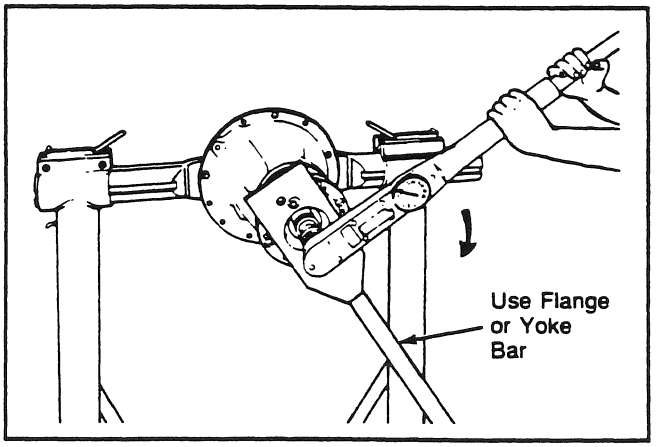


Fig. 51

Assembly - Differential and Ring Gear Assembly

⚠ WARNING

Hot surfaces. Wear protective clothing and gloves. Severe personal injury could result.

1. Heat the ring gear in a tank of water to a temperature of 160°F - 180°F (71°C - 82°C) for 10 to 15 minutes.

NOTE: *Do not press a cold ring gear on the flange case half. Damage to the flange case half can occur. Metal particles between the parts could cause the gear runout to exceed the design specification of 0.008 inch (0,2 mm).*

2. Use a safe lifting device and remove the ring gear from the tank of hot water. Install the ring gear on the flange case half immediately after the gear is heated. If the ring gear does not fit easily on the flange case half, reheat the gear.

3. Align the bolt holes of the ring gear and flange case half. Install the bolts and nuts retaining the ring gear to the flange case half. Install the bolts from the gear side of the assembly. The bolt heads **must** be against the ring gear (see **Fig. 52**). Tighten the nuts to the specified torque.

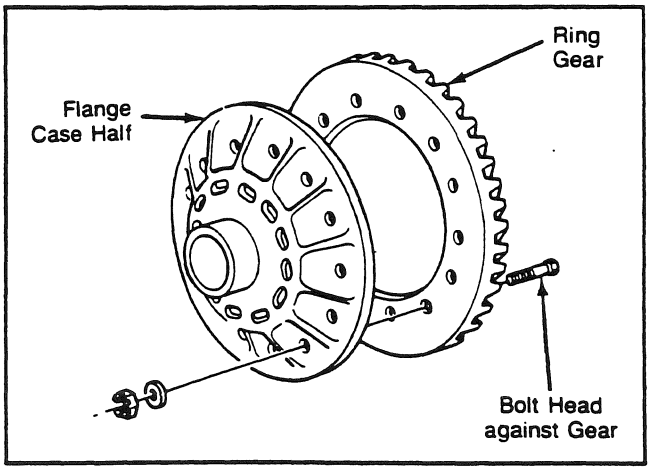


Fig. 52

4. Install the bearing cones on both of the case halves. Use a press and sleeve of the correct size (see **Fig. 53**).

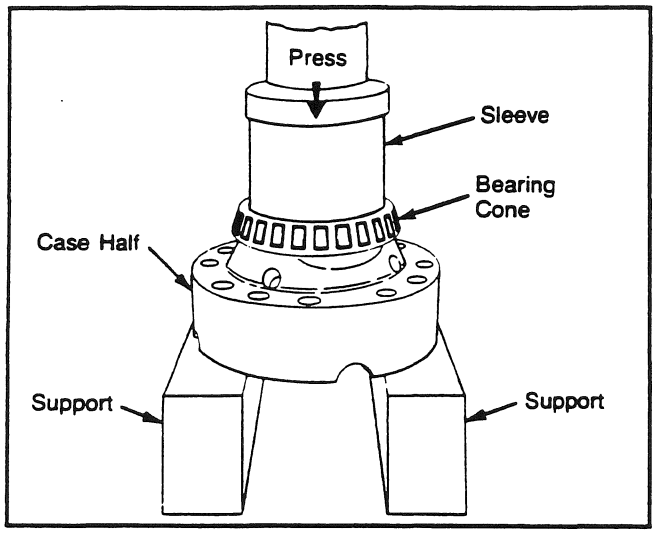


Fig. 53

5. Apply system oil on the inside surfaces of both case halves, spider, thrust washers, side gears and differential pinions.

6. Place the flange case half on a clean workbench, ring gear teeth toward the top. Install one thrust washer and side gear into the flange case half (see **Fig. 54**).

NOTE: *The side gears have different length hubs. Install the correct length side gear into the flange case half.*

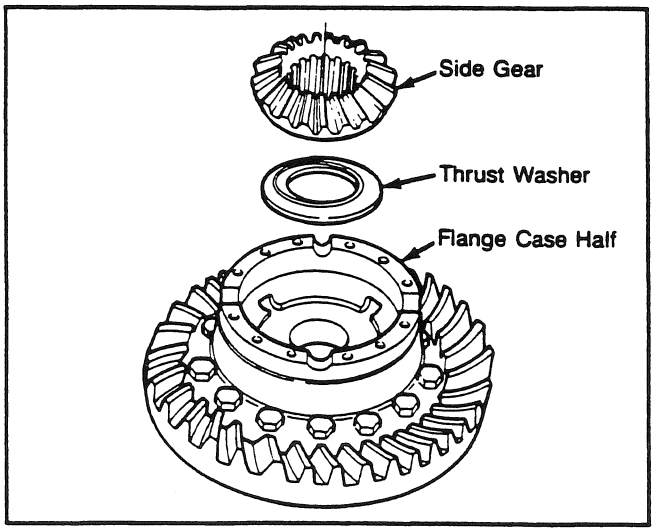


Fig. 54

7. Install the spider, differential pinions and thrust washers into the flange case half (see **Fig. 55**). Install the second side gear and thrust washer over the spider and differential pinions (see **Fig. 56**).

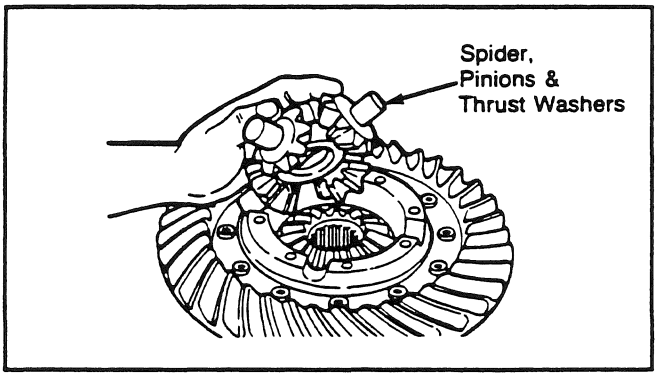


Fig. 55

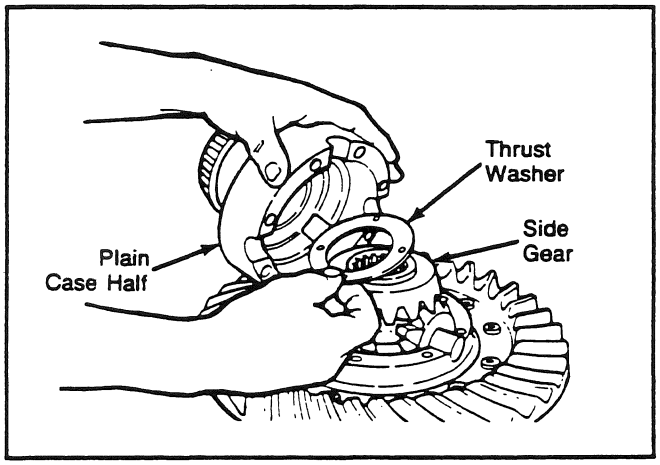


Fig. 56

8. Install the plain half of the differential case over the flange case half and gears. Align the match marks of the two case halves (see **Fig. 57**).

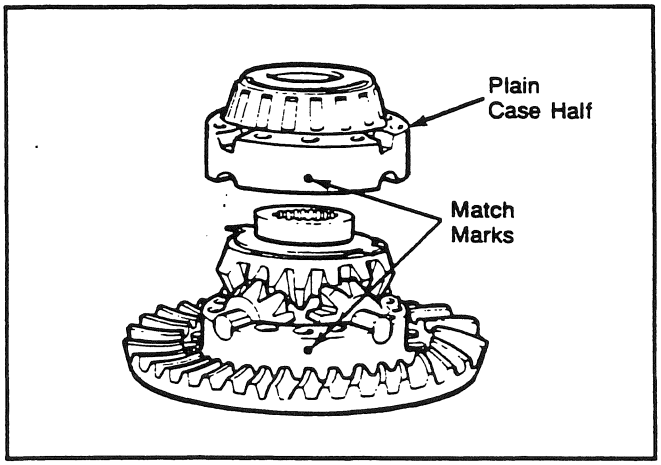


Fig. 57

9. Install four bolts into the case halves. The distance between the bolts **must** be equal. Tighten the bolts to the specified torque in a diagonal pattern (see **Fig. 58**). Install the remaining bolts. Tighten the bolts to the specified torque.

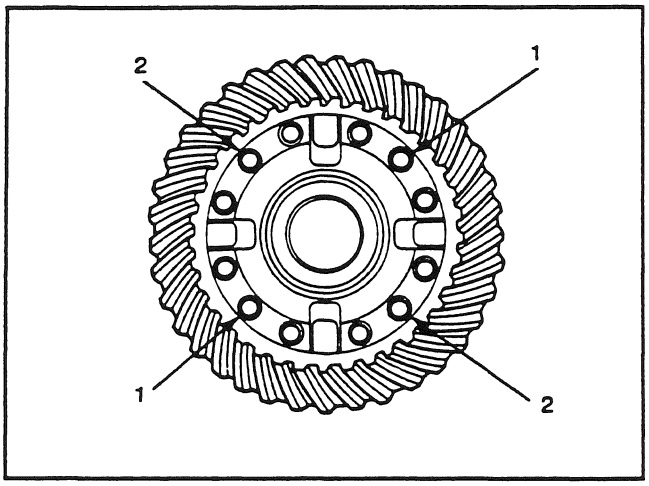


Fig. 58

Checking Differential Side Gear Rotating Resistance

Check the rotating resistance of the differential side gears as follows:

Specification:
50 lbf.ft (67,8 N.m; 6,9 kgf.m) torque (maximum) applied to one side gear.

1. Make a tool for checking the differential side gear rotating resistance. You can make the tool from an axle shaft with splines that match the splines of the differential side gears (see **Fig. 59**).

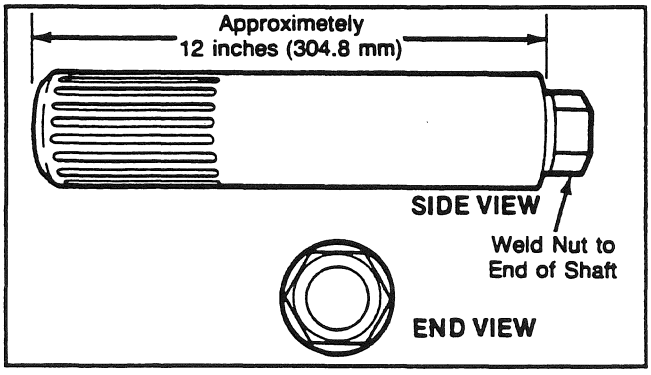


Fig. 59

2. Install the differential and ring gear assembly in a vise with soft jaws. Install the tool into the differential until the splines of the tool and one side gear engage (see **Fig. 60**).

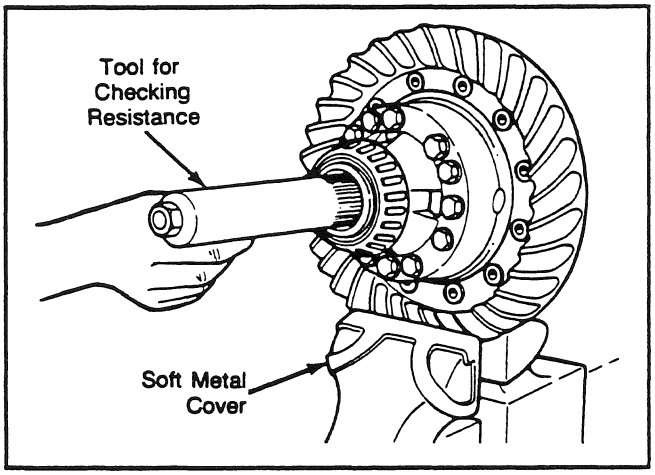


Fig. 60

3. Attach a dial indicator type torque wrench to the nut of the tool and turn the differential gears. As the differential gears turn, read the value indicated on the torque wrench (see **Fig. 61**). If the torque value exceeds the specification, disassemble the differential case halves.

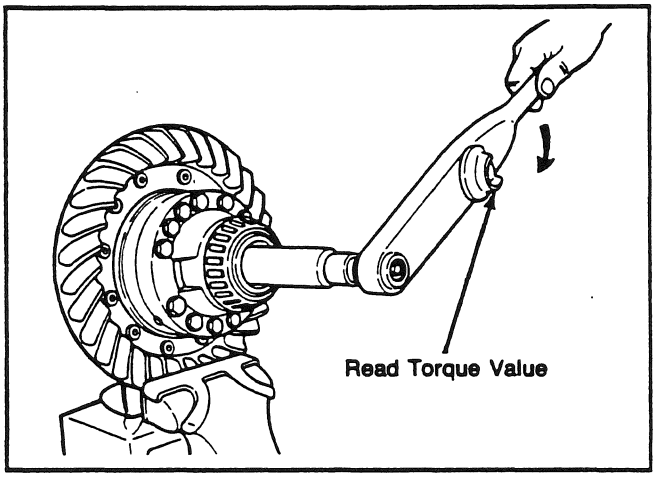


Fig. 61

4. Check the case halves, spider, gears and thrust washers for the problem that causes the torque value to exceed the specification. Repair or replace defective parts; then repeat steps 1 to 4.

Installing Differential and Ring Gear Assembly into Carrier

1. Clean and dry the bearing cups and bores of the carrier legs and bearing caps. Apply system oil on the inner diameter of the bearing cups and on both case half bearing cones. Ensure there is no oil on the outer diameter of the bearing cups or in the bearing bores.

2. Apply a continuous bead of adhesive ('Loctite' **RC 635**, or equivalent) to the bearing bores in the carrier and bearing caps. Apply the adhesive 360° around the smooth, ground surfaces only. Do not apply adhesive onto the threads (see **Fig. 62**).

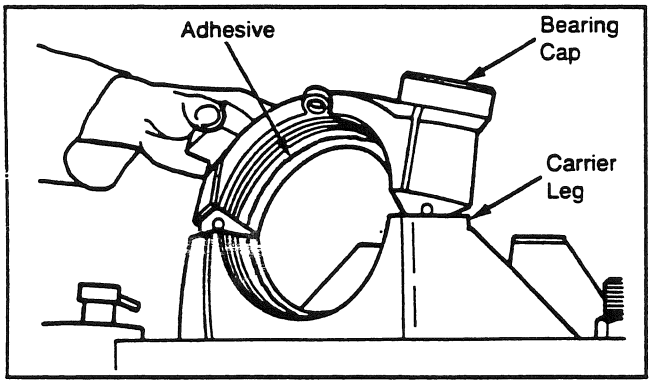


Fig. 62

3. The adhesive becomes hard (dry) in approximately two hours. Perform the differential assembly, bearing preload, backlash and tooth contact pattern procedures within two hours of applying the adhesive. If two hours have passed since the application, clean the parts and apply new adhesive.

4. Install the bearing cups over the case half bearing cones. Use a safe lifting device to install the differential and ring gear assembly into the carrier (see **Fig. 63**). The bearing caps **must** sit squarely in the bores between the carrier legs.

5. Install both adjusting rings between the carrier legs. Turn each adjusting ring hand tight against the bearing cup. Install the bearing caps over the bearings and adjusting rings in the correct position as marked before removal (see **Fig. 64**).

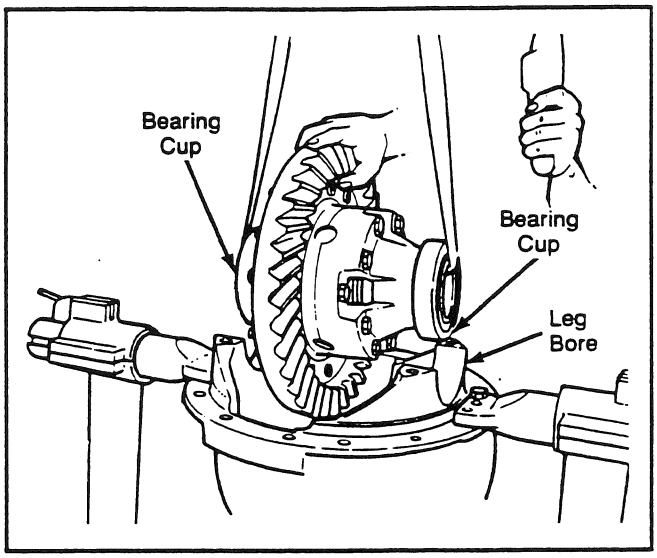


Fig. 63

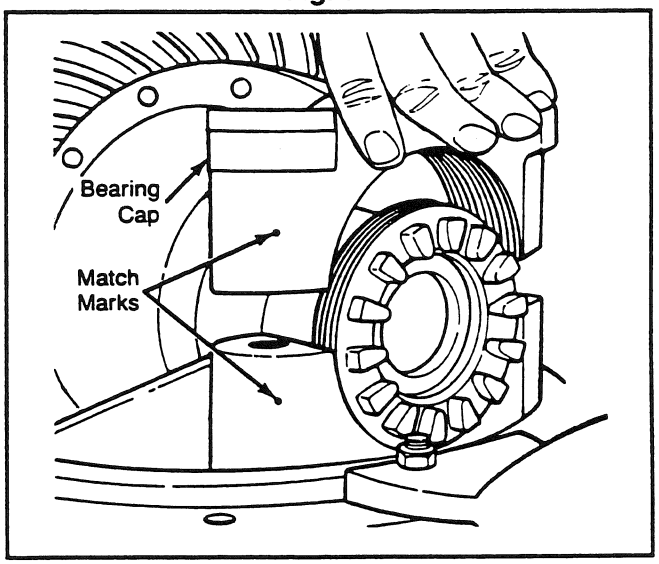
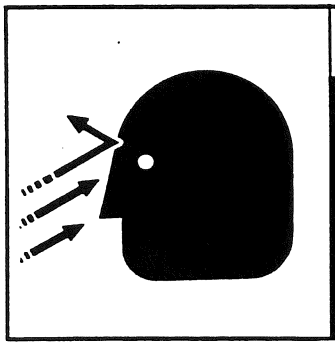


Fig. 64



⚠ WARNING

Do not hit steel parts with a steel hammer.
Danger of breaking parts.
Flying pieces can cause injury.

6. Hit each bearing cap into position with a light leather, plastic or rubber mallet. The caps **must** fit easily against the bearings, adjusting rings and carrier. Do not force the bearing caps into position.

NOTE: *If the bearing caps are not installed correctly, the bores and threads of the caps and carrier will not match. You will have problems installing the caps on the carrier and damage to parts can occur.*

7. If the bearing caps do not fit correctly, check the alignment of the match marks on the caps and carrier. Install the bolts and washers retaining the bearing caps to the carrier. Tighten the bolts by hand four to six turns; then tighten the bolts to the specified torque.

8. Do not install the cotter pin and lock plate securing the adjusting rings. Continue the procedure by adjusting the differential bearing preload, ring gear backlash adjustment and tooth contact pattern check.

Adjusting Differential Bearing Preload

Specifications:

Differential bearing preload - 15 to 35 lbf.in. (1,7 to 3,9 N.m; 0,17 to 0,40 kgf.m)
or
Expansion between bearing caps - 0.006 to 0.013 inch (0,15 to 0,33 mm)

Method 1

1. Install a dial indicator on the carrier mounting flange. Adjust the dial indicator plunger against the back surface of the ring gear (see **Fig. 65**).

NOTE: *When turning the adjusting rings, always use a tool that engages two or more opposite notches. A "T" bar wrench is useful for this purpose. The lugs can be damaged if the tool does not correctly fit into the notches (see **Fig. 66**).*

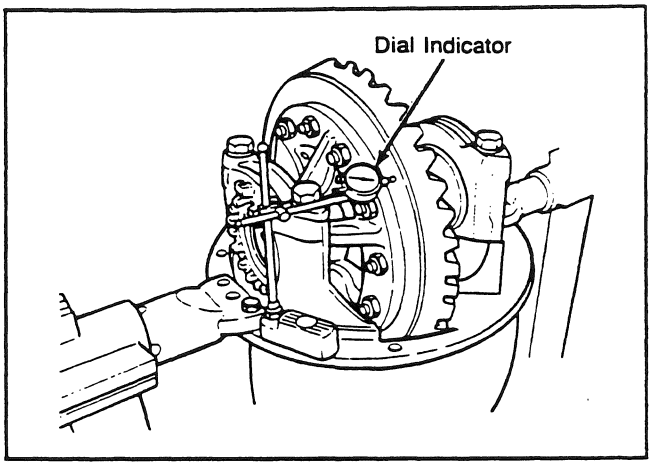


Fig. 65

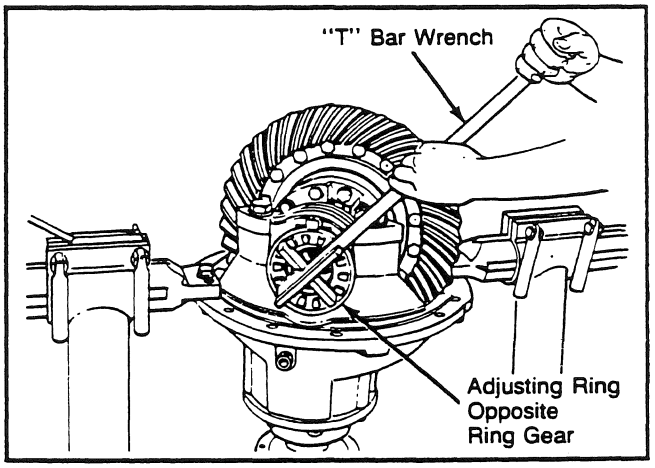


Fig. 66

2. Loosen the adjusting ring opposite the ring gear. Allow a small amount of end play to show on the dial indicator. Move the differential and ring gear assembly to the left and right with pry bars while reading the dial indicator. Use either of the following steps.

   a) Use two pry bars installed between the adjusting rings and ends of the differential case. The pry bars **must not** touch the differential bearings (see **Fig. 67**).

   b) Use two pry bars installed between the differential case or ring gear and the carrier at places other than described in step a). The pry bars **must not** touch the differential bearings (see **Fig. 68**).

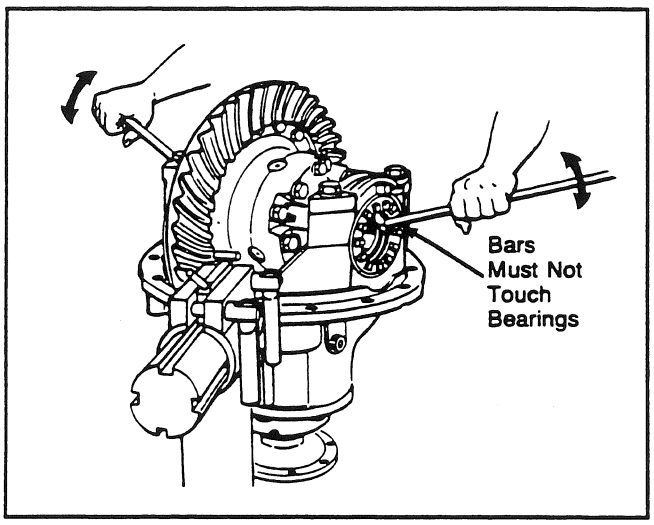


Fig. 67

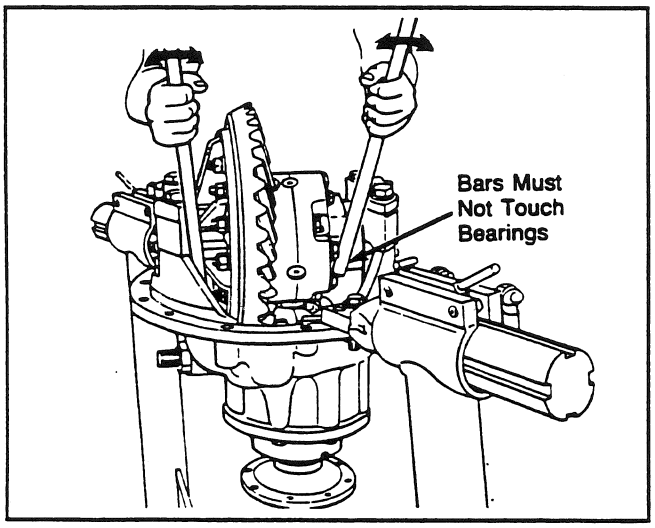


Fig. 68

3. Tighten the same adjusting ring so that no end play (zero end play) shows on the dial indicator. Move the differential and ring gear to the left and right as needed. Repeat step 2 a) or 2 b). Tighten each adjusting ring one notch from the zero end play. Continue the procedure by checking the ring gear runout.

Method 2

1. An alternative method of checking differential bearing preload is to measure the expansion between the bearing caps after you tighten the adjusting rings. Use the following procedure.

a) Turn both adjusting rings hand tight against the differential bearings.

b) Measure the distance **X** or **Y** between opposite surfaces of the bearing caps. Use a large micrometer of the correct size (see **Figs. 69** and **70**). Note the measurement.

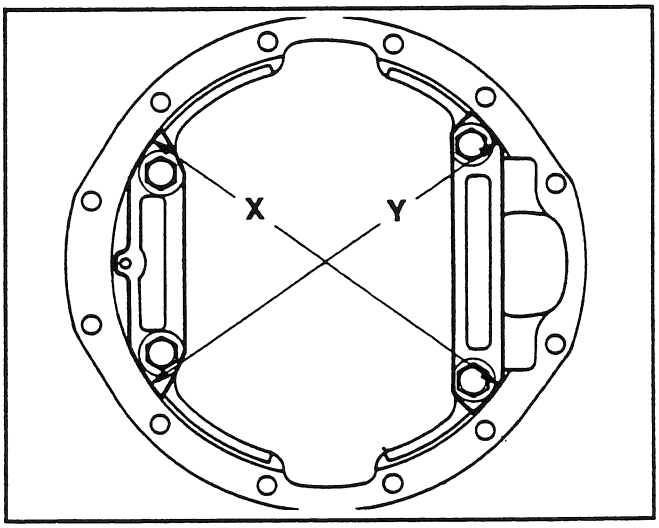


Fig. 69

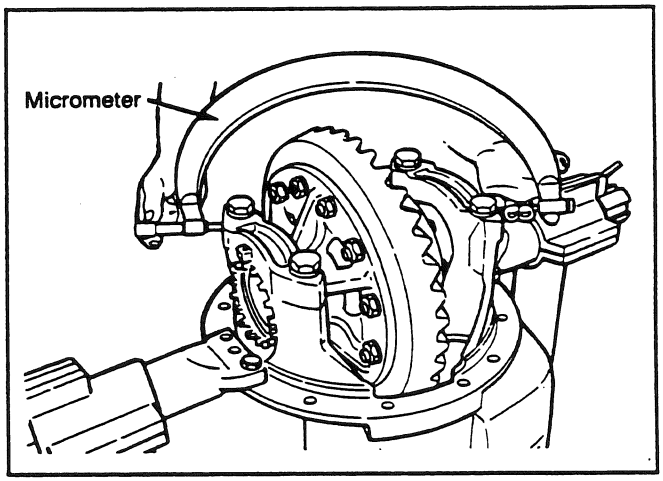


Fig. 70

c) Tighten each adjusting ring one notch.

d) Measure the distance **X** or **Y** again. Compare this dimension with the measurement noted in step 1 b). The difference between the two dimensions is the amount the bearing caps have expanded.

Example:

Distance X or Y before tightening adjusting rings
= 15.315 inches (389,00 mm)
Distance X or Y after tightening adjusting rings
= 15.324 inches (389,23 mm)

15.324 inches minus 15.315 inches = 0.009 inch (0,23 mm) difference.

2. If the dimension is within specifications, continue the procedure by checking the ring gear runout. If the dimension is less than the specifications, repeat steps 1 c) and 1 d).

Checking Ring Gear Runout

Specification:

0.008 inch (0,20 mm)

1. Install a dial indicator on the carrier mounting flange. Adjust the dial indicator plunger to touch the back surface of the ring gear (see **Fig. 71**). Adjust the indicator needle to zero (0).

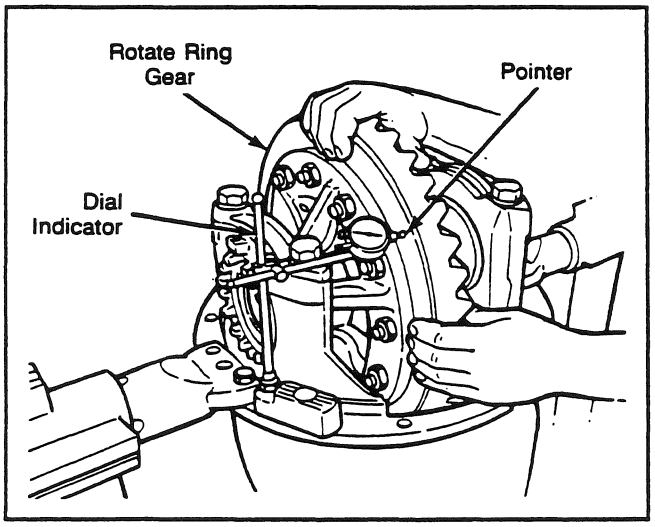


Fig. 71

2. Turn the differential and ring gear assembly while reading the dial indicator. The ring gear runout **must not exceed** 0.008 inch (0,20 mm).

3. If the ring gear runout exceeds specifications, remove the differential and ring gear assembly from the carrier. See **Removing Differential and Ring Gear Assembly from Carrier** in this section and the following steps.

   a) Check the differential parts, including the carrier, for the problem that causes the gear runout to exceed specifications. Repair or replace parts.

   b) After repairing or replacing parts, install the differential and ring gear assembly in the carrier. See **Installing Differential and Ring Gear Assembly into Carrier** in this section.

4. Repeat the differential bearing preload adjustment.

Checking Ring Gear Backlash

Specifications:

Ring gears with a pitch diameter of less than 17 inches (431,8 mm)

Range of backlash setting - 0.008 to 0.018 inch (0,20 - 0,46 mm)

Backlash setting for new gear sets - 0.012 inch (0,30 mm)

Ring gears with a pitch diameter of 17 inches (431,8 mm) or greater than 17 inches

Range of backlash setting - 0.010 - 0.020 inch (0,25 - 0,51 mm)

Backlash setting for new gear sets - 0.015 inch (0,38 mm)

NOTE: *Measure the ring gear outside diameter for the approximate pitch diameter (see **Fig. 72**).*

1. If you are installing the old gear set, adjust the backlash to the setting that was measured before the carrier was disassembled. If you are installing a new gear set, adjust the backlash to the correct specification for new gear sets.

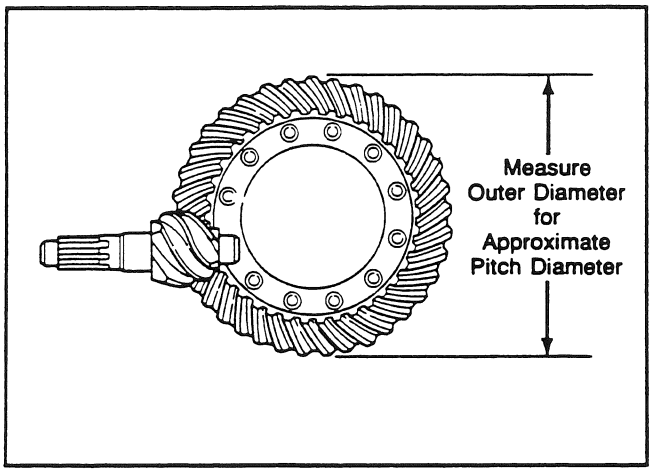


Fig. 72

2. When checking the tooth contact patterns, you can adjust the backlash within the specification limits to change the location of the pattern.

3. Install a dial indicator on the carrier mounting flange. Adjust the dial indicator plunger to touch the tooth surface of the ring gear (see **Fig. 73**). Adjust the indicator needle to zero (0). Hold the drive pinion in position.

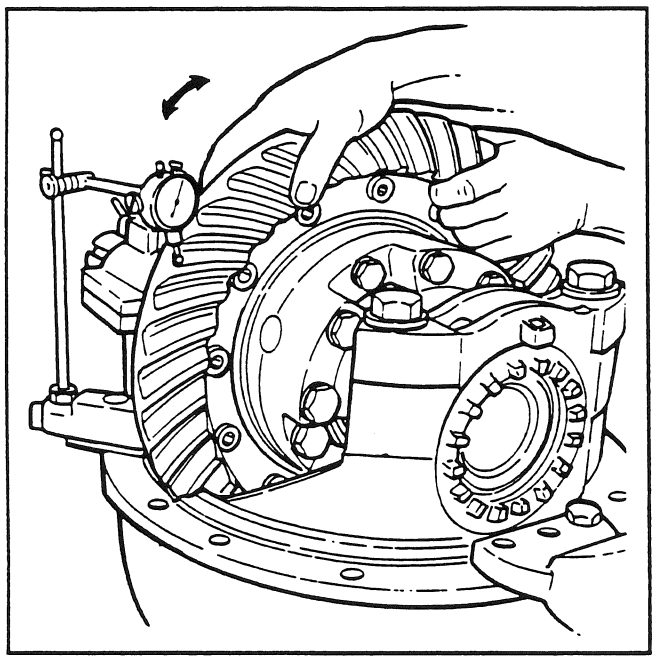


Fig. 73

4. Turn the differential and ring gear assembly a small amount in both directions against the drive pinion teeth and read the dial indicator. If the backlash reading is within specification, continue the procedure by checking tooth contact patterns. If the backlash reading is not within specification, adjust backlash as follows.

a) Increase backlash by moving the ring gear away from the drive pinion (see **Fig. 74**).

b) Decrease backlash by moving the ring gear toward the drive pinion (see **Fig. 75**).

5. Loosen one adjusting ring by one notch. Tighten the opposite ring by the same amount (see **Figs. 74** and **75**). When adjusting backlash, move the ring gear only. Do not move the drive pinion. Repeat steps 3 to 5 until the backlash is within specifications.

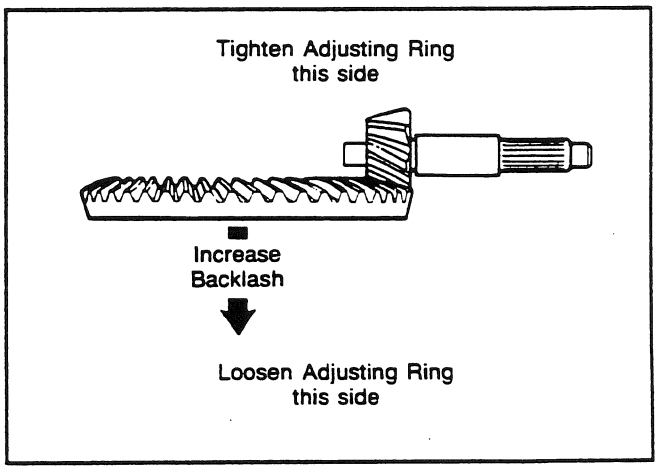


Fig. 74

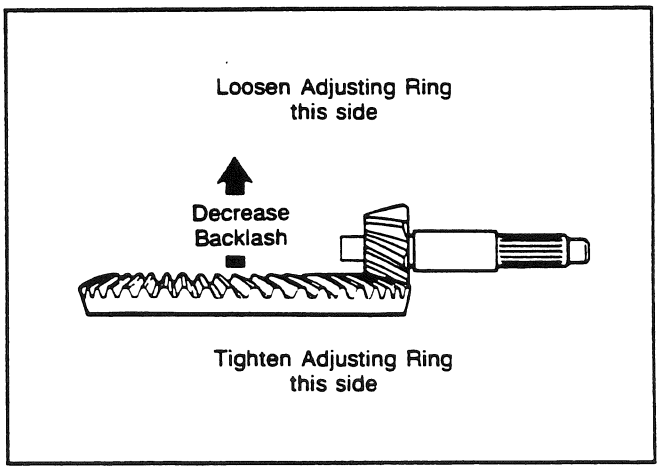


Fig. 75

Checking Tooth Contact Patterns

Look at the gear set part numbers (See **Fig. 76**). Examples of part numbers are:
36786-K for the ring gear
36787-K for the drive pinion

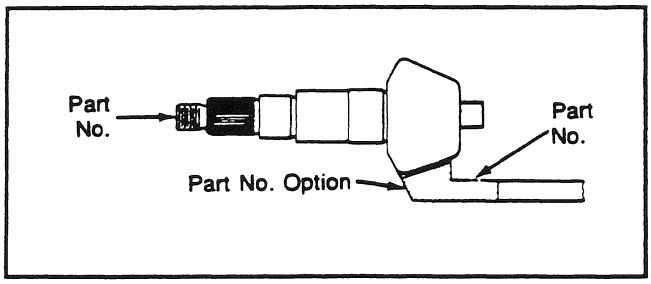


Fig. 76

1. In the following procedure, the contact pattern movement in the length of the tooth is shown as toward the "heel" or "toe" of the ring gear (see **Fig. 77**). Always check tooth contact patterns on the drive side of the gear teeth (see **Fig. 78**).

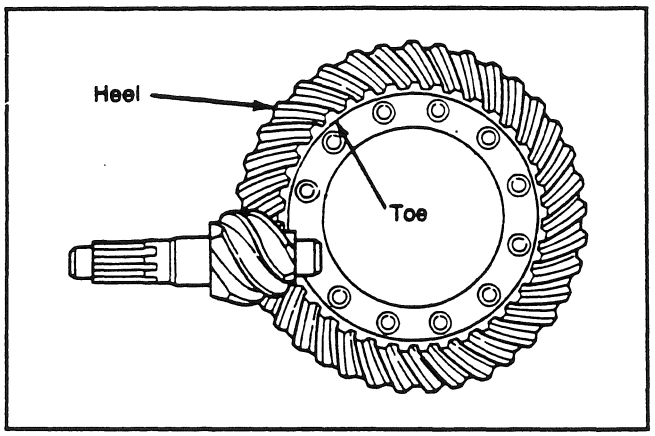


Fig. 77

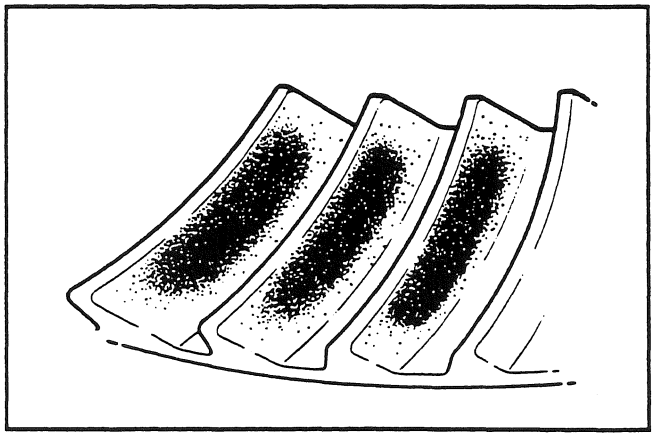


Fig. 78

2. Adjust the backlash of a new gear set to either 0.012 inch (0,30 mm) or 0.015 inch (0,38 mm). Adjust the backlash of an old gear set to the figure that was measured before the carrier was disassembled.

3. Apply marking compound to twelve teeth of the ring gear (see **Fig. 79**). Turn the ring gear so that the twelve teeth are next to the drive pinion. Move the ring gear forward and backward past the drive pinion six times to make the contact patterns on the twelve teeth. Repeat if needed for a clearer pattern.

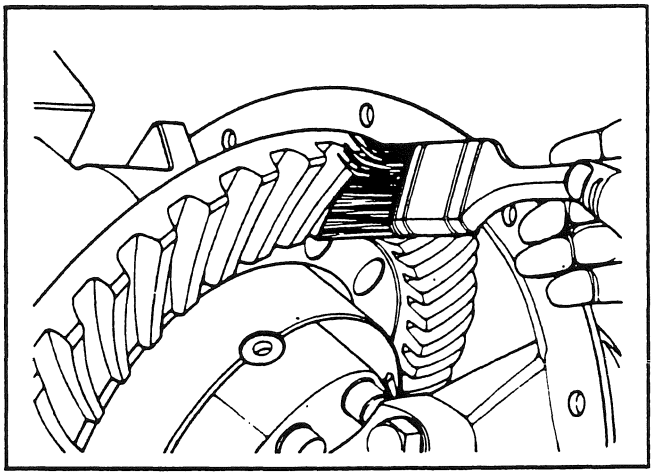


Fig. 79

4. Look at the contact patterns on the ring gear teeth. Compare the patterns to **Figs. 80, 81** and **82.**

5. For a new gear set, the location of a good hand rolled contact pattern is between the center and toe of the tooth, and in the center between the top and bottom of the tooth (see **Fig. 80**).

6. During operation, a good pattern extends approximately the full length of the gear tooth. The top of the pattern is near the top of the gear tooth (see **Fig. 83**).

7. The location of a good, hand rolled *contact pattern* for an old gear set **must** match the *wear pattern* in the ring gear. The contact pattern is smaller in area than the wear pattern.

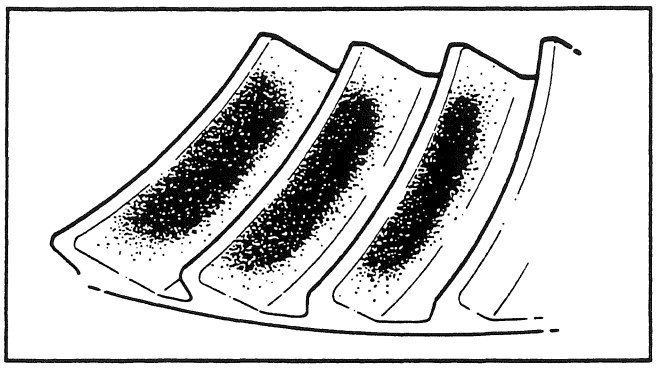


Fig. 80

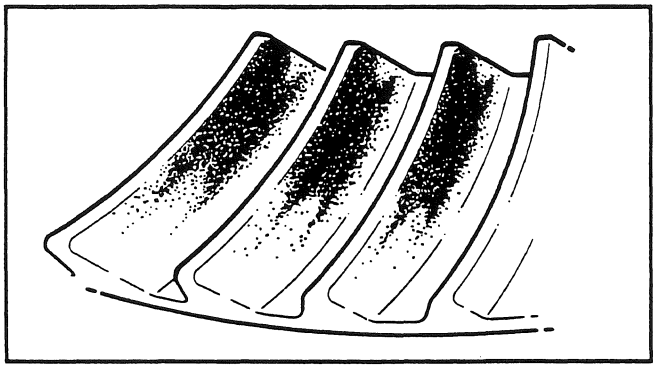


Fig. 81

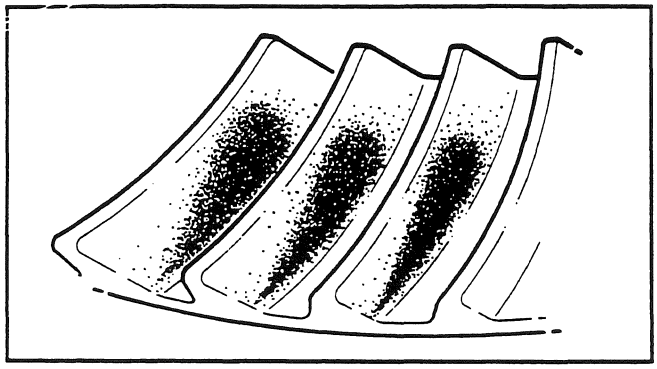


Fig. 82

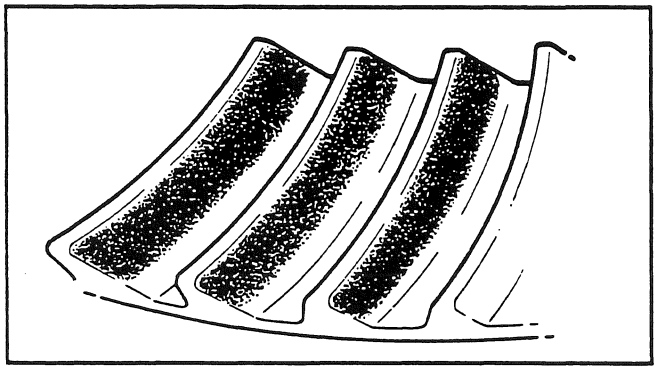


Fig. 83

8. If the contact patterns need adjusting, continue with step 9 and move the contact patterns between the top and bottom of the gear teeth. If the contact patterns are in the center of the gear teeth, continue with step 10.

9. Change the shim pack thickness under the bearing cage to move the contact patterns between the top and bottom of the gear teeth. A high contact pattern shows that the drive pinion is not installed deep enough into the carrier. A low contact pattern shows that the drive pinion is installed too deep in the carrier.

   a) Remove the drive pinion and bearing cage from the carrier. See **Disassembly - Drive Pinion and Bearing Cage Assembly** in this section.

   b) To correct a high contact pattern (see **Fig. 81**), decrease the shim pack thickness under the bearing cage. When you decrease the shim pack thickness, the drive pinion moves toward the ring gear (see **Fig. 84**).

   c) To correct a low contact pattern (see **Fig. 82**), increase the shim pack thickness under the bearing cage. When you increase the shim pack thickness, the drive pinion moves away from the ring gear (see **Fig. 85**).

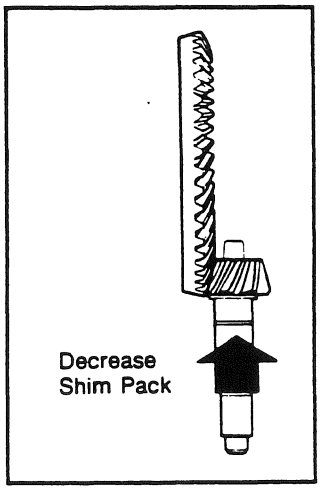


Fig. 84

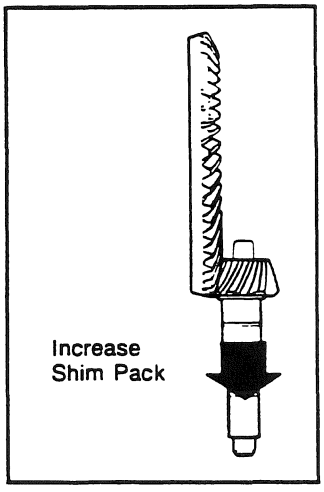


Fig. 85

d) Install the drive pinion, bearing cage and shims into the carrier. See **Installing Drive Pinion and Bearing Assembly into Carrier** in this section.

e) Repeat steps 3 to 8 until the contact patterns are in the center between the top and bottom of the gear teeth.

10. Adjust the ring gear backlash within specifications to move the tooth contact patterns to the correct location in the length of the gear teeth. See **Checking Ring Gear Backlash** in this section.

a) Decrease backlash to move the tooth contact patterns toward the toe of the ring gear teeth (see **Fig. 86**).

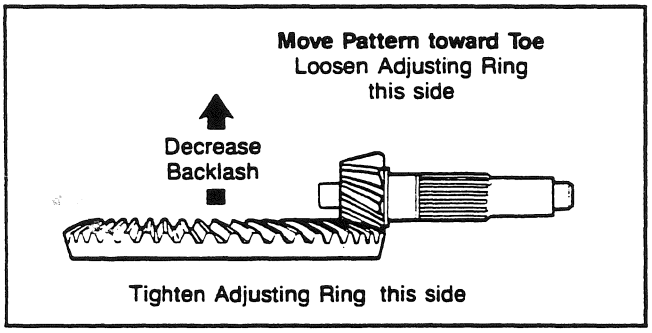


Fig. 86

b) Increase backlash to move the tooth contact patterns toward the heel of the ring gear teeth (see **Fig. 87**).

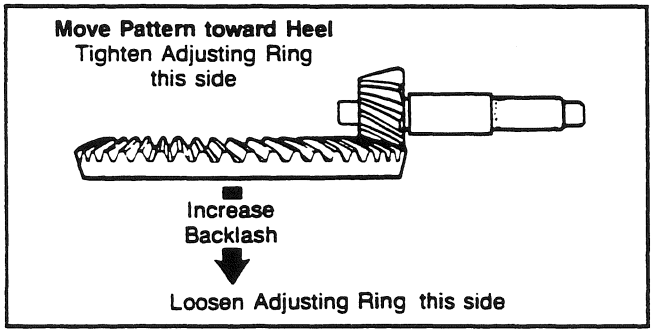


Fig. 87

c) Repeat steps 3 to 8 and 10 until the contact patterns are at the correct location in the length of the gear teeth.

11. Install the cotter pin and lock plate securing the two adjusting rings. Use the following procedures.

a) Install the cotter pin between the adjusting ring lugs and through the bearing cap boss. Bend the two ends of the cotter pin around the boss (see **Fig. 88**).

b) Install the lock plate on the bearing cap so that the tab is between the adjusting ring lugs. Install the two bolts retaining the lock plate to the bearing cap (see **Fig. 88**). Tighten the bolts to the specified torque.

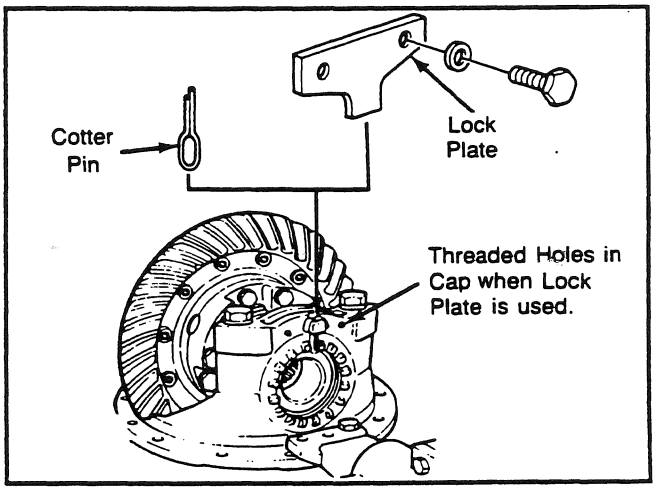


Fig. 88

Installing Differential Shift Assembly

1. Apply threadlocking compound P/N **40945** to the threads of the shifter shaft. Install the fork into its correct position in the carrier case (see **Fig. 89**).

2. Hold the fork in position. Install the shifter shaft spring into the shifter shaft opening, through the fork bore and into the bore for the shifter shaft spring. Slide the shifter shaft over the spring. Install the shifter shaft into the fork and tighten to the specified torque (see **Fig. 90**).

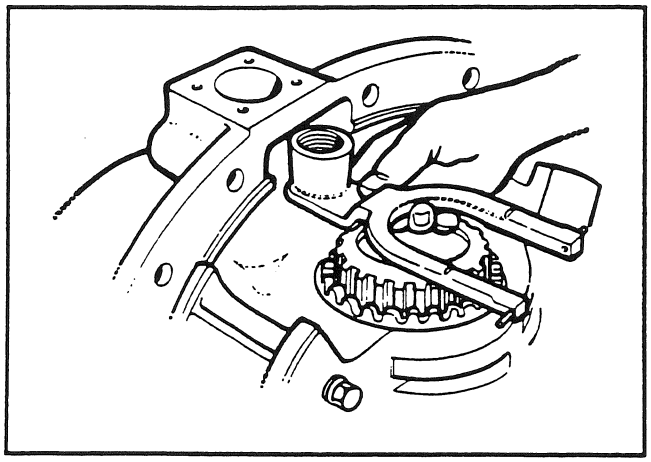


Fig. 89

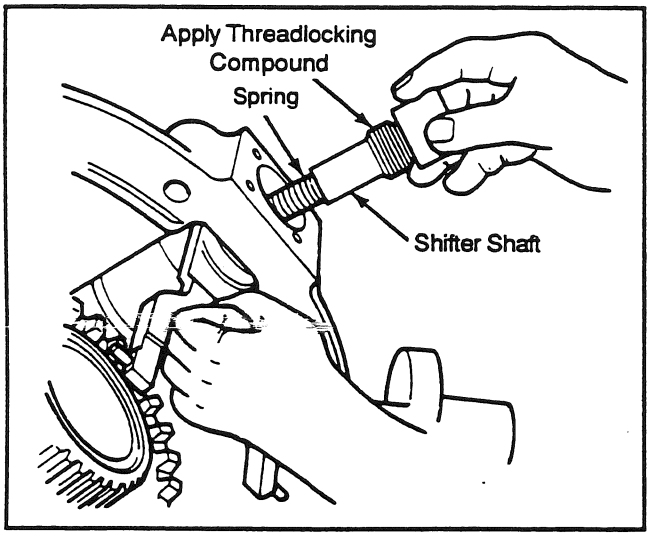


Fig. 90

3. Lubricate the piston O ring with system oil. Install the O ring into its groove on the piston. Apply a bead of silicone sealant P/N 32338 onto the washer end of the tube. Install the piston into the tube (see **Fig. 91**). Install the washer and tube into the housing bore. Make sure the pilot journal on the piston engages in its bore on the shifter shaft (see **Fig. 92**).

4. Install the copper gasket into its bore on the inside of the cover. Place the cover over the tube so that the hydraulic port points up when the carrier is installed into the final drive housing. Secure the cover with four bolts and lockwashers. Tighten the bolts to the specified torque (see **Fig. 93**).

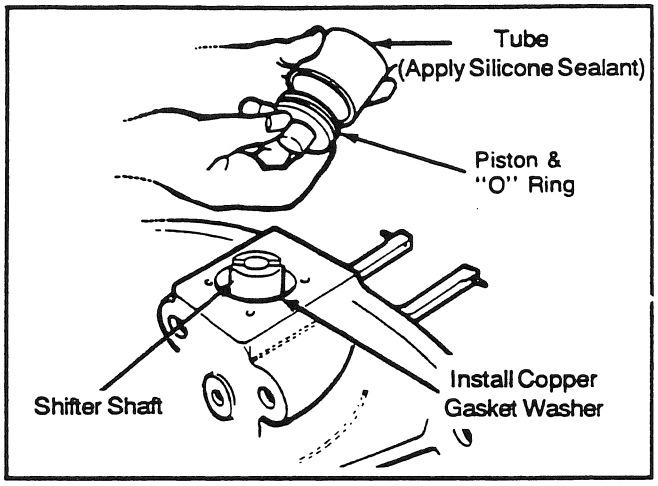


Fig. 91

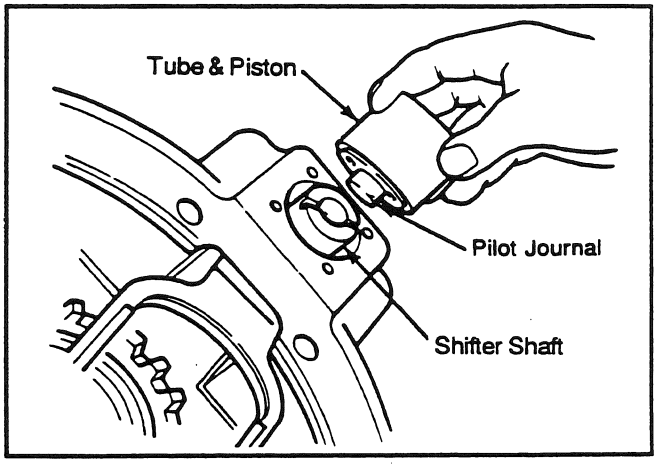


Fig. 92

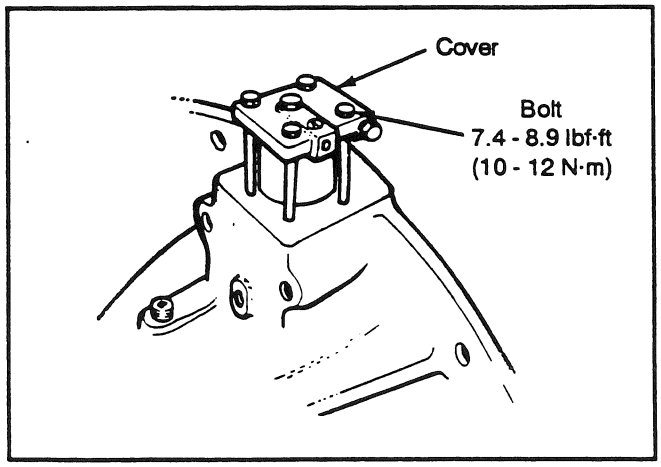


Fig. 93

5. Slide the collar into the fork. Engage the collar splines with the differential case splines. Use the manual engaging bolt to help engage the collar and differential case splines.

6. Before installing the carrier, you must shift and hold the differential lock in the locked (engaged) position. Install the manual engaging bolt into the hole in the center of the cover. Turn the manual engaging bolt to the right until the head is approximately 1/4 inch (6 mm) from the cover. Do not turn the bolt beyond its normal stop. The bolt is now in the service position and the differential lock is completely engaged.

7. You will feel a small amount of spring resistance when turning the manual engaging bolt. If you feel a high resistance before reaching the locked (engaged) position, **stop turning the bolt.** Otherwise the cover and bolt threads will be damaged.

8. A high resistance to the bolt indicates that the splines of the collar and the differential case half are not aligned or engaged. Align the splines as follows:

   a) As you turn the manual engaging bolt, rotate the drive pinion to align the splines of the collar and differential case half.

   b) Reduced spring resistance indicates the splines are engaged. Continue turning the manual engaging bolt until the head is approximately 1/4 inch (6 mm) from the cover.

9. Hold the collar in the locked (engaged) position. Tap the two roll pins in the fork ends until they are level with the outer faces of the yoke (see **Fig. 94**).

10. While the collar is still in the locked position, install the sensor switch. Connect a battery/bulb tester to the sensor switch and turn the switch into its hole until contact with the fork causes the tester light to energize. Turn the switch one additional revolution and tighten the lock nut to the specified torque.

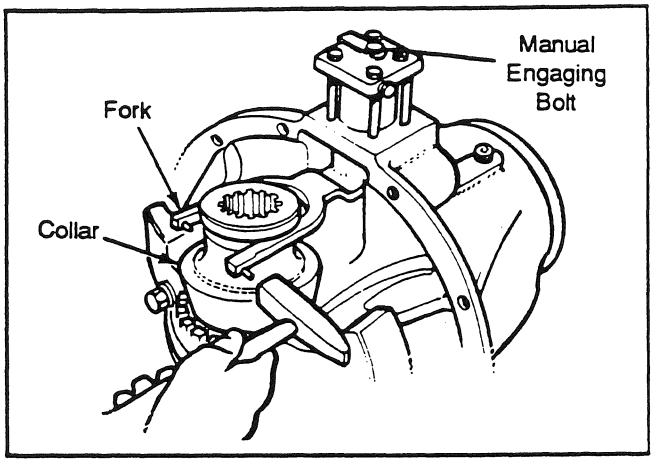
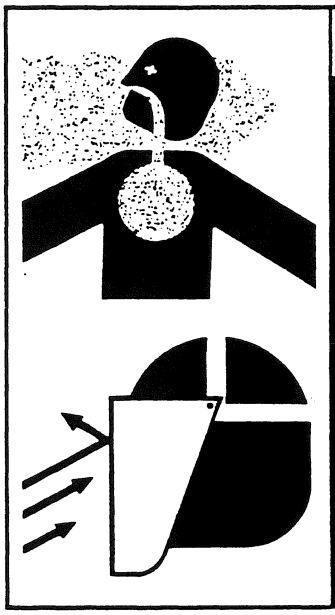


Fig. 94

Installing Carrier to Final Drive Housing



⚠ WARNING

Chemical hazard. Wear goggles, protective clothing and respirator. Handle chemicals according to manufacturer's instructions. Severe personal injury or death could result.

1. Clean the final drive housing and carrier mounting surfaces. Use a cleaning solvent and rags to remove dirt. Blow dry the cleaned areas with moisture free compressed air. Inspect the housing for damage.

2. Apply a uniform bead of silicone sealant P/N **56247** to the housing mounting surface (see **Fig. 95**). Use a safe lifting device and install the carrier into the housing.

NOTE: *Do not use a hammer or mallet to install the carrier. Using a hammer or mallet can damage the carrier mounting flange and cause oil leaks.*

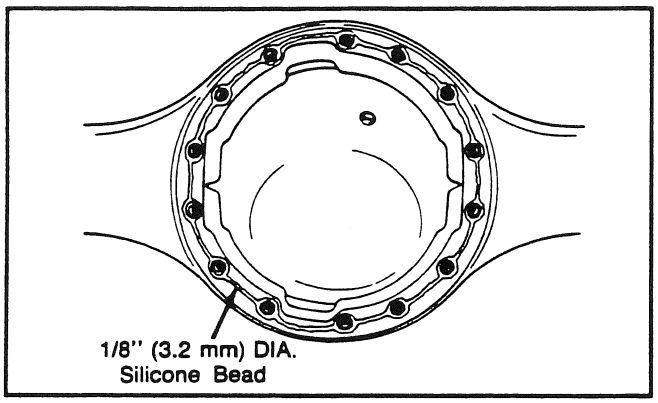


Fig. 95

6. Install bolts and washers in the four corner locations around the carrier and housing (see **Fig. 96**). Tighten the bolts hand tight. Carefully push the carrier into position. Tighten the four bolts two or three turns each in a diagonal sequence. Repeat this procedure until the four bolts are tightened to the specified torque.

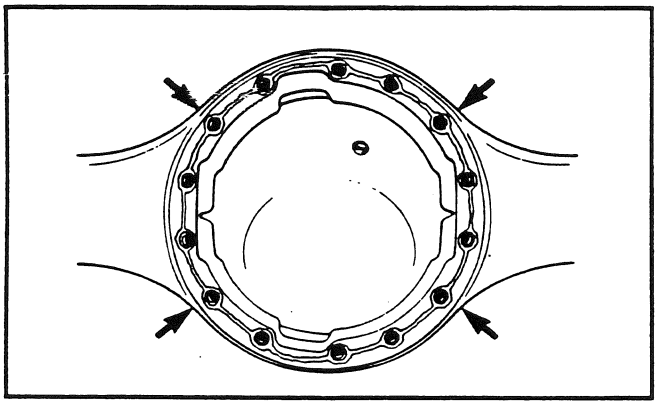


Fig. 96

7. Install the other bolts and lockwashers securing the carrier to the housing. Tighten the bolts to the specified torque.

8. Remove the bolt and gasket from the storage position in the differential lock cover. Remove the manual engaging bolt from the service position. Removing the manual engaging bolt disengages the differential lock.

9. Clean the bolt, gasket, cover and threaded hole in the center of the cover. Install the bolt and gasket into the operating position in the cover. Install the manual engaging bolt into the storage position (see **Fig. 97**). Tighten the bolt and manual engaging bolt to the specified torques.

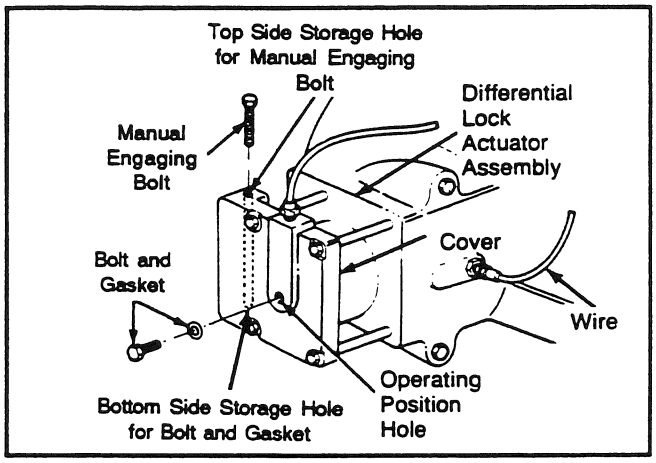


Fig. 97

Installing Inner and Outer Bushings

1. You should install the inner and outer bushings using a stepped mandrel, preferably made from case-hardened mild steel. To make an appropriate stepped mandrel, refer to the following chart and **Fig. 98**.

2. Take care to insert the bushings squarely into the final drive housing journals to avoid damage to the lining material. Apply a smear of system oil to the outside surface of the bushings before installation.

Model	P/N	Nominal Bushing Bore (inches)	Installed Bushing I.D. (inches)	Bushing Length (inches)
710/710A 720/720A	37583	5	4.9988 5.0056	3.5
710/710A 720/720A	37582	5.25	5.2502 5.2570	4
730/730A	12638	6.25	6.2502 6.2570	3.725
730/730A	37626	6.75	6.7502 6.7570	4

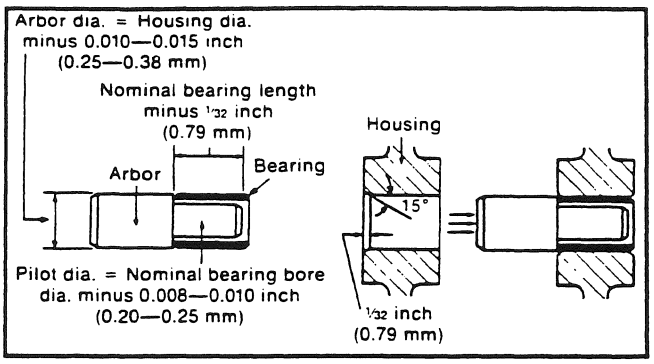


Fig. 98

Installing Flanged Sleeves and Axle Shafts

1. Lubricate and install the seal. Lubricate and install new inner and outer thrust plates. Install a lifting eye in the flanged sleeve. Install the flanged sleeve using a safe lifting device (see **Fig. 99**). Remove the lifting eye.

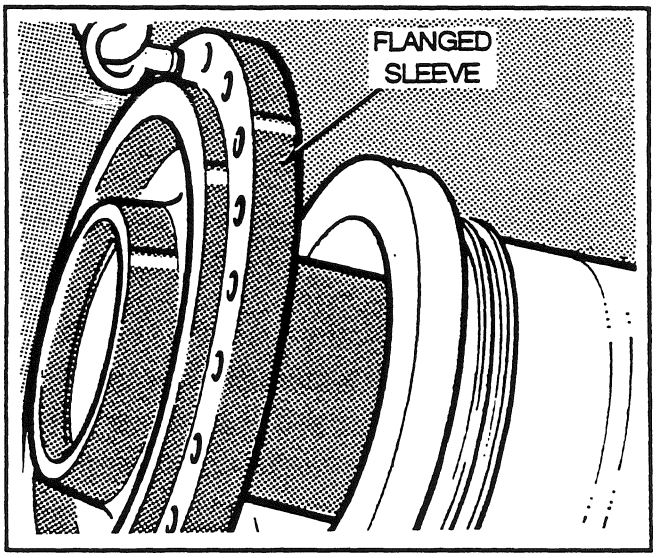


Fig. 99

2. Apply a uniform bead of silicone sealant P/N **56247** to the split ring surface that contacts the flanged sleeve, and the surfaces where the split rings contact each other. Carefully install the split rings over the seal. Secure the two halves with the nuts and bolts. Install nuts and bolts to temporarily secure the split rings to the flanged sleeve. Repeat steps 1 and 2 for the other split rings and flanged sleeve.

3. Lubricate the bearings with system oil. Install the bearings onto the axle shafts using a hydraulic press. Do not apply heat to the bearings.

4. Install the right-hand axle shaft as follows:

   a) Install the axle shaft into the final drive housing until it stops against the differential lock collar.

   b) Turn the axle shaft until the splines of the shaft and the collar engage.

   c) Push the axle shaft further into the housing until it stops against the differential side gear.

   d) Turn the axle shaft until the splines of the shaft and the side gear engage.

   e) Push the axle shaft completely into the housing until fully installed.

5. Install the left-hand axle shaft. Retain the axle shaft bearings with new snap rings. Lubricate the oil seal lips with tandem oil. Use a soft metal drift to install the seals.

Installing Final Drive Assembly to Grader

1. Apply a uniform bead of silicone sealant P/N **56427** to the tandem mounting surface and the drive sprocket bearing surface.

2. Attach a safe lifting device to the final drive assembly. Position the assembly and align the splines of the axle shaft and drive sprocket.

3. Apply threadlocking compound P/N **40945** to the bolts retaining the final drive split rings to the tandem. Install the bolts and lockwashers. Tighten the bolts to the specified torque.

4. Install the end cap, new tabwasher and bolts securing the drive sprocket. Tighten the bolts to the specified torque. Bend the tabwasher corners to secure the bolt heads.

5. Apply a uniform bead of silicone sealant P/N **56247** to the side cover plate mounting surface. Install the side cover plate and secure with the bolts. Repeat steps 1 through 5 for the other tandem.

6. If applicable, install and connect the transverse brake lines. Remove any spilled brake fluid to avoid paint damage.

7. Attach a safe lifting device to the rear of the grader frame. Raise the end of the grader and remove the stands. Roll the final drive and tandem assembly under the grader. Lower the grader until the frame brackets rest on the final drive mounting plates. Install the bolts and special washers. Tighten the bolts to the specified torque.

8. Remove and discard the lockwire securing the slip yoke and drive shaft together. Connect and retain the lower drive shaft to the final drive yoke. Tighten the bolts to the specified torque.

9. Connect all brake lines between the rear frame and tandems. Ensure all connections are clean and tight. Remove any spilled brake fluid to prevent paint damage.

NOTE: *For graders equipped with drum brakes, add brake fluid to the master cylinder reservoir as required. Bleed the brake fluid system before driving the grader. Refer to Section 16,* ***Master Cylinder - Drum Service Brakes****, of this Shop Manual.*

10. Connect the sensor switch wiring harness to the main wiring harness. Install the hydraulic hose to the differential lock cylinder cover.

11. Pass the battery cables through the grommet. Install one battery and connect the battery cables. Close and secure the battery box(es).

12. Refer to the lubrication specifications detailed in your **700 Series Operator's Manual** for the capacities and recommended tandem and final drive lubricating oils. Remove the upper pipe plug from the final drive housing. Fill the final drive until oil reaches the bottom of the plug hole. Clean the plug. Apply pipe sealant P/N **19167** to the plug threads and install the plug.

13. Remove and clean the tandem filler plugs and level check plugs. Fill both tandems to the bottom of the check plug hole. Apply pipe sealant P/N **19167** to the plug threads and install the plugs.

Checking the Differential Lock - Stationary Test

Make sure you read and understand the following instructions before attempting the stationary test.

1. Make a visual safety check around the grader. Ensure all personnel are away from the area. Signal your intention and start the engine when it is safe to do so. Position the moldboard at 90° to the frame. Apply down pressure to the moldboard and lift the front wheels about 18 inches (45 cm) off the ground.

2. Pull the right-hand blade lift hydraulic control lever and retract the cylinder until both left-hand tandem wheels are about 2 inches (5 cm) off the ground.

3. Release the hand brake. Do not depress the service brake pedal or the engine will stall. Move the differential lock/unlock switch upward and unlock the differential. The light above the switch should energize.

4. With the engine at idle, depress the clutch pedal. Shift the transmission pulser lever to **1 - 1**. Shift the transmission model lever to forward.

5. Slowly release the clutch pedal.

   a) Left-hand tandem wheels should rotate, indicating the differential has unlocked. System is working correctly.

   b) Grader tries to lurch forward or the engine stalls, indicating the differential has not unlocked. Repeat steps 4 and 5 to remove the driving torque. The differential should unlock. If the differential does not unlock, return the grader to the SERVICE POSITION. Have a qualified service technician check the differential hydraulic and/or electrical system(s).

6. After this procedure, perform the road test before returning the grader to service.

Differential Electrical and Hydraulic Systems (See **Fig. 100**, electrical schematic).

1. Conditions when differential is locked:
   a) Right-hand door post switch in down position.
   b) Solenoid valve energized, and grounded at differential lock sensor switch.
   c) Electrical relay energized, and grounded through closed sensor switch.
   d) Electrical relay contacts open to deenergize light.

2. Conditions when differential is unlocked:
   a) Right-hand door post switch in up position.
   b) Solenoid valve deenergized.
   c) Differential unlocked by spring tension.
   d) Shift fork opens sensor switch contacts to deenergize electrical relay.
   e) Electrical relay terminals **87A NC** and **C** connect to energize light.

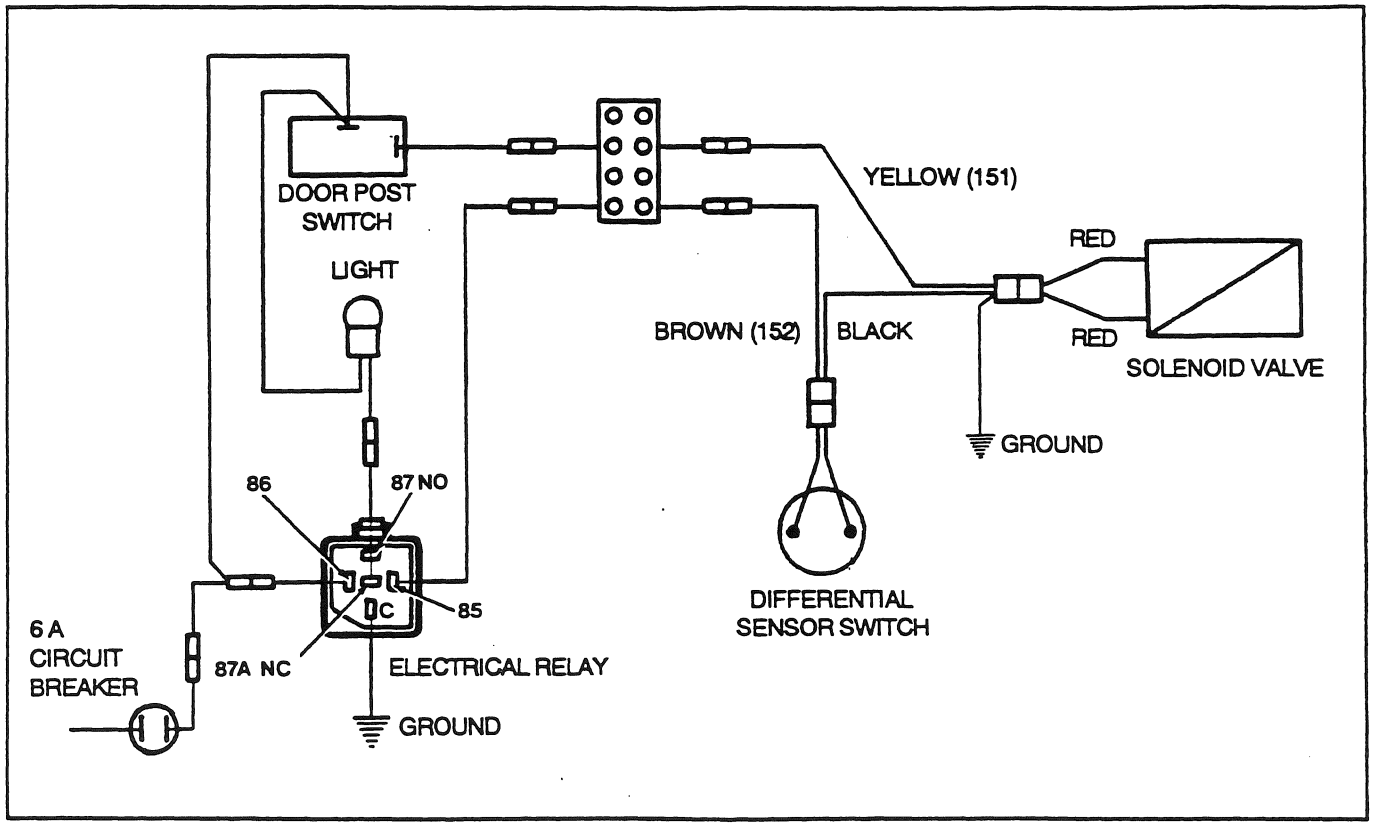


Fig. 100

3. Install a tee fitting and 0 - 300 psi (0 - 20 bar) pressure gauge at the differential lock cover inlet to determine operation of the solenoid valve (see **Fig.101**).

NOTE: *The differential may not lock if the differential case and shift collar splines do not align. The machine may have to be steered slightly to align the splines.*

Checking the Differential Lock - Road Test

1. Make a visual check around the grader. Ensure the hand brake is applied and the transmission is in neutral. Signal your intention to start the engine. Start the engine when it is safe to do so.

2. The lock/unlock differential control switch is mounted in the electrical panel on the right-hand door post. Move the control switch to the unlocked (disengaged) position. The light above the switch should energize.

NOTE: *If the light does not energize when you move the control switch to the unlocked (disengaged) position, the differential is still locked. Do not continue the test. Shut down the engine and place the grader in the SERVICE POSITION. Make sure the manual engaging bolt was removed from the differential lock cover. After this check, continue with the test.*

3. Drive the grader at 5 to 10 mph (8 to 16 km/h) and check the differential lock/unlock light. The light must remain energized when the control switch is in the unlocked position.

4. Continue to drive the grader and move the control switch to the locked (engaged) position. The light should deenergize when the control switch is in the locked position. Return the grader to the repair shop. Place the grader in the SERVICE POSITION.

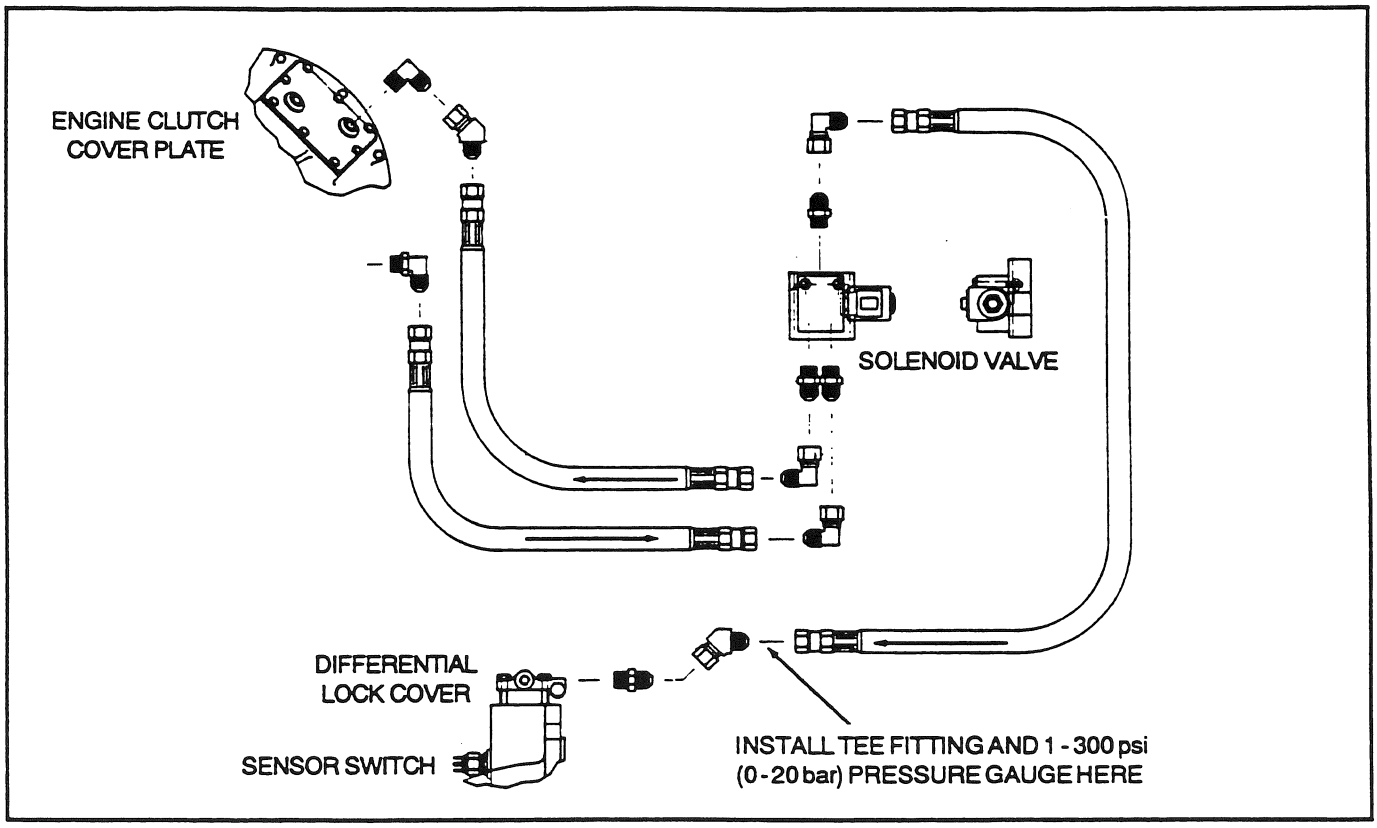


Fig. 101

Input Yoke Three-piece Pilot Tool - Part Number 58439

Champion recommends using the three-piece pilot tool (see **Fig. 102**) when installing the input yoke on the drive pinion. The yoke and pinion splines are an interference fit and the pilot tool helps you correctly install the yoke.

Order the tool through Champion's Distribution Center, quoting part number **58439**.

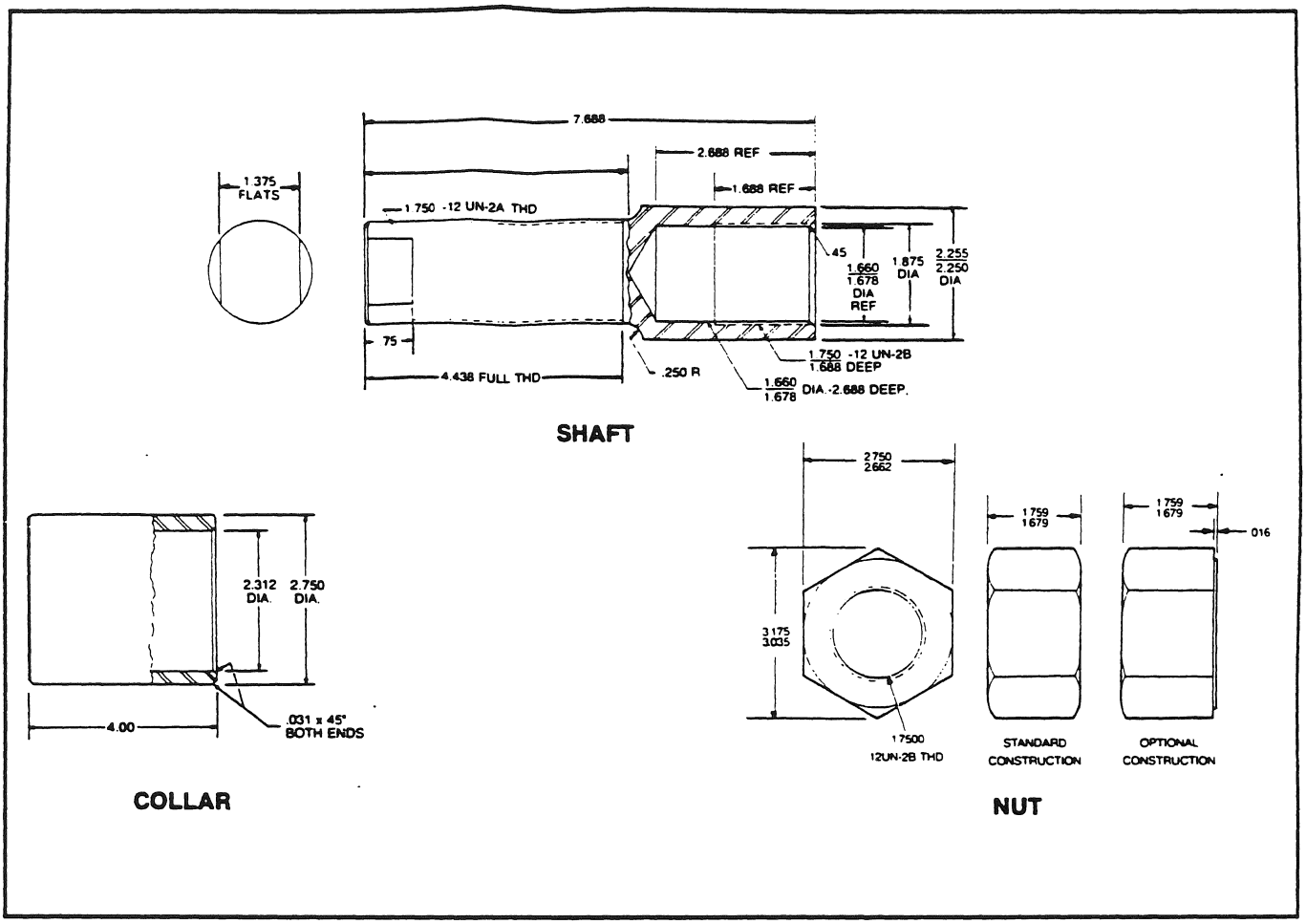
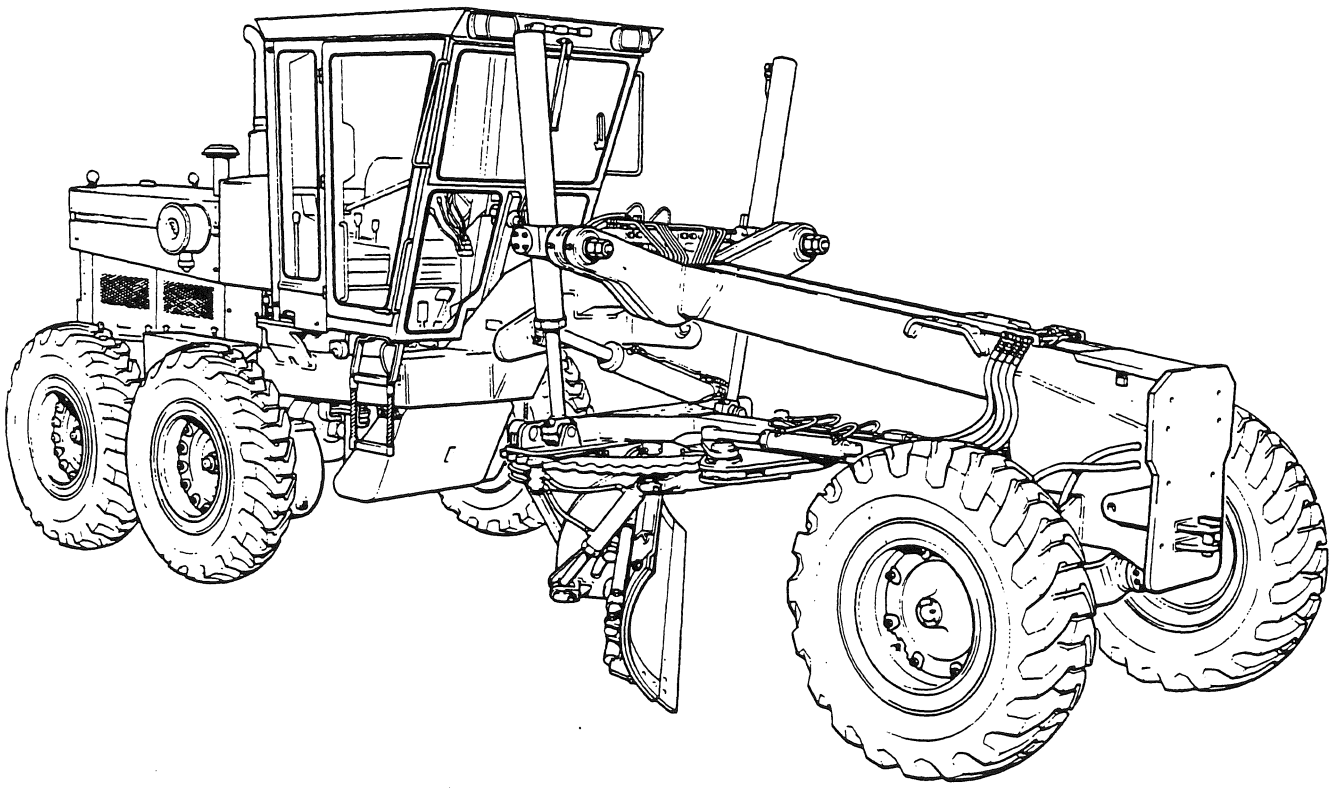


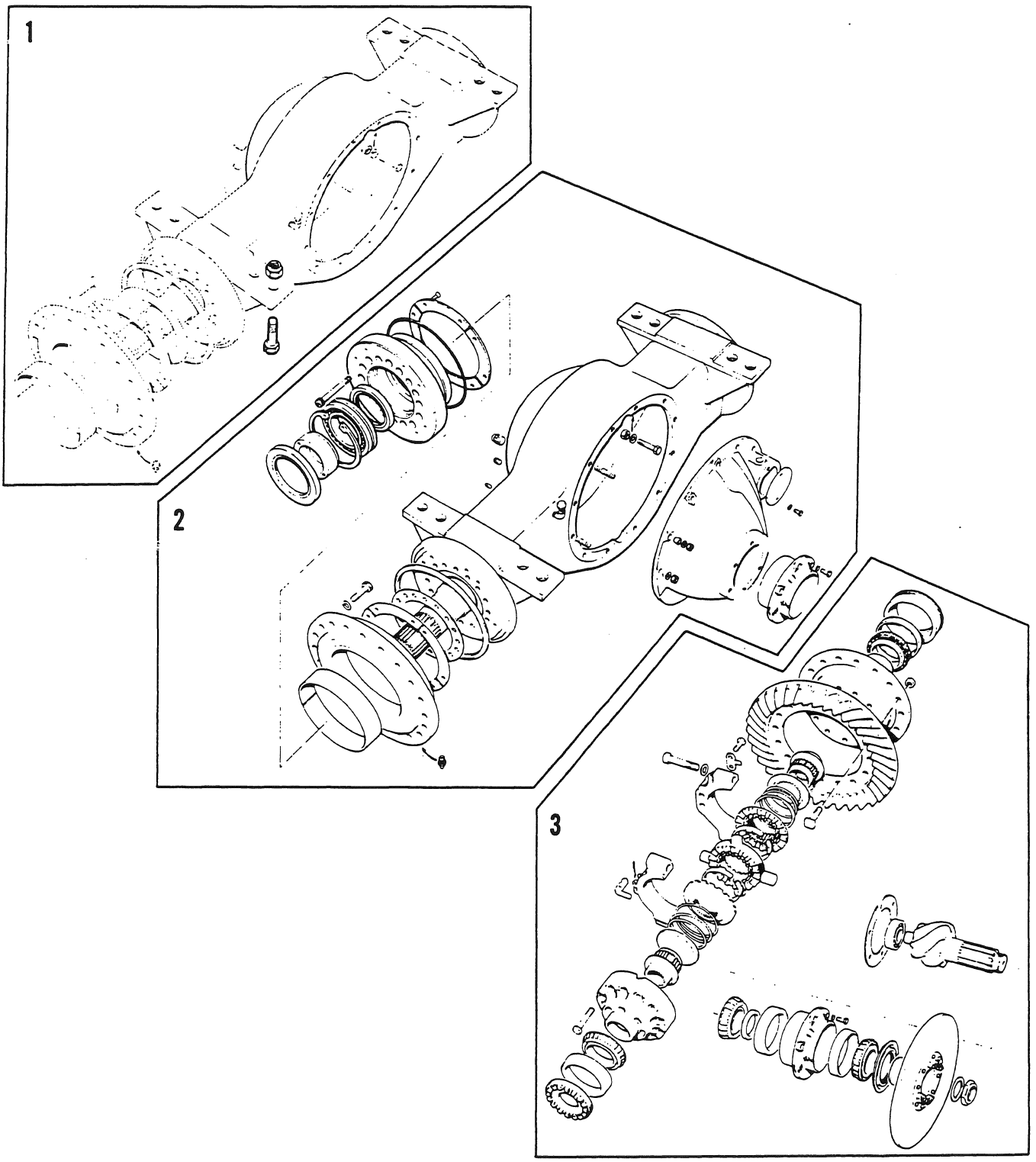
Fig. 102

SECTION 9A

SINGLE REDUCTION FINAL DRIVE

Models: 710/710A S/N **16224, 16245** to **19481**
U.S. S/N **2012-2** to **2658-2**

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Description and Operation

The single reduction final drive, equipped with NoSpin, is used on models 710 and 710A graders. Since the only reduction is provided by the ring gear and pinion the tandems must provide a greater reduction ratio than on other Champion graders.

However, in a sharp turn the outside wheels may "unlock" and overspeed while the inside wheels turn at ring gear speed. This allows minimum tire scuffing in turns and tighter turns. This action is completely automatic in operation.

NoSpin provides the advantage of a lock/unlock action. When operating in a normal forward or reverse operation both tandems are locked together. This provides the same speed and torque at either wheel regardless of traction.

Housing construction is cast iron for maximum strenght and rigidity. Also, to support the axles an outboard double barreltype, self-aligning bearing is used. Two seals are used to keep oil in the final drive and dirt out.

Torque Guide

Application	Torque Value		
Pivot Ring Retainer Bolts	285 N.m	29 kgf.m	210 lbf-ft
Carrier Assembly Nuts	285 N.m	29 kgf.m	210 lbf-ft
Pinion Locknut	854 N.m	87 kgf.m	630 lbf-ft
Pinion Cage & Cup Assembly Bolts	149 N.m	15 kgf.m	110 lbf-ft
Differential Case Bolts	210 N.m	21 kgf.m	155 lbf-ft
Ring Gear Nuts	210 N.m	21 kgf.m	155 lbf-ft
Bearing Cap Bolts	508 N.m	52 kgf.m	375 lbf-ft
Ajuster Lock Bolts	285 N.m	29 kgf.m	210 lbf-ft
Pivot Ring Bolts	230 N.m	23 kgf.m	170 lbf-ft
Axle Housing Bolts	1301,5 N.m	133 kgf.m	960 lbf-ft

Troubleshooting

Problem	Cause	Remedy
Noisy final drive.	Incorrect tooth contact or backlash setting.	Adjust the tooth contact and backlash setting as recommended in this section.
Oil leaks.	Loose bolts or nuts.	Tighten all bolts and nuts to the recommended torque.
	Defective oil seals, O rings or gasket sealant.	Remove defective parts and install new components.
Excessive vibration.	Worn or damaged gears or bearings.	Completely disassemble the final drive assembly. Remove defective parts and install new components.
	Loose mounting bolts.	Tighten the mounting bolts to the recommended torque.
Frequent loud snapping or cracking noises.	Defective differential.	Disassemble the differential. Remove defective parts and install new components.

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General

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chances of foreign matter entering the final drive and causing damage. Make sure proper tools are available and in good working order. For a complete overhaul, you will require a safe lifting device rated at not less than 12,700 kg (28,000 lb), a press, and a gear puller.

Discard all oil seals, O rings and snap rings. Clean and inspect final drive components (refer to **Cleaning and Inspection**). Refer to the 700 Series Parts Manual when ordering replacement parts.

Refer to Lubrication Specifications detailed in the front of this manual for the recommended final drive and tandem lubricants.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH ADEQUATE STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS INSTALLED BEHIND THE LEFT FRONT ENGINE COVER. ON ARTICULATED MACHINES, INSTALL THE BLOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances appear in Metric (SI), Imperial and U.S. quantities. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

Troubleshooting (Continued)

Problem	Cause	Remedy
Continuous clicking sound when the grader is moving straight forward.	Rolling radii are unequal for the driving wheel tires.	Adjust tire pressures or install correct size and type of tire until the radii are equal.
	Excessive load on one side of the grader.	Reduce the load or raise the tire pressure on the heavily loaded side until the rolling radii are equal on both sides.
	Defective differential.	Disassemble the differential. Remove defective parts and install new com-

Cleaning and Inspection

Cleaning - General

WARNING

ALKALI CLEANING SOLVENTS AND VAPORS ARE EXTREMELY HARMFUL AND CAN CAUSE SERIOUS INJURY TO EYES, LUNGS AND SKIN. ALWAYS WEAR PROTECTIVE CLOTHING, GOGGLES AND RESPIRATOR. USE UTMOST CARE WHEN HANDLING CHEMICALS.

Immerse small parts, gears and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Cleaning and Inspection (Continued)

Cleaning - General (Continued)

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used. Ensure all oil passages are unblocked.

Cleaning - Bearings

CAUTION

YOU ARE RECOMMENDED TO WEAR COTTON GLOVES WHEN HANDLING BEARINGS. THIS PREVENTS SKIN ACIDS AND PERSPIRATION CONTAMINATING THE RACES AND ROLLING ELEMENTS.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air. **DO NOT** spin bearings when drying. Rotate bearings slowly by hand to assist drying. Lubricate all bearings; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning - Axle Housing and Carrier

Thoroughly clean the interior and exterior of the axle housing and carrier to remove all traces of oil and dirt. These parts can also be steam-cleaned. Dry immediately.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Cleaning and Inspection (Continued)

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new cups and mating cones. After inspection, lubricate all bearings; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - Oil Seals, O Rings and Snap Rings

Replace all oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Apply a thin coating of 'Permatex No. 2', or equivalent, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings before installation.

Inspection - Gears and Shafts

If crack detection equipment is available, use the process to check parts. Examine teeth of all gears for wear, pitting, chipping, nicks, cracks and scores. If gear teeth show spots where the case hardening has worn through or cracked, replace the gear.

Always replace the ring gear and pinion as a matched set. Small nicks can be removed using a suitable grinding stone. Inspect shafts for signs of bent or twisted splines and replace any deformed axles.

Inspection - Axle Housing and Carrier

Inspect the axle housing and carrier. Ensure that they are thoroughly clean and all mating surfaces and bearing bores are free from nicks and burrs. Check for evidence that would cause subsequent oil leaks.

Cleaning and Inspection (Continued)

Inspection - Differential Assembly

Inspect the splines of the side gears and clutches. Remove any burrs or small chipped edges. Check the side gear hubs for fractures.

Replace the differential cases if the trunnion grooves or end thrust surfaces are worn or scored.

Check the differential case thrust and bearing surfaces for signs of metal pickup or wear. Replace excessively worn parts.

Check each clutch and holdout ring assembly for precise alignment of holdout ring to the spider center cam. Ensure the holdout ring rotates in the groove with little resistence.

Replace holdout rings if teeth are excessively worn, fractured or chipped.

Check the center cam for free movement. The cam must rotate within the limits of the spider key. **DO NOT** remove the center cam from the spider. If either part of the assembly is damaged or excessively worn, replace the complete spider-center cam assembly.

Inspect the clutch teeth on the spider and driven clutches. Remove small chips and restore the teeth using a fine grinding stone. Replace mating components if one part has excessively worn or rounded teeth.

Cams on the center cam and driven clutches must not be excessively chipped. A smooth wear pattern up to 50% of the cam width face is acceptable.

Cleaning and Inspection (Continued)

Inspection - Differential Assembly (Continued)

Check the side gear outer splines for wear or distortion. Ensure that the side gear and drive axle splines do not bind.

Check the springs of the NoSPIN assembly for a spring load measurement of (13 N.m; 1,3 kgf.m; 115 lbf-in.) at the operating height of 23 mm (0.9 in.).

NOTE

A dial indicator type spring tester is the best tool for the procedure described above. If a tester is <u>not</u> available, a weight equal to the specified can be placed on the spring and the operating height can be measured.

Replacing springs in the NoSpin should only be done when the proper spring load and operating height is not the same as specified.

SINGLE REDUCTION FINAL DRIVE

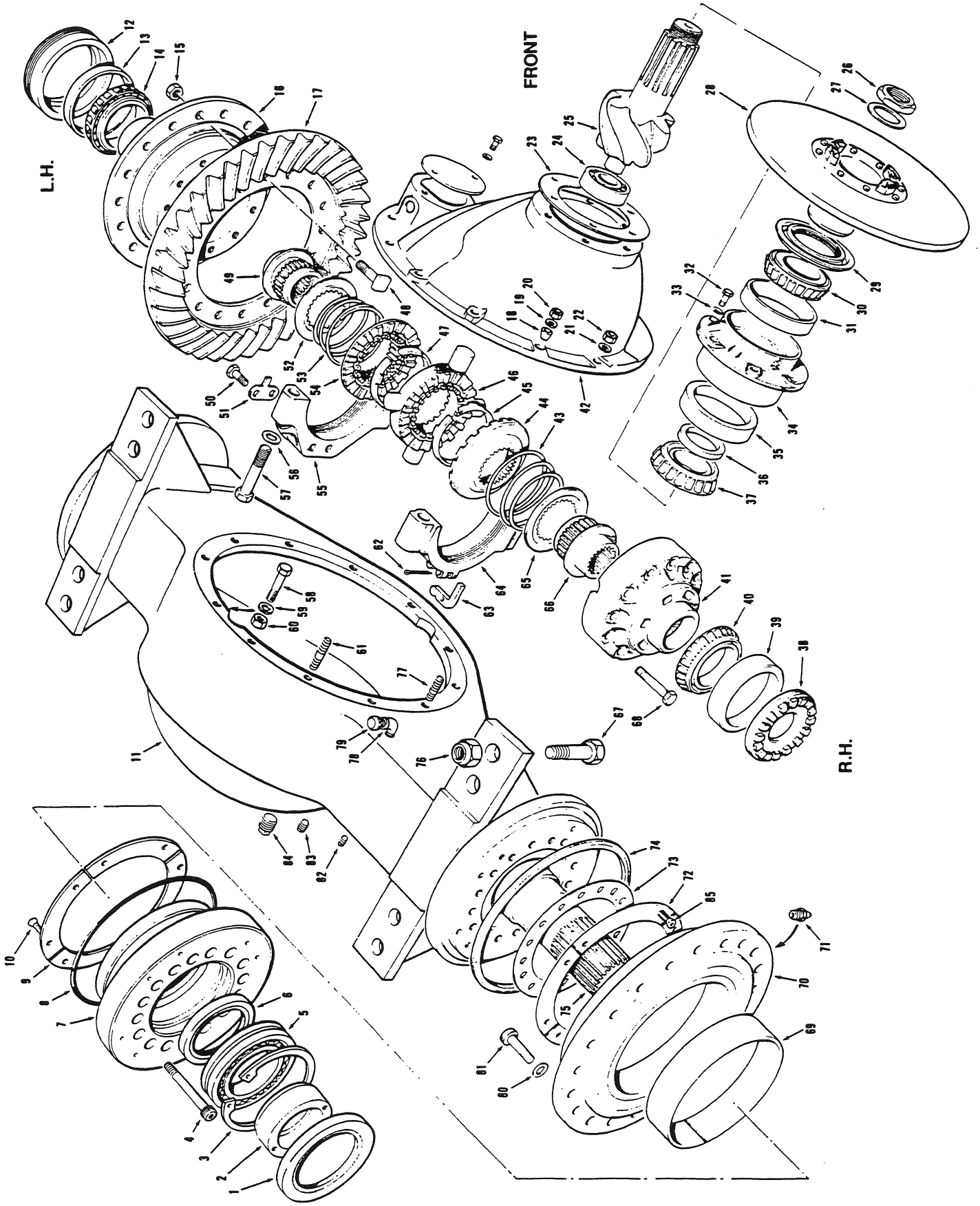


Fig. 1

Item	Description	Item	Description	Item	Description
1	Outer oil seal	29	Oil seal and retainer assy.	55	Bearing cap
2	Spacer	30	Outer bearing cone	56	Washer
3	Snap ring	31	Outer bearing cup	57	Bolt
4	Bolt	32	Bolt	58	Bolt
5	Bearing	33	Internal tooth lock-washer	59	Lockwasher
6	Inner oil seal	34	Cage and cup assy.	60	Nut
7	Pivot ring retainer	35	Inner bearing cup	61	Stud
8	O ring	36	Spacer	62	Cotter pin
9	Thrust plate	37	Inner bearing cone	63	Right hand adjuster lock
10	Bolt	38	Right hand bearing adjuster	64	Bearing cap
11	Axle housing	39	Right hand bearing cup	65	Retainer
12	Left hand bearing adjuster	40	Right hand bearing cone	66	Side gear
13	Left hand bearing cup	41	Right hand differen-tial case	67	Bolt
14	Left hand bearing cone	42	Carrier assembly	68	Bolt
15	Nut	43	Spring	69	Bushing
16	Left hand differen-tial case	44	Clutch	70	Pivot ring
17	Ring gear (matched set)	45	Holdout ring	71	Grease fitting
18	Conical washer	46	Spider assembly	72	Thrust plate
19	Lockwasher	47	Holdout ring	73	Shim
20	Nut	48	Special bolt	74	"Uniring" seal
21	Lockwasher	49	Side gear	75	Drive axle
22	Nut	50	Bolt	76	Locknut
23	Shim	51	Left hand adjuster lock	77	Stud
24	Pilot bearing	52	Retainer	78	90° elbow
25	Pinion (matched set)	53	Spring	79	Breather
26	Pinion locknut	54	Clutch	80	Lockwasher
27	Washer			81	Bolt
28	Brake disc and yoke assembly			82	Pipe plug
				83	Pipe plug
				84	Pipe plug
				85	Bolt

Key to Fig. 1

SINGLE REDUCTION FINAL DRIVE ASSEMBLY

Removal from Grader

Fig. 2
Place a container under the drain plug (84). Remove the plug and drain the lubricating oil. Analyze the drained oil. If metal particle contamination is present, completely disassemble the final drive assembly to remove defective parts.

Fig. 3
Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard and lift the front wheels off the ground. Stop the engine. Turn the isolation switch to the "OFF" position.

Fig. 4
Disconnect the tube from the brake master cylinder to the three-way connector located on the inner right hand side of the rear frame. Immediately plug the tube and connector to prevent dirt and moisture entering the brake hydraulic system. Wipe up any spilled brake fluid to prevent paint damage.

Fig. 5
Disconnect the emergency brake cable.

Fig. 6

CAUTION

THE EMERGENCY BRAKE CALIPER ASSEMBLY IS EXTREMELY HEAVY.

Remove the bolts, lockwashers and flatwashers. Carefully remove the emergency brake caliper assembly. Remove the bolts, lockwashers, brake disc fender and two spacers.

Fig. 7
Disconnect the lower drive shaft universal joint from the final drive input yoke. Secure the two halves of the slip yoke with lockwire.

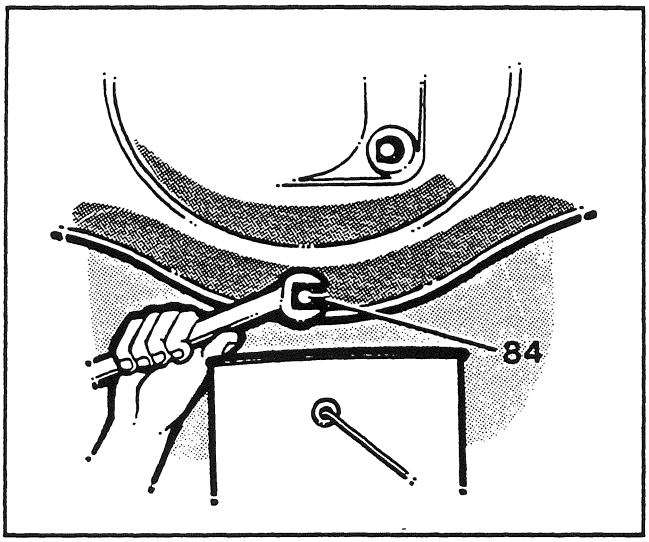
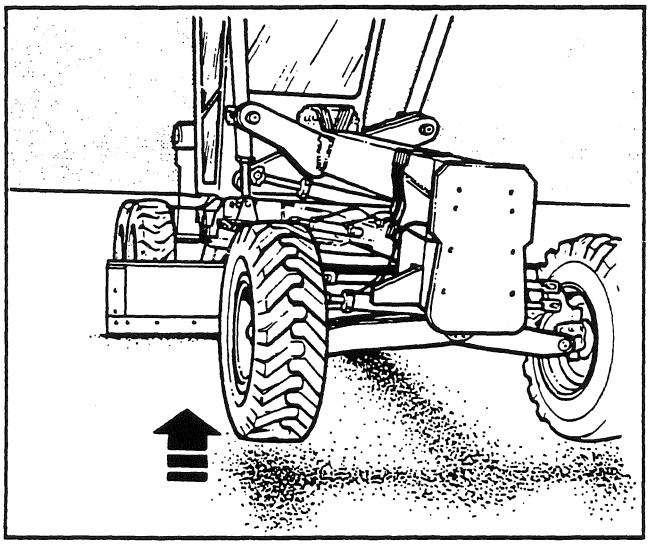


Fig. 2



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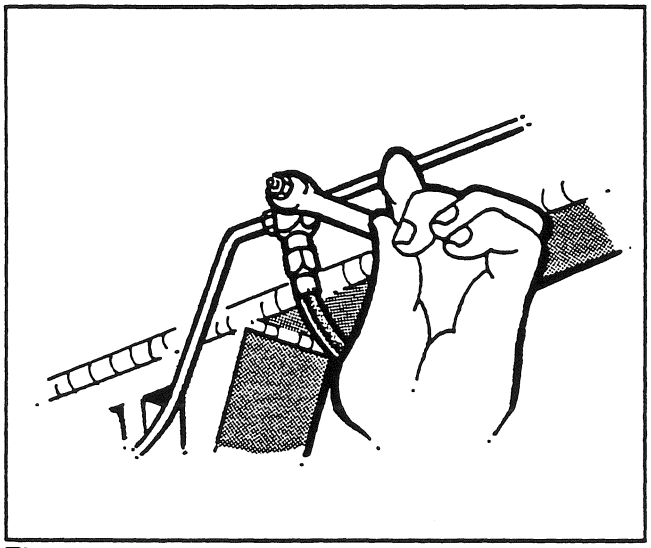

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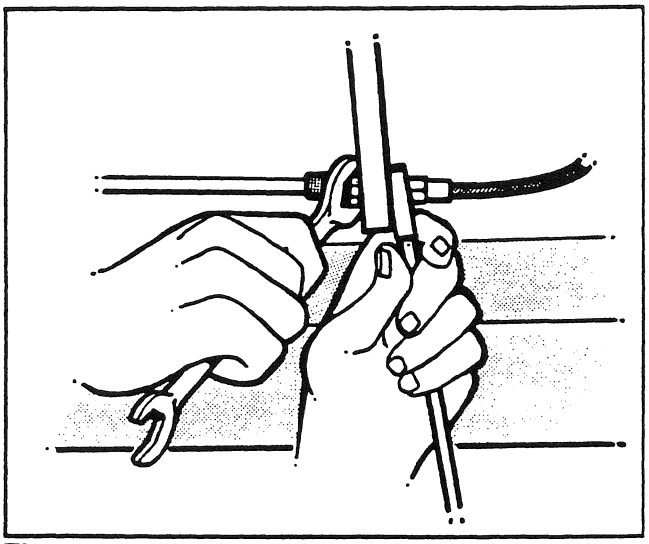

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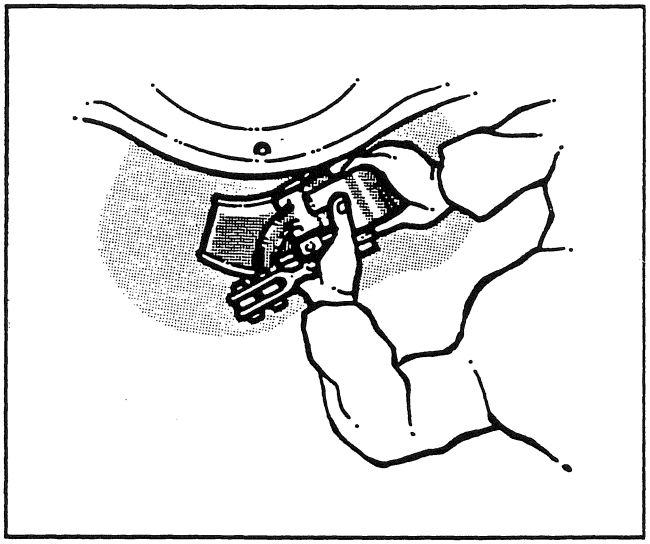

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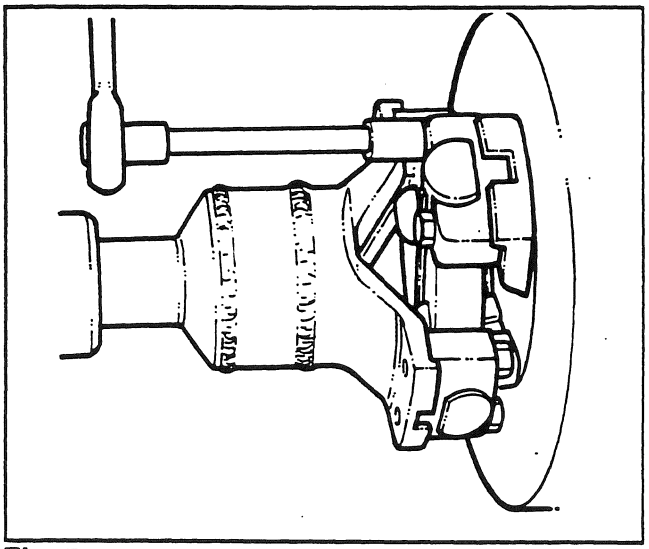

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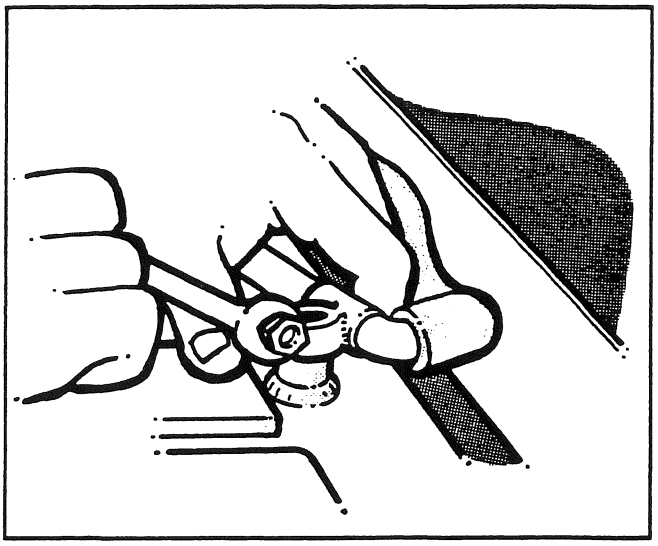

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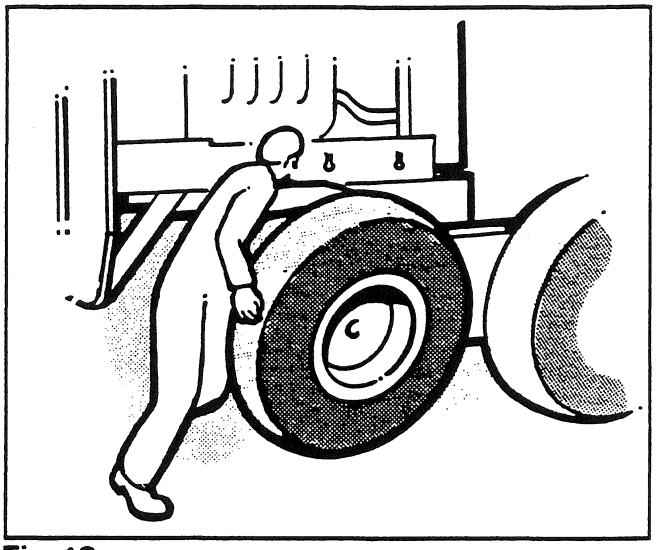
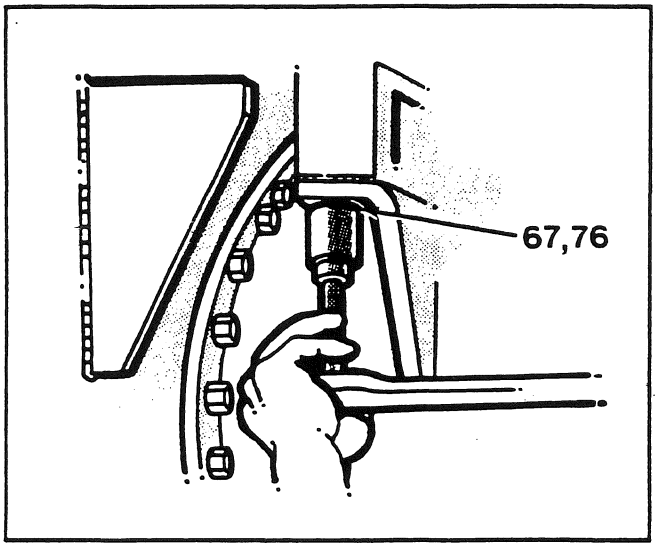


Fig. 10



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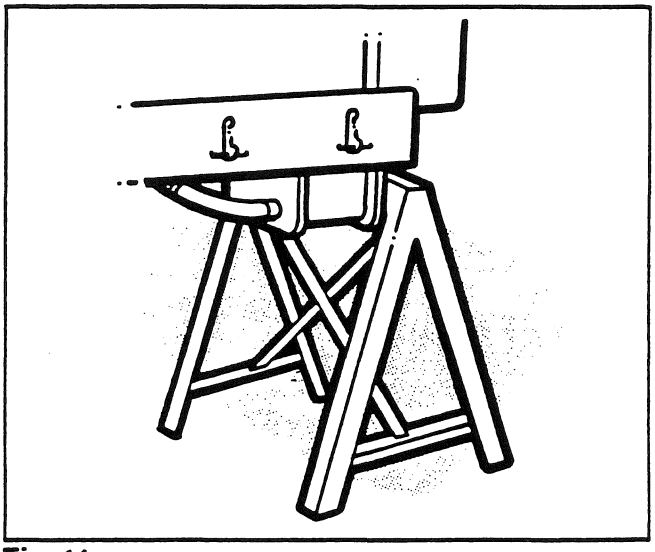


Fig. 11

SINGLE REDUCTION FINAL DRIVE ASSEMBLY

Removal from Grader (Continued)

Fig. 8
Open the battery box(es) and disconnect the battery cables. Remove one battery and pass the cables through the grommet.

Fig. 9
Attach a safe lifting device to the rear of the grader frame. Remove the bolts (**67**) and locknuts (**76**) retaining the final drive assembly to the frame brackets.

Fig. 10
Raise the rear end of the grader clear of the final drive. Roll out the final drive and tandem assembly from under the grader.

Fig. 11
Lower the rear end of the grader onto safe, adequate stands

MAJOR COMPONENTS

Removal and Disassembly

Fig. 12
Install wedges in front and behind the tires. Place a container under the tandem drain plug. Remove the plug and drain the lubricating oil. Clean and install the drain plug.

Fig. 13
Remove, clean and install the deep reach magnetic plugs. If the oil and magnetic plugs are contaminated with metal particles, completely disassemble the tandem to remove defective parts.

Fig. 14
Disconnect and remove the transverse brake line. Immediately plug the line and connector. Wipe up any spilled fluid to avoid paint damage.

Fig. 15
Remove the bolts securing the cover plate and remove the plate. Discard the gasket and remove any traces of sealant.

Fig. 16
Remove the bolts, lockwashers and end plate.

Fig. 17
Support the final drive assembly on safe, adequate stands. Attach a safe lifting device to the tandem. Remove the bolts (**81**) and lockwashers (**80**) retaining the final drive to the tandem.

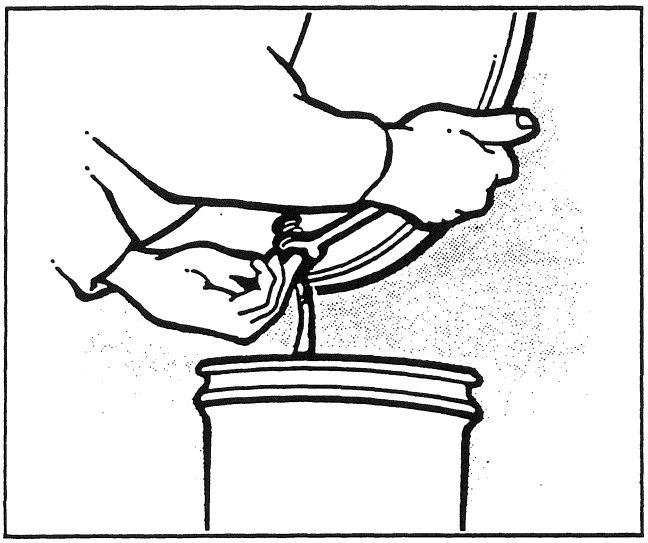
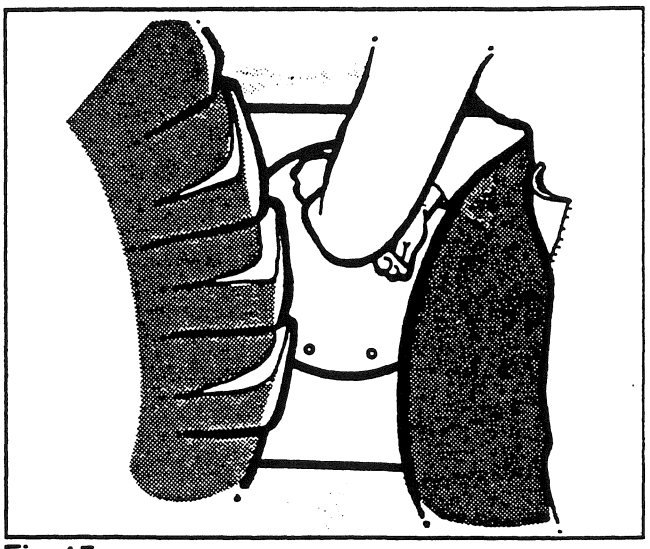


Fig. 12



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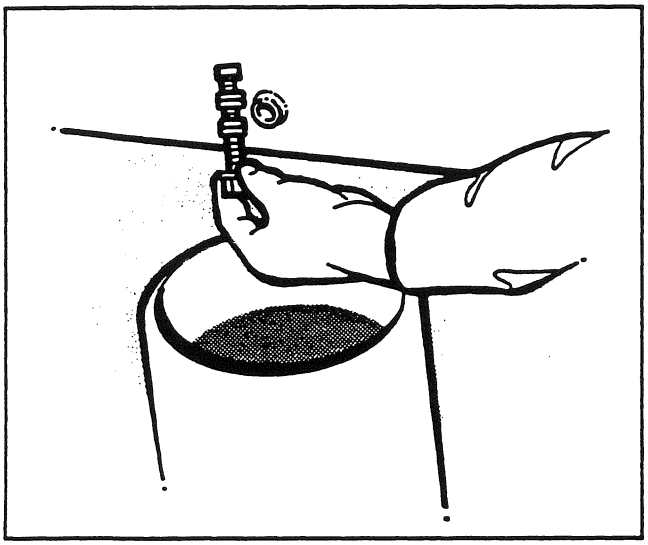


Fig. 13

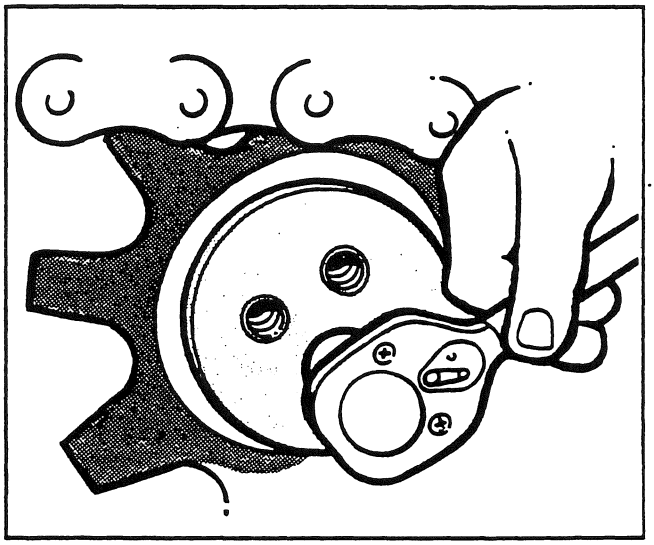
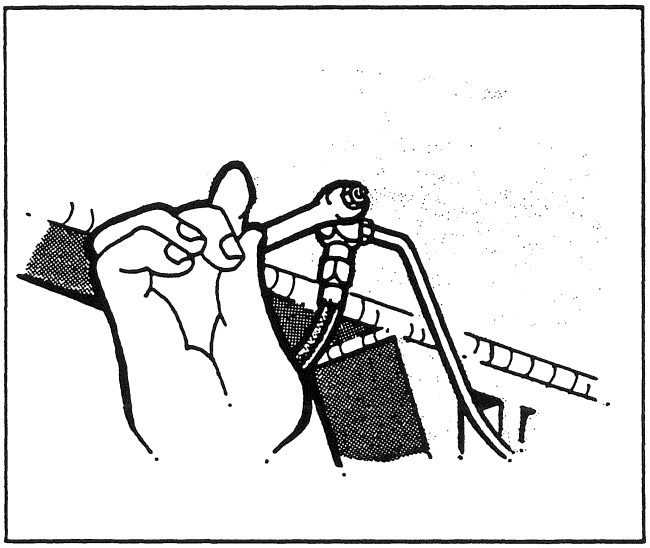


Fig. 16



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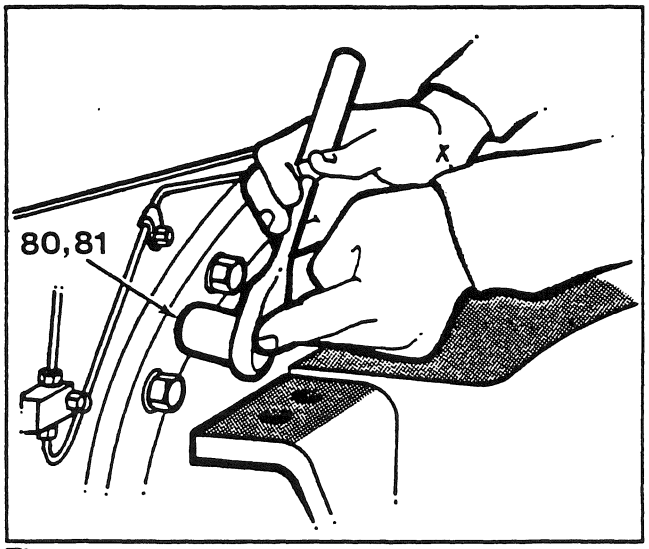

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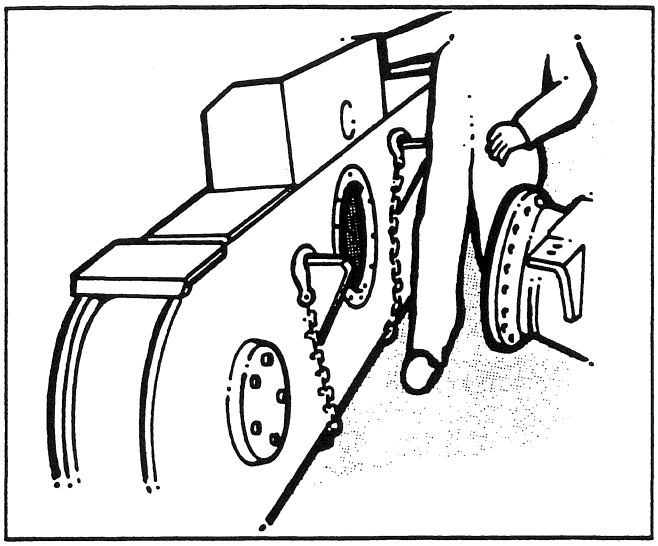

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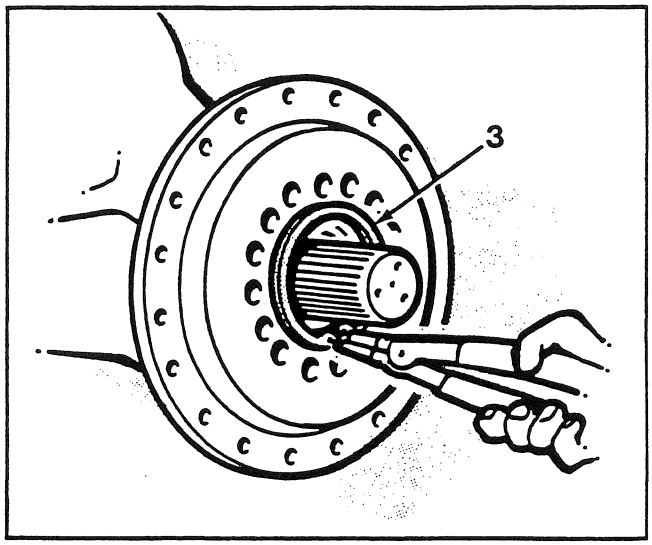

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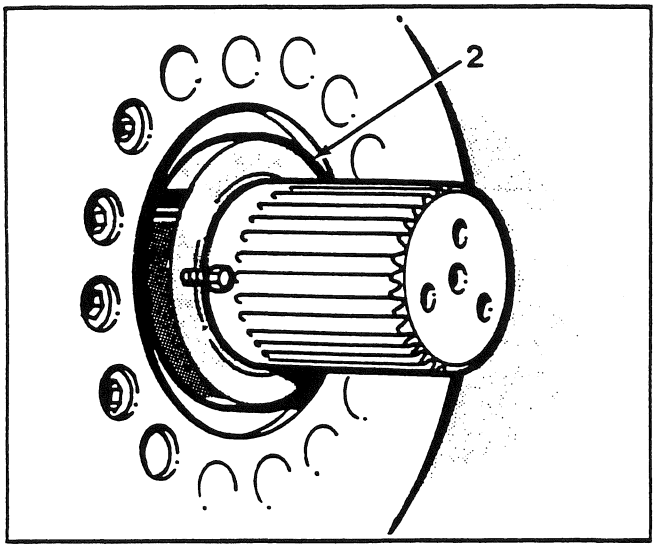
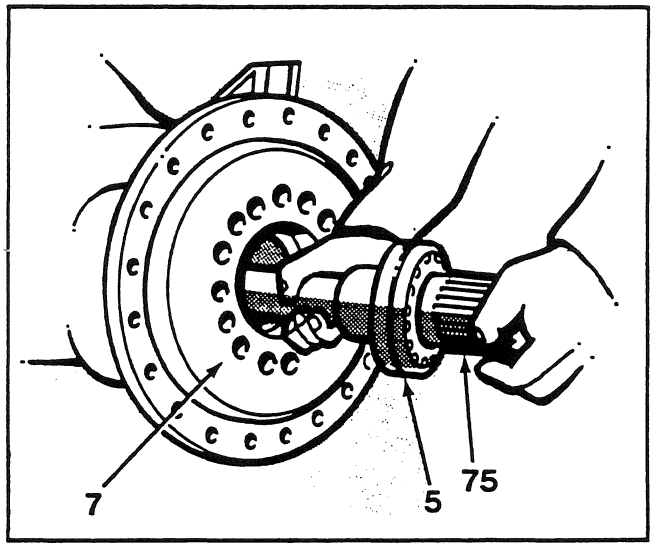


Fig. 19



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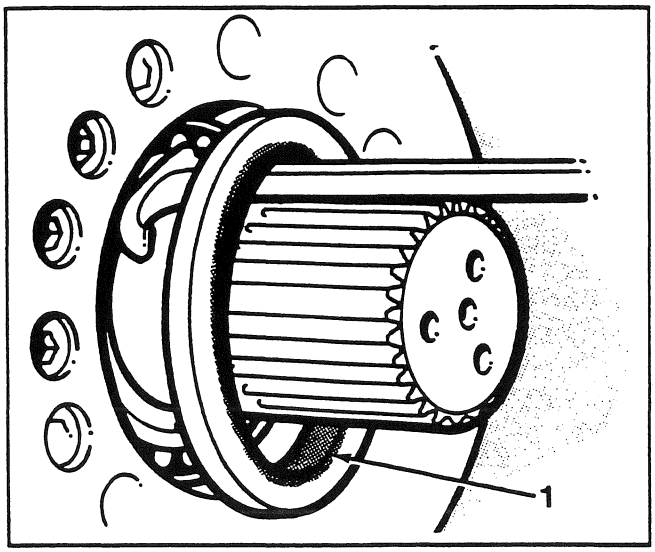

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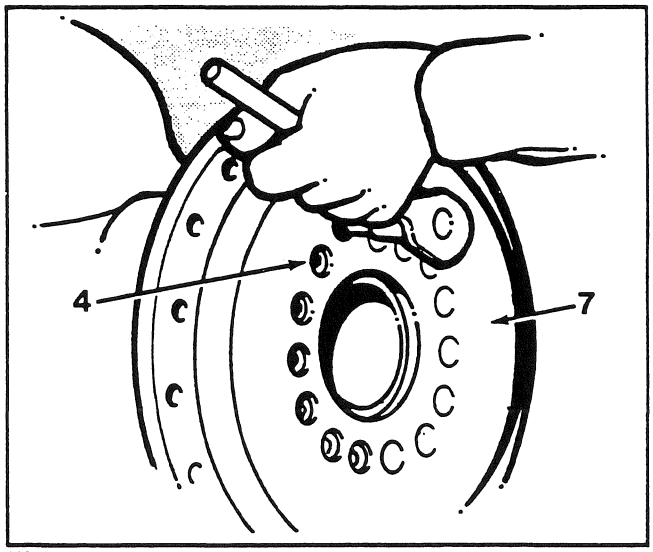


Fig. 23

MAJOR COMPONENTS

Removal and Disassembly (Continued)

Fig. 18
Carefully remove the tandem. Use a pry bar to remove the drive sprocket and chains. Repeat the previous steps for the other tandem.

Fig. 19
Place the final drive assembly with the input carrier assembly at the top. Remove the spacer (**2**).

Fig. 20
Remove and discard the outer oil seal (**1**).

Fig. 21
Remove and discard the snap ring (**3**).

Fig. 22
Remove the drive axle and bearing assembly from the pivot ring retainer (**7**). Remove the bearing (**5**) from the drive axle (**75**). Place the bearing and drive axle to one side for cleaning and inspection.

Fig. 23

CAUTION

THE PIVOT RING (70) MAY BE LOOSE. TAKE CARE WHEN SEPARATING.

Remove the bolts (**4**) securing the pivot ring retainer (**7**).

Removal and Disassembly (Continued)

Fig. 24
Carefully remove the pivot ring retainer (**7**). Also remove the bolts (**10**) retaining the thrust plate segments (**9**).

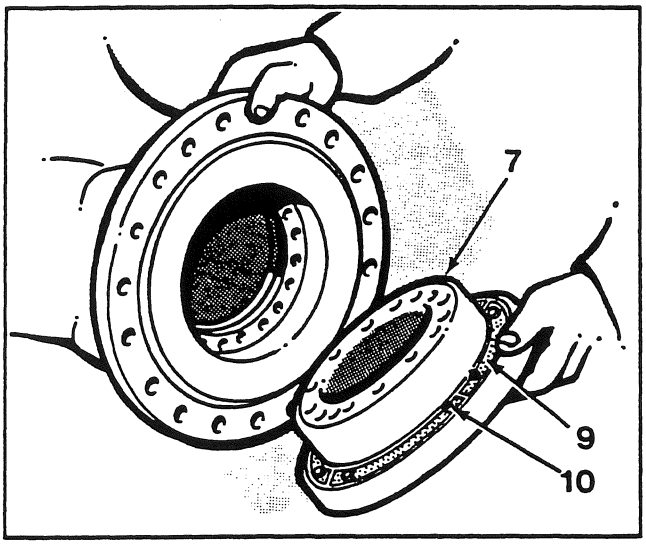
Fig. 25
Remove the shims (**73**).

Fig. 26
Remove and discard the inner oil seal (**6**) and O ring (**8**).

Fig. 27
Carefully remove the pivot ring assemby (**69**), (**70**).

Fig. 28
Remove and discard the "Uniring" seal (**74**).

Fig. 29
Remove the bolts (**85**) retaining the thrust plate segments (**72**). Remove the segments. Repeat the previous steps for the other side. Place all parts to one side for cleaning and inspection.



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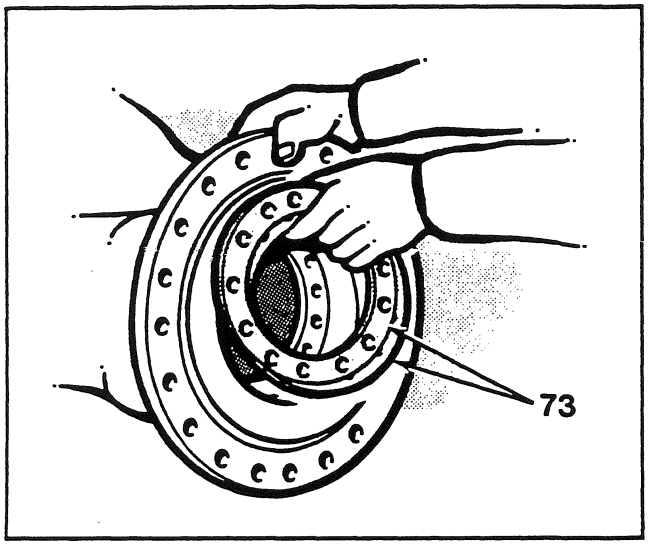

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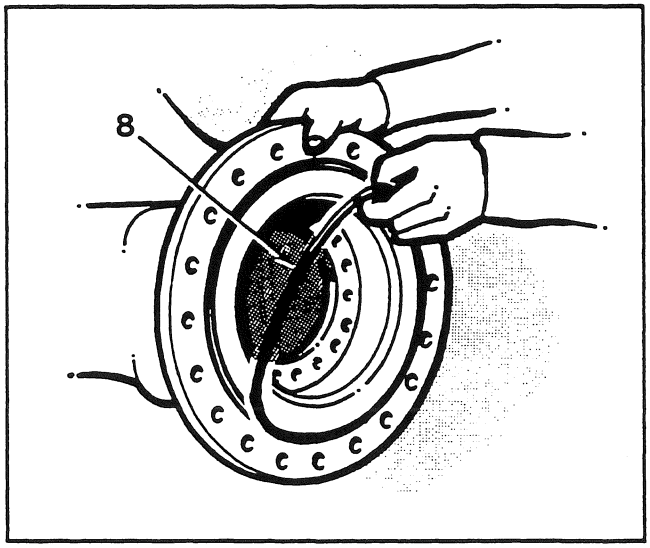
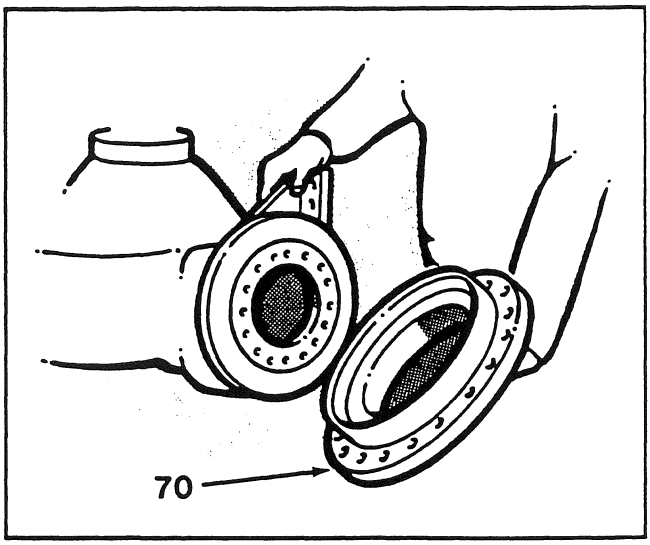


Fig. 26



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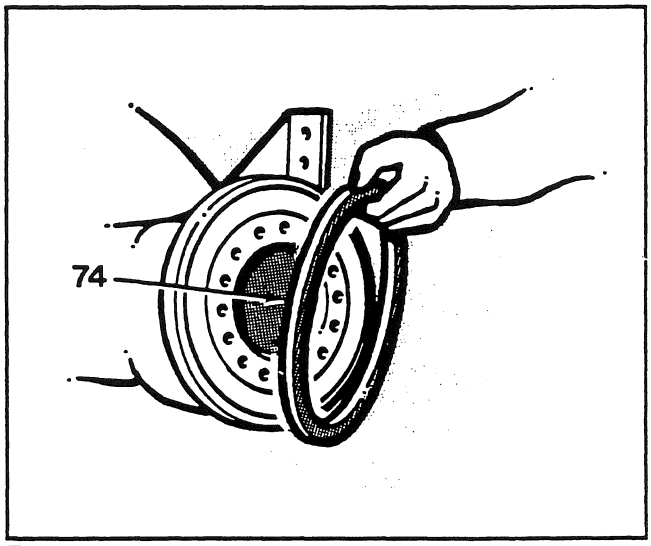

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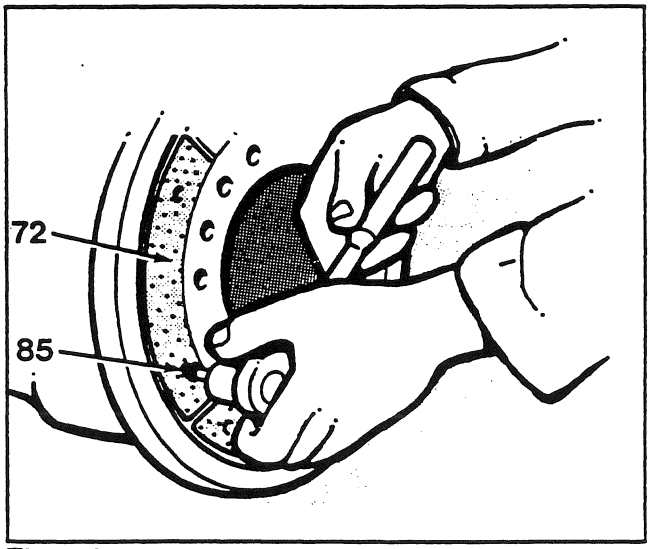

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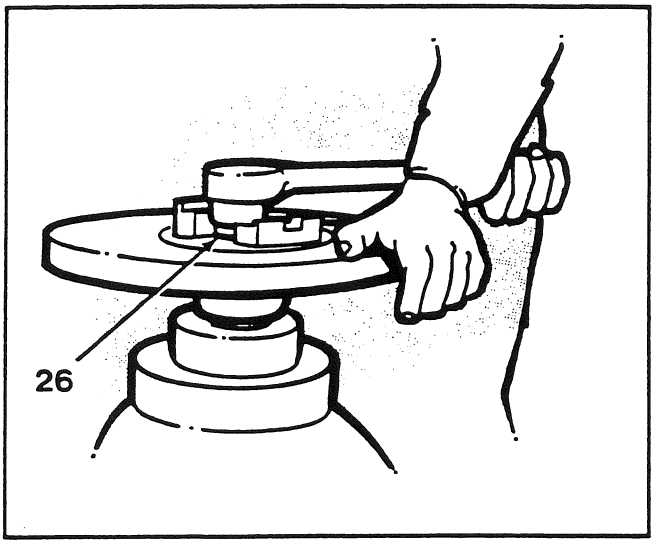

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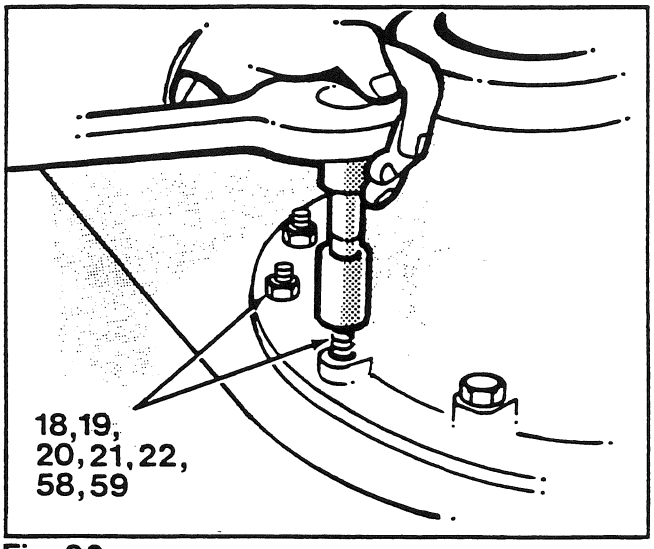

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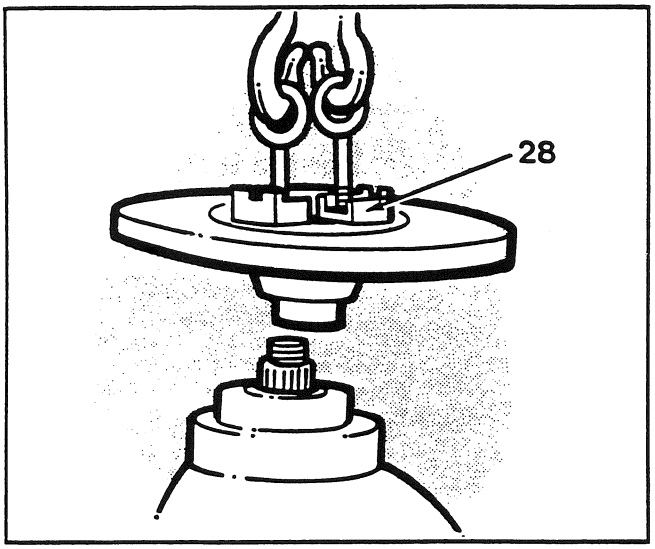

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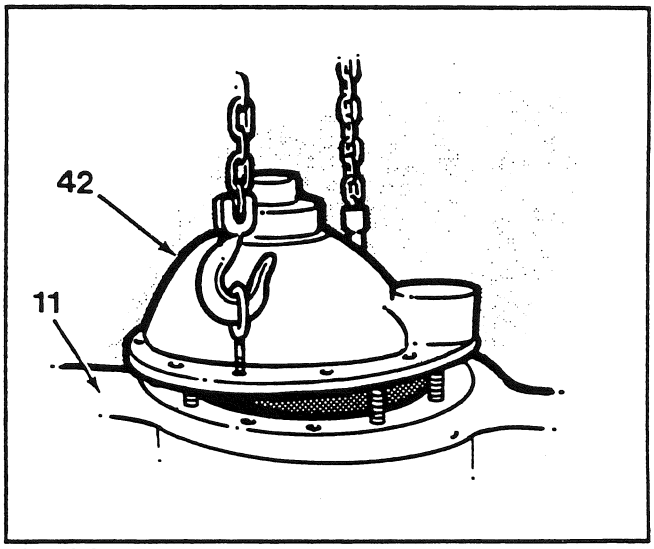


Fig. 33

MAJOR COMPONENTS

Removal and Disassembly (Continued)

Fig. 30
Remove and discard the pinion locknut (**26**).

Fig. 31
Install two lifting eyebolts into the yoke (**28**). Remove the washer (**27**), brake disc and yoke assembly.

Fig. 32
Remove the bolts (**58**), nuts (**20** and **22**), lockwashers (**59, 21** and **19**) and conical washers (**18**).

Fig. 33

WARNING

THE CARRIER ASSEMBLY IS EXTREMELY HEAVY. SUPPORT THE ASSEMBLY IN A SUITABLE SERVICE FIXTURE OR ON A STRONG WORKBENCH.

Install two lifting eyebolts and attach a safe lifting device. Using a pry bar, carefully separate and remove the carrier assembly (**42**) from the axle housing (**11**). Install the carrier assembly into the service fixture or on the workbench.

DIFFERENTIAL HEAD ASSEMBLY

Disassembly

NOTE

If using the original gear set, check and record the tooth contact pattern and backlash BEFORE disassembly. DO NOT perform this step if replacing the gear set.

Fig. 34
Remove and discard the lockwire retaining the bearing cap bolts (**57**).

Fig. 35
Punch mark the bearing caps (**55** and **64**) and bearing adjusters (**12** and **38**) to ensure correct assembly.

Fig. 36
Remove the left hand adjuster lock bolts (**50**). Remove the left hand adjuster lock (**51**).

Fig. 37
Remove and discard the cotter pin (**62**) retaining the right hand adjuster lock (**63**).

Fig. 38
Remove the right hand adjuster lock (**63**).

Fig. 39
Remove the bolts (**57**) and washers (**56**) securing the left and right hand bearing caps (**55**) and (**64**).

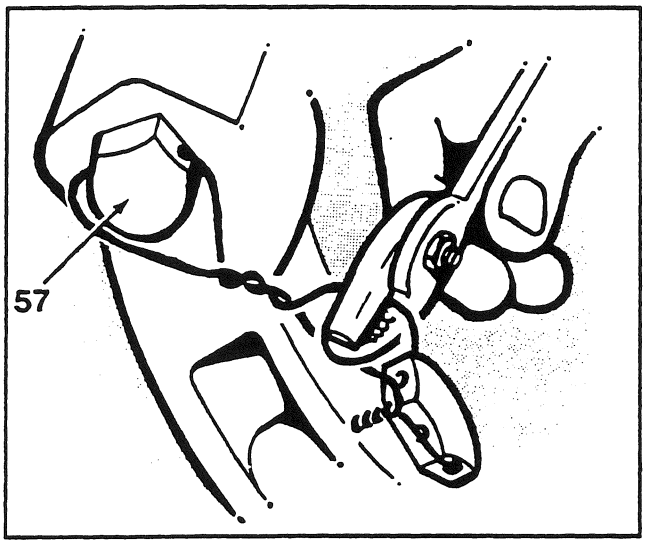
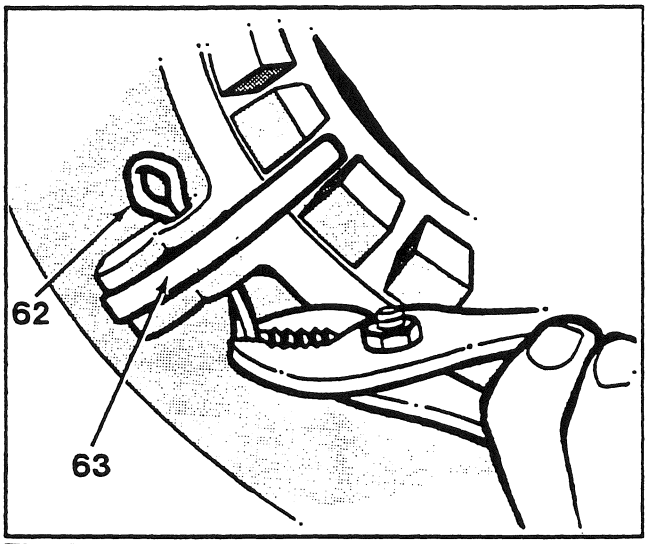


Fig. 34



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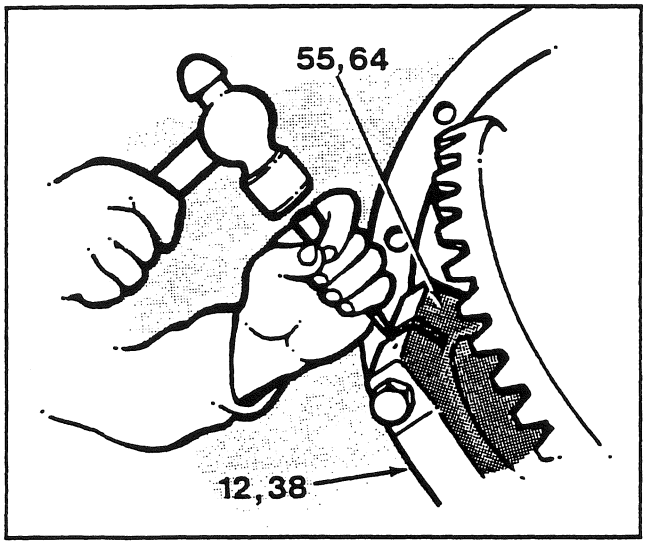

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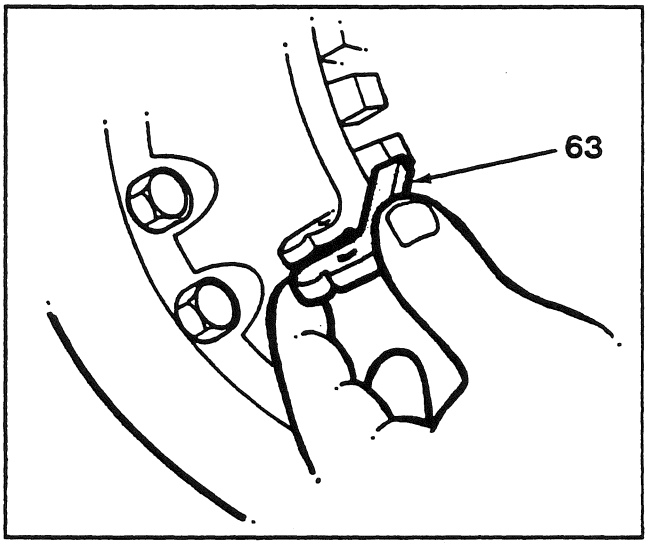

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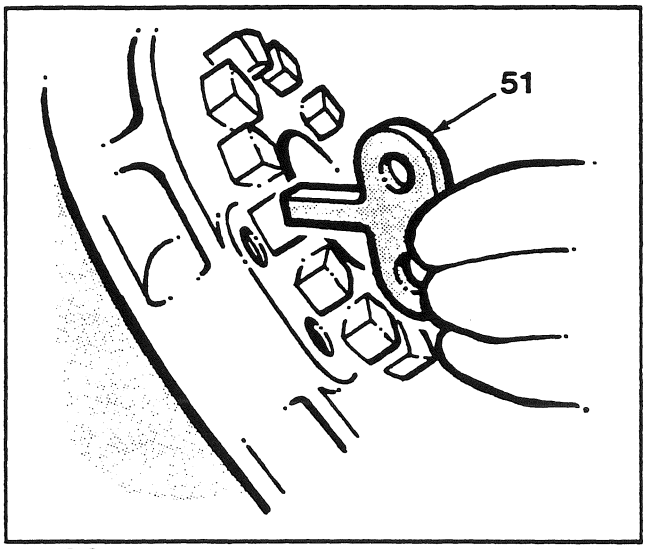

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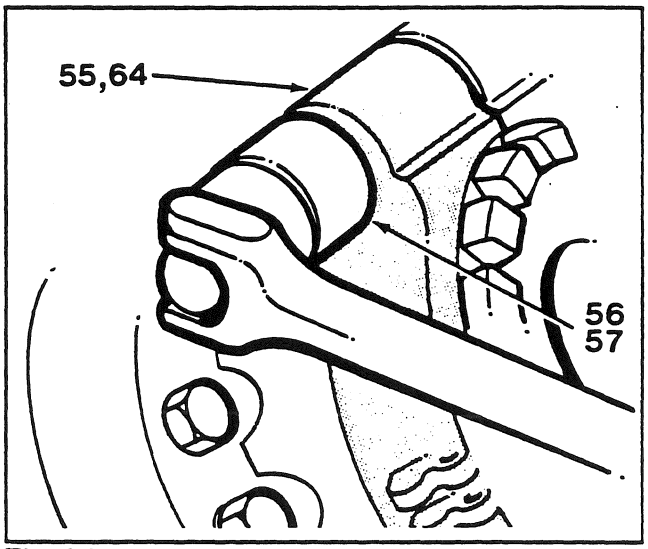

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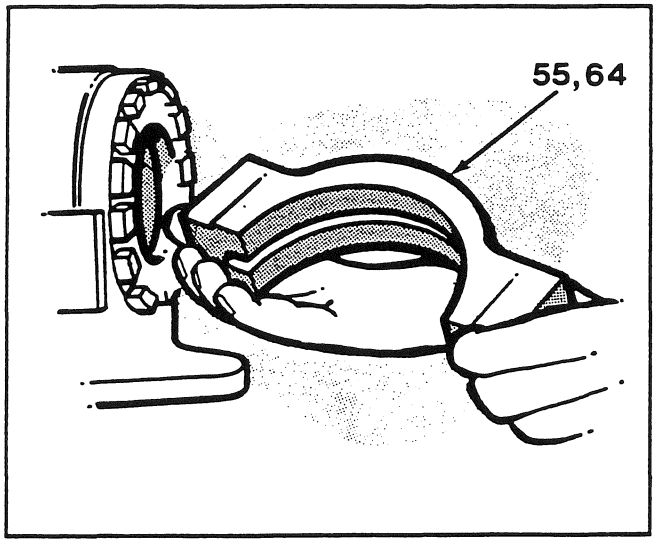

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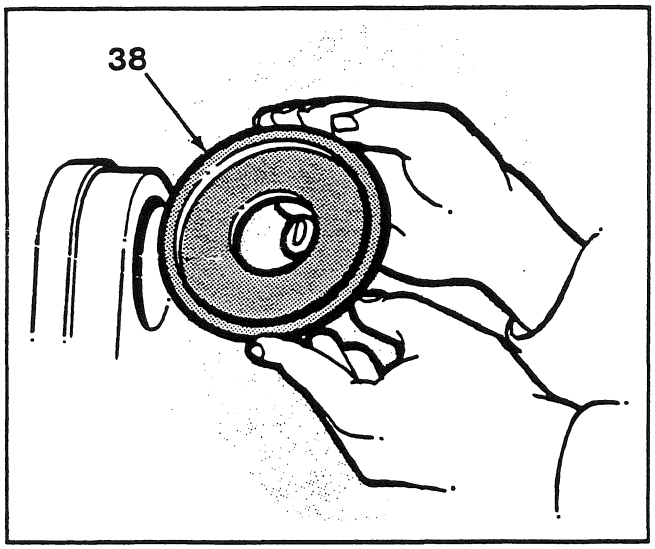

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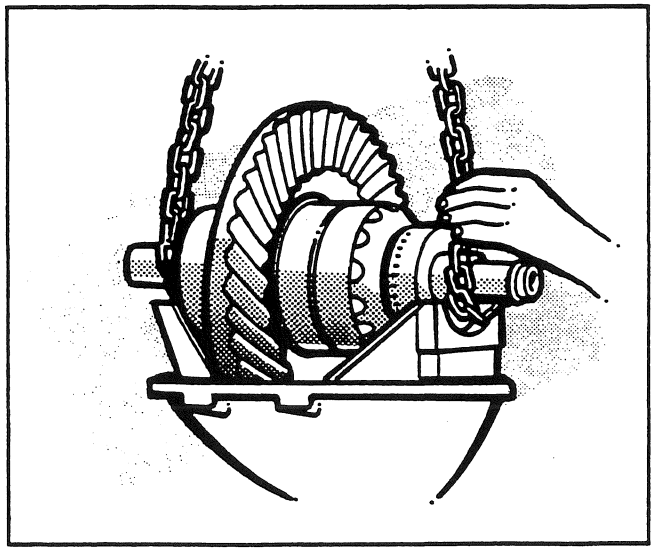
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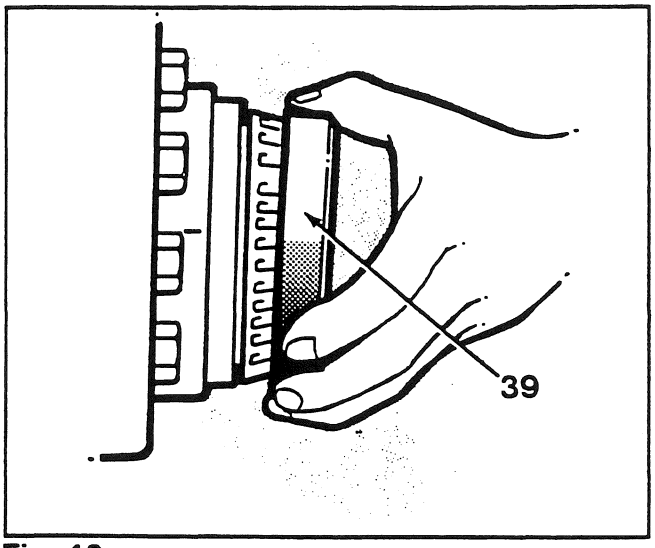

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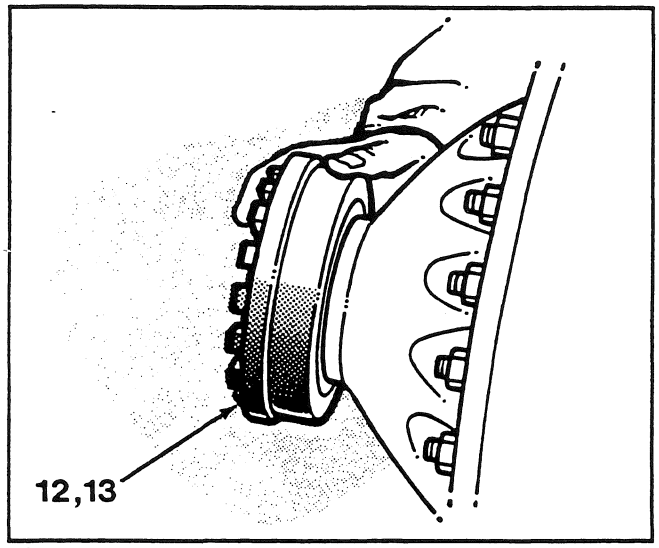

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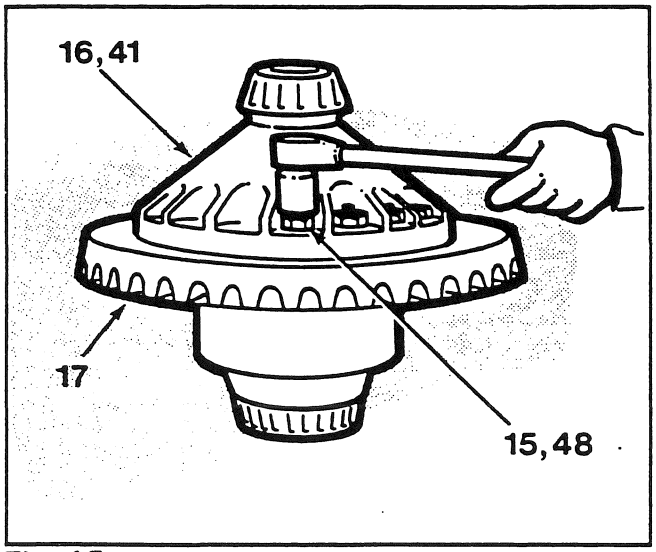


Fig. 45

DIFFERENTIAL HEAD ASSEMBLY

Disassembly (Continued)

Fig. 40
Remove the left and right hand bearing caps (**55**) and (**64**).

Fig. 41
Remove the right hand bearing adjuster (**38**).

Fig. 42
Use a safe lifting device to remove the differential assembly from the carrier housing.

Fig. 43
Remove the right hand bearing cup (**39**).

Fig. 44
Remove the left hand bearing cup (**13**) and adjuster (**12**) assembly.

Fig. 45
Place the differential assembly on the workbench. Punch mark the differential cases (**16** and **41**) to ensure correct assembly. Remove the nuts (**15**) and special bolts (**48**) retaining the ring gear (**17**).

DIFFERENTIAL HEAD ASSEMBLY

Disassembly (Continued)

Fig. 46
Remove the ring gear (**17**).

Fig. 47
Slowly loosen the differential case bolts (**68**) in a diagonal sequence to gradually release the spring compression.

Fig.48
Press down on the differential case (**41**) when removing the bolts (**68**).

Fig. 49
Carefully release and remove the differential case (**41**).

Fig. 50
Remove the side gears (**49**) and (**66**).

Fig. 51
Remove the spring retainers (**52**) and (**65**).

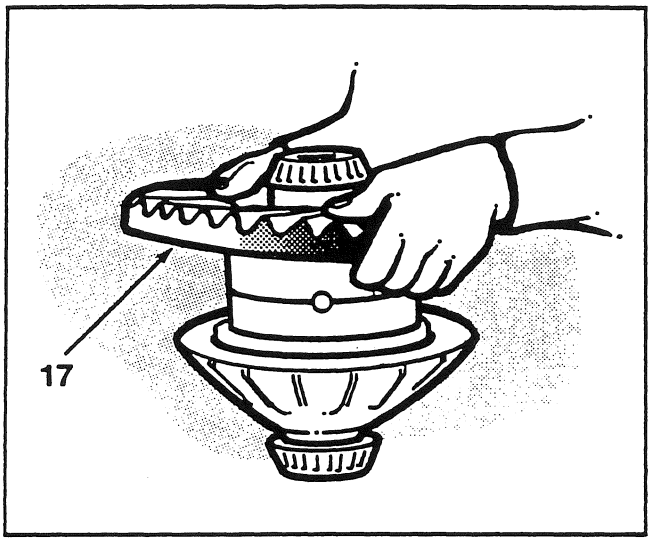
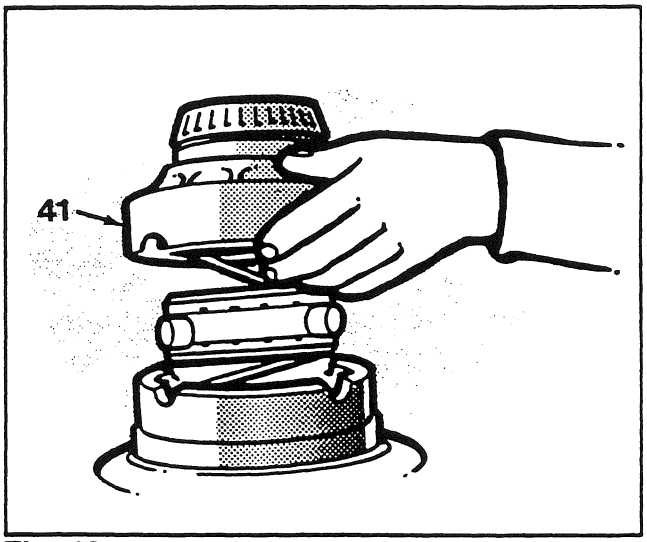


Fig. 46



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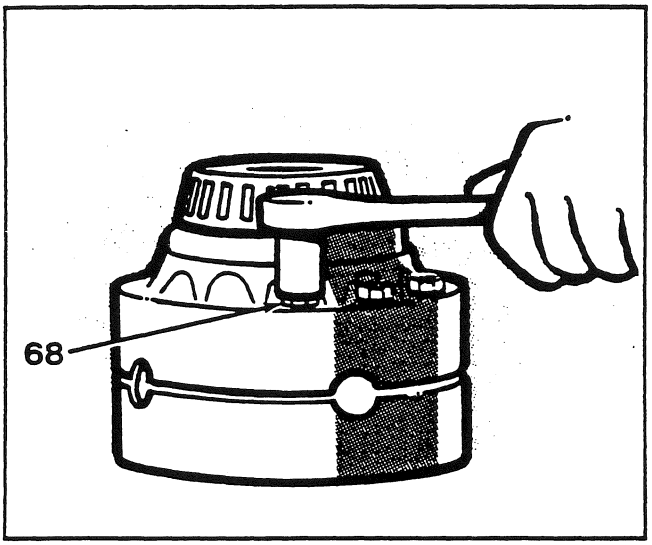

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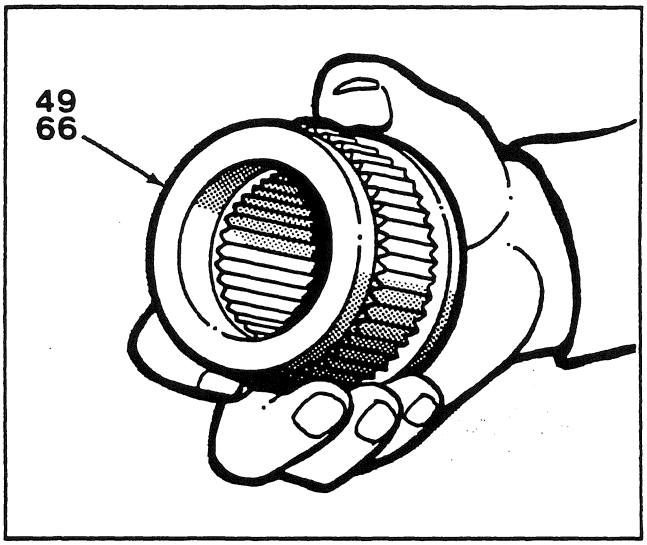

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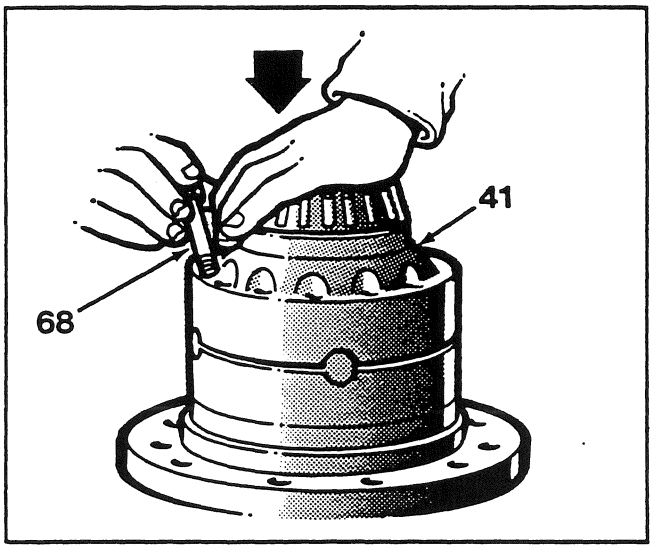

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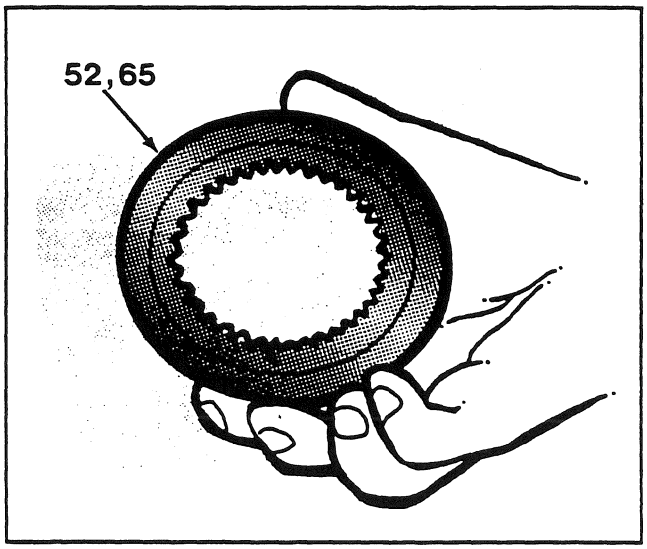

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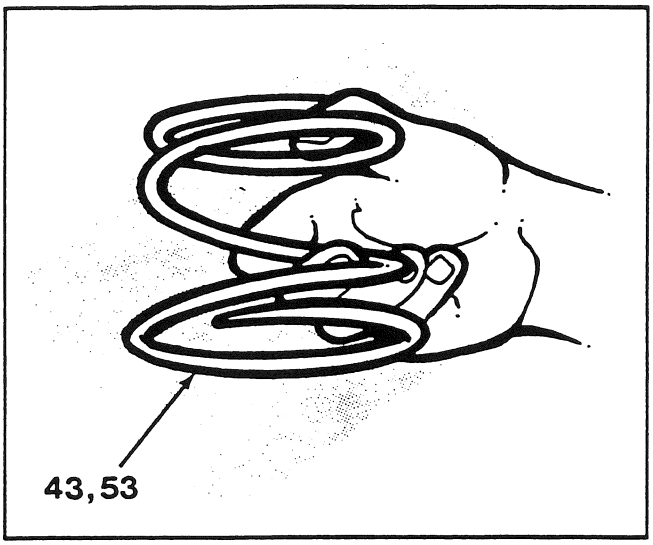

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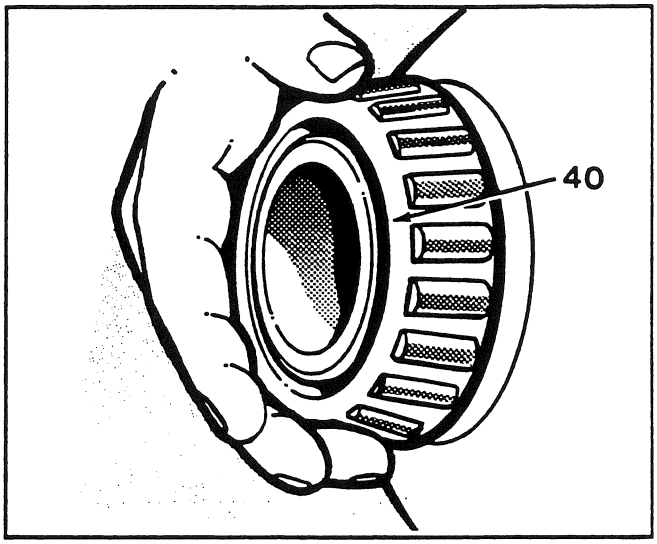

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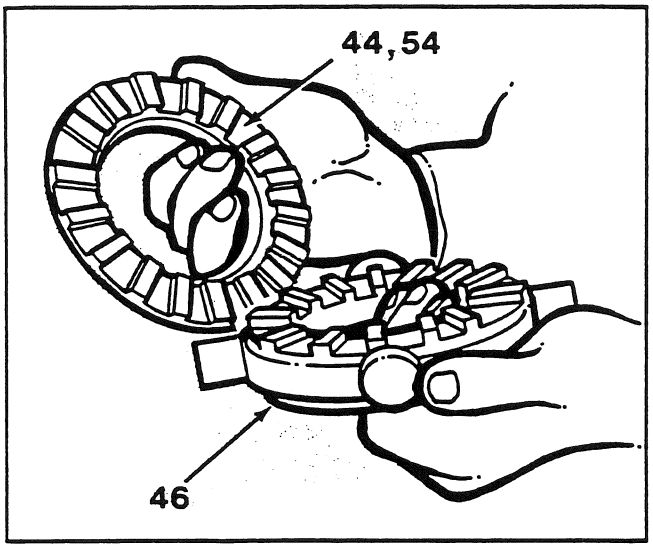
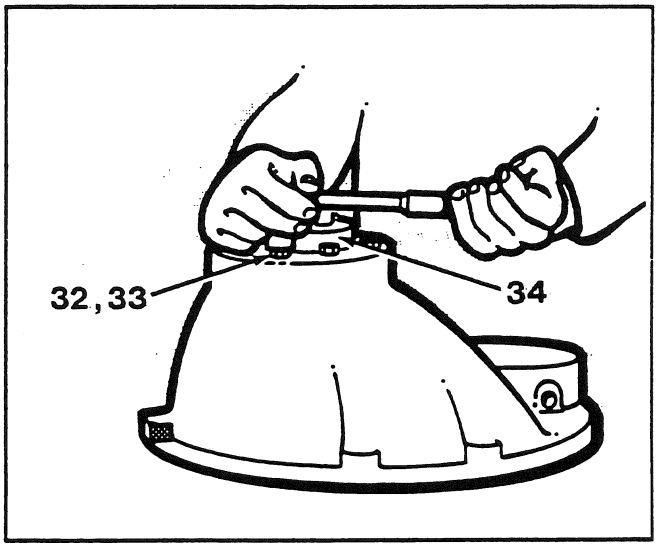


Fig. 53



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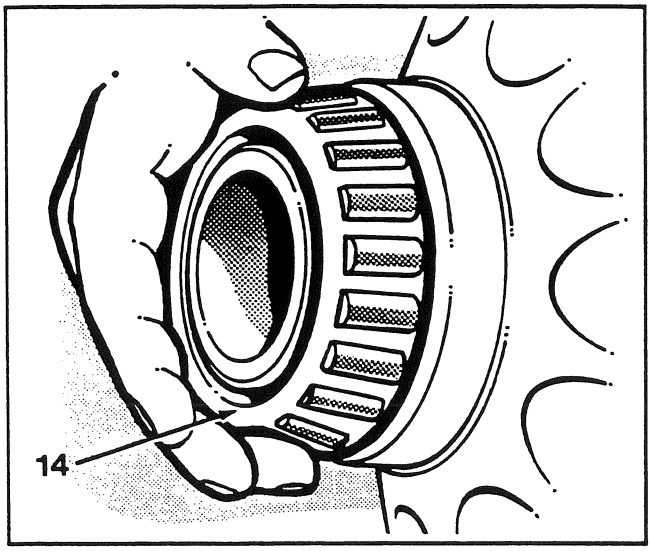

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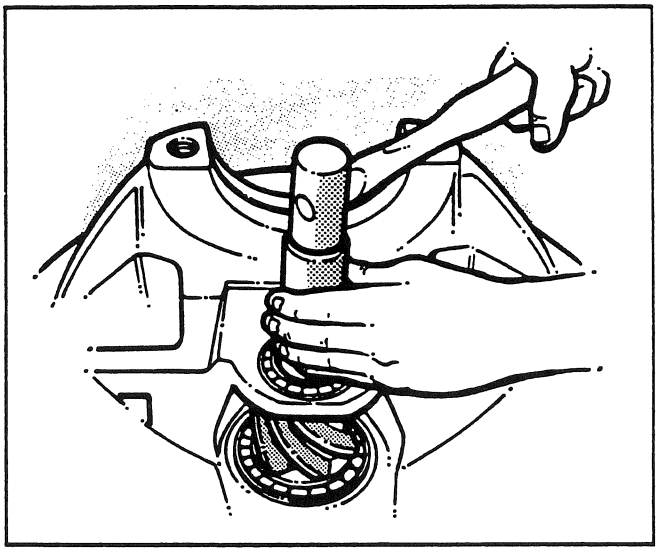


Fig. 57

DIFFERENTIAL HEAD ASSEMBLY

Disassembly (Continued)

Fig. 52
Remove the springs (**53**) and (**43**).

Fig. 53
Remove the clutches (**44**) and (**54**) and spider assembly (**46**).

Fig. 54
Check for damage and wear of the left hand bearing cone (**14**). Replace the cone if required.

Fig. 55
Check for damage and wear of the right hand bearing cone (**40**). Replace the cone if required. Place all parts to one side for cleaning and inspection.

Fig. 56
Remove the bolts (**32**) and lockwashers (**33**) retaining the pinion cage and cup assembly (**34**).

Fig. 57

CAUTION

DO NOT STRIKE THE OUTER RACE OF THE PILOT BEARING. DO NOT ALLOW THE PINION AND BEARING ASSEMBLY TO FALL OUT OF THE CARRIER DURING DISASSEMBLY.

CAUTION

IF THE ORIGINAL GEAR SET IS TO BE USED, KEEP THE SHIMS (23). RECORD THE NUMBER AND SIZE OF SHIMS.

Remove the pinion and bearing assembly using a hammer and brass drift, by striking the pilot bearing end.

DIFFERENTIAL HEAD ASSEMBLY

Disassembly (Continued)

Fig. 58
Remove the pinion cage shims (**23**).

Fig. 59
Secure the pinion cage and cup assembly (**34**) in a vise. By striking the non-threaded end of the pinion (**25**). Remove the pinion, pilot bearing (**24**) and inner bearing cone (**37**).

Fig. 60
Remove and discard the oil seal and retainer assembly (**29**).

Fig. 61
Remove the outer bearing cone (**30**).

Fig. 62
Remove the inner bearing cup (**35**) using a hammer and brass drift.

Fig. 63
Turn the pinion cage and cup assembly over and remove the outer bearing cup (**31**) using a hammer and brass drift.

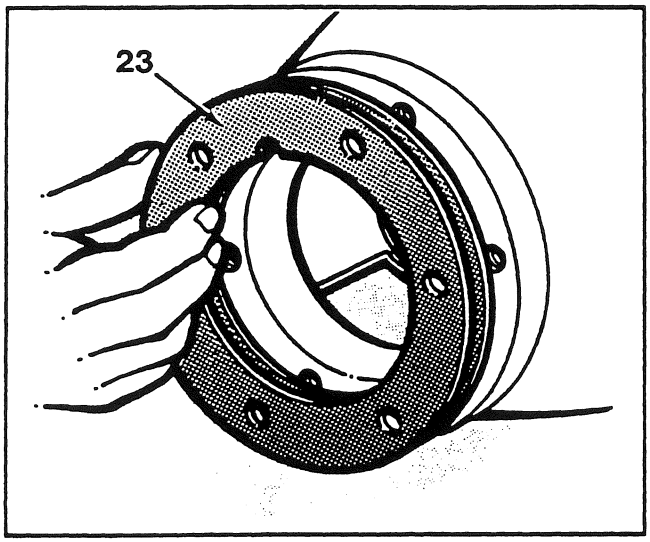


Fig. 58

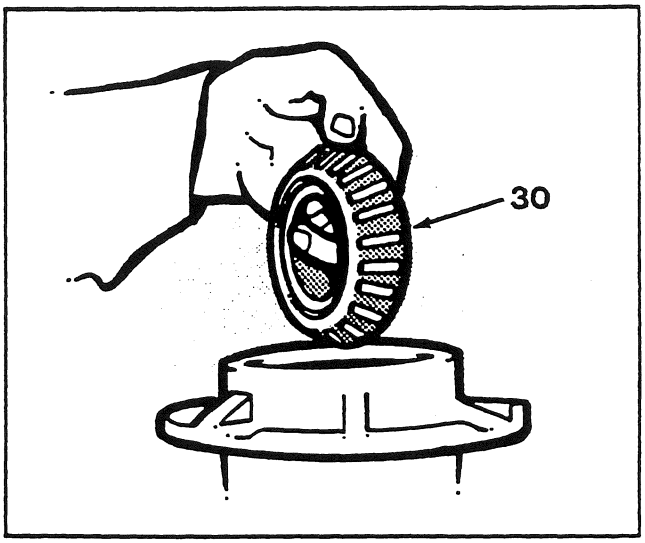


Fig. 61

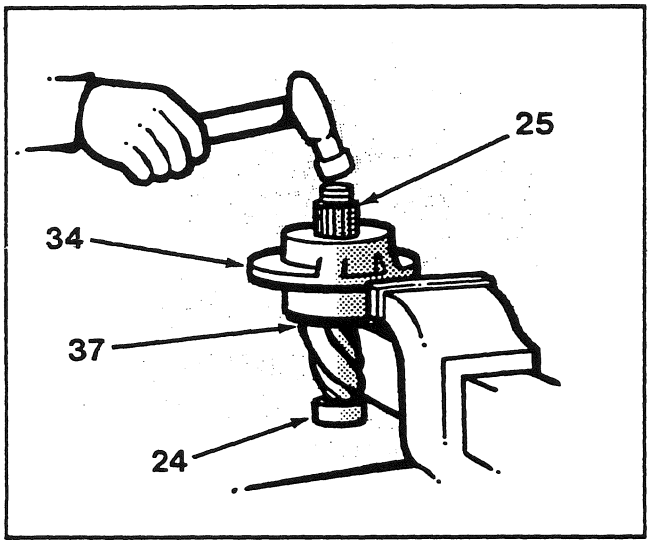


Fig. 59

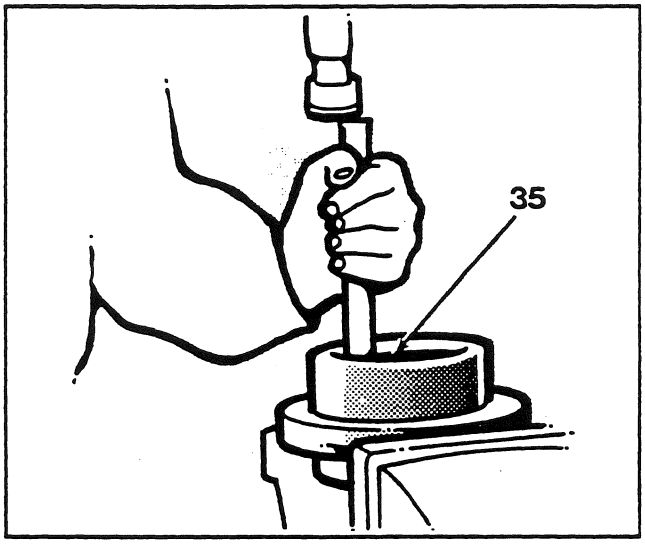


Fig. 62

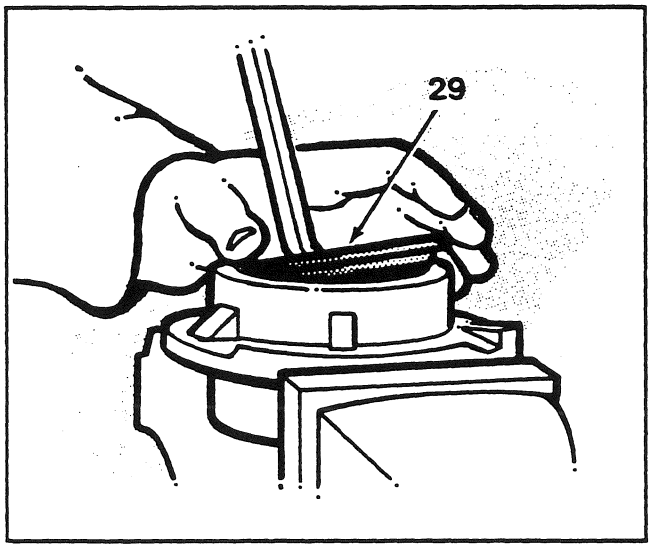


Fig. 60

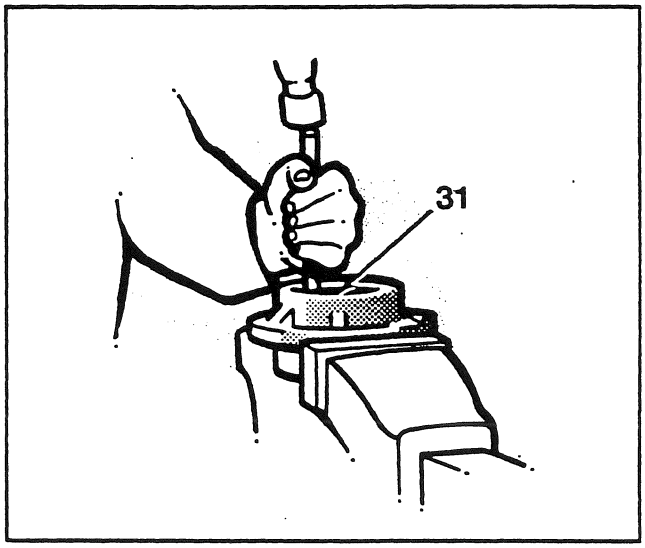
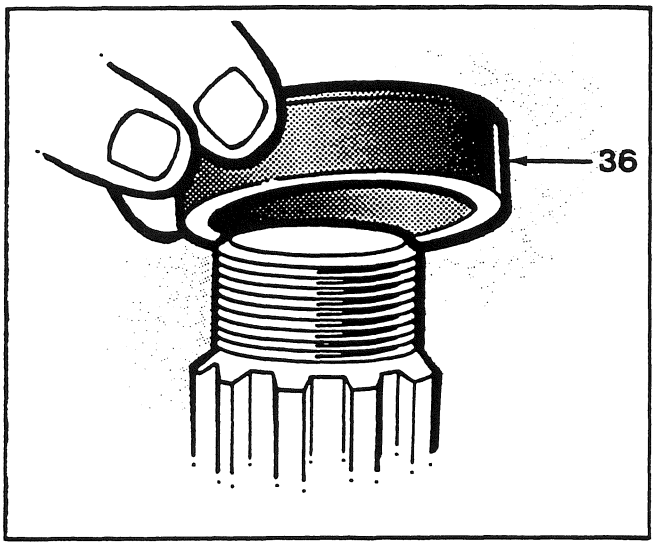


Fig. 63



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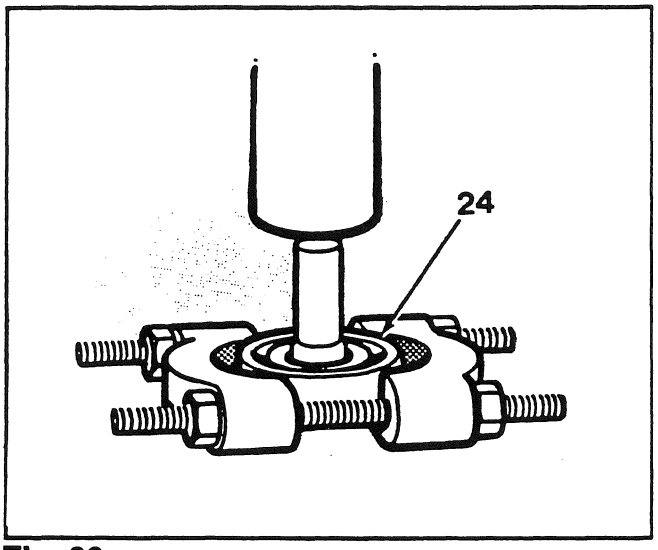


Fig. 66

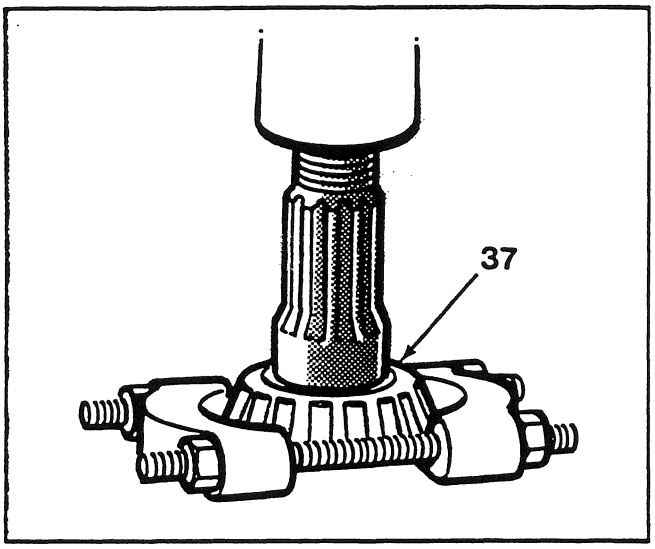


Fig. 65

DIFFERENTIAL HEAD ASSEMBLY

Disassembly (Continued)

Fig. 64
Remove the spacer (**36**).

Fig. 65
Use a split-type bearing puller to remove the inner bearing cone (**37**).

Fig. 66
Use a split-type bearing puller to remove the pilot bearing (**24**). Place all parts to one side for cleaning and inspection.

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments

Fig. 67

IMPORTANT

DURING ASSEMBLY, THE PINION AND DIFFERENTIAL BEARING PRELOAD MUST BE ADJUSTED. PERFORM THE FOLLOWING TRIAL TEST BEFORE CONTINUING THE ASSEMBLY.

Use a brass hammer to install the inner bearing cup (**35**) into the pinion cage and cup assembly (**34**).

Fig. 68

Use a brass drift to install the outer bearing cup (**31**).

NOTE

The cups must be firmly seated and recessed below the outer surfaces of the cage.

Fig. 69

Lubricate with final drive oil and install the pilot bearing (**24**) and inner bearing cone (**37**).

Fig. 70

If necessary, adjust the bearing preload by changing the spacer. A thicker spacer will decrease preload and a thinner spacer will increase preload. Lubricate with final drive oil and install the spacer (**36**).

NOTE

Spacer thickness for this differential model is 16,205 mm (0.638 in.). Test results may determine altering spacer thickness.

Fig. 71

Install the pinion cage and cup assembly (**34**) over the inner bearing cone (**37**).

Fig. 72

Lubricate with final drive oil and install the outer bearing cone (**30**).

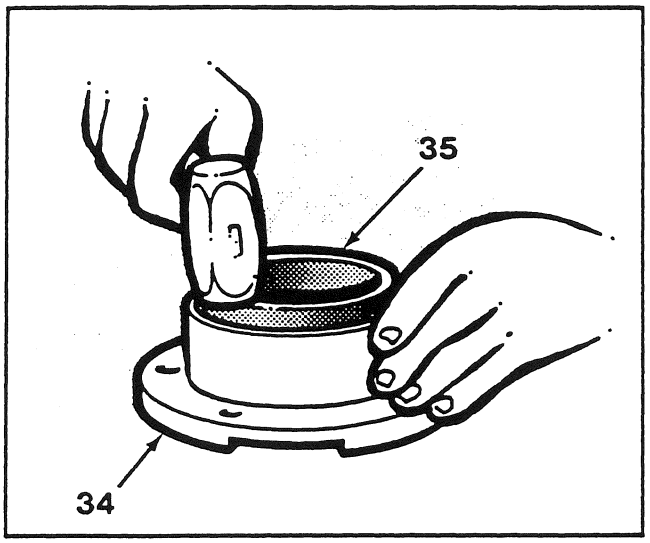


Fig. 67

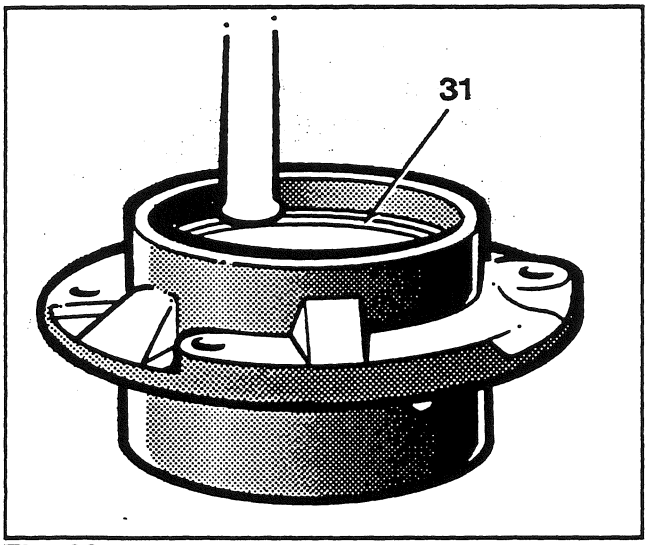


Fig. 68

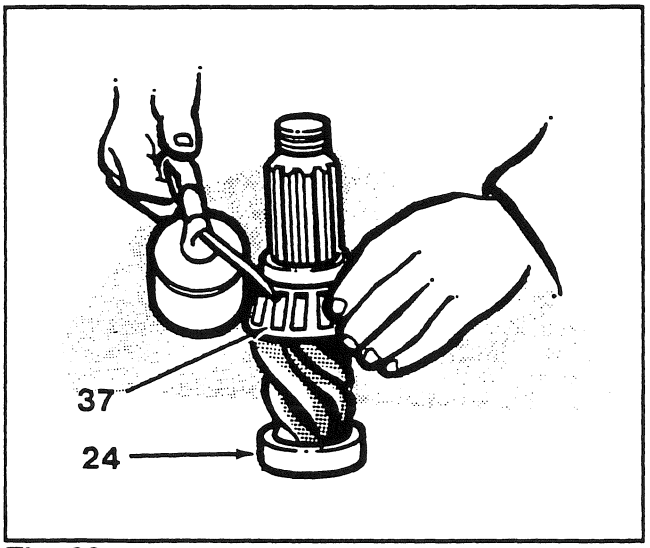


Fig. 69

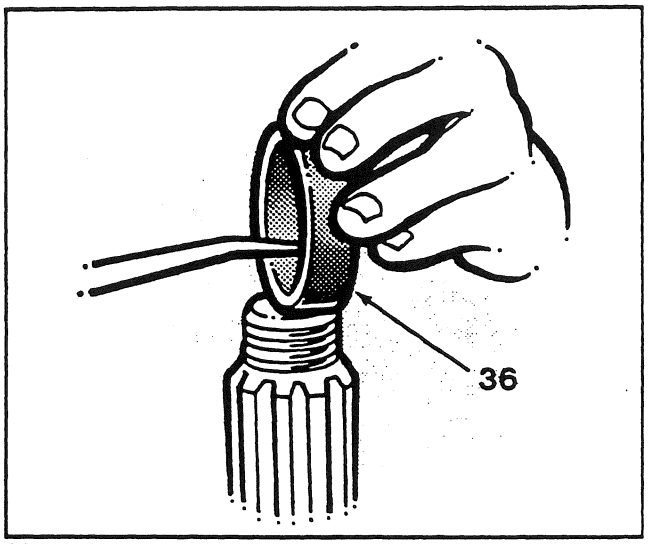


Fig. 70

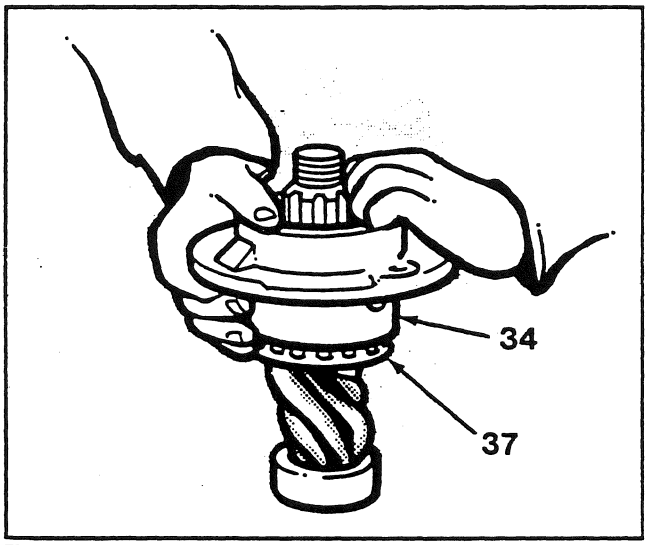


Fig. 71

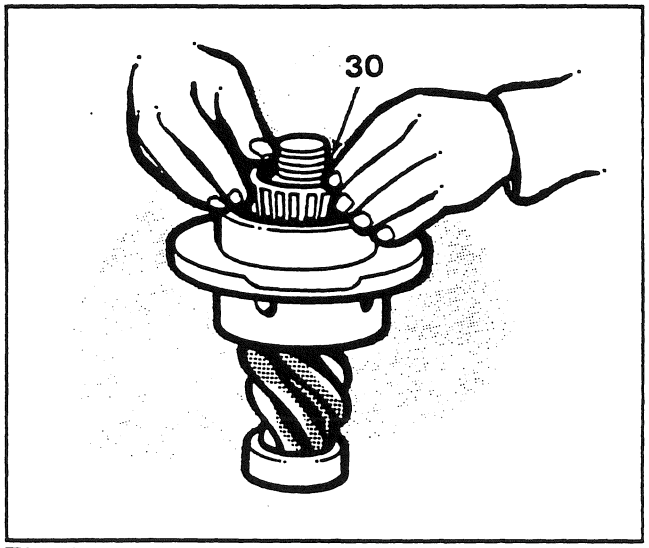


Fig. 72

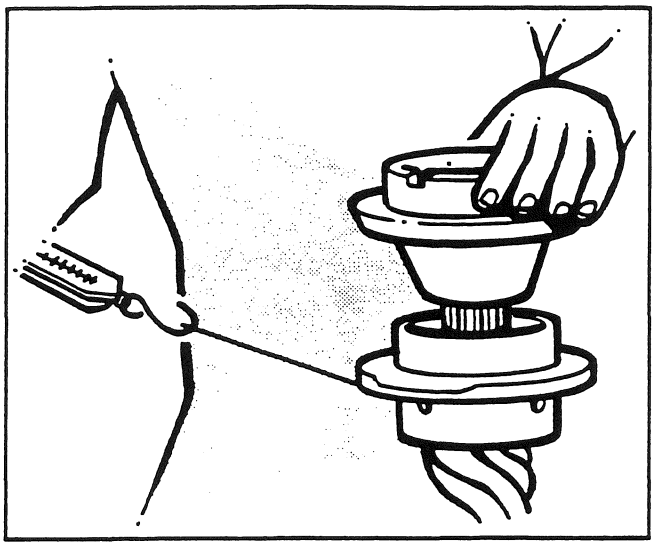
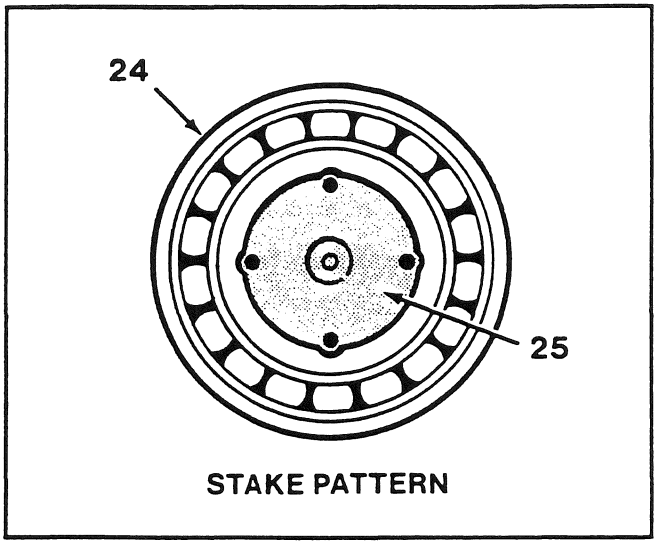


Fig. 73



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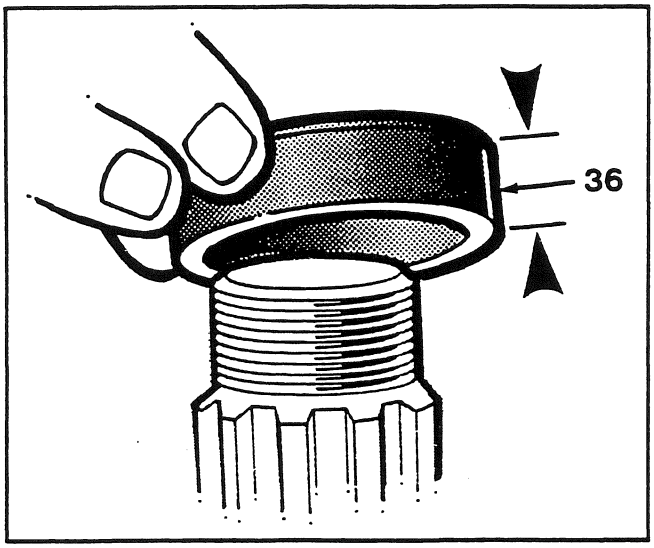

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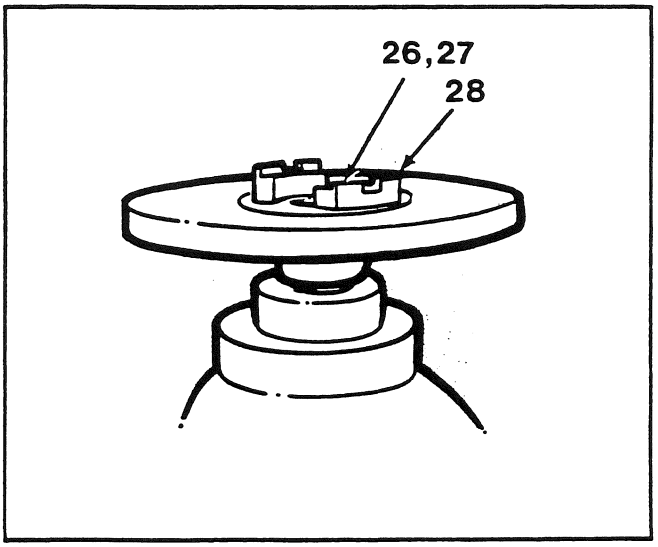

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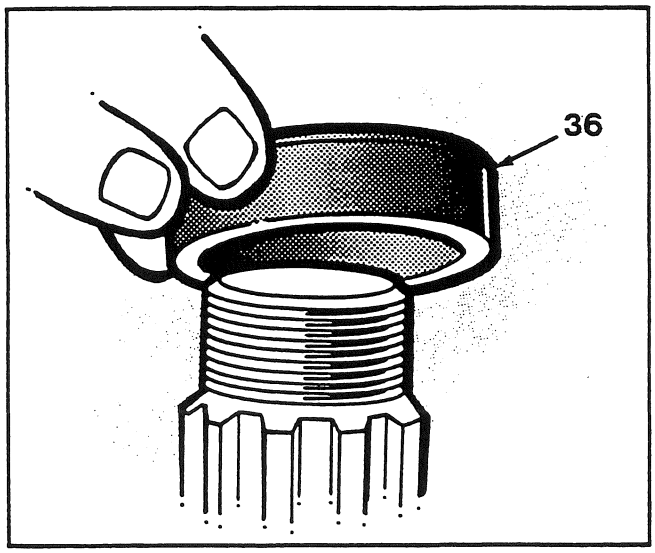

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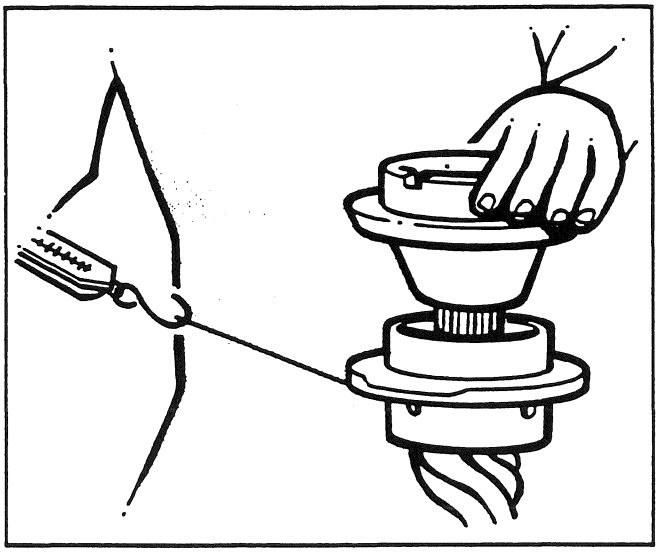


Fig. 78

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 73
Check the assembly rolling torque. Wrap soft wire around the cage, attach a spring balance and pull the wire to rotate the assembly. Correct bearing preload is a rolling torque of 1,1 to 2,3 N.m; 0,11 to 0,23 kgf.m (10 to 20 lbf-in.) or 2 to 3 kg (4 to 7 lb) on the spring scale.

Fig. 74
Note the spacer size determined by the trial test. Select a spacer (**36**) 0,0254 mm (0.001 in.) larger for installation at final assembly. The larger spacer compensates for any size increase when the bearings are pressed on the pinion shaft.

Fig. 75

CAUTION

A FINAL PRELOAD TEST MUST BE MADE FOLLOWING COMPLETE PINION ASSEMBLY.

Disassemble and re-assemble the pinion and bearing assembly. Install the spacer (**36**) selected in the previous step.

Fig. 76
Use a center punch to secure the pilot bearing (**24**) on the pinion spigot (**25**).

Fig. 77
Temporarily install the yoke (**28**), washer (**27**) and old pinion locknut (**26**). Torque-tighten the locknut.

Fig. 78

CAUTION

MAKE THE FINAL PRELOAD TEST BEFORE CONTINUING THE ASSEMBLY.

Install the yoke of the pinion assembly in a vise with soft face jaws. Check the rolling torque in the same way as the trial test. Wrap soft wire around the cage, attach a spring balance and pull the wire to rotate the assembly. Correct bearing preload is a rolling torque of 1,7 to 4,0 N.m; 0,17 to 0,4 kgf.m (15 to 35 lbf-in.) or 3 to 6 kg (6 to 13 lb) on the spring scale.

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 79

CAUTION

USE ONLY THE CORRECT SIZE SPACER. DO NOT GRIND SPACERS OR USE SHIMS. THIS CAN ACCELERATE THE LOSS OF BEARING PRE-LOAD, AND GEAR OR BEARING FAILURE.

If necessary, adjust the bearing preload by disassembling the cage and cup assembly and changing the spacer (**36**). A thicker spacer will decrease preload and a thinner spacer will increase preload. If no adjustment is necessary, remove the pinion assembly from the vise. Remove the pinion locknut, washer and yoke.

Fig. 80

Coat the outside of the oil seal and carrier (**29**) with 'Permatex No. 2', or equivalent. Lubricate the oil seal lips. Carefully install the oil seal.

Fig. 81

Install the emergency brake disc, yoke (**28**), washer (**27**) and torque-tighten a new locknut (**26**).

Fig. 82

Lightly lubricate all parts with final drive oil before assembling the differential assembly. Place the left hand differential case (**16**), with the open side facing up, on a clean workbench.

Fig. 83

Install the side gear (**49**), spline side up, into the bore of the differential case (**16**). Ensure that the side gear rotates freely in the case.

Fig. 84

CAUTION

INCORRECT INSTALLATION OF THE SPRING RETAINER CAN RESTRICT SPRING ACTION AND PREVENT PROPER DIFFERENTIAL OPERATION.

Install the spring retainer (**52**), with the side gear flange firmly seated in the cupped portion of the retainer.

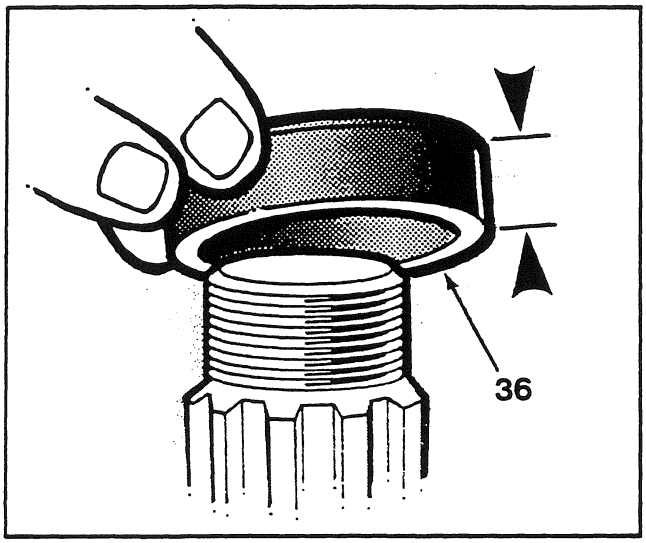
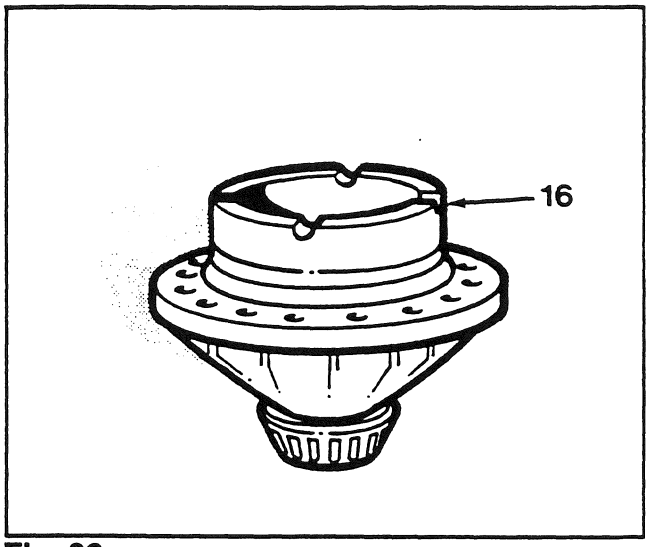


Fig. 79



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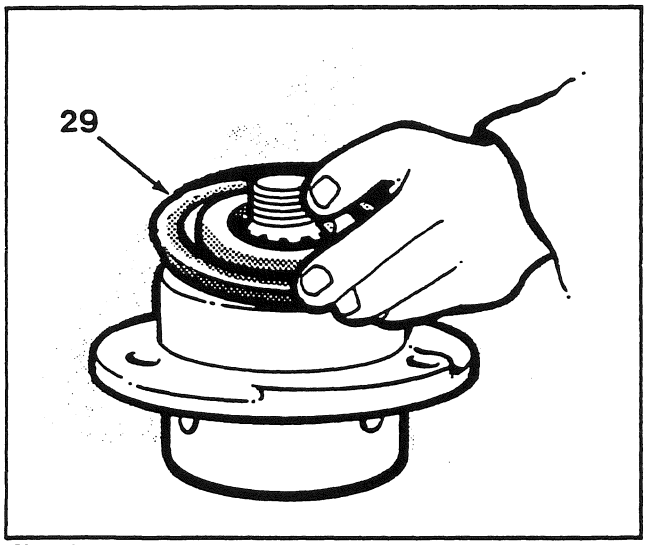


Fig. 80

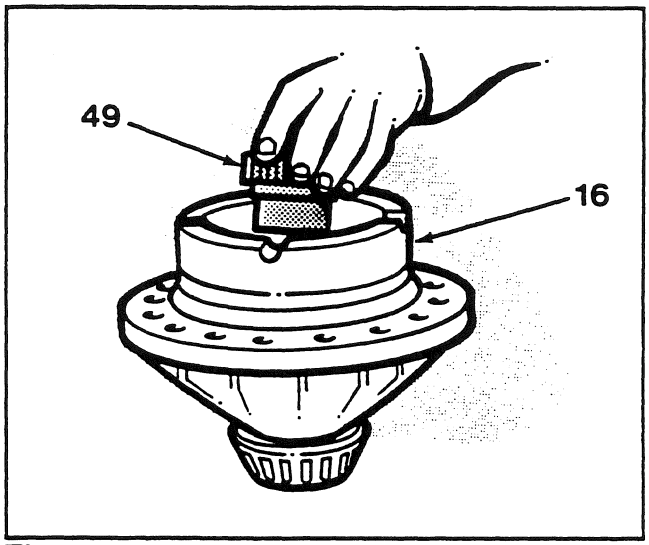


Fig. 83

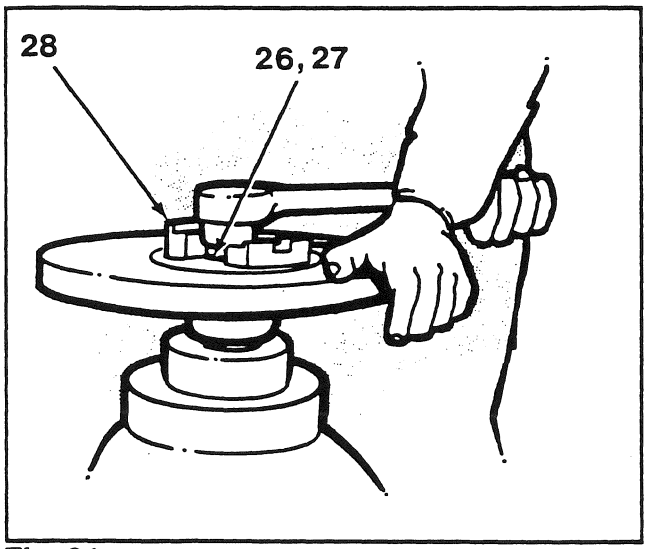
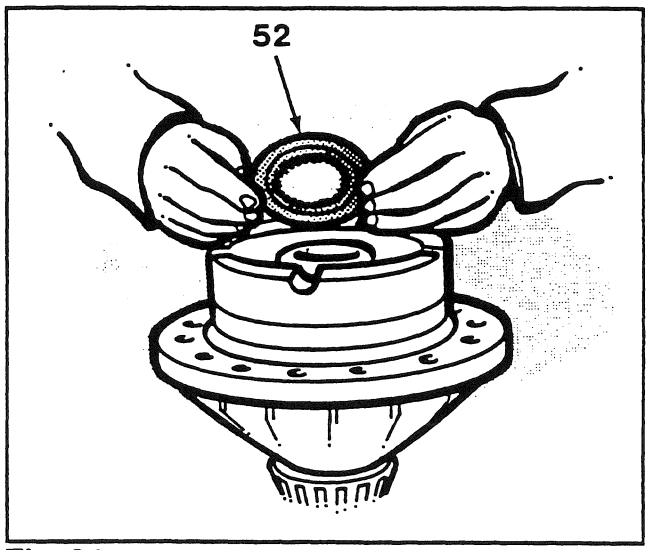


Fig. 81



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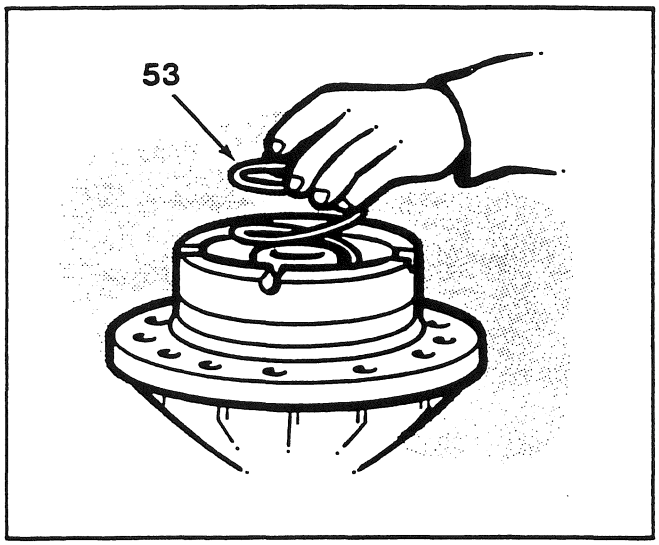

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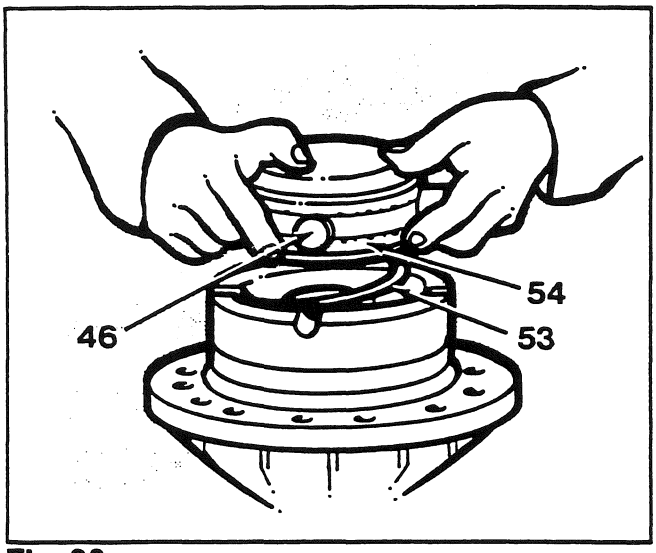

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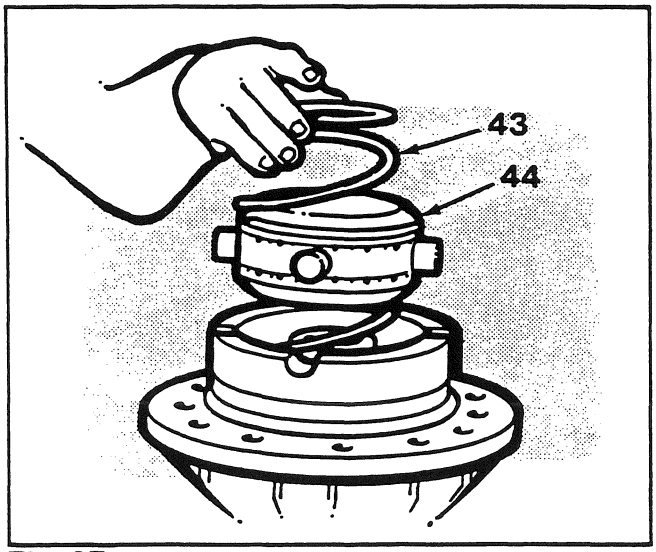

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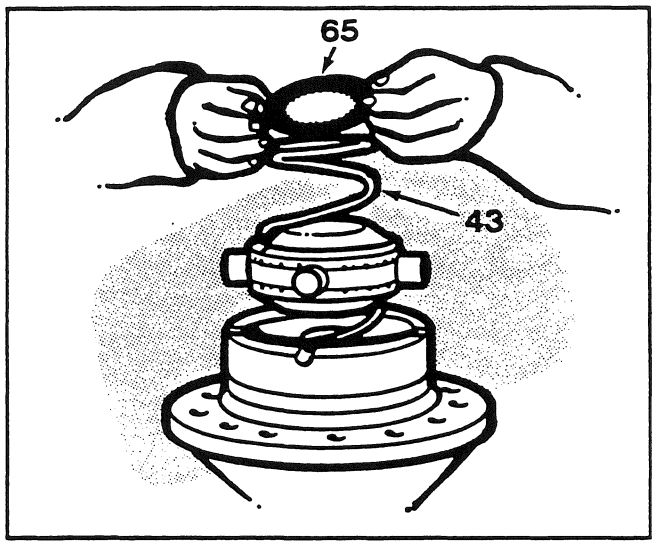

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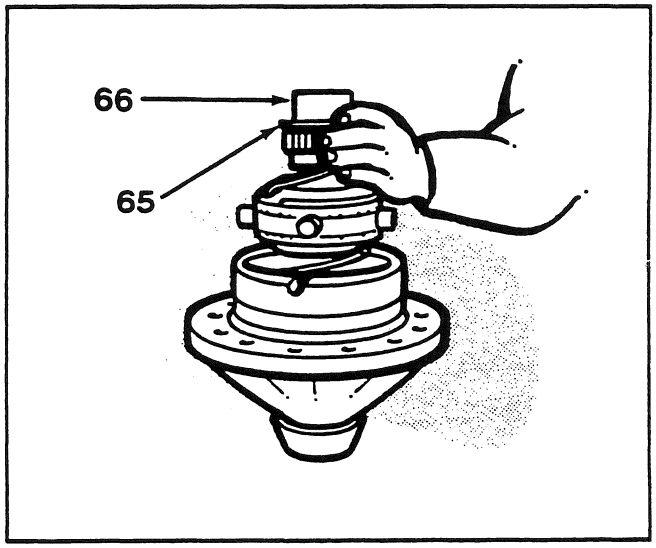


Fig. 89

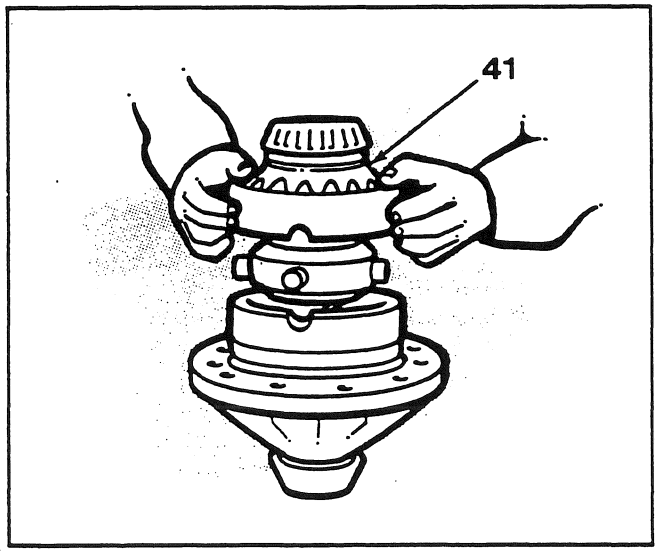


Fig. 90

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 85
Install the spring (**53**), with the smaller diameter against the spring retainer.

Fig. 86
Place the spider assembly (**46**) onto the clutch (**54**), ensuring that the gap in the holdout ring is aligned with the long tooth, or key, of the spider. Place the spider assembly over the spring (**53**).

Fig. 87
Install the second spring (**43**), with the larger diameter against the clutch (**44**).

Fig. 88
Install the spring retainer (**65**) over the spring (**43**).

Fig. 89
Install the side gear (**66**), with the flange firmly seated in the cupped portion of the spring retainer (**65**).

Fig. 90
Align the punch marks and place the right hand differential case (**41**) over the clutch and spider assembly.

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 91

WARNING

USE EXTREME CARE WHEN COMPRESSING THE DIFFERENTIAL CASE.

Compress the differential case (**41**), engage the side gear and clutch splines and the spider trunnions. Install two bolts (**68**) opposite one another to secure the case.

Fig. 92

Gradually release the pressure and install the remaining bolts (**68**). Torque-tighten the bolts.

Fig. 93

Place the ring gear (**17**) onto the flange of the left hand differential case (**16**).

Fig. 94

Secure the gear (**17**) with the special bolts (**48**) and nuts (**15**). Turn the assembly over and torque-tighten the nuts.

Fig. 95

Coat the carrier assembly flange with gasket eliminator, Champion part number **25303** or 'Loctite' 515.

Fig. 96

Install the shims (**23**), ensuring that the lubrication hole is not obstructed.

NOTE

If the original gear set is used, install the original quantity and size of shims. When installing a new gear set, use a 16,205 mm (0.638 in.) thick shim pack.

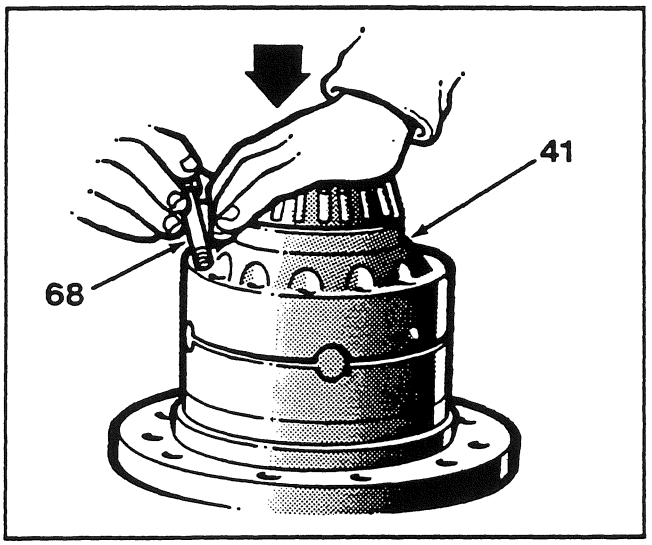


Fig. 91

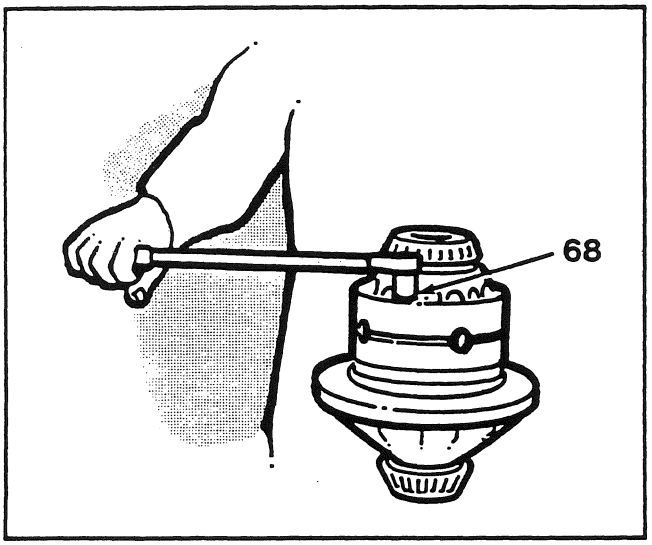
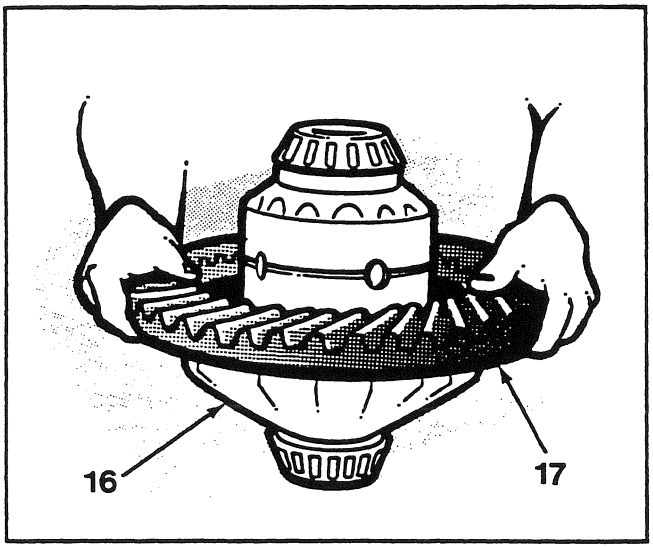


Fig. 92



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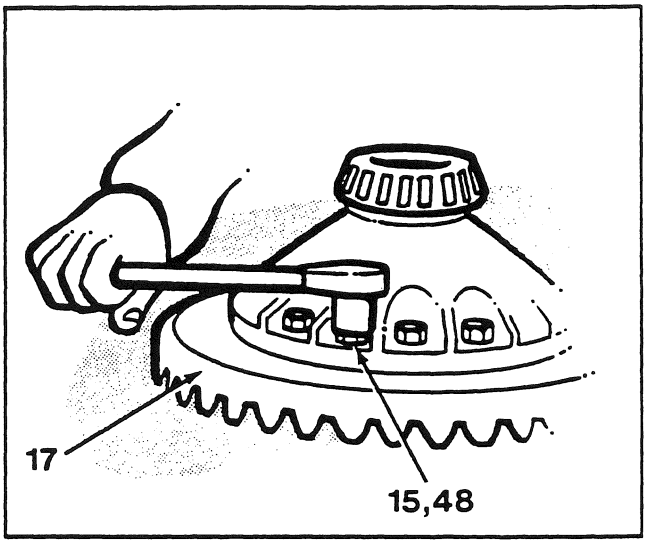

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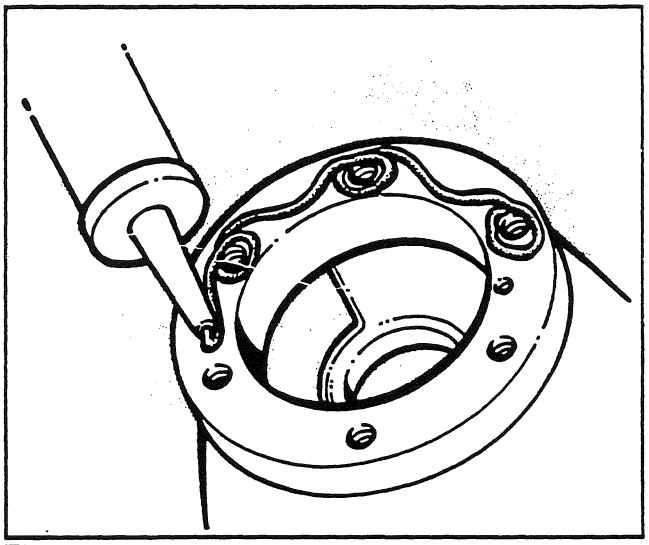
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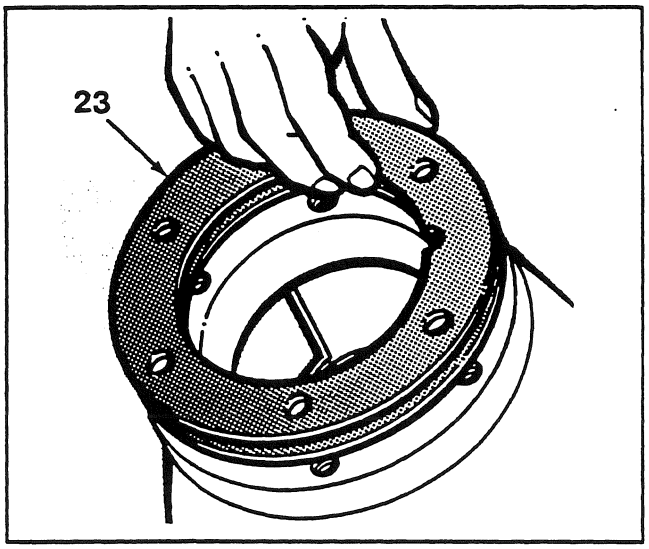

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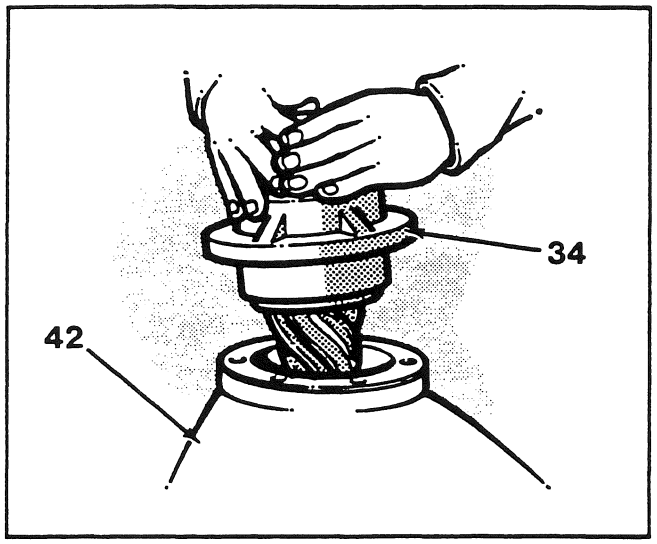

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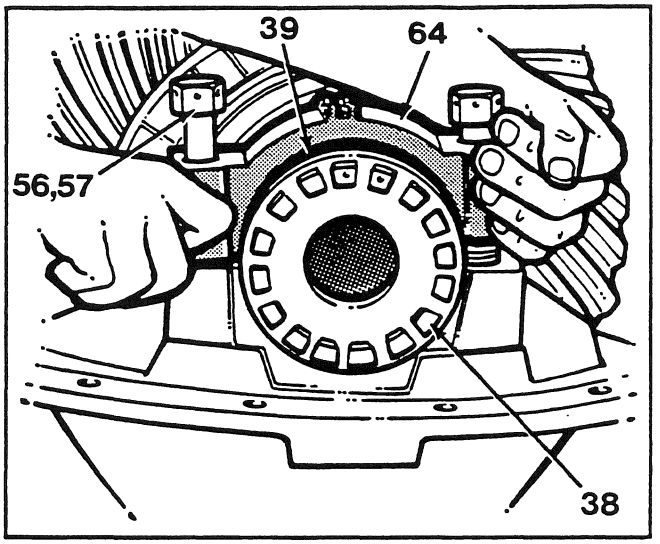


Fig. 100

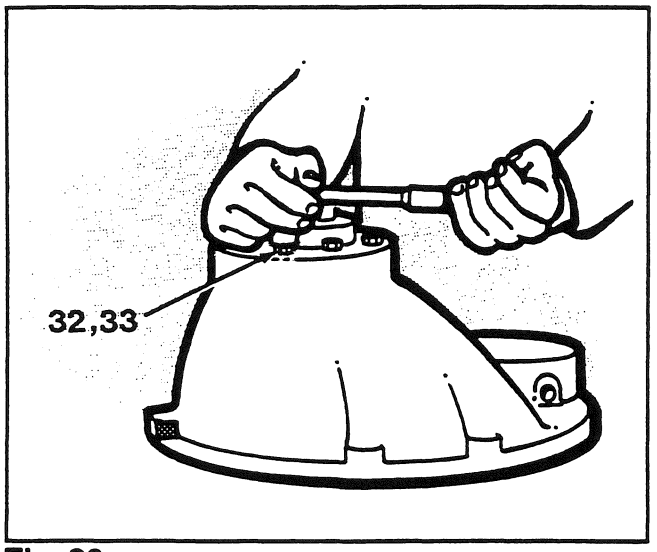


Fig. 98

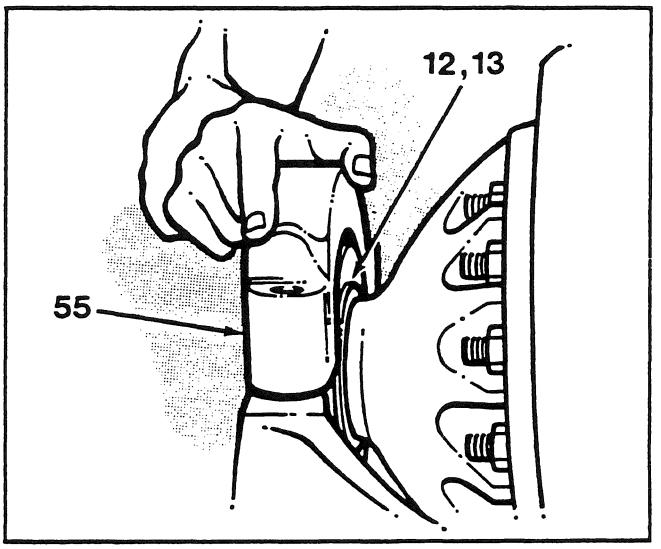


Fig. 101

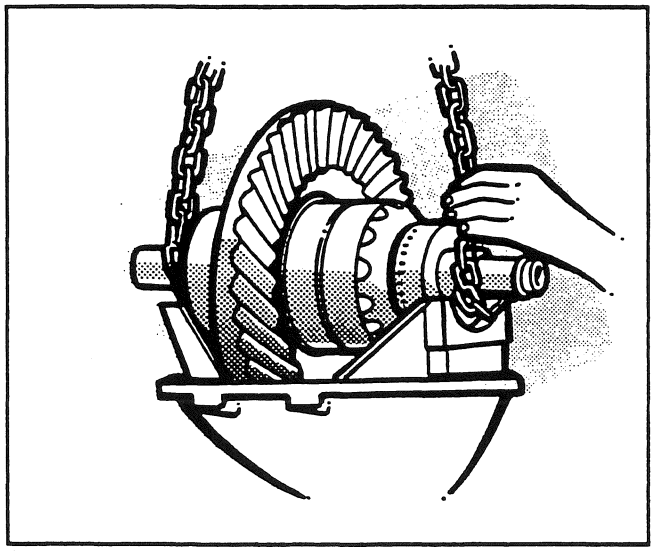


Fig. 99

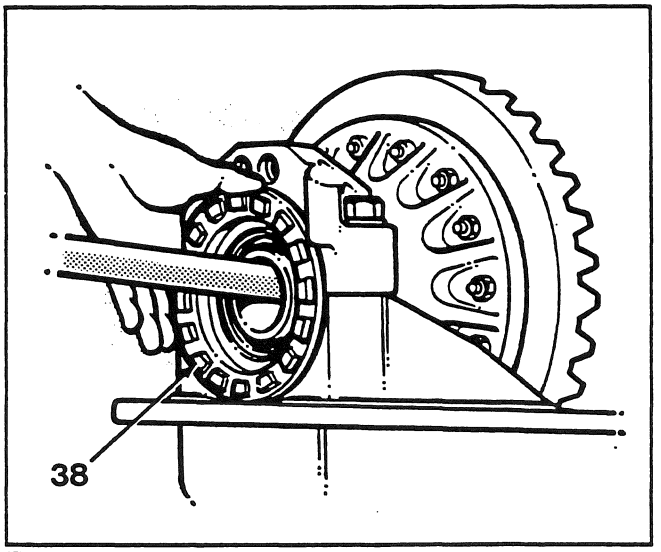


Fig. 102

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 97
Install the pinion assembly onto the shims and carrier, ensuring that the lubrication holes in the carrier (**42**) and cage (**34**) are aligned.

Fig. 98
Coat the threads of the bolts (**32**) with 'Loctite' RC 60, or equivalent. Install the bolts and lockwashers (**33**). Torque-tighten the bolts.

Fig. 99
Support the carrier and pinion assembly with the open side at the top. Using a safe lifting device, lower the differential assembly and install into the carrier.

Fig. 100
Lubricate with final drive oil and install the right hand bearing cup (**39**), bearing adjuster (**38**) and bearing cap (**64**). Install the two bolts (**57**) and washers (**56**) retaining the bearing cap. Secure the bolts to finger-tightness only. Turn the adjuster until the first thread is exposed.

Fig. 101
Install the left hand bearing cup (**13**) into the bearing adjuster (**12**). Lubricate with final drive oil the bearing cup and adjuster threads. Install the bearing cap (**55**), bolts (**57**) and washers (**56**). Secure the bolts to finger-tightness only.

Fig. 102
Install a length of metal rod through the differential assembly bore. Place the bearing adjuster and cup assembly over the metal rod. Raise and lower the differential assembly while threading the adjuster (**38**) into position.

NOTE

The carrier assembly is now ready for bearing preload, ring gear backlash and gear tooth contact adjustments.

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 103

Check that the first thread of the right hand bearing adjuster is visible. Tighten the left hand bearing adjuster until there is no backlash between the pinion and ring gear.

Measure the ring gear backlash with a dial test indicator. If the original gear set is used, adjust to the backlash specification recorded before disassembly.

NOTE

To test absence of backlash, face in the direction of the ring gear teeth. Push on the gear while gently rocking the gear from side to side. There should be no free movement.

Loosen the left hand bearing adjuster by a distance of one notch.

Tighten the right hand bearing adjuster until it abuts against the bearing cup.

Tighten the right hand bearing adjuster until it abuts against the bearing cup. This is indicated by increased resistance to adjuster movement.

Rotate the ring gear and check for points where binding occurs. At these points, loosen and retighten the left hand bearing adjuster. Make all further adjustments from the point of tightest mesh.

Continue tightening the adjuster by a distance of two or three notches. Install the dial test indicator and check the backlash measurement.

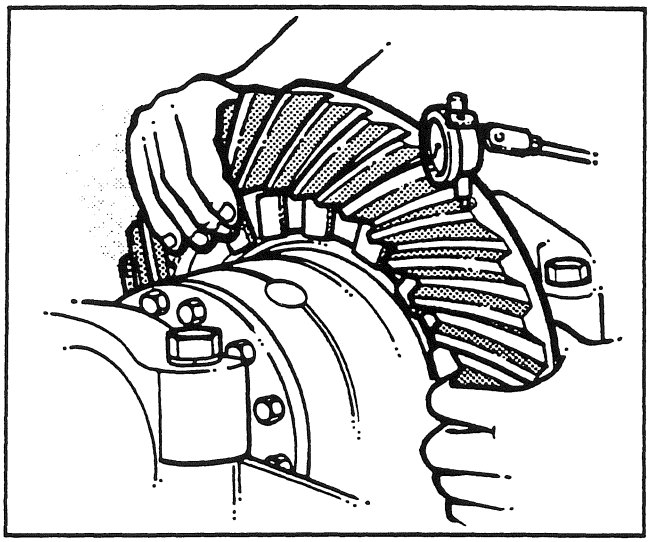


Fig. 103

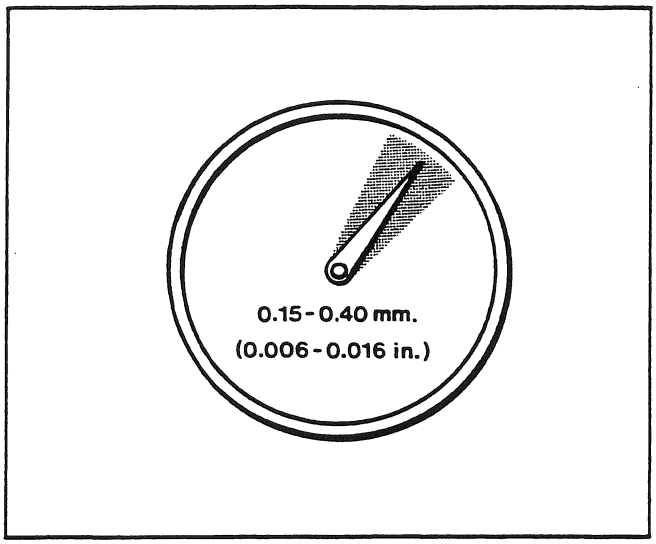
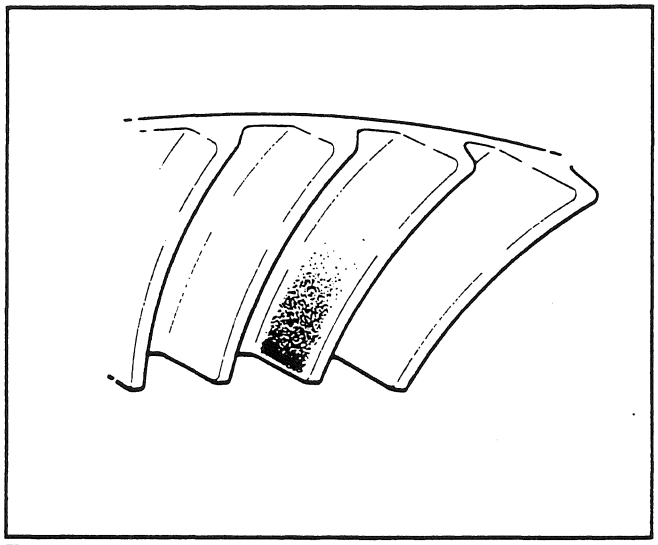


Fig. 104



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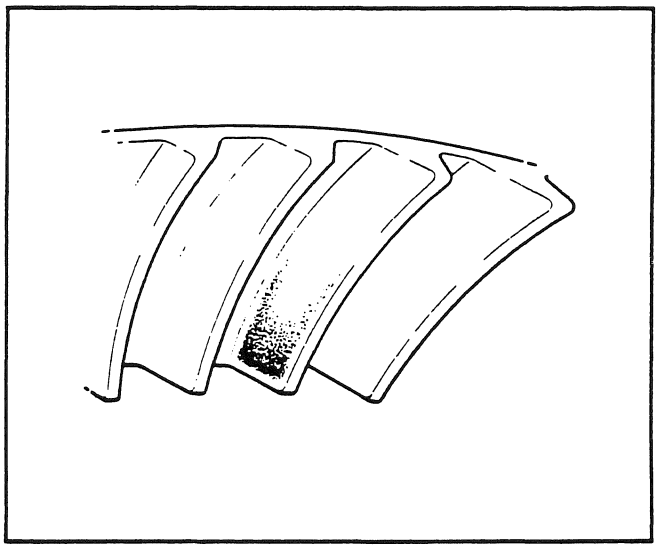

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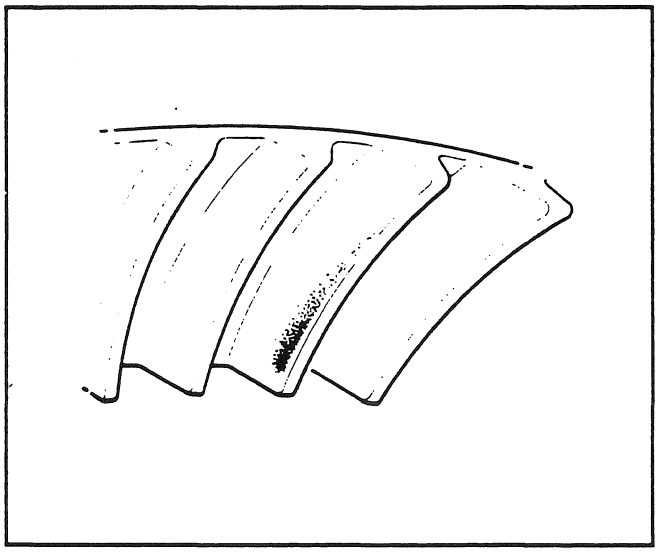


Fig. 107

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 104
The backlash specification should be between 0,15 mm and 0,40 mm (0.006 in. and 0.016 in.). If necessary, adjust the backlash setting as follows before proceeding with any further adjustments.

To increase backlash: Loosen the left hand bearing adjuster one notch at a time. Tighten the right hand adjuster until it abuts against the bearing cup. Recheck the backlash.

To reduce backlash: Loosen the right hand bearing adjuster one notch at a time. Tighten the left hand adjuster until there is resistance. Continue tightening the adjuster by a distance of two or three notches. Recheck the backlash.

Fig. 105
Apply mechanic's blue compound onto the ring gear teeth and inspect the tooth contact pattern. This illustration shows a contact pattern for a new, correctly adjusted gear set.

Fig. 106
This illustration shows a contact pattern for an original, correctly adjusted gear set. If the pattern shows incorrect tooth depth contact, change the pinion position by altering the number of shims (23). An original gear set should show a proper contact pattern with the same shims removed at disassembly.

Fig. 107
If the pattern is similar to that illustrated, the pinion is not close enough to the ring gear. Remove shims to move the pinion inward. Re-adjust the backlash. Re-check the tooth contact pattern.

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 108
If the pattern is similar to that illustrated, the pinion is close to the ring gear. Add shims to move the pinion outward. Re-adjust the backlash. Re-check the tooth contact pattern.

Fig. 109
If the pattern is similar to that illustrated, there is insufficient backlash. Loosen the left hand bearing adjuster one notch and tighten the right hand bearing adjuster one notch. Re-check the backlash. Repeat this procedure until the backlash is between 0,15 mm and 0,40 mm (0.006 in. and 0.016 in.).

Fig. 110
If the pattern is similar to that illustrated, there is excessive backlash. Loosen the right hand bearing adjuster one notch and tighten the left hand bearing adjuster one notch. Re-check the backlash. Repeat this procedure until the backlash is between 0,15 mm and 0,40 mm (0.006 in. and 0.016 in.).

Fig. 111
Following the gear set adjustment, align the bearing adjusters and adjuster locks. Torque-tighten the bearing cap bolts (**57**) and secure with lockwire.

Fig. 112
Install the left hand adjuster lock (**51**).

Fig. 113
Retain the adjuster lock with the bolts (**50**). Torque-tighten the bolts and secure with lockwire.

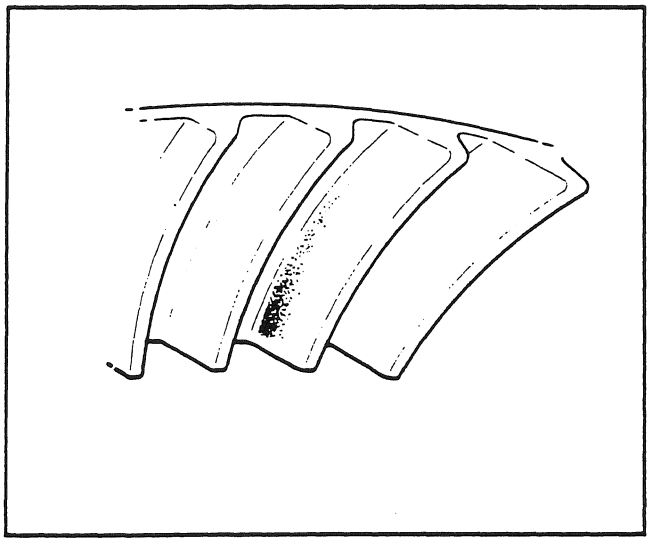


Fig. 108

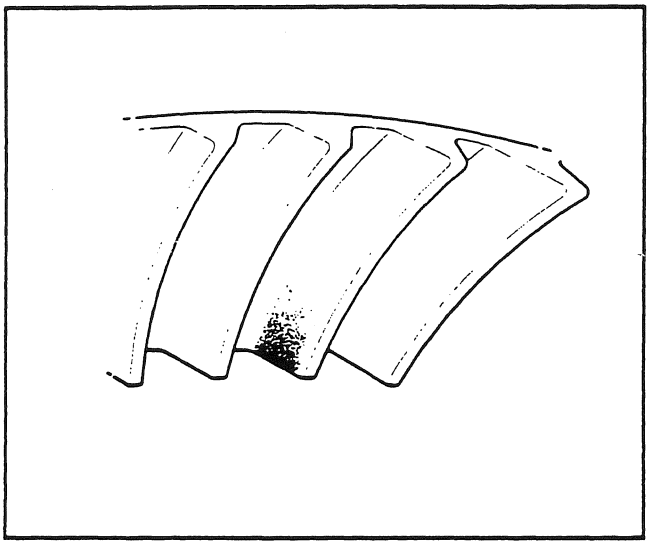


Fig. 109

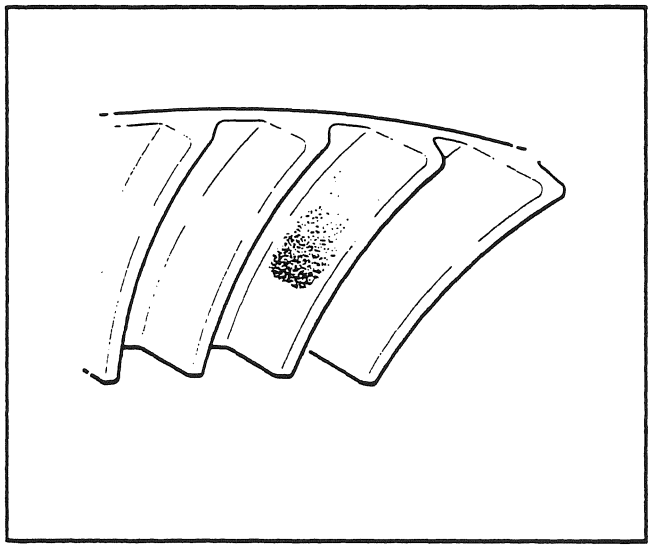


Fig. 110

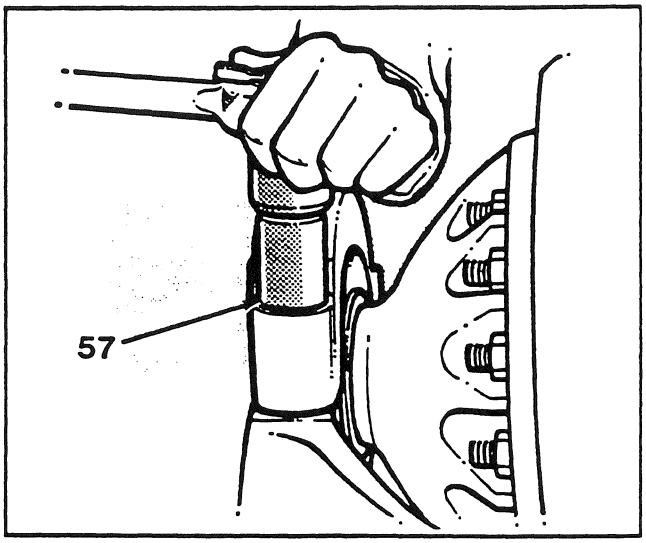


Fig. 111

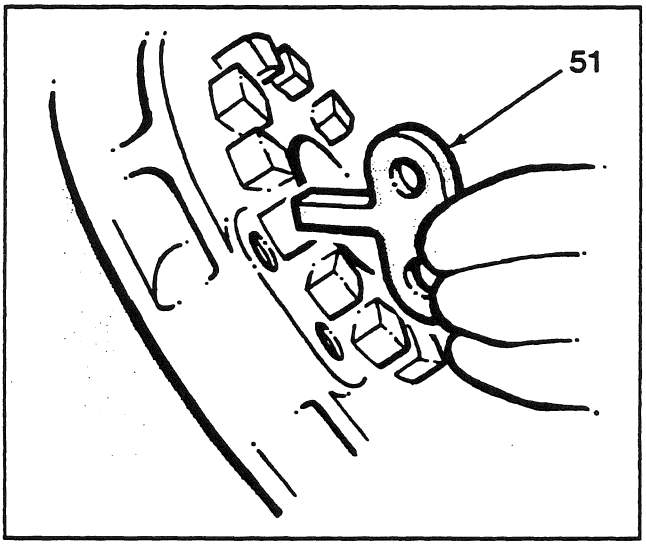


Fig. 112

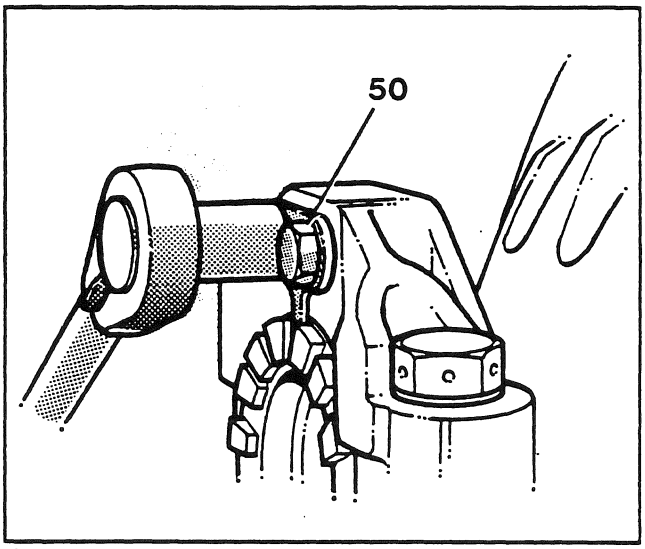
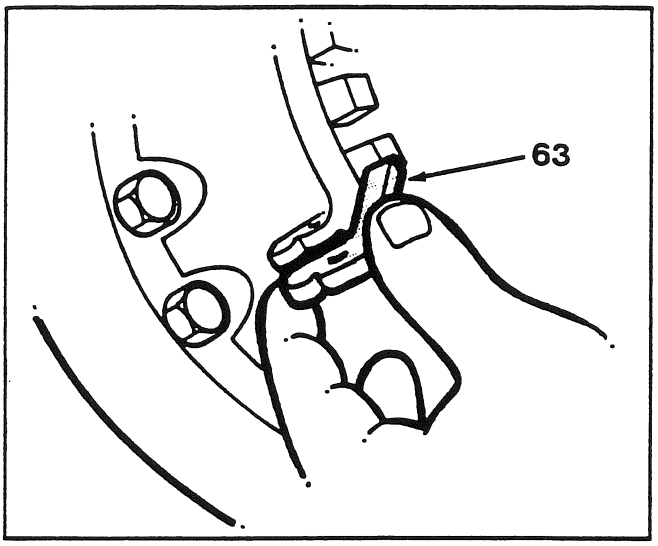


Fig. 113



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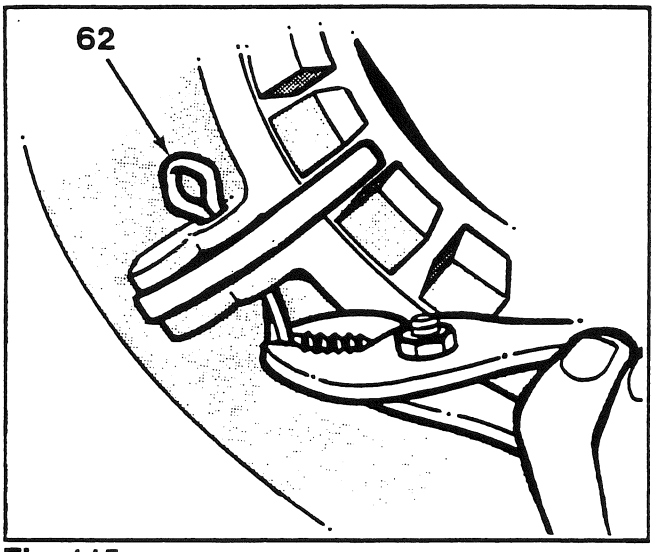


Fig. 115

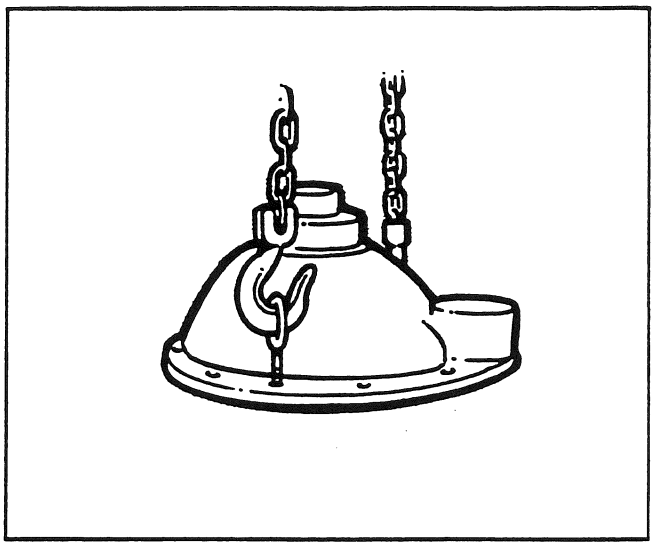


Fig. 116

DIFFERENTIAL HEAD ASSEMBLY

Assembly and Adjustments (Continued)

Fig. 114
Install the right hand adjuster lock (**63**).

Fig. 115
Secure the adjuster lock with a new cotter pin (**62**).

Fig. 116
The carrier assembly is now ready for installation to the axle housing. Install two lifting eyes into the yoke.

Assembly and Installation

Fig. 117
Coat the axle housing opening with gasket eliminator, Champion part number **25303** or 'Loctite' 515.

Fig. 118
Using a safe lifting device, lower the carrier assembly onto the axle housing (**11**).

Fig. 119
Coat the threads of the nuts (**20** and **22**) with locking compound, Champion part number **40945** or 'Loctite' 242. Install the nuts, lockwashers (**19** and **21**) and conical washers (**18**); then torque-tighten.

Fig. 120
Coat the threads of the bolts (**58**) with locking compound, Champion part number **40945** or 'Loctite' 242. Install the bolts and lockwashers (**59**). Torque-tighten the bolts.

Fig. 121
Install the brake disc and input yoke assembly (**28**). Secure it with a new locknut. Torque tighten the locknut.

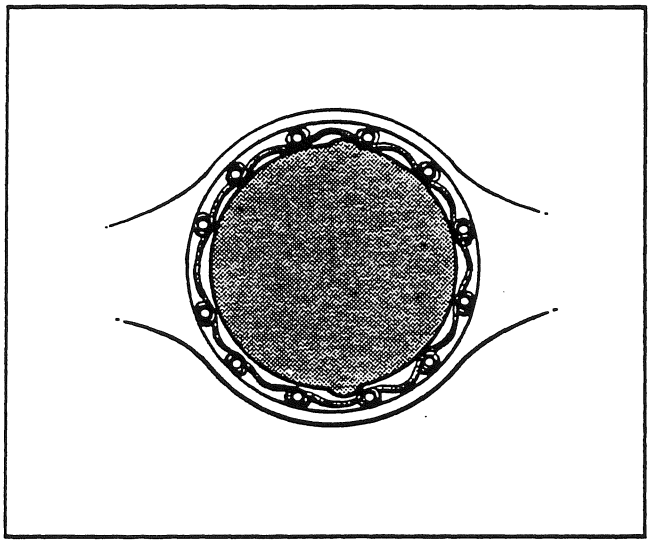


Fig. 117

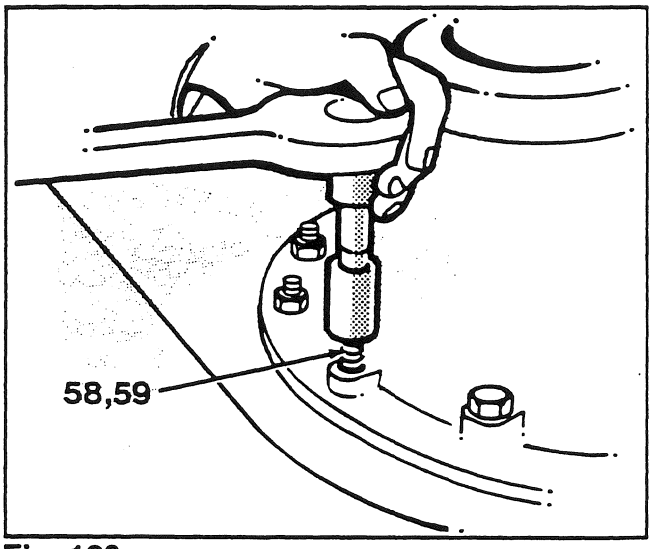
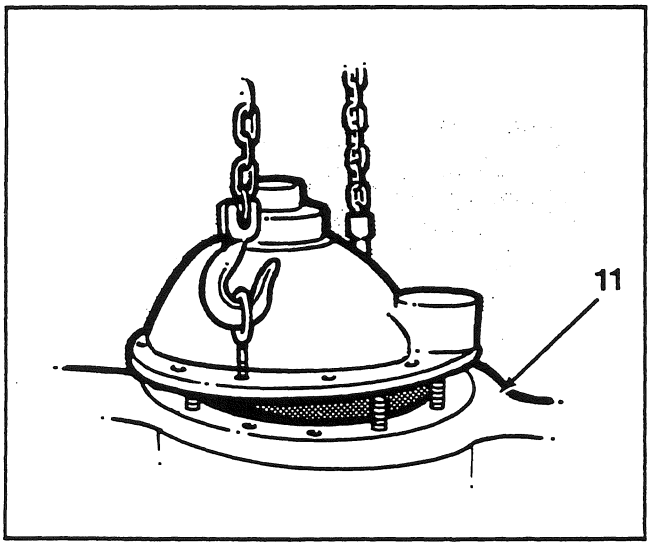


Fig. 120



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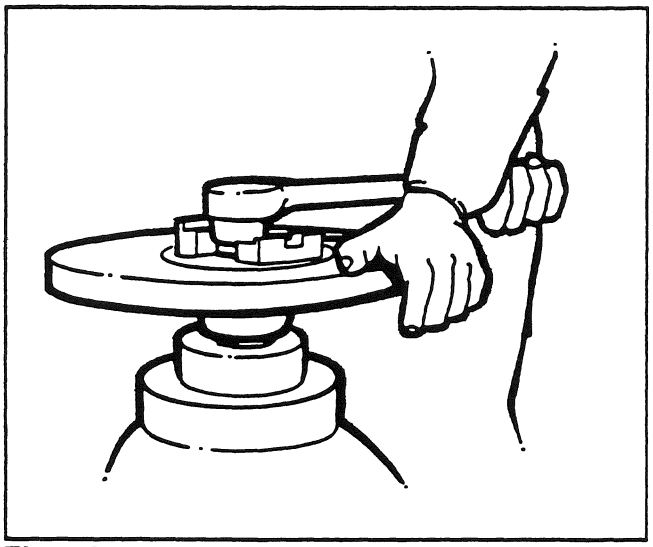

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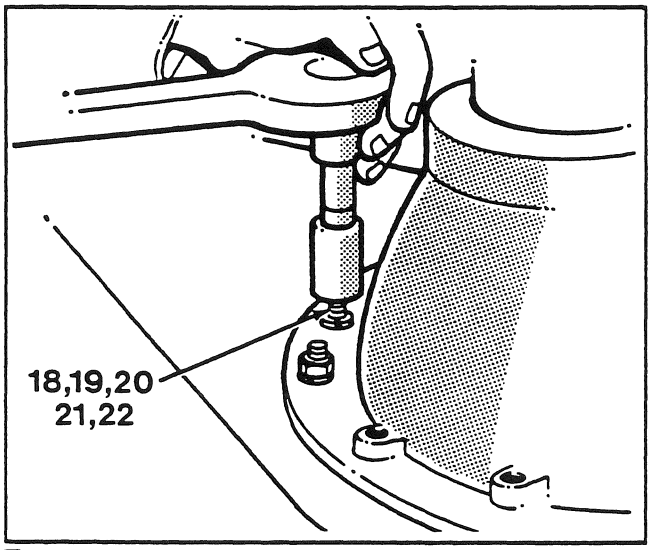

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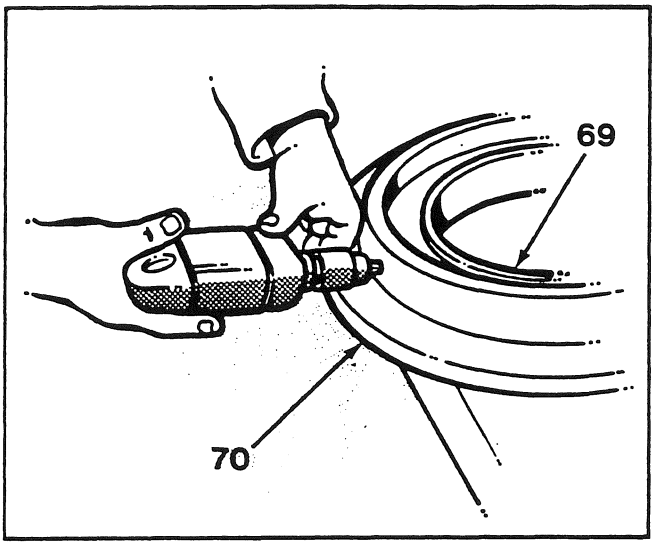

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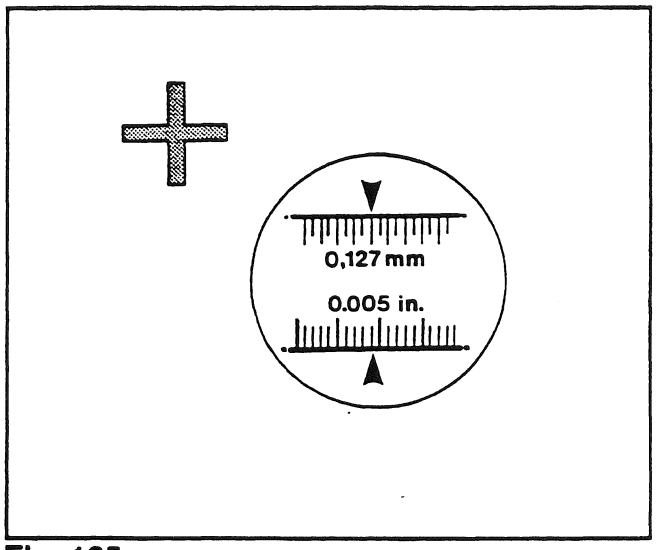

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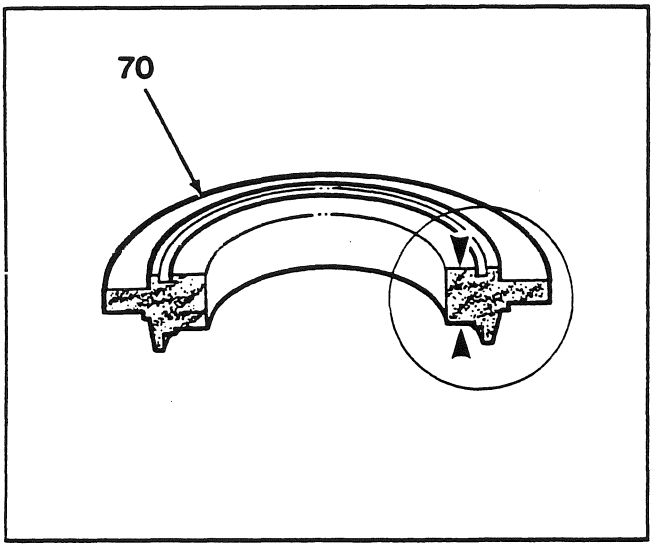
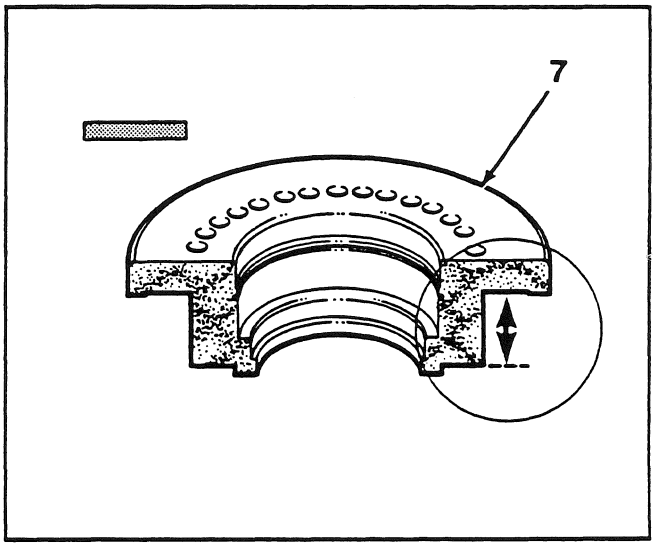


Fig. 123



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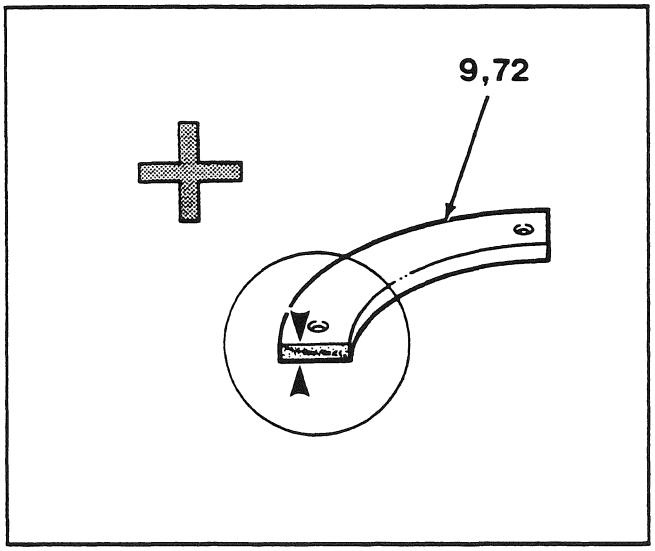


Fig. 124

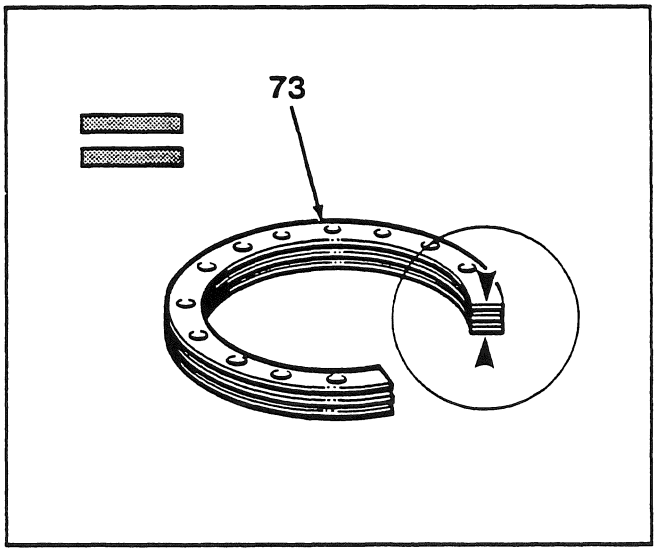


Fig. 127

Assembly and Installation (Continued)

Fig. 122
If the bushing (**69**) has been removed from the pivot ring (**70**), use a press and sleeve to install a new bushing. Ensure that the edge of the bushing is flush with the surface of the pivot ring. Remove the grease fitting (**71**) from the pivot ring. Use the lubrication passage as a guide and drill a 4,8 mm (3/16 in.) hole through the bushing into the grease groove. Remove all burrs from the groove and hole using fine grade emery paper. Install the grease fitting. If new thrust plate segments (**9** and **72**) are installed, remove all burrs using a fine grinding stone.

Fig. 123
Before installing the complete pivot ring sub-assembly, use precision instruments to measure the thickness between the two machined surfaces of the pivot ring (**70**) in four places.

Fig. 124
Measure the thickness of both thrust plates (**9** and **72**).

Fig. 125
Add the dimensions; plus the constant clearance measurement of 0,127 mm (0.005 in.).

Fig. 126
Measure the depth from the machined flange to the shim bearing surface of the pivot ring retainer (**7**) in four places.

Fig. 127
Add a sufficient number of 0,127 mm (0.005 in.) shims (**73**) to exceed the final dimension in Fig. 124 by 0,025 mm to 0,152 mm (0.001 in. to 0.006 in.).

Assembly and Installation (Continued)

Fig. 128
Place the thrust plate segments (**72**) into position on the axle housing (**11**). Coat the threads of the bolts (**10**) with locking compound, Champion part number **40945** or 'Loctite' 242 and secure the thrust plate segments.

Fig. 129
Lubricate and install a new "Uniring" seal (**74**). Coat the "Uniring" seal and thrust plate segments with grease.

Fig. 130

CAUTION

ENSURE THAT THE "UNIRING" SEAL IS NOT DAMAGED OR DISPLACED WHEN THE PIVOT RING AND PIVOT RING RETAINER ARE INSTALLED.

Turn the axle housing over until the flange is pointing up. Coat the inside machined surface of the pivot ring assembly (**69**),(**70**) with grease. Install the pivot ring and place squarely over the "Uniring" seal (**74**).

Fig. 131
Ensure that the pivot ring grease fitting (**71**) is correctly positioned.

Fig. 132
Coat the pivot ring hub with grease. Lubricate and install a new O ring (**8**).

Fig. 133
Install the shims (**73**) previously calculated. Place the thrust plate segments (**9**) into position on the pivot ring retainer (**7**). Coat the threads of the bolts (**10**) with locking compound, Champion part number **40945** or 'Loctite' 242 and secure the thrust plate segments.

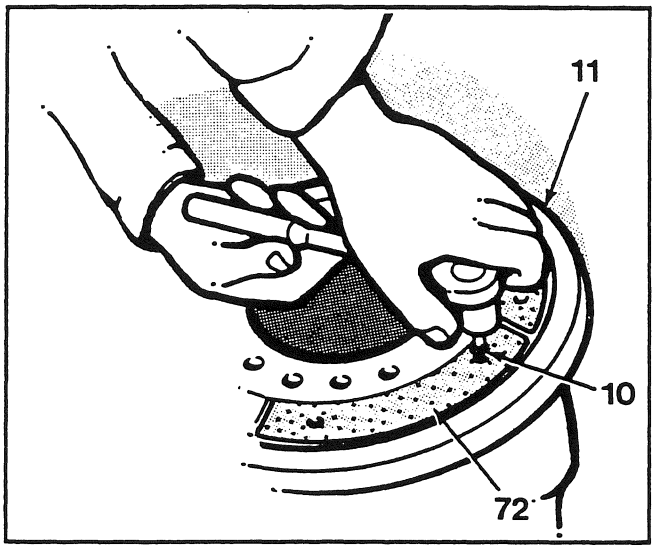


Fig. 128

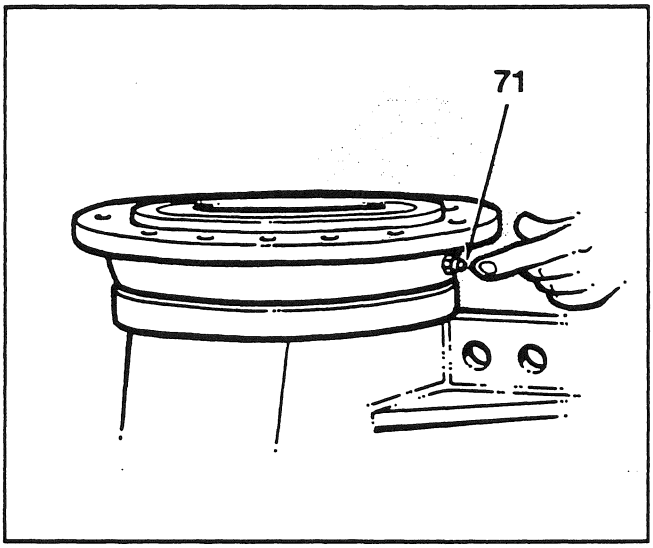


Fig. 131

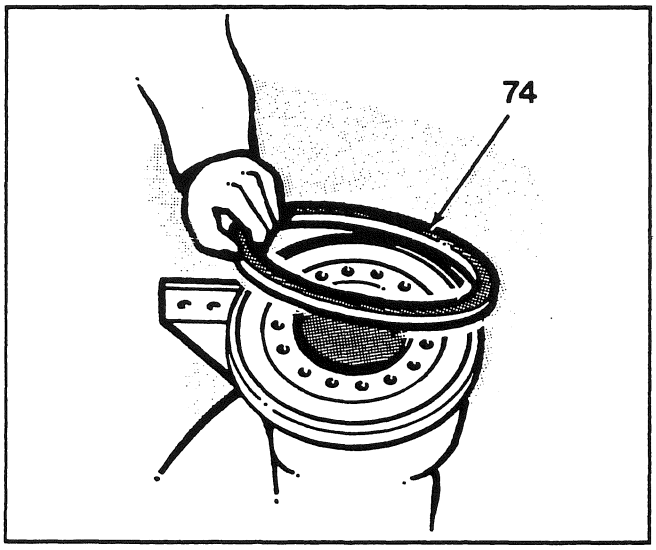


Fig. 129

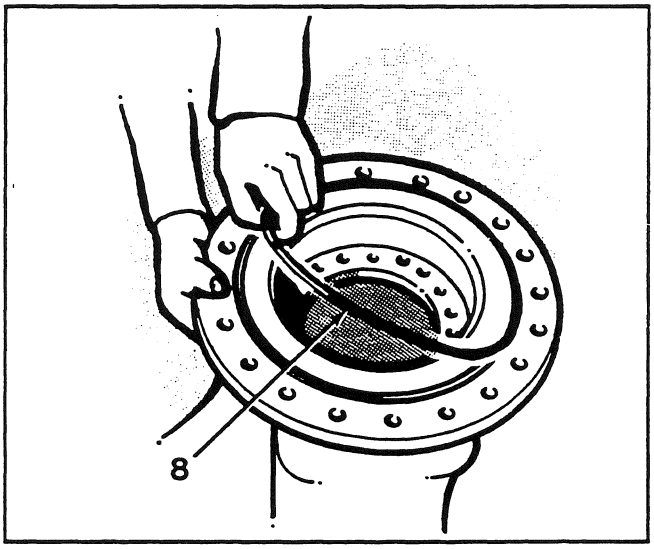


Fig. 132

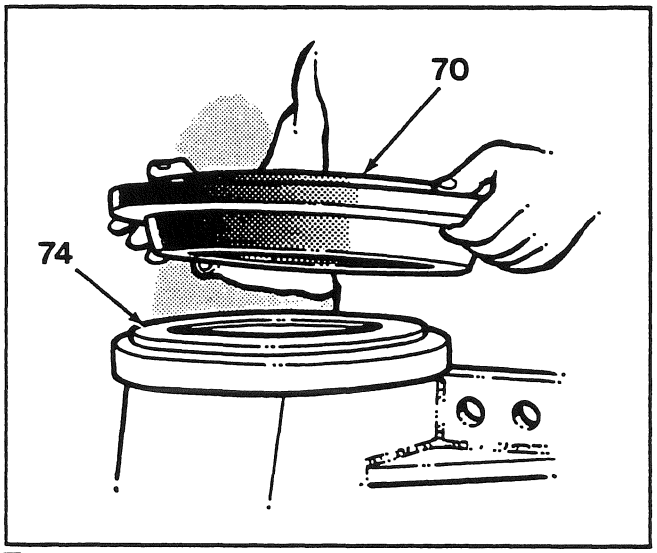
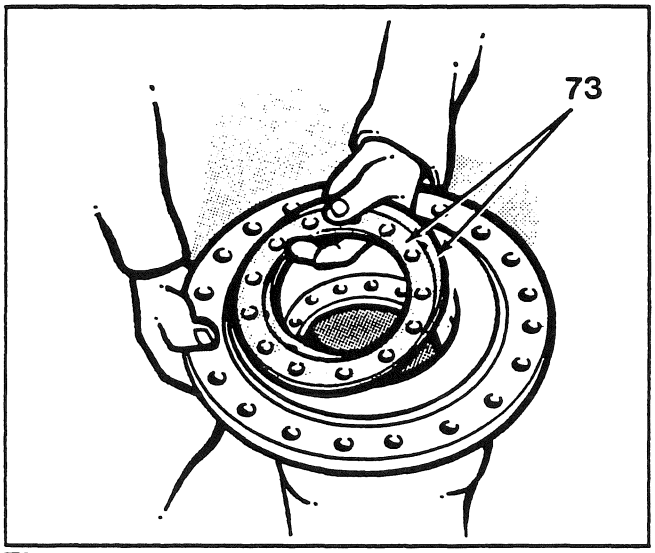


Fig. 130



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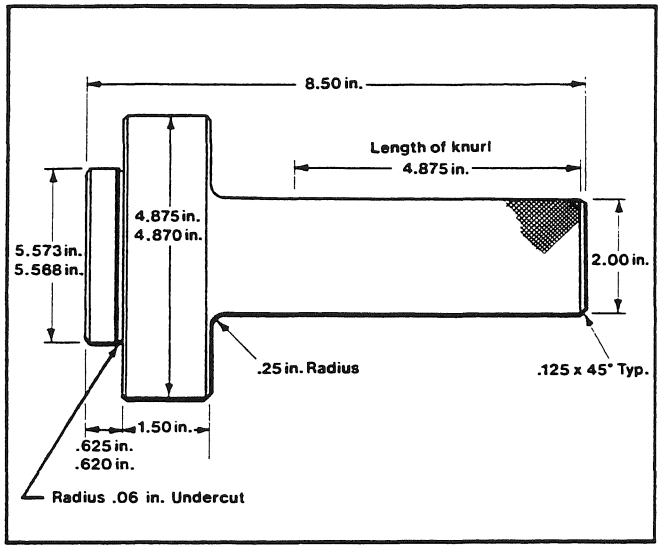

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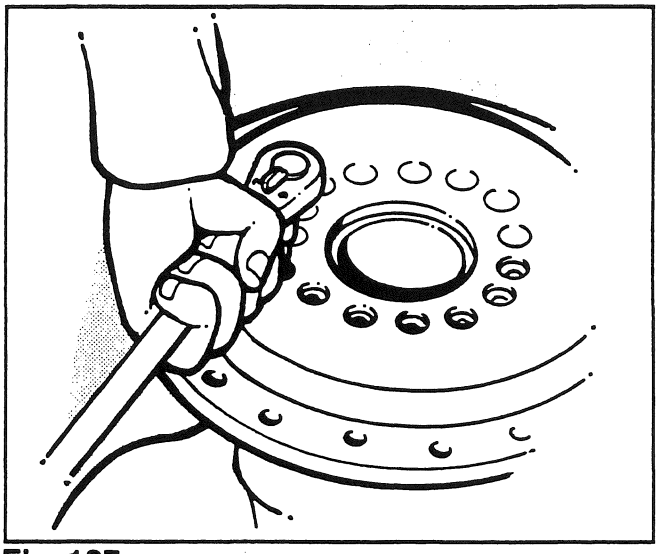

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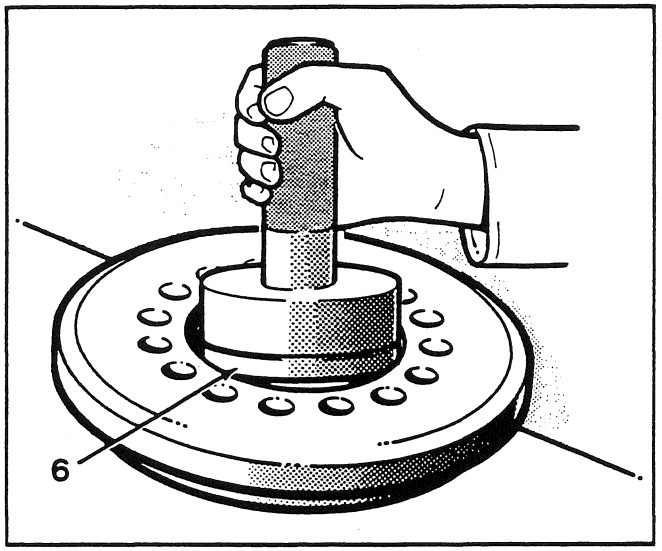

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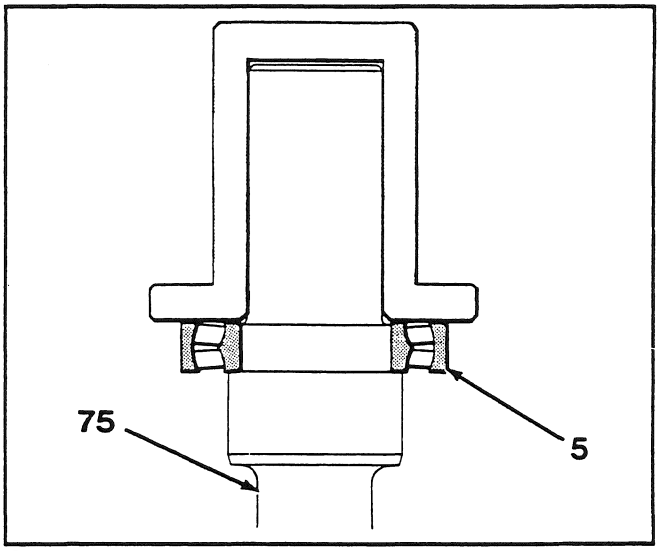

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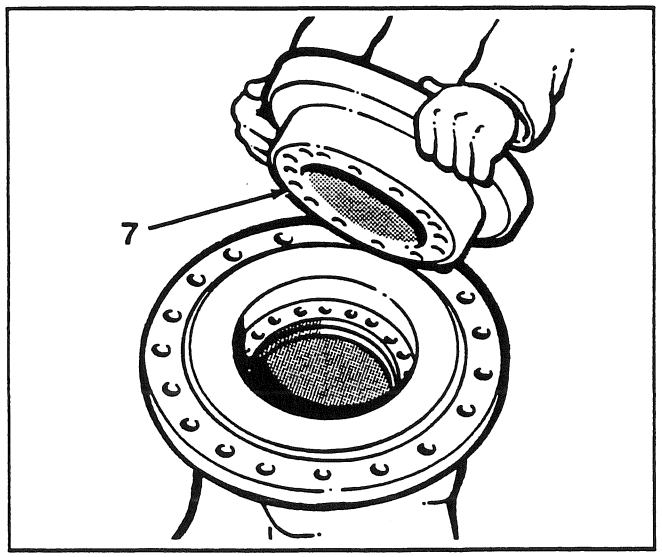


Fig. 136

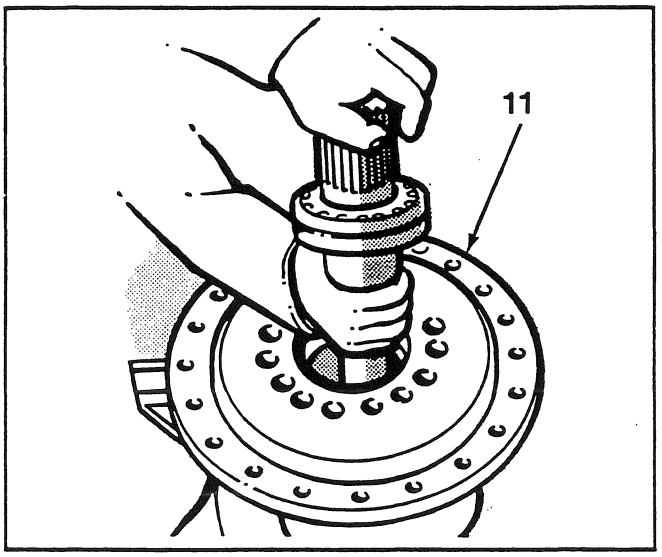


Fig. 139

Assembly and Installation (Continued)

Fig. 134
If you do not already have one, make a tool according to the illustration.

Fig. 135
Coat the carrier of the inner oil seal (**6**) with 'Permatex No. 2', or equivalent. Lubricate the oil seal lips. Install the oil seal using the tool made from illustration Fig. 134.

Fig. 136
loat the outside of the pivot ring retainer hub and thrust plates with grease. Carefully lower the pivot ring retainer (**7**) over the pivot ring. Ensure that the O ring is not displaced.

Fig. 137
Coat the threads of the bolts (**4**) with locking compound, Champion part number **40945** or 'Loctite' 242. Install six bolts in an even pattern. Tighten the bolts in a diagonal sequence to gradually compress the pivot ring over the "Uniring" seal. Torque-tighten the bolts. Install a threaded shackle into one of the pivot ring outside holes. Insert a 1 meter (3 ft) long metal bar into the eye of the shackle and check to see if the pivot ring assembly can be rotated. Rotation should just overcome any resistance.

If the pivot ring assembly can not be rotated, disassemble and add a shim (**73**). Re-assemble and check the pivot ring assembly rotation. After checking the rotation, install the remaining bolts (**4**) and gradually tighten them in a diagonal sequence. Torque-tighten the bolts.

Fig. 138
Heat the bearing (**5**) evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. If the bearing must be pressed into place, use a tubular drift that contacts the full face of the bearing. Ensure the bearing is lubricated with final drive oil. Install the bearing onto the drive axle (**75**).

Fig. 139

CAUTION

TAKE EXTRA CARE WHEN INSTALLING THE DRIVE AXLE AND BEARING ASSEMBLY. LUBRICATE THE AXLE SPLINES TO ENSURE POSITIVE ENGAGEMENT WITH THE DIFFERENTIAL SIDE GEAR SPLINES.

Carefully place the drive axle and bearing assembly into the axle housing (**11**).

Assembly and Installation (Continued)

Fig. 140
Cool the drive axle (**75**) in a freezer or with dry ice. If the axle must be pressed into place, use a soft metal drift. Install the drive axle.

Fig. 141
Retain the drive axle with a new snap ring (**3**).

Fig. 142
Coat the carrier of the outer oil seal (**1**) with 'Permatex No. 2', or equivalent. Lubricate the oil seal lips with tandem oil. Using a soft metal drift, install the oil seal.

Fig. 143
Lubricate and carefully install the spacer (**2**). Repeat the previous steps for the other pivot ring and drive axle sub-assembly.

Fig. 144
Coat around the tandem opening with gasket eliminator, Champion part number **25303** or 'Loctite' 515.

Fig. 145
Attach a safe lifting device to the final drive assembly. Maneuver the assembly to align the drive axle splines with the sprocket splines in the tandem.

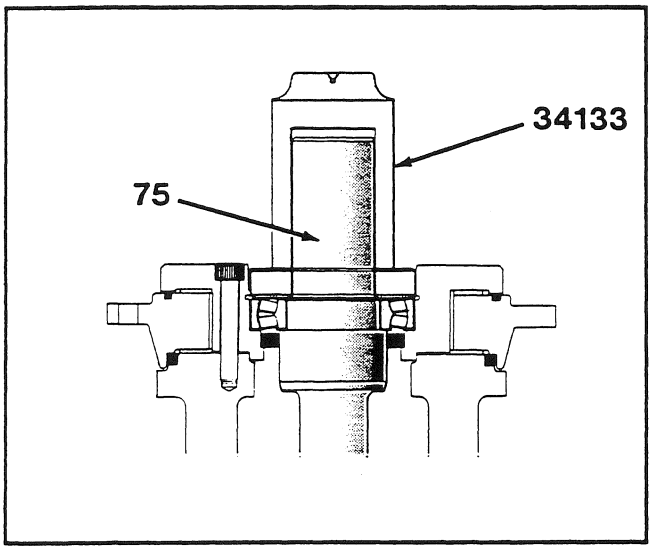


Fig. 140

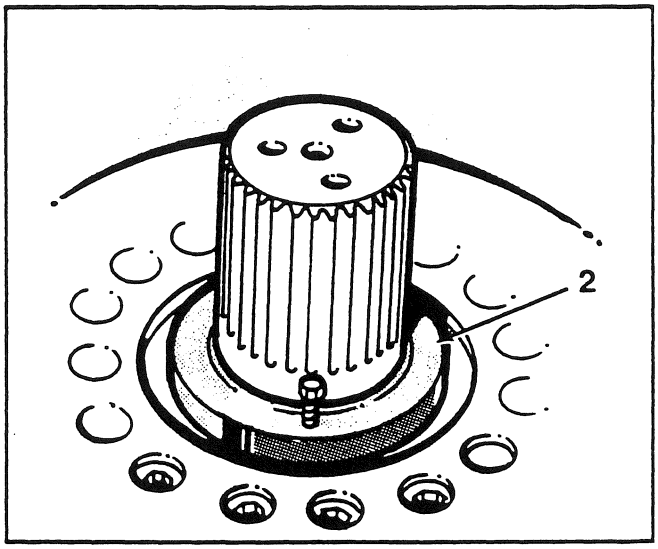


Fig. 143

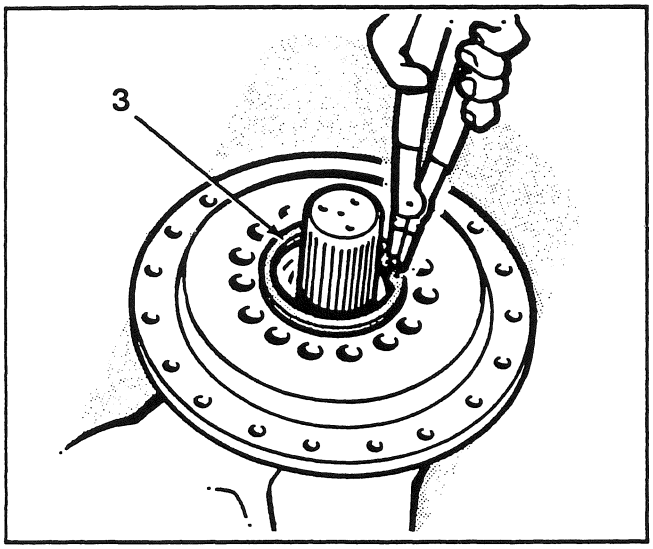
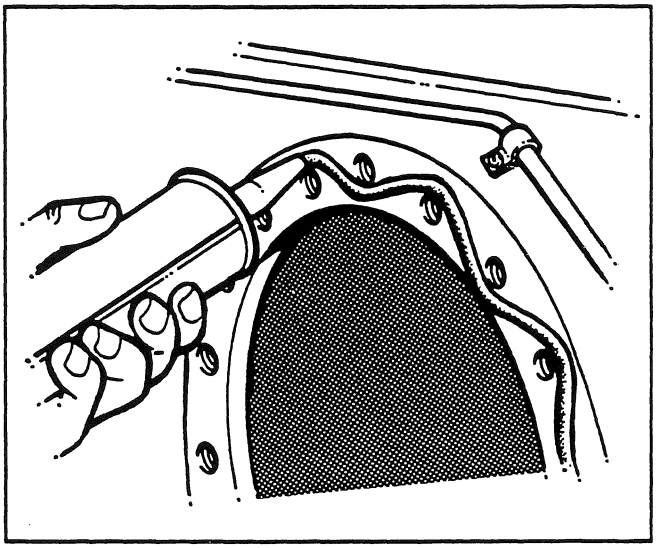


Fig. 141



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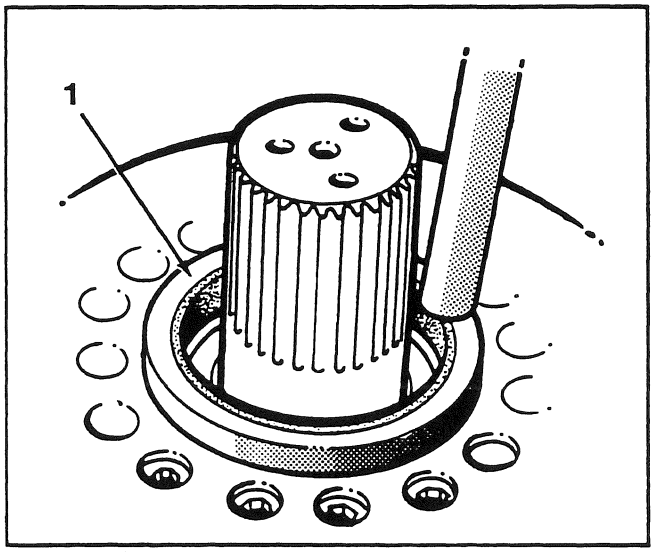

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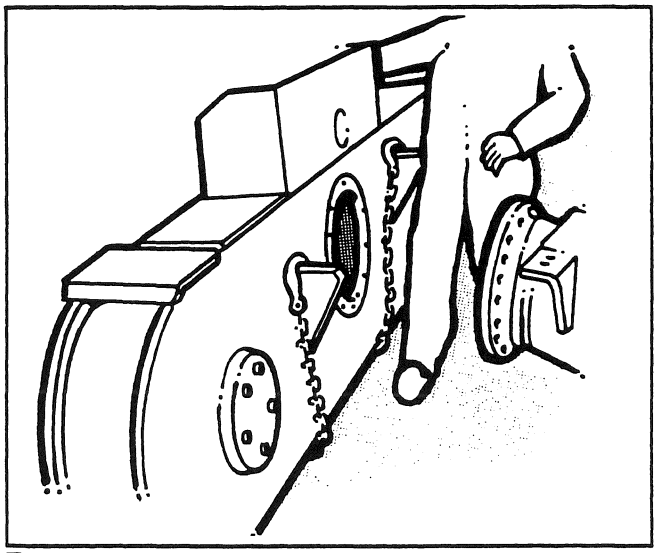


Fig. 145

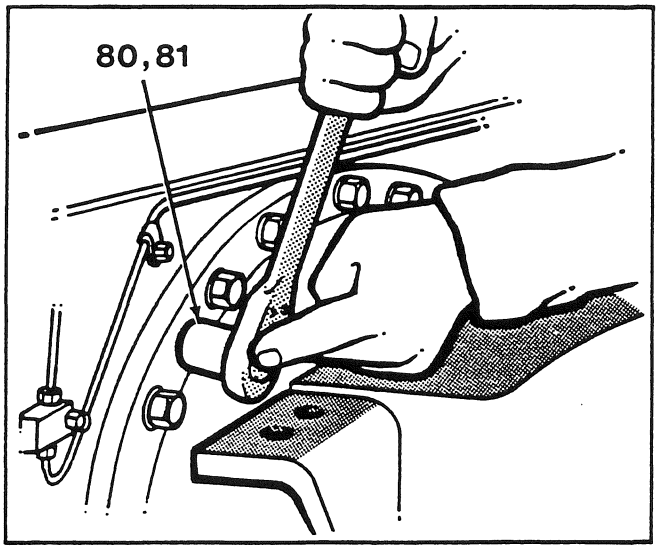
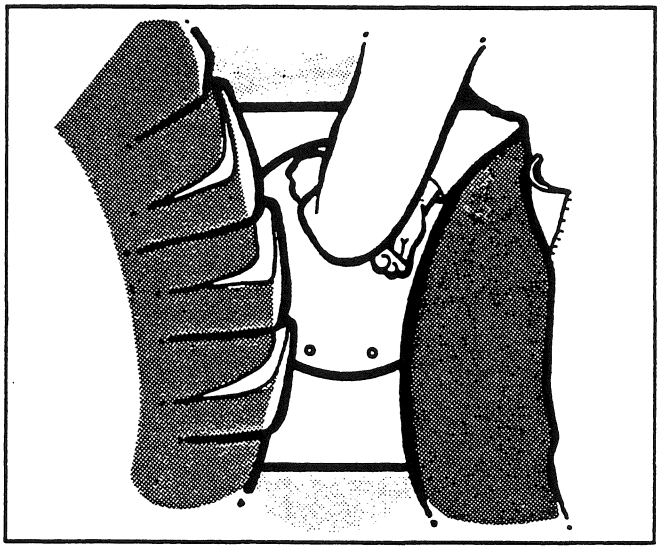


Fig. 146



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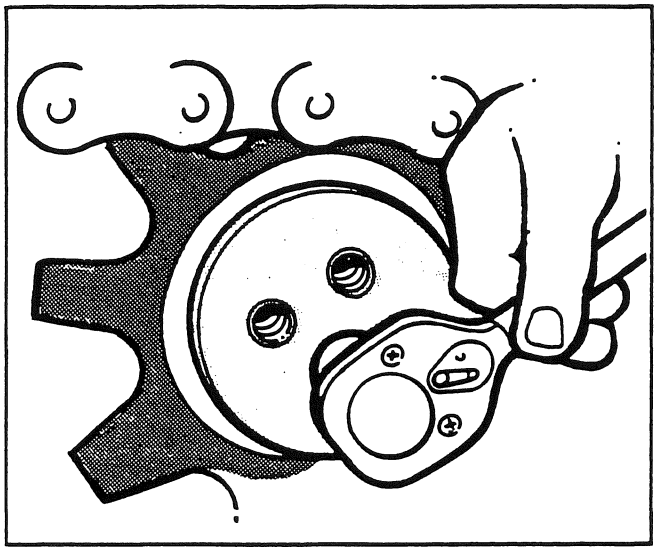

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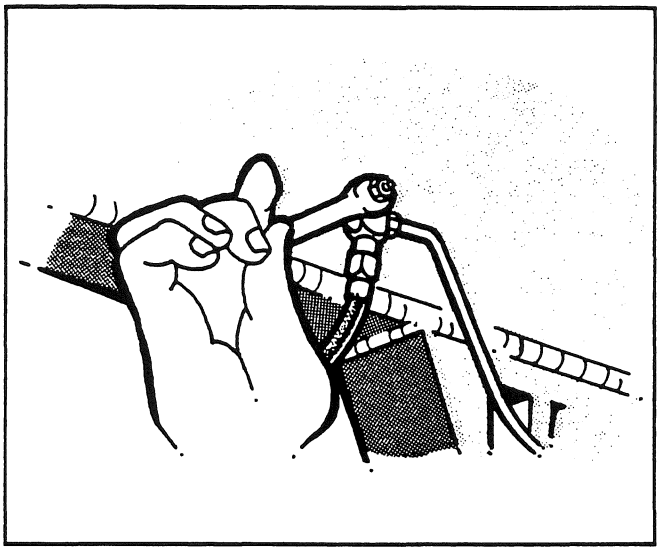

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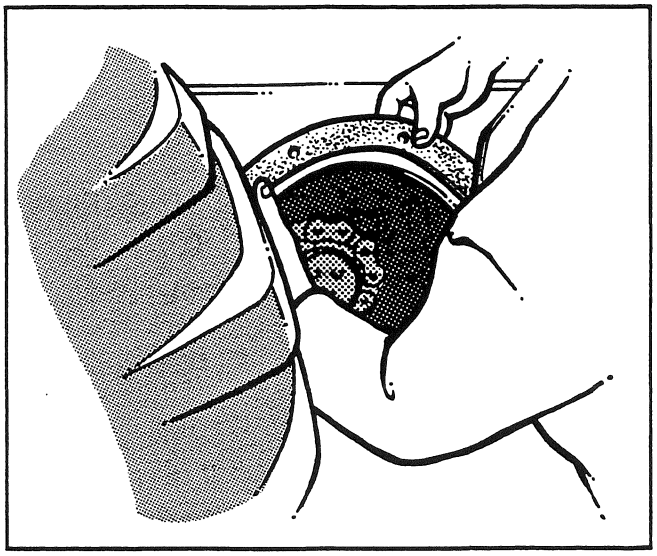


Fig. 148

Assembly and Installation (Continued)

Fig. 146
Coat the threads of the bolts (**81**) with locking compound, Champion part number **40945** or 'Loctite' 242, that retain the final drive to the tandem. Install the bolts and lockwashers (**80**). Torque-tighten the bolts.

Fig. 147
Install the end plate, bolts and lockwashers on the drive sprocket.

Fig. 148
Install a new cover plate gasket or use gasket eliminator, Champion part number **25303** or 'Loctite' 515.

Fig. 149
Install the cover plate and secure with the bolts. Repeat the previous steps for the opposite tandem.

Fig. 150
Install the transverse brake line. Wipe up any spilled fluid to avoid paint damage.

SINGLE REDUCTION FINAL DRIVE ASSEMBLY

Installation to Grader

Fig. 151
Attach a safe lifting device to the rear of the grader frame. Raise the rear end of the grader and remove the stands. Roll the final drive and tandem assembly under the grader. Lower the grader until the frame brackets rest on the final drive mounting plates. Install the bolts (**67**) and new locknuts (**76**). Torque-tighten the bolts.

Fig. 152
Remove and discard the lockwire securing the two halves of the lower driveshaft slip yoke. Re-connect the lower driveshaft. Place the brake disc fender and two spacers into position. Retain with the bolts and lockwashers.

CAUTION

THE EMERGENCY BRAKE CALIPER ASSEMBLY IS EXTREMELY HEAVY.

Place the emergency brake caliper assembly into position and retain with the bolts, lockwashers and flatwashers.

Fig. 153
Re-connect the emergency brake cable.

Fig. 154
Re-connect the tube from the master cylinder to the three-way connector on the inner right hand side of rear frame. Ensure all tube connections are clean and tight. Wipe up any spilled brake fluid to prevent paint damage.

NOTE

Add brake fluid as required. Bleed the brake system of air before driving the grader (See section on brakes).

Fig. 155
Pass the battery cables through the grommet, install one battery and reconnect the cables. Close and secure the battery box(es).

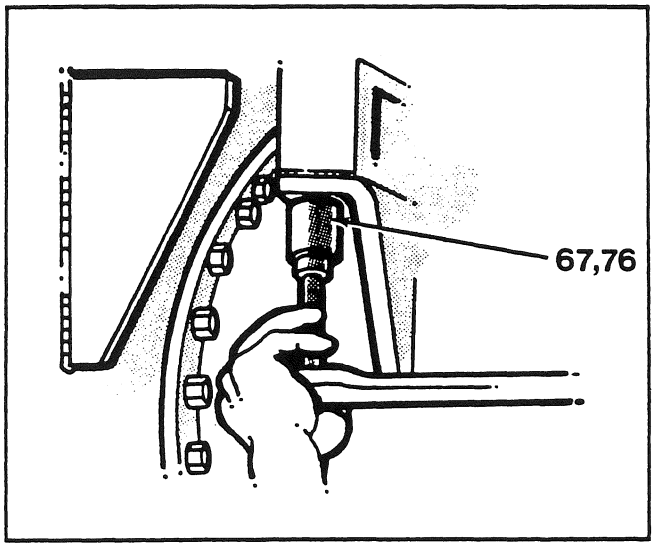
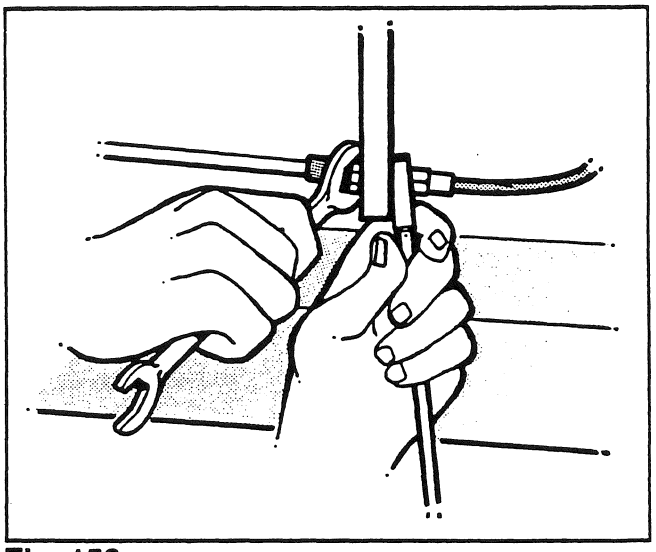


Fig. 151



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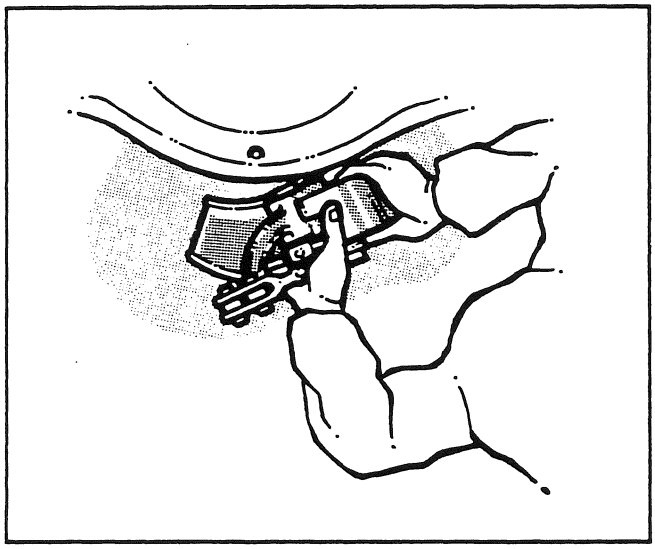


Fig. 152

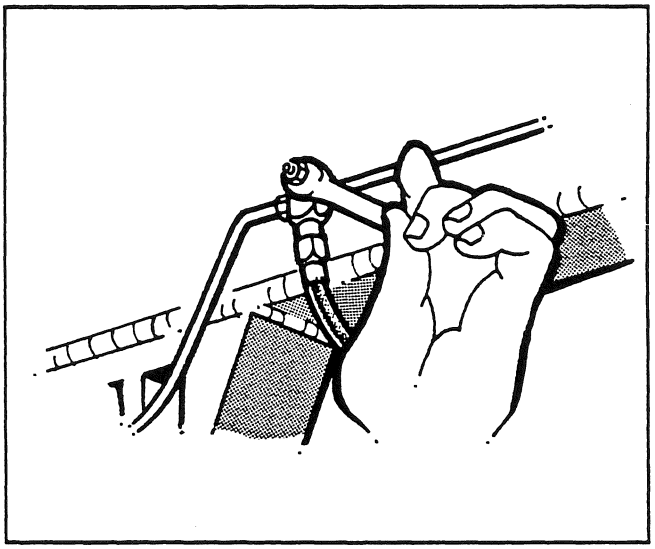


Fig. 154

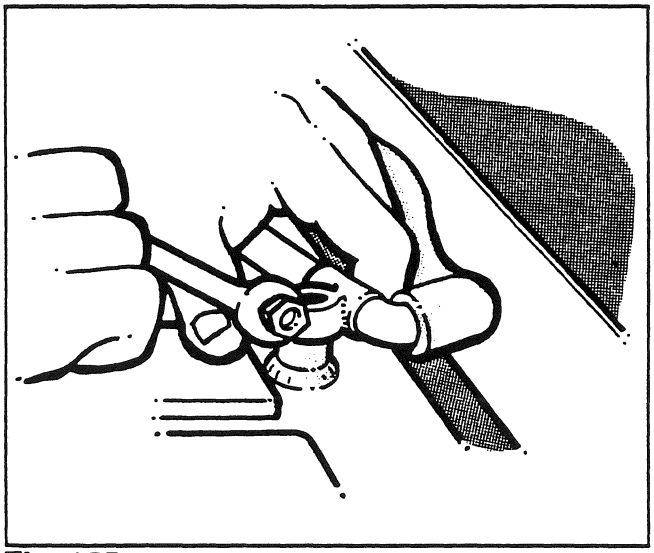


Fig. 155

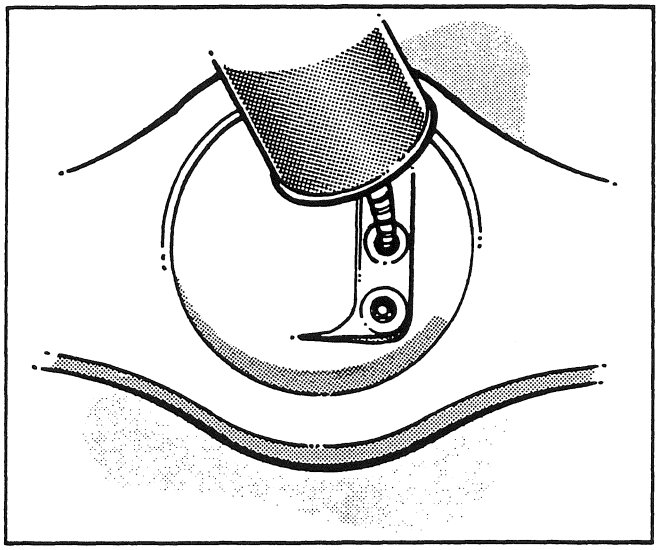


Fig. 156

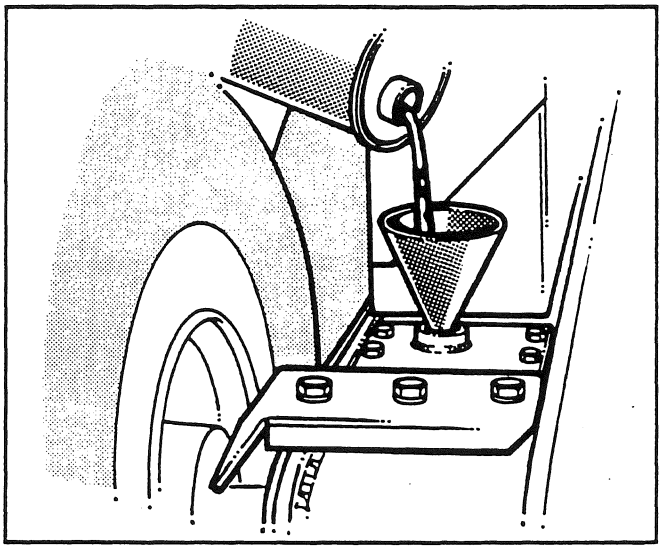


Fig. 157

SINGLE REDUCTION FINAL DRIVE ASSEMBLY

Installation to Grader (Continued)

Fig. 156

Refer to Lubrication Specifications detailed in the front of this manual for the recommended tandem and final drive lubricating oils. Remove the upper pipe plug (83) from the axle housing. Refill the final drive to the bottom of the plug hole. Clean and install the plug.

NOTE

The final drive oil capacity is 19 litres (4.2 Imp. gal, 5.0 U.S gal).

Fig. 157

Remove and clean the tandem filler plugs and level check plugs. Refill both tandems to the bottom of the check plug hole. Install the filler and level check plugs.

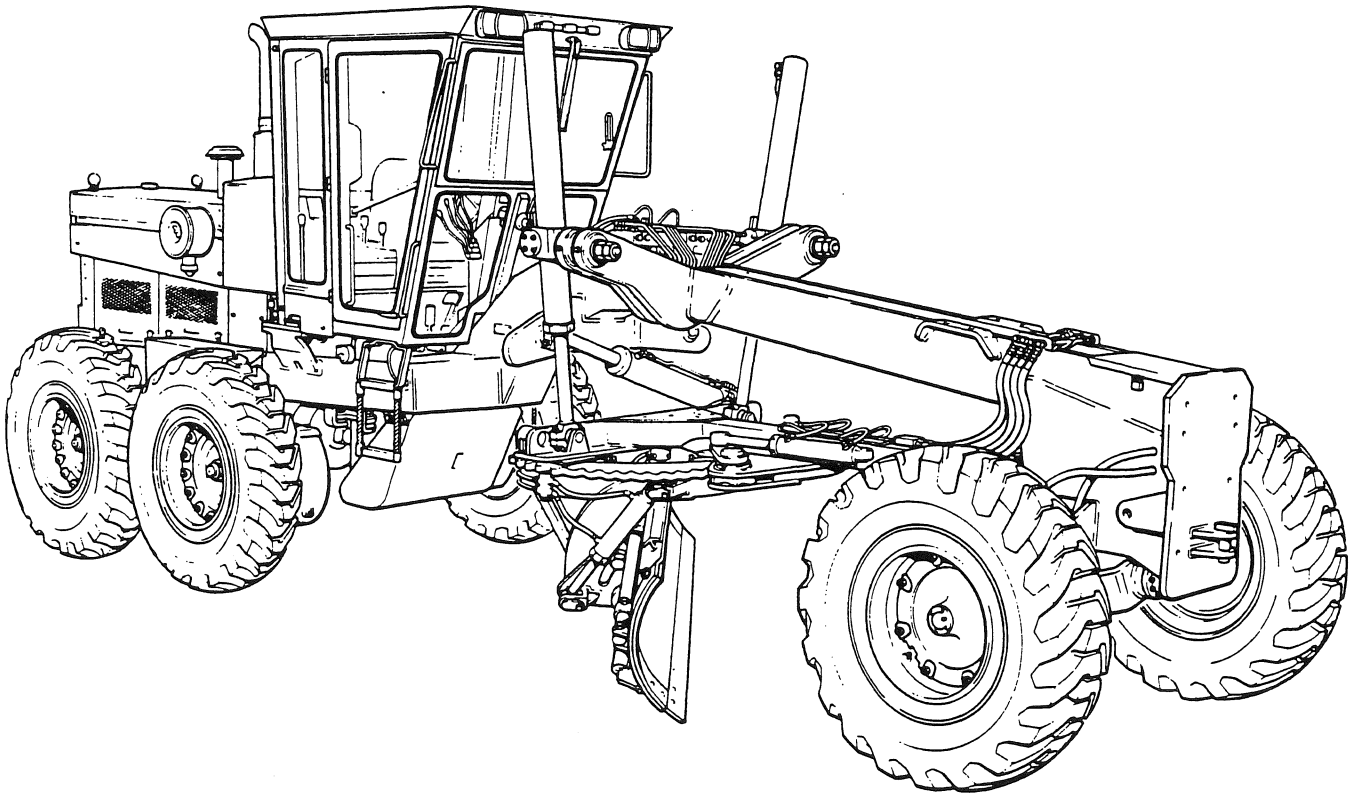
NOTE

The tandem oil capacity is 30 litres (6.6 Imp. gal, 7.9 U.S gal). Oil disc brake tandem capacity is 100 litres (22 Imp. gal, 26.5 U.S gal).

Select the isolation switch to the "ON" position and start the engine. Raise the moldboard to lower the front wheels. Road test the grader to check for leaks.

SECTION 10

LOCK / UNLOCK DIFFERENTIAL FINAL DRIVE



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LOCK/UNLOCK DIFFERENTIAL FINAL DRIVE

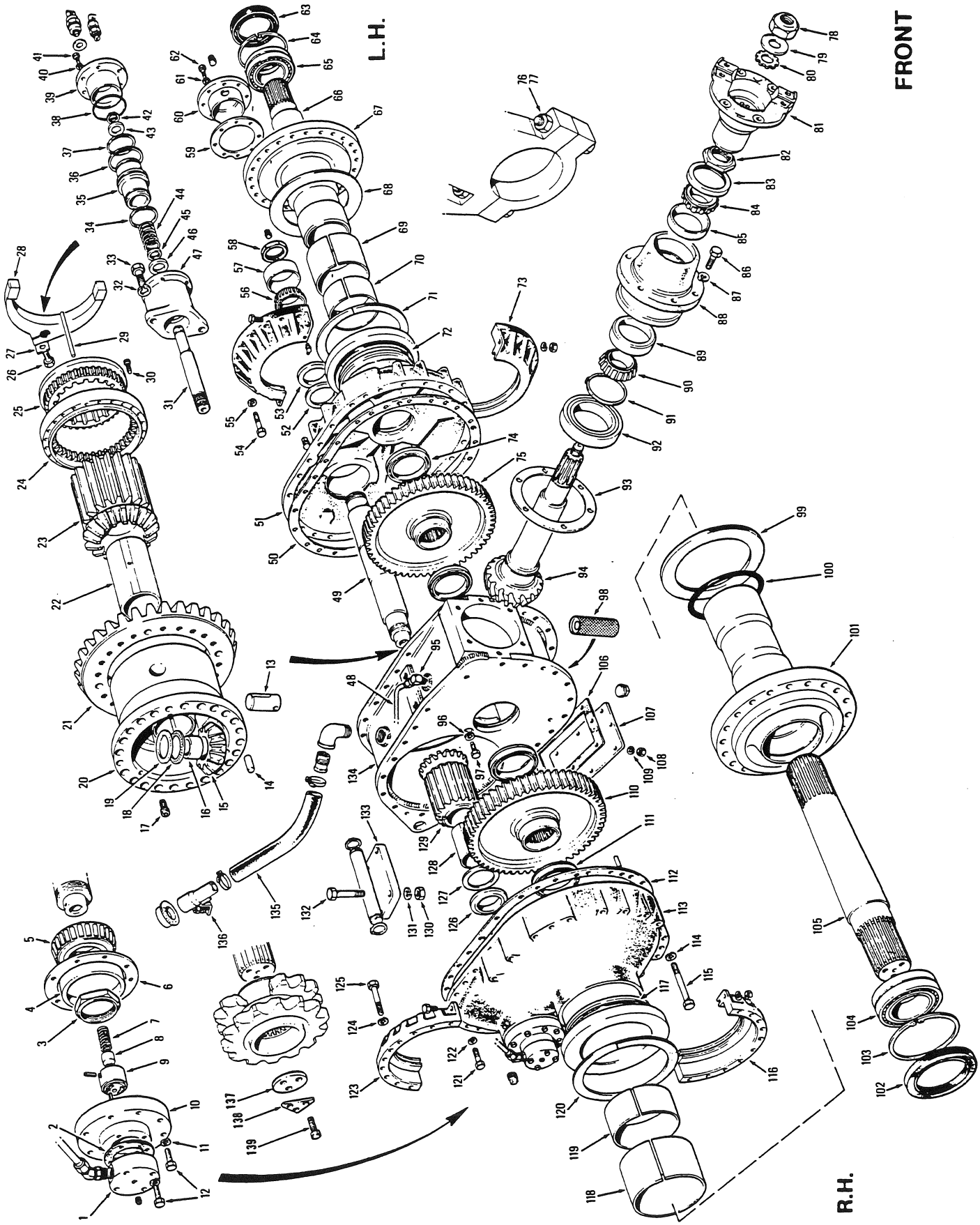


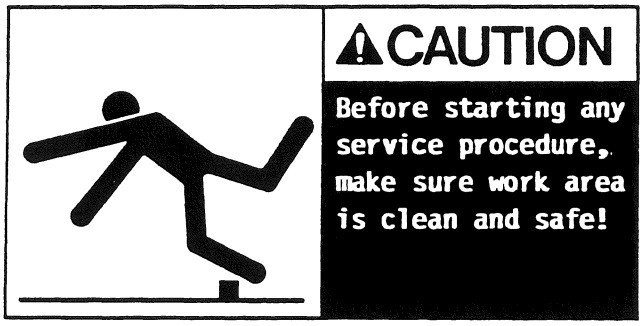
FIG. 1

LOCK/UNLOCK DIFFERENTIAL FINAL DRIVE

Item	Description	Item	Description	Item	Description
1	End cap	48	Hydraulic tube	95	Suction tube
2	Gasket	49	Cross shaft	96	Lockwasher
3	Nut	50	Gasket	97	Lockscrew
4	Bearing cup	51	L.H. side housing	98	Strainer
5	Bearing cone	52	Bearing	99	Outer thrust plate
6	Shim	53	Thrust washer	100	O ring
7	Spring	54	Capscrew	101	Flange sleeve
8	Plunger	55	Lockwasher	102	Oil seal
9	Pump	56	Bearing cone	103	Snap ring
10	Pump mount adapter	57	Bearing cup	104	Bearing
11	Lockwasher	58	Nut	105	Drive axle
12	Capscrew	59	Shim	106	Gasket
13	Pin	60	End cap	107	Cover plate
14	Dowel pin	61	Lockwasher	108	Nut
15	Spider gear	62	Capscrew	109	Lockwasher
16	Bushing	63	Oil seal	110	Bull gear
17	Capscrew	64	Snap ring	111	Bearing
18	Bearing	65	Bearing	112	Gasket
19	Washer	66	Drive axle	113	R.H. side housing
20	Differential housing	67	Flanged sleeve	114	Lockwasher
21	Spiral pinion gear	68	Outer thrust plate	115	Bolt
22	Pinion sleeve	69	Bushing	116	Half-ring
23	Spider pinion gear	70	Bushing	117	"Uniring" seal
24	Shift clutch gear	71	Inner thrust plate	118	Bushing
25	Shift clutch	72	"Uniring" seal	119	Bushing
26	Lockscrew	73	Half-ring	120	Inner thrust plate
27	Tabwasher	74	Bearing	121	Bolt
28	Shifter fork	75	Bull gear	122	Lockwasher
29	Dowel pin	76	Bolt	123	Half-ring
30	Capscrew	77	Nut	124	Lockwasher
31	Shift rail	78	Locknut	125	Bolt
32	Lockwasher	79	Washer	126	Thrust washer
33	Capscrew	80	Washer	127	Bearing
34	Piston ring	81	Brake flange yoke	128	Pinion sleeve
35	Piston	82	Nut	129	Spider pinion gear
36	Piston ring	83	Oil seal	130	Nut
37	Piston ring	84	Bearing cone	131	Lockwasher
38	O Ring	85	Bearing cup	132	Bolt
39	Shift cylinder cap	86	Capscrew	133	Mounting plate
40	Lockwasher	87	Lockwasher	134	Main case
41	Capscrew	88	Pinion cap	135	Hose
42	Snap ring	89	Bearing cup	136	Filler pipe
43	Retainer	90	Bearing cone	137	Sprocket retainer
44	Spring	91	Snap ring	138	Lockplate
45	Washer	92	Bearing	139	Capscrew
46	Oil seal	93	Shim		
47	Barrel	94	Spiral pinion shaft		

Key to Fig. 1

General



Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks or proper stands; a build stand (if available); a hydraulic press; shop tools and some special tools listed in the front of this Shop Manual Section.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

THE SERVICE POSITION IS AS FOLLOWS:- PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH PROPER STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS.

THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

Description

The double reduction final drive with hydraulic lock/unlock differential allows the grader operator two modes of operation.

In the normal operating position, the differential is locked and drives all four tandem wheels to provide maximum traction. In the unlocked position, the wheels can rotate at different speeds (differential action). This effectively reduces the turning radius.

The operator moves a switch in the cab to unlock the differential. An energized solenoid allows oil to force the cylinder piston and shifter fork and unlock the spider pinion gear from the differential housing.

Description (cont.)

When the piston reaches the unlocked position, it activates a switch that energizes an indicator light in the cab.

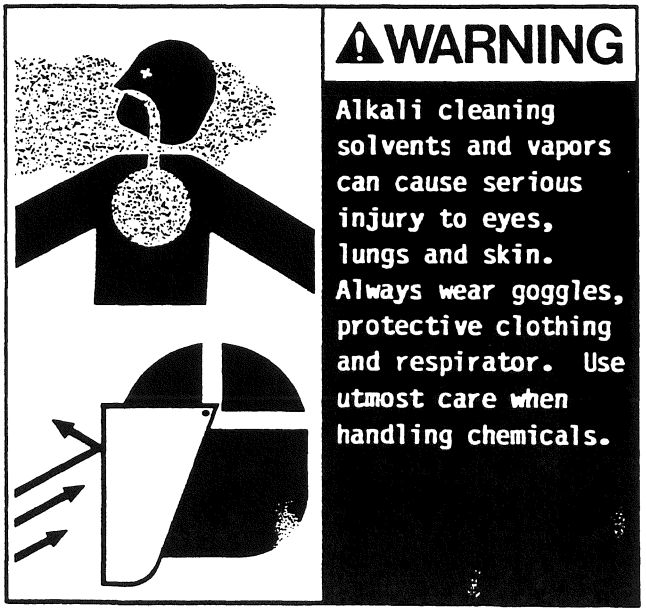
Oil used to unlock the differential flows from the filtered side of the transmission. All return and leakage oil flows to the transmission sump.

The differential final drive uses a bi-directional oil pump to lubricate the bull gear bearings, spider pinion bearings and spider gears. The pump is mounted on the right hand side of the cross shaft.

Refer to the Lubrication Specifications at the front of this Shop Manual for the recommended lubricants used in the lock/unlock differential final drive.

Cleaning and Inspection

Cleaning - Bearings and Small Parts



You are recommended to wear cotton gloves when handling bearings. This prevents transfer of skin acids and perspiration onto bearing races.

Immerse bearings and small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags. Make sure all oil passages are unblocked. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping.

Cleaning and Inspection (cont.)

Inspection - Bearings (cont.)

When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - Gaskets, Oil Seals, O Rings and Snap Rings

Replace all gaskets, oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Before installation, apply a thin coating of adhesive/sealant, Champion part number **19200**, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings with system oil.

Torque Guide

Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 106	Pinion bearing outer race lockscrew	102	10,4	75
Fig. No. 115	Side housing capscrews	271-305	28-31	200-225
Fig. No. 119	Bearing cap capscrews	41-47	4,0-4,8	30-35
Fig. No. 126	Shift clutch gear capscrews	41-47	4,0-4,8	30-35
Fig. No. 127	Spiral pinion gear capscrews	108-135	11-14	80-100
Fig. No. 130	Cross shaft bearing cone retaining locknuts	271-305	28-31	200-225
Fig. No. 132	Cross shaft bearing cone retaining locknuts	271-305	28-31	200-225
Fig. No. 136	Spiral pinion gear capscrews	108-135	11-14	80-100
Fig. No. 140	Pump mount adapter	41-47	4,0-4,8	30-35
Fig. No. 141	Pump mount adapter	41-47	4,0-4,8	30-35
Fig. No. 145	Shift cylinder barrel capscrews	108-135	11-14	80-100
Fig. No. 169	Pinion cap capscrews	271-305	28-31	200-225
Fig. No. 173	Shift cylinder cap capscrews	7,0-11	0,7-1,0	5.0-8.0
Fig. No. 178	Pump end cap capscrews	41-47	4,0-4,8	30-35
Fig. No. 189	Brake flange yoke locknut	271	28	200
Fig. No. 200	Half-ring to tandem case capscrews	13-20	1,4-2,0	10-15
Fig. No. 202	Sprocket retainer plate capscrews	108-135	11-14	80-100
Fig. No. 209	Hanger bracket half-clamp nuts	1844	188	1360
Fig. No. 209	Mounting plate nuts	380	39	280
Fig. No. 210	Drive shaft to final drive capscrews	13	1,4	10

Adjustments

Fig. No.	Application	N.m	kgf.m	lbf.in.
Fig. No. 142	Cross shaft rolling torque	4,5 - 7,3	0,5 - 0,7	40 - 65
		kg		lb
Fig. No. 158	Spiral pinion shaft assembly rolling torque ...	198 - 4,3		4.2 - 9.5
		mm		in.
Fig. No. 170	Spiral pinion and gear backlash	0,3 +/- 0,1		.012 +/- .004
Fig. No. 172	Shifter fork to shift clutch gear clearance	0,5		.020

Special Tools

Fig. No.	Description	Part No.
Fig. No. 53	Deep-reach socket wrench	43004
Fig. No. 111	Inner bushing installation tools	18512 18513
Fig. No. 111	Outer bushing installation tools	18511 18512
Fig. No. 116	Shift rail oil seal installation tool	45006
Fig. No. 158	Deep-reach socket wrench	43004
Fig. No. 187	Drive axle and bearing assembly installation drift	45007

Differential Final Drive - Removal

Fig. 2

Park the grader on level ground. Place the transmission mode lever in **Neutral**. Centralize the circle, drawbar and moldboard assembly using the circle shift and blade lift cylinders.

Fig. 3

Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **Service Position.**

Fig. 4

Drain the differential final drive lubricating oil. Clean and install the magnetic drain plug.

Fig. 5

Drain the lubricating oil from both tandem cases. Clean and install the magnetic drain and long-reach plugs.

Fig. 6

Remove the filler pipe (136) and hose (135) from the frame.

Fig. 7

Disconnect the brake lines from the tee fittings on the frame. Plug the lines and fittings and wipe away any spilled brake fluid.

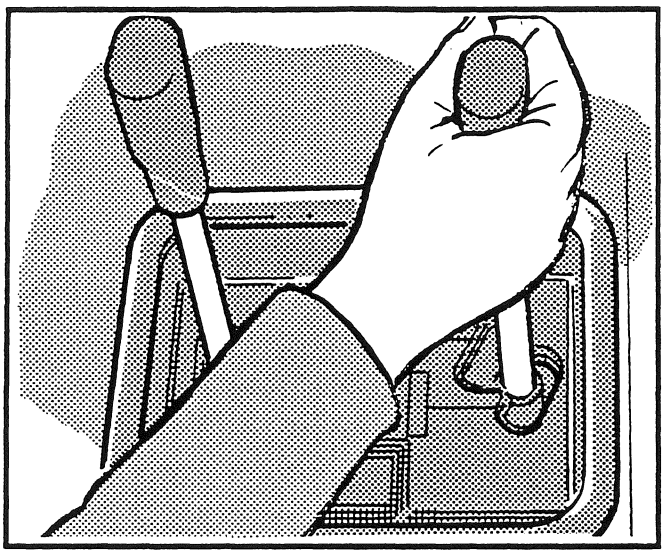


Fig. 2

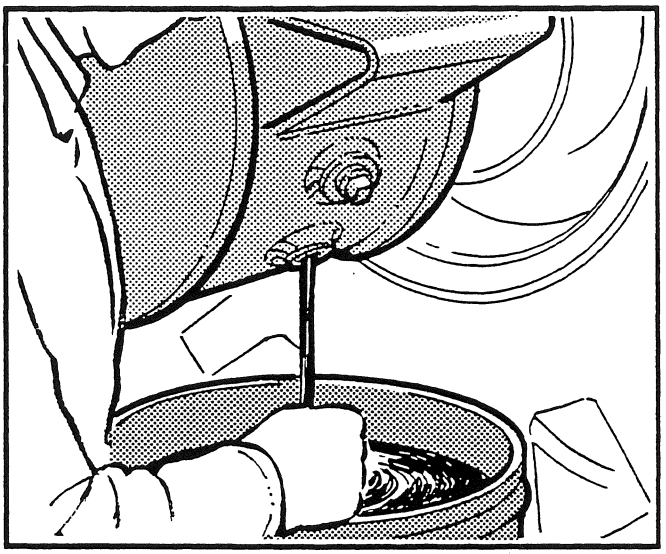


Fig. 5

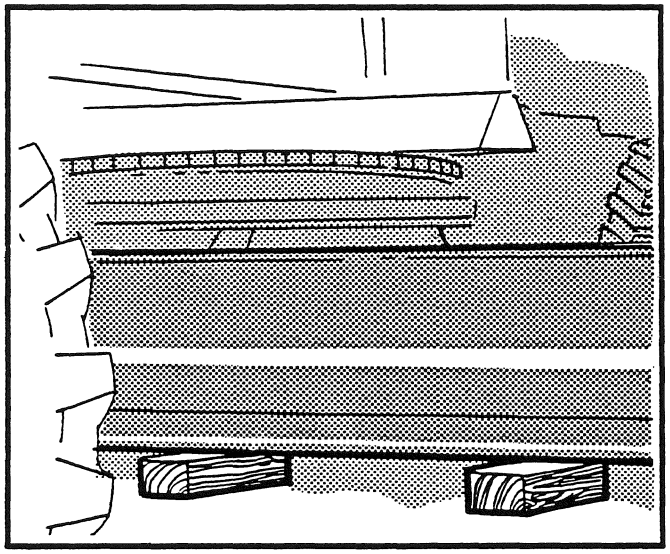


Fig. 3

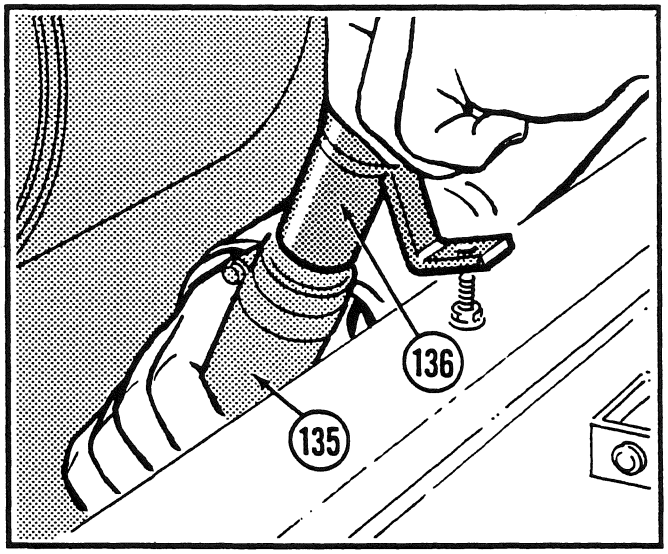


Fig. 6

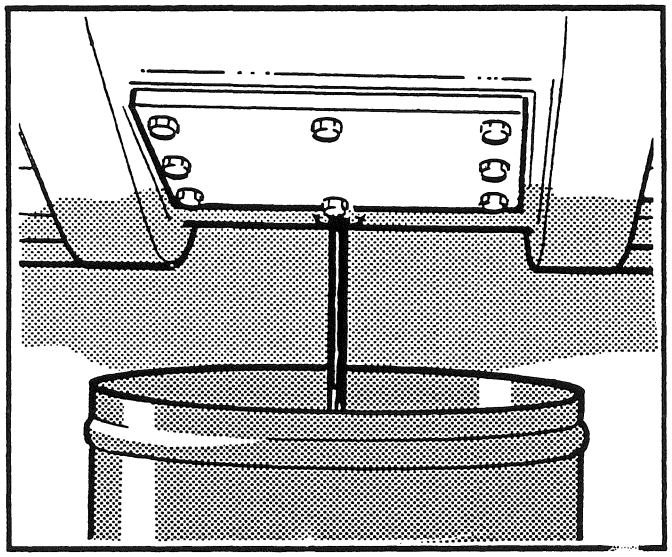


Fig. 4

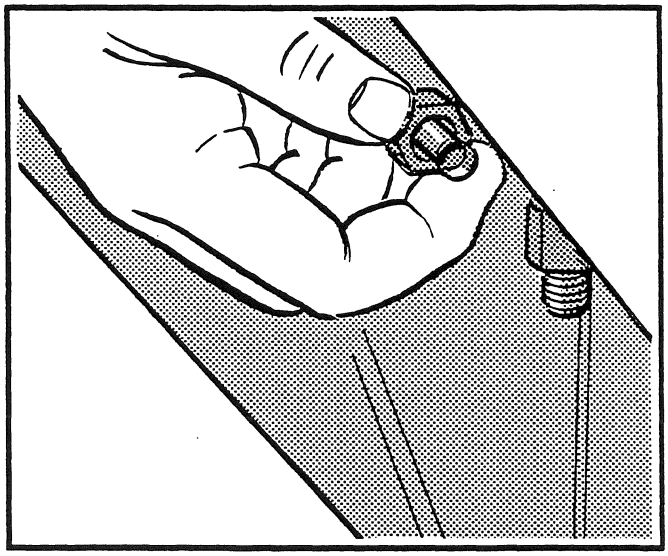


Fig. 7

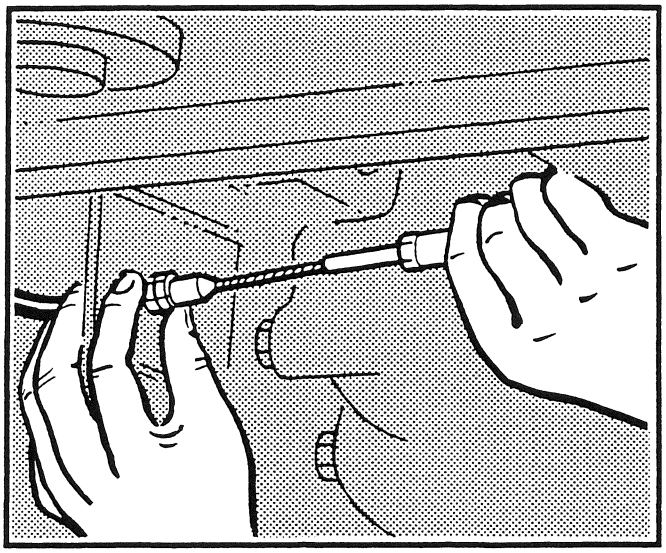


Fig. 8

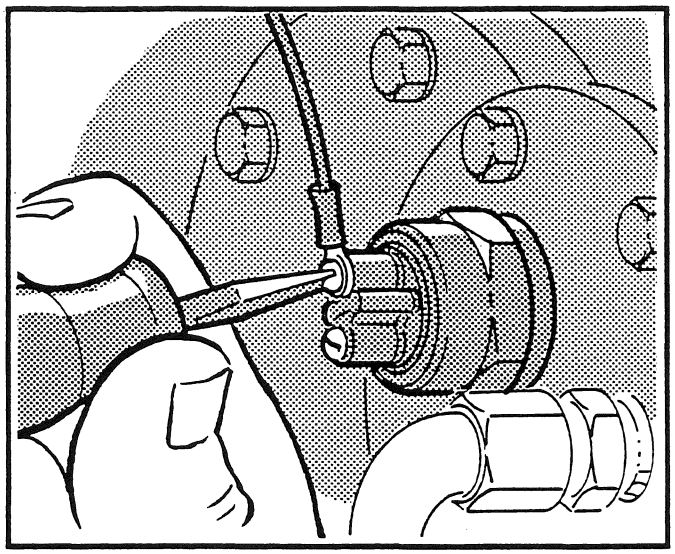
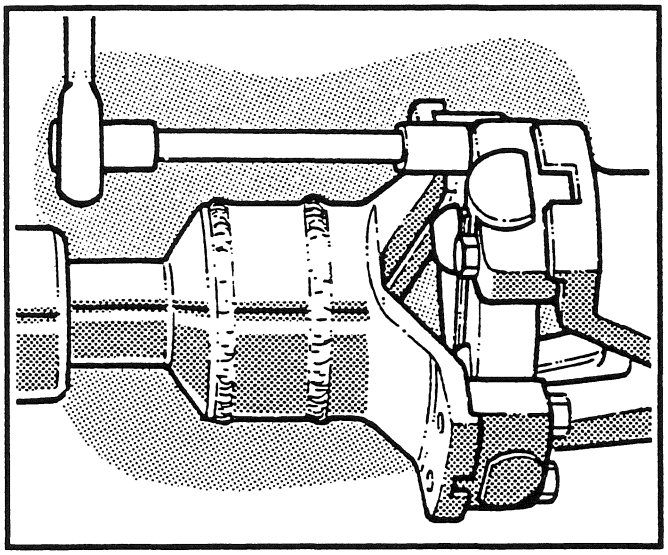


Fig. 11



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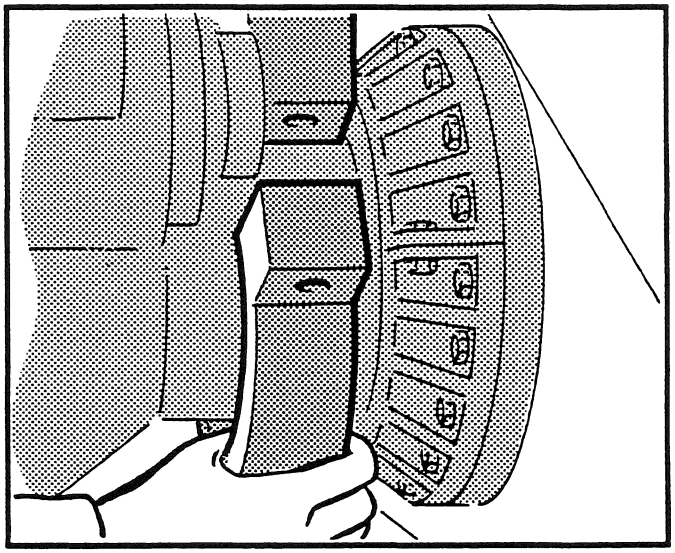

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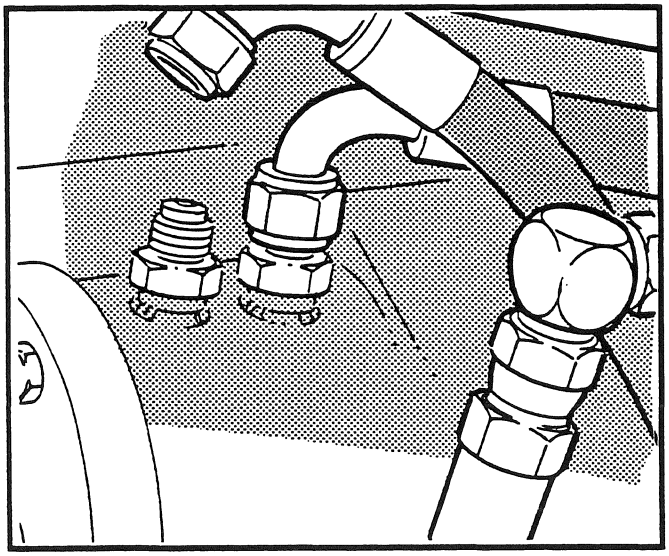


Fig. 10

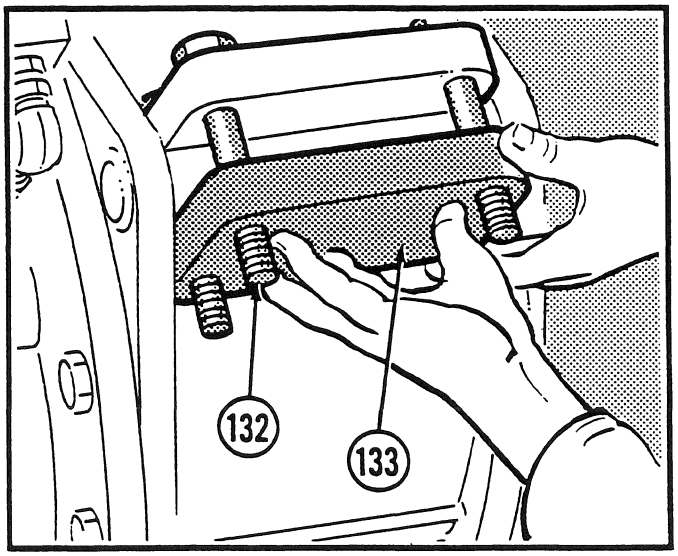


Fig. 13

Differential Final Drive - Removal (cont.)

Fig. 8

Disconnect the parking brake cable. Remove the fender and the parking brake assembly.

Fig. 9

Disconnect the lower drive shaft from the front of the differential final drive.

Fig. 10

Disconnect the three hose fittings from the lock/unlock cylinder. Plug the ports and hoses. Identify the fittings to avoid confusion during assembly.

Fig. 11

Disconnect the wires from the lock/unlock switch terminals.

Fig. 12

Remove the nuts (77) and bolts (76) from the final drive hanger bracket half-clamps. Identify the halves to ensure that you install them in the same locations during assembly.

Fig. 13

Remove the nuts (130), bolts (132) and lockwashers (131) and remove the rear mounting plate (133).

Differential Final Drive - Removal (cont.)

Fig. 14
Start the engine and raise the front wheels just off the ground using the moldboard. Shut down the engine.

Fig. 15
Disconnect the battery cables and remove the battery box.

Fig. 16
Attach the lifting device to the rear of the grader frame. Raise the frame until it is clear of the differential final drive. On articulated models, **make sure** that the emergency brake disc does not interfere with the mounting brackets.

Fig. 17
Roll the differential final drive and tandem assembly out from under the frame.

Fig. 18
Lower the frame onto a secure stand.

Fig. 19
Remove the capscrews retaining the tandem cover plates. Remove the plates and discard the gaskets. If gasket eliminator compound has been used, remove all traces of the sealant.

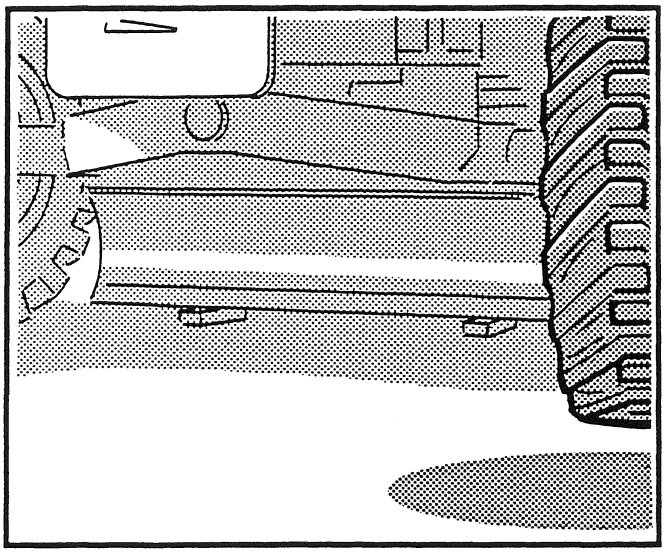


Fig. 14

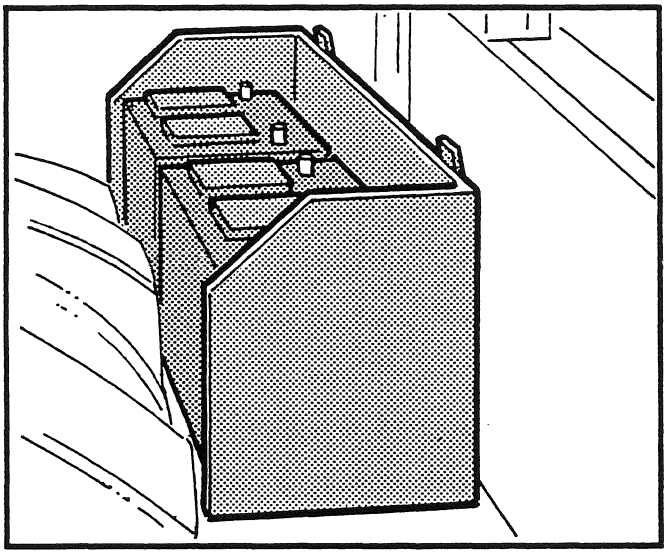


Fig. 15

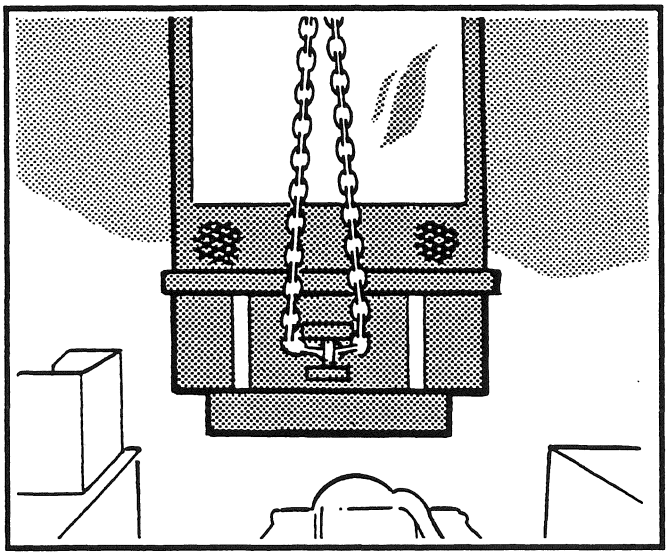


Fig. 16

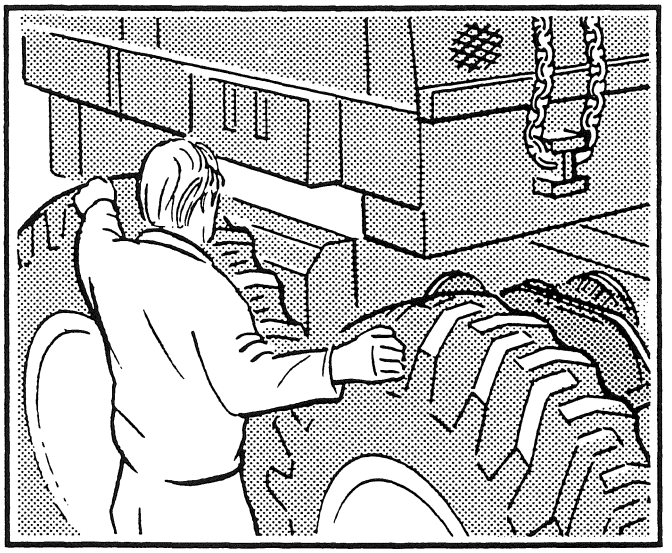


Fig. 17

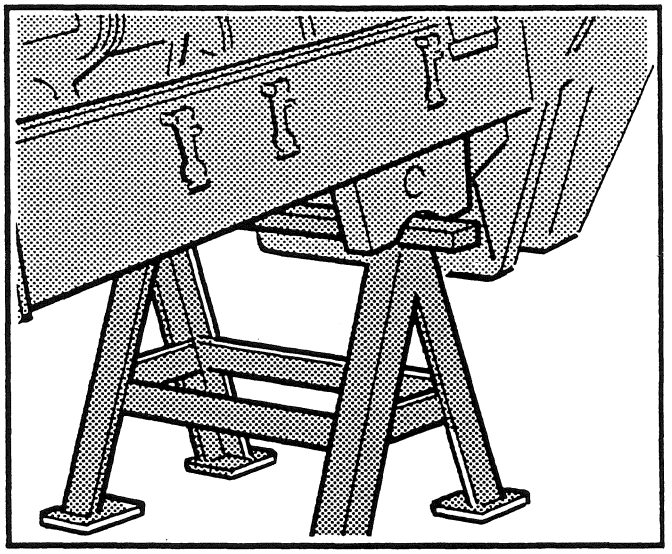


Fig. 18

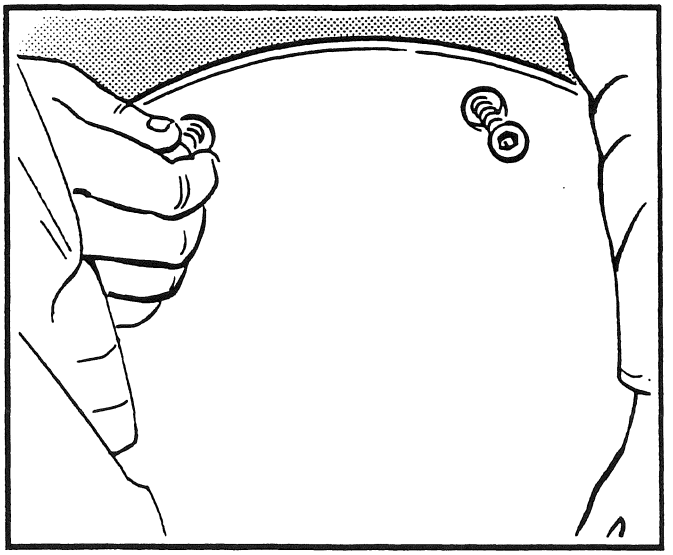


Fig. 19

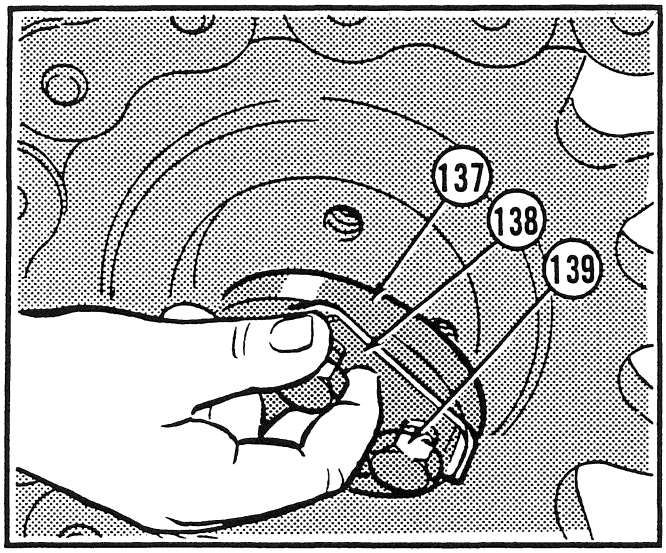
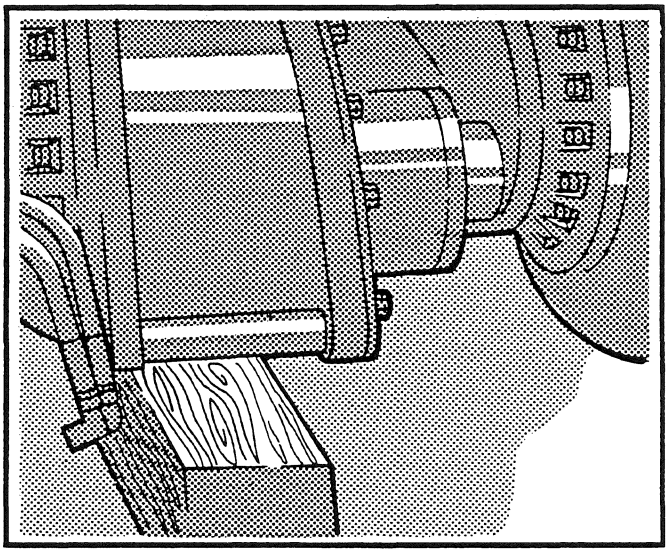


Fig. 20



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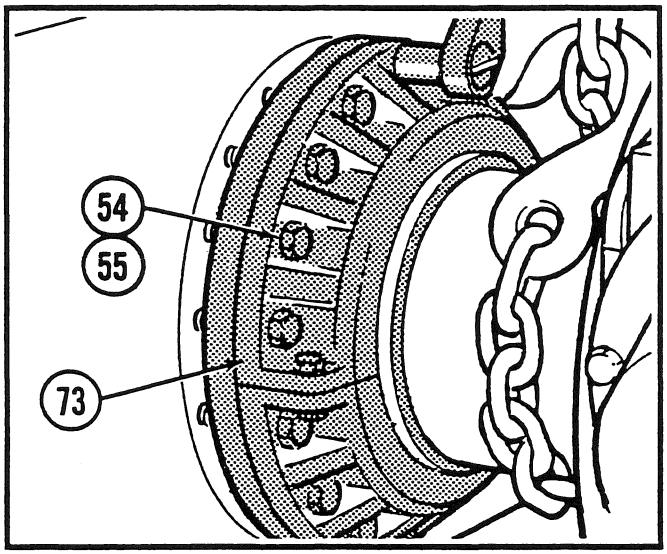


Fig. 21

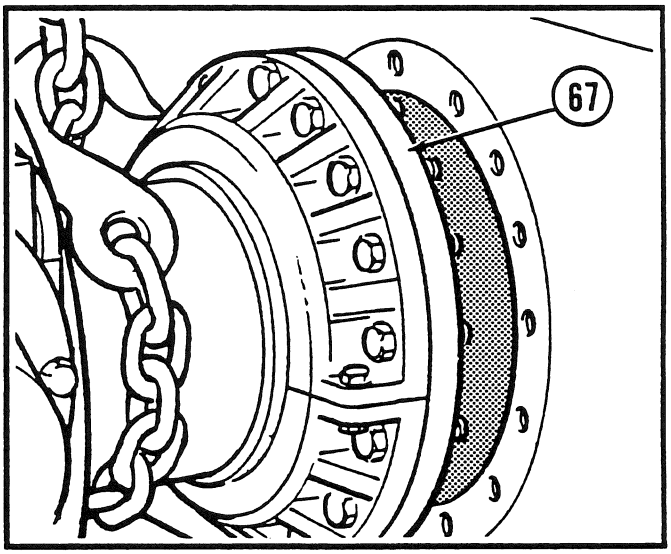


Fig. 24

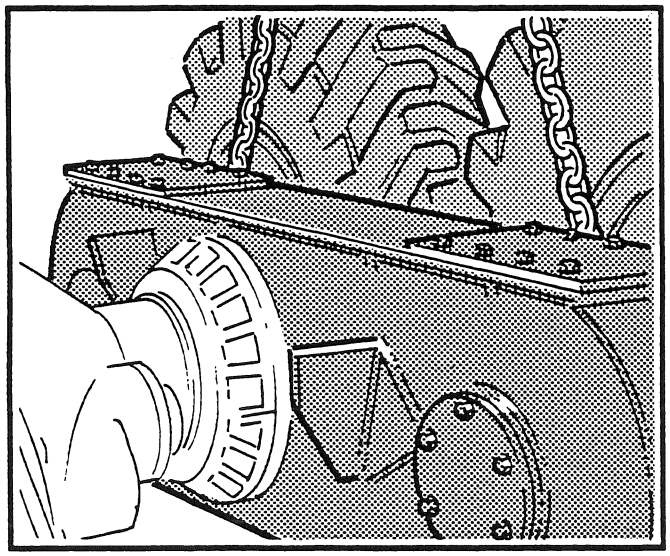


Fig. 22

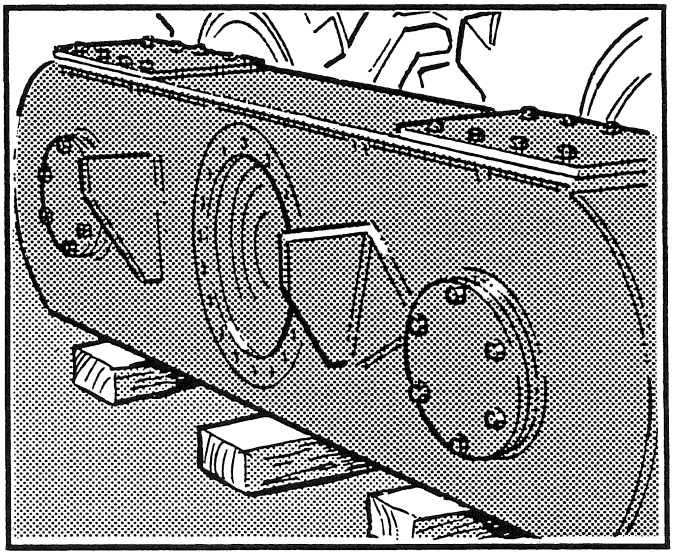


Fig. 25

Differential Final Drive - Removal (cont.)

Fig. 20
Release the tabs and remove the capscrews (139), lockplate (138) and sprocket retainer (137). Remove and discard the lockplate.

Fig. 21
Remove the capscrews (54) and lockwashers (55) retaining the half-rings (73) to the tandem.

Fig. 22
Attach the lifting device to the tandem case.

Fig. 23
Support the weight of the differential final drive on proper blocks.

Fig. 24
Remove the tandem case from the differential final drive assembly using the lifting device. Make sure that the flanged sleeve (67) separates from the tandem and remove the tandem. Discard the gasket. If gasket eliminator compound has been used, remove all traces of the sealant.

Fig. 25
Lower the tandem on blocks.

Differential Final Drive - Removal
(cont.)

Fig. 26

Attach the lifting device to the differential final drive assembly. Support the other tandem case on proper blocks or stands.

Fig. 27

Release the tabs and remove the capscrews (139), lockplate (138) and sprocket retainer (137). Remove and discard the lockplate. Remove the capscrews (125) and lockwashers (124) retaining the differential final drive assembly to the tandem case.

Fig. 28

Remove the tandem case from the differential final drive assembly using the lifting device. Make sure that the flanged sleeve (101) separates from the tandem case. Remove and discard the gasket. If gasket eliminator compound has been used, remove all traces of the sealant.

Differential Final Drive - Disassembly

Fig. 29

Although the assembly can be overhauled on the floor, many procedures will be easier and faster by rotating the assembly in a build stand. If a stand is available, install the differential final drive using the lifting device.

Fig. 30

If you have not already done so, drain the oil from the differential final drive and both tandems. Clean and install the magnetic drain and long reach plugs.

Fig. 31

Remove the hydraulic tube (48) from the differential final drive.

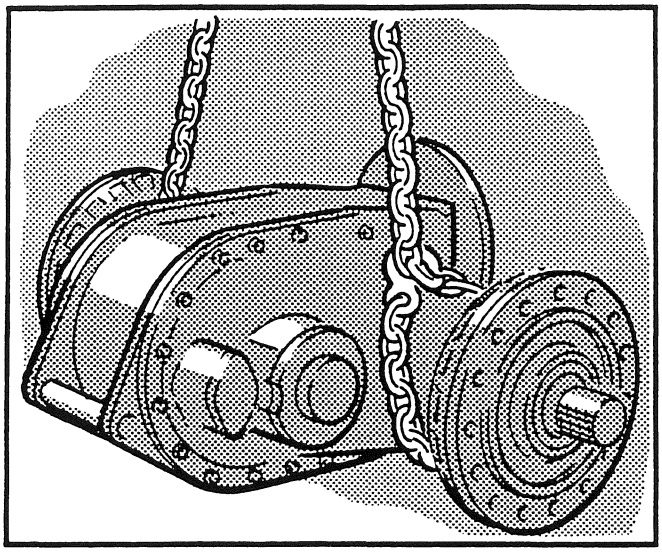
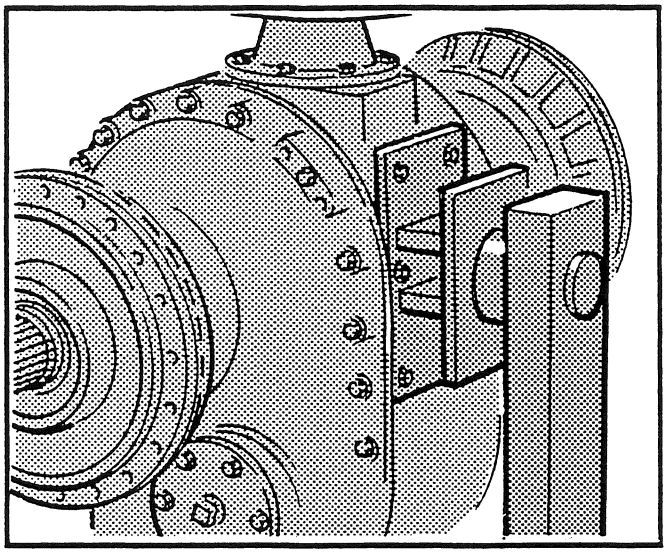


Fig. 26



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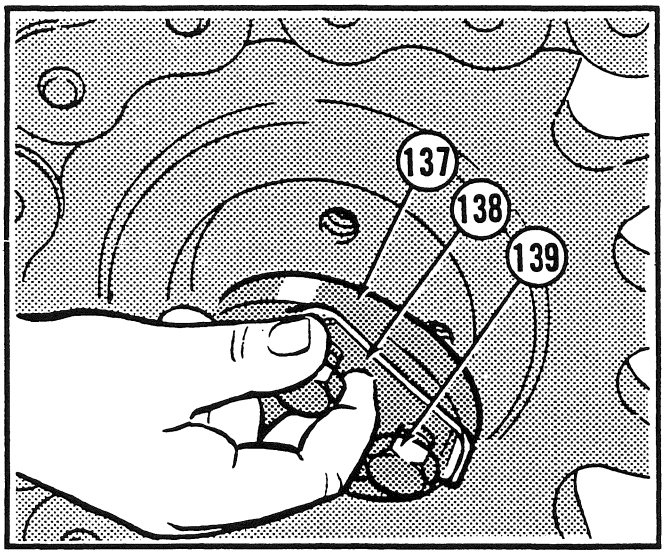

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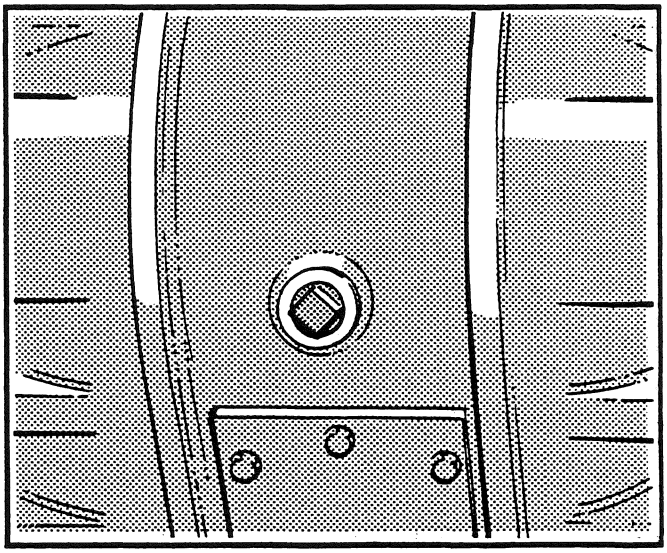

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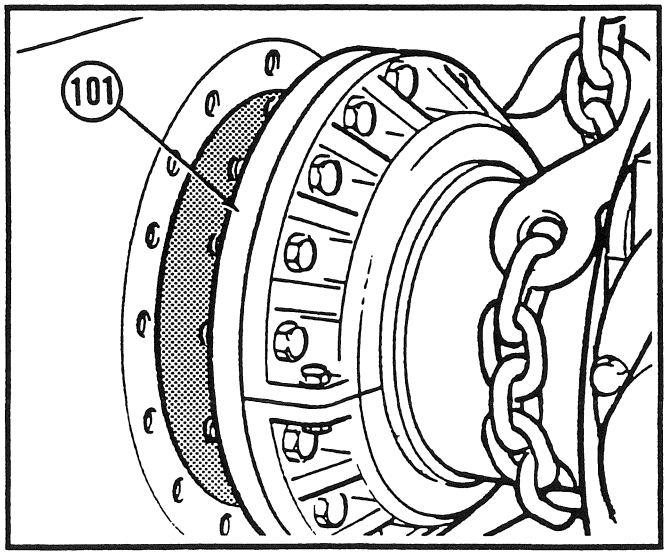


Fig. 28

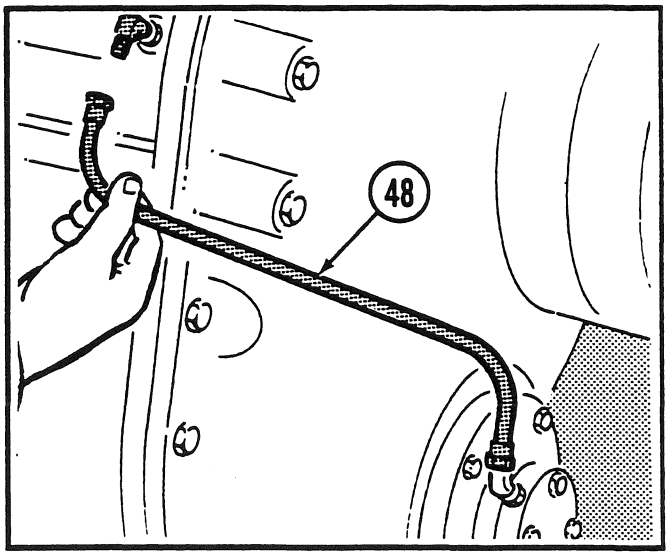


Fig. 31

LOCK/UNLOCK DIFFERENTIAL FINAL DRIVE

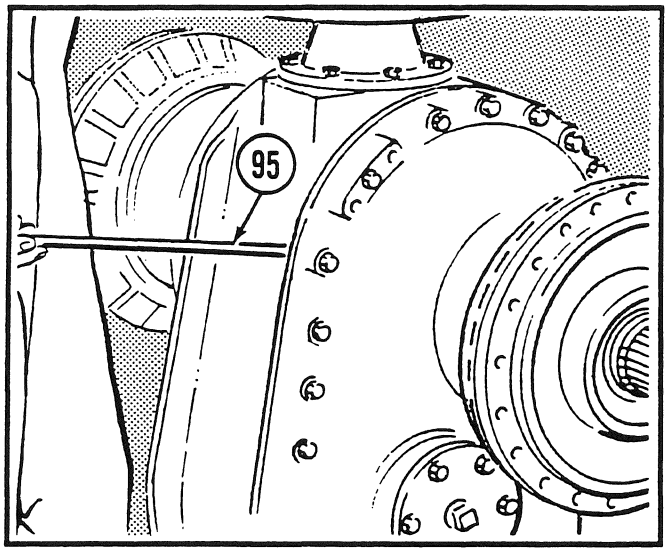
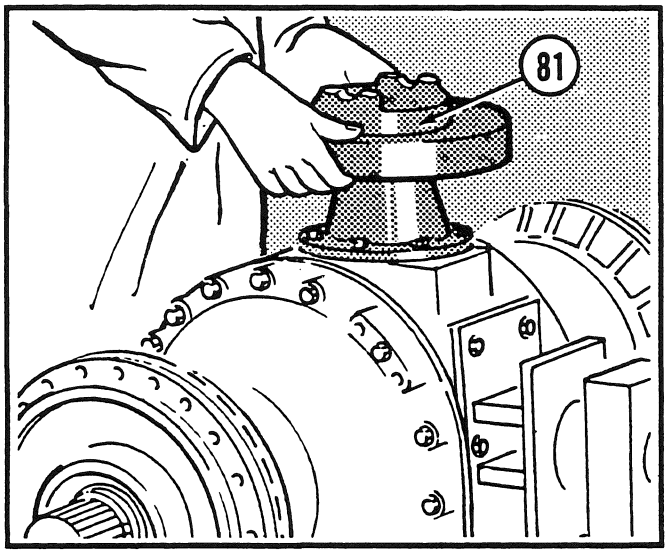


Fig. 32



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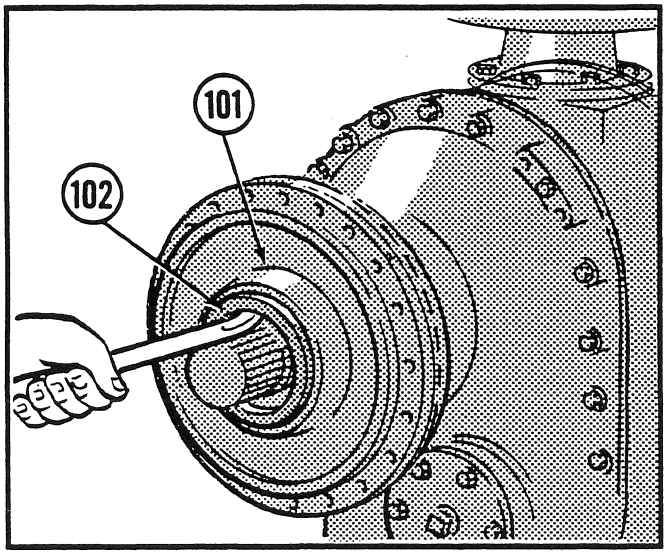

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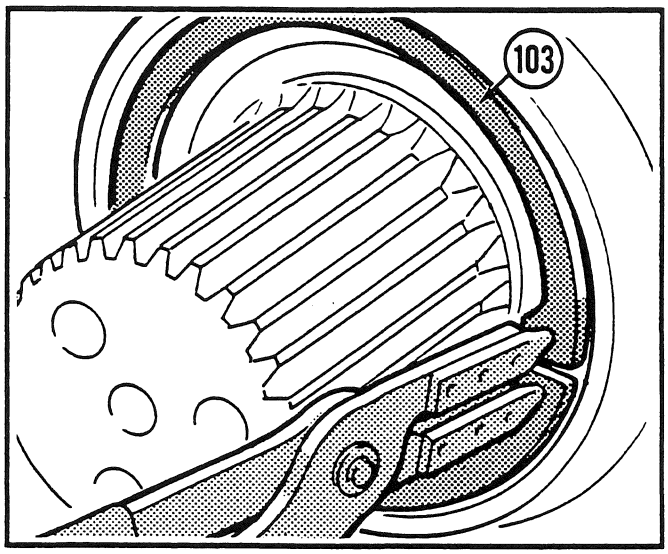

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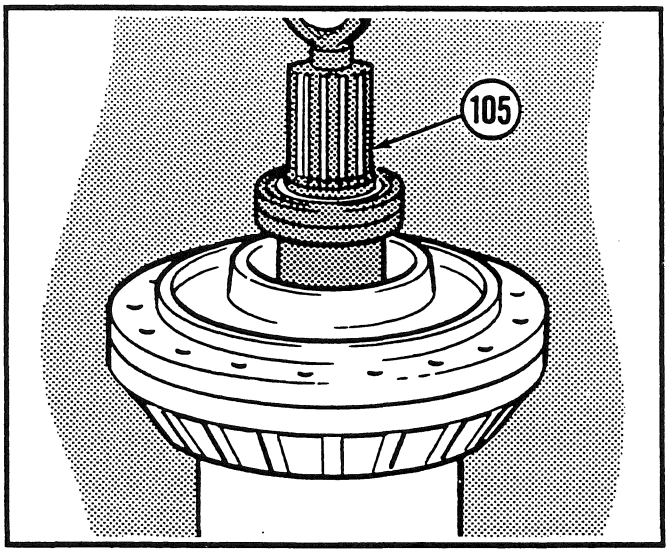

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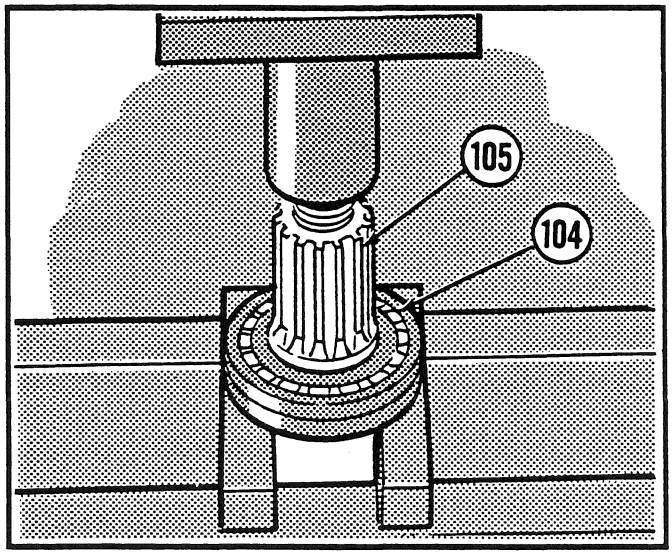


Fig. 37

Differential Final Drive - Disassembly (cont.)

Fig. 32

Remove the oil suction tube (95). The strainer will be removed later.

Fig. 33

Remove the brake flange yoke (81) and brake disc assembly.

Fig. 34

Using a pry bar, remove the oil seal (102) from the right hand flanged sleeve (101).

Fig. 35

Using snap ring pliers, remove the internal snap ring (103) from flanged sleeve.

Fig. 36

Install a lifting eye in the end of the drive axle (105). Using a hoist, remove the drive axle and bearing assembly.

Fig. 37

Remove the lifting eye from the end of the drive axle (105). Install the drive axle in a press and remove the bearing (104).

Differential Final Drive - Disassembly (cont.)

Fig. 38

Separate the split ring halves (116 and 123) and remove them from the side housing (113). The halves are a matched pair. You are recommended to assemble the halves while the overhaul is in progress.

Fig. 39

Install a lifting eye in the flanged sleeve (101). Using the hoist, remove the flanged sleeve.

Fig. 40

Remove the O ring (100) and outer thrust plate (99) from the end of the side housing (113). Discard the O ring.

Fig. 41

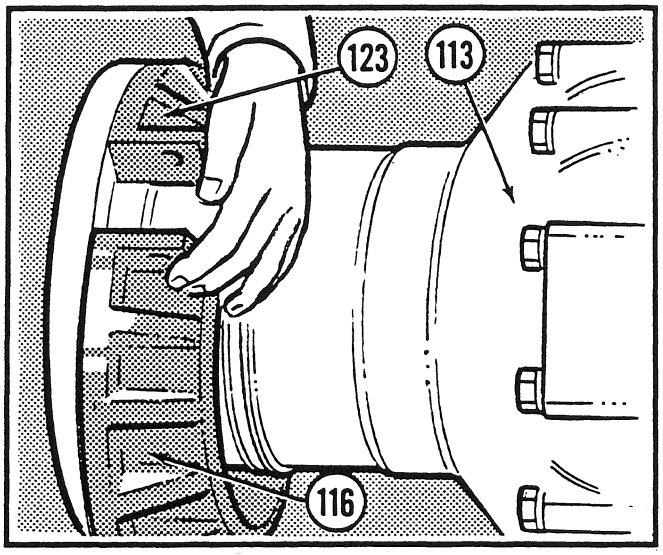
Remove the inner thrust plate (120).

Fig. 42

Using a screwdriver, lift the "Uniring" seal (117) over the side housing lip. Discard the "Uniring" seal. Remove the drive axle (66) and flanged sleeve (67) from the opposite side of the differential final drive using the procedures in Figures 34 to 42.

Fig. 43

Remove the capscrews (12) and lock-washers (11) retaining the pump end cap (1) and remove the end cap. Remove and discard the gasket (2).



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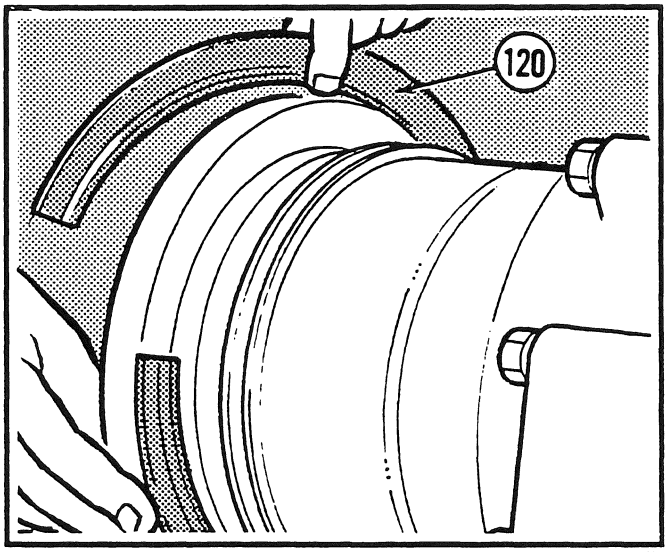
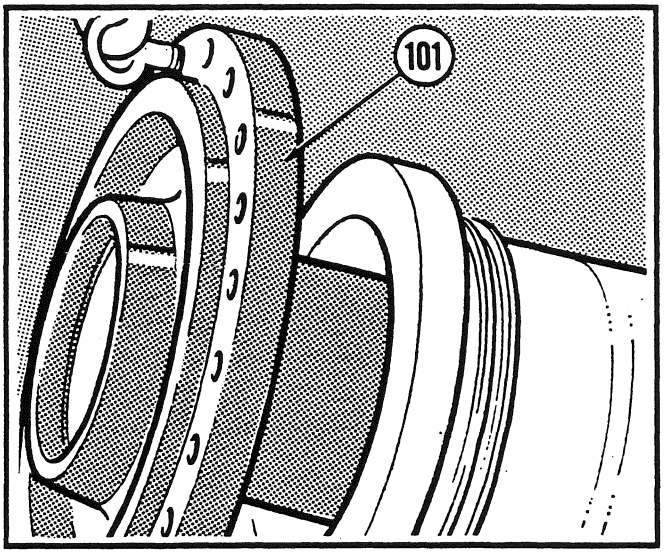


Fig. 41



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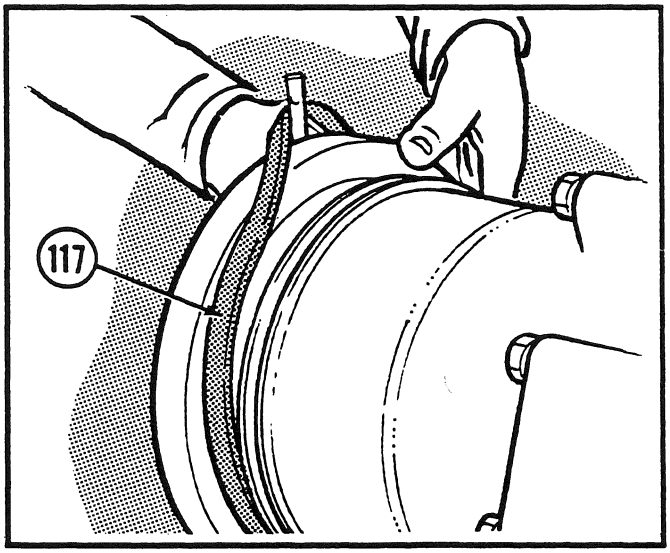
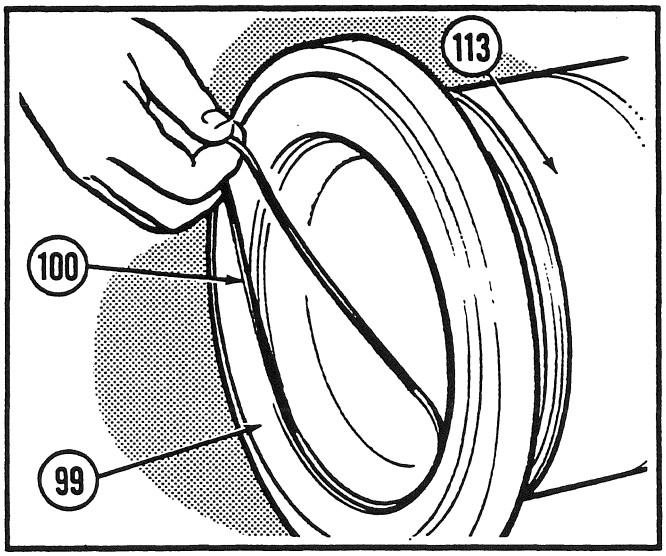


Fig. 42



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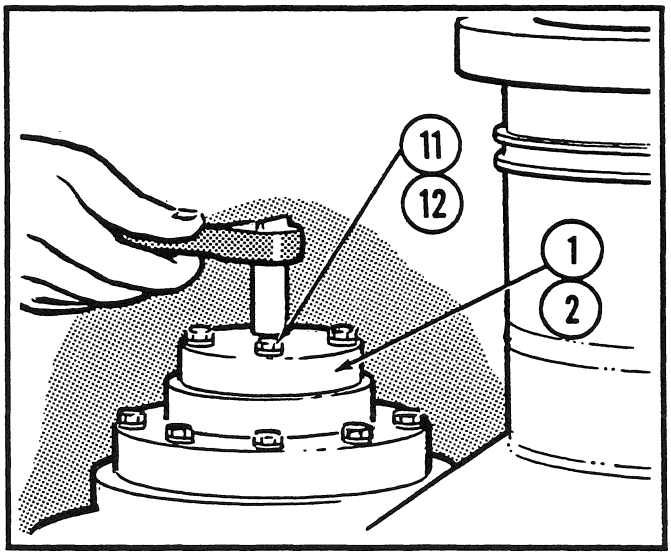

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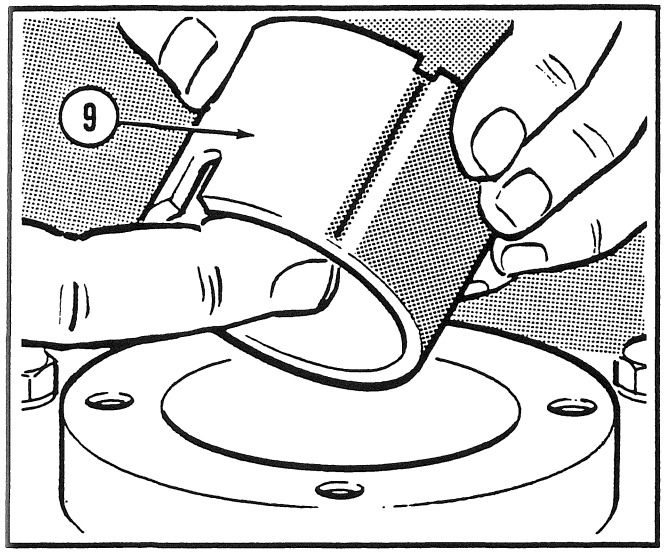
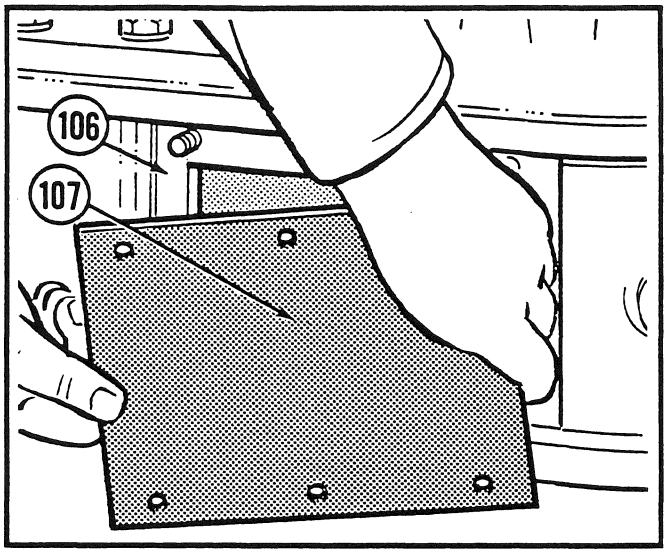


Fig. 44



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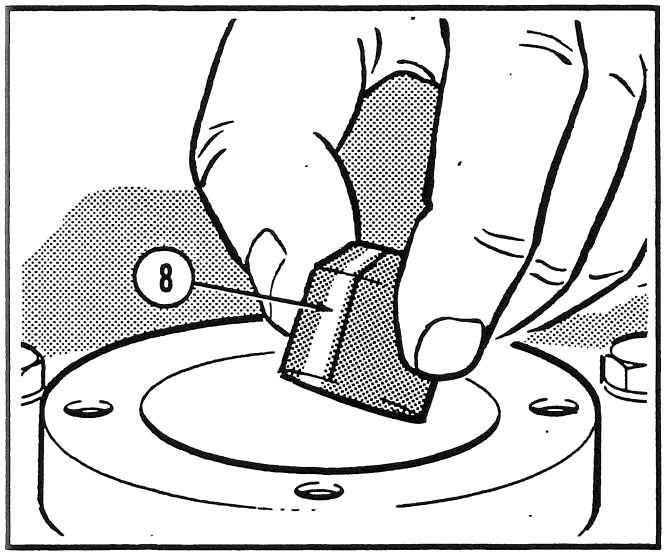

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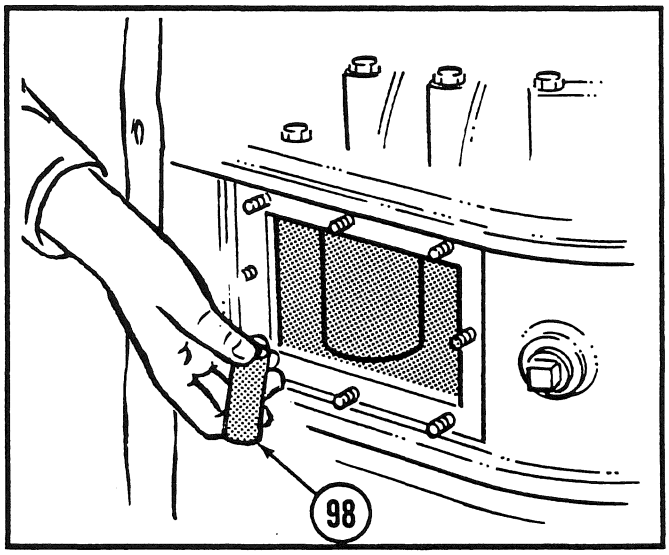

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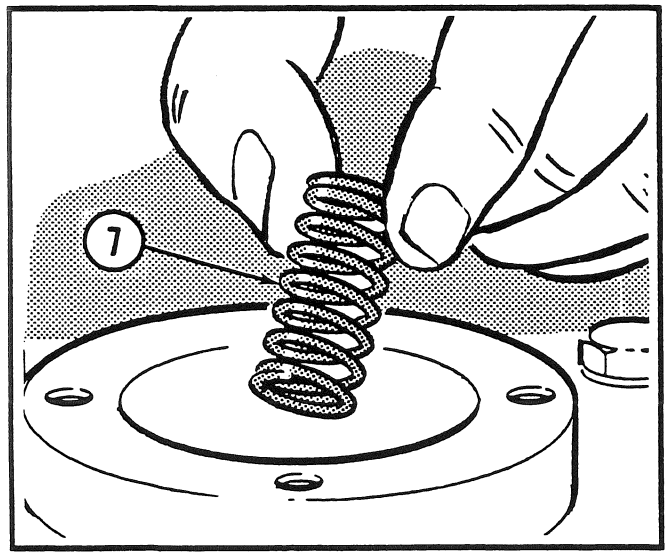

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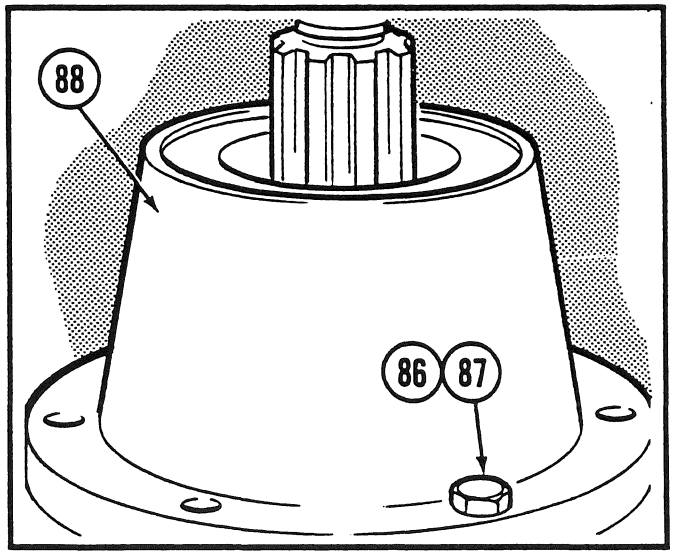


Fig. 49

Differential Final Drive - Disassembly (cont.)

Fig. 44

Remove the pump (9).

Fig. 45

Remove the plunger (8).

Fig. 46

Remove the spring (7).

Fig. 47

Remove the nuts (108) and lockwashers (109) retaining the cover plate (107). Remove and discard the gasket (106).

Fig. 48

Remove the strainer (98) from inside the main case (134) and install it on the oil suction tube (95).

Fig. 49

Remove all the capscrews (86) and lockwashers (87) retaining the pinion cap (88).

Differential Final Drive - Disassembly (cont.)

Fig. 50
Install a lifting eye on the spiral pinion shaft (94). Use the hoist to remove the pinion shaft.

Fig. 51
Remove the shims (93) and discard any that show signs of damage.

Fig. 52
Install the spiral pinion shaft in a vise with soft jaws. Using a pry bar, remove the oil seal (83) from the pinion cap (88).

Fig. 53
Using the special tool listed in the beginning of this Shop Manual section, remove the stake nut (82).

Fig. 54
Using a press, force the spiral pinion shaft (94) out of the pinion cap (88). DO NOT use a puller or hammer to remove the pinion shaft. Doing so will damage the pinion cap.

Fig. 55
Remove the outer bearing cone (84).

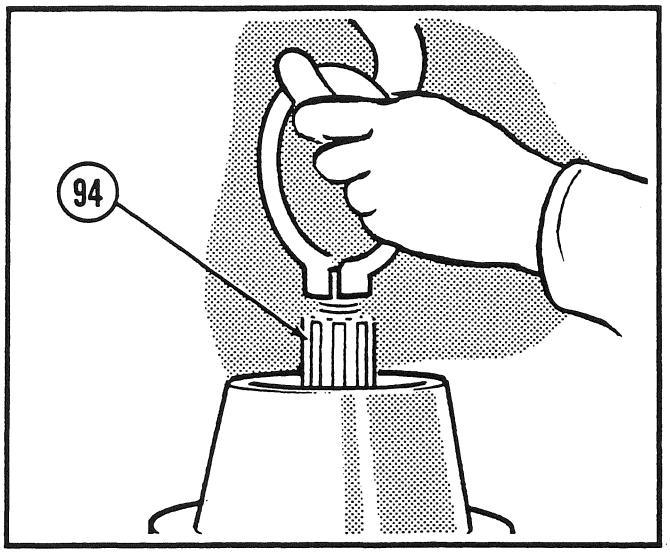


Fig. 50

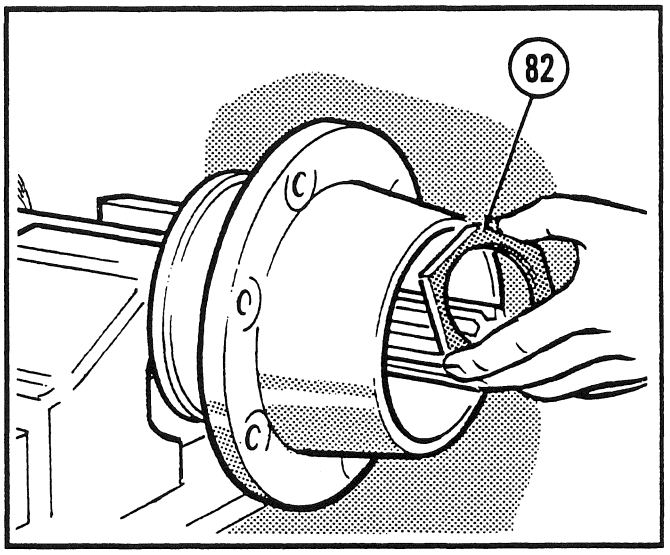


Fig. 53

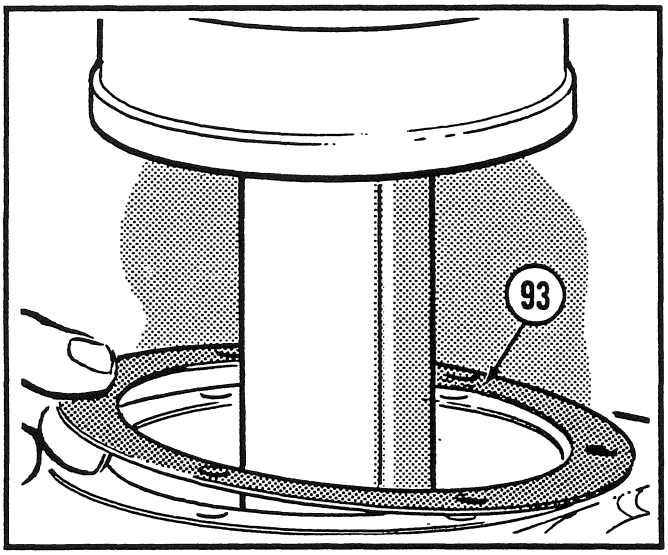
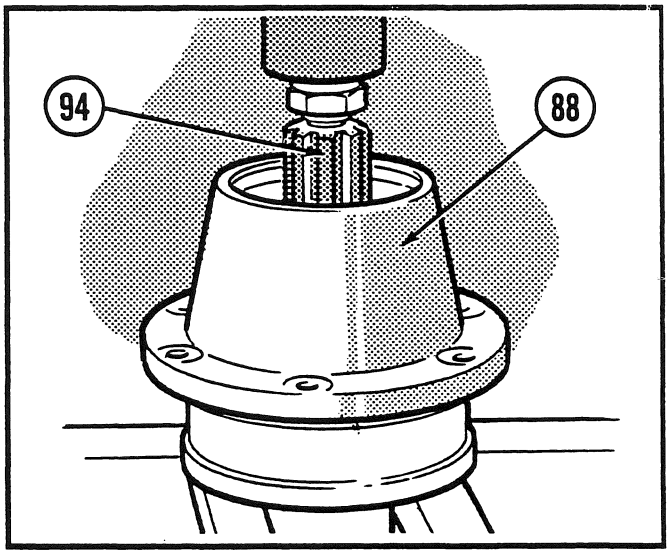


Fig. 51



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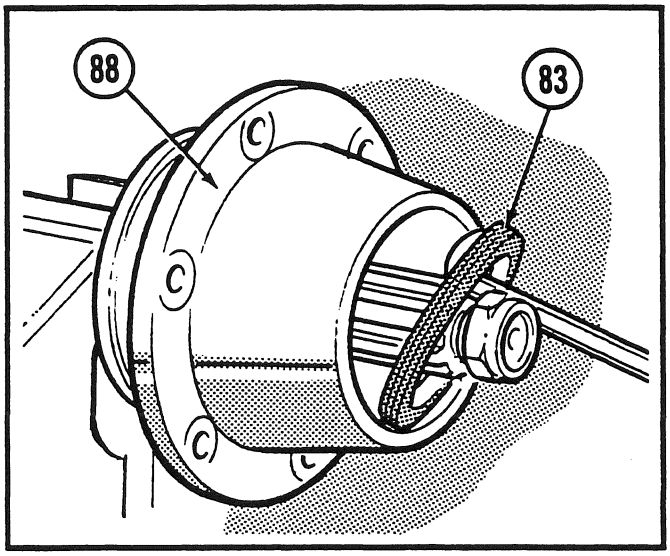


Fig. 52

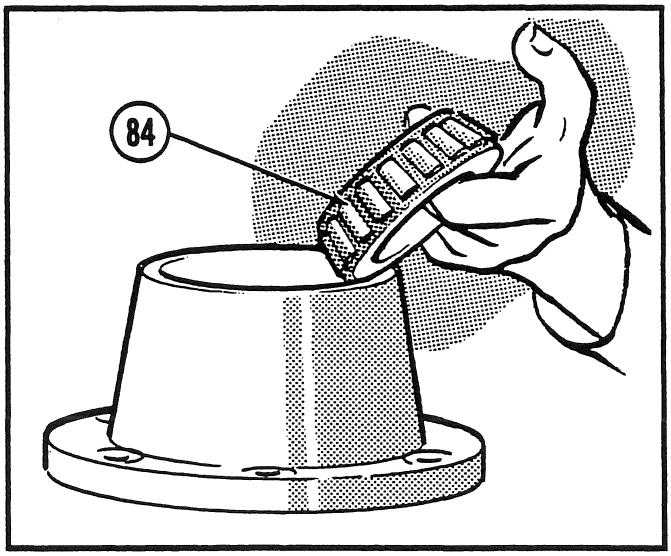
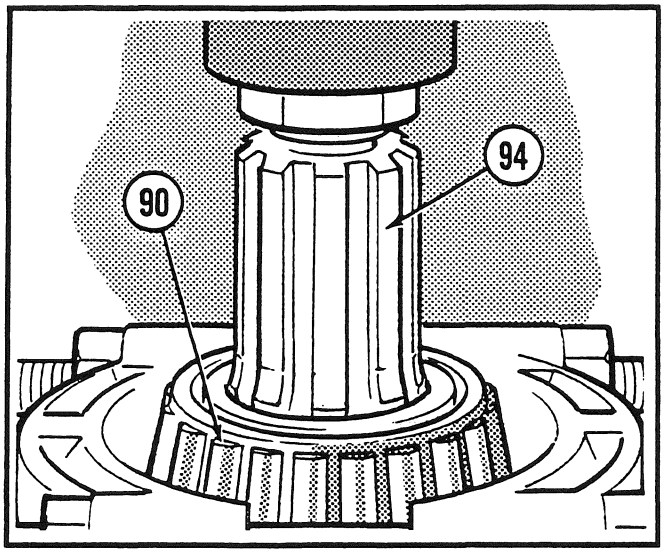


Fig. 55



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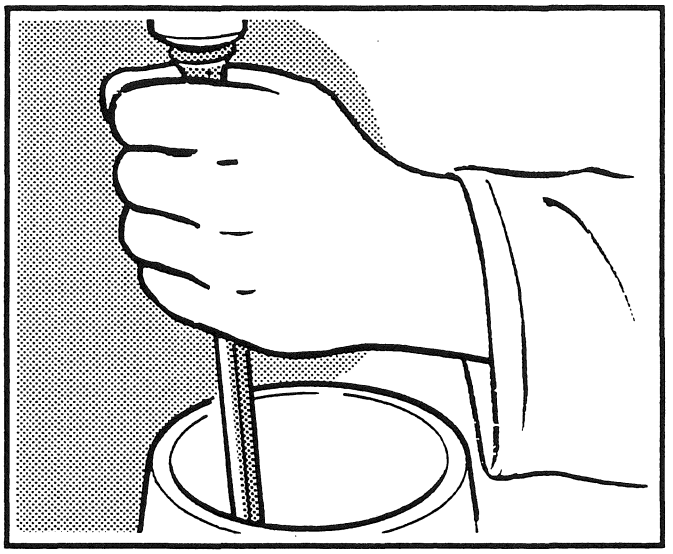

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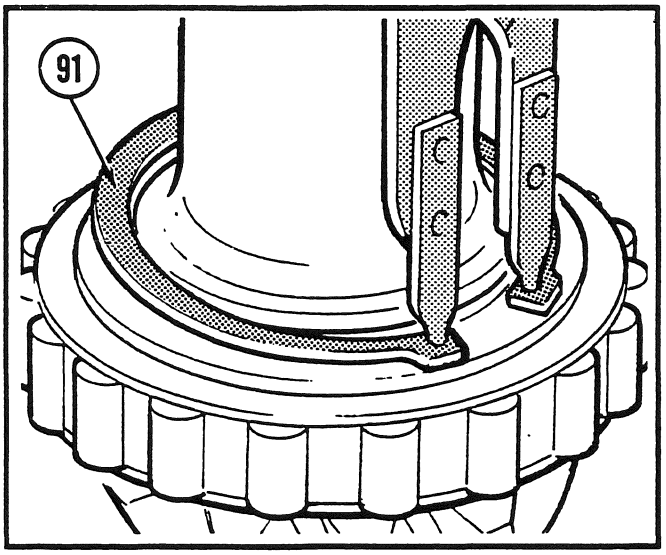

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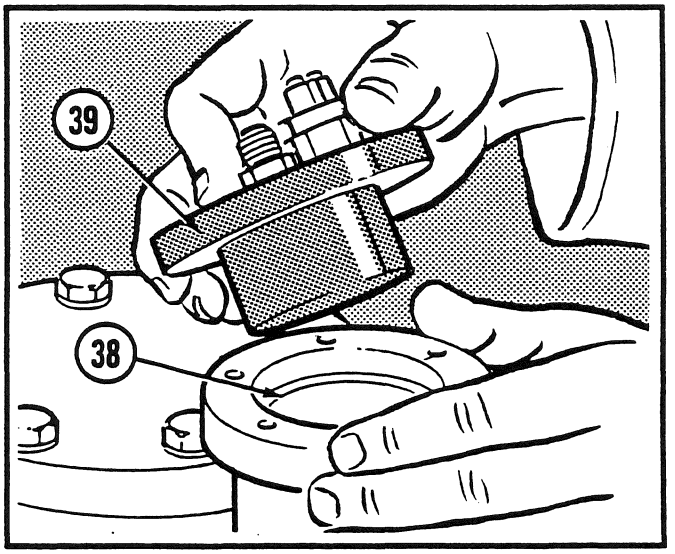

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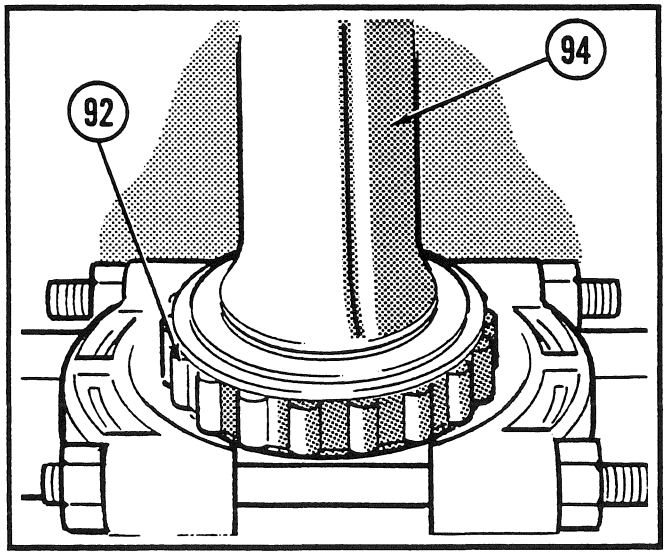

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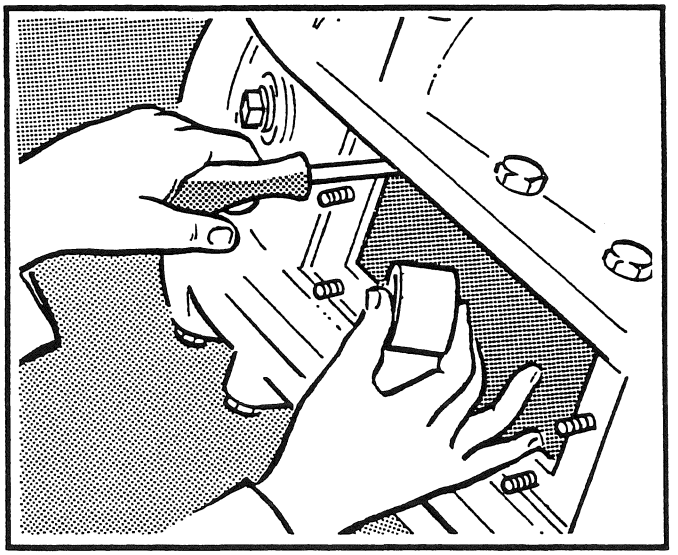


Fig. 61

Differential Final Drive - Disassembly (cont.)

Fig. 56

Using a press, remove the inner bearing cone (90) from the spiral pinion shaft (94).

Fig. 57

Using snap ring pliers, remove and discard the bearing snap ring (91).

Fig. 58

Using a press, remove the bearing (92) from the spiral pinion shaft (94).

Fig. 59

Using a soft metal drift, remove the bearing cups (85 and 89) from the pinion cap.

Fig. 60

Remove the capscrews (41) and lock-washers (40) retaining the shift cylinder cap (39) located on the left hand side housing (51). Remove the shift cylinder cap. Remove and discard the O ring (38).

Fig. 61

Gaining access through the inspection port, install a 5 cm (2 in.) spacer between the differential housing (20) and the shifter fork (28).

Differential Final Drive - Disassembly (cont.)

Fig. 62

Compress the shift cylinder spring (44) by pushing down on the piston (35). Using snap ring pliers, remove the snap ring (42) from the shift rail (31). Remove the retainer (43).

Fig. 63

Remove the piston (35). Remove and discard the piston rings (34, 36 and 37).

Fig. 64

Remove the spring (44).

Fig. 65

Remove the washer (45).

Fig. 66

Remove the capscrews (33) and lockwashers (32) retaining the shift barrel (47). Remove the shift barrel.

Fig. 67

Remove the capscrews (121 and 115) and lockwashers (122 and 114) retaining the right hand side housing (113).

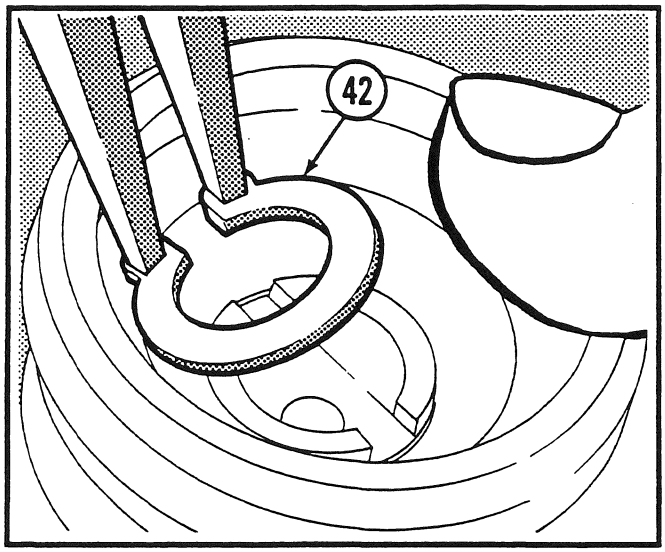


Fig. 62

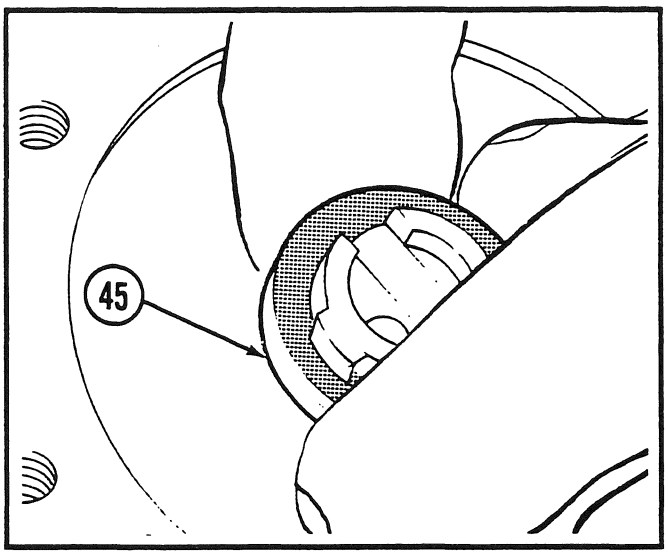


Fig. 65

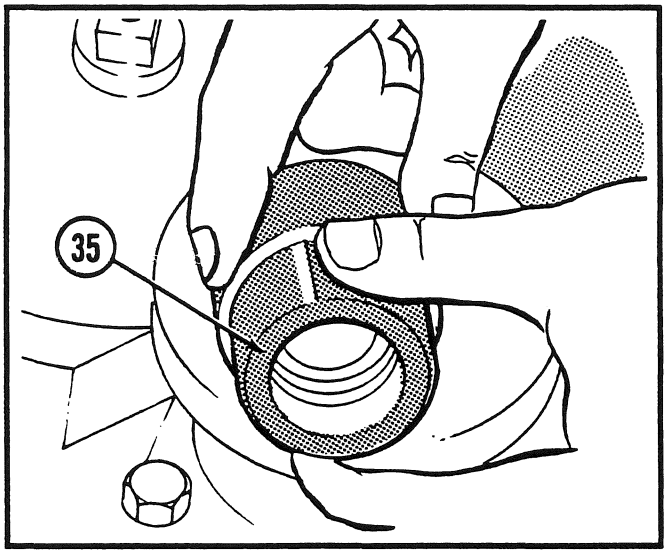
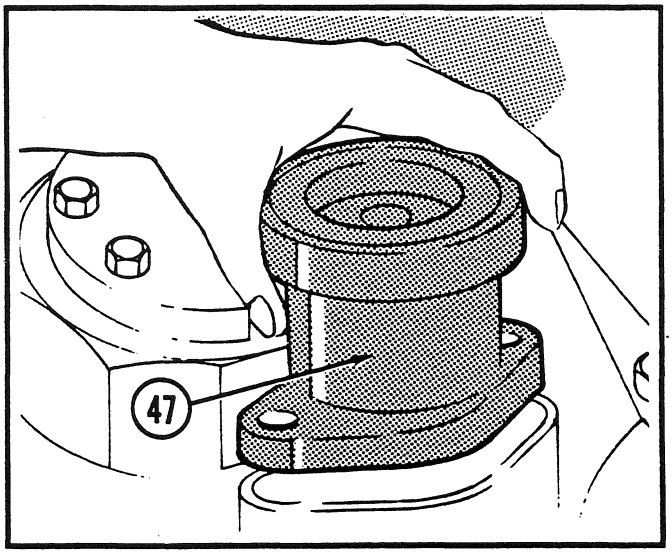


Fig. 63



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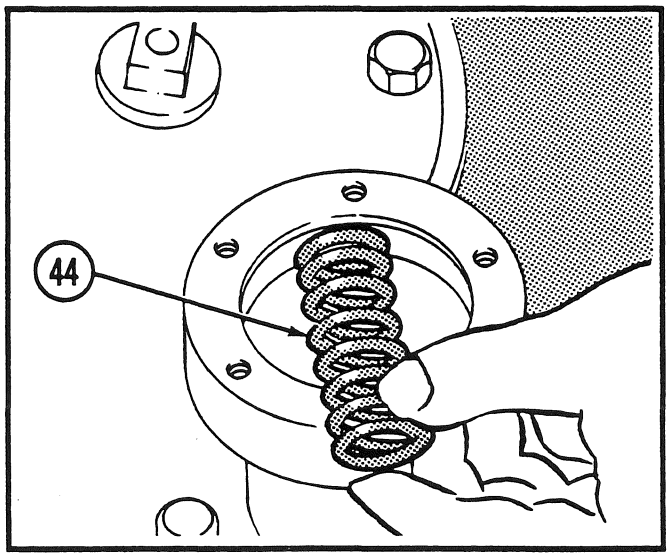
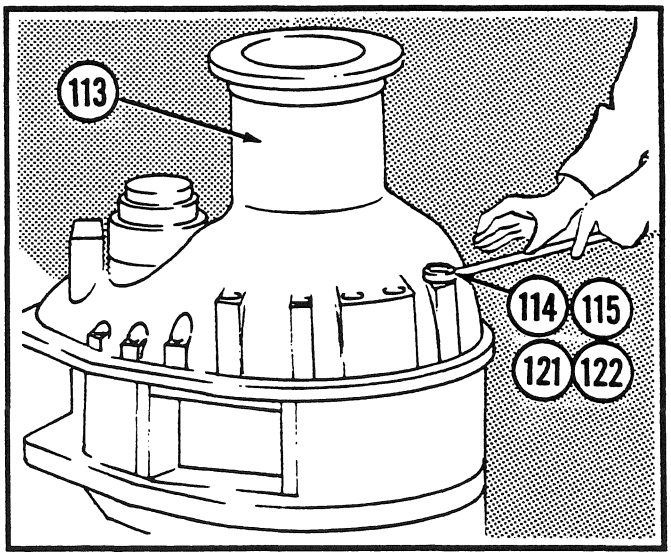


Fig. 64



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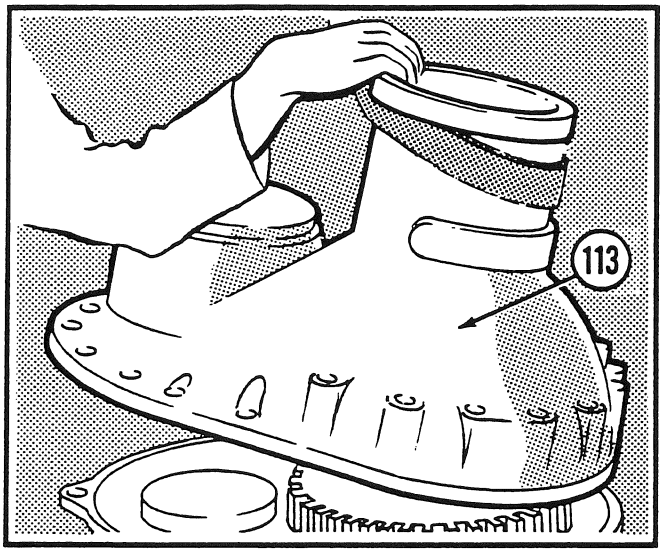

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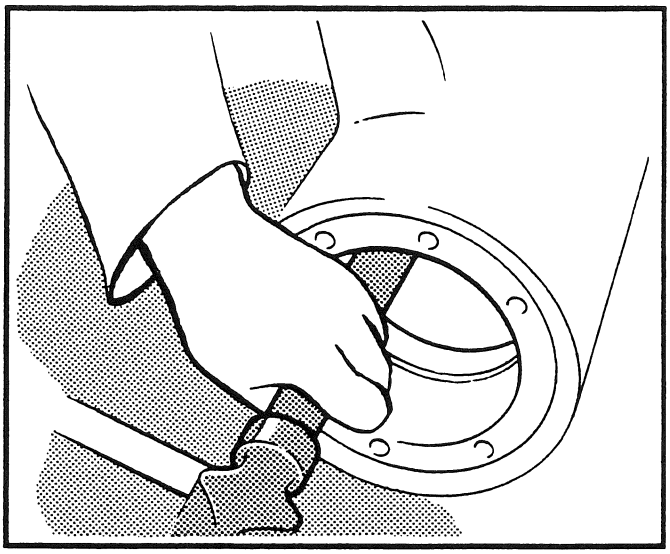

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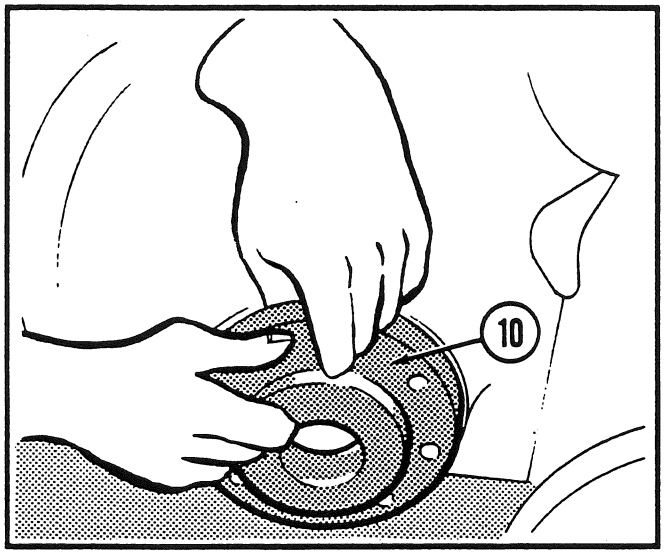

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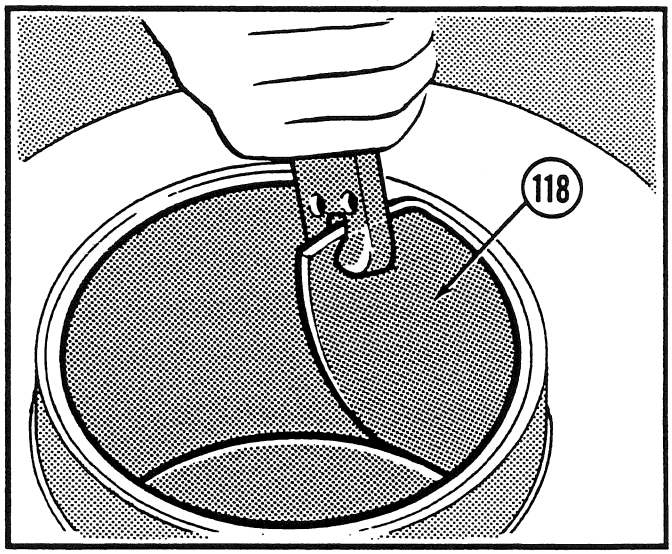

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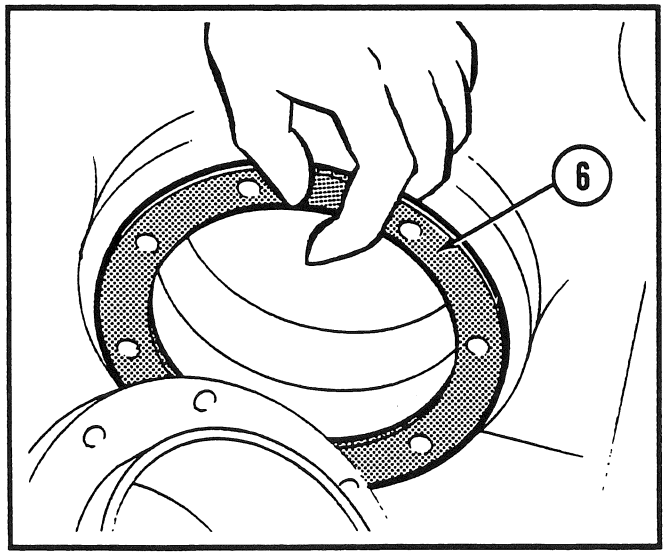


Fig. 70

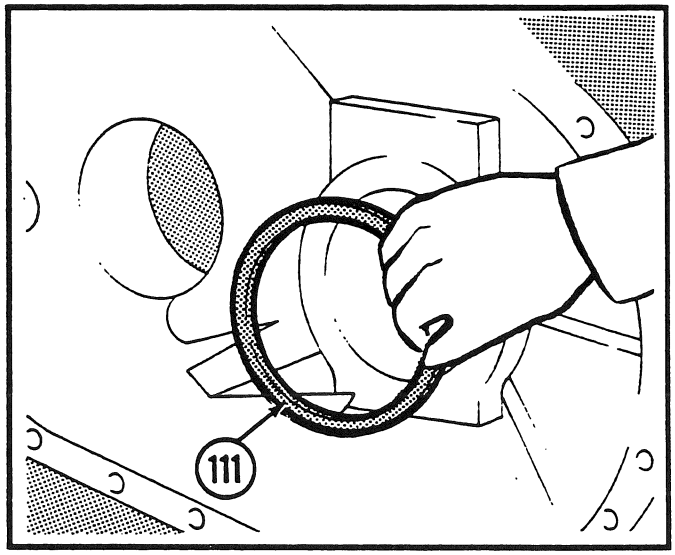


Fig. 73

Differential Final Drive - Disassembly (cont.)

Fig. 68

Attach lifting tackle to the right hand side housing (113), pry it free, and remove it. Remove and discard the gasket (112).

Fig. 69

Remove the capscrews (12) and lockwashers (11) retaining the pump mount adapter (10).

Fig. 70

Remove the pump mount adapter (10) and remove any shims (6).

Fig. 71

Using a soft metal drift, remove the cross shaft bearing cup (4) from the bearing bore.

Fig. 72

Using a hammer and chisel, lift one corner of the outer bushing (118). Using vise grips clamped on the bushing, remove the bushing. Repeat this procedure for the inner bushing (119).

Fig. 73

Using a drift, remove the bull gear outer bearing race (111) from the side housing.

Differential Final Drive - Disassembly (cont.)

Fig. 74

Remove the bull gear (110).

Fig. 75

Check the bull gear inner bearing races (111) for damage. Replace the complete bearing if necessary.

Fig. 76

Remove two socket head capscrews (17) from the differential housing (20) and install lifting eyes.

Fig. 77

Remove the cross shaft and differential housing assembly from the main case (134) using the lifting device. Place the assembly on a clean work bench.

Fig. 78

Remove the bearing locknut (3) from the end of the cross shaft (49).

Fig. 79

Remove the bearing cone (5) from the cross shaft using an appropriate puller.

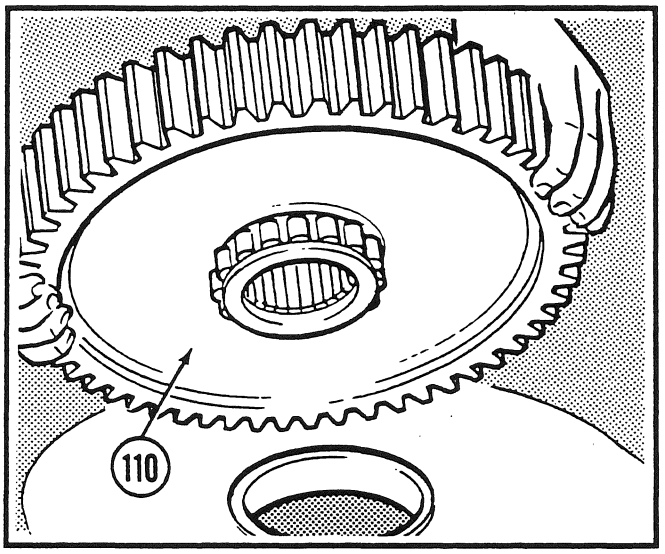
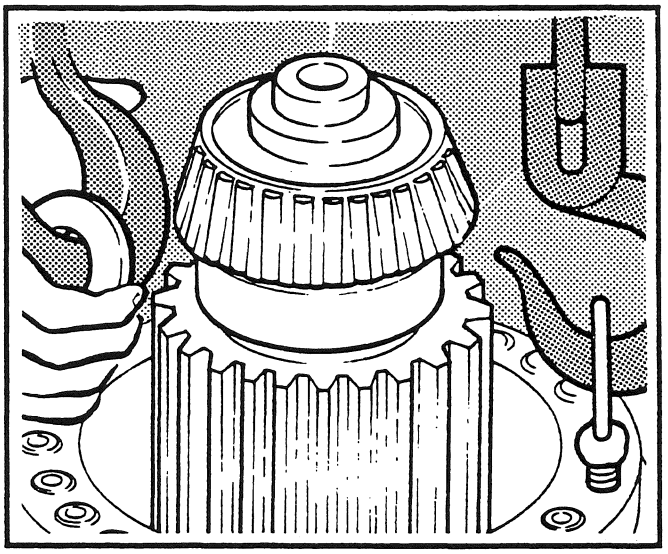


Fig. 74



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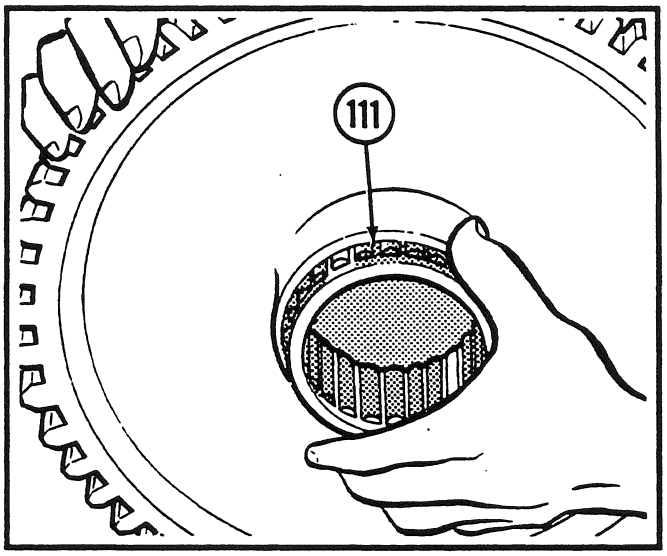

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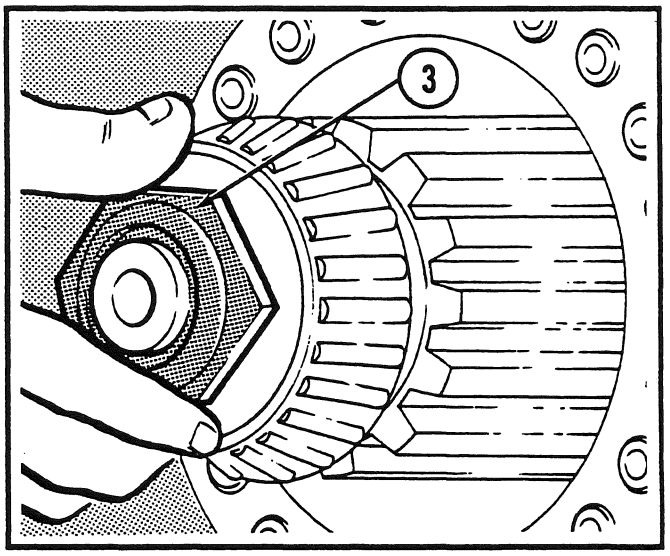

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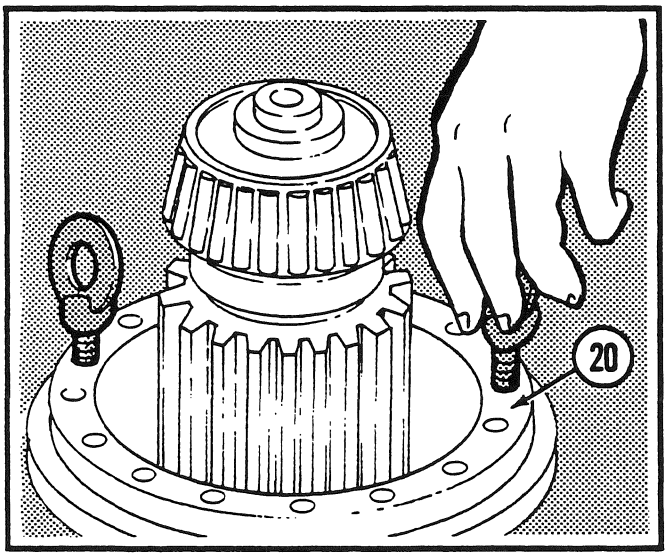

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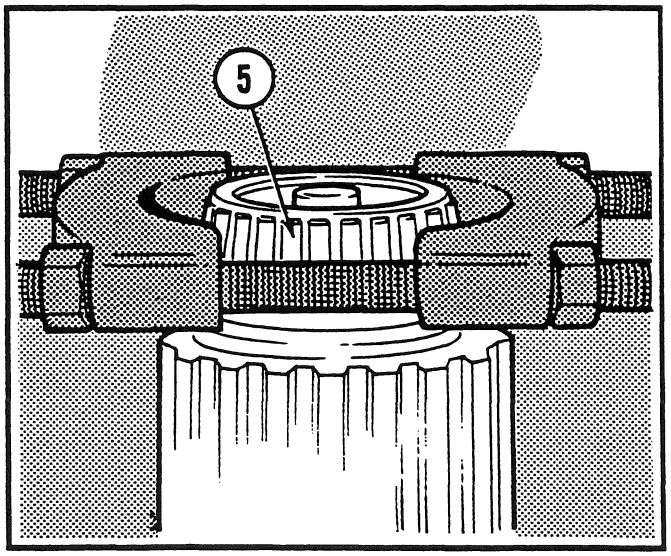

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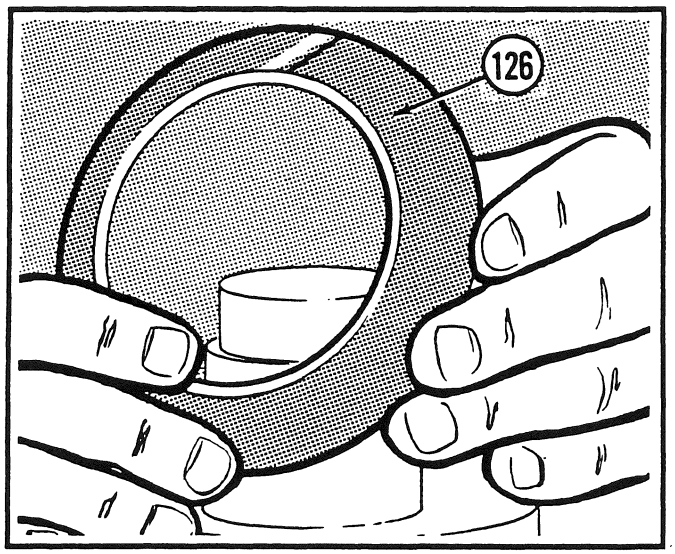

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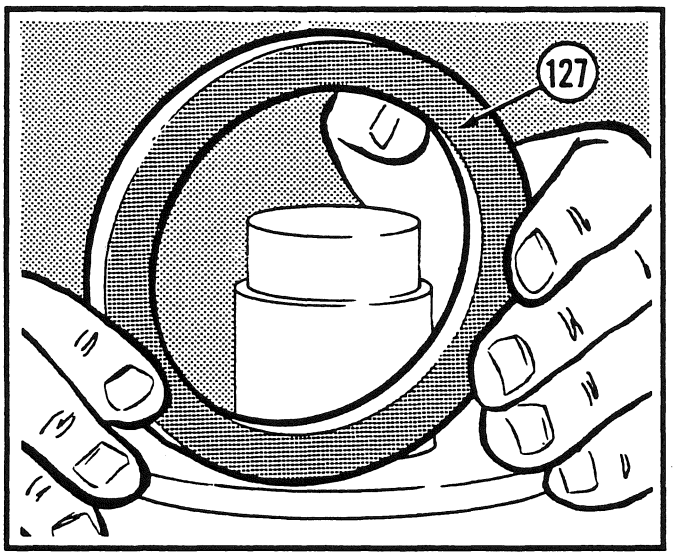

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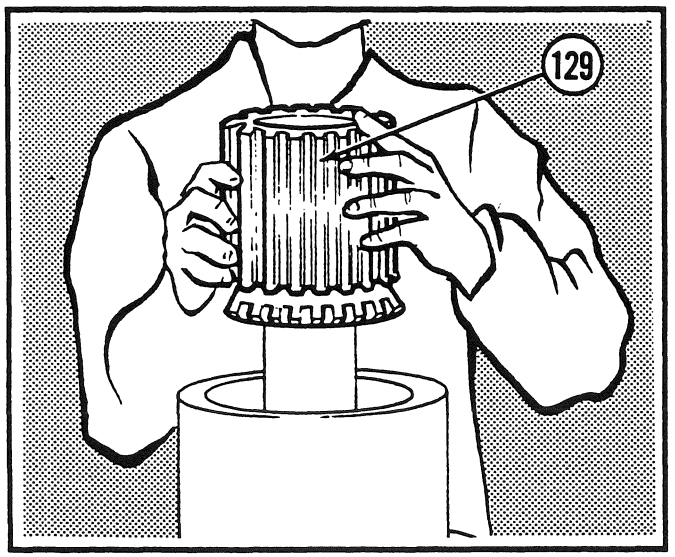

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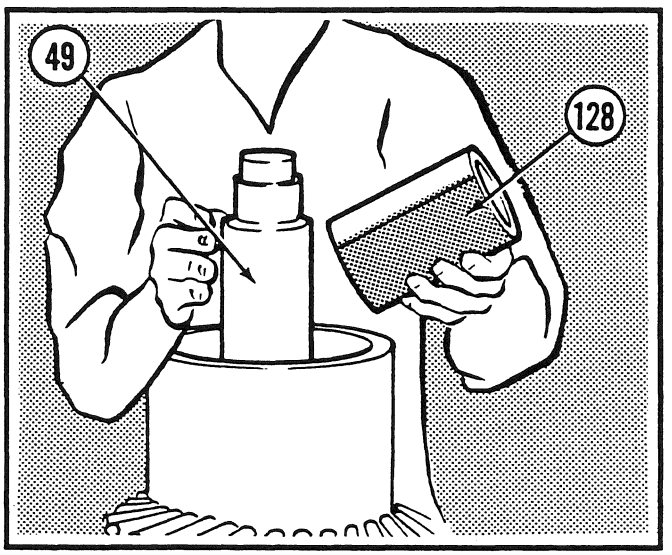

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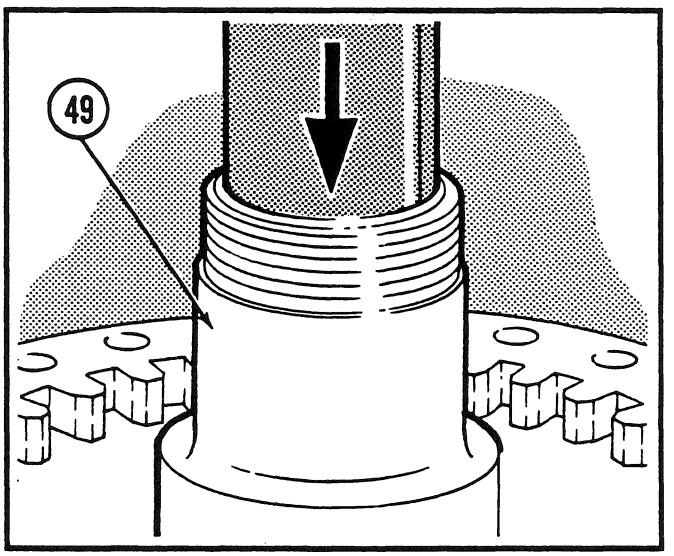

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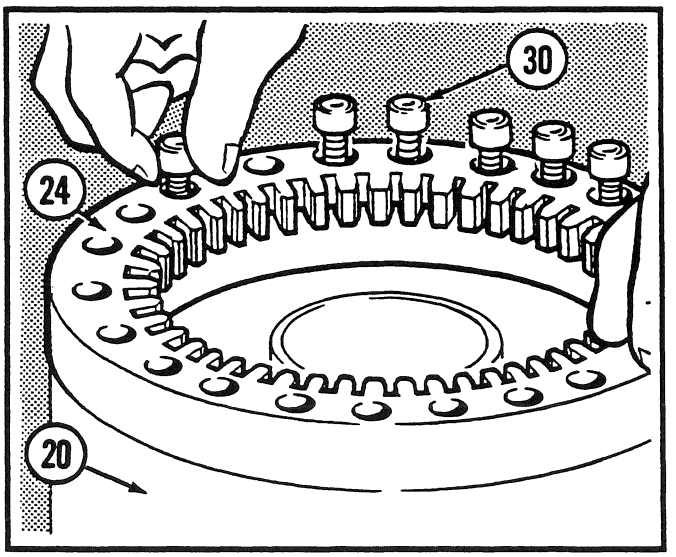


Fig. 85

Differential Final Drive - Disassembly (cont.)

Fig. 80

Remove the thrust washer (126).

Fig. 81

Remove the thrust bearing (127).

Fig. 82

Remove the spider pinion gear (129).

Fig. 83

Remove the pinion sleeve (128) from the cross shaft (49). Repeat the procedures described in Figure 78 through Figure 81 to disassemble the opposite end of the cross shaft.

Fig. 84

Using a press, force the cross shaft (49) out of the differential housing (20).

Fig. 85

Remove the socket head capscrews (30) retaining the shift clutch gear (24) to the differential housing (20).

Differential Final Drive - Disassembly (cont.)

Fig. 86

Using a long drift, remove the three dowel pins (29) from the housing (20). The dowel pins are used to retain the spider gear pins (13).

Fig. 87

Remove the shift clutch gear (24) from the differential housing (20).

Fig. 88

Turn the housing over and remove the capscrews (17) retaining the spiral pinion gear (21).

Fig. 89

To release the spiral pinion gear (21) from the differential housing (20), use a suitable drift to carefully remove the four dowel pins (14).

Fig. 90

Remove the spider gear pins (13) from the differential housing (20).

Fig. 91

Remove the three spider gears (15), bushings (16), needle thrust bearings (18), and washers (19).

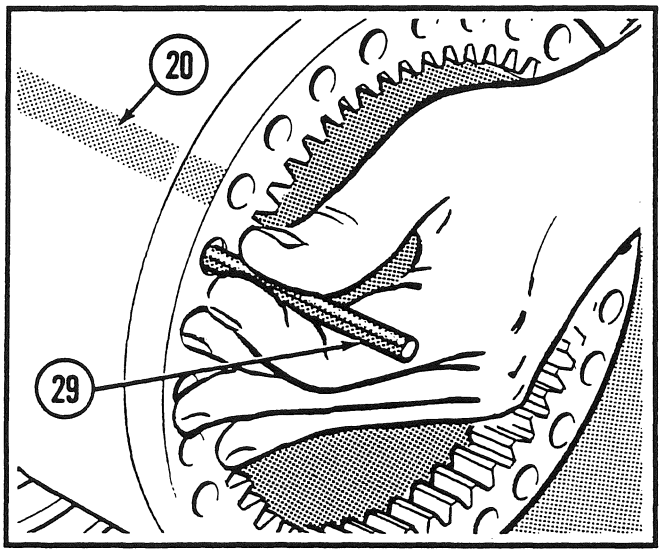
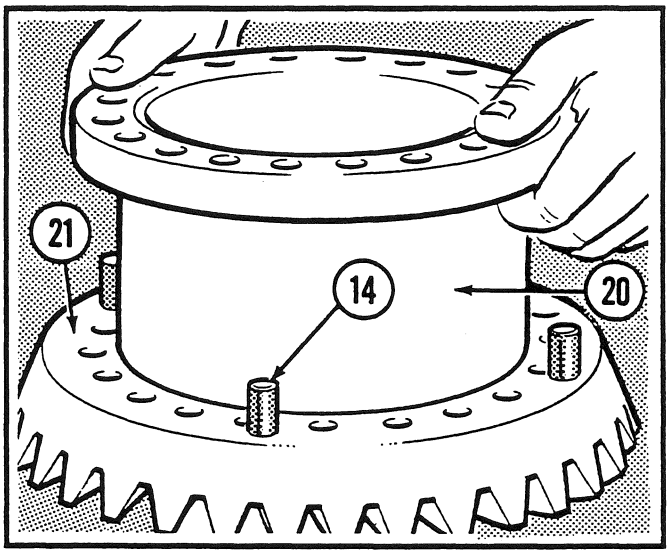


Fig. 86



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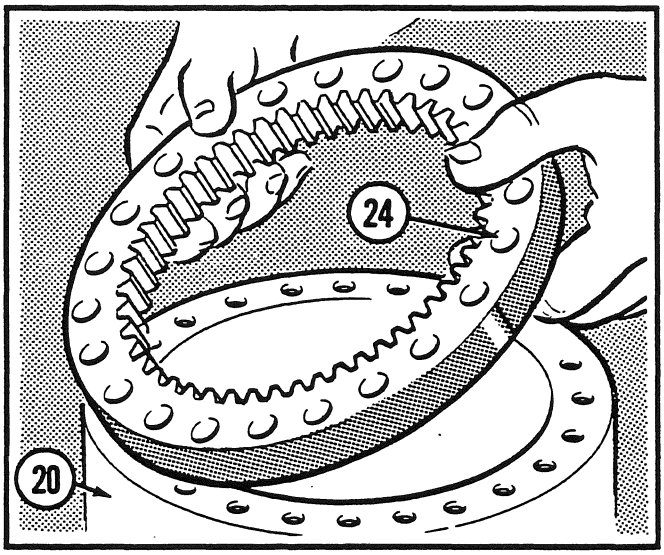
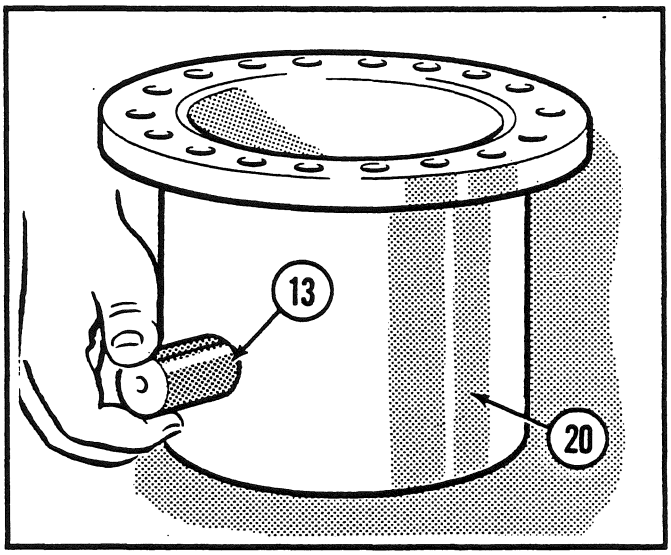


Fig. 87



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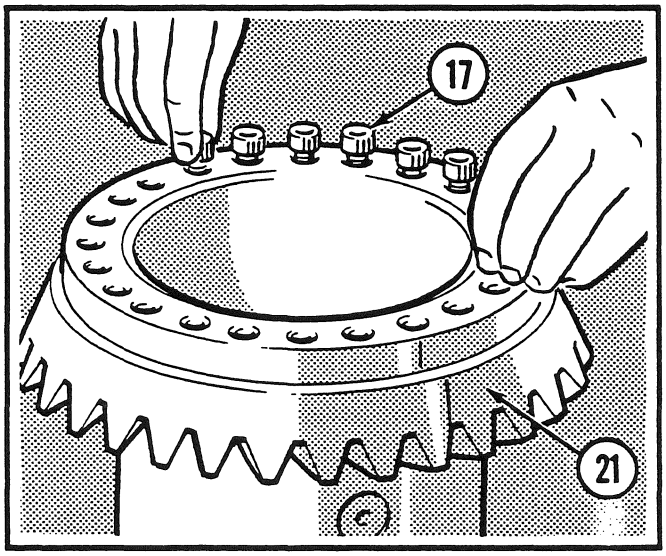


Fig. 88

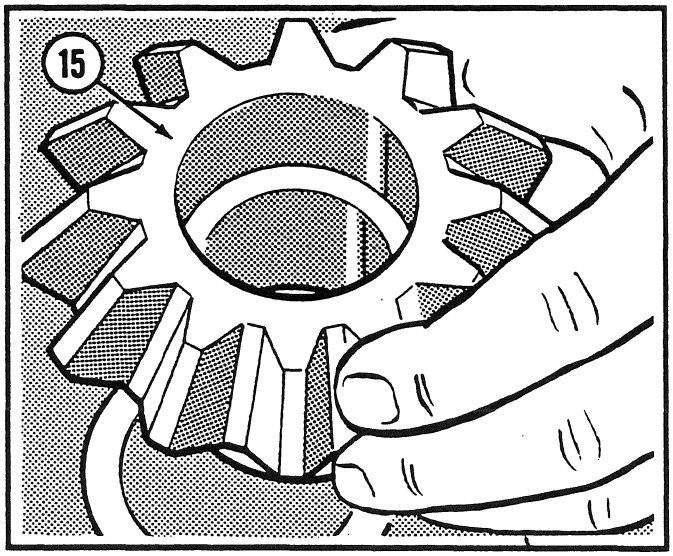
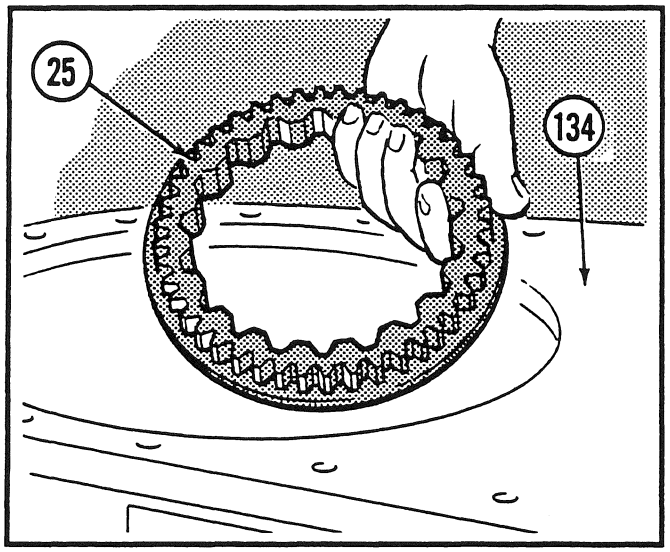


Fig. 91



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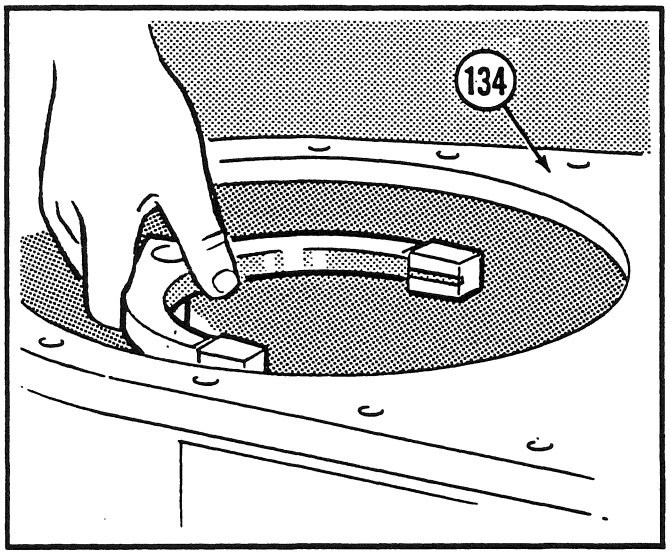


Fig. 93

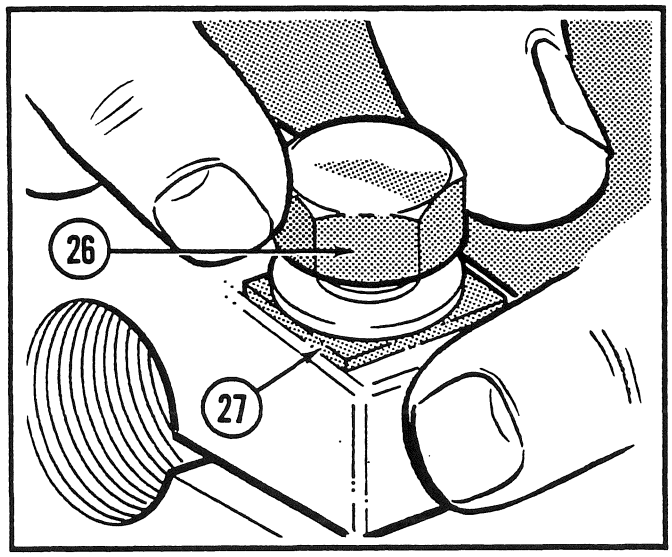


Fig. 94

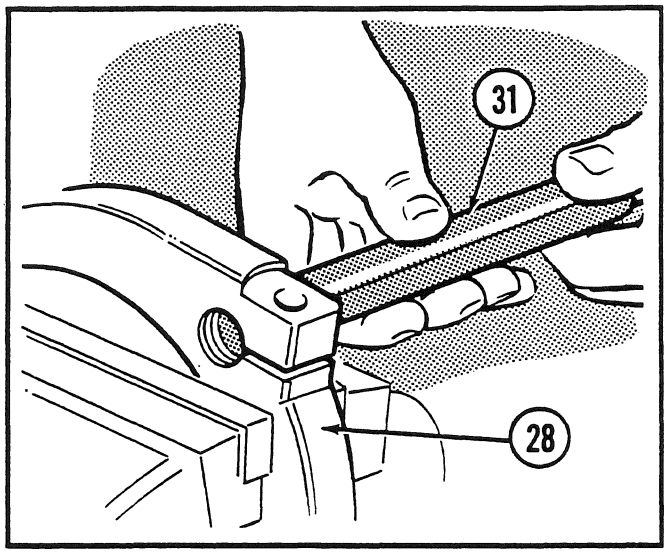


Fig. 95

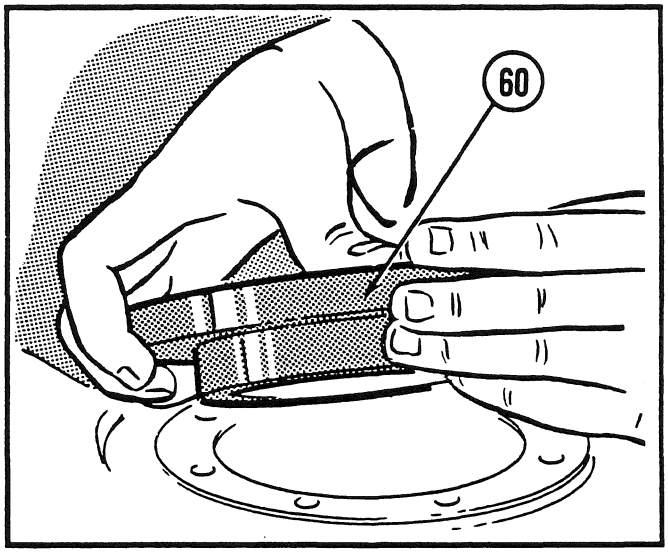


Fig. 96

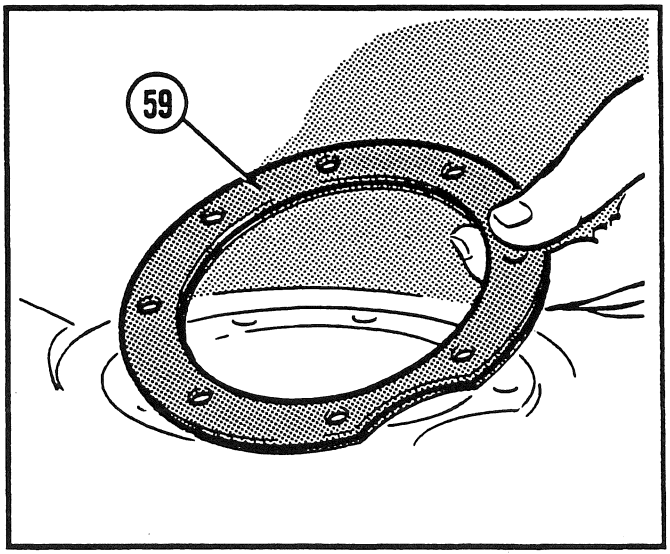


Fig. 97

Differential Final Drive - Disassembly (cont.)

Fig. 92

Remove the shift clutch (25) from the shifter fork (28). Remove the shift clutch from the main case (134).

Fig. 93

Remove the shifter fork assembly from the main case (134).

Fig. 94

Release the tabwasher (27) and loosen the shifter fork lockscrew (26).

Fig. 95

Unscrew the shift rail (31) from the shifter fork (28).

Fig. 96

Remove the capscrews (62) and lockwashers (61) retaining the cross shaft bearing cap (60) and remove the cap.

Fig. 97

Remove the cross shaft bearing cap shim pack (59) and discard any fiber shims. Put steel shims aside for reuse.

Differential Final Drive - Disassembly (cont.)

Fig. 98

Using a pry bar, remove the shift rail oil seals (46). Repeat the procedures described in Figure 67 to Figure 75 to remove the left side housing (51), bull gear (75), and other related components.

Fig. 99

Remove the lockscrew (97) and lockwasher (96) securing the pinion bearing outer race (92) to the main case (134).

Fig. 100

Using a soft metal drift, remove the outer race (92) from the main case (134). Disassembly of the differential final drive is now complete.

Fig. 101

Discard all O rings, seals, gaskets, and snap rings.

Fig. 102

Clean the housings in a hot tank, then carefully rinse and dry them.

Fig. 103

Clean gears, shafts and bearings with solvent. Inspect for any scratches, damage or wear. Use an approved crack detection process whenever possible.

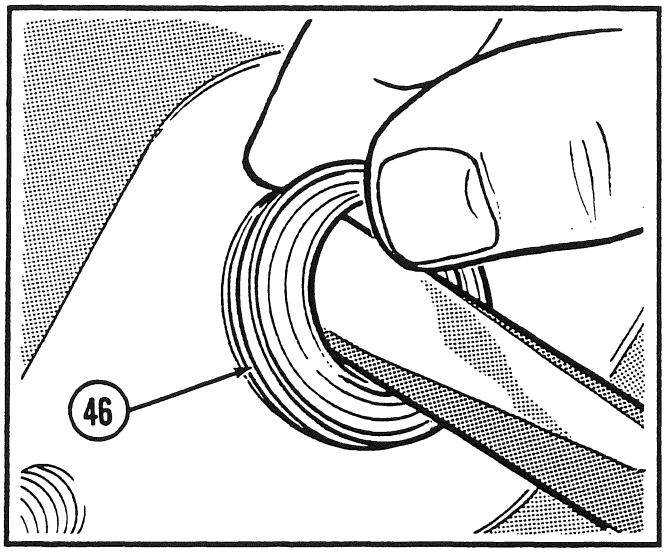


Fig. 98

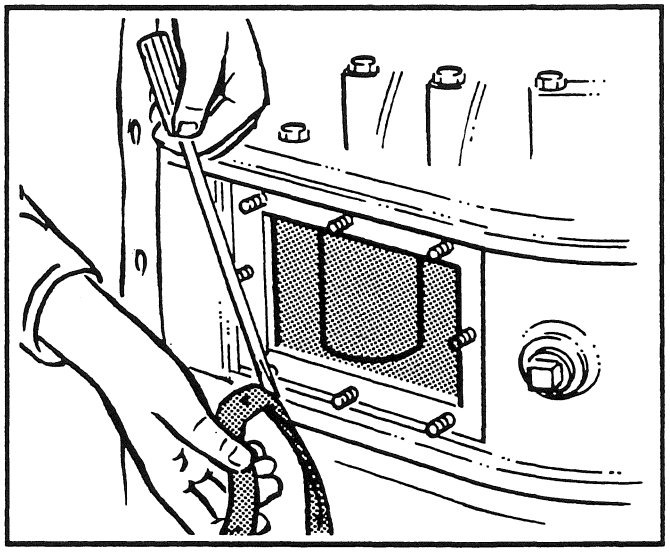


Fig. 101

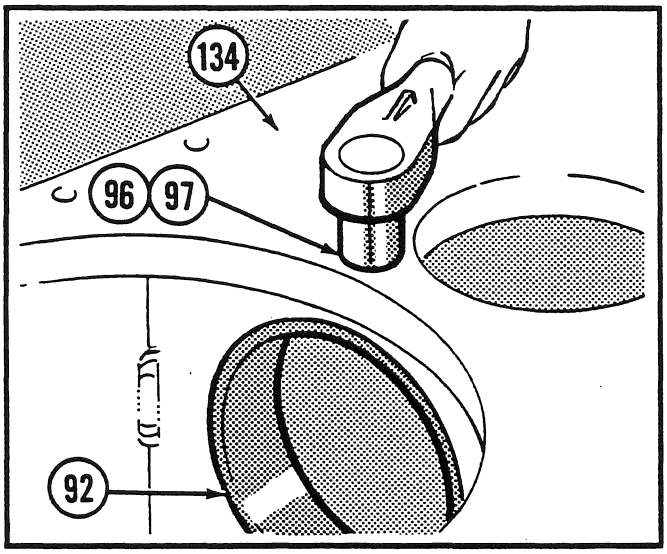


Fig. 99

Fig. 102

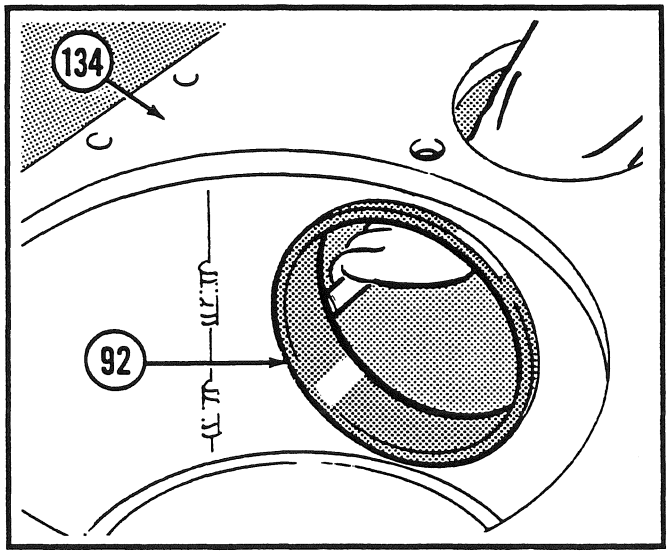


Fig. 100

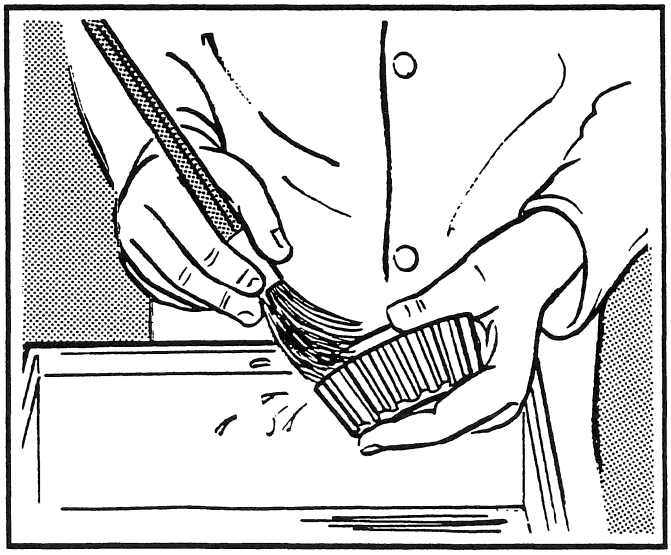


Fig. 103

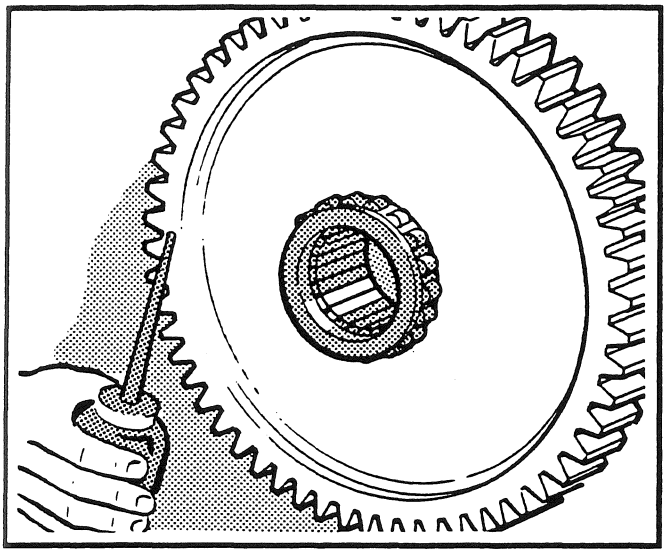
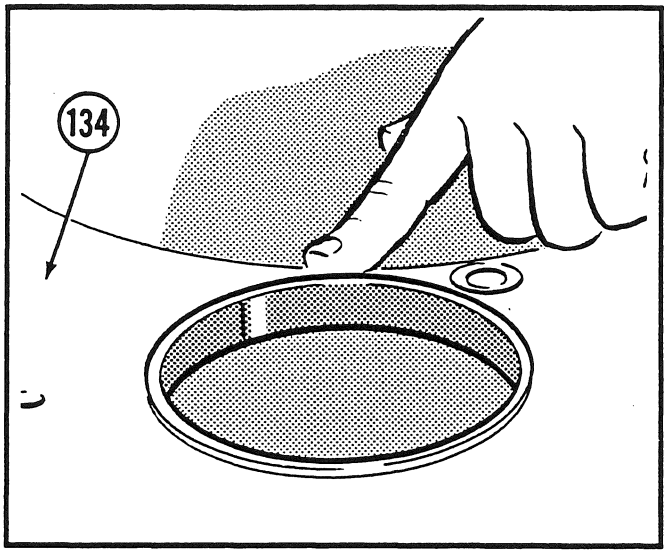


Fig. 104



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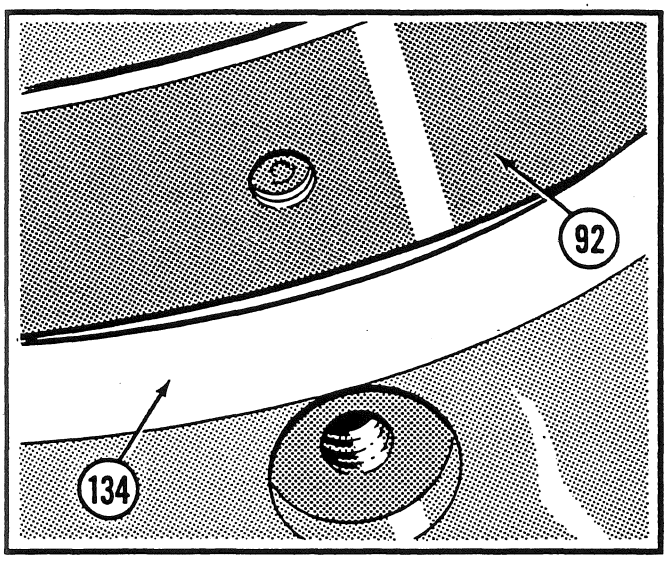
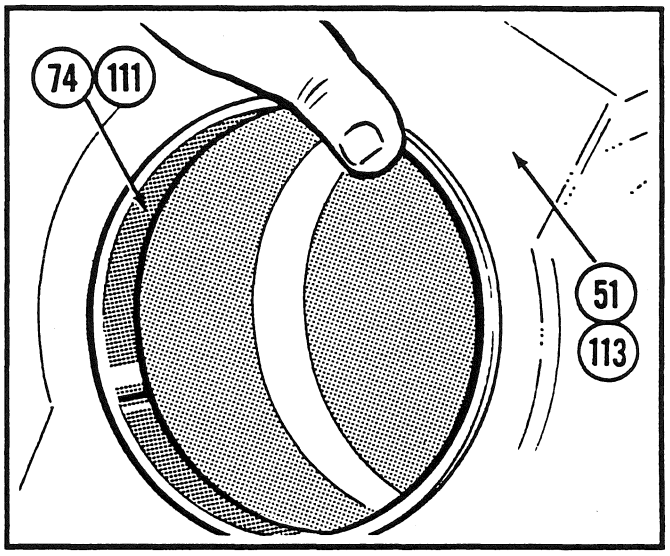


Fig. 105



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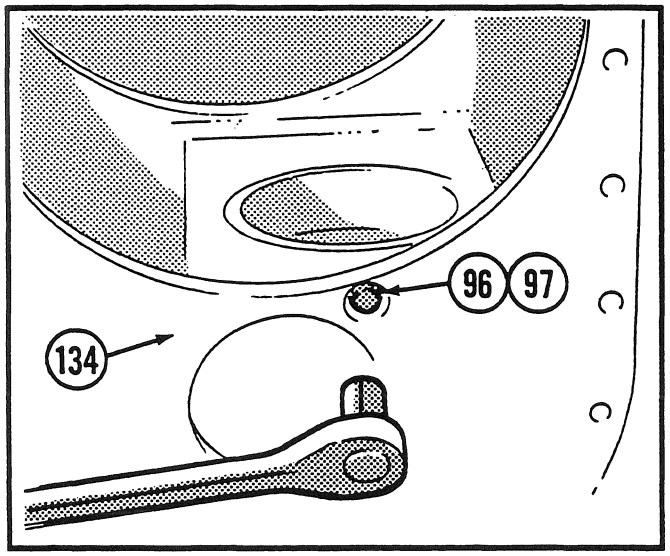

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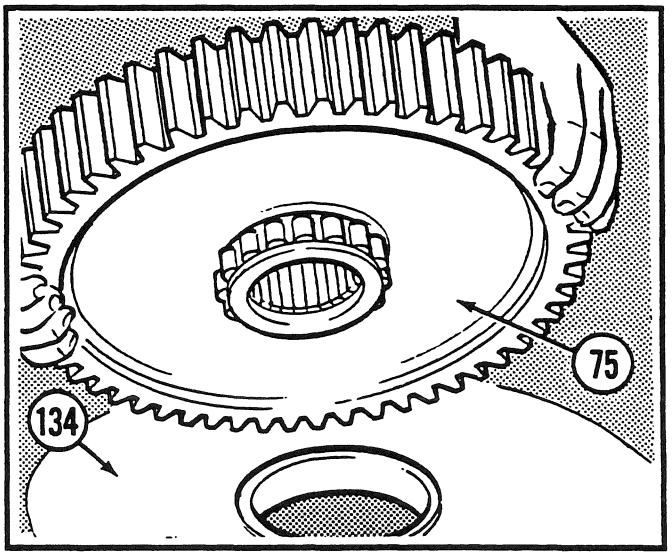


Fig. 109

Differential Final Drive - Assembly

Fig. 104

Apply fresh lubricant to all bearings and bearing surfaces. Wrap bearings in paper or lint-free cloth and store them in a cool, dry place.

Fig. 105

Apply lubricant to the outer race of the pinion bearing (92) and install it in the main case (134). Take care to align the dimple in the race with the lockscrew hole.

Fig. 106

Install the lockscrew (97) and lock-washer (96) in the main case (134). Tighten the lockscrew to the specified torque.

Fig. 107

Install the bull gear bearing outer races in the main case (134).

Fig. 108

Install the bull gear bearing outer races (74 and 111) in the side housings (51 and 113).

Fig. 109

Install the first bull gear (75) in the main case (134).

Differential Final Drive - Assembly (cont.)

Fig. 110

Install a new gasket (50) on the main case (134). Check to see if the "extra" hole in the gasket aligns with the pry slot. If it does, turn the gasket over.

Fig. 111

Using a press and the special tools listed at the beginning of this Shop Manual section, install new inner (70 and 119) and new outer (69 and 118) sleeve bushings in the side housings.

Fig. 112

Lower the left hand side housing (51) onto the main case (134). Take care to engage the bull gear bearing inner race (74) with the outer race in the side housing.

Fig. 113

Install the dowel pins. The dowel pins verify assembly of the side housing to the main case.

Fig. 114

Install the side housing capscrews (115 and 121) and lockwashers (114 and 122). Two capscrew holes are open into the main case - be sure to apply sealing compound, Champion part number 19167, to these capscrews before you install them. See Figure 192.

Fig. 115

Tighten the capscrews to the specified torque.

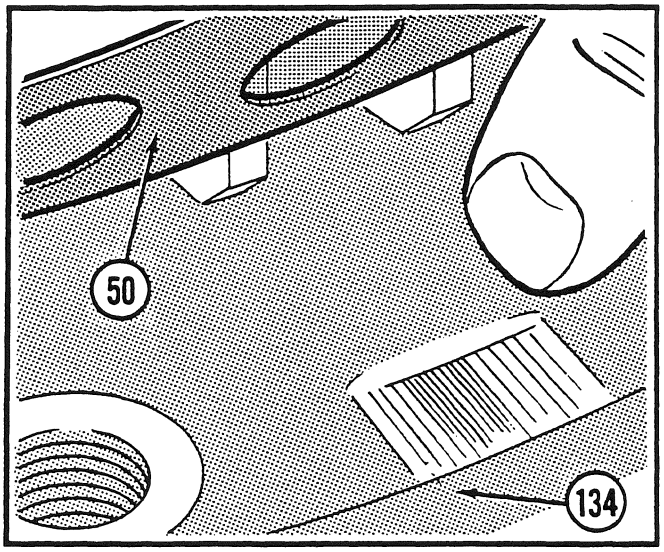


Fig. 110

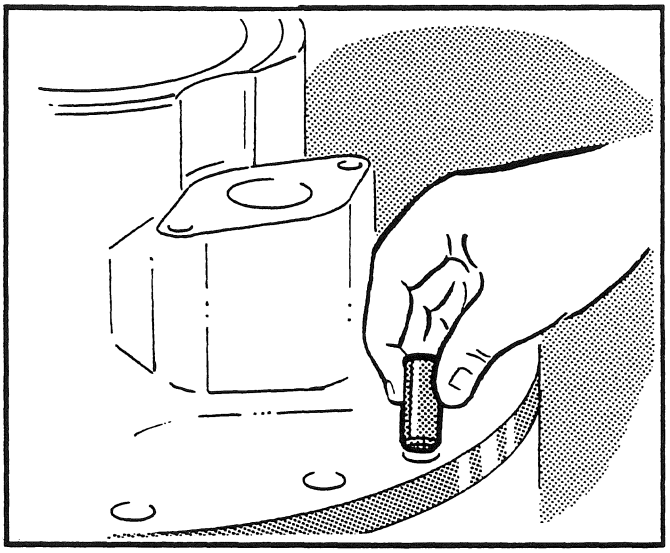
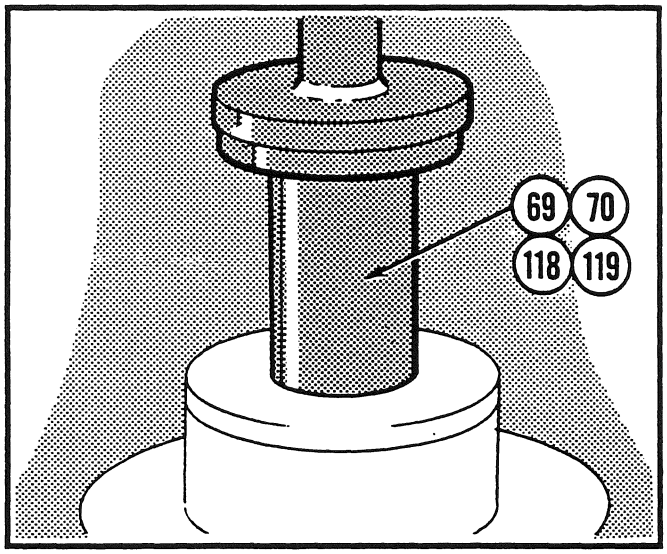


Fig. 113



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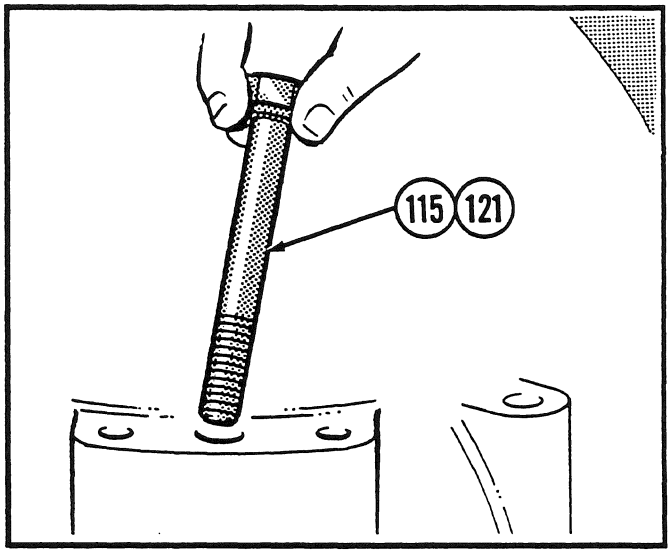

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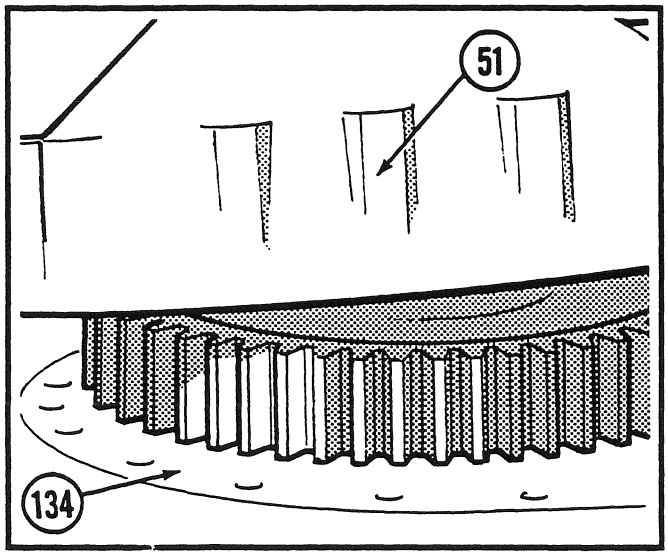


Fig. 112

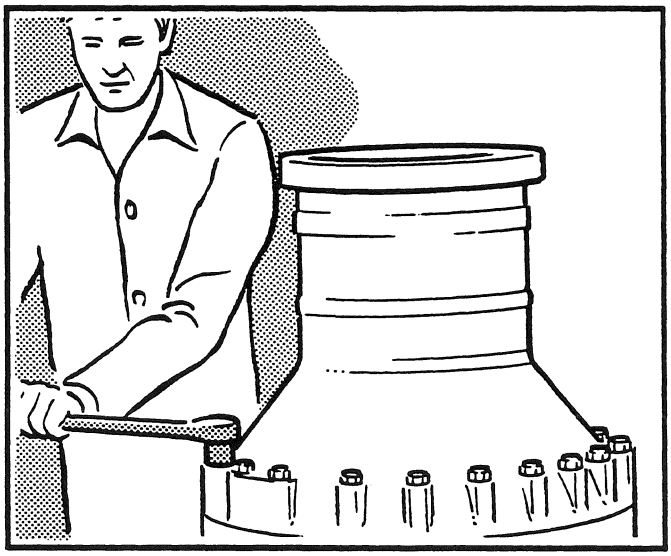


Fig. 115

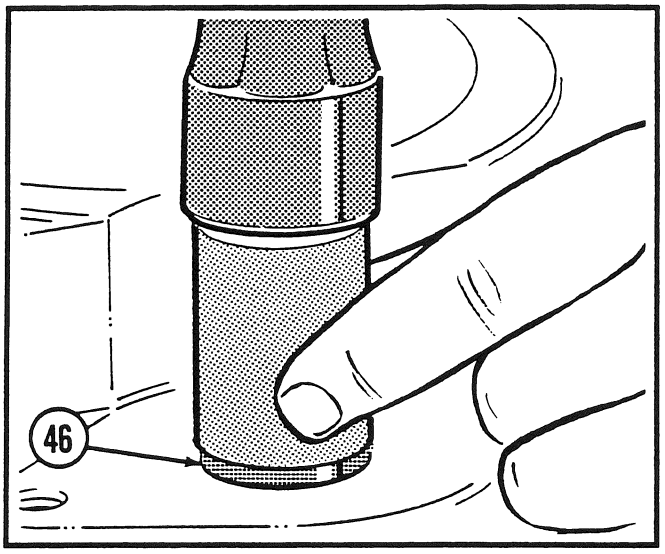
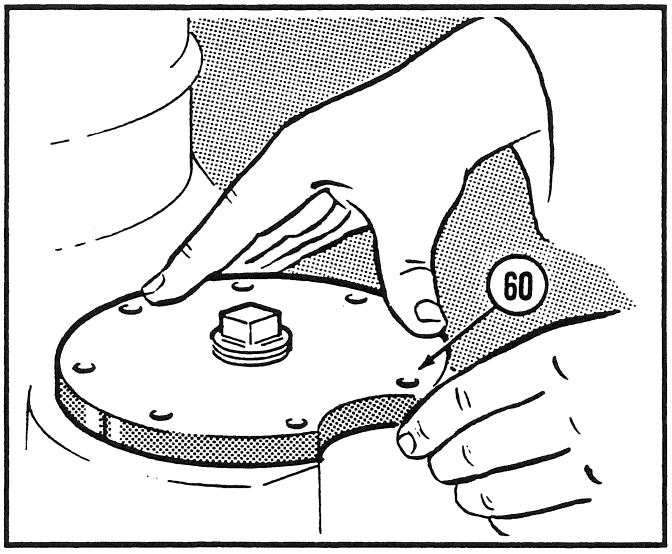


Fig. 116



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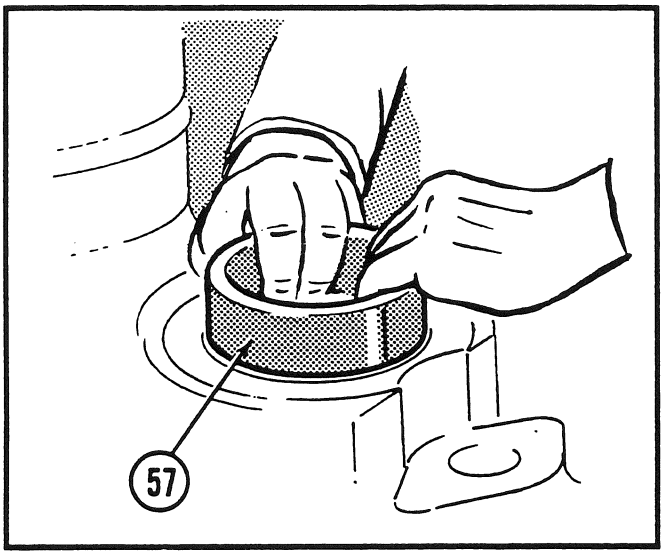

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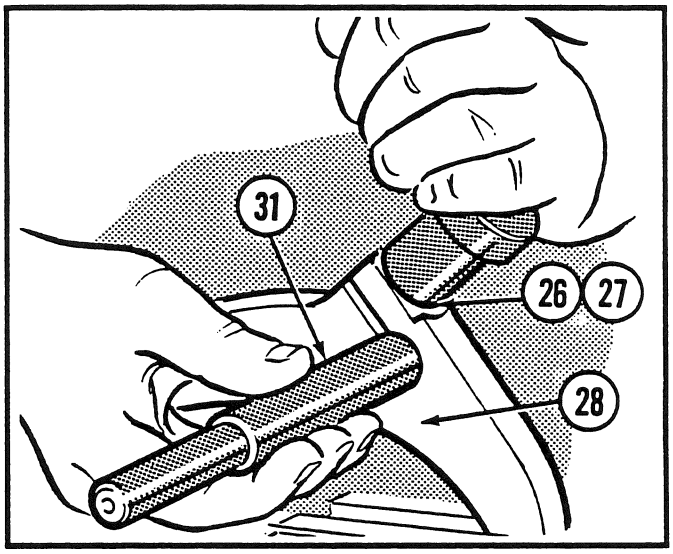

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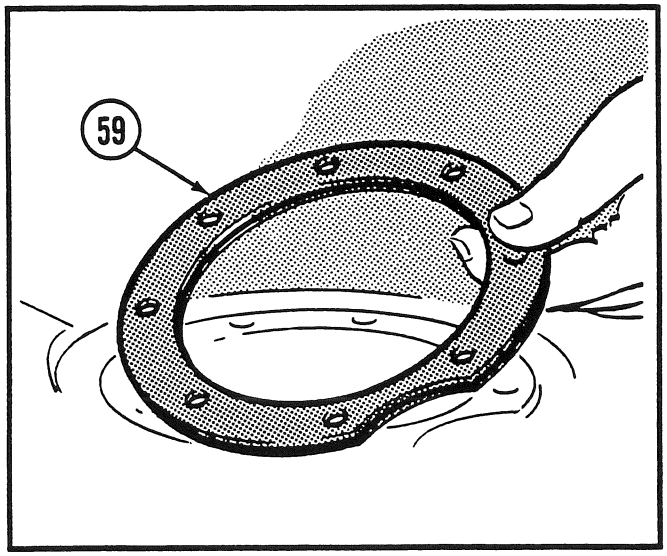

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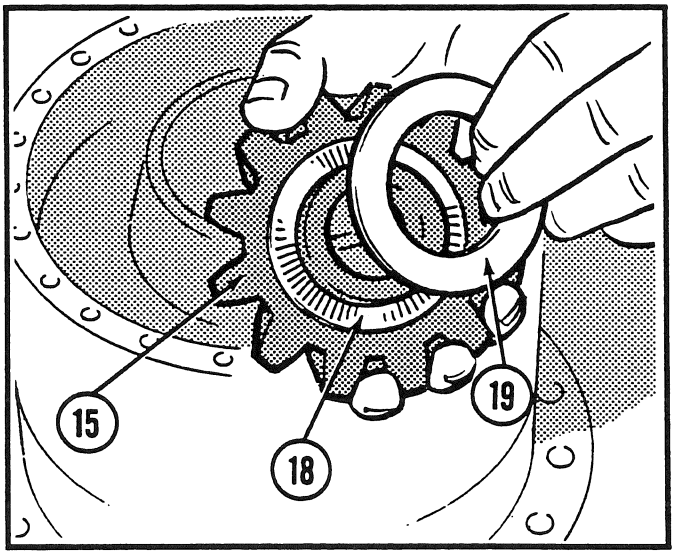


Fig. 121

Differential Final Drive - Assembly (cont.)

Fig. 116

Apply a thin layer of adhesive/sealant, Champion part number 19200, onto the outside diameter of both shift rail seals (46). Install them in the side housing (51) using the special tool listed at the front of this Shop Manual Section; or a drift with an outside diameter equal to that of the seals. Wipe away any excess sealant.

Fig. 117

Use a soft faced hammer and install the cross shaft bearing cup (57) in the side housing.

Fig. 118

Assemble a shim pack (59) 1,27 mm (.050 in.) thick and place it on the housing.

Fig. 119

Install the bearing cap (60), capscrews (62) and lockwashers (61). Tighten the capscrews to the specified torque.

Fig. 120

Install the shifter rail (31) into the shifter fork (28) and retain it with the lockscrew (26). Tighten the screw sufficiently enough so that you can just turn the rail. Bend the tabwasher (27) to secure the screw.

Fig. 121

Install the bushings (16), thrust bearings (18) and washers (19) onto the spider gears (15).

Differential Final Drive - Assembly (cont.)

Fig. 122
Install the spider gear pins (13); taking care to align the dowel holes with the holes in the differential housing (20).

Fig. 123
Place the spiral pinion gear (21) on the differential housing (20). Install the dowels (14) and align with the holes in the flange. Use capscrews to pull the spiral pinion gear into position.

Fig. 124
Install the shift clutch gear (24); making sure to align the dowel pin holes.

Fig. 125
Force the three dowel pins (29) into the differential housing assembly.

Fig. 126
Apply the threadlocking compound, Champion part number 40945, to the shift clutch gear capscrews (30) and install them. Tighten the capscrews to the specified torque.

Fig. 127
Turn the differential housing assembly over. Apply threadlocking compound, Champion part number 40945, to eighteen of the spiral pinion gear capscrews (17). Install and tighten the capscrews to the specified torque.

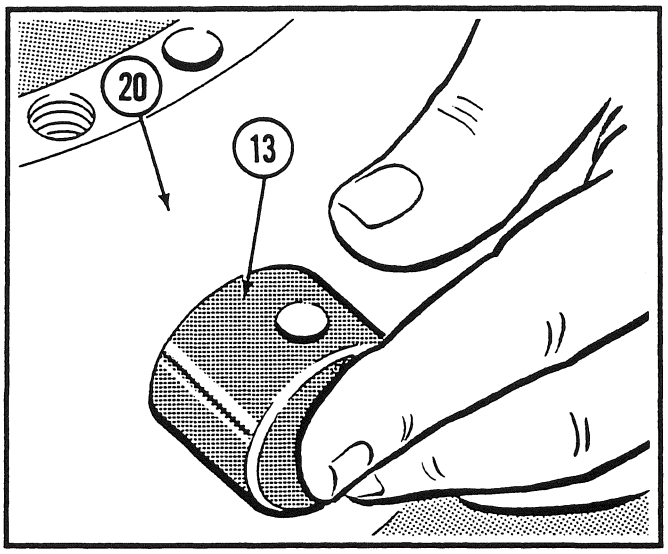
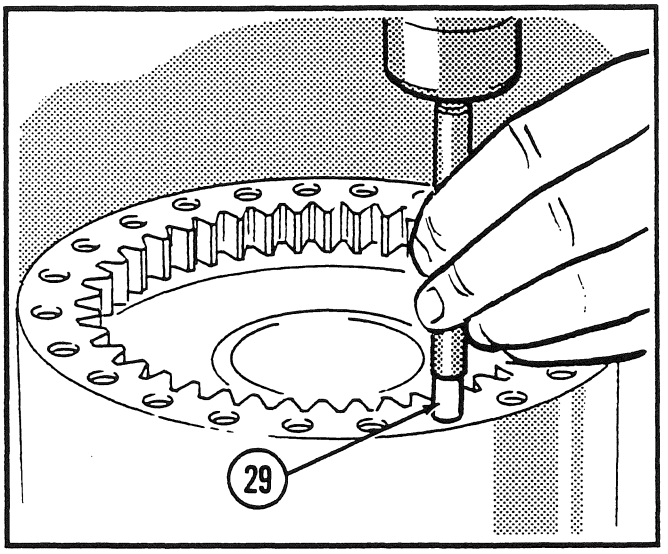


Fig. 122



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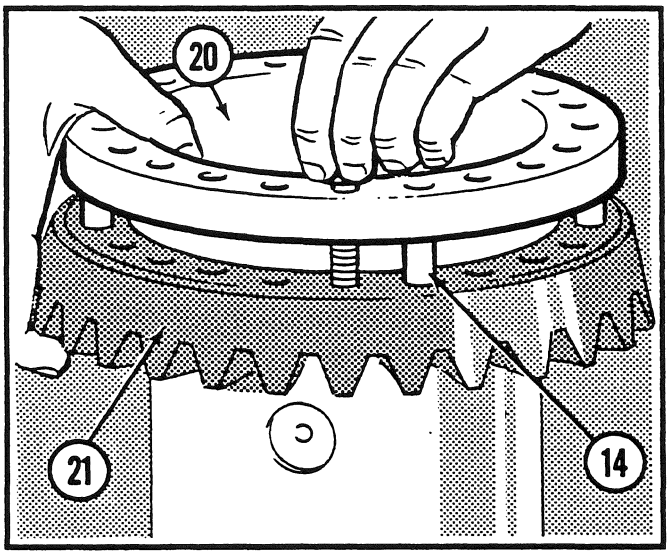
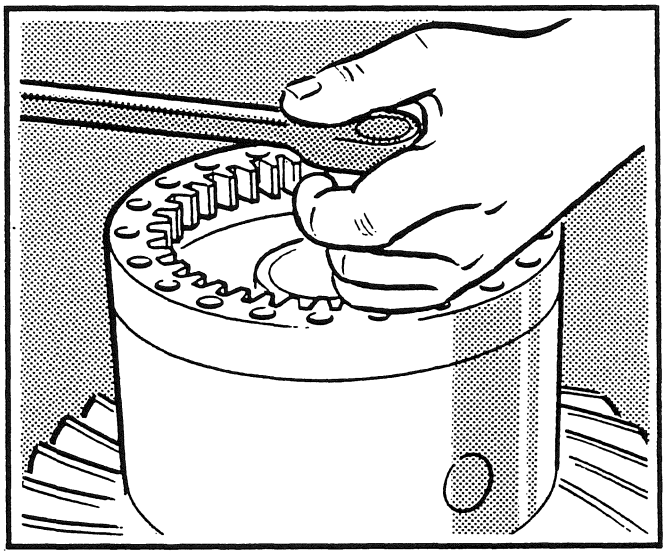


Fig. 123



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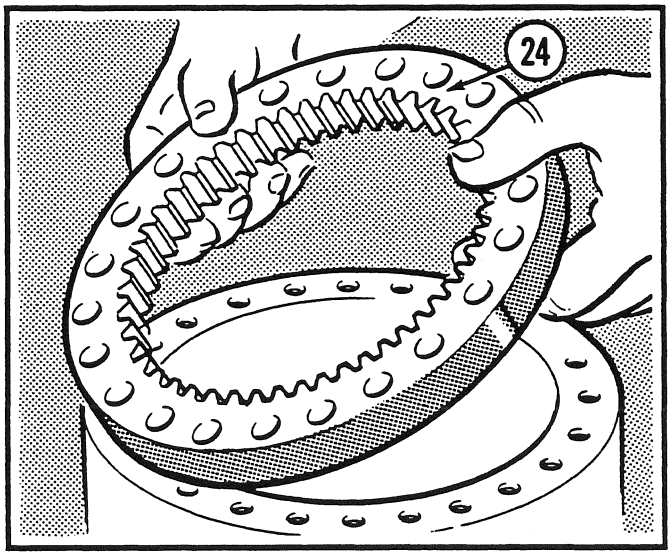

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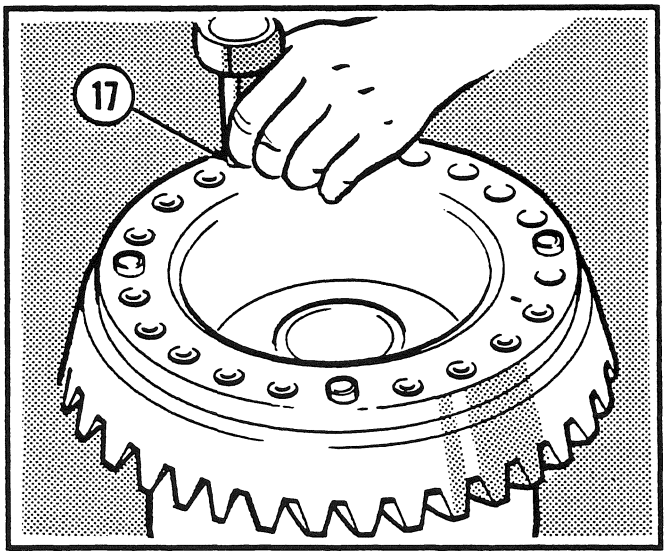

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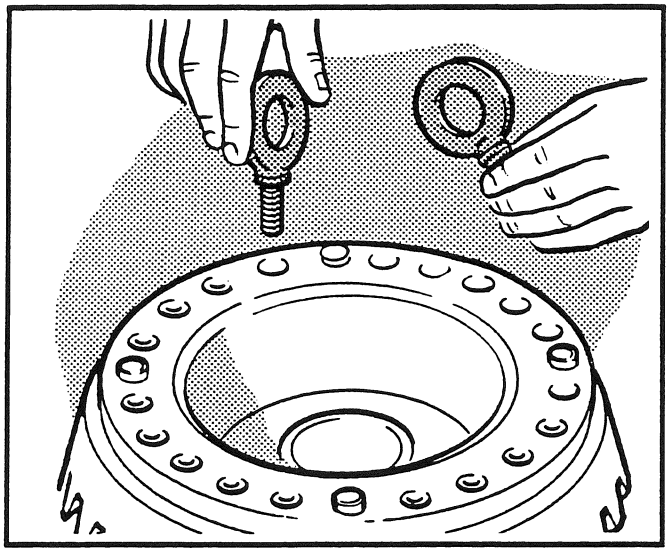

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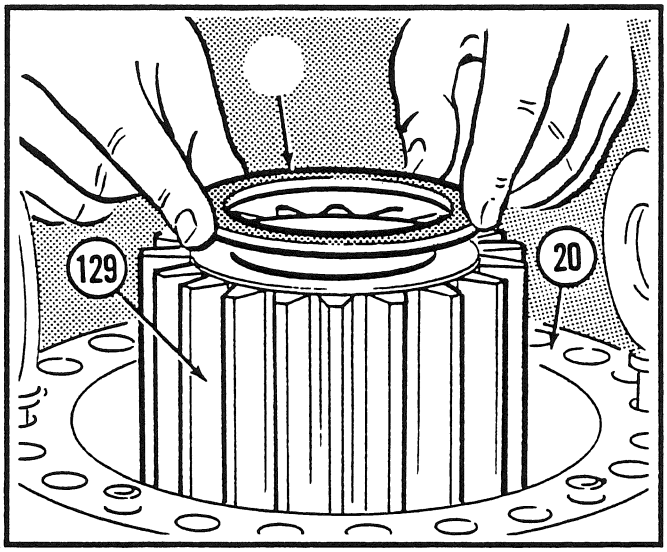

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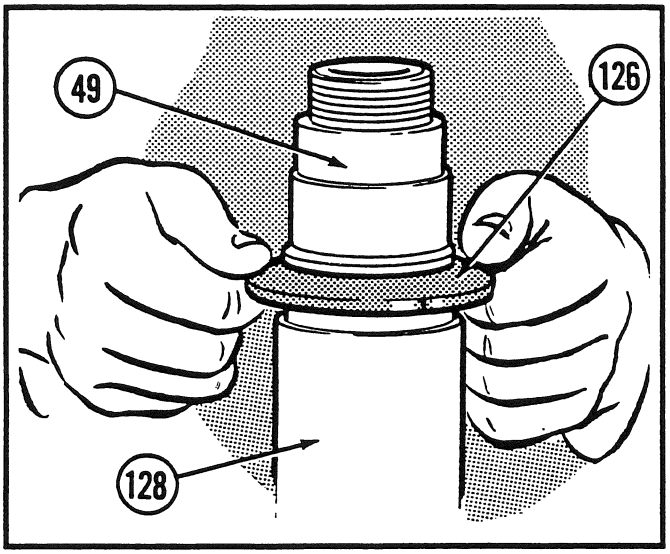

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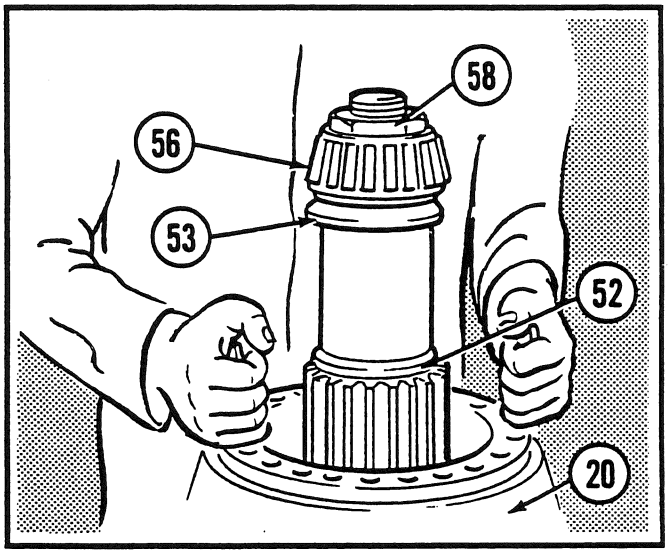

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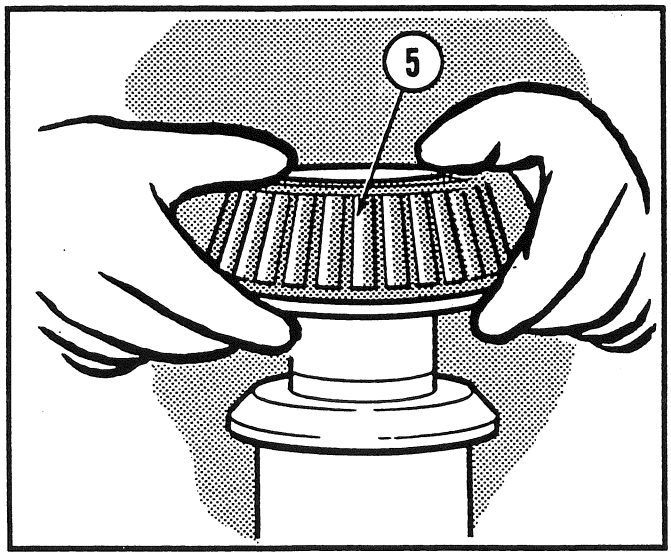

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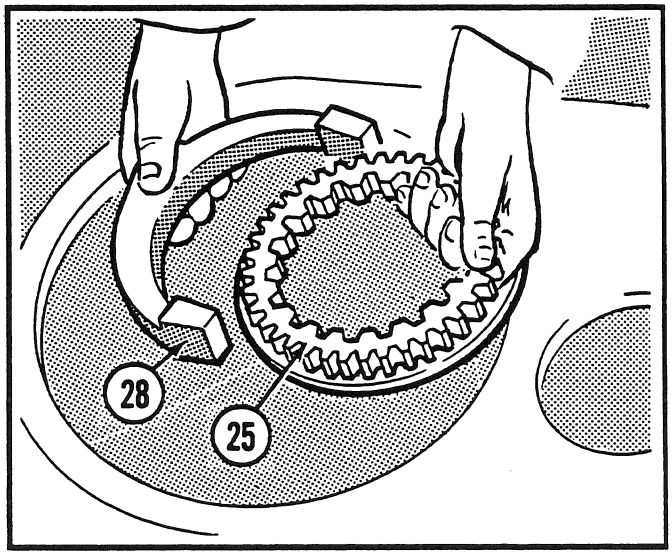


Fig. 133

Differential Final Drive - Assembly (cont.)

Fig. 128
Install lifting eyes into the two remaining holes.

Fig. 129
Install the pinion sleeve (128) and thrust washer (126) on the pump end of the cross shaft (49).

Fig. 130
Heat the cross shaft bearing cone (5) evenly in an oven or oil bath type heater to 121 C (250 F) maximum. DO NOT use an induction heater. If the bearing cone must be pressed into place, use a tubular steel drift that contacts the cone face only. Lubricate the bearing before installation. Install the bearing cone onto the end of the shaft. Retain the cone with the self-locking nut (3) and tighten to the specified torque.

Fig. 131
Install the spider pinion gear (129) and the thrust bearing (127) into the differential housing (20).

Fig. 132
Press the cross shaft into the differential housing (20), and install the thrust bearing (52), thrust washer (53), bearing cone (56) and retainer nut (58) on the opposite side. Tighten the nut to the specified torque.

Fig. 133
Slide the shift clutch (25) into the shifter fork (28).

Differential Final Drive - Assembly (cont.)

Fig. 134
Install the shift rail and shifter fork assembly into the left hand side housing (51).

Fig. 135
Install the differential assembly into the final drive main case (134) using the lifting device.

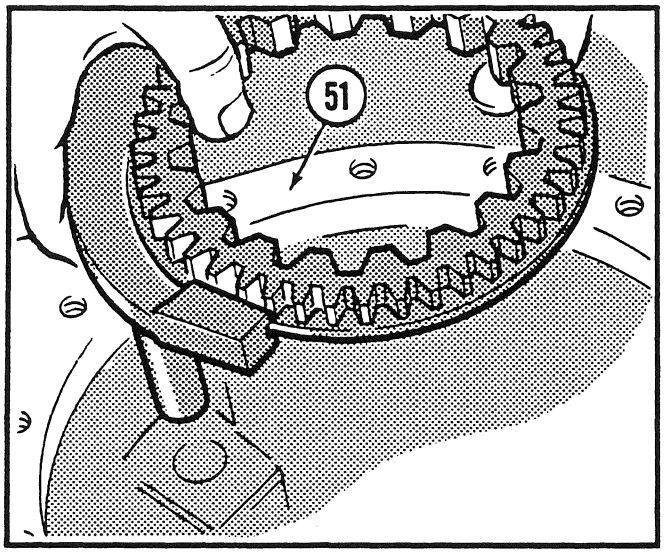
Fig. 136
Remove the lifting eyes. Apply thread-locking compound, Champion part number 40945, to the two remaining spiral pinion gear capscrews (17) and install them. Tighten the capscrews to the specified torque.

Fig. 137

Install the remaining bull gear (110) on the main case (134).

Fig. 138
Install the right-hand side housing (113) using the procedures described in Fig. 112 through Fig. 115.

Fig. 139
Install the remaining cross shaft bearing cup (4) in the side housing using a soft faced hammer.



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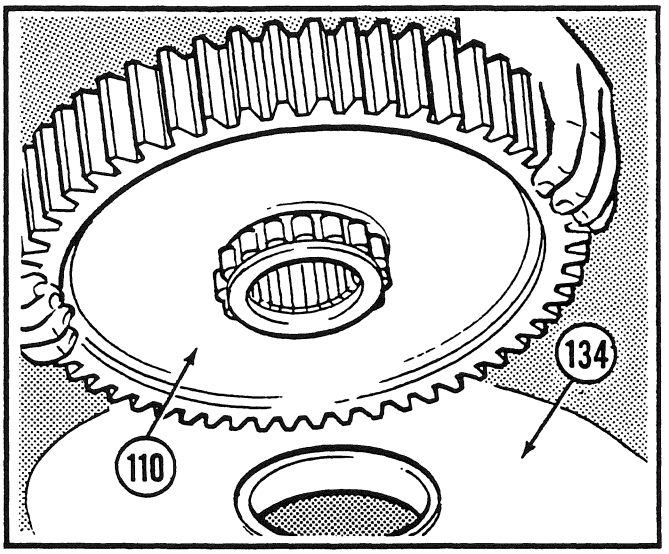

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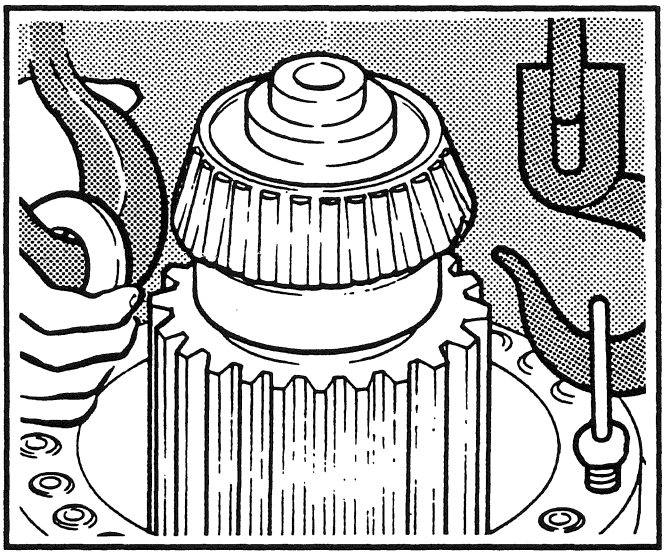
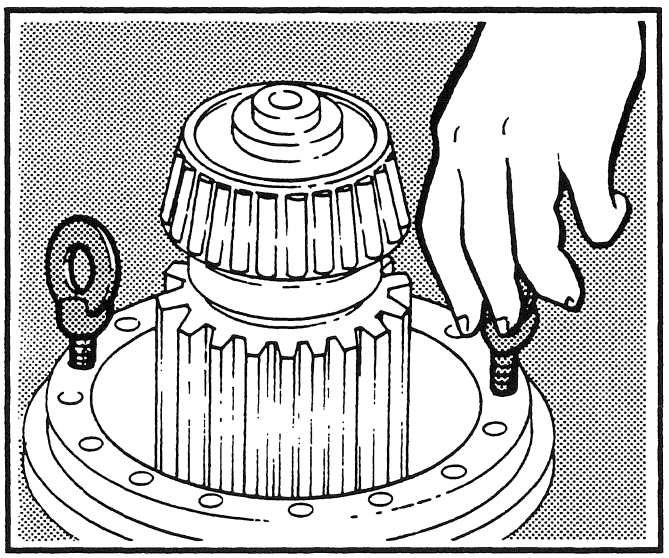


Fig. 135

Fig. 138



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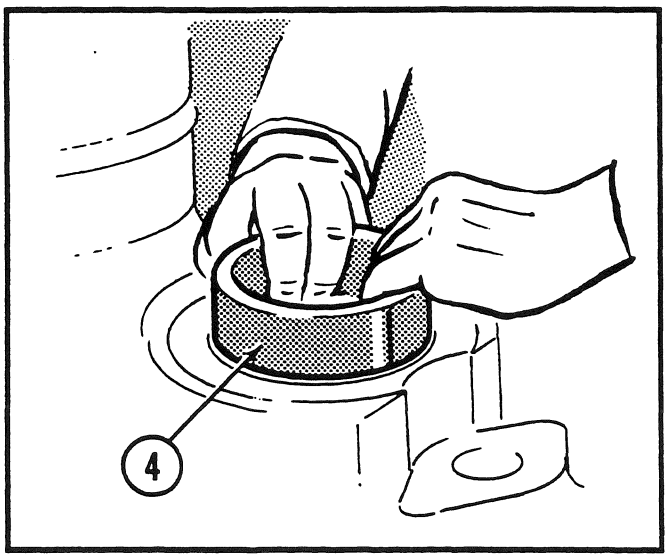

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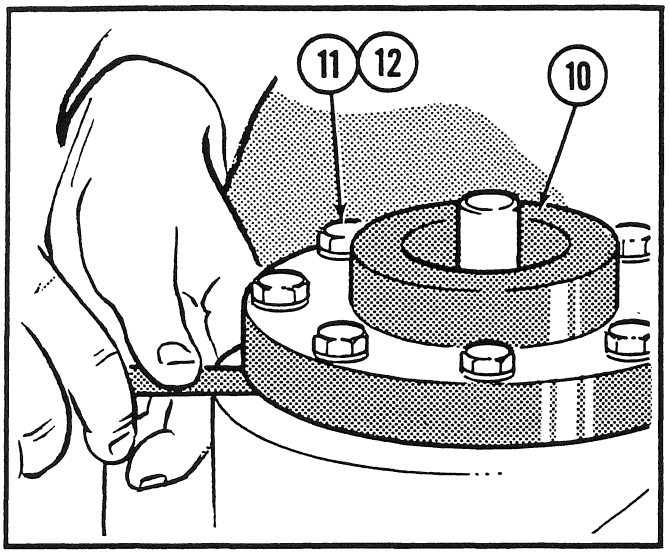

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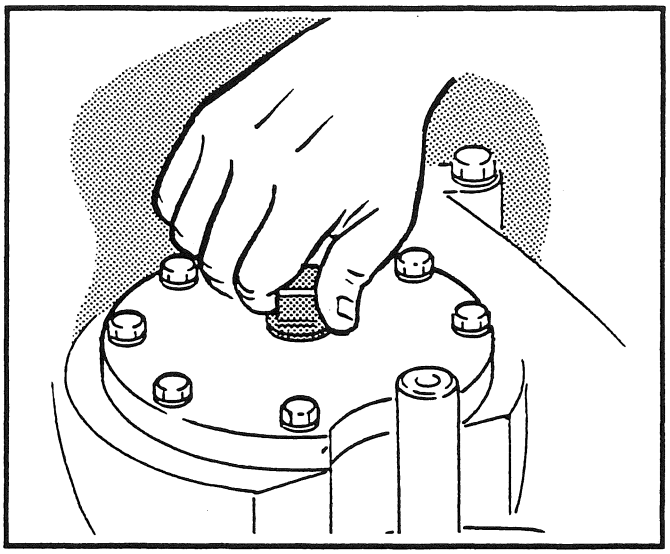


Fig. 143

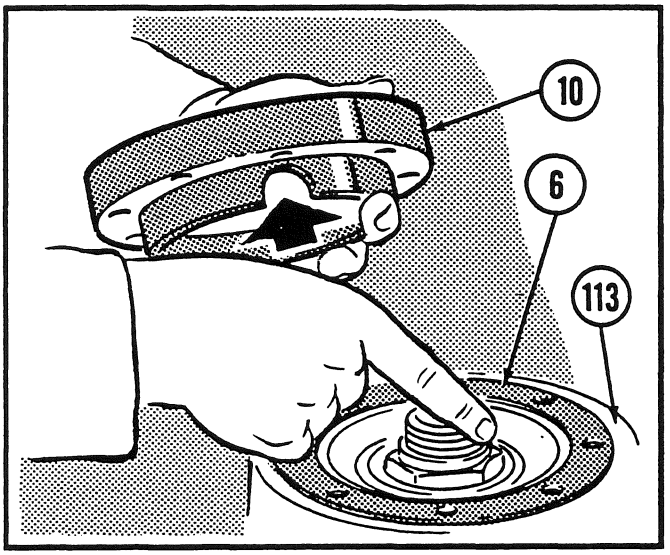
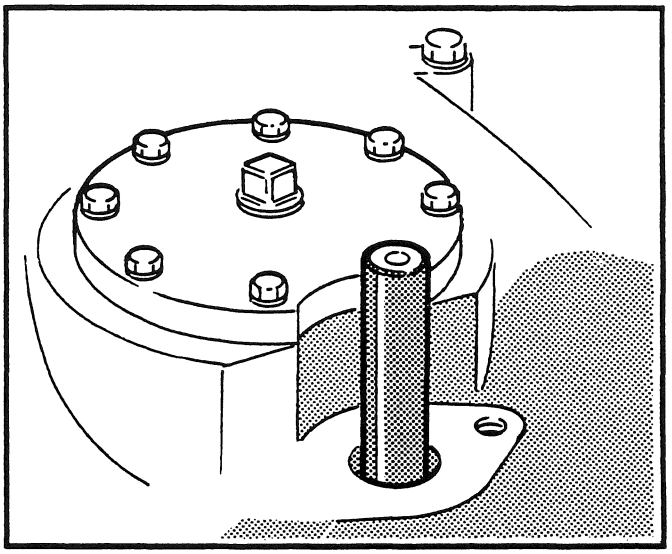


Fig. 141



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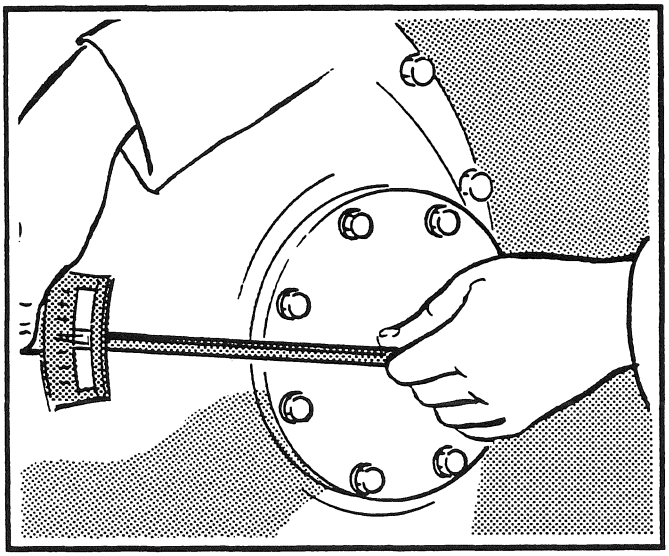


Fig. 142

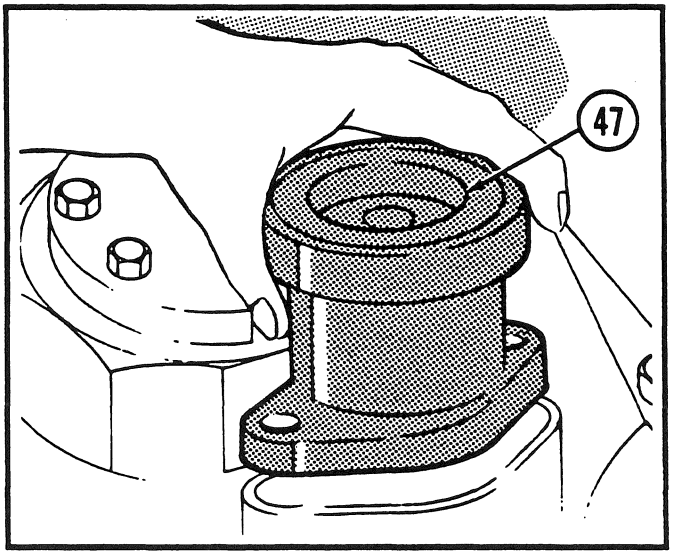


Fig. 145

Differential Final Drive - Assembly (cont.)

Fig. 140

Install the pump mount adapter (10). Install the adapter capscrews (12) and lockwashers (11) and tighten them evenly to the specified torque. Using feeler gauges, measure the gap between the adapter and the side housing surface. Remove the pump mount adapter.

Fig. 141

Assemble a shim pack (6) equal in thickness to the previous feeler gauge measurement. Install the shim pack and re-install the adapter (10), making sure that the cap aligns with the upper lubrication port in the side housing (113). Tighten the capscrews to the specified torque.

Figure 142

Rotate the differential assembly. Check the rolling torque until it agrees with the adjustment specification listed at the front of this Shop Manual Section.

Fig. 143

Install the pipe plug in the bearing cap.

Fig. 144

Slide the shift clutch into the disengaged position and place a 5 cm (2 in.) spacer between the shifter fork and the shift clutch gear.

Fig. 145

Install the shift cylinder barrel (47) onto the side housing. Install the capscrews (33) and lockwashers (32). Tighten the capscrews to the specified torque.

Differential Final Drive - Assembly (cont.)

Fig. 146
Install new piston rings (34, 36 and 37) onto the piston (35).

Fig. 147
Install the washer (45).

Fig. 148
Install the spring (44).

Fig. 149
Install the piston (35) and retainer (43).

Fig. 150
Compress the shift cylinder spring by pushing down on the piston. Using snap ring pliers, install a new snap ring (42) on the shift rail (31). Release the pressure applied to the piston.

Fig. 151
Remove the spacer between the shifter fork (28) and the shift clutch gear (24).

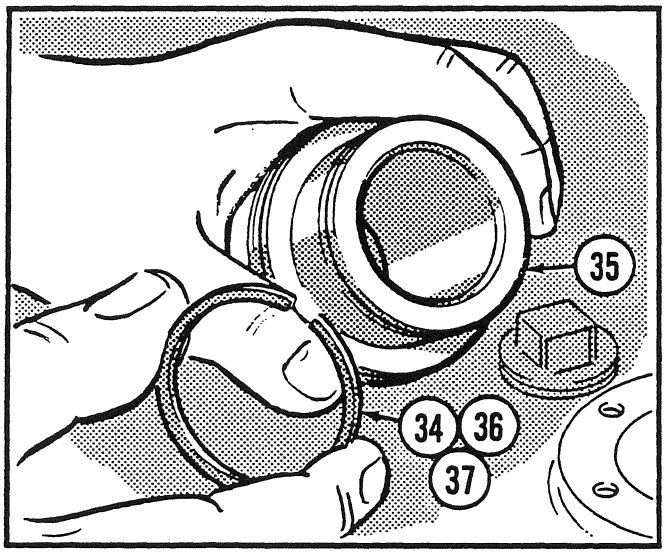
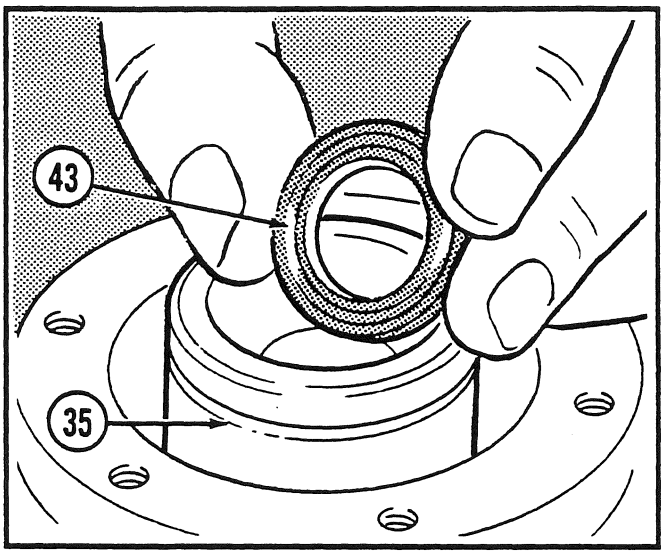


Fig. 146



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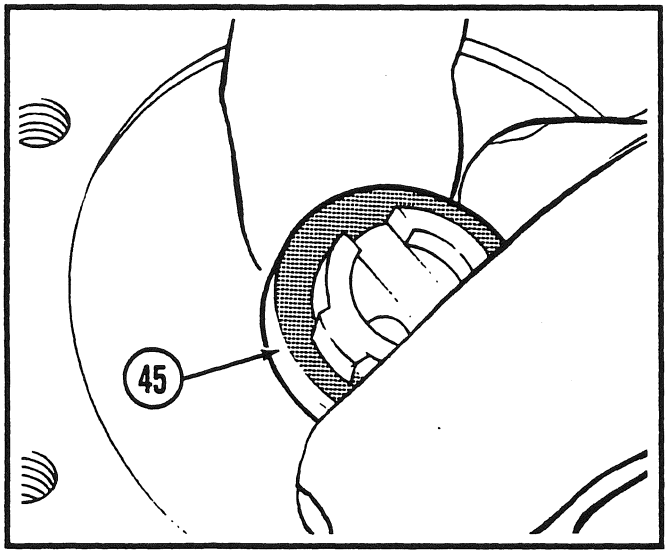
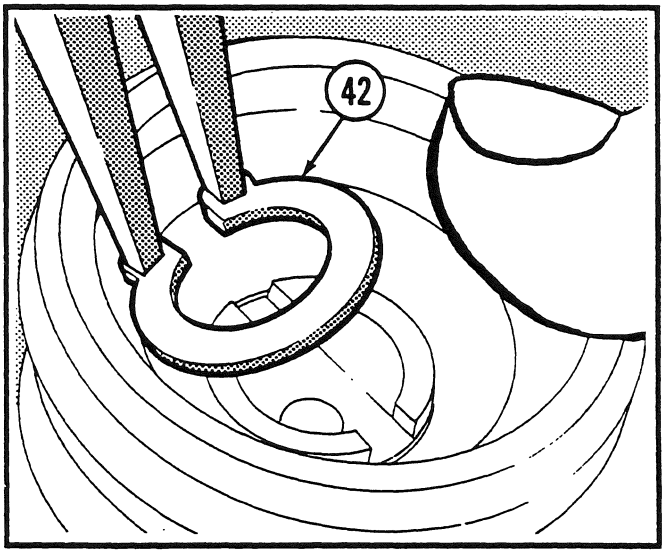


Fig. 147



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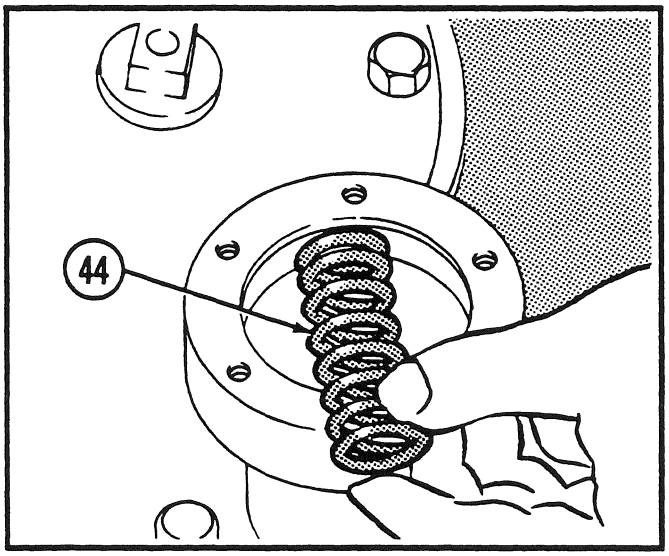


Fig. 148

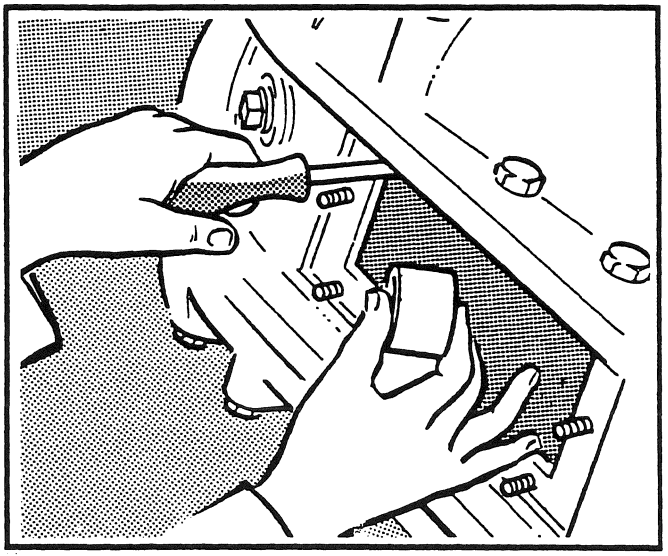


Fig. 151

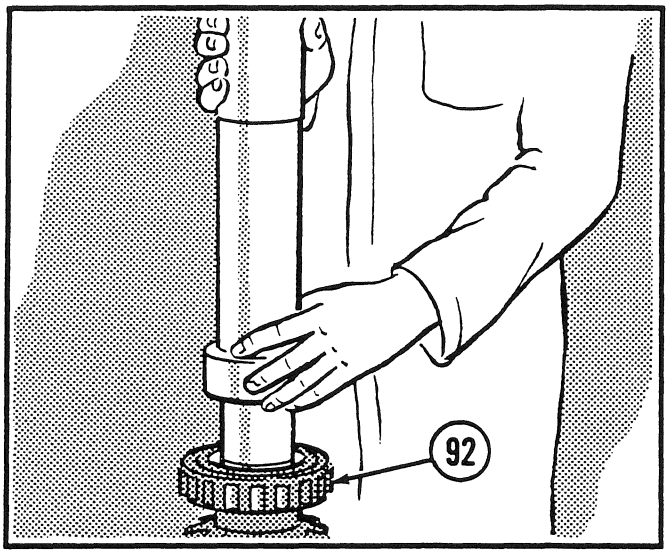
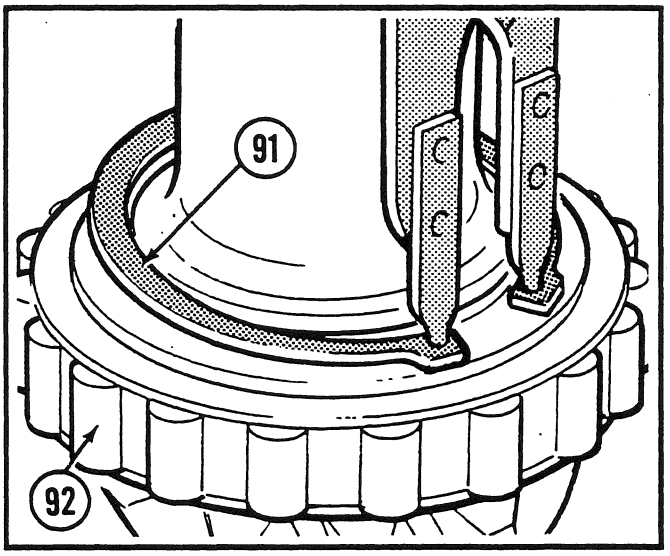


Fig. 152



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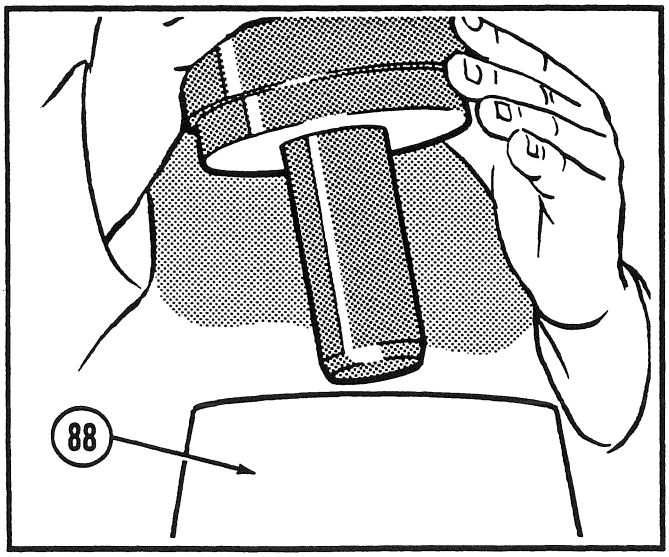

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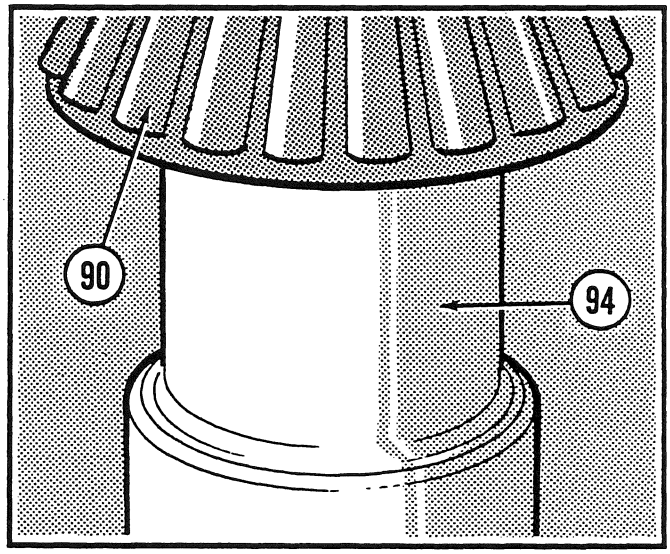
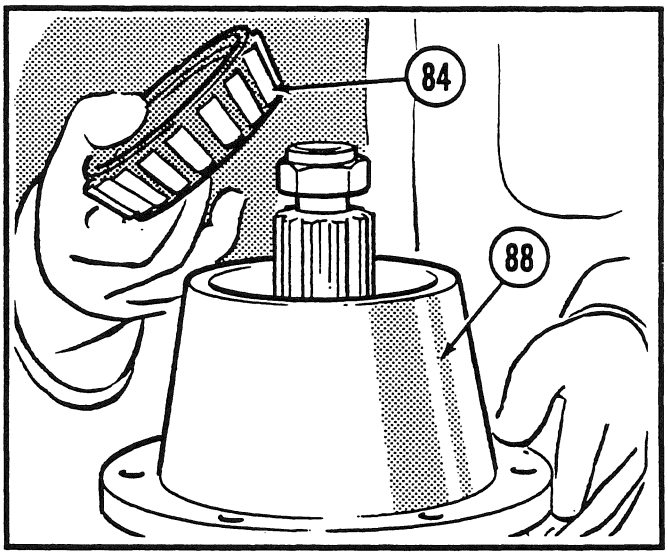


Fig. 155



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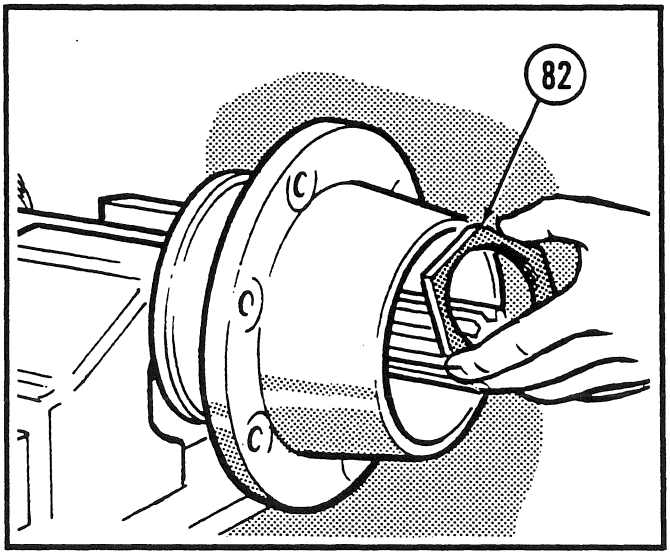


Fig. 157

Differential Final Drive - Assembly (cont.)

Fig. 152
Apply adhesive/sealant, Champion part number 19200, onto the inner surface of the bearing (92). Install the bearing using an appropriate tubular drift and a hydraulic press.

Fig. 153
Retain the bearing (92) with a new snap ring (91).

Fig. 154
Install the pinion bearing cups (85 and 89) in the pinion cap (88) using an appropriate soft metal drift. The cups are easier to install when chilled in a freezer or in dry ice.

Fig. 155
Heat the spiral pinion shaft inner bearing cone (90) evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. If the bearing cone must be pressed into place, use a tubular soft metal drift that contacts the cone face only. Lubricate the bearing before installation. Install the bearing onto the end of the shaft (94).

Fig. 156
Install the pinion cap (88). Heat the spiral pinion shaft outer bearing cone (84) evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. If the bearing cone must be pressed into place, use a tubular soft metal drift that contacts the cone face only. Lubricate the bearing before installation. Install the bearing cone onto the end of the shaft.

Fig. 157
Secure the spiral pinion shaft in a vise and install the nut (82).

Differential Final Drive - Assembly (cont.)

Fig. 158
Secure the spiral pinion shaft assembly in a vise with soft jaws. Tighten or loosen the nut (82) using the special tool listed at the front of this Shop Manual Section. Wrap soft wire around the pinion cap (88) and attach a spring balance scale to the end of the wire. Pull the wire and adjust the nut tightness until the assembly rolling torque agrees with the adjustment specification listed at the front of this Shop Manual Section.

Fig. 159
When the rolling torque is correctly adjusted, secure the nut (82) by bending the raised portion into the spline hollows in four places.

Fig. 160
Apply a thin layer of adhesive/sealant, Champion part number 19200, onto the outside diameter of a new oil seal (83). Install the oil seal in the pinion cap (88). Lubricate the seal lips.

Fig. 161
Record the pinion depth number etched on the end of the spiral pinion shaft (94). This number will be used to calculate the thickness of the shim pack used under the pinion cap.

Fig. 162
Install the threaded lifting eye on the end of the spiral pinion shaft (94). Install the shaft into the main case (134) using the lifting device. Align the drain hole with the horizontal center of the pinion shaft.

Fig. 163
Place a 0,5 mm (.021 in.) feeler gauge between the face of the pinion gear and the differential housing (20). Lower the spiral pinion shaft (94) onto the gauge.

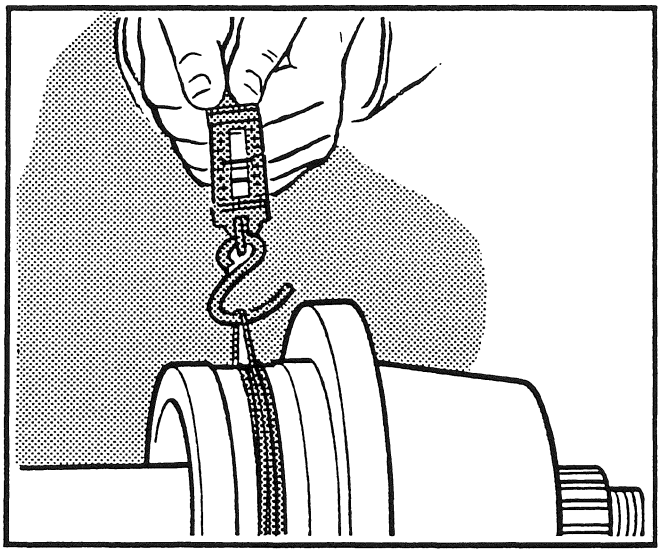


Fig. 158

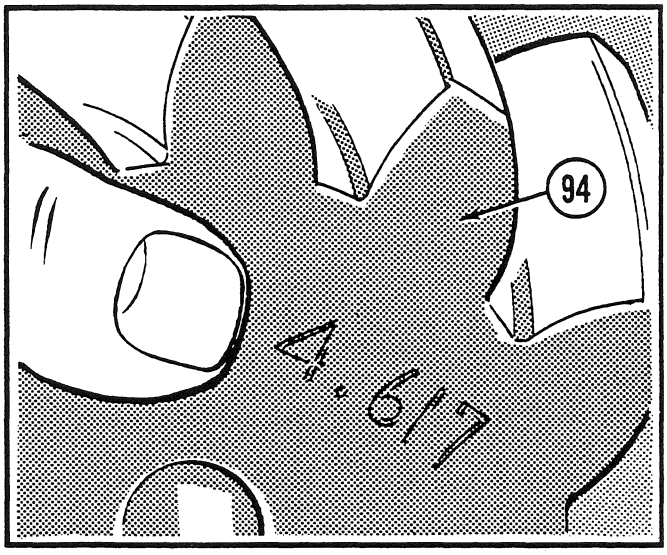


Fig. 161

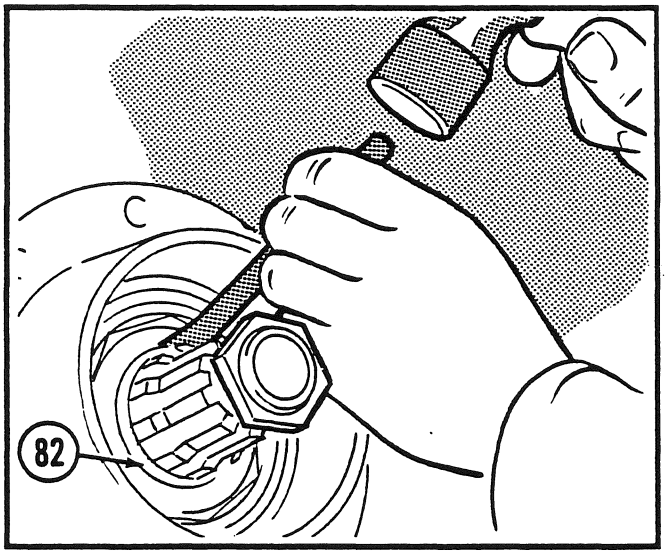
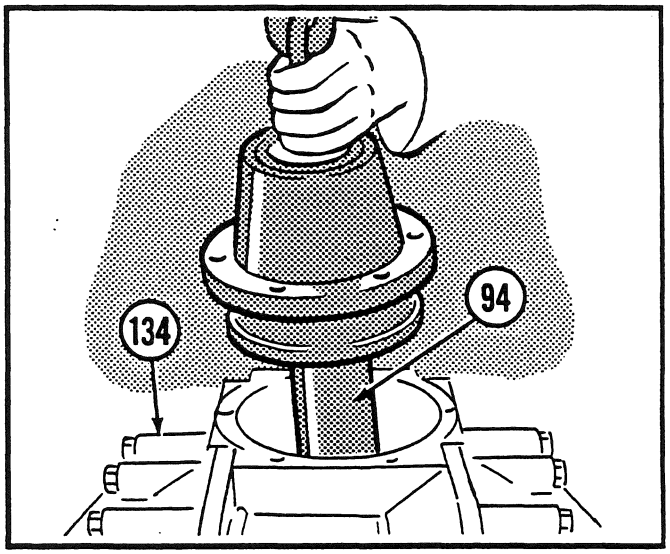


Fig. 159



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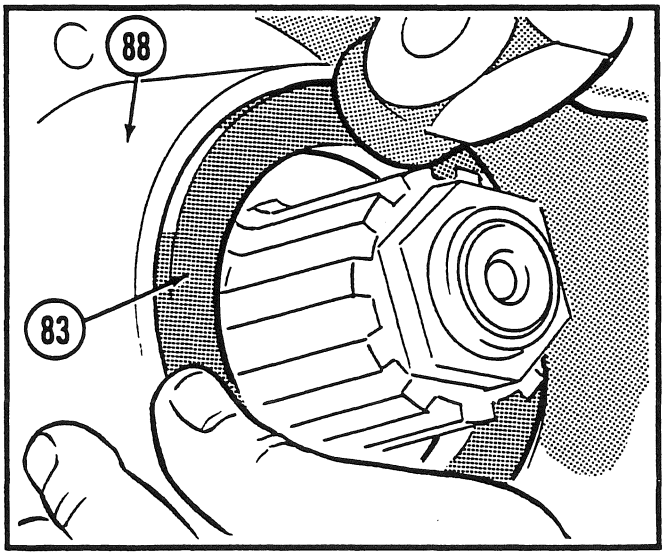

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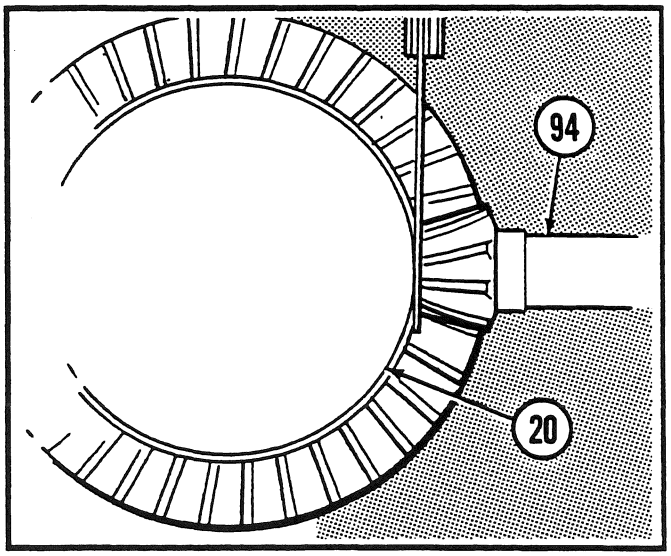

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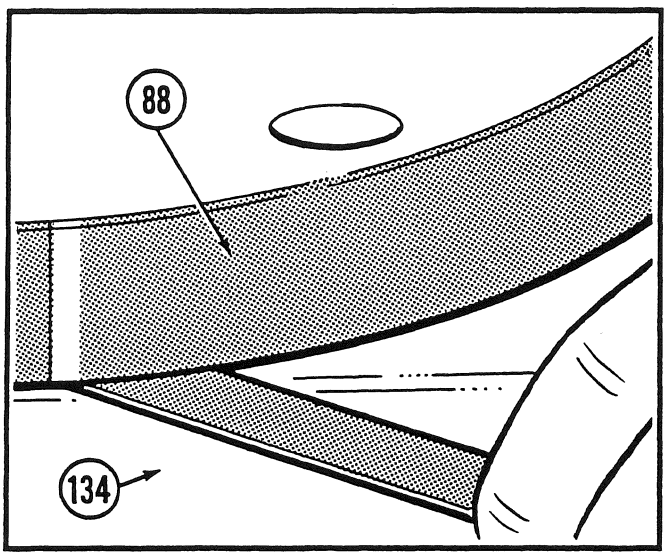

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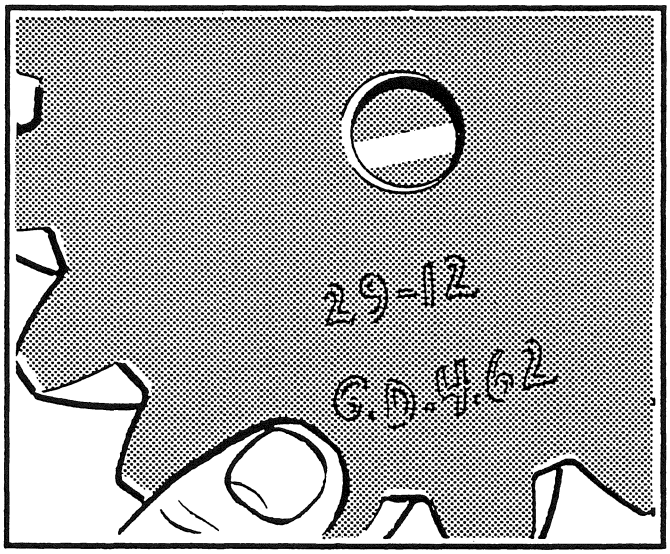

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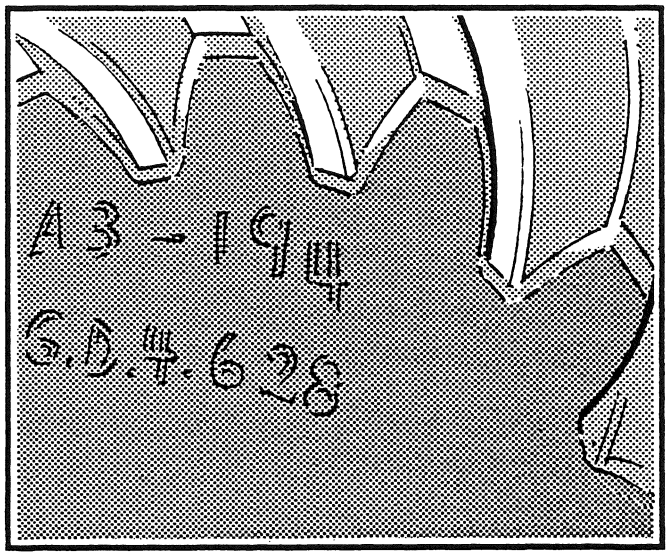

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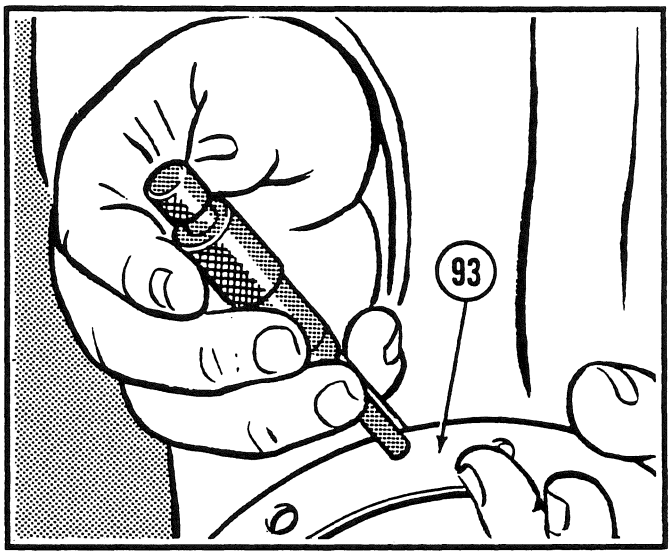


Fig. 168

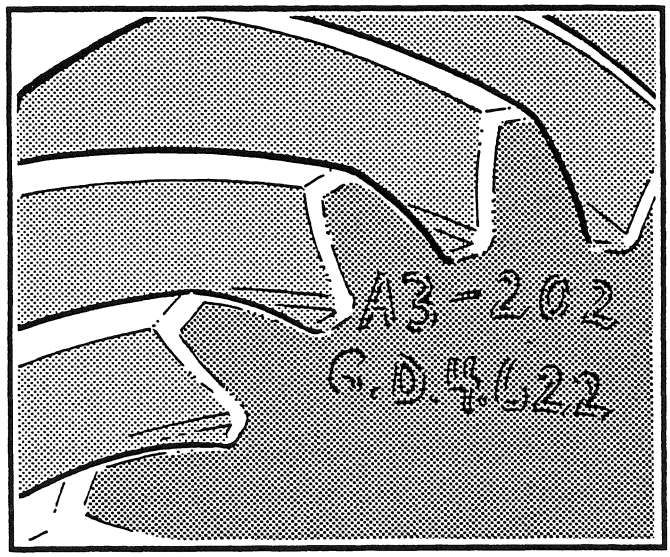


Fig. 166

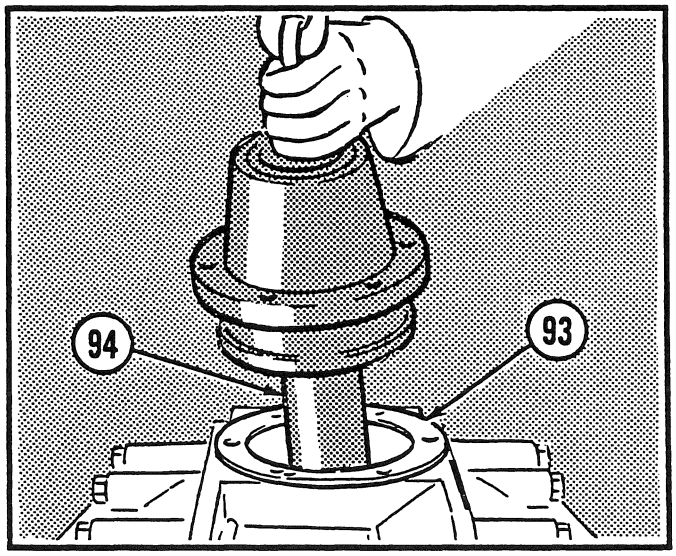


Fig. 169

Differential Final Drive - Assembly (cont.)

Fig. 164

Measure the gap between the pinion cap (88) and the machined surface of the main case (134) in at least four places. Calculate the average measurement.

Fig. 165

Compare the pinion depth number previously recorded with the design constant number 4.625. If the depth number is LARGER than the constant, ADD THE DIFFERENCE TO YOUR GAP MEASUREMENT.

Fig. 166

If the depth number is SMALLER than the constant, SUBTRACT THE DIFFERENCE FROM YOUR GAP MEASUREMENT.

Fig. 167

If the pinion depth number and constant are EQUAL, USE THE GAP MEASUREMENT.

Fig. 168

Remove the pinion shaft and assemble a shim pack (93) equal in thickness to the calculated measurement.

Fig. 169

Install the shim pack (93) and reinstall the pinion shaft (94). Make sure to align the lubrication ports in the cap with those in the main case. Install the capscrews (86) and lockwashers (87). Tighten the capscrews to the specified torque.

Differential Final Drive - Assembly (cont.)

Fig. 170
Install a dial indicator through the inspection hole, engaging the plunger onto the center of one of the spiral pinion gear teeth. Rotate the gear slightly and measure the backlash in at least four places; and compare with the adjustment specification listed at the front of this Shop Manual Section.

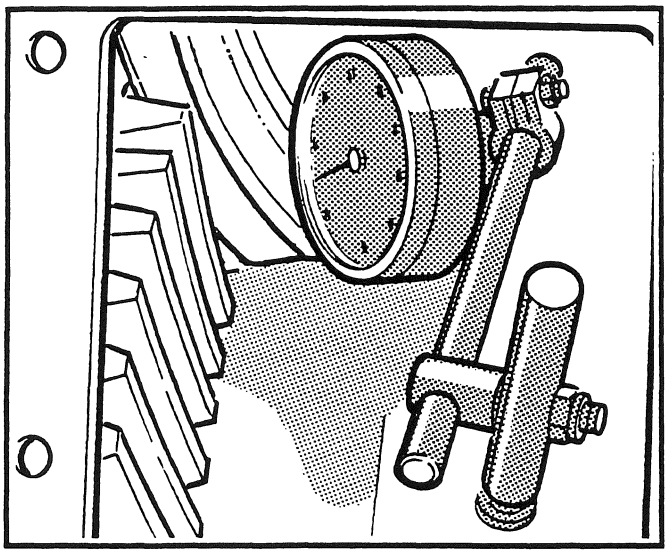
Fig. 171
To decrease backlash, remove a shim or shims (6) from the spiral pinion gear side and install them on the opposite side. Reverse this procedure to increase backlash. **Remember**, if you take a shim from one side of the cross shaft, you **must** install it on the opposite side!

Fig. 172
Measure the gap between the shifter fork (28) and the shift clutch gear (24) using a feeler gauge. Compare with the adjustment specification listed at the front of this Shop Manual Section. Adjust by rotating the shift rail with the clutch engaged.

Fig. 173
Install the shift cylinder cap (39) with a new O ring (38) on the shift barrel housing (47). Install the capscrews (41) and lockwashers (40). Tighten the capscrews to the specified torque.

Fig. 174
Rotate the differential final drive assembly. Install the pump spring (7).

Fig. 175
Install the plunger (8).



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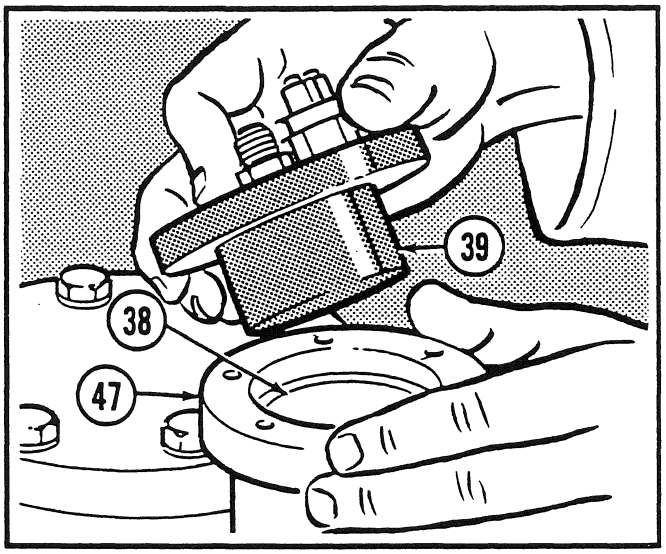

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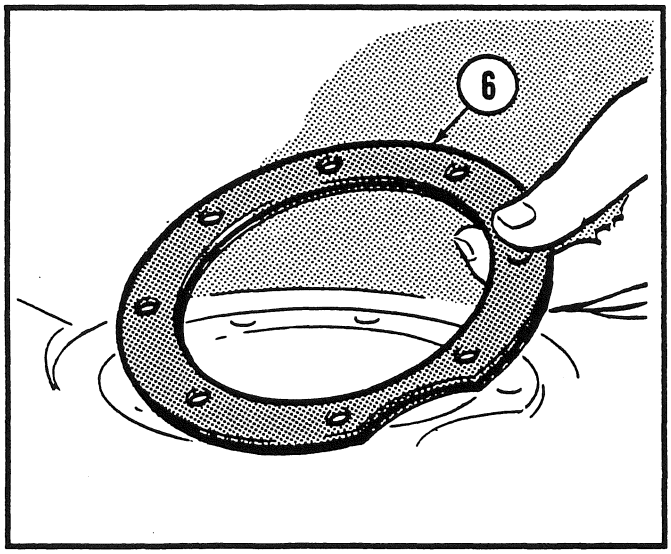

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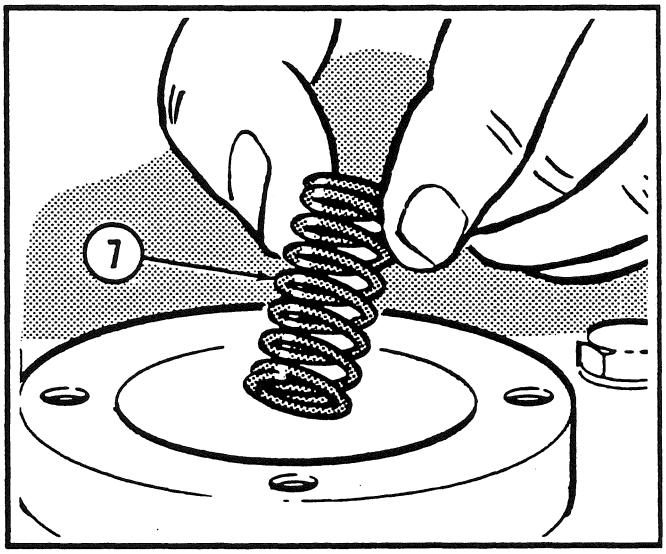

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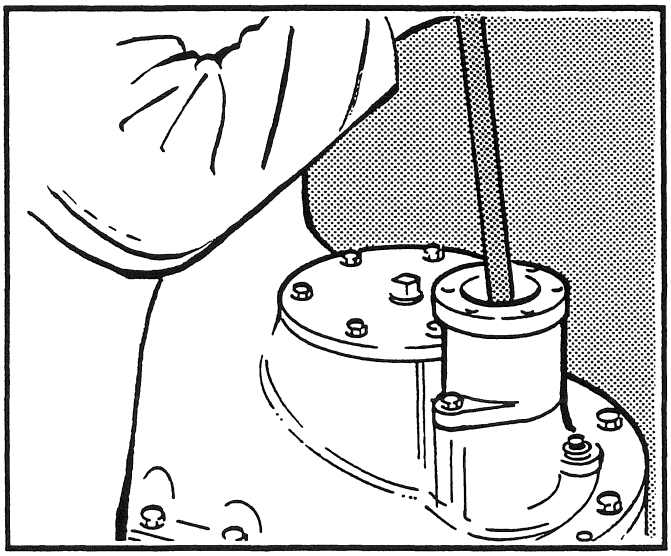
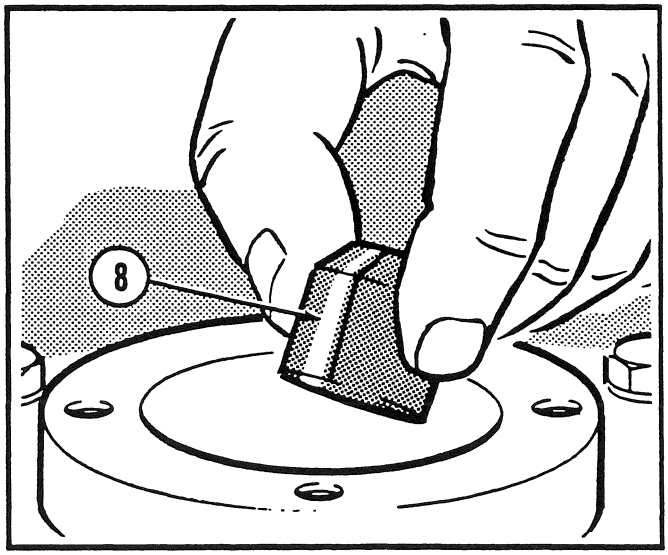


Fig. 172



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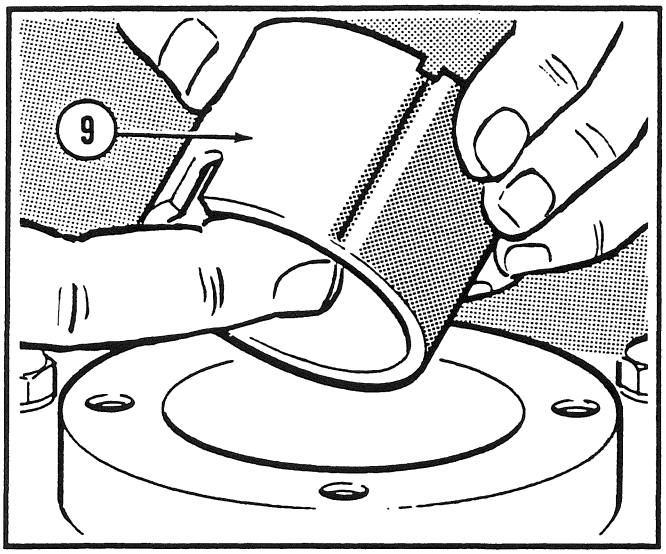

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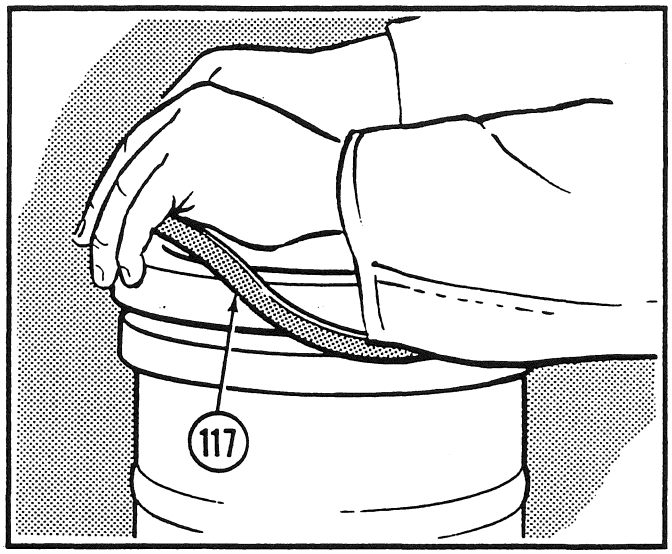

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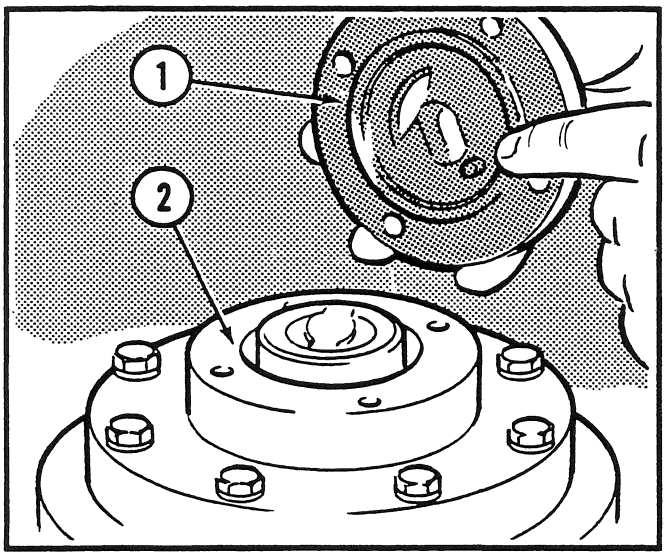

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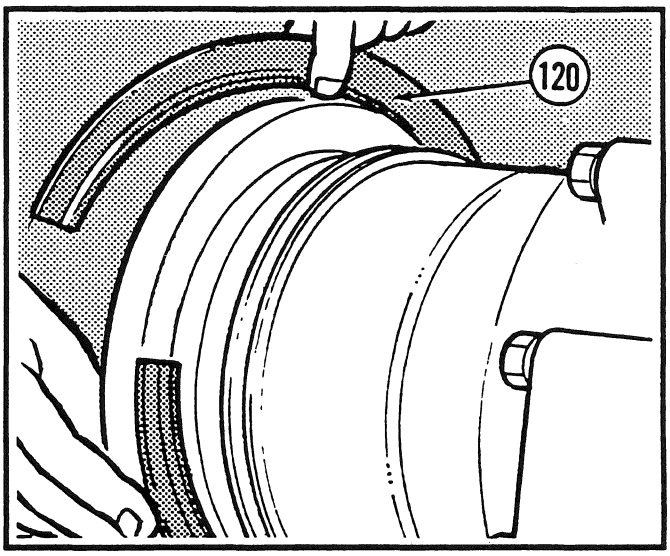

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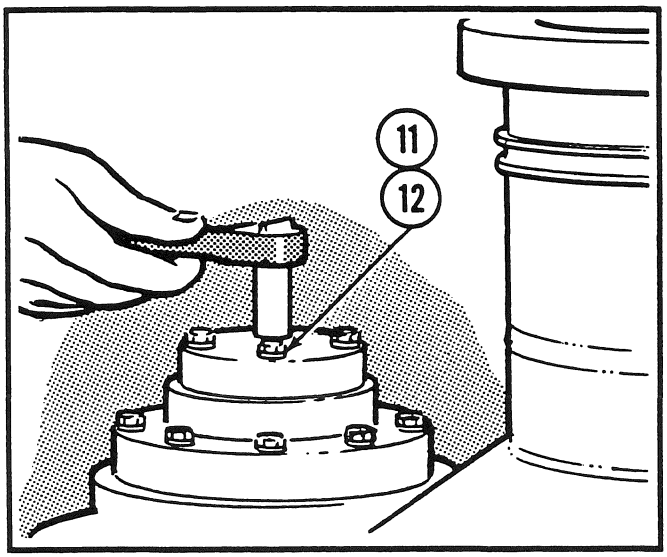

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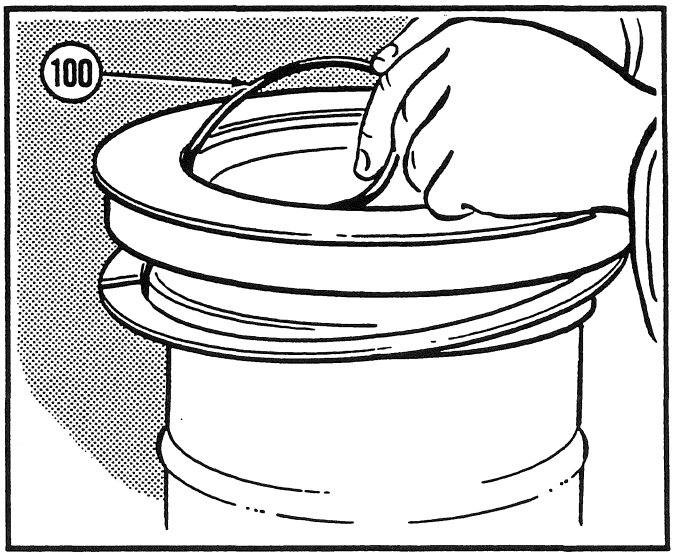


Fig. 181

Differential Final Drive - Assembly (cont.)

Fig. 176
Install the pump (9), aligning the drive slot with the roll pin on the cross shaft (49).

Fig. 177
Install a new gasket (2). Install the end cap (1), aligning the roll pin with the slot in the pump body.

Fig. 178
Install the capscrews (12) and lockwashers (11). Tighten the capscrews evenly so that they pull the pump (9) into place against the spring (7). Tighten the capscrews to the specified torque.

Fig. 179
Lubricate a new "Uniring" seal (117) and install it on the side housing extension.

Fig. 180
Lubricate and install the new inner and outer thrust plates (99 and 120).

Fig. 181
Lubricate and install a new O ring (100).

Differential Final Drive - Assembly (cont.)

Fig. 182
Carefully lower the flanged sleeve (101) into the side housing (113) using the lifting device.

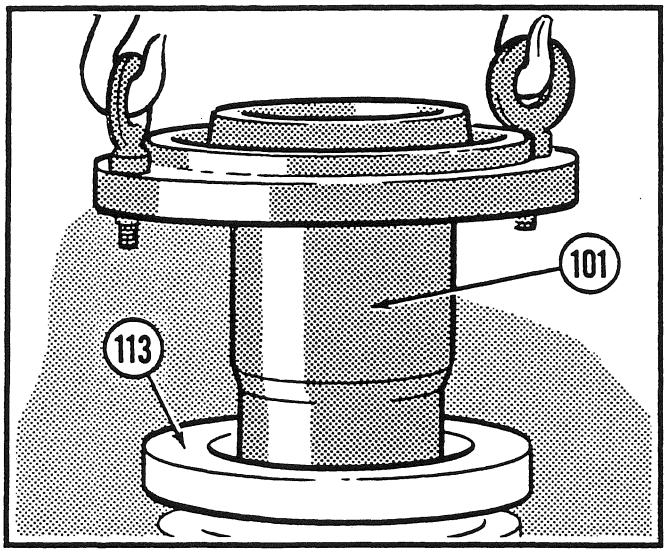
Fig. 183
Carefully install the half-rings (116 and 123) over the "Uniring" seal (117). Fasten the two halves together.

Fig. 184
Temporarily install two capscrews and nuts to secure the half-rings (116 and 123) to the flanged sleeve (101).

Fig. 185
Heat the bearing (104) evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. If the bearing must be pressed into place, use a tubular soft metal drift that contacts the inner race only. Lubricate the bearing and install on the drive axle (105).

Fig. 186
Install a lifting eye into the end of the drive axle (105). Lower the drive axle assembly into the flanged sleeve (101). Align the drive axle and bull gear hub splines. Remove the lifting eye.

Fig. 187
Force the bearing (104) into place in the flanged sleeve (101) using the special tool listed at the front of this Shop Manual Section. Secure the bearing with a new snap ring (103).



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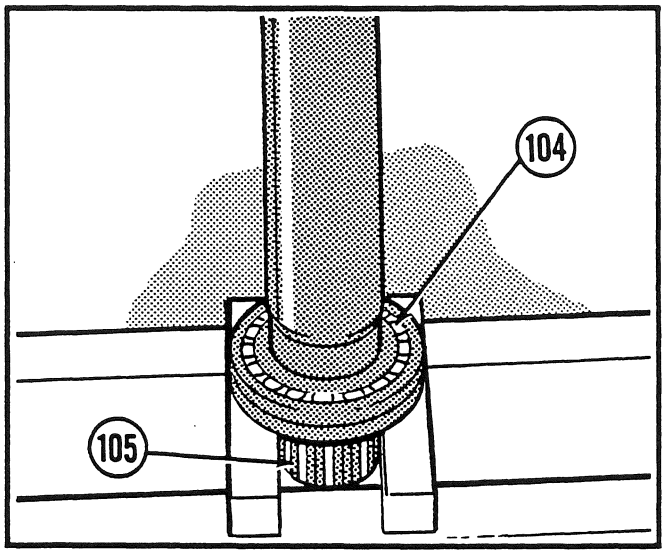

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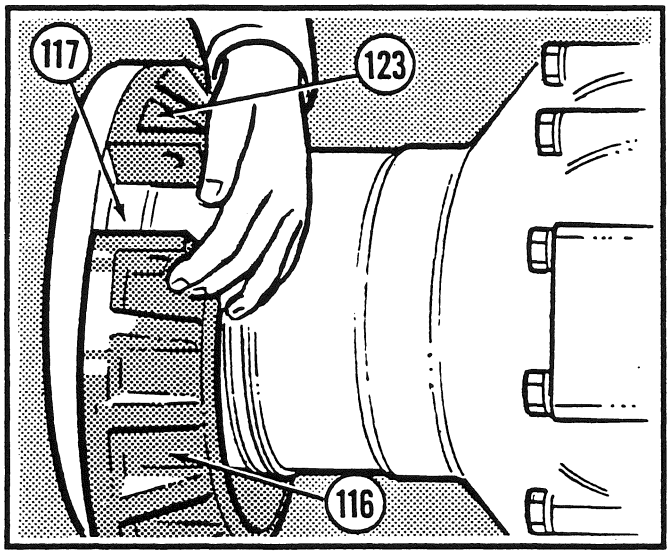

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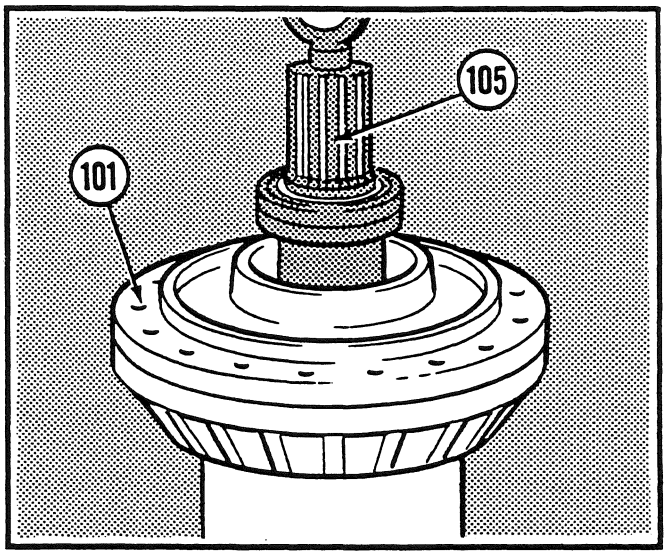

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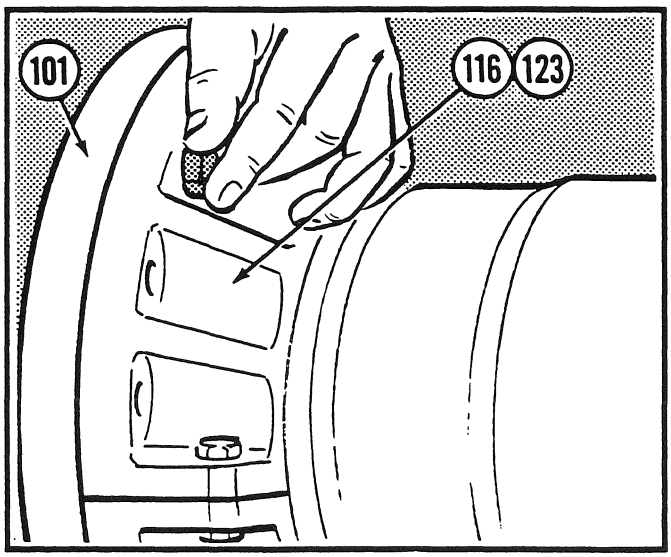

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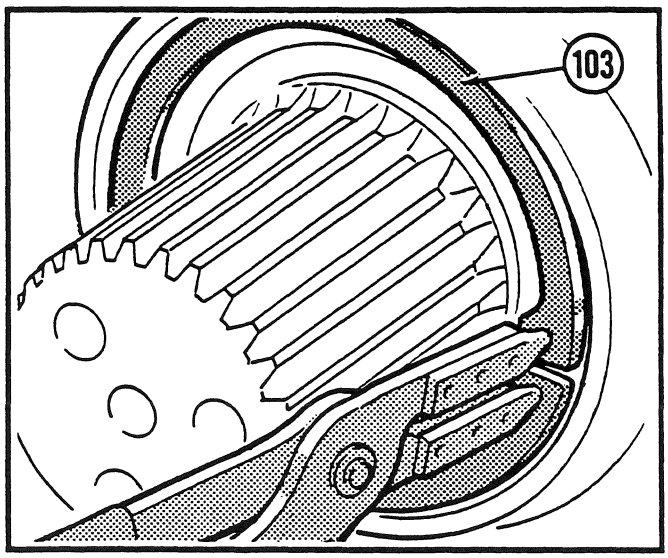

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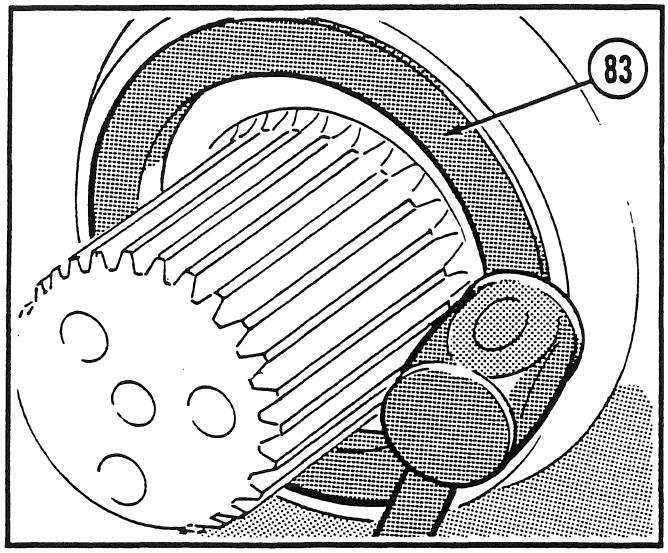

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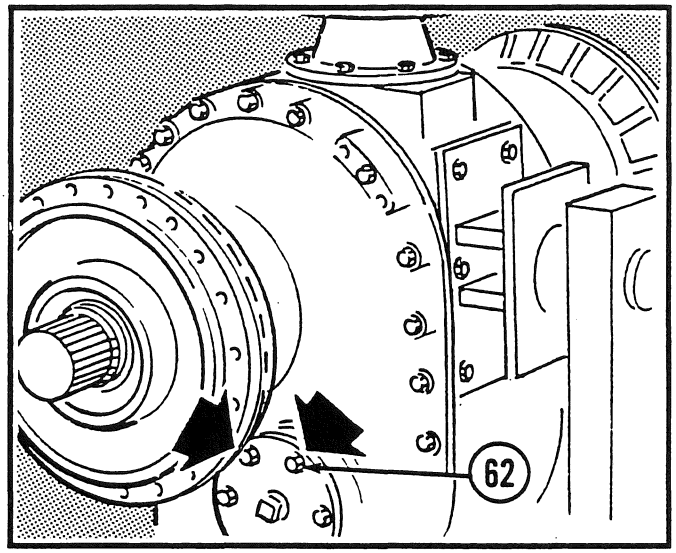

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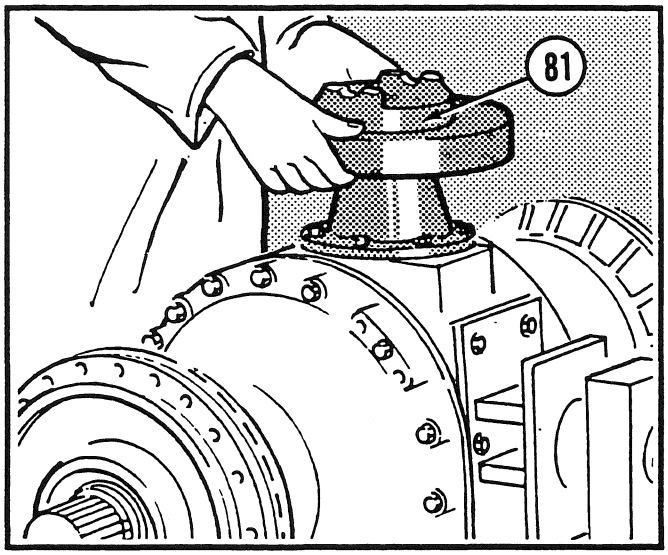

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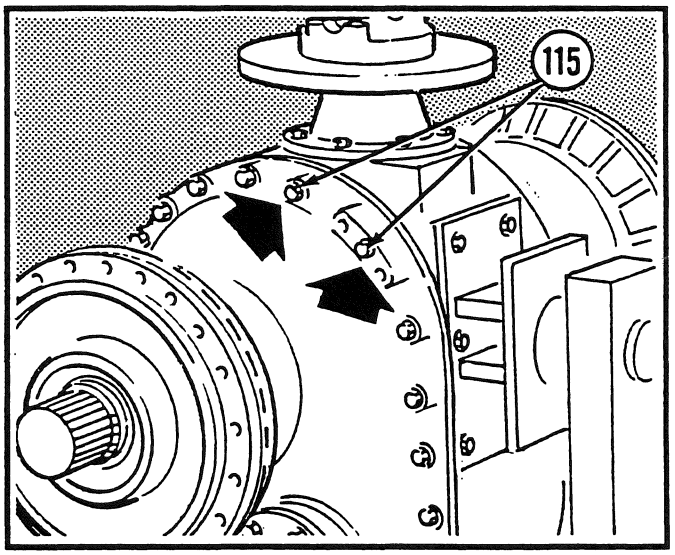


Fig. 192

Fig. 190

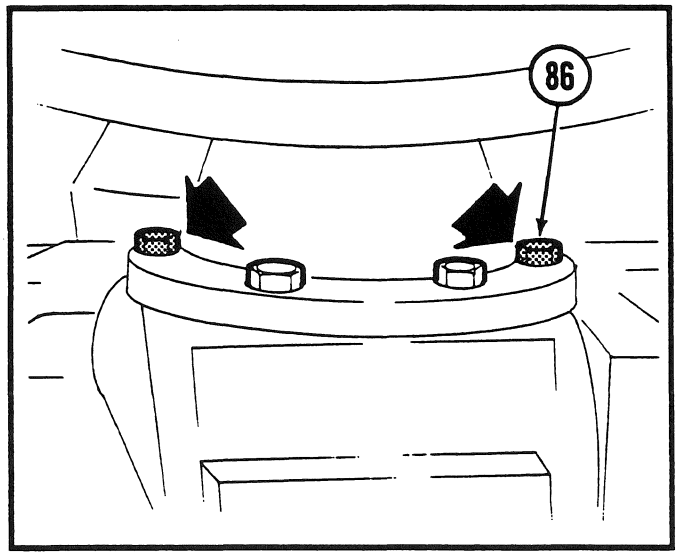


Fig. 193

Differential Final Drive - Assembly (cont.)

Fig. 188
Apply a thin coating of adhesive/ sealant, Champion part number 19200, onto the outer diameter of a new oil seal (83). Install the seal using a soft faced hammer. Repeat the installation procedures described in Fig. 179 through Fig. 188 for the opposite flanged sleeve and axle.

Fig. 189
Install the brake disc and brake flange yoke (81). Install the washers and locknut. Tighten the locknut to the specified torque.

Fig. 190
There are certain capscrews on the final drive which could leak during normal operation. Champion recommends that you apply a thread sealing compound, Champion part number 19167, to these capscrews (Figs. 191, 192 and 193).

Fig. 191
Apply thread sealing compound to the two capscrews (62) on the cross shaft bearing cap and their equivalents on the opposite side.

Fig. 192
Apply thread sealing compound to the two capscrews (115) on both the left and right hand side housings.

Fig. 193
Apply thread sealing compound to the two capscrews (86) retaining the pinion cap.

Differential Final Drive - Assembly (cont.)

Fig. 194
Remove the differential final drive assembly from the build stand and install the suction tube (95).

Fig. 195
Install the hydraulic tube (48).

Fig. 196
Install the strainer (98) on the end of the suction tube (95).

Fig. 197
Install a new inspection cover gasket (106). Install the inspection cover (107), lockwashers (109) and nuts (108). Assembly of the differential final drive is now complete.

Differential Final Drive - Installation

Fig. 198
Before installing the tandem on the differential, install new gaskets or apply gasket eliminator, Champion part number 25303, to the mounting surfaces of the flanged sleeves.

Fig. 199
Remove the capscrews temporarily installed in Fig. 184. Install the differential onto the tandem while aligning the axle splines with those of the tandem sprocket. Take care not to damage the oil seal when installing the sprocket onto the drive axle.

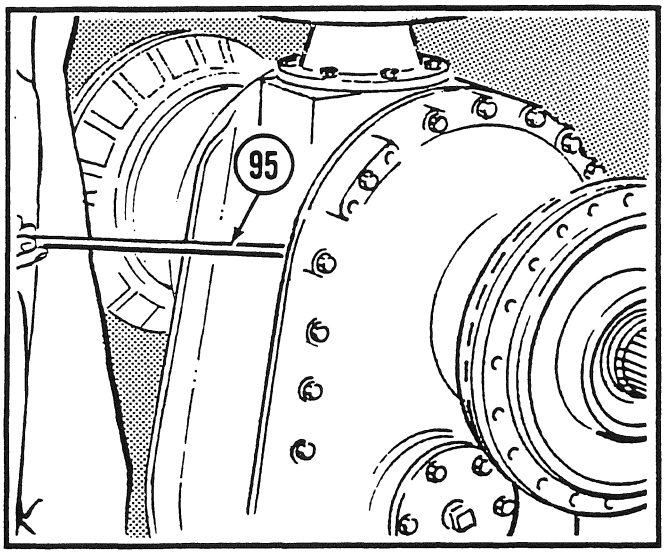
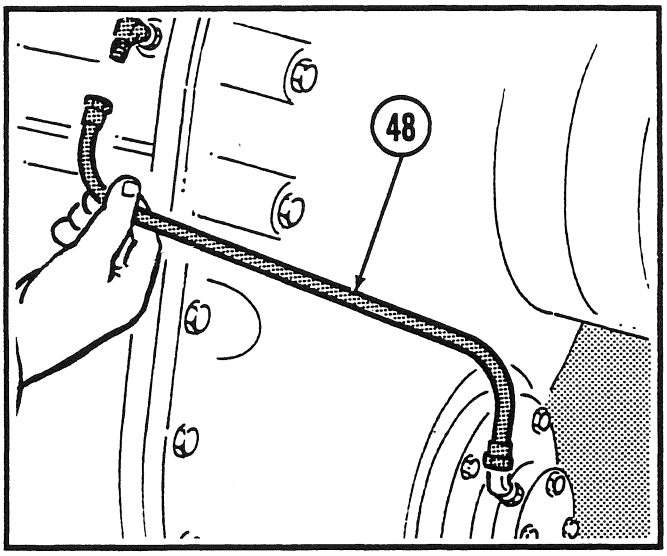


Fig. 194



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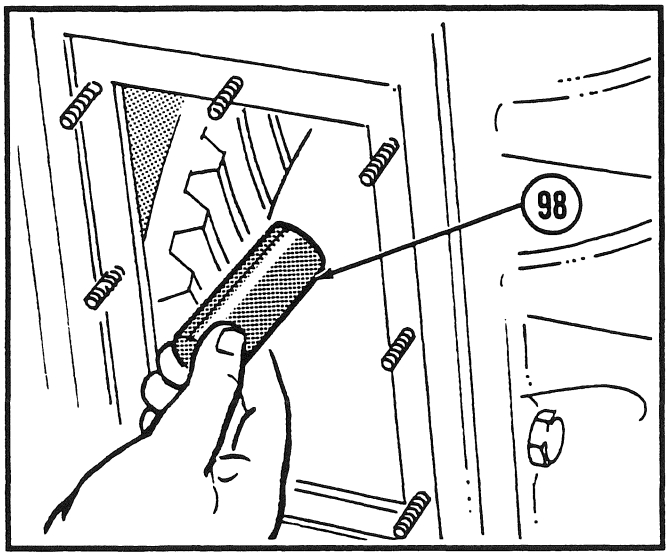

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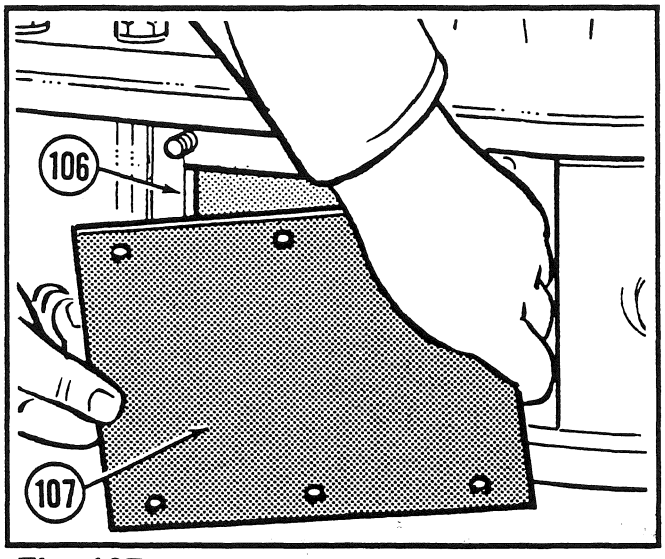

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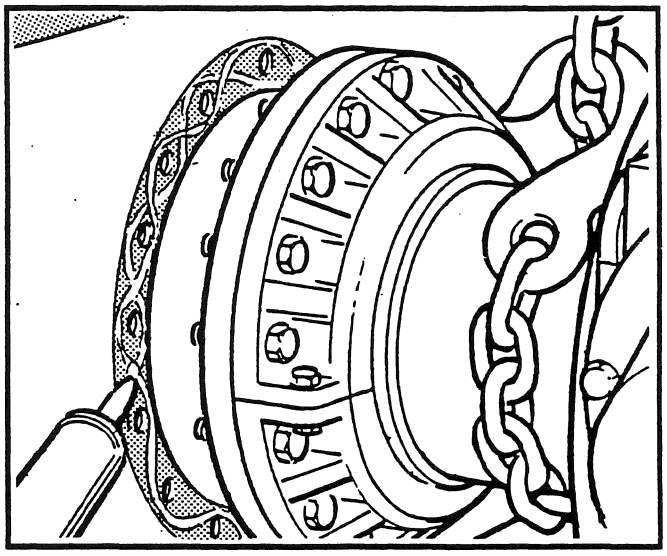
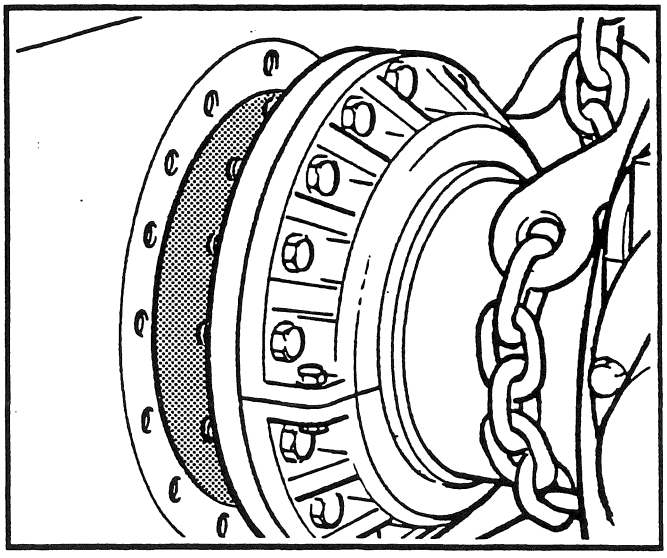


Fig. 198



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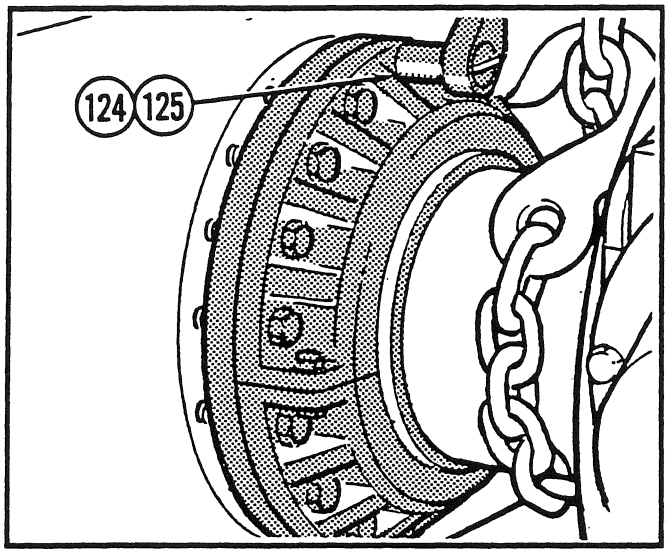


Fig. 200

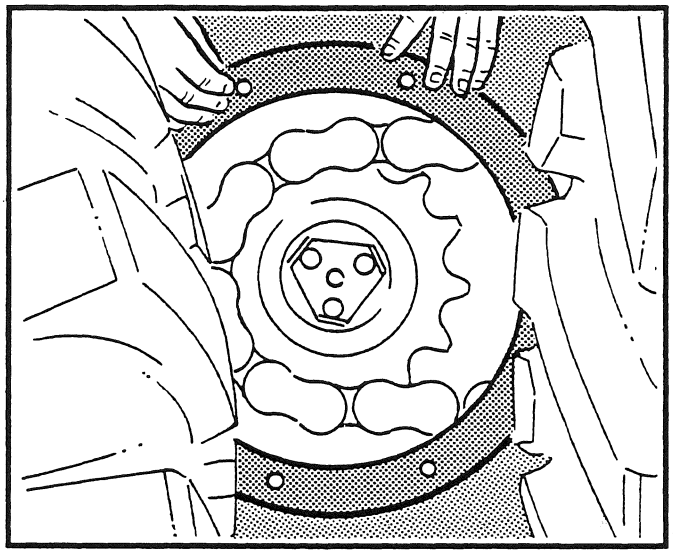
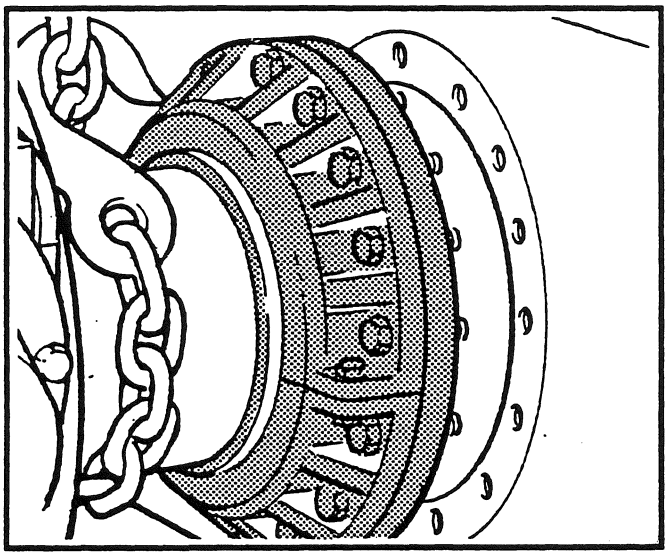


Fig. 203



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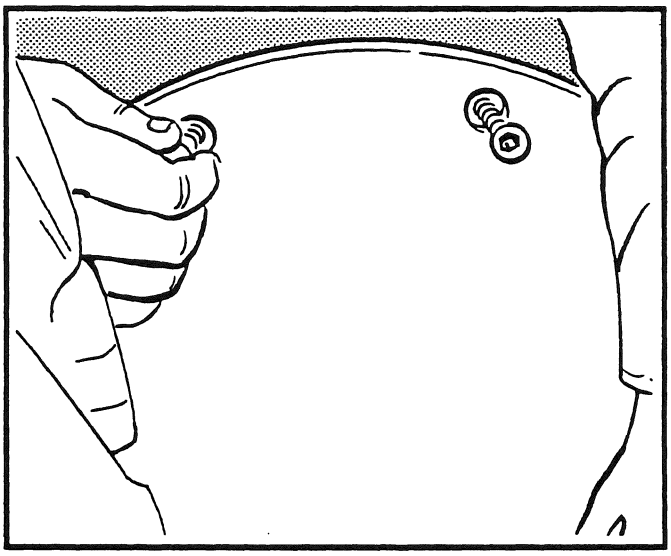

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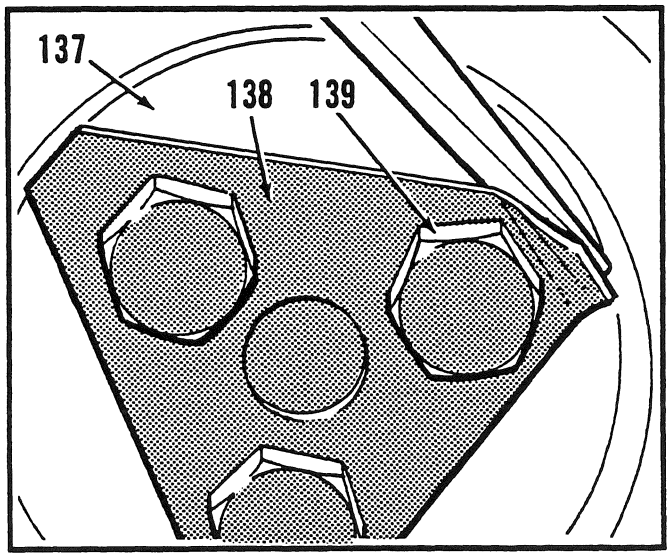

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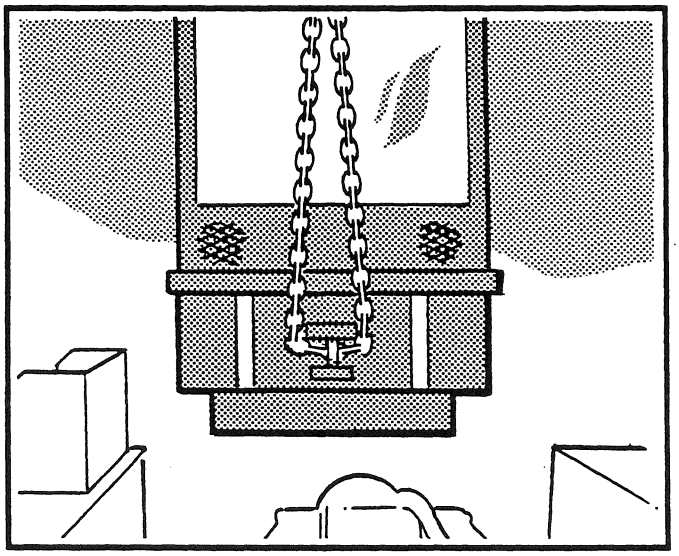


Fig. 205

Differential Final Drive - Installation (cont.)

Fig. 200
Install the capscrews (125) and lockwashers (124) that retain the halfrings to the tandem case. Tighten the capscrews to the specified torque.

Fig. 201
Support the weight of the differential final drive on proper blocks or stands. Repeat the procedures described in Fig. 198 through Fig. 200 and install the other tandem.

Fig. 202
Install the sprocket retainer (137), new lockplate (138) and capscrews (139) for each drive sprocket. Tighten the capscrews to the specified torque. Bend the lockplate corner tabs to secure the capscrew heads.

Fig. 203
Install a new gasket or apply gasket eliminator compound, Champion part number 25303, around the tandem cover plate opening.

Fig. 204
Install the tandem cover plates and fasten them with the capscrews. Remove the blocks supporting the differential final drive assembly.

Fig. 205
Raise the frame using the lifting device. Remove the stand.

Differential Final Drive - Installation (cont.)

Fig. 206
Roll the differential final drive and tandem assembly into position under the frame.

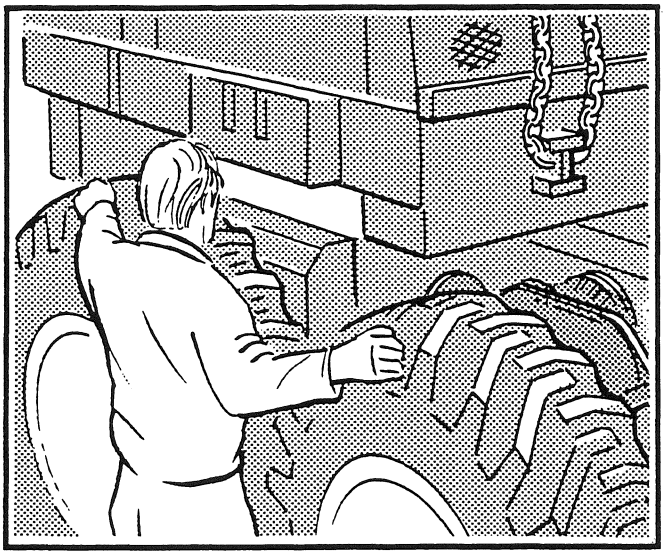
Fig. 207
Carefully lower the frame onto the differential final drive housing using the lifting device. On articulated machines, **make sure** that the parking brake disc does not interfere with the mounting brackets.

Fig. 208
Install the hanger bracket half-clamps (**be sure** to check the matching identification marks). Retain with the nuts (77) and bolts (76), but **DO NOT** torque tighten.

Fig. 209
Install the mounting plate (133) and retain with the nuts (130), bolts (132) and lockwashers (131). Tighten the nuts (77 and 130) to the specified torque.

Fig. 210
Re-connect the lower drive shaft to the differential final drive brake flange yoke. Tighten the capscrews to the specified torque.

Fig. 211
Install the parking brake assembly.



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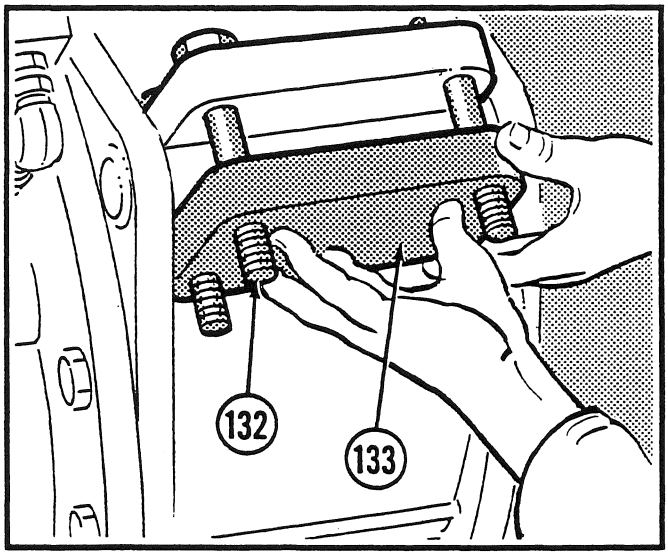

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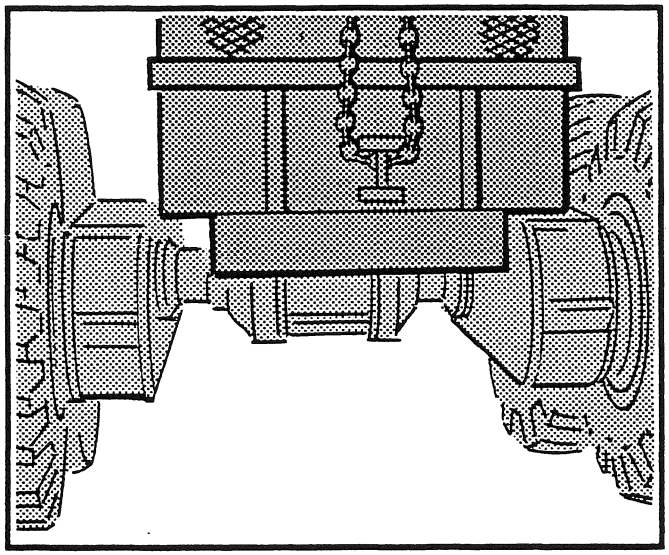

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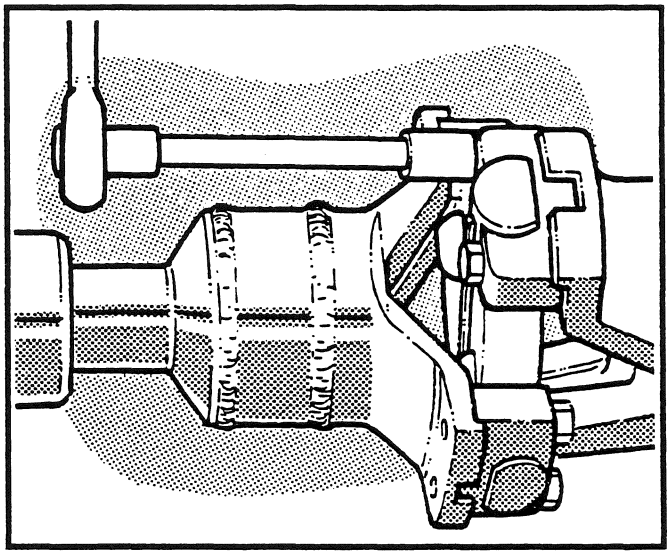

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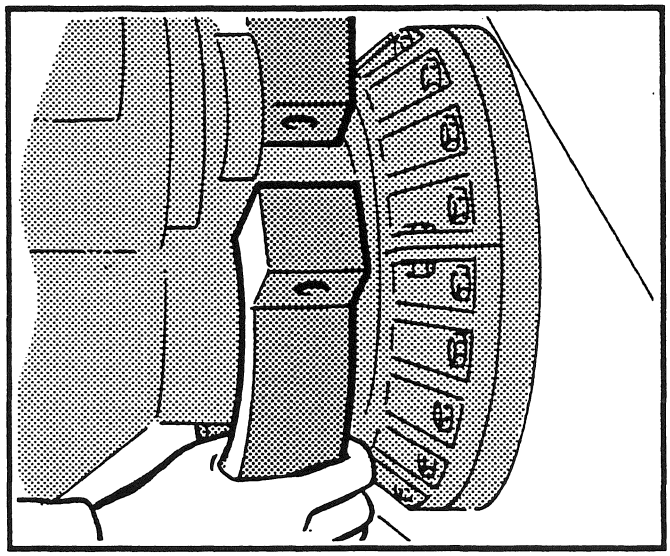

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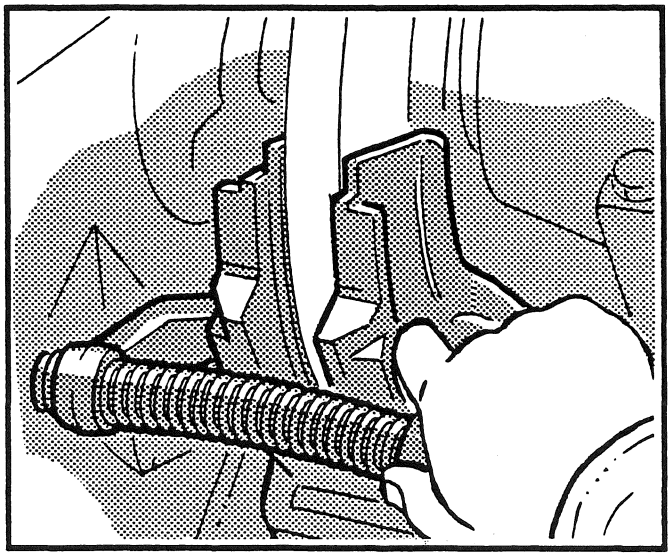

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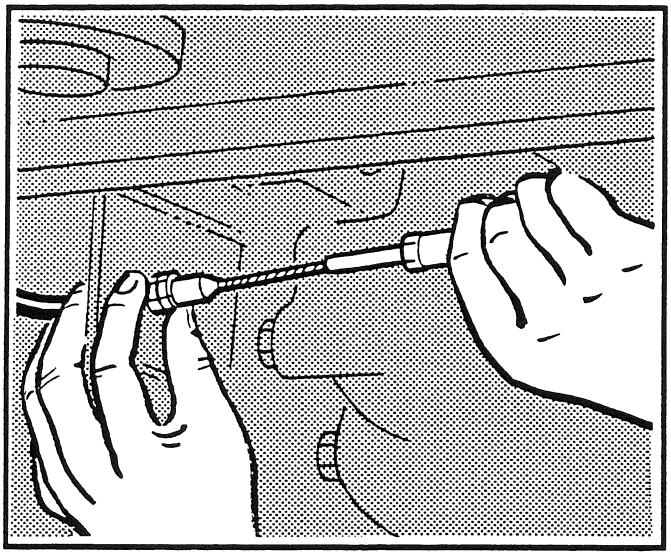


Fig. 212

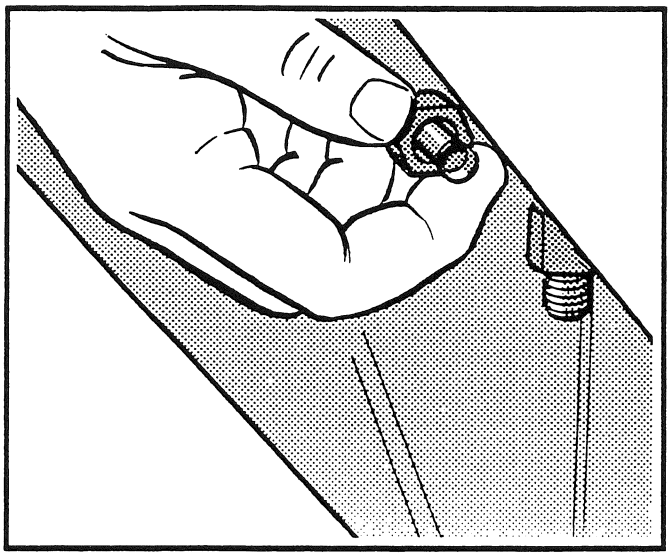


Fig. 215

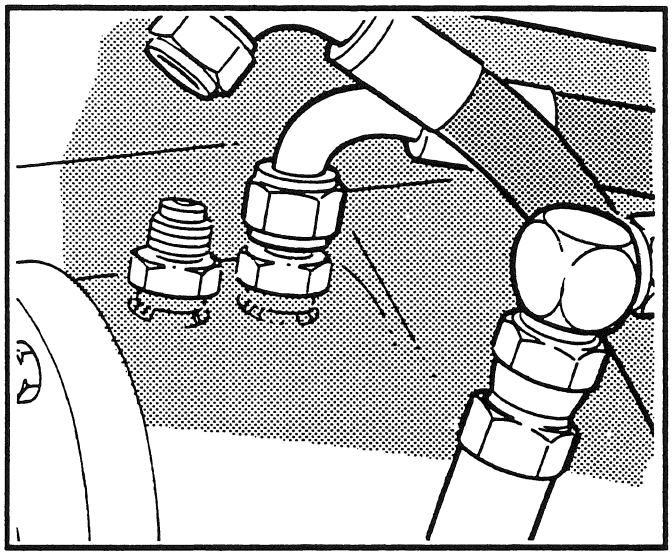


Fig. 213

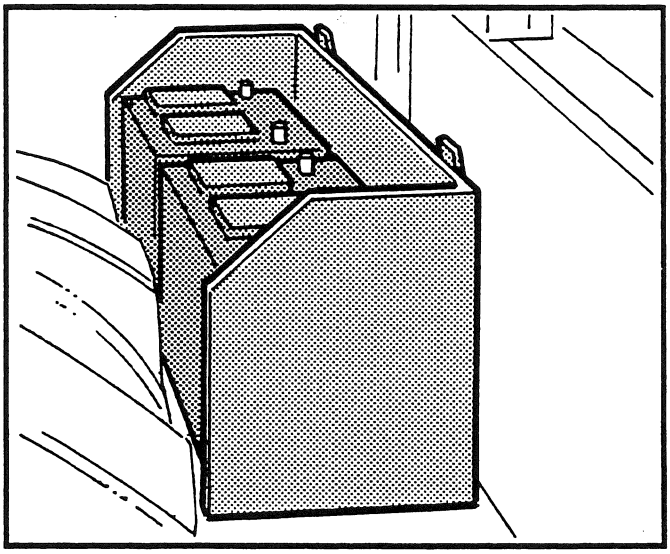
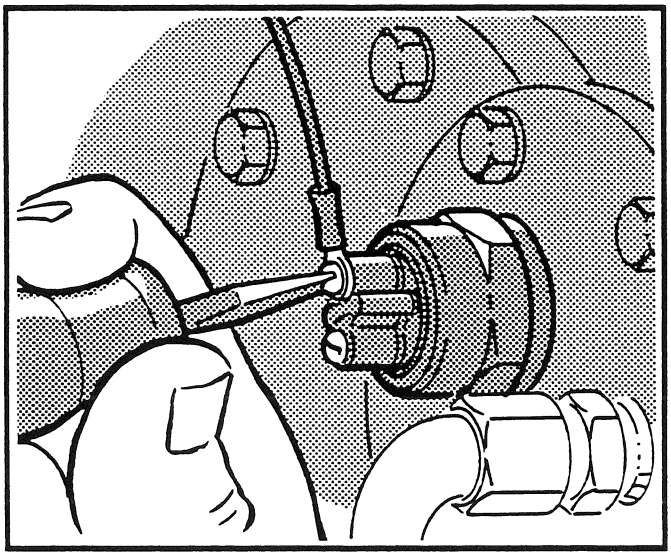


Fig. 216



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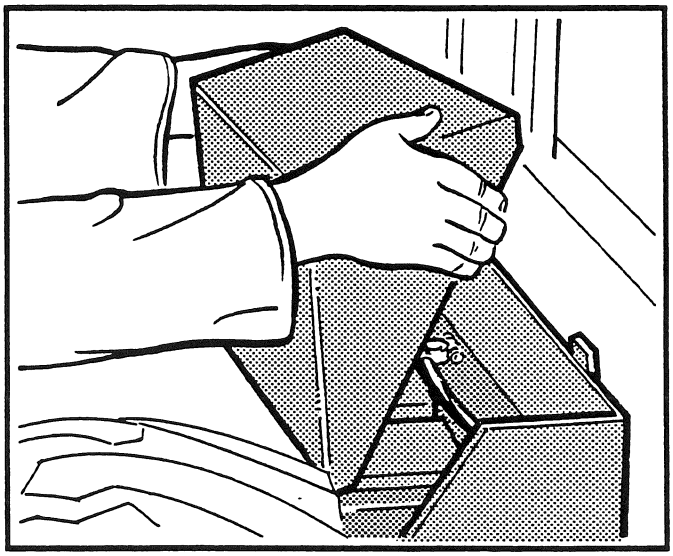


Fig. 217

Differential Final Drive - Installation (cont.)

Fig. 212

Re-connect the parking brake cable and adjust the brake shoe clearance. Install the parking brake fender.

Fig. 213

Identify and re-connect the three hydraulic hoses to the lock/unlock cylinder.

Fig. 214

Re-connect the wires to the lock/unlock switch terminals.

Fig. 215

Re-connect the brake lines at the tee fittings on the frame. Be sure to wipe up any spilled fluid immediately.

Fig. 216

Install the battery box and connect the battery cables to the proper terminals.

Fig. 217

Install the battery box cover.

Differential Final Drive - Installation (cont.)

Fig. 218
Install the filler pipe (136) and hose (135) on the frame.

Fig. 219
Fill the differential final drive to the correct level using the lubricant recommended in the Lubrication Specifications at the front of this Shop Manual.

Fig. 220
Fill the tandem cases to the correct level using the lubricant recommended in the Lubrication Specifications at the front of this Shop Manual.

Fig. 221
Purge the brake system as described in the appropriate section of this Shop Manual.

Fig. 222
Removal and installation of the lock/unlock differential final drive is now complete. **Road test the grader to make sure that the lock/unlock differential final drive works properly.** Check all connections for leaks.

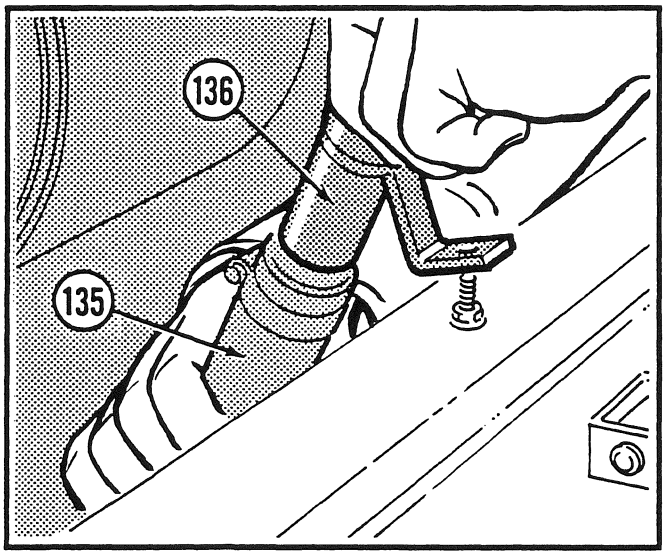


Fig. 218

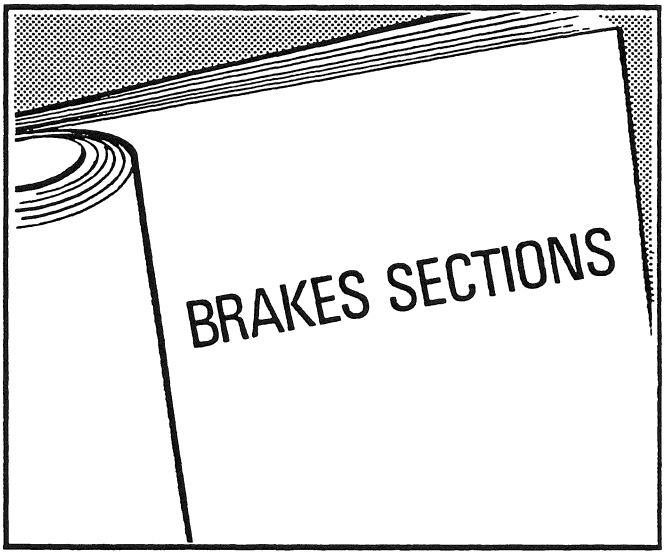


Fig. 221

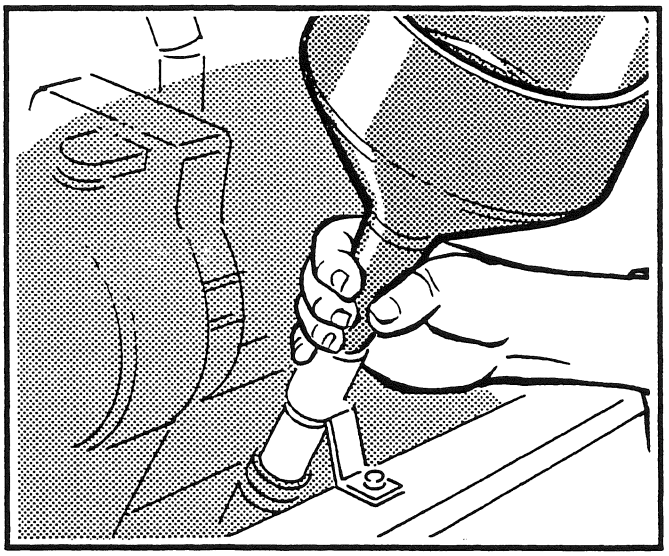


Fig. 219

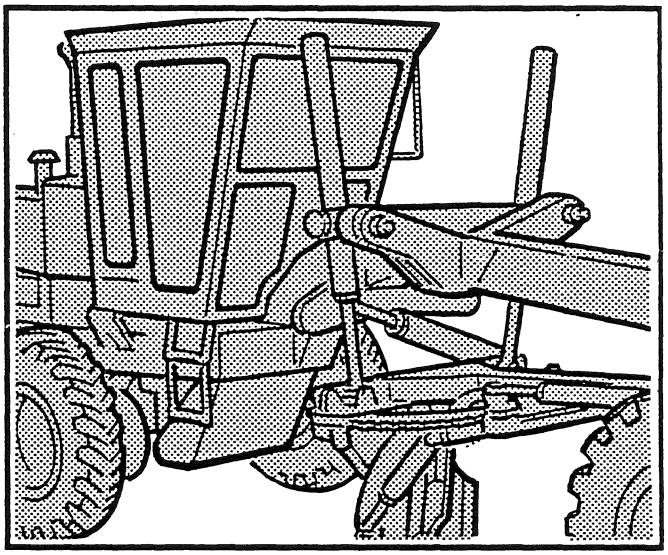


Fig. 222

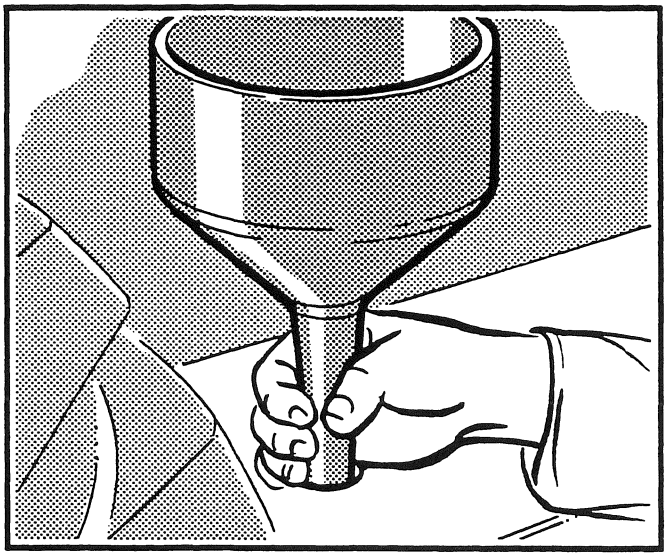
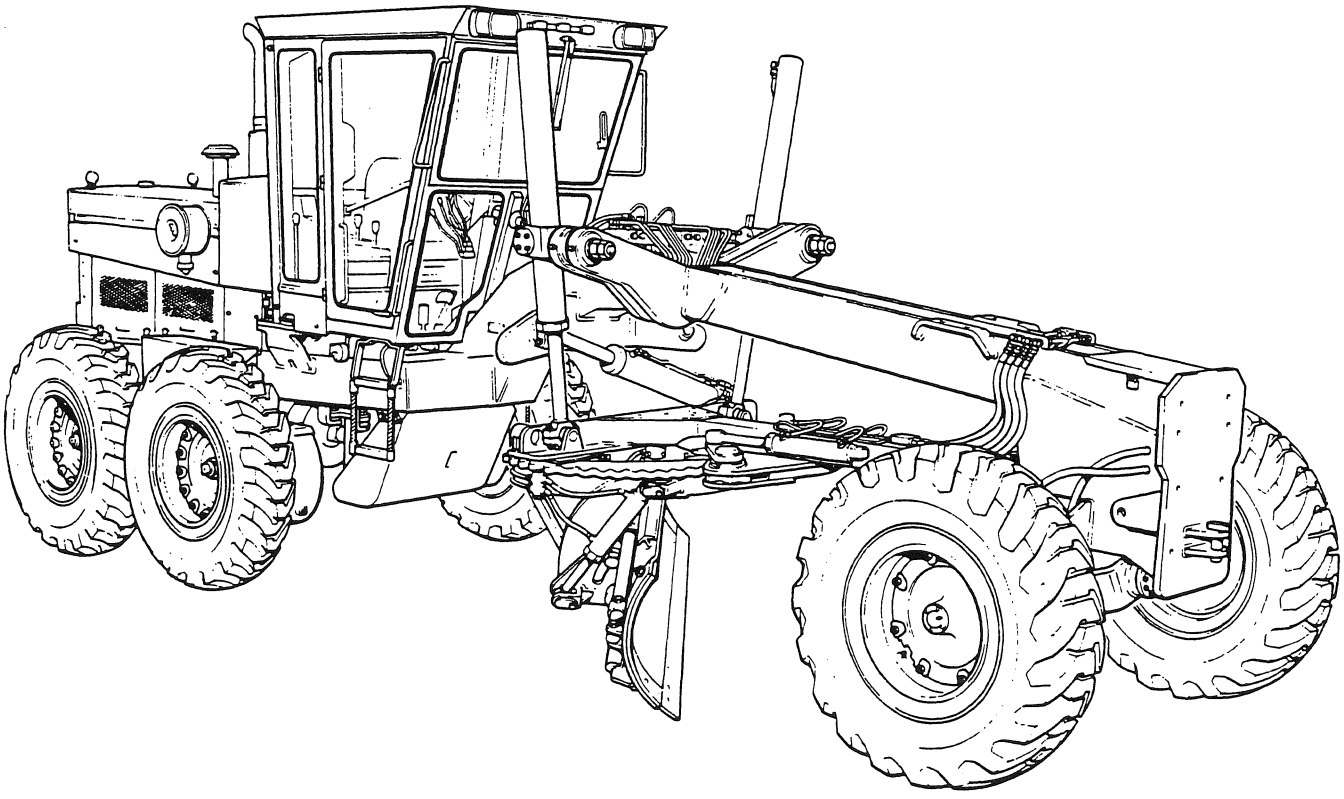


Fig. 220

SECTION 11

STANDARD
DOUBLE REDUCTION FINAL DRIVE

Applicable to graders S/N **16224**, **16245** to **20324**
U.S. S/N **2021-2** to **2658-2**



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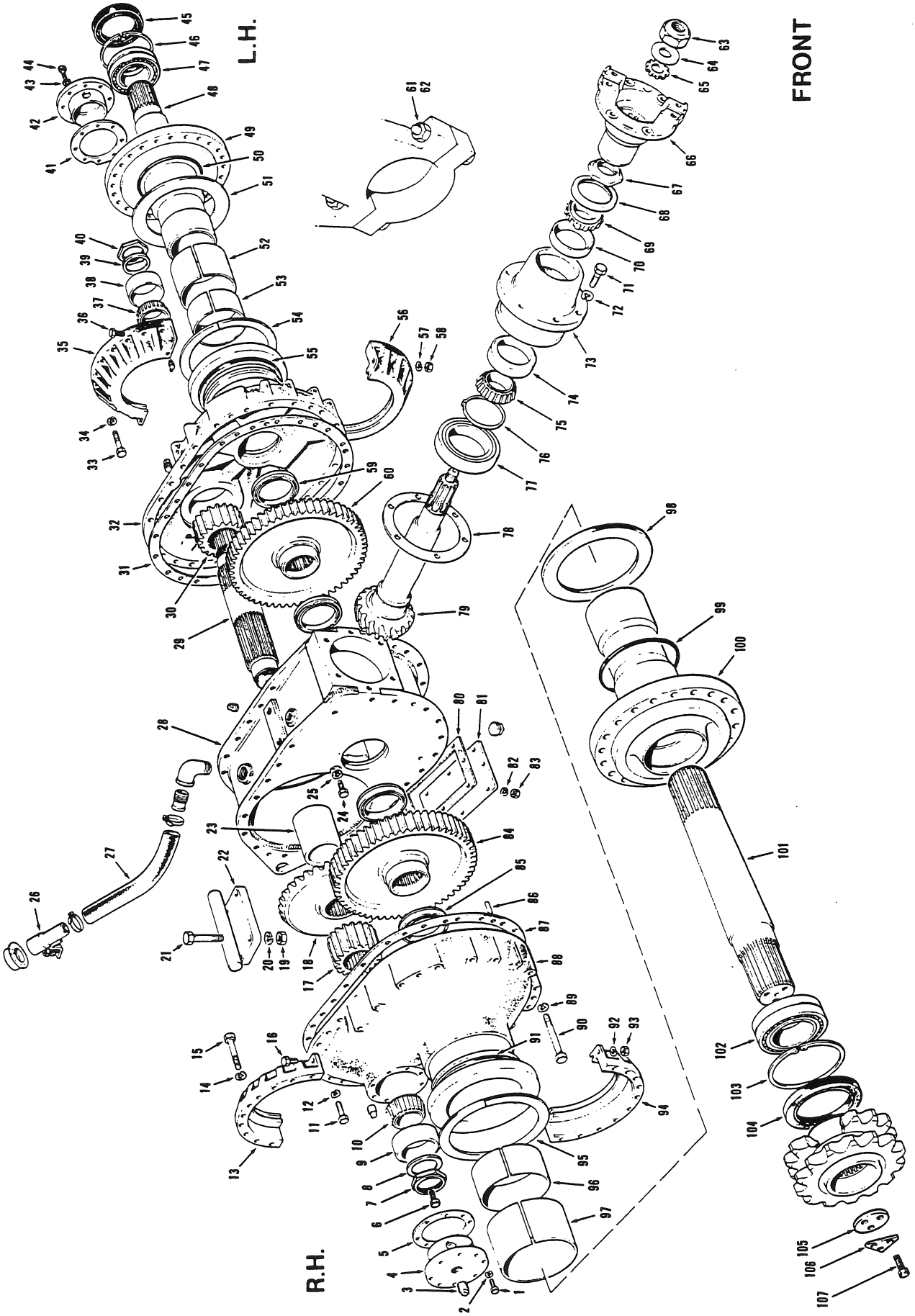
STANDARD DOUBLE REDUCTION FINAL DRIVE

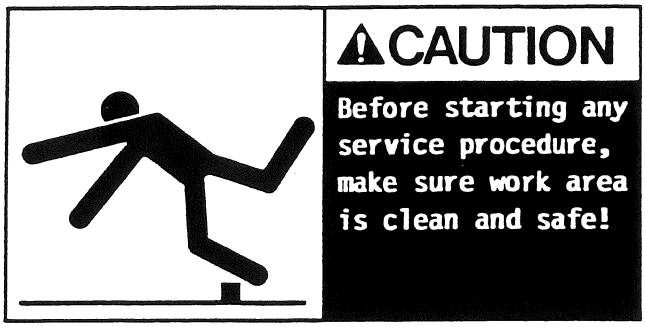


STANDARD DOUBLE REDUCTION FINAL DRIVE

Item	Description	Item	Description	Item	Description
1	Capscrew	37	Bearing cone	73	Pinion cap
2	Lockwasher	38	Bearing cup	74	Bearing cup
3	Pipe plug	39	Bearing spacer	75	Bearing cone
4	Cross shaft right hand cap	40	Locknut	76	Snap ring
5	Shim pack	41	Shim pack	77	Bearing
6	Capscrew	42	Cross shaft left hand cap	78	Shim pack
7	Locknut	43	Lockwasher	79	Spiral pinion shaft
8	Bearing spacer	44	Capscrew	80	Gasket
9	Bearing cup	45	Oil seal	81	Cover plate
10	Bearing cone	46	Snap ring	82	Lockwasher
11	Capscrew	47	Bearing	83	Nut
12	Lockwasher	48	Drive axle	84	Bull gear
13	Half-ring	49	Flanged sleeve	85	Bearing
14	Lockwasher	50	O Ring	86	Dowel pin
15	Capscrew	51	Outer thrust plate	87	Gasket
16	Bolt	52	Outer bushing	88	Right hand side housing
17	Spur pinion	53	Inner bushing		
18	Spiral pinion gear	54	Inner thrust plate	89	Lockwasher
19	Nut	55	"Uniring" seal	90	Capscrew
20	Lockwasher	56	Half-ring	91	"Uniring" seal
21	Bolt	57	Lockwasher	92	Lockwasher
22	Mounting plate	58	Nut	93	Nut
23	Spacer	59	Bearing	94	Half-ring
24	Screw	60	Bull gear	95	Inner thrust plate
25	Lockwasher	61	Nut	96	Inner bushing
26	Breather pipe	62	Bolt	97	Outer bushing
27	Breather hose	63	Locknut	98	Outer thrust plate
28	Main case	64	Plain washer	99	O Ring
29	Cross shaft	65	Star washer	100	Flanged sleeve
30	Spur pinion	66	Brake flange yoke	101	Drive axle
31	Gasket	67	Locknut	102	Bearing
32	Left hand side housing	68	Oil seal	103	Snap ring
33	Capscrew	69	Bearing cone	104	Oil seal
34	Lockwasher	70	Bearing cup	105	Sprocket retainer
35	Half-ring	71	Capscrew	106	Lockplate
36	Bolt	72	Lockwasher	107	Capscrew

Key to Fig. 1

General



Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks or proper stands; a build stand (if available); a hydraulic press; shop tools and some special tools listed in the front of this Shop Manual Section.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

THE SERVICE POSITION IS AS FOLLOWS:- PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH PROPER STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS LOCATED BEHIND THE ENGINE SIDE PANELS. ON ARTICULATED MACHINES, INSTALL THE LOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS.

THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

Description

The standard double reduction final drive is used for gear reduction and changing power flow direction. The spiral pinion shaft transmits the power flow to the spiral pinion gear and two spur pinions splined to the cross shaft. Tapered roller bearings support the shaft.

The spur pinions mesh with bull gears which are supported by roller bearings. Each bull gear is splined to a drive axle which is supported at the outer end by a double-race, self-aligning roller bearing. The power flow is divided equally at the spur pinions and bull gears where it continues by way of the drive axles, sprockets and chains to the tandem stub axles and wheels.

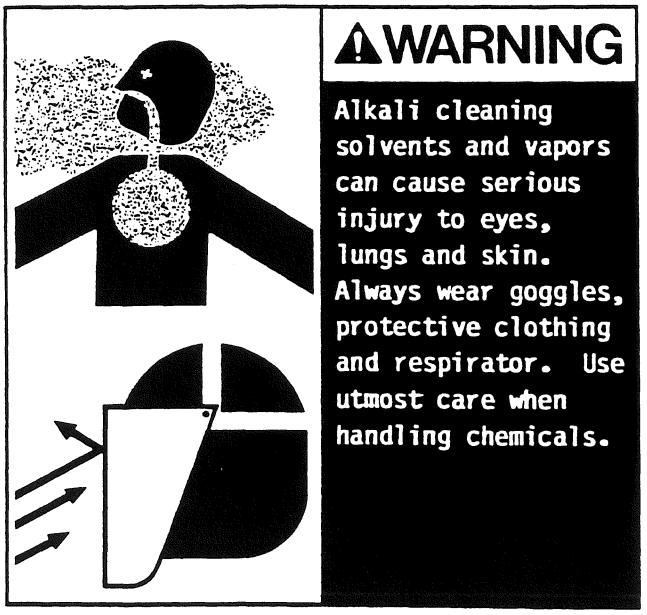
Description (Continued)

Two flanged sleeves transfer the machine weight between the final drive and tandem cases. The sleeves oscillate in two teflon-coated, steel-backed bronze bushings installed in both side housings. The flanged sleeves and tandem cases are held together by half-rings. The half-rings prevent side movement of the flanged sleeves in the bushings.

Refer to the Lubrication Specifications at the front of this Shop Manual for the recommended lubricants used in the standard double reduction final drive.

Cleaning and Inspection

Cleaning - Bearings and Small Parts



You are recommended to wear cotton gloves when handling bearings. This prevents transfer of skin acids and perspiration onto bearing races.

Immerse bearings and small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags. Make sure all oil passages are unblocked. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning and Inspection (Continued)

Inspection - Gaskets, Oil Seals, O Rings and Snap Rings

Replace all gaskets, oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Before installation, apply a thin coating of adhesive/sealant, Champion part number **19200**, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings with system oil.

Inspection - Gears and Shafts

If crack detection equipment is available, use the process to check parts. Examine teeth of all gears for wear, pitting, chipping, nicks, cracks and scores. If gear teeth show spots where the case hardening has worn through or cracked, replace the gear.

Small nicks can be removed using a appropriate grinding stone. Inspect shafts for signs of bent or twisted splines and replace any deformed axles.

Torque Guide

Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 61	Spiral pinion shaft bearing outer race retaining screw	142	14,5	105
Fig. No. 68	Left and right hand side housing capscrews	271-305	28-31	200-225
Fig. No. 70	Cross shaft left hand cap capscrews	41-47,5	4-5	30-35
Fig. No. 75	Cross shaft left and right hand bearing cone locknut	678	69	500
Fig. No. 82	Cross shaft right hand cap capscrews	41-47,5	4-5	30-35
Fig. No. 99	Pinion cap capscrews	271-305	28-31	200-225
Fig. No. 112	Brake flange yoke locknut	305	31	225
Fig. No. 115	Half-ring to tandem case capscrews	271-305	28-31	200-225
Fig. No. 117	Sprocket retainer plate capscrews	271-305	28-31	200-225
Fig. No. 124	Hanger bracket half-clamp mounting nuts	1301,5	133	960
Fig. No. 124	Mounting plate nuts	380	39	280
Fig. No. 125	Drive shaft to brake flange yoke capscrews	271-305	28-31	200-225

Adjustments

Fig. No.	Application	N.m	kgf.m	lbf.in.
Fig. No. 84	Cross shaft rolling torque	4,5 - 7,3	0,5 - 0,7	40 - 65
			kg	lb
Fig. No. 90	Spiral pinion shaft assembly rolling torque		6,8 - 15,8	15 - 35
			mm	in.
Fig. No. 100	Spiral pinion and gear backlash		0,203 - 0,406	.008 - .016

Special Tools

Fig. No.	Description	Part No.
Fig. No. 41	Deep-reach socket wrench	43004
Fig. No. 57	Spiral pinion shaft bearing outer race removal tool	18504
Fig. No. 62	Bull gear bearing outer race installation tool	33174
Fig. No. 64	Inner bushing installation tools	18512
		18513
Fig. No. 64	Outer bushing installation tools	18511
		18512
Fig. No. 78	Inner bushing installation tools	18512
		18513
Fig. No. 78	Outer bushing installation tools	18511
		18512
Fig. No. 86	Spiral pinion shaft bearing inner race installation tool	45261
Fig. No. 87	Pinion cap bearing cup installation tools	18507
		18508
		18509
		18510
Fig. No. 88	Spiral pinion shaft bearing cone installation tool	18518
Fig. No. 89	Deep-reach socket wrench	43004
Fig. No. 90	Deep-reach socket wrench	43004
Fig. No. 95	Spiral pinion shaft depth setting gauge	45294

Final Drive - Removal

Fig. 2
Park the grader on level ground. Place the transmission mode lever in **Neutral.** Centralize the circle, drawbar and moldboard assembly using the circle shift and blade lift cylinders.

Fig. 3.
Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **Service Position.**

Fig. 4
Drain the final drive lubricating oil. Clean and install the magnetic drain plug.

Fig. 5
Drain the lubricating oil from both tandem cases. Clean and install the magnetic drain and long-reach plugs.

Fig. 6
Remove the breather pipe (26) and breather hose (27) from the frame.

Fig. 7
Disconnect the brake lines from the tee fittings on the frame. Plug the lines and fittings and wipe away any spilled brake fluid.

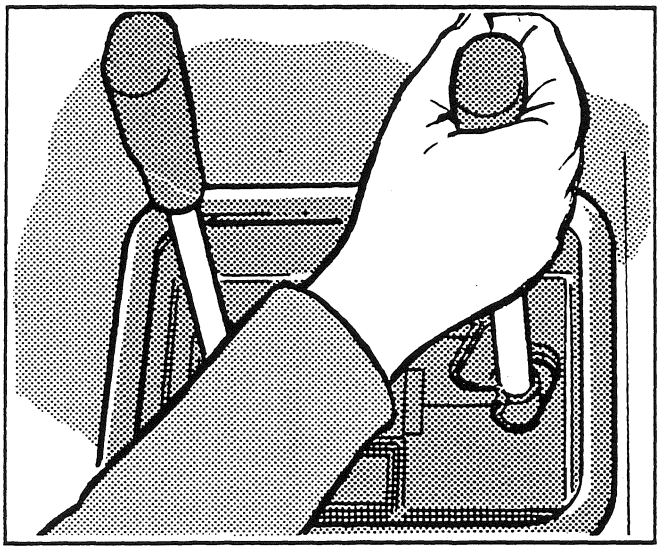


Fig. 2

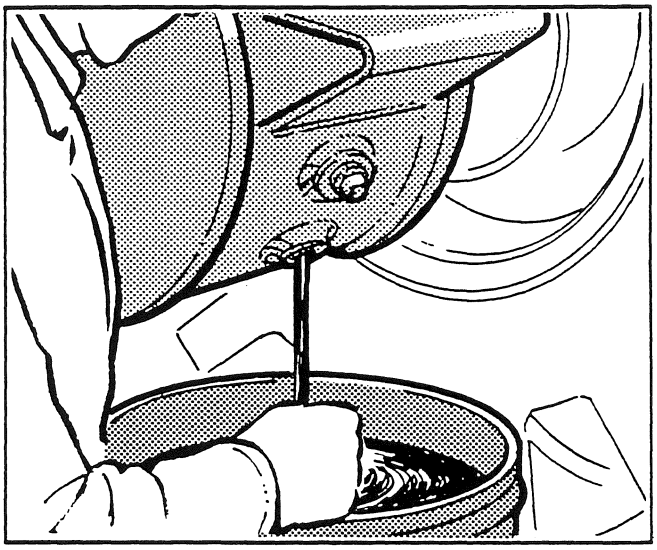


Fig. 5

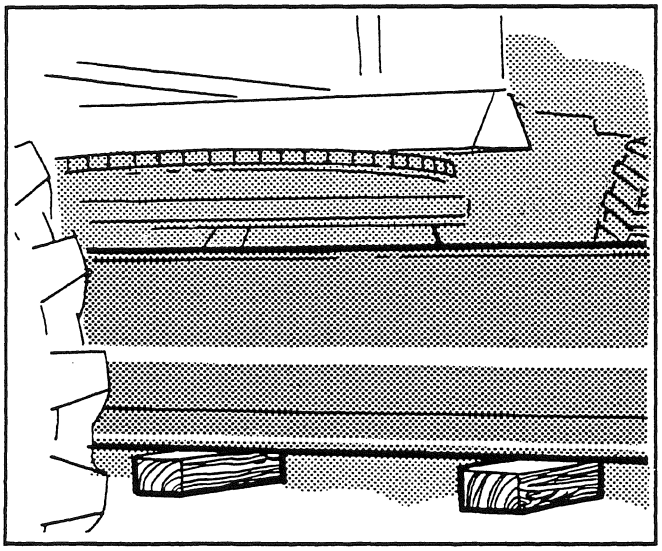


Fig. 3

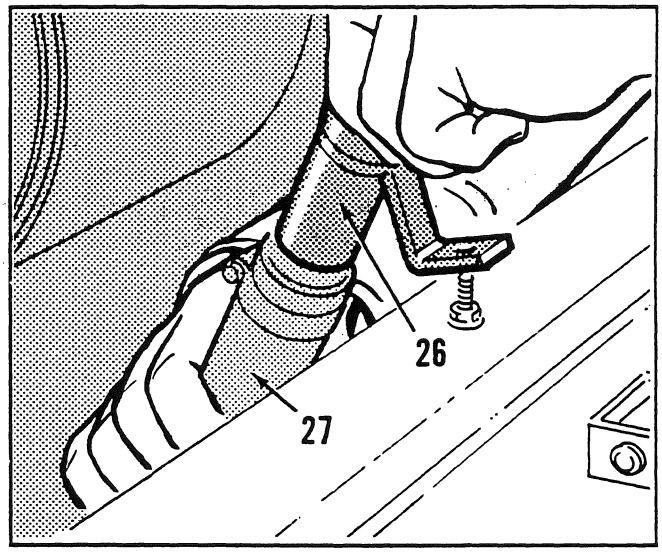


Fig. 6

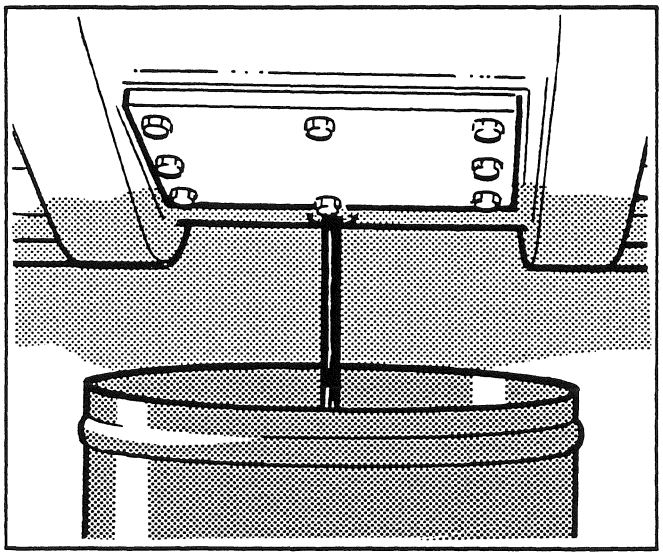


Fig. 4

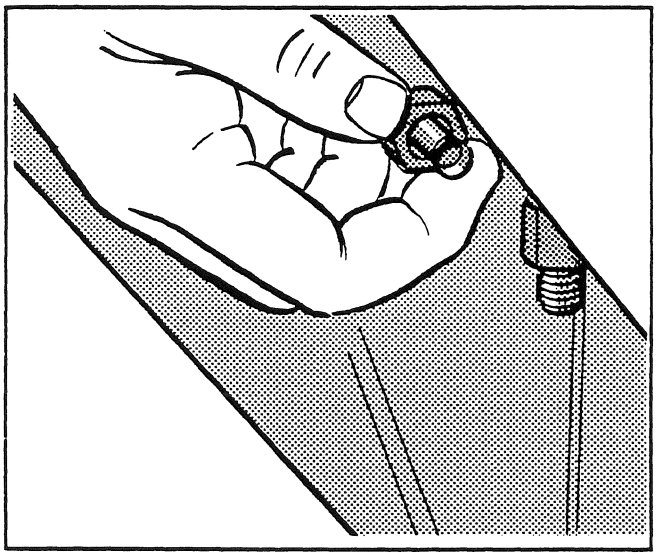


Fig. 7

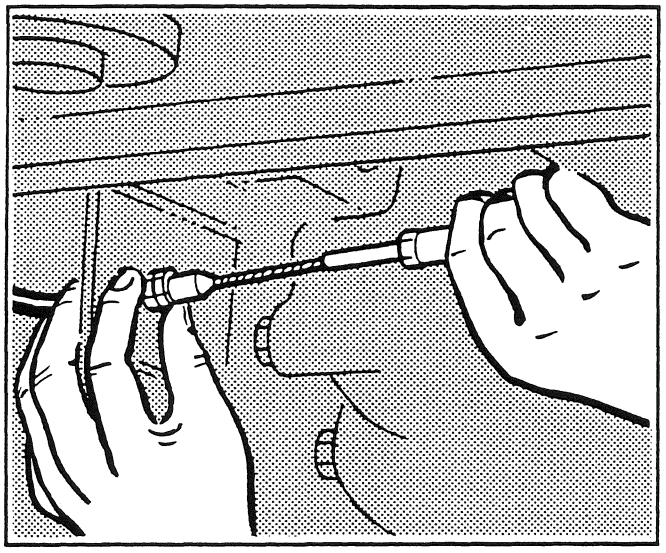


Fig. 8

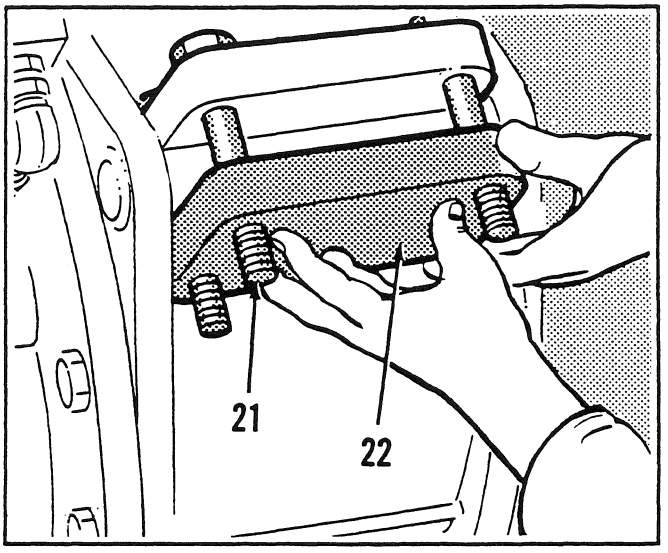


Fig. 11

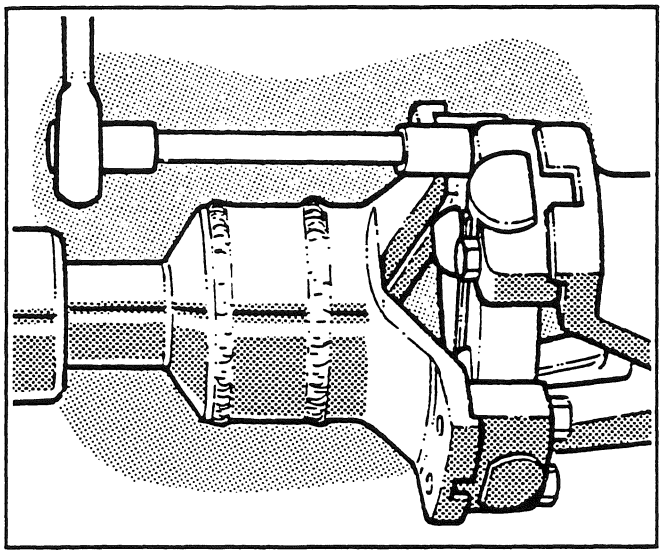


Fig. 9

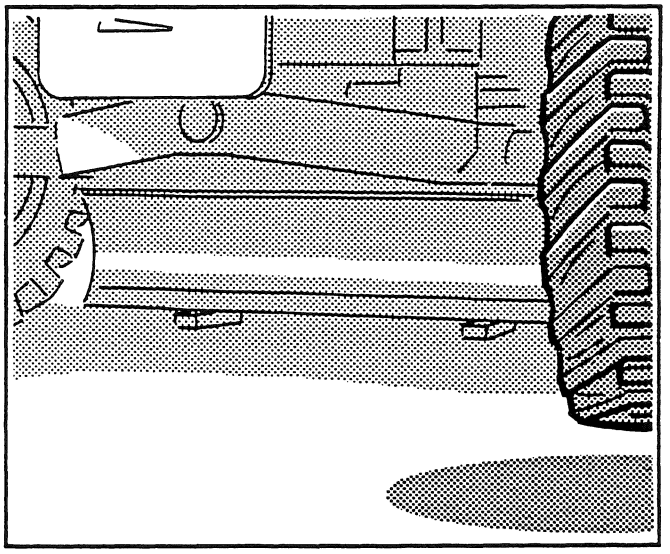


Fig. 12

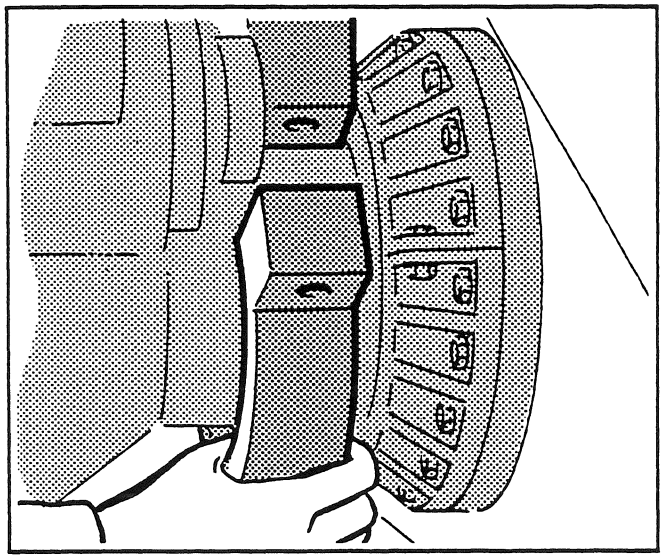


Fig. 10

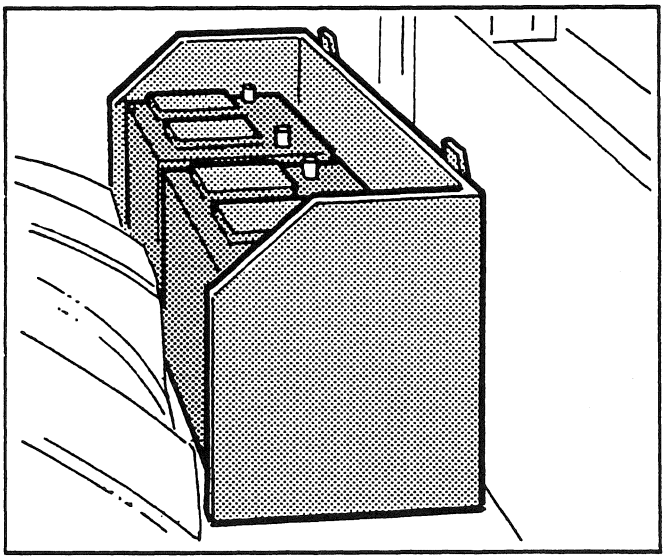


Fig. 13

Final Drive - Removal (Continued)

Fig. 8
Disconnect the parking brake cable. Remove the fender and the parking brake assembly.

Fig. 9
Disconnect the lower drive shaft from the brake flange yoke on the front of the final drive.

Fig. 10
Remove the nuts (61) and bolts (62) securing the final drive hanger bracket half-clamps. Identify the halves to ensure that you install them in the same locations during assembly.

Fig. 11
Remove the nuts (19), bolts (21) and lockwashers (20) and remove the mounting plate (22).

Fig. 12
Start the engine and raise the front wheels just off the ground using the moldboard. Shut down the engine.

Fig. 13
Disconnect the battery cables and remove the battery box.

Final Drive - Removal (Continued)

Fig. 14
Attach the lifting device to the rear of the grader frame. Raise the frame until it is clear of the final drive assembly. On articulated models, **make sure** that the parking brake disc does not interfere with the mounting brackets.

Fig. 15
Roll the final drive and tandem assembly out from under the frame.

Fig. 16
Lower the frame onto a secure stand.

Fig. 17
Remove the capscrews retaining the tandem cover plates. Remove the plates and discard the gaskets. If gasket eliminator compound has been used, remove all traces of the sealant.

Fig. 18
Release the tabs and remove the capscrews (107), lockplate (106) and sprocket retainer (105) from the right hand tandem. Discard the lockplate.

Fig. 19
Remove the capscrews (15) and lockwashers (14) retaining the half-rings (13 and 94) to the tandem.

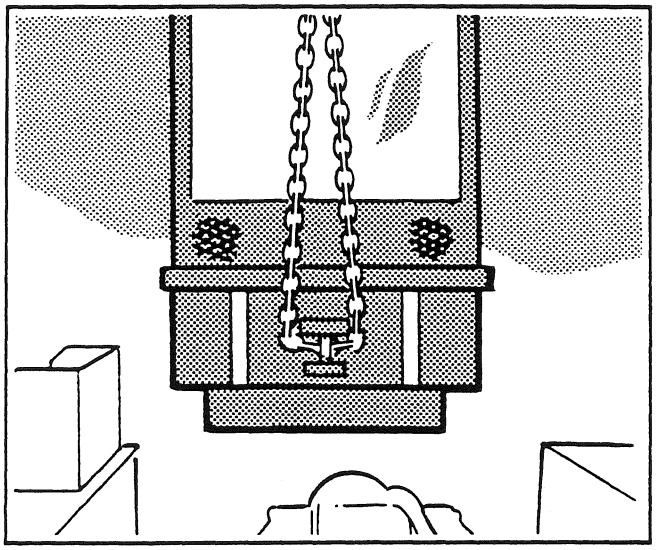


Fig. 14

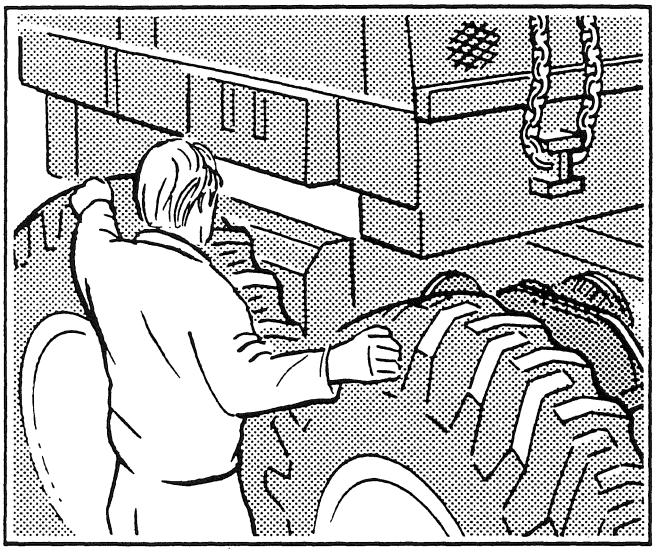


Fig. 15

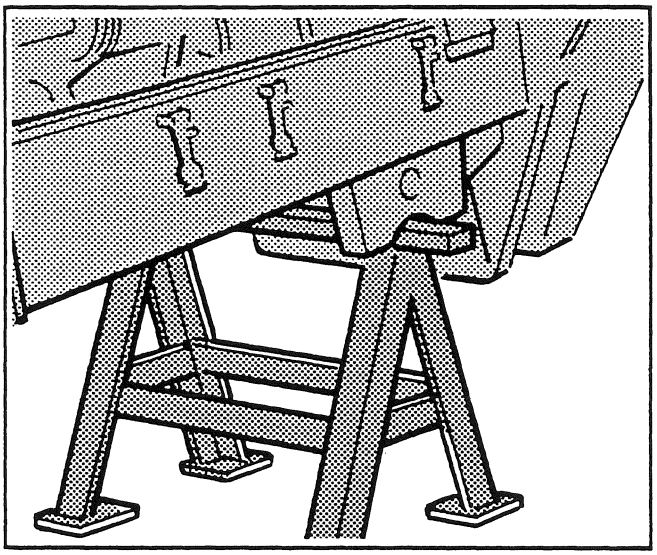


Fig. 16

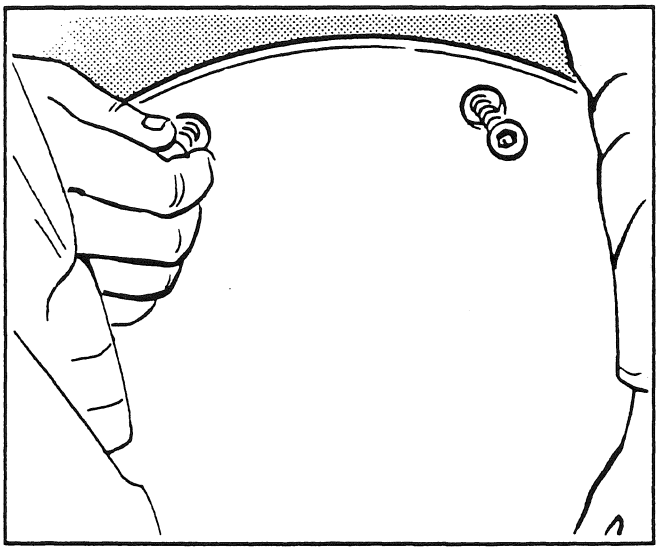


Fig. 17

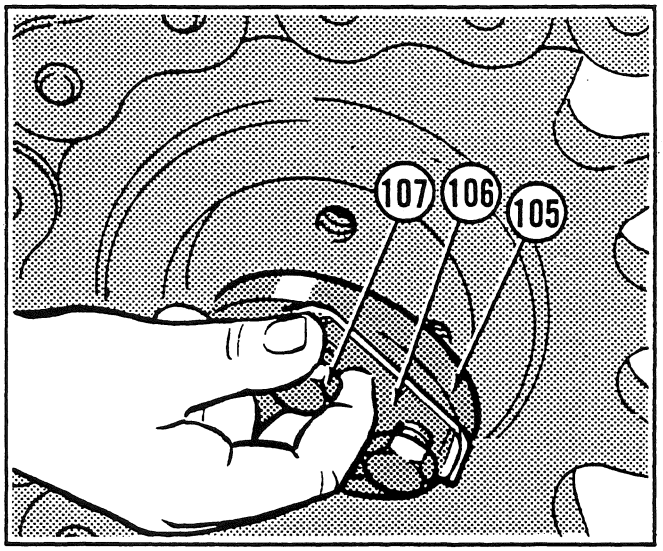


Fig. 18

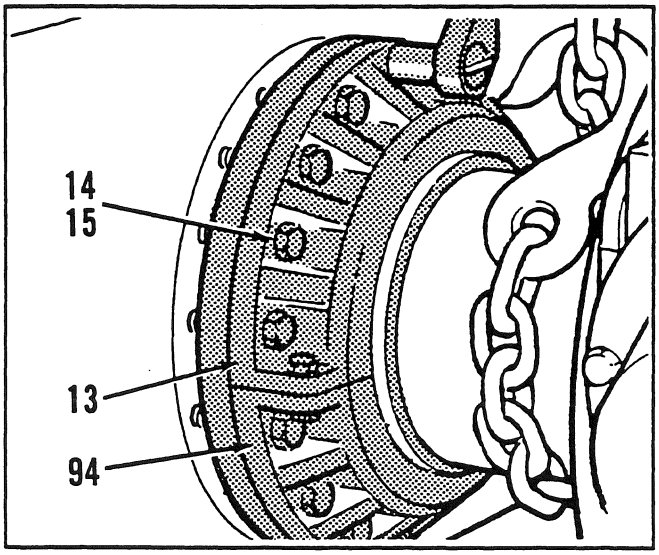


Fig. 19

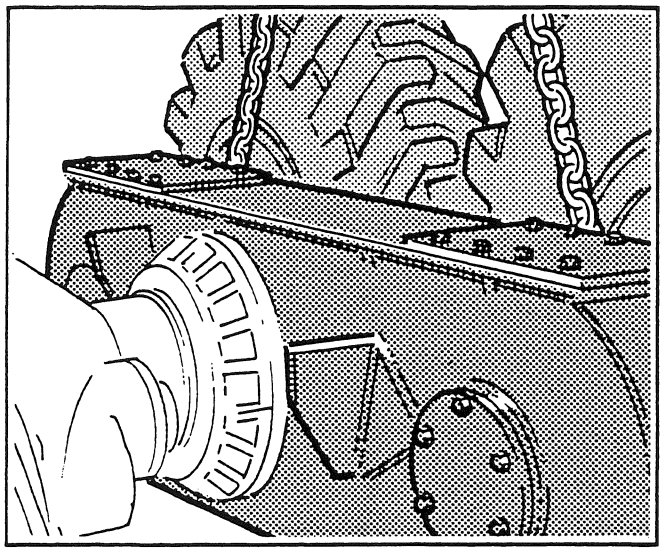


Fig. 20

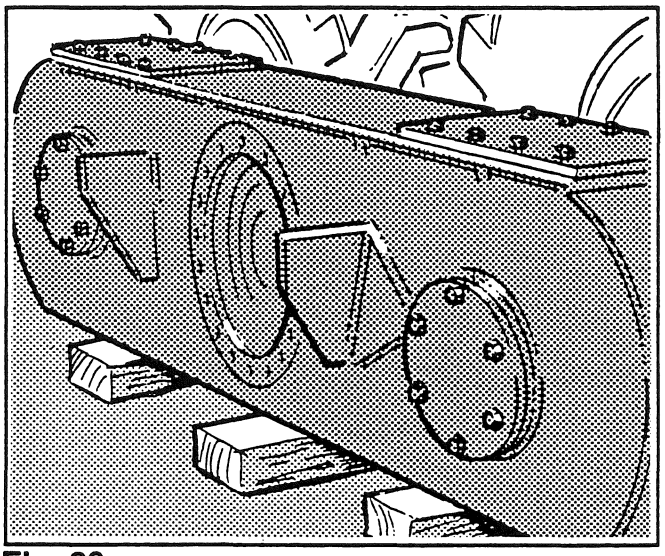
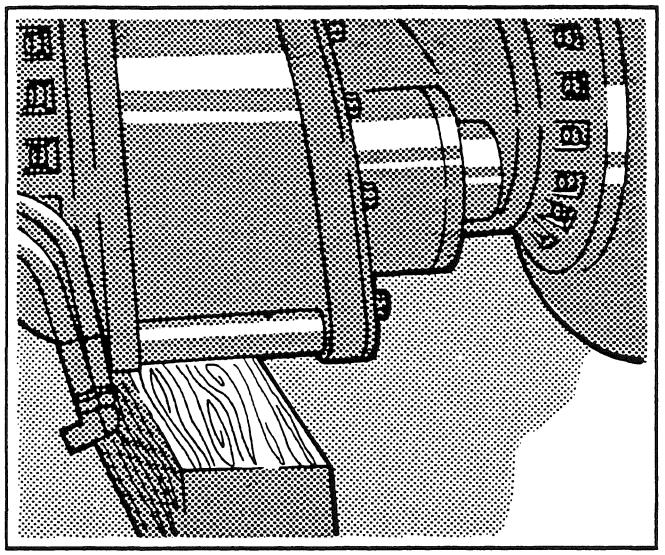


Fig. 23



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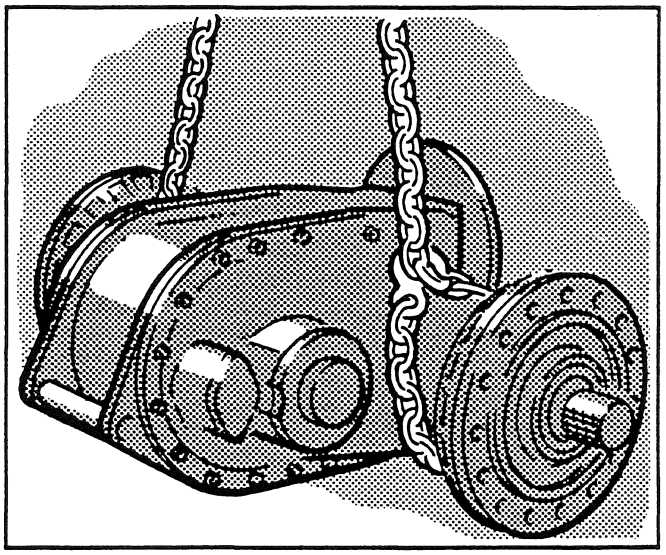

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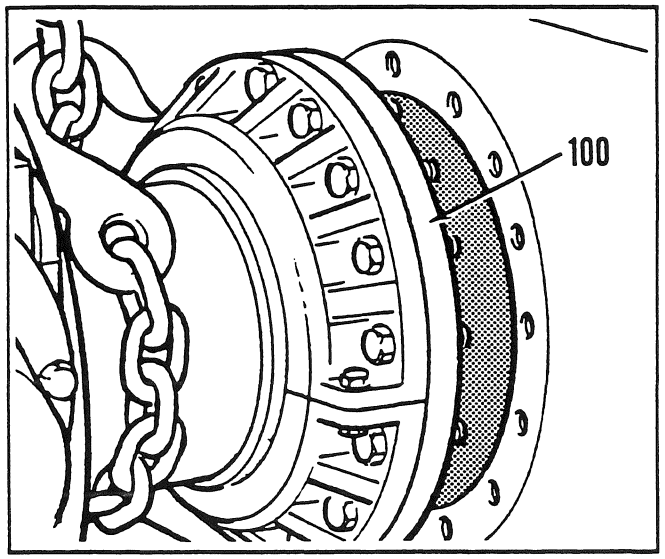

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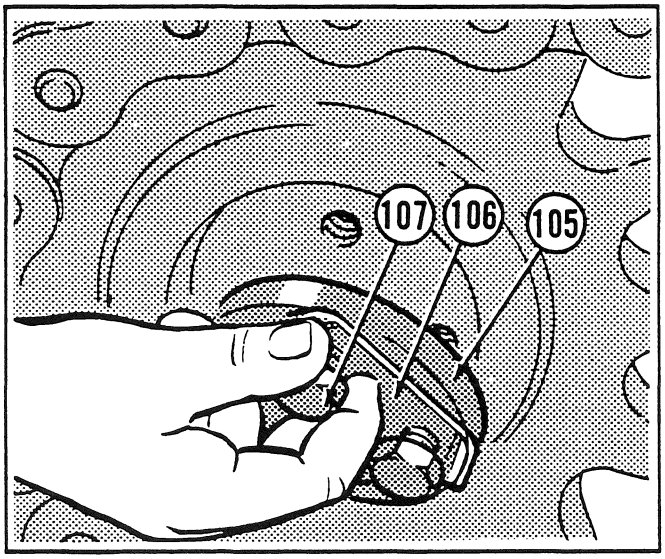


Fig. 25

Final Drive - Removal (Continued)

Fig. 20
Attach the lifting device to the tandem case.

Fig. 21
Support the weight of the final drive assembly on proper blocks.

Fig. 22
Remove the tandem case from the final drive assembly using the lifting device. Make sure that the flanged sleeve (100) separates from the tandem case. Remove and discard the gasket. If gasket eliminator compound has been used, remove all traces of the sealant.

Fig. 23
Support the tandem case on proper blocks or stands.

Fig. 24
Attach the lifting device to the final drive assembly. Support the other tandem case on proper blocks or stands.

Fig. 25
Release the tabs and remove the capscrews (107), lockplate (106) and sprocket retainer (105) from the left hand tandem. Discard the lockplate. Remove the capscrews (33) and lockwashers (34) retaining the final drive assembly to the tandem case.

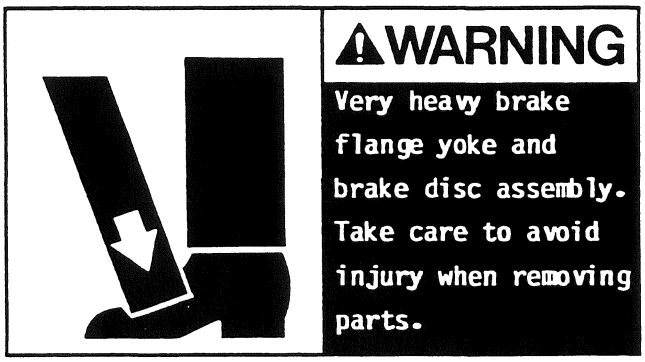
Final Drive - Removal (Continued)

Fig. 26
Remove the tandem case from the final drive assembly using the lifting device. Make sure that the flanged sleeve (49) separates from the tandem case. Remove and discard the gasket. If gasket eliminator compound has been used, remove all traces of the sealant.

Fig. 27
Although the final drive assembly may be overhauled on the floor, many procedures will be easier and faster by rotating the assembly in a build stand. If a stand is available, install the assembly using the lifting device.

Final Drive - Disassembly

Fig. 28



Remove the locknut (63) and washers (64 and 65). Inspect the locknut for possible re-use. Locknuts can normally be re-used twice from new. If in doubt, discard the part. Remove the brake flange yoke and brake disc assembly (66).

Fig. 29
Remove and discard the oil seal (104) from the flanged sleeve (100).

Fig. 30
Remove and discard the snap ring (103) from the flanged sleeve (100).

Fig. 31
Install a lifting eye in the end of the drive axle (101). Remove the drive axle and bearing assembly from the flanged sleeve (100) using the lifting device.

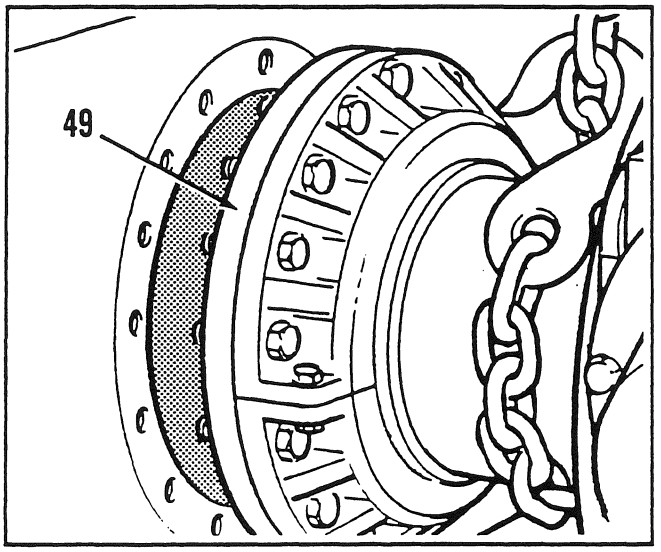


Fig. 26

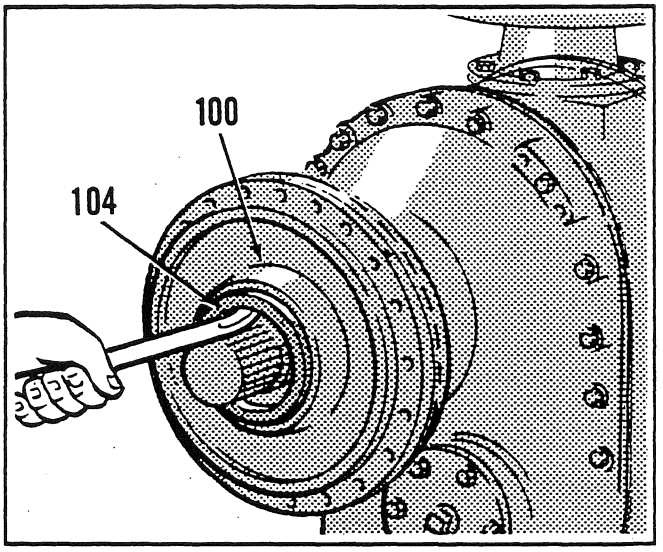


Fig. 29

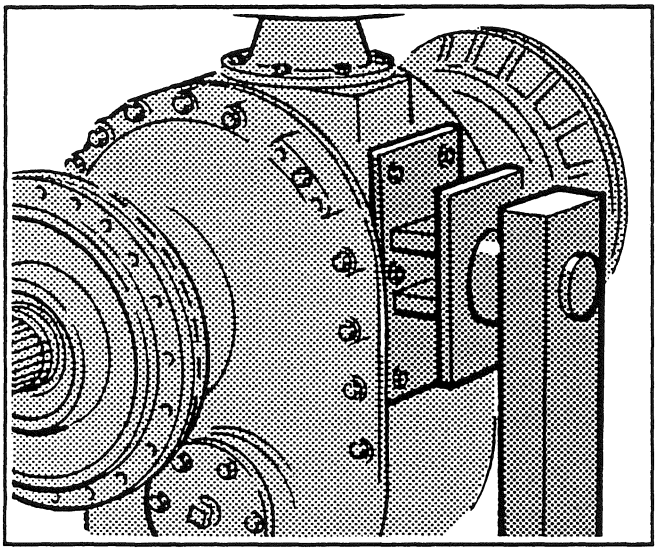


Fig. 27

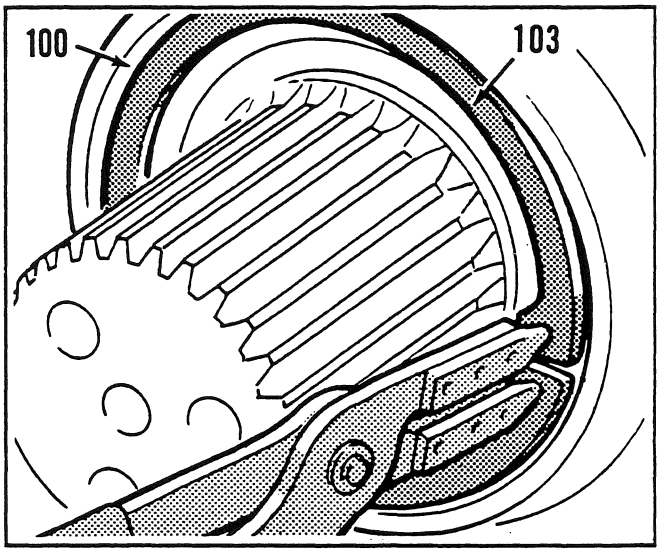


Fig. 30

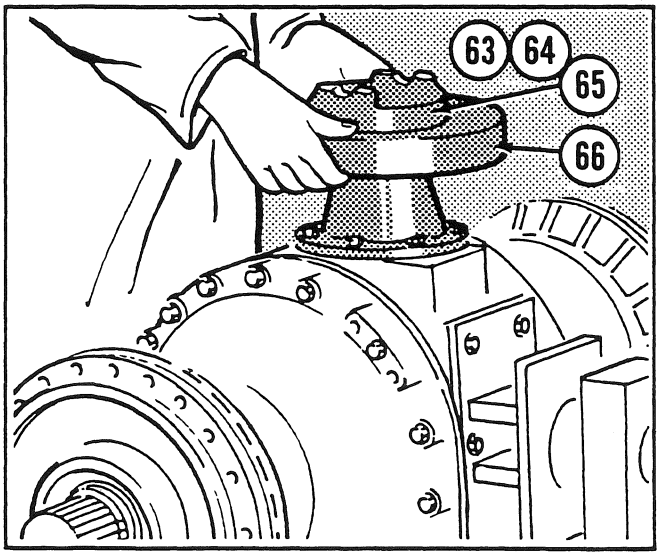


Fig. 28

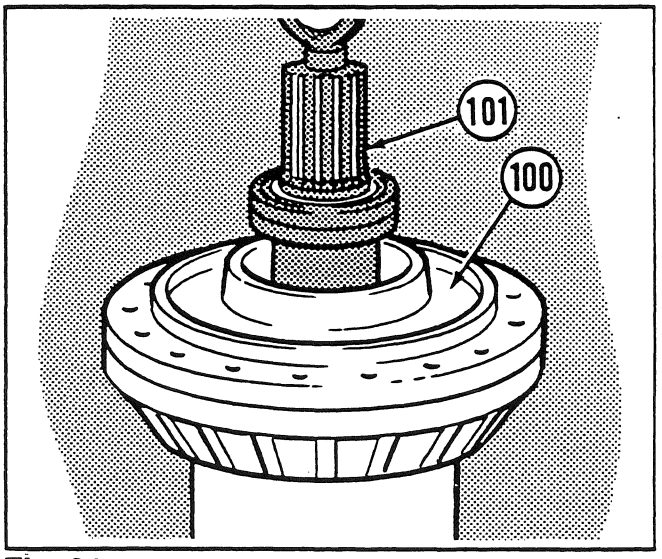


Fig. 31

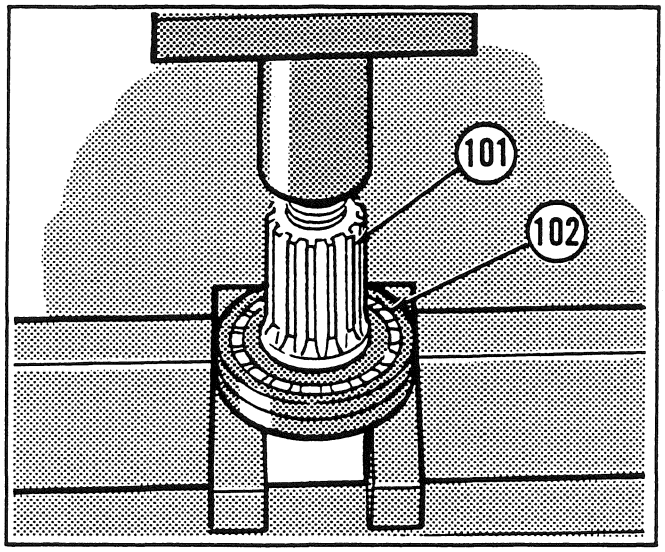


Fig. 32

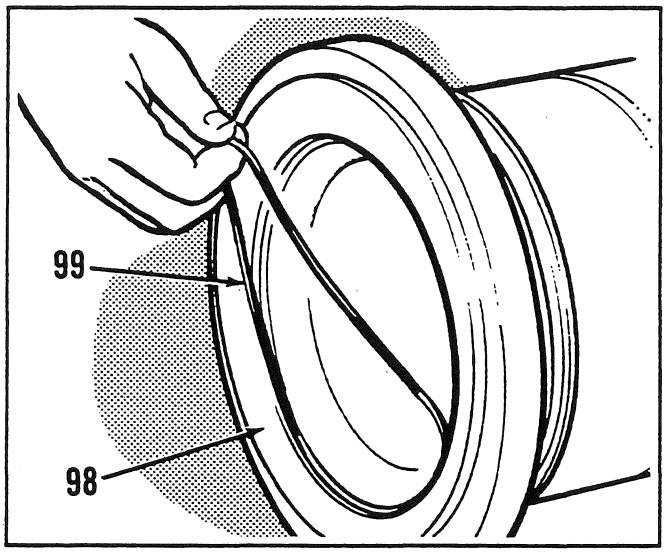


Fig. 35

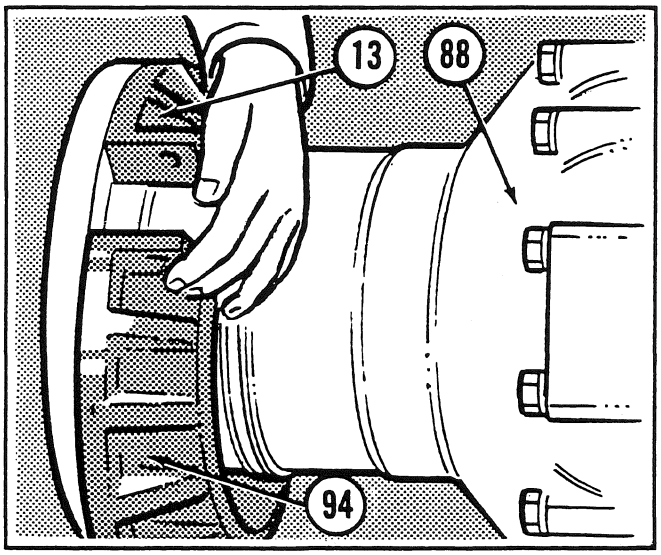


Fig. 33

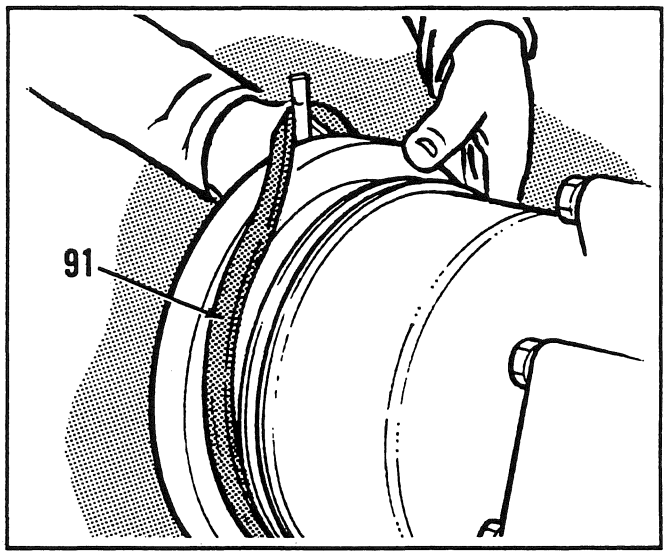


Fig. 36

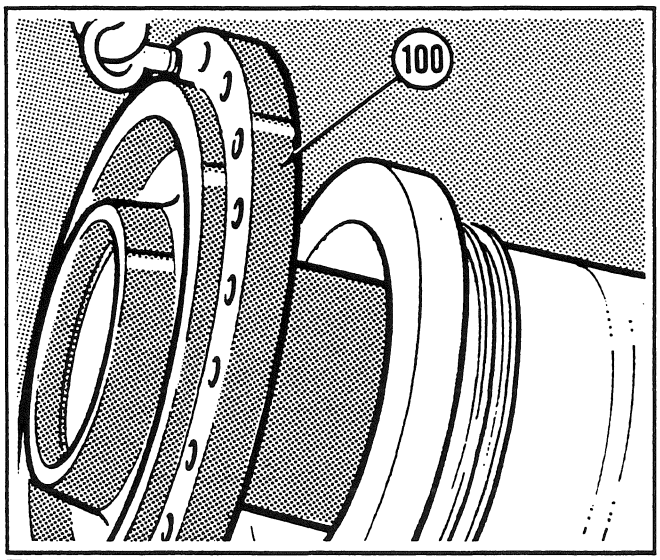


Fig. 34

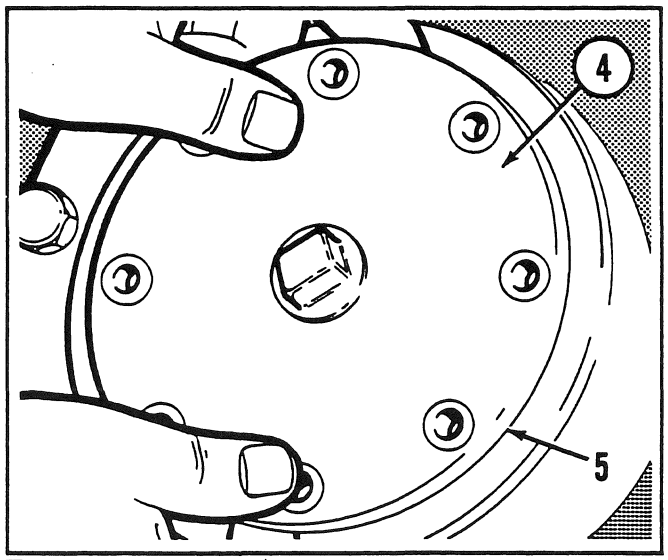


Fig. 37

Final Drive - Disassembly (Continued)

Fig. 32
Remove the lifting eye from the end of the drive axle (101). Remove the bearing (102) from the drive axle using a hydraulic press.

Fig. 33
Remove the nuts (93), bolts (16) and lockwashers (92) securing the half-rings (13 and 94). Separate the half-rings and remove them from the side housing (88).

NOTE

The half-rings are a matched pair. Keep them temporarily bolted together during the overhaul process. Remove all traces of gasket sealant from the half-ring flanges.

Fig. 34
Install a lifting eye in the flanged sleeve (100). Remove the flanged sleeve using the lifting device. Remove all traces of gasket sealant from the flange.

Fig. 35
Remove and discard the inner thrust plate (95), outer thrust plate (98) and O ring (99).

Fig. 36
Remove the "Uniring" seal (91) using a pry bar. Discard the "Uniring" seal. Repeat the procedures from **Fig. 29** to **Fig. 36** and remove the drive axle and flanged sleeve parts from the left hand side.

Fig. 37
Remove the capscrews (1) and lockwashers (2) retaining the cross shaft right hand cap (4). Remove the cap and shim pack (5). Discard any damaged shims.

Final Drive - Disassembly (Continued)

Fig. 38
Remove the nuts (83) and lockwashers (82) retaining the cover plate (81). Remove and discard the gasket (80).

Fig. 39
Remove the capscrews (71) and lockwashers (72) retaining the pinion cap (73). Install a lifting eye on the spiral pinion shaft (79). Remove the spiral pinion shaft and cap assembly using the lifting device. Remove the shim pack (78) and discard any damaged shims.

Fig. 40
Install the spiral pinion shaft and cap assembly in a vise with soft jaws. Remove and discard the oil seal (68).

Fig. 41
Remove the locknut (67) using **special tool, part number 43004.** Inspect the locknut for possible re-use. Locknuts can normally be re-used twice from new. If in doubt, discard the part.

Fig. 42
Remove the spiral pinion shaft (79) from the cap pinion (73) using a hydraulic press. **DO NOT** use a puller or hammer to remove the spiral pinion shaft. The pinion cap can be damaged.

Fig. 43
Remove the bearing cone (69). Remove the bearing cups (70 and 74) from the pinion cap (73) using a soft metal drift.

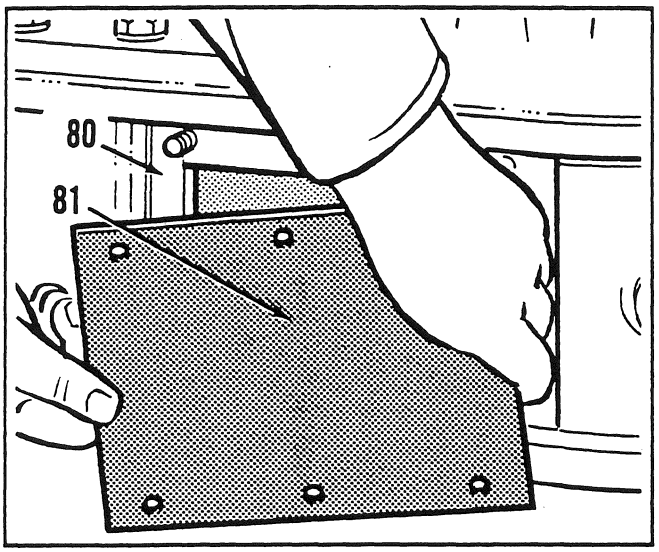


Fig. 38

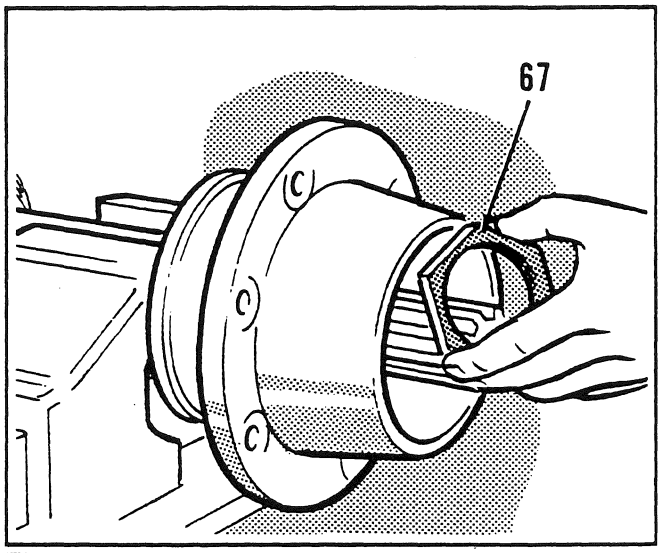


Fig. 41

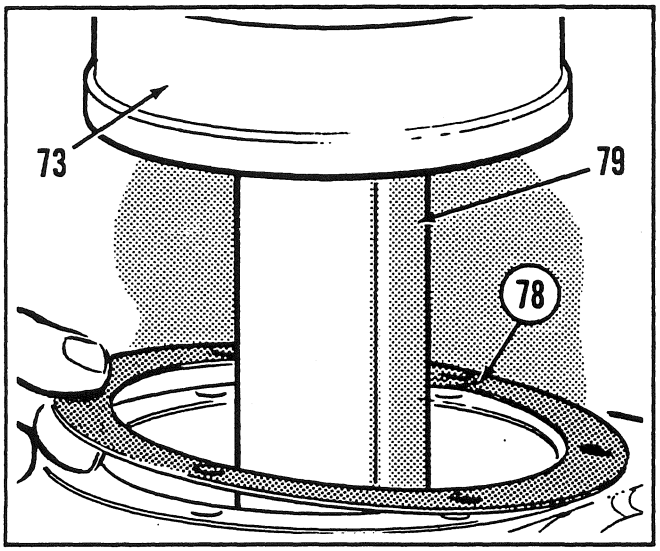


Fig. 39

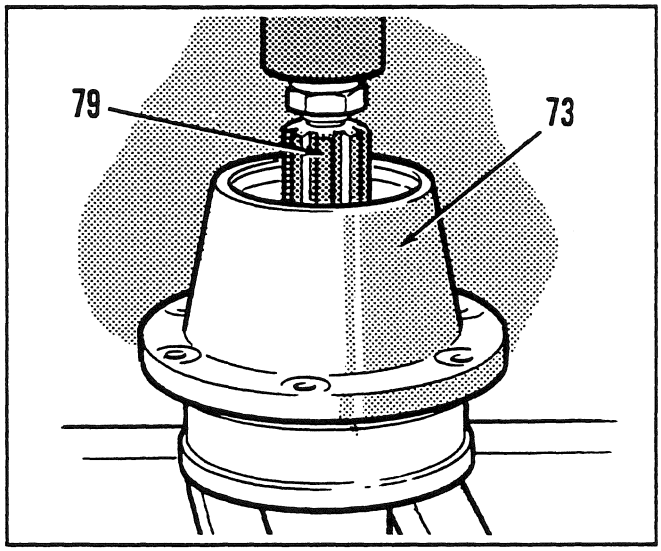


Fig. 42

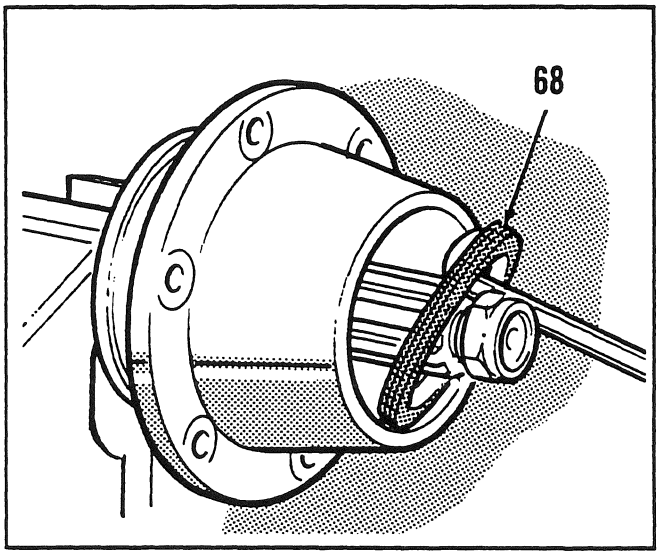


Fig. 40

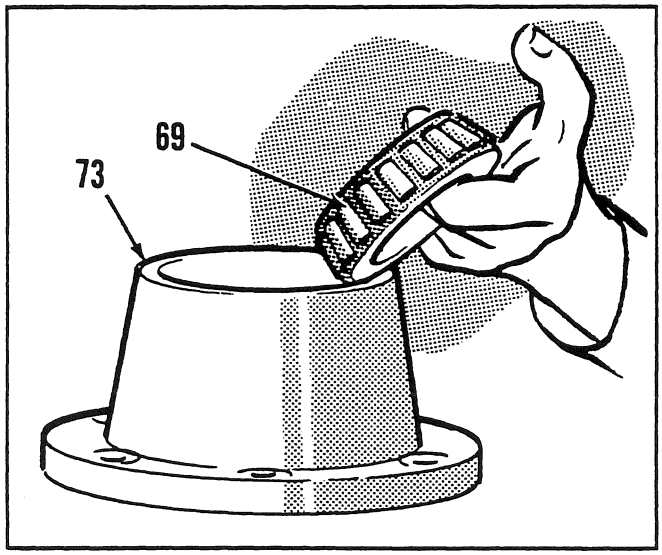


Fig. 43

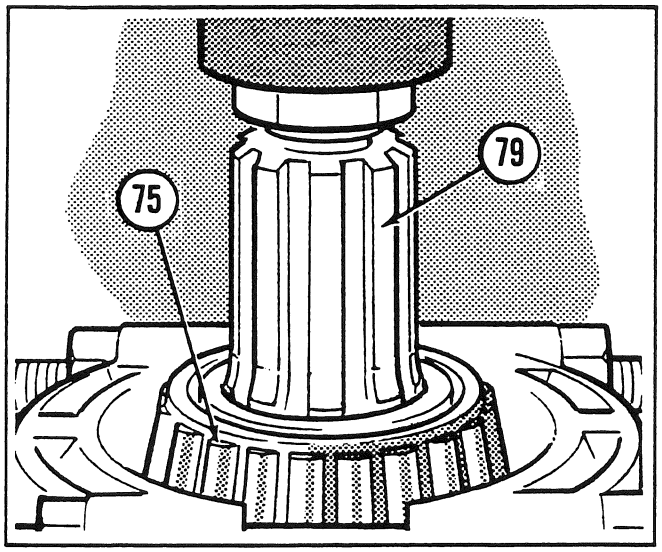


Fig. 44

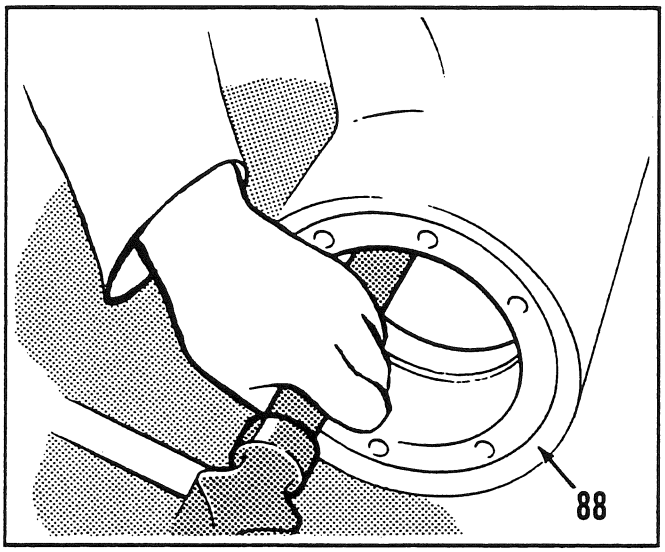


Fig. 47

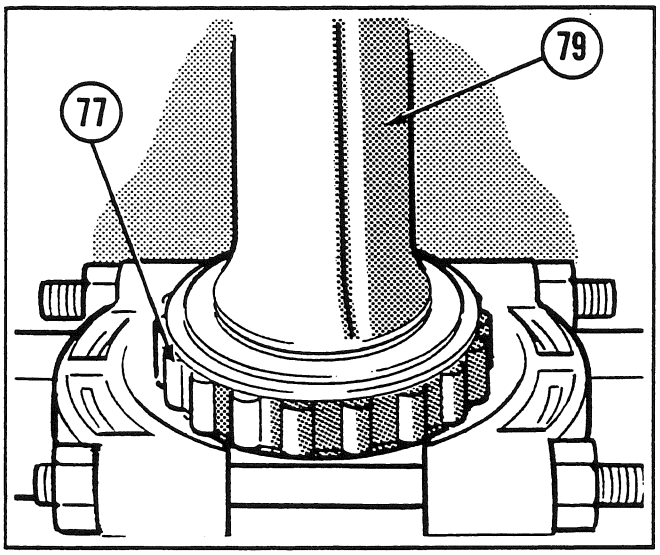


Fig. 45

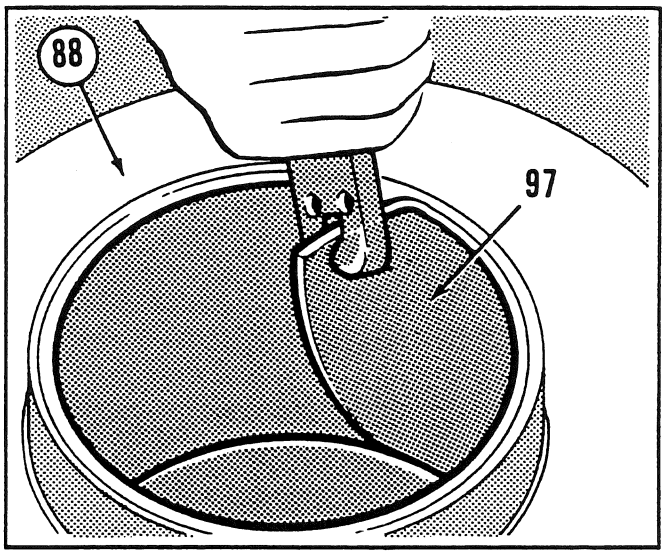


Fig. 48

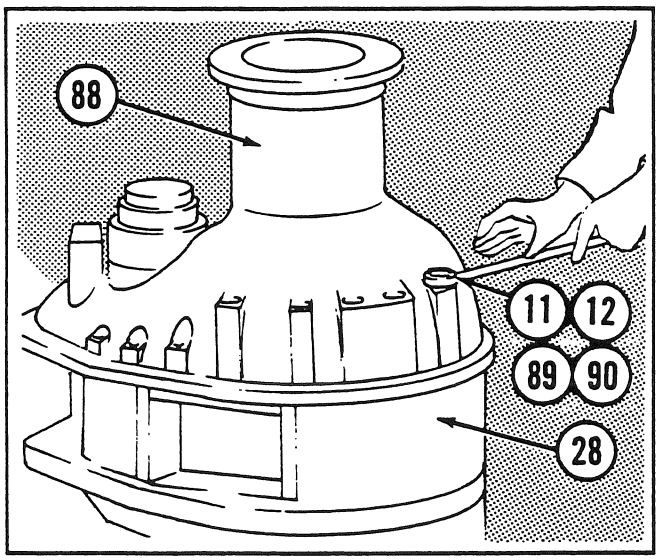


Fig. 46

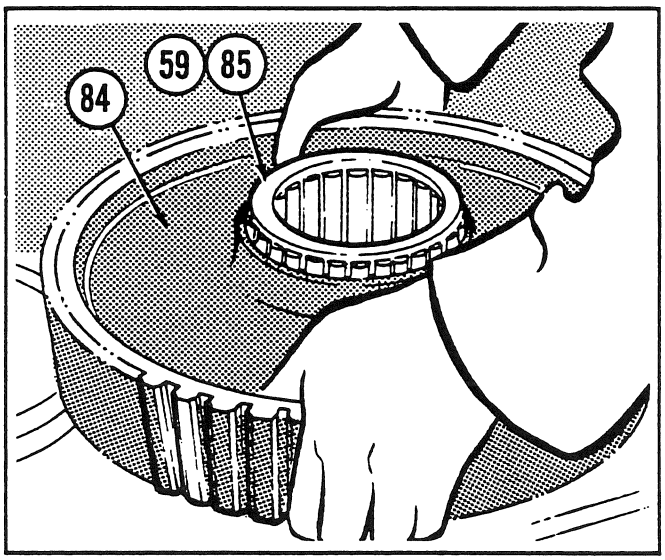


Fig. 49

Final Drive - Disassembly (Continued)

Fig. 44
Remove the bearing cone (75) from the spiral pinion shaft (79) using a hydraulic press and a bearing separating device.

Fig. 45
Remove and discard the snap ring (76). Remove the bearing inner race (77) from the spiral pinion shaft (79) using a hydraulic press and a bearing separating device.

Fig. 46
Remove the capscrews (11 and 90) and lockwashers (12 and 89) retaining the right hand side housing (88). Remove the side housing from the main case (28) using the lifting device. Remove and discard any traces of gasket (87) or gasket eliminator compound from the side housing and main case flanges.

Fig. 47
Remove the cross shaft bearing cup (9) and bull gear bearing outer race (85) from the side housing (88) using a soft metal drift.

Fig. 48
Pry up one corner of the outer bushing (97) using a chisel. Remove the bushing from the side housing (88). Repeat this procedure for the inner bushing (96).

Fig. 49

Remove the bull gear (84) from the main case (28). Remove the bearing inner races (59 and 85) from the bull gear hubs using a puller.

Final Drive - Disassembly (Continued)

Fig. 50
Remove the cross shaft assembly from the main case (28) using the lifting device. Place the cross shaft assembly on a clean work bench in readiness for disassembly.

Fig. 51
Remove the locknuts (7 and 40) and bearing spacers (8 and 39) from both ends of the cross shaft (29). Inspect the locknuts for possible reuse. Locknuts can normally be re-used twice from new. If in doubt, discard the part. Remove the bearing cone (37) and spur pinion (30) from the cross shaft using a hydraulic press.

Fig. 52
Remove the bearing cone (10) and spur pinion (17) from the cross shaft (29) using a hydraulic press.

Fig. 53
Remove the spiral pinion gear (18) from the cross shaft (29) using a hydraulic press. Remove the spacer (23) from the cross shaft.

Fig. 54
Turn the final drive assembly over onto the left hand side. Remove the capscrews (44) and lockwashers (43) retaining the cross shaft left hand cap (42). Remove the cap and shim pack (41). Discard any damaged shims.

Fig. 55
Repeat the procedures from **Fig. 46** to **Fig. 49** and remove the left hand side housing (32), bull gear (60) and related parts.

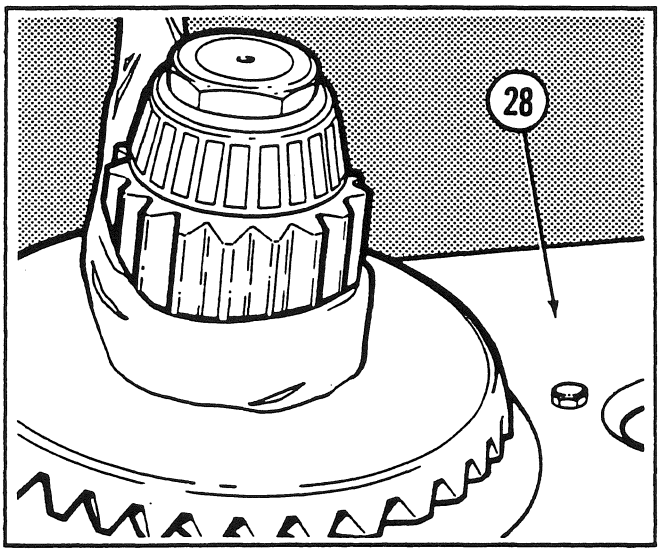


Fig. 50

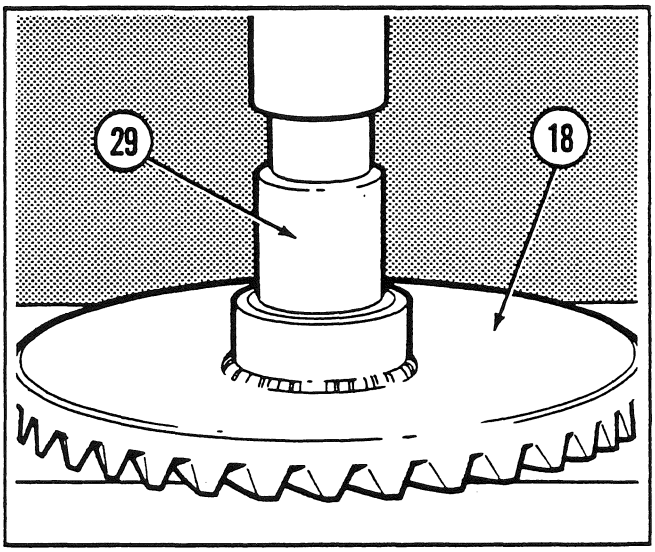


Fig. 53

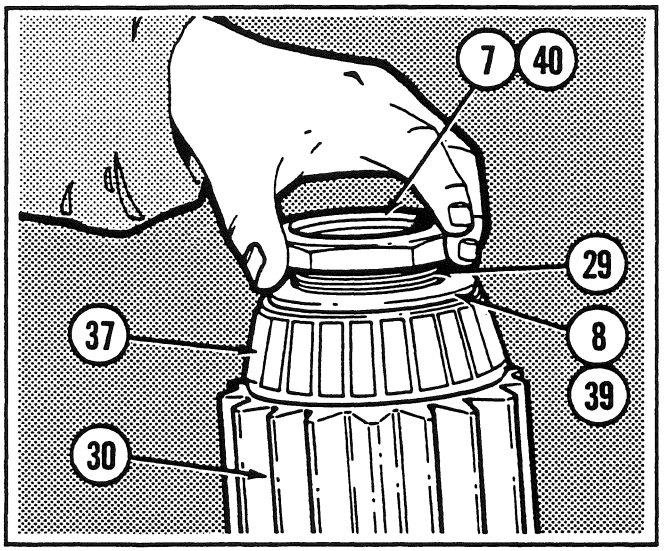


Fig. 51

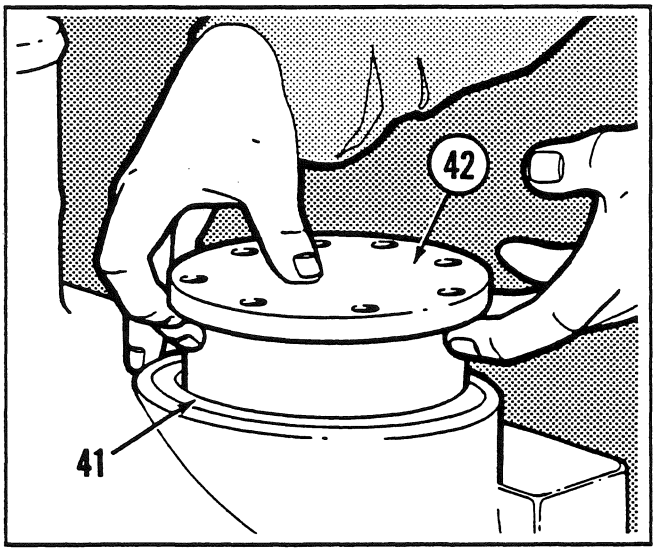


Fig. 54

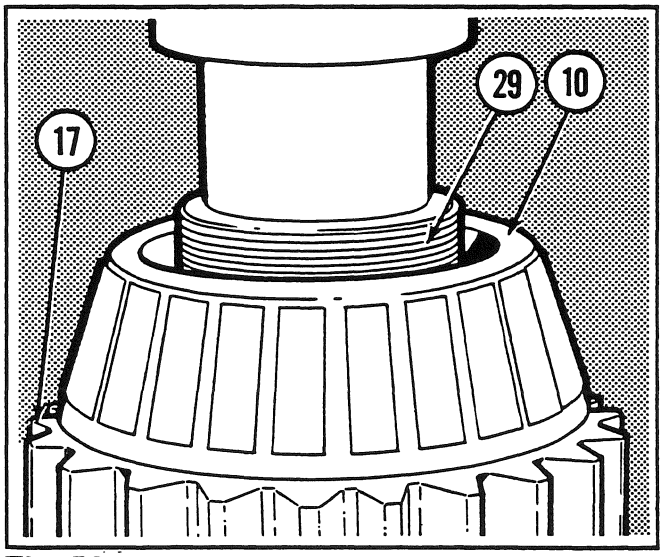
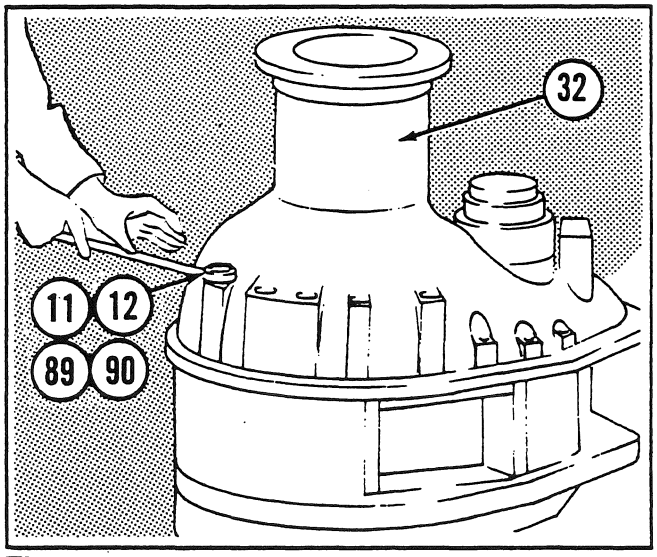


Fig. 52



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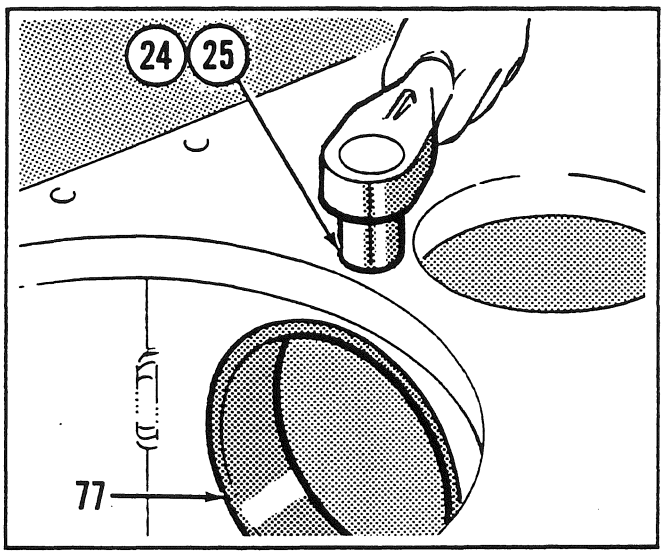


Fig. 56

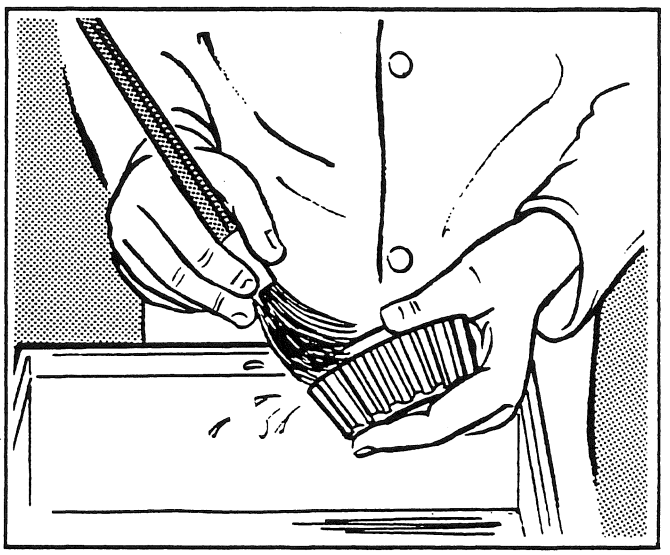


Fig. 59

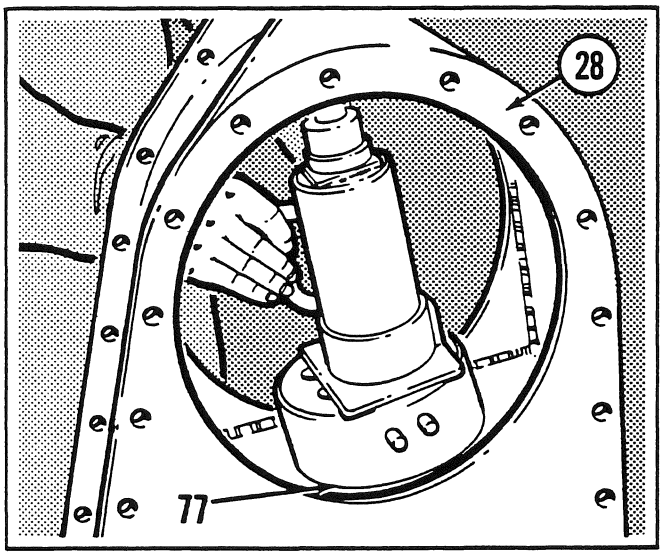


Fig. 57

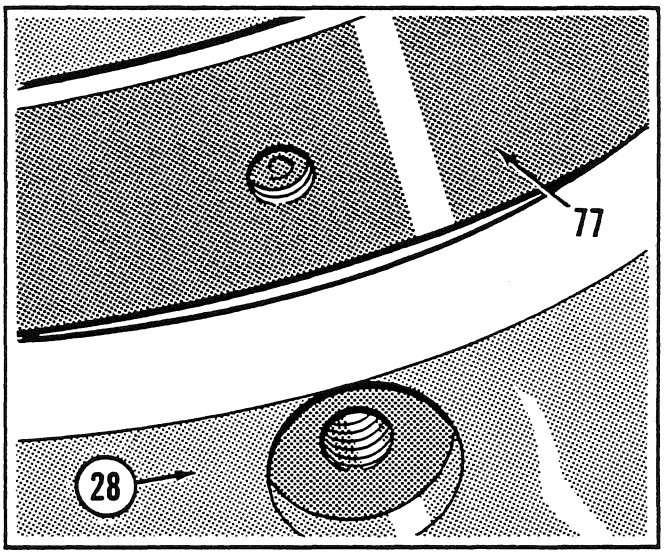


Fig. 60

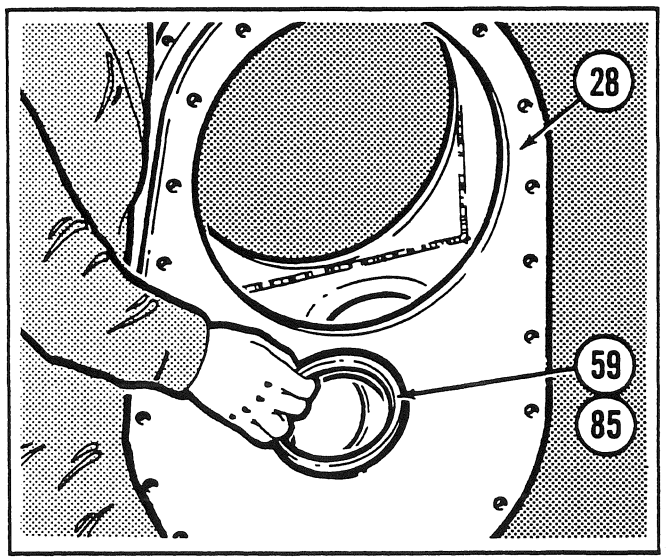


Fig. 58

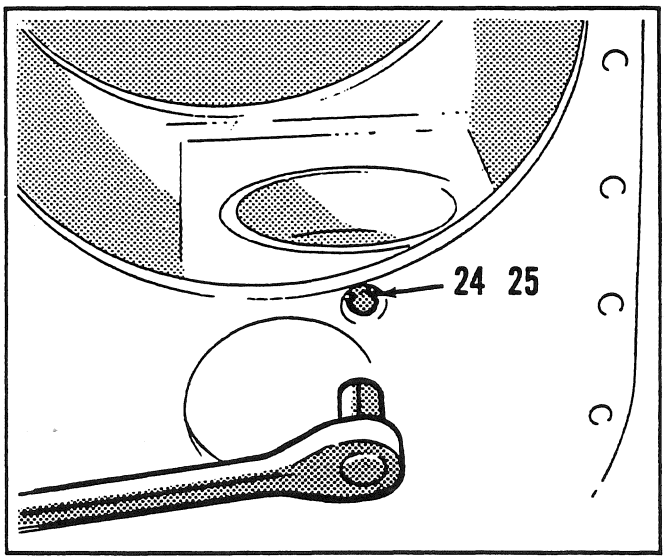


Fig. 61

Final Drive - Disassembly (Continued)

Fig. 56
Remove the screw (24) and lockwasher (25) securing the spiral pinion shaft bearing outer race (77).

Fig. 57
Remove the bearing outer race (77) from the main case (28) using a hydraulic jack and the **special tool, part number 45261.**

Fig. 58
Remove the bull gear bearing outer races (59 and 85) from the main case (28) using a soft metal drift.

Fig. 59
Following disassembly of the final drive assembly, refer to **Cleaning and Inspection** on pages 2 and 3 of this Shop Manual Section. Thoroughly clean and inspect all parts before assembling the final drive.

Final Drive - Assembly

Fig. 60
Lubricate the spiral pinion shaft bearing outer race (77). Install the race in the main case (28) bore using a soft metal drift. Take care to align the dimple with the threaded hole.

Fig. 61
Install the screw (24) and lockwasher (25). Tighten the screw to the specified torque.

Final Drive - Assembly (Continued)

Fig. 62
Lubricate the bull gear bearing outer races (59 and 85). Install the races in the main case (28) and side housing bores using **special tool, part number 33174.**

Fig. 63

Lubricate and install the bearing inner races (59 and 85) onto the bull gear (60) hubs. The bearings are easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Install the bull gear on the left hand side of the main case (28).

Fig. 64
Install a new inner bushing (53) and outer bushing (52) in the left hand side housing (32) using a hydraulic press and **special tools, part numbers 18511, 18512 and 18513.**

Fig. 65
Install a new gasket (31) on the main case (28). Check to see if the "extra" hole in the gasket aligns with the pry slot. If it aligns, turn the gasket over.

Fig. 66
Lower the left hand side housing (32) onto the main case (28) using the lifting device. Take care when engaging the bull gear bearing inner and outer races.

Fig. 67
If the dowel pins (86) were removed, use a soft metal drift to install new parts.

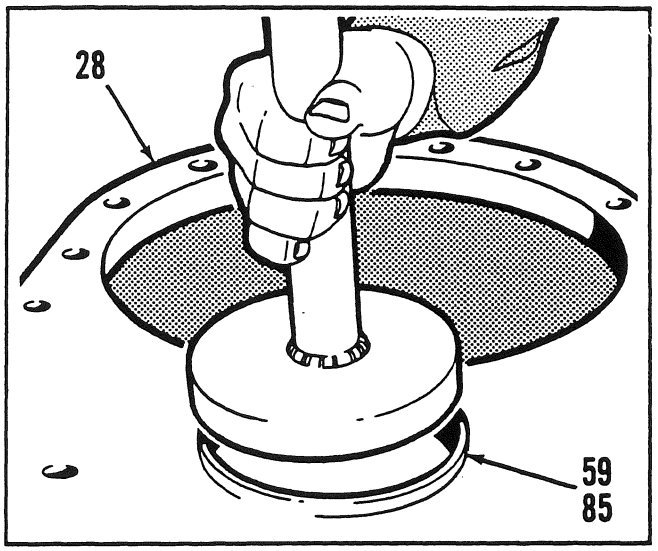
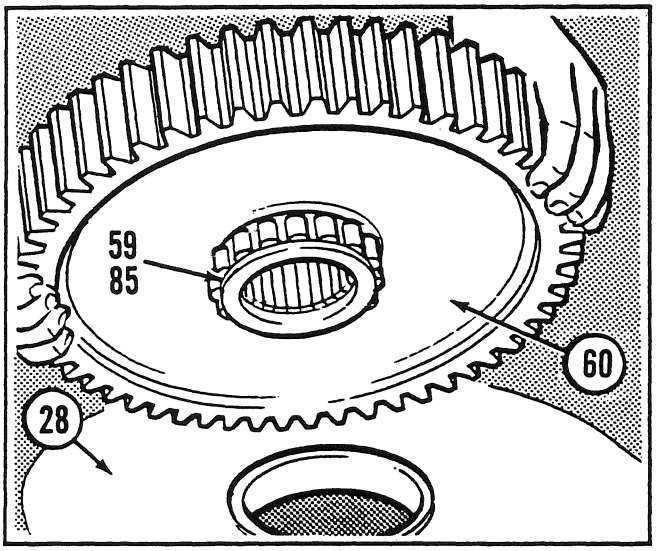


Fig. 62



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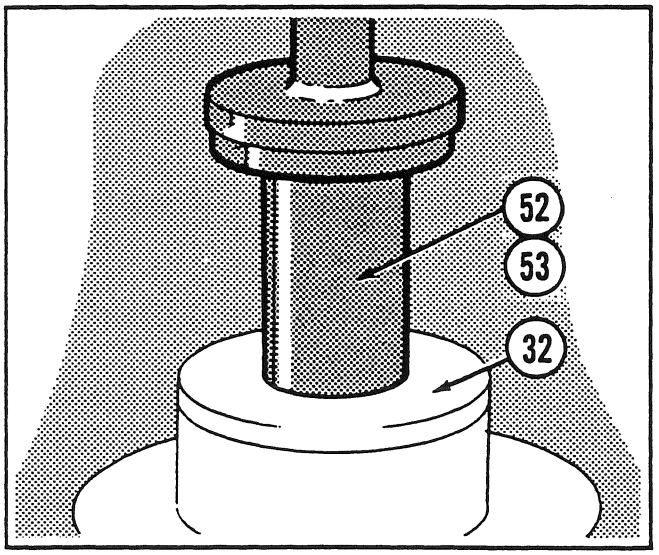

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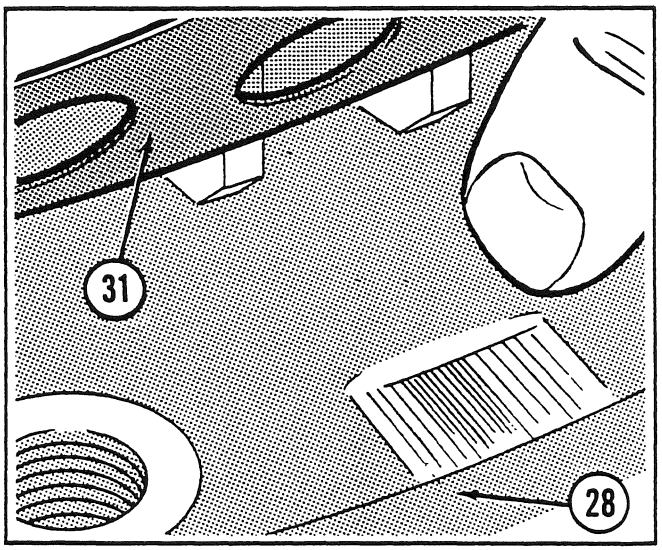


Fig. 65

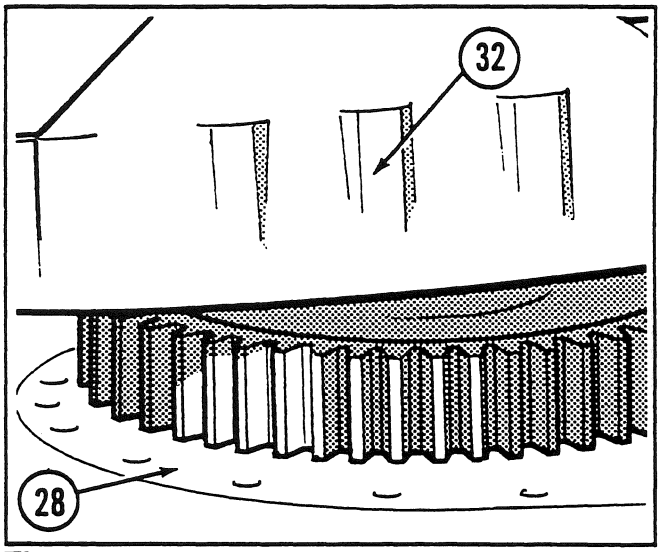
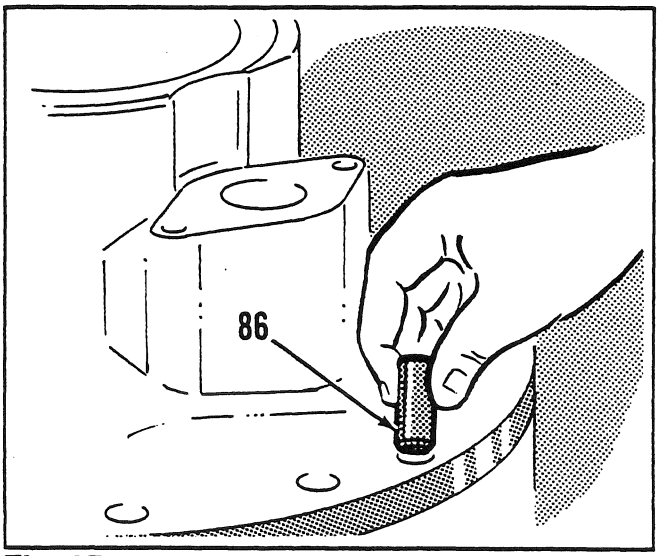


Fig. 66



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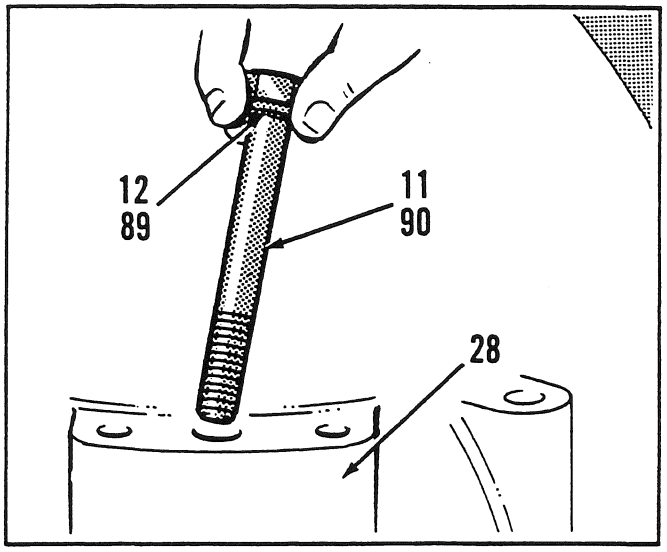

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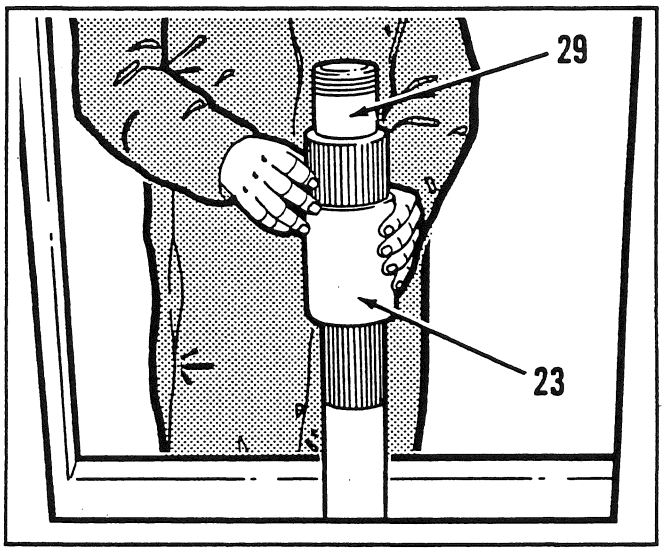

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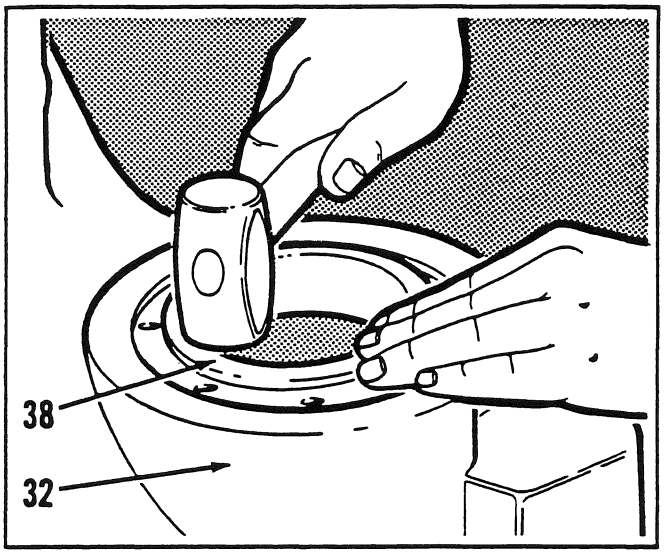
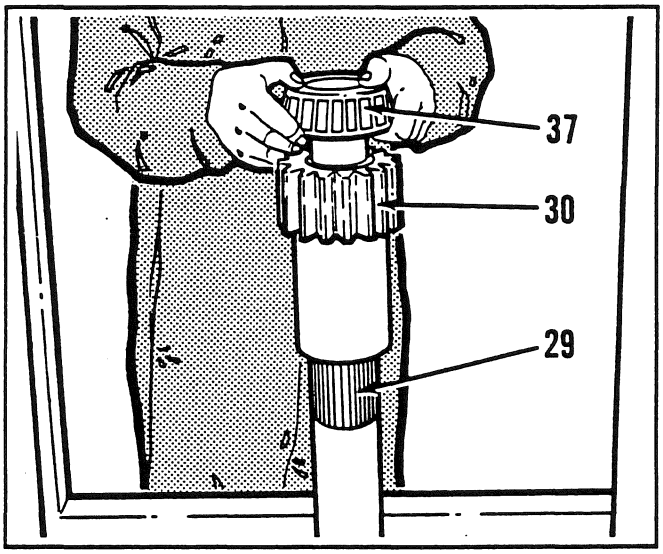


Fig. 69



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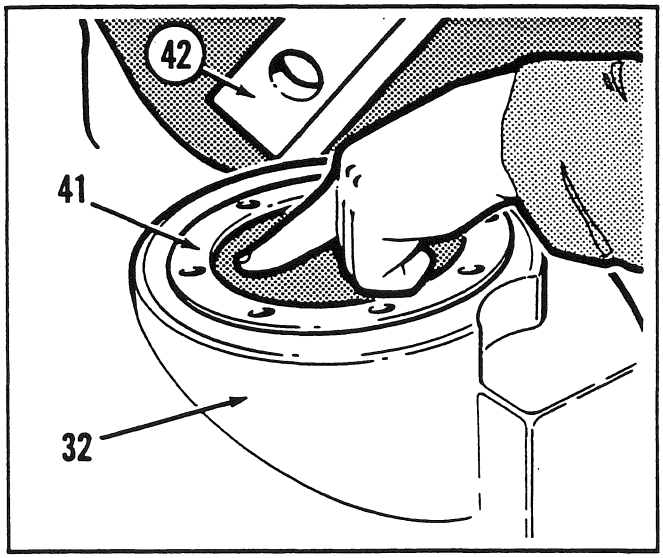


Fig. 70

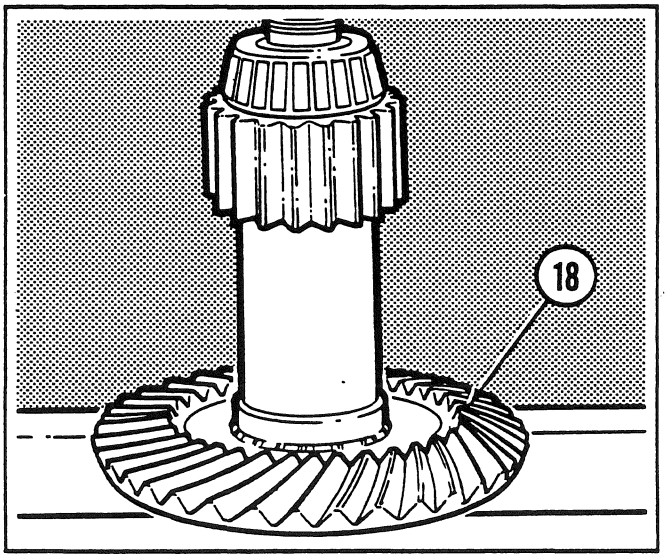


Fig. 73

Final Drive - Assembly (Continued)

Fig. 68
Install the capscrews (11 and 90) and lockwashers (12 and 89). Two capscrew holes open into the main case (28). Make sure you apply sealing compound, Champion part number **19167**, onto the capscrew threads before installation. Tighten the capscrews to the specified torque.

Fig. 69
Lubricate the cross shaft bearing cup (38) and install into the side housing (32) using a soft metal hammer or drift.

Fig. 70
Assemble a shim pack (41) 1,27 mm (0.50 in.) thick and place it on the side housing (32). Install the cross shaft left hand cap (42). The hole in the cap should align with the upper lubrication port in the side housing. Install the capscrews (44) and lockwashers (43). Apply sealing compound, Champion part number **19167**, onto the two forward capscrew threads. Tighten the capscrews to the specified torque.

Fig. 71
Apply anti-seize compound, Champion part number **30453**, to all splines and tapered roller bearing journals. Place the cross shaft (29) on a clean work bench with the left hand (short splined) end up. Install the spacer (23).

Fig. 72
Install the spur pinion (30) on the cross shaft (29). Lubricate the bearing cone (37). Install the bearing cone using a hydraulic press and a soft metal tubular drift having the same diameter as the cone inner race. The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F).

Fig. 73
Install the spiral pinion gear (18) with the teeth toward the spacer, onto the cross shaft (29).

Final Drive - Assembly (Continued)

Fig. 74
Turn the cross shaft assembly over. Install the spur pinion (17) on the cross shaft (29). Lubricate the bearing cone (10). Install the bearing cone using a hydraulic press and a soft metal tubular drift having the same diameter as the cone inner race. The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F).

Fig. 75
Install the bearing spacers (8 and 39) and locknuts (7 and 40), refer to text in **Fig. 51.** Tighten the locknuts to the specified torque.

Fig. 76
Lower the cross shaft assembly into the main case (28) using the lifting device. Make sure the spiral pinion gear teeth are pointing down.

Fig. 77

Lubricate and install the bearing inner races (59 and 85) onto the bull gear (84) hubs. The bearings are easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Install the bull gear on the left hand side of the main case (28).

Fig. 78
Install a new inner bushing (96) and outer bushing (97) in the right hand side housing (88) using a hydraulic press and **special tools, part numbers 18511, 18512 and 18513.**

Fig. 79
Install a new gasket (87) on the main case (28). Check to see if the "extra" hole in the gasket aligns with the pry slot. If it aligns, turn the gasket over.

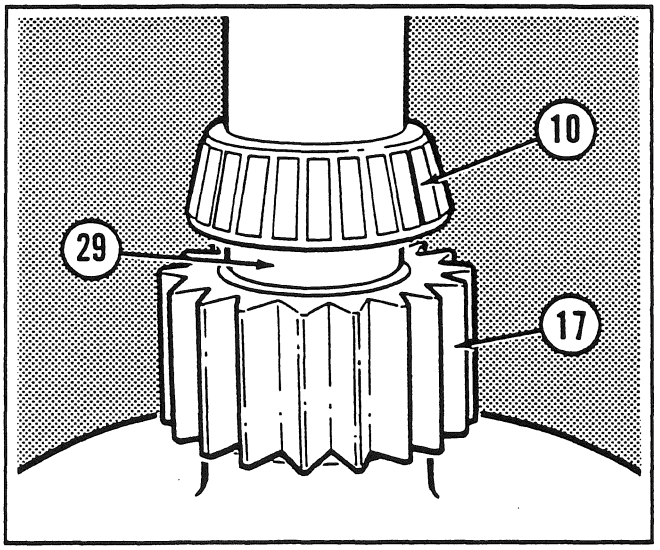


Fig. 74

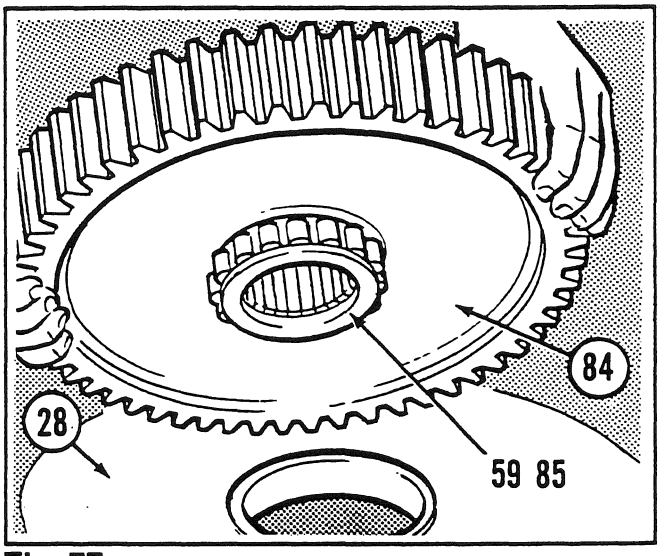


Fig. 77

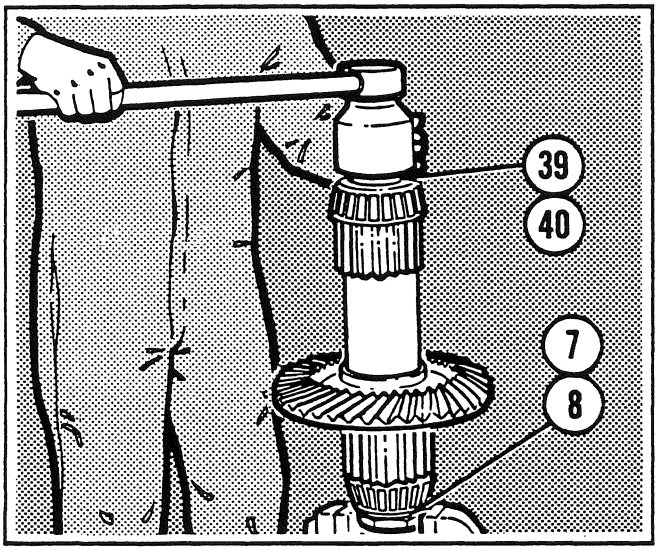


Fig. 75

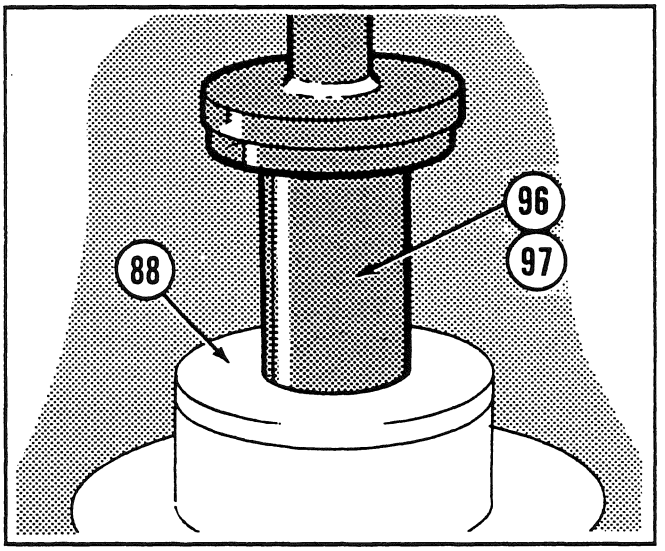


Fig. 78

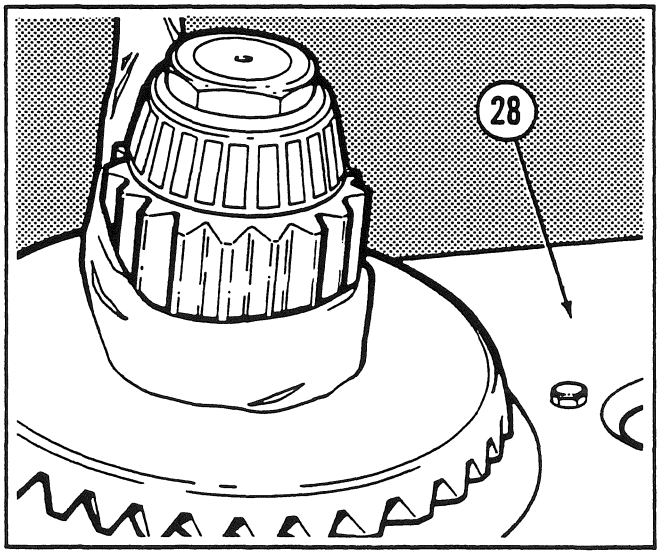
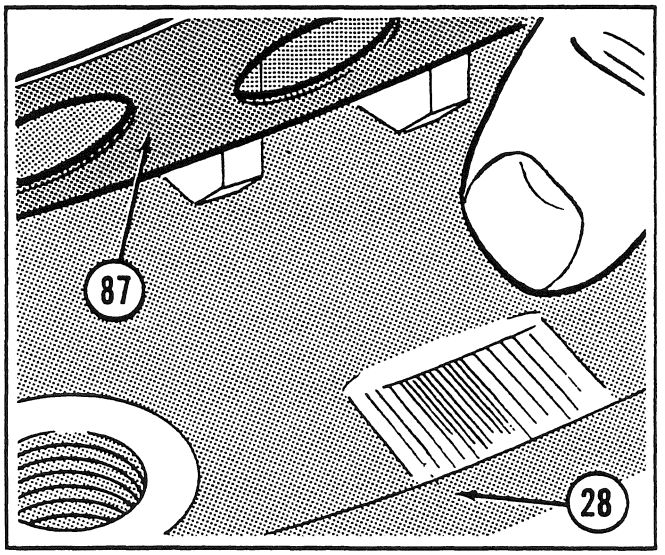


Fig. 76



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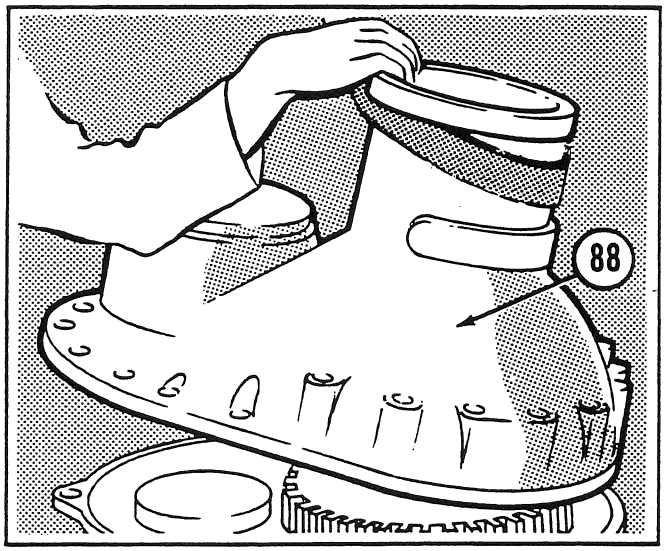


Fig. 80

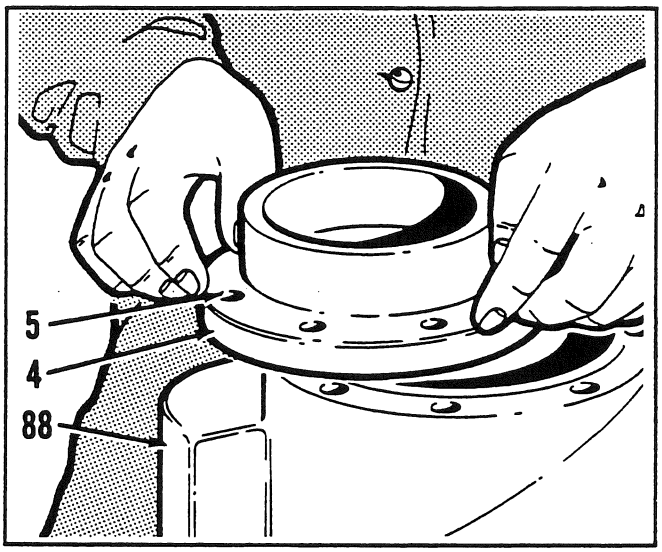


Fig. 83

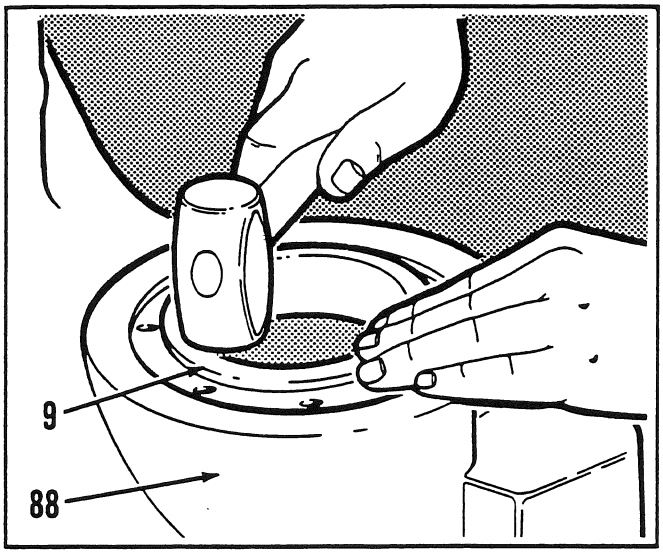


Fig. 81

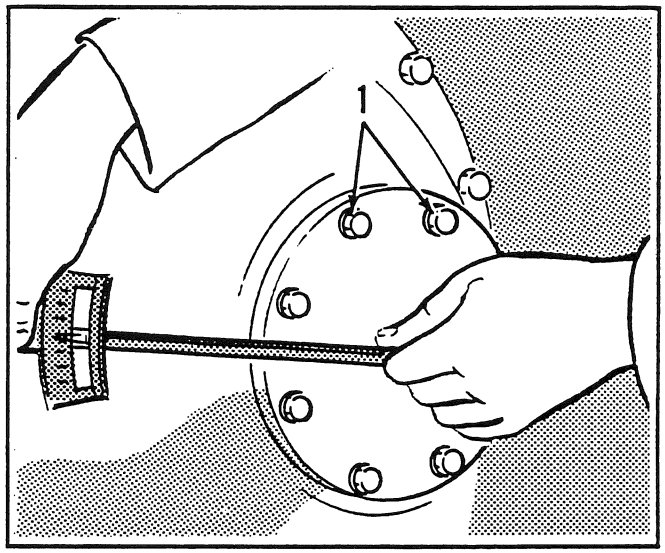


Fig. 84

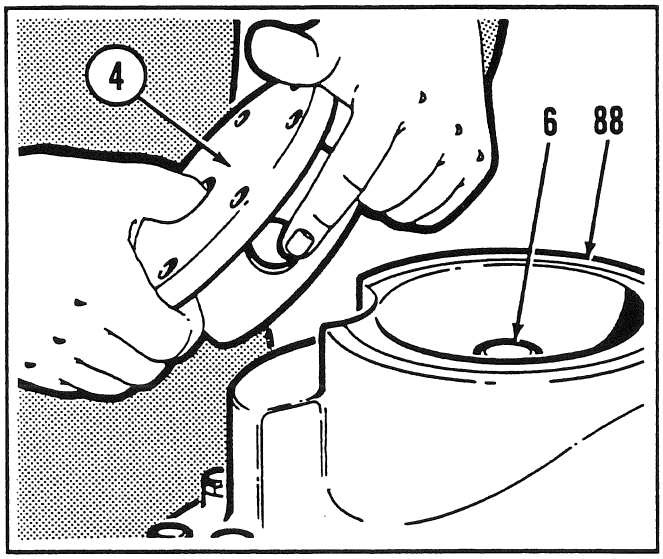


Fig. 82

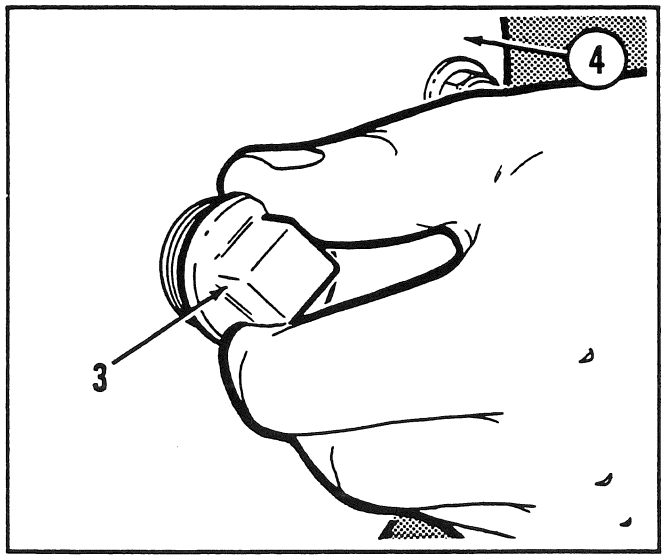


Fig. 85

Final Drive - Assembly (Continued)

Fig. 80
Repeat the procedures from **Fig. 66** to **Fig. 68** and install the right hand side housing (88) and related parts.

Fig. 81
Lubricate the cross shaft bearing cup (9) and install into the side housing (88) using a soft metal hammer or drift.

Fig. 82
Install the cross shaft right hand cap (4) without the shim pack. The hole in the side of the cap aligns with the upper lubrication port in the side housing (88). Install the capscrews (1) and lockwashers (2). Remove the pipe plug (3). Install a torquemeter and engage with the capscrew head (6) on the cross shaft. Tighten the capscrews (1), while oscillating the cross shaft, until the rolling torque agrees with the adjustment specification listed in the front of this Shop Manual Section. Tighten the capscrews to the specified torque.

Fig. 83
Measure the gap between the cross shaft cap (4) and the side housing (88) machined surface in four places. Remove the cap. Assemble a shim pack (5) equal in thickness to this measurement. Install the shim pack; cross shaft cap; capscrews (1) and lockwashers (2). Tighten the capscrews to the specified torque.

Fig. 84
Install a torquemeter and engage with the capscrew head (6) on the cross shaft. Oscillate the cross shaft and check the rolling torque with the adjustment specification listed in the front of this Shop Manual Section. Add or remove shims (5) to agree with the specification. Apply sealing compound, Champion part number **19167**, onto the two forward capscrew (1) threads. Tighten the capscrews to the specified torque.

Fig. 85
Apply sealing compound, Champion part number **19167**, onto the pipe plug (3) threads. Install the plug in the cross shaft cap (4).

Final Drive - Assembly (Continued)

Fig. 86
Apply adhesive/sealant, Champion part number **19200,** to the bearing surface of the spiral pinion shaft (79). Lubricate the inner bearing race (77). Install the race with the large radius towards the gear using a hydraulic press and the **special tool, part number 45261.** The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Retain the bearing with a new snap ring (76).

Fig. 87
Lubricate the bearing cups (70 and 74) and install into the pinion cap (73) using a soft metal drift. You can also use a hydraulic press and **special tools, part numbers 18507, 18508, 18509 and 18510.** The cups are easier to install when chilled in a freezer or in dry ice.

Fig. 88
Lubricate the bearing cone (75) and install onto the spiral pinion shaft (79) using a hydraulic press and the **special tool, part number 18518.** The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Make sure the cone abuts the shoulder on the shaft.

Fig. 89
Install the pinion cap (73) onto the spiral pinion shaft (79). Lubricate the bearing cone (69) and install onto the shaft using a hydraulic press and a soft metal tubular drift having the same diameter as the cone inner race. The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F). Retain the bearing with the locknut (67) using the special **tool, part number 43004.** Refer to text for **Fig. 41.**

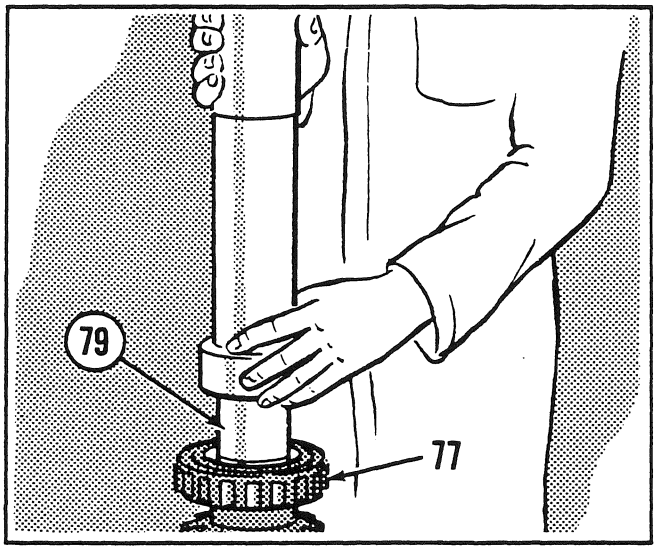


Fig. 86

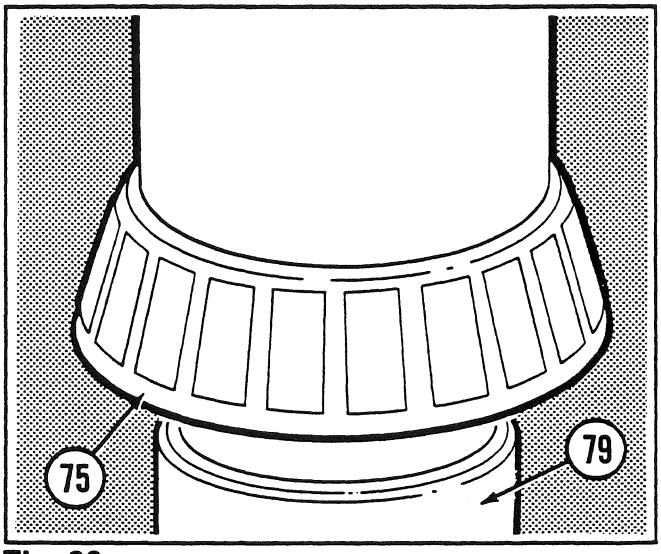


Fig. 88

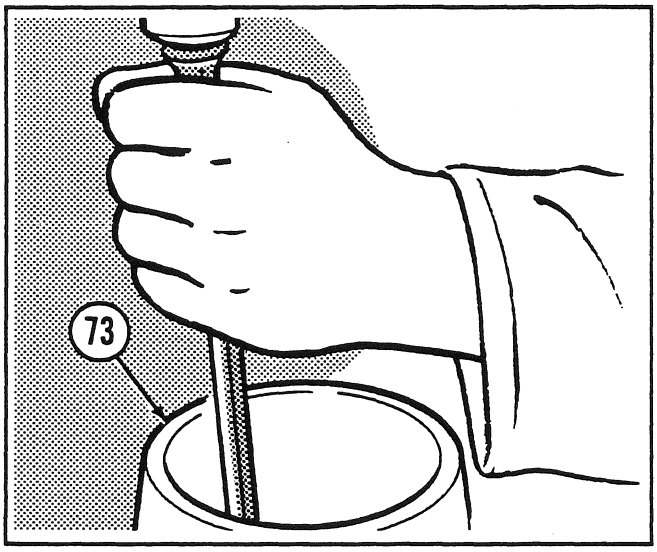


Fig. 87

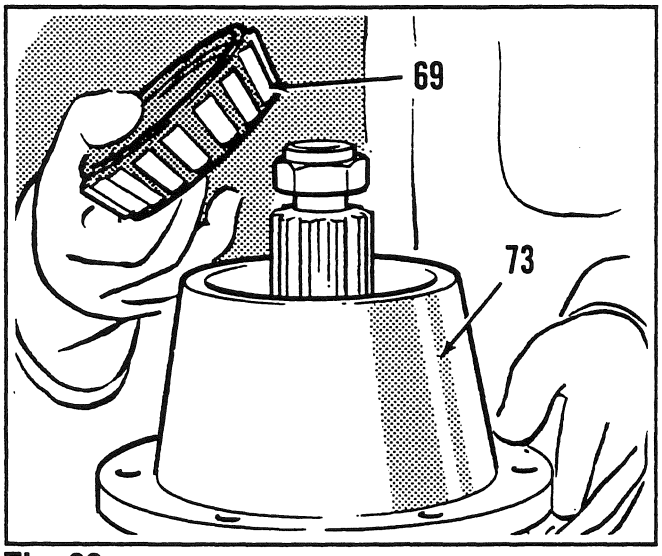


Fig. 89

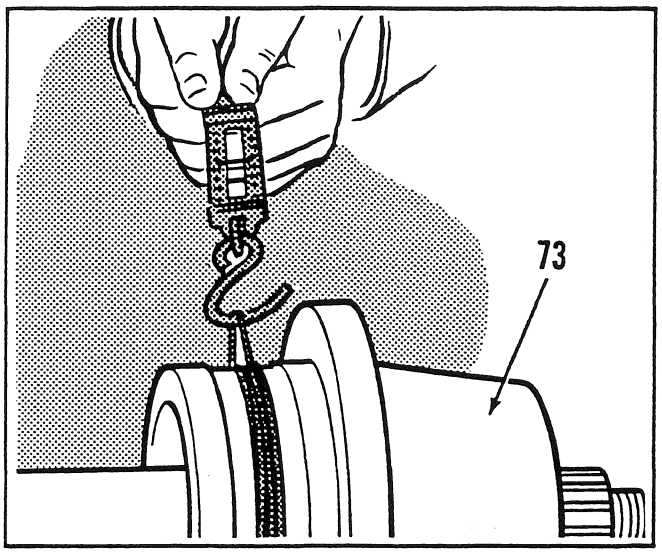


Fig. 90

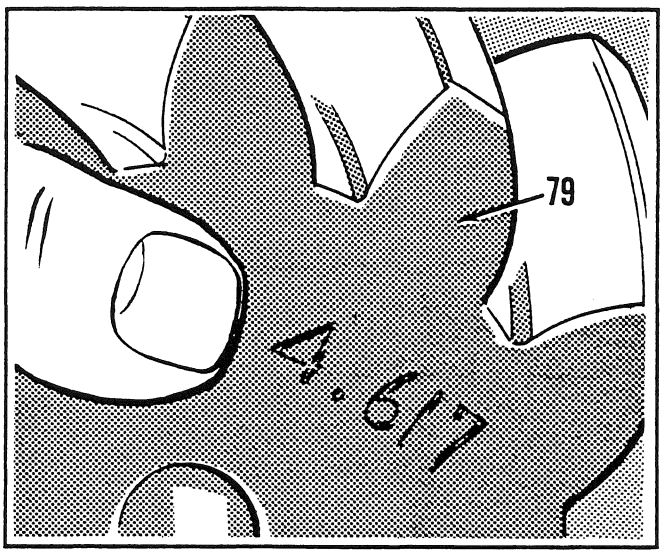


Fig. 93

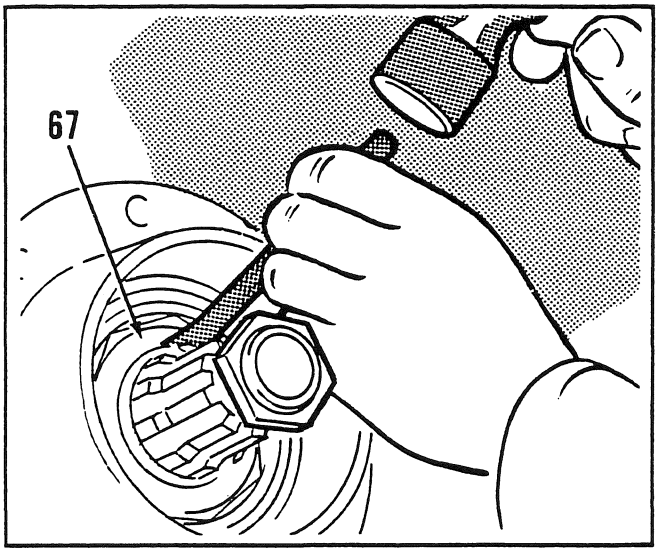
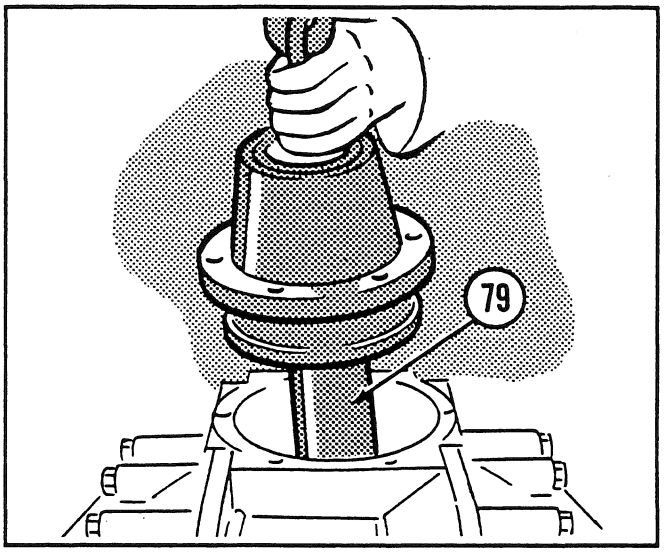


Fig. 91



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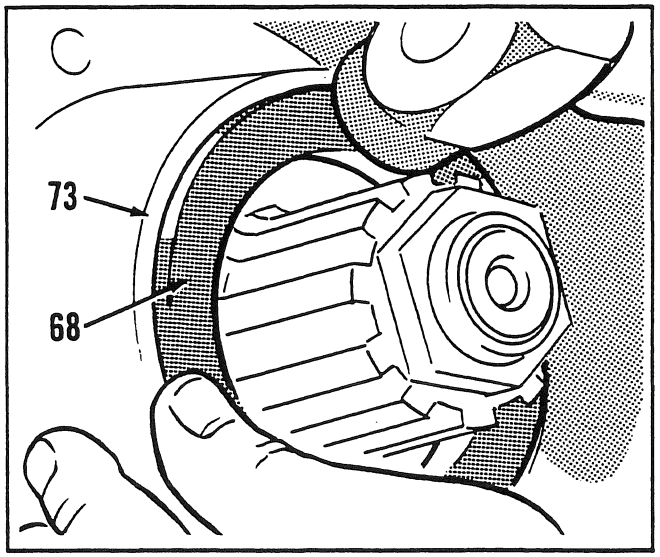


Fig. 92

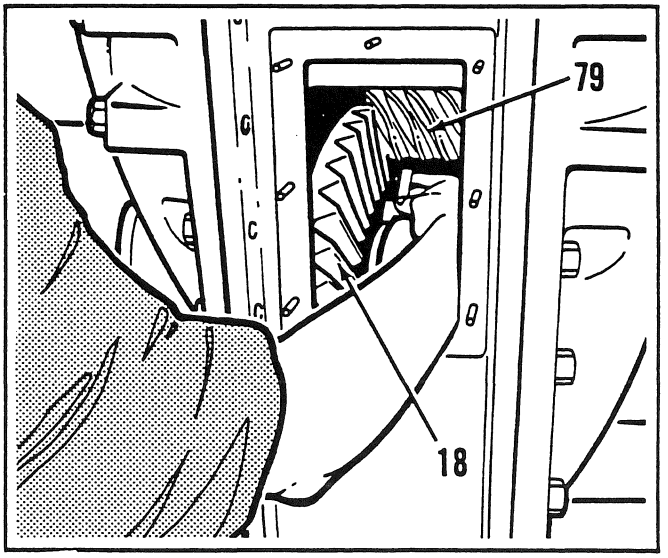


Fig. 95

Final Drive - Assembly (Continued)

Fig. 90
Secure the spiral pinion shaft assembly in a vise with soft jaws. Tighten or loosen the locknut (67) using special **tool, part number 43004.** Wrap soft wire around the pinion cap (73) and attach a spring balance scale to the end of the wire. Pull the wire and adjust the locknut tightness until the assembly rolling torque agrees with the adjustment specification listed in the front of this Shop Manual Section.

Fig. 91
When the rolling torque is correctly adjusted, secure the locknut (67) by bending the raised portion into the spline hollows in four places.

Fig. 92
Apply a thin layer of sealant, Champion part number **19200** onto the outside diameter of a new oil seal (68). Install the oil seal in the pinion cap (73). Lubricate the seal lips with system oil.

Fig. 93
Record the pinion depth number etched on the face of the spiral pinion shaft (79). This number will be used to calculate the thickness of the shim pack (78) used under the pinion cap.

Fig. 94
Install a threaded lifting eye on the end of the spiral pinion shaft (79). Install the shaft using the lifting device. Align the oil drain hole with the horizontal center of the pinion shaft.

Fig. 95
Install the **special tool, part number 45294,** between the face of the spiral pinion shaft (79) and the machined shoulder of the spiral pinion gear (18).

Final Drive - Assembly (Continued)

Fig. 96
Use feeler gauges to measure the gap between the pinion cap (73) and the machined surface of the main case (28) in at least four places. Calculate the average measurement.

Fig. 97
Compare the recorded pinion depth number with the design constant number **4.625.** If the depth number is **larger** than the constant number, **add the difference** to your gap measurement. If the depth number is **less** than the constant number, **subtract the difference** from your gap measurement. If the depth number and constant number are **equal**, use the gap measurement **as it is.**

Fig. 98
Remove the special tool. Remove the spiral pinion shaft assembly (79) using the lifting device.

Fig. 99
Assemble a shim pack (78) equal in thickness to the adjusted gap measurement. Re-install the spiral pinion shaft assembly; together with the shim pack. Install the capscrews (71) and lockwashers (72). Apply sealing compound, Champion part number **19167,** onto the two side capscrew threads. Tighten the capscrews to the specified torque.

Fig. 100
Install a dial indicator through the inspection hole, engaging the plunger onto the center of one of the spiral pinion gear teeth. Rotate the gear slightly and measure the backlash in at least four places; and compare with the adjustment specification listed in the front of this Shop Manual Section.

Fig. 101
To increase backlash, remove a shim or shims from the left hand side of the cross shaft and install them on the opposite side. Reverse this procedure to decrease backlash. **Remember,** if you take a shim from one side of the cross shaft, you **must** install it on the opposite side!

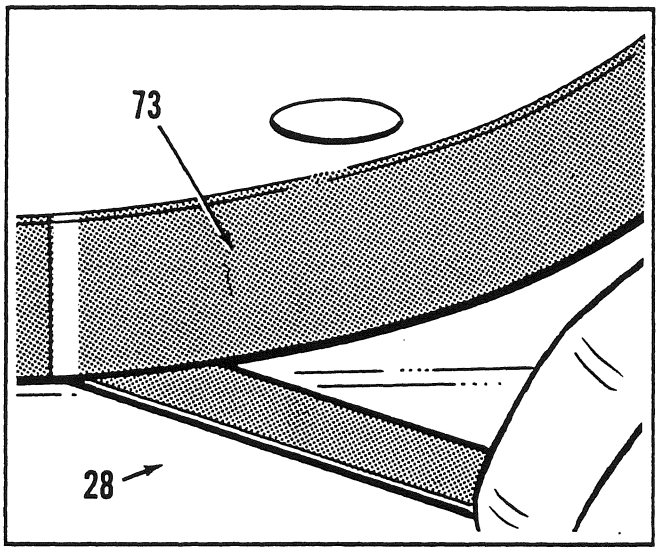


Fig. 96

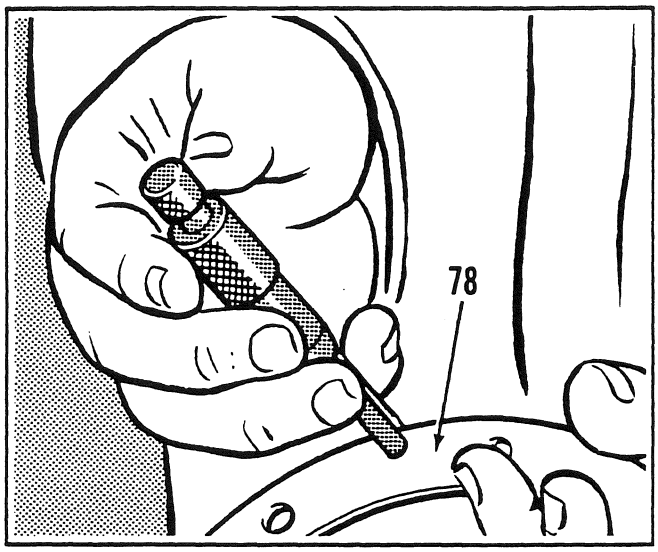


Fig. 99

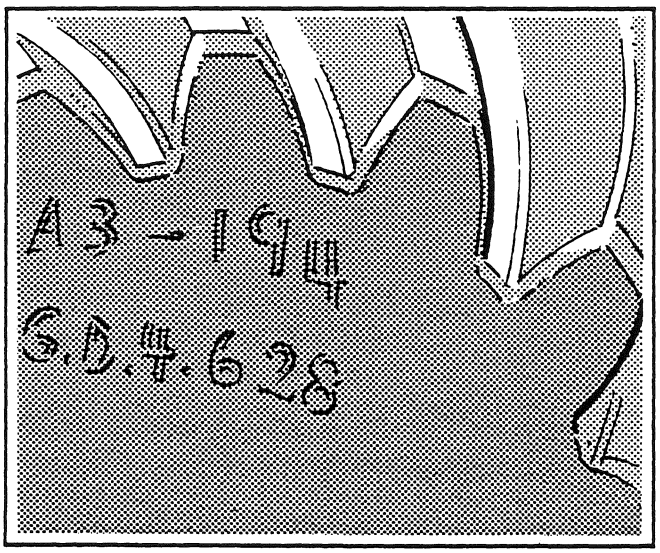


Fig. 97

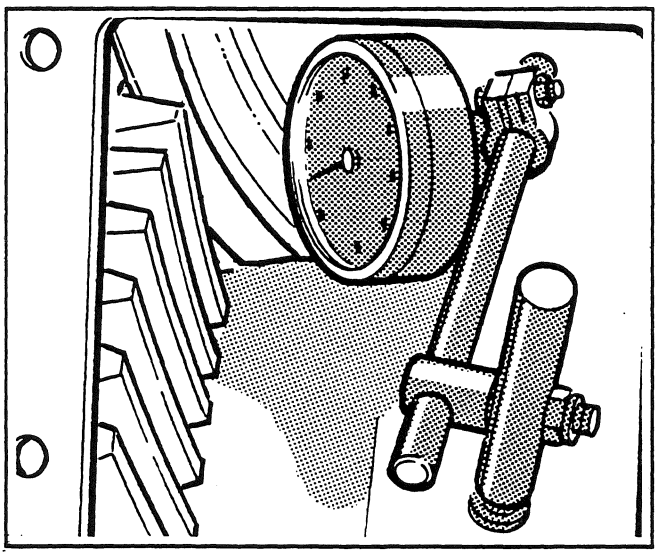


Fig. 100

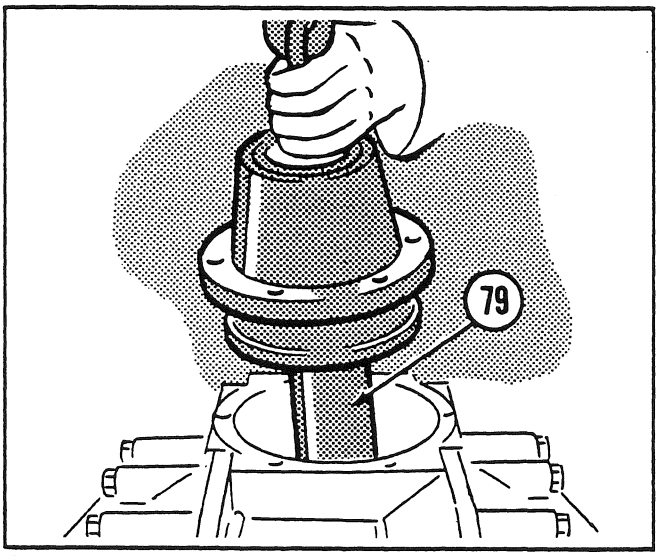


Fig. 98

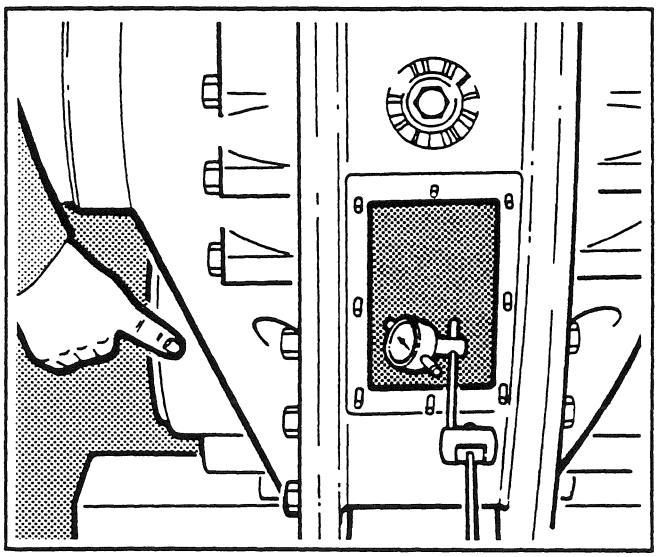


Fig. 101

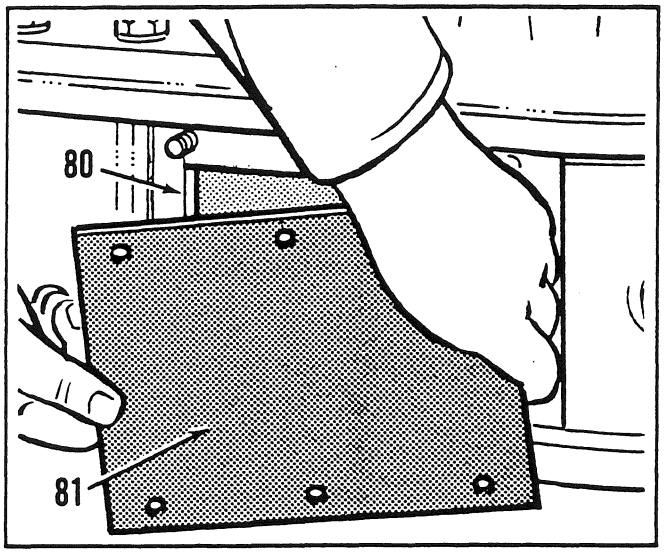
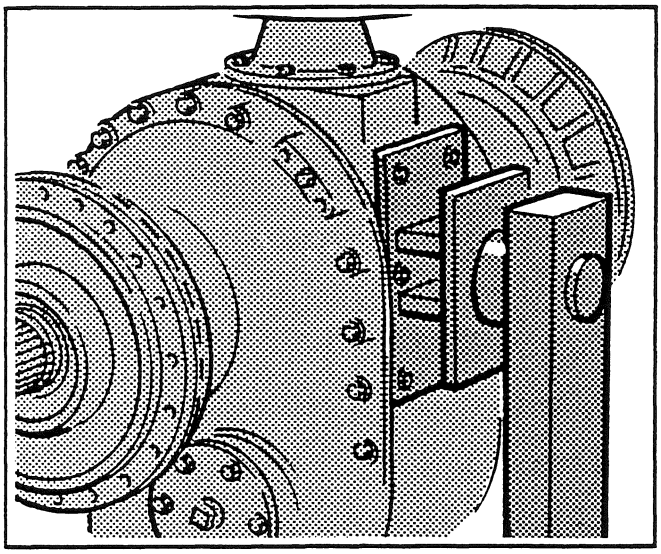


Fig. 102



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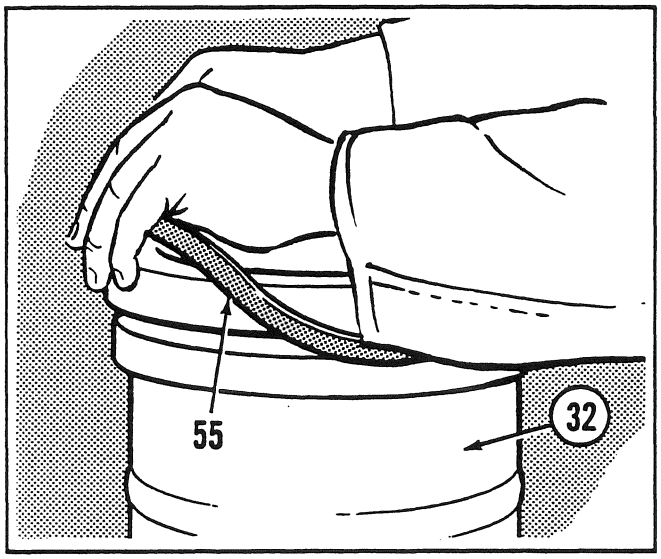

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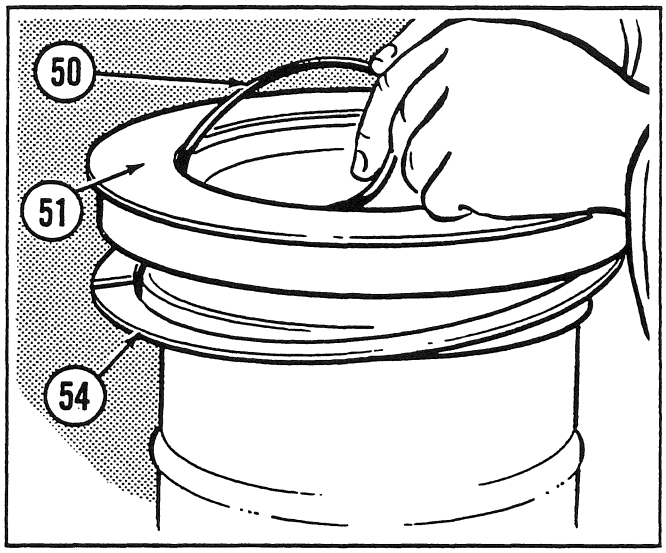

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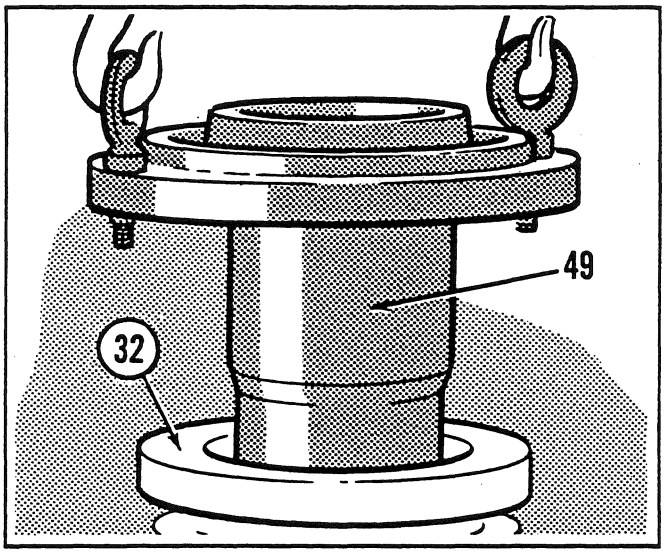

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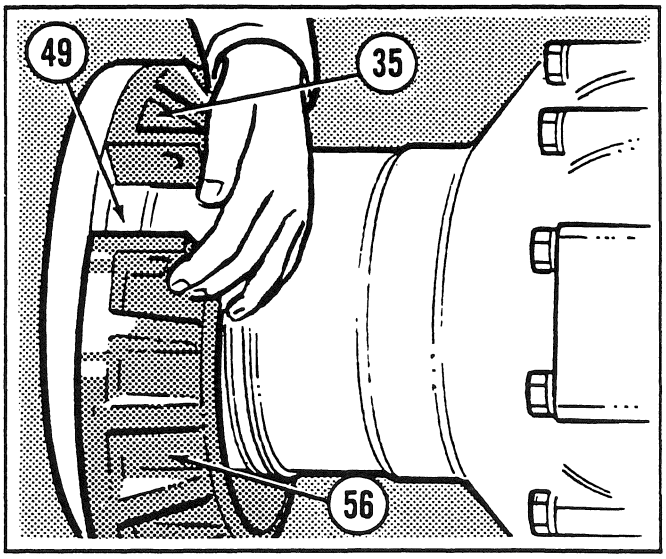


Fig. 107

Final Drive - Assembly (Continued)

Fig. 102
Install the cover plate (81) and a new gasket (80), or apply gasket eliminator compound, Champion part number **25303.** Secure the cover plate with the nuts (83) and lockwashers (82).

Fig. 103
Turn the final drive assembly onto the left hand side.

Fig. 104
Lubricate a new "Uniring" seal (55) and install it on the left hand side housing (32).

Fig. 105
Lubricate and install a new inner thrust plate (54). Lubricate and install a new outer thrust plate (51). Lubricate and install a new O ring (50).

NOTE

Earlier models of this final drive were assembled without O rings. If you are working on one of the earlier models, Champion recommends that you install O rings to help prevent leakage at the flanged sleeves.

Fig. 106
Carefully lower the flanged sleeve (49) onto the side housing (32) using lifting eyes. Remove the eyes.

Fig. 107
Rotate the final drive 90 degrees. Apply gasket sealant Champion part number **37168,** onto the mating surfaces of the half-rings (35 and 56) and the inner face of the flange sleeve (49). Carefully install the half-rings over the "Uniring" seal. Secure the two halves with the nuts (58), bolts (36) and lockwashers (57). Install nuts and bolts to temporarily secure the half rings to the flanged sleeve.

Final Drive - Assembly (Continued)

Fig. 108
Lubricate the bearing (47) and install onto the drive axle (48) using a hydraulic press. The bearing is easier to install when heated. Use only an oven or oil bath type heater and **DO NOT** exceed 121°C (250°F).

Fig. 109
Install a lifting eye in the end of the drive axle (48). Lower the drive axle assembly into the flanged sleeve (49) using the lifting device. Align the drive axle and bull gear hub splines. Retain the bearing with a new snap ring (46). Remove the lifting eye.

Fig. 110
Apply a thin layer of adhesive/sealant, Champion part number **19200** onto the outside diameter of a new oil seal (45). Install the oil seal in the flanged sleeve (49). Lubricate the seal lips with system oil.

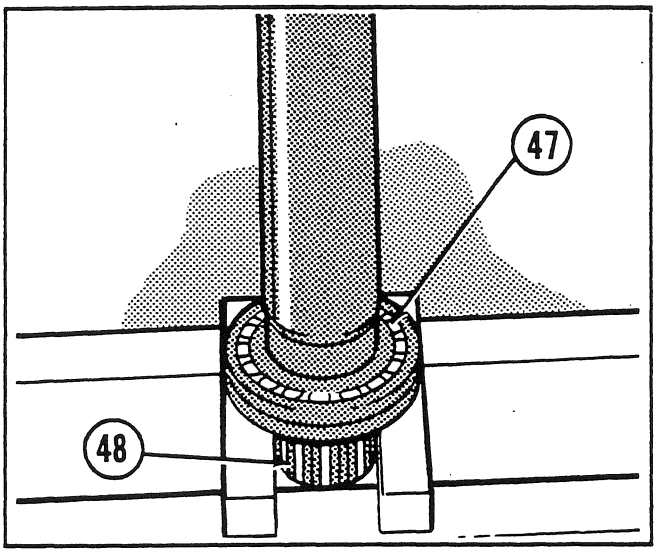
Fig. 111
Repeat the procedures from **Fig. 104** to **Fig. 110** and install the right hand flanged sleeve (100) and related parts.

Fig. 112

Install the brake flange yoke and brake disc assembly (66). Install the star washer (65), plain washer (64) and locknut (63), refer to text in **Fig. 28.** Tighten the locknut to the specified torque.

Final Drive - Installation

Fig. 113
Before installing the final drive assembly to the tandem cases, install new gaskets or apply gasket eliminator compound, Champion part number **25303**, to the flanged sleeve mounting surfaces.



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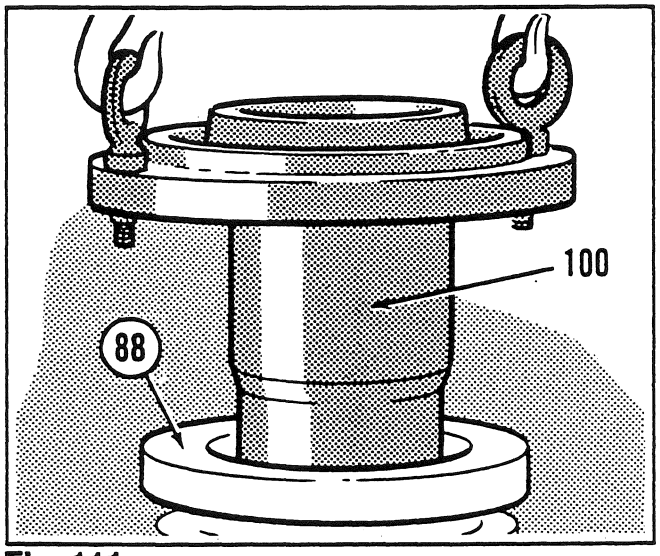

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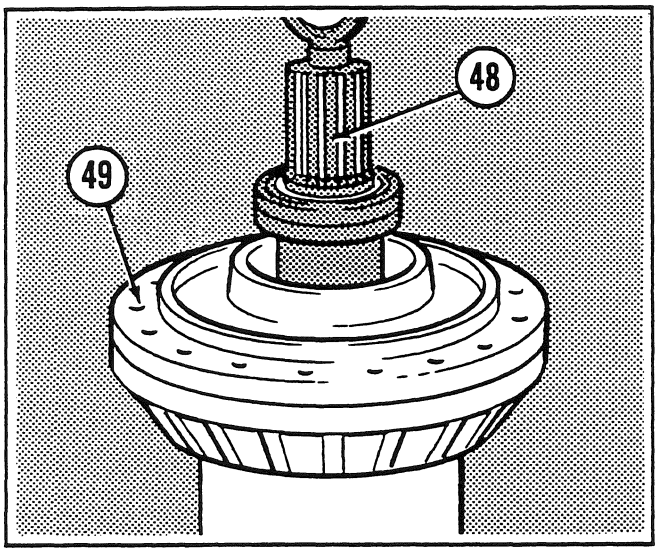

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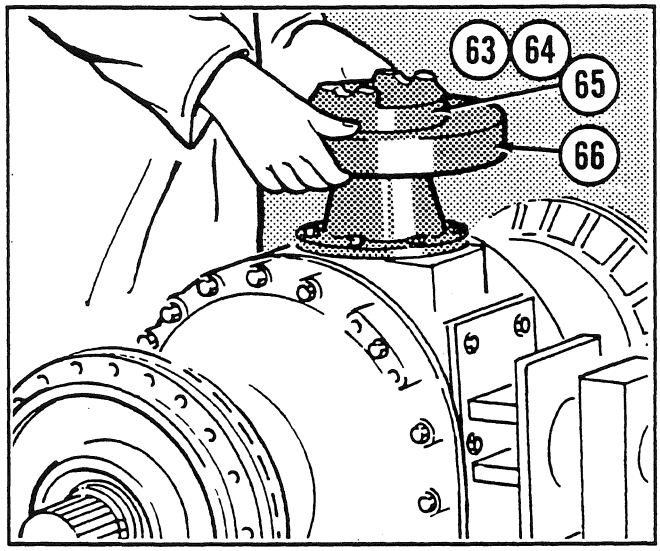

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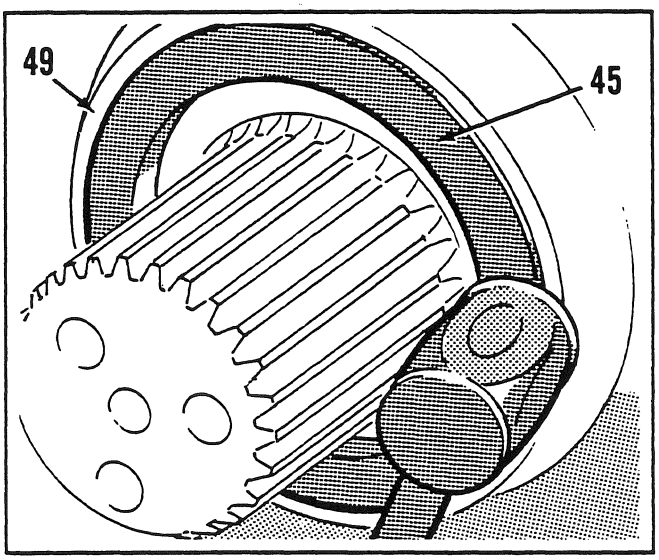

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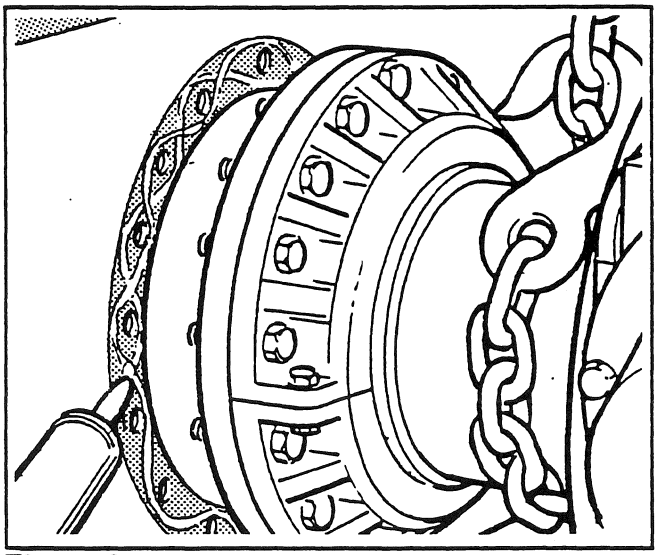
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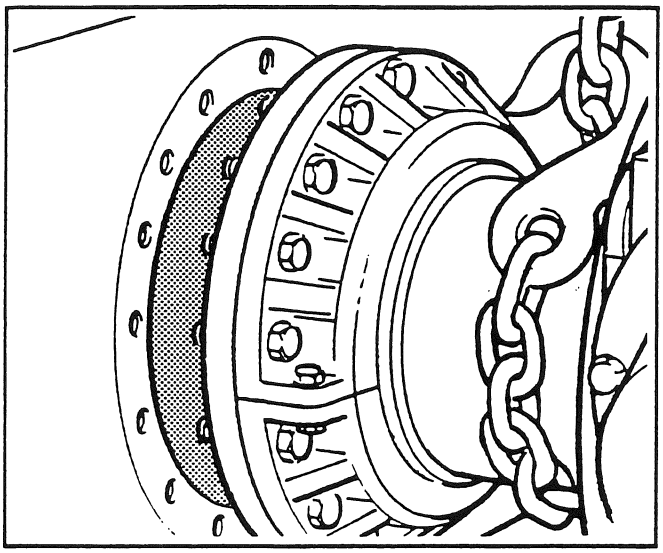

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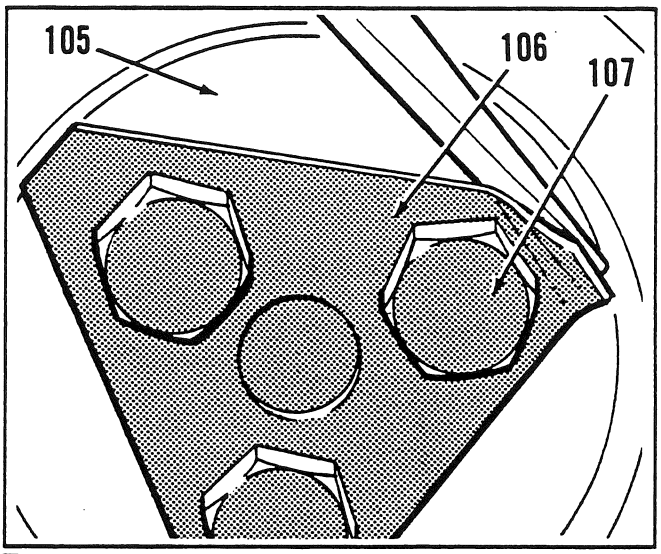

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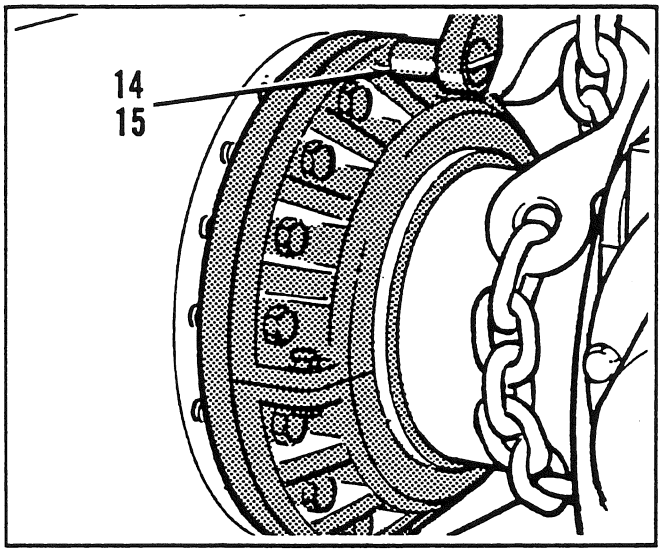

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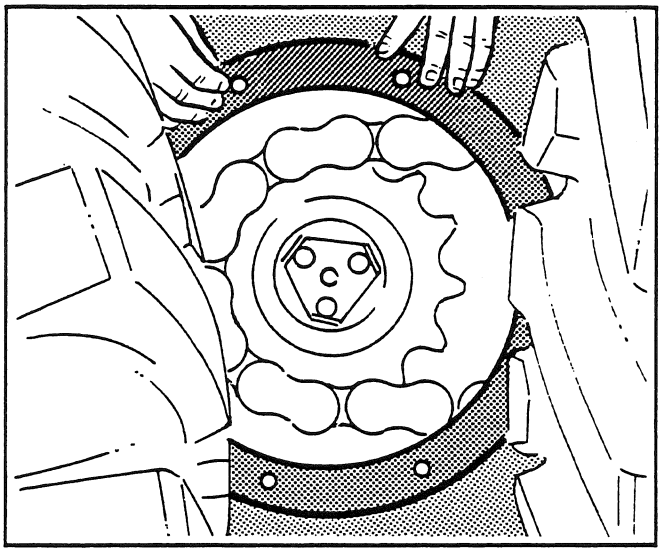

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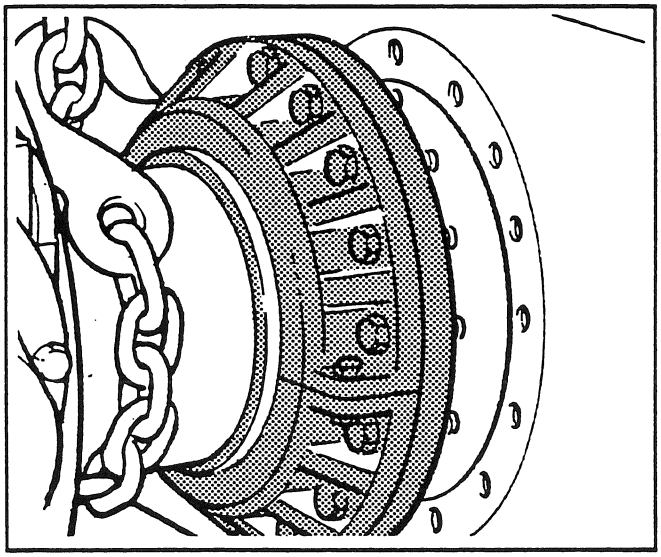

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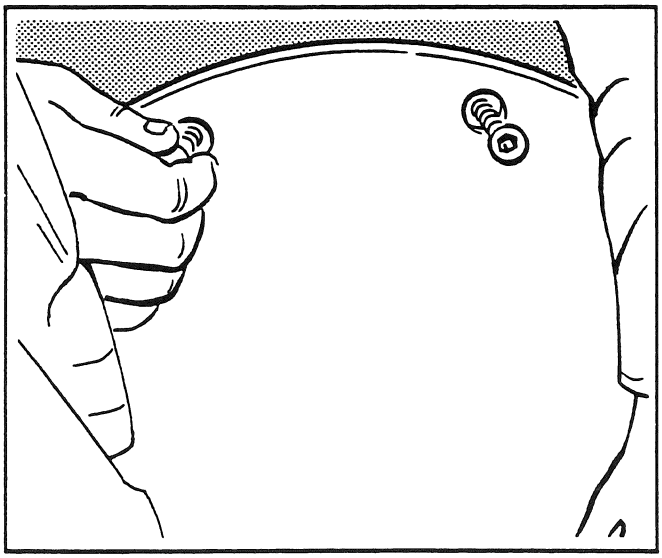


Fig. 119

Final Drive - Installation (Continued)

Fig. 114
Remove the nuts and bolts, temporarily securing the half-rings to the flange sleeve, installed in **Fig. 107.** Install the final drive assembly onto one tandem using the lifting device. Make sure you align the drive axle and tandem sprocket splines. Take care not to damage the oil seal (45) when engaging the drive axle and sprocket.

Fig. 115
Install the capscrews (15) and lockwashers (14) that retain the half-rings to the tandem case. Tighten the capscrews to the specified torque.

Fig. 116
Support the weight of the final drive assembly on proper blocks or stands. Repeat the procedures from **Fig. 113** to **Fig. 115** and install the other tandem case.

Fig. 117
Install the sprocket retainer (105), new lockplate (106) and capscrews (107) for each drive sprocket. Tighten the capscrews to the specified torque. Bend the lockplate corner tabs to secure the capscrew heads.

Fig. 118
Install a new gasket or apply gasket eliminator compound, Champion part number **25303,** around the tandem cover plate opening.

Fig. 119
Install the tandem cover plates and fasten them with the capscrews. Remove the blocks supporting the final drive assembly.

Final Drive - Installation (Continued)

Fig. 120
Raise the frame using the lifting device. Remove the stand.

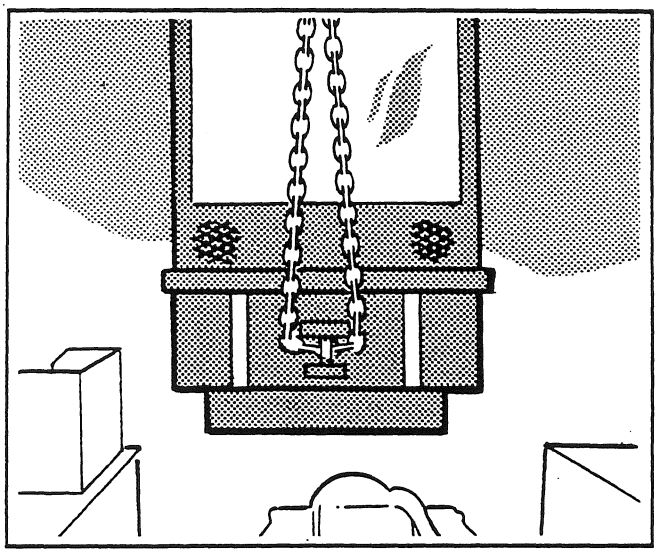
Fig. 121
Roll the final drive and tandem assembly into position under the frame.

Fig. 122
Carefully lower the frame onto the final drive assembly using the lifting device. On articulated models, **make sure** that the parking brake disc does not interfere with the mounting brackets.

Fig. 123
Install the hanger bracket half-clamps (**be sure** to check the matching identification marks). Retain with the nuts (61) and bolts (62), but **DO NOT** torque tighten.

Fig. 124
Install the mounting plate (22) and retain with the nuts (19), bolts (21) and lockwashers (20). Tighten the nuts (61 and 19) to the specified torque.

Fig. 125
Re-connect the lower drive shaft to the final drive brake flange yoke. Tighten the capscrews to the specified torque.



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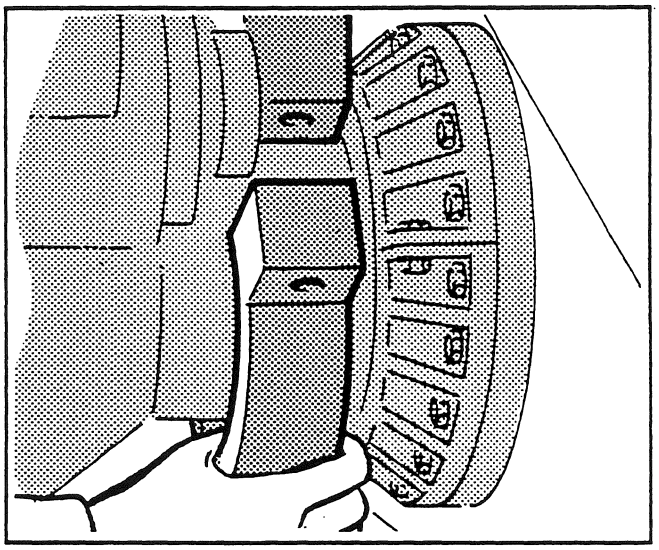

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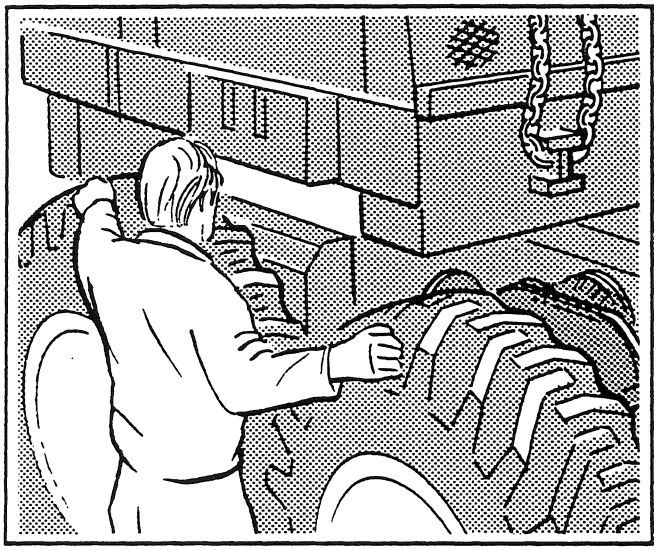

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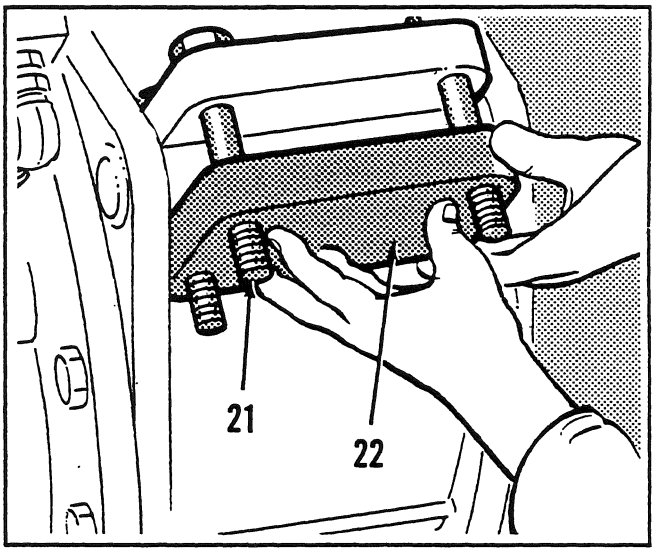

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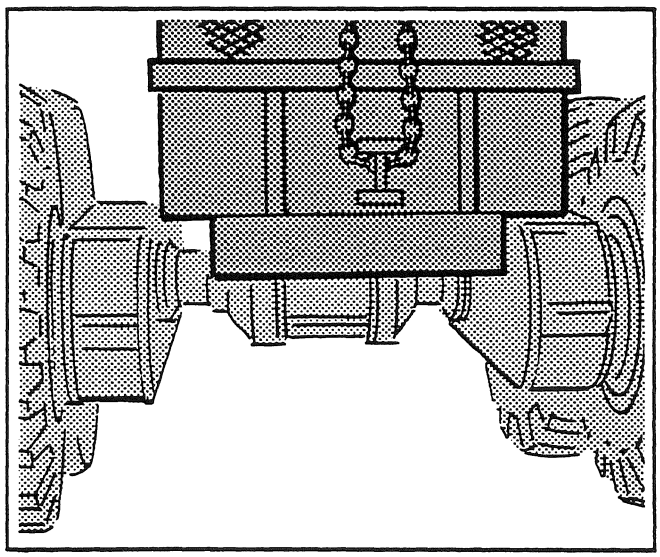

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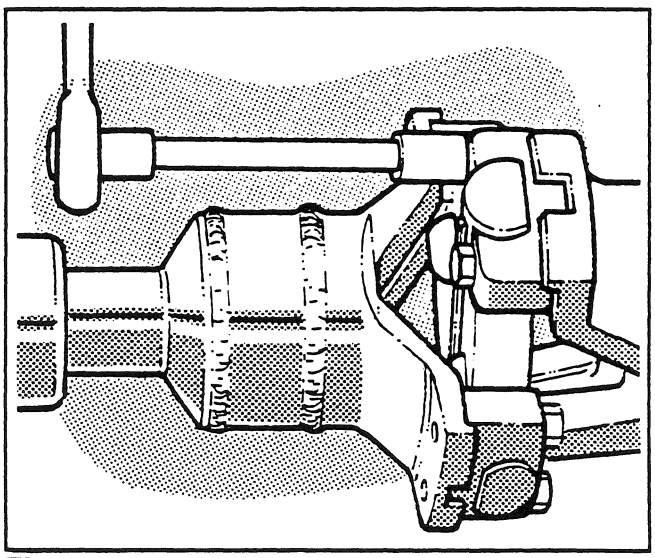

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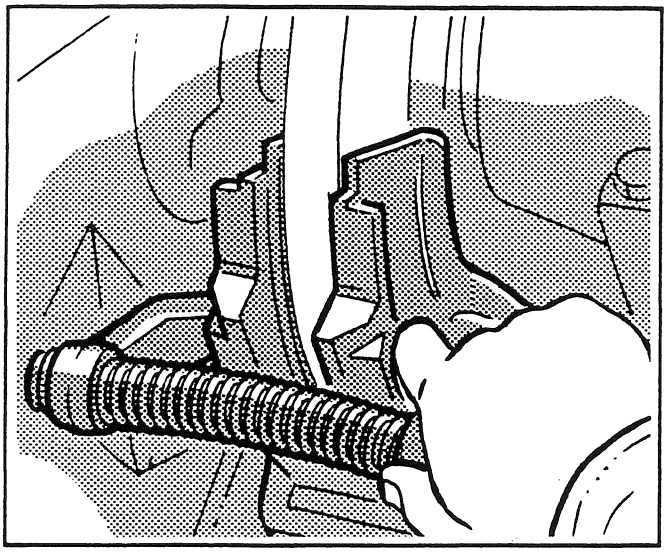

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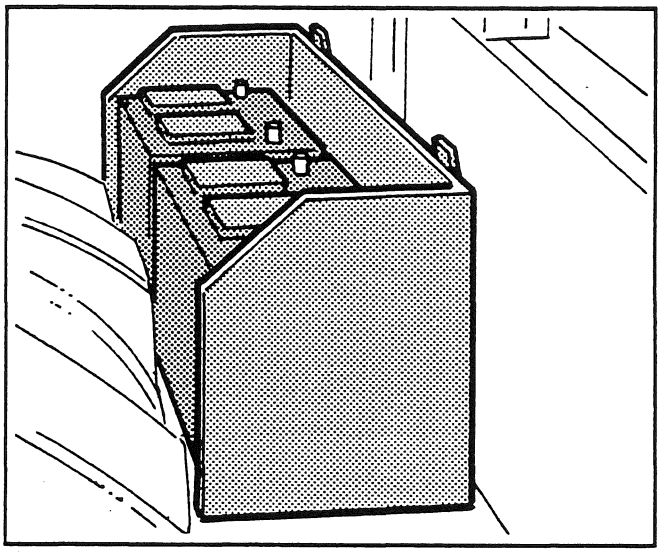

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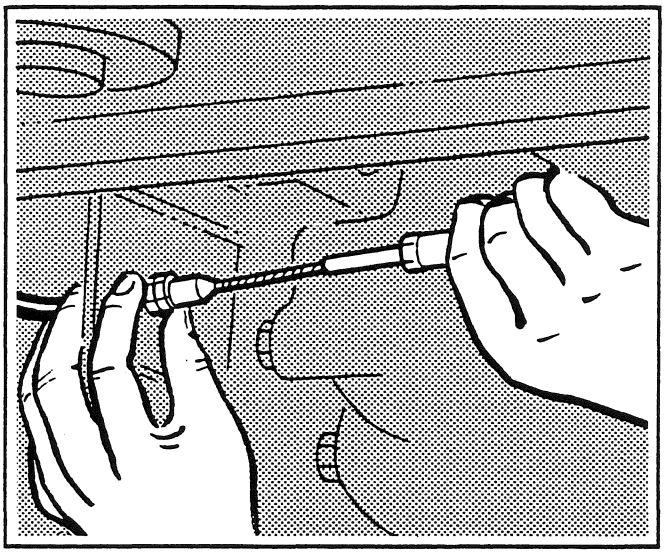

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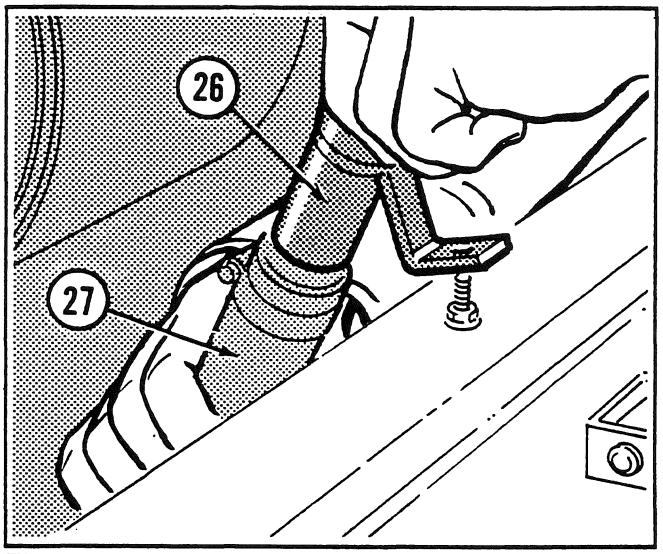

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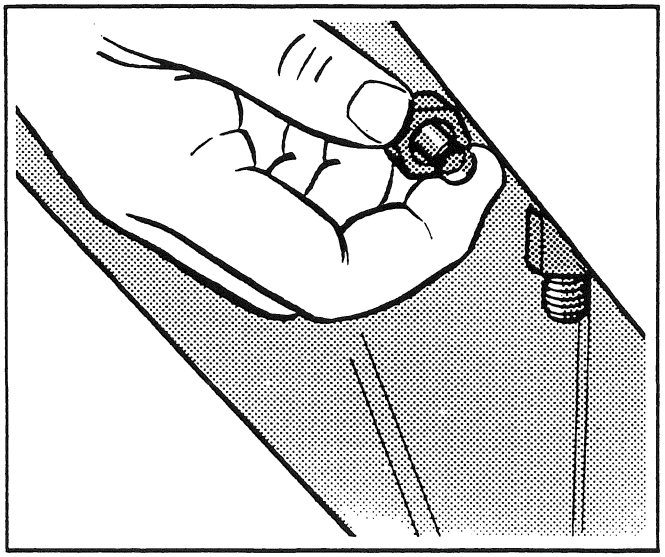

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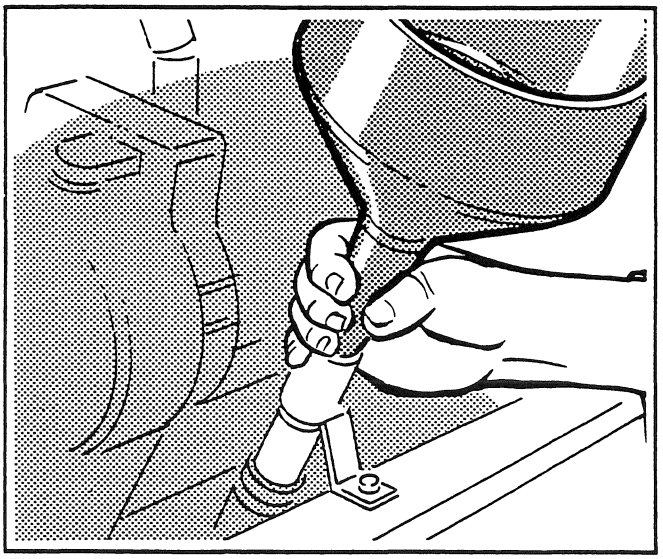


Fig. 131

Final Drive - Installation (Continued)

Fig. 126
Install the parking brake assembly.

Fig. 127
Re-connect the parking brake cable and adjust the brake shoe clearance. Install the parking brake fender.

Fig. 128
Re-connect the brake lines at the tee fittings on the frame. Make sure you wipe up any spilled fluid immediately.

Fig. 129
Install the battery box and re-connect the battery cables to the proper terminals. Install the battery box cover.

Fig. 130
Install the breather hose (27) and breather pipe (26) on the frame.

Fig. 131
Fill the final drive assembly to the correct level using the lubricant recommended in the Lubrication Specifications at the front of this Shop Manual.

Final Drive - Installation (Continued)

Fig. 132
Purge the brake hydraulic system as described in the appropriate section of this Shop Manual. Fill both tandem assemblies to the correct level using the lubricant recommended in the Lubrication Specifications at the front of this Shop Manual.

Fig. 133
Removal, overhaul and installation of the standard double reduction final drive is now complete. **Road test the grader to make sure that the final drive functions properly.** Check all connections for leaks and rectify where necessary.

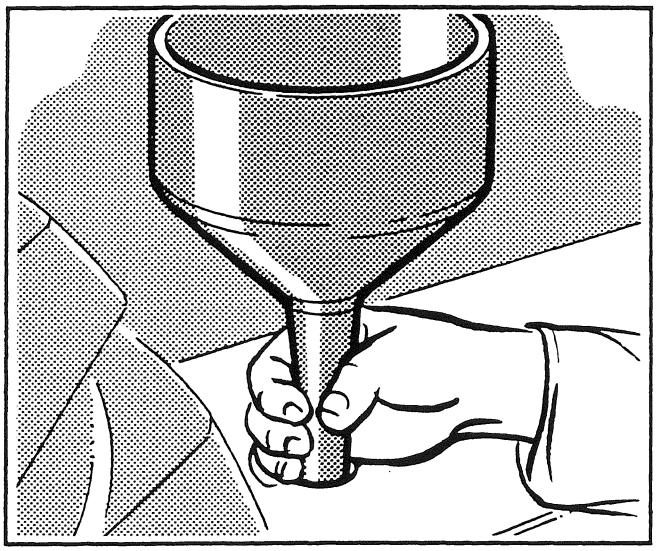


Fig. 132

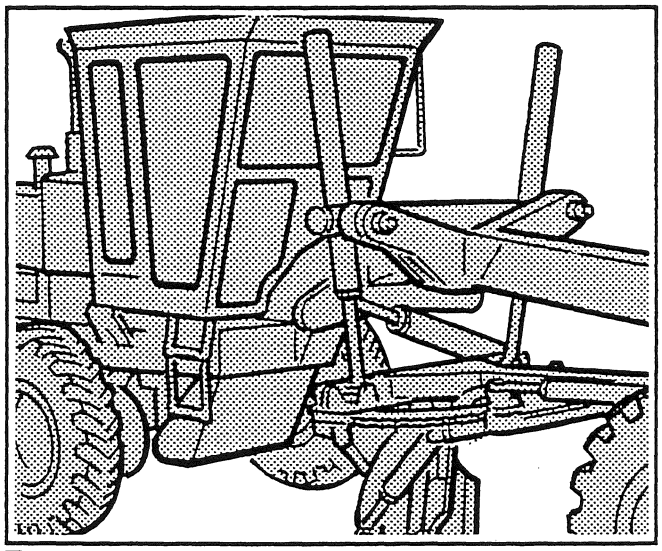
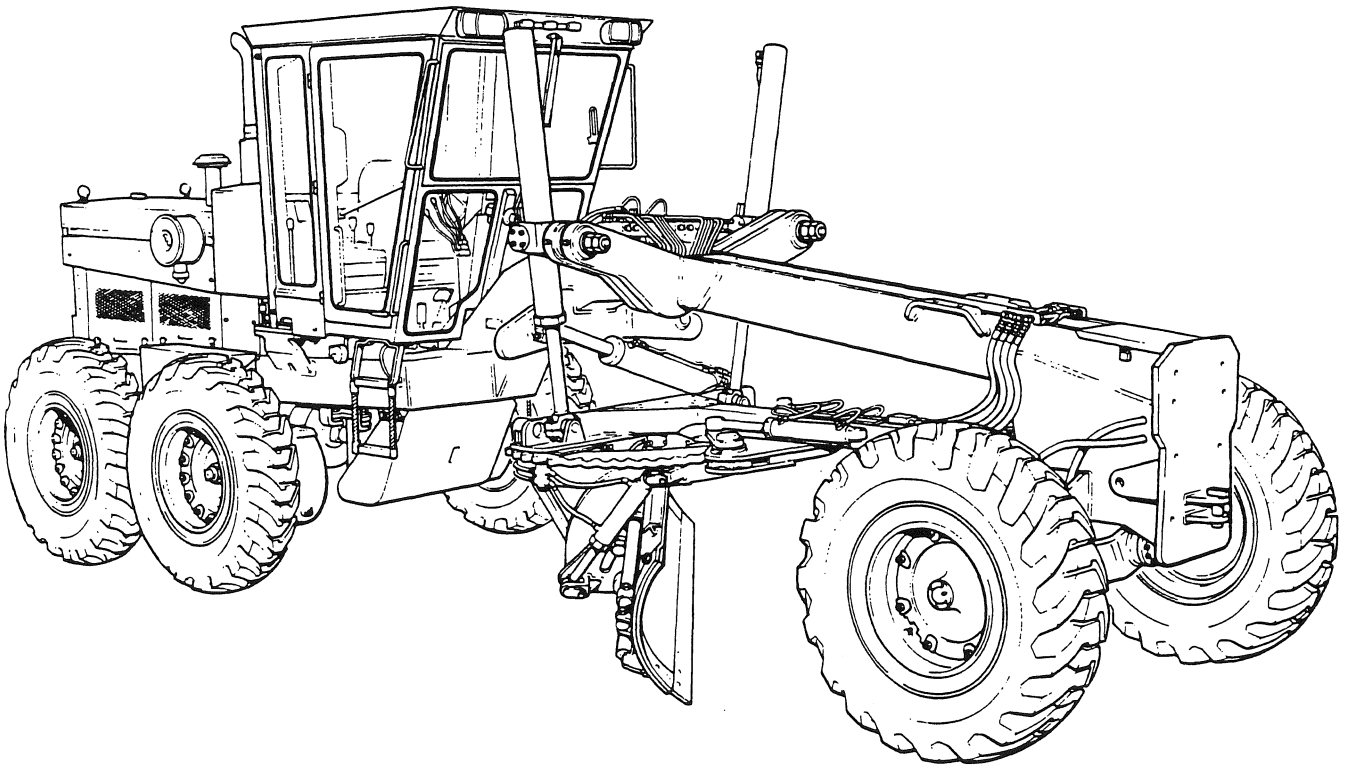


Fig. 133

SECTION 12

STANDARD BRAKES AND TANDEMS



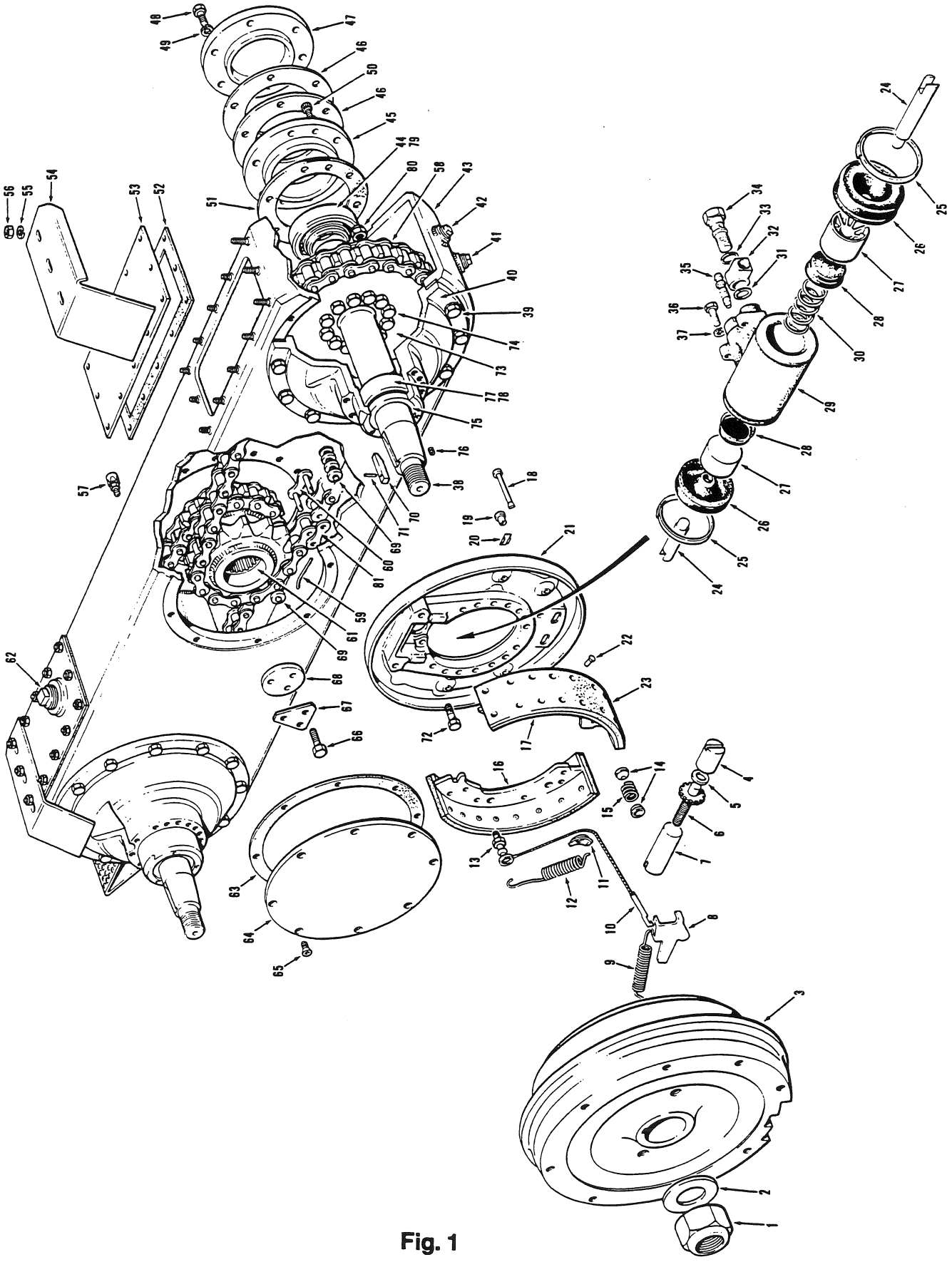


Fig. 1

Item	Description	Item	Description	Item	Description
1	Wheel nut	25	Strap	54	Shield-Brake line
2	Washer	26	Boot	55	Lockwasher
3	Wheel	27	Piston	56	Nut
4	Socket	28	Cup	57	Breather
5	Washer	29	Body	58	Chain-Drive
6	Adjusting screw	30	Spring	59	Cotter Pin
7	Pivot nut	31	Gasket-Inner	60	Link-Chain
8	Lever-Auto adjuster	32	Inlet fitting	61	Sprocket-double drive
9	Spring-Adjuster screw (white)	33	Gasket-Outer	62	Plug-Filler
		34	Bolt	63	Gasket
10	Cable assembly	35	Bleeder screw	64	Side plate cover
11	Cable guide-Auto adjuster	36	Bolt	65	Bolt
		37	Lockwasher	66	Bolt
12	Spring-Shoe return (black)	38	Stub axle	67	Washer-Tab
		39	Bolt and lockwasher	68	Plate-Retaining
13	Pin	40	Bearing housing-Stub axle	69	Plugs-Magnetic
14	Cup			70	Key
15	Spring-Shoe hold down	41	Drain plug	71	Pin-Key
		42	Level plug	72	Capscrews-Backing plate
16	Shoe and lining assembly (L.H.)	43	Tandem case		
		44	Bearing cup	73	Sprocket-Stub axle
17	Shoe and lining assembly (R.H.)	45	Bearing flange	74	Bolt
		46	Shim pack	75	Oil seal
18	Pin	47	Bearing cap	76	Set screws
19	Cover-Probe hole	48	Bolt	77	Bearing cup
20	Cover-Adjusting hole	49	Washer	78	Bearing cone
21	Backing plate	50	Socket head capscrews	79	Bearing cone
22	Rivet	51	Gasket	80	Nut-Sprocket
23	Lining-drilled	52	Gasket	81	Link-Chain
24	Link-Wheel cylinder	53	Cover plate		

Key to Fig. 1

TABLE OF CONTENTS PAGE

General

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chances of foreign matter entering the brakes and tandem causing damage. For a complete overhaul you will require a suitable lifting device, blocks and safety stands, a wheel puller, and a brake adjusting wrench.

Discard all oil seals, O rings, snap rings, and tabwashers. Clean and inspect brake and tandem components. Refer to the 700 Series Parts Manual when ordering replacement parts.

Refer to Lubrication Specifications detailed in the front of this manual for the recommended brake fluid and tandem lubricants.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH ADEQUATE STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS INSTALLED BEHIND THE LEFT FRONT ENGINE COVER. ON ARTICULATED MACHINES, INSTALL THE BLOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances appear in Metric (SI), Imperial and U.S. quantities. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

Description and Operation

Four wheel booster brakes are standard equipment on all 700 Series models except models 710 and 710A where two wheel rear mounted booster brakes are standard equipment. Power for the booster cylinder is supplied by oil in the return line of the steering system.

When the brake is depressed, a valve in the booster cylinder is closed and oil pressure builds up (relief), and presses on the push rod of the master cylinder. Brake fluid then is forced into all four wheel cylinders to expand the shoes against the brake drums.

The wheel brakes are self-adjusting drum type brakes. All four shoe sets are adjusted tight against the drums, then backed off four notches on the adjusting wheel. The linings should be replaced when worn to within 1/16 in. (1,59 mm) of the rivet heads retaining them to the shoes.

1/2 in. - 1 in. (12,70 mm. - 25,40 mm.) free travel on the pedal is required to ensure that the booster assembly is fully neutralized when the pedal is released.

The tandem assembly divides the power flow from a single floating drive axle (each side) to two tandem mounted axles and drive wheels. The tandem case is fabricated from steel plate, and is stress relieved before machining. Two plates are used to provide additional stiffness to the tandem assembly. This adds accuracy to the machining, which is done in a single jig, thus eliminating misalignment of the chains. The chains connect a double-drive sprocket on the final drive axle and the driven sprockets on the stub axles.

The shim pack under the inner bearing cap should be gauged so that a definite pre-load is felt when you turn the sprocket by hand. No provision is made for tightening the chains. A certain amount of slack is required and a slight rubbing of the chain on the bottom of the tandem case is normal and no cause for concern. However, a chain which has excessive slack and appears to require tightening may have a pitch of more than 2" (or 1.75" for the 710). If this is the case, it should be replaced as continued use will caused undue wear on the sprockets. For lubrication, the system oil should be changed once per year or every 2000 hours. At the same time, the two magnetic plugs in each tandem should be removed, cleaned and replaced.

Cleaning and Inspection

Cleaning - General

WARNING

ALKALI CLEANING SOLVENTS AND VAPORS ARE EXTREMELY HARMFUL AND CAN CAUSE SERIOUS INJURY TO EYES, LUNGS AND SKIN. ALWAYS WEAR PROTECTIVE CLOTHING, GOGGLES AND RESPIRATOR. USE UTMOST CARE WHEN HANDLING CHEMICALS.

CAUTION

YOU ARE RECOMMENDED TO WEAR COTTON GLOVES WHEN HANDLING BEARINGS. THIS PREVENTS SKIN ACIDS AND PERSPIRATION CONTAMINATING THE RACES AND ROLLING ELEMENTS.

Immerse small parts and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

Cleaning - Bearings

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning and Inspection (Continued)

Inspection - Oil Seals, O Rings and Snap Rings

Replace all oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Apply a thin coating of 'Permatex No. 2', or equivalent, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings before installation.

Inspection - Sprockets and Drive Shafts

If crack detection equipment is available, use the process to check parts. Examine teeth of all sprockets for wear, pitting, chipping, nicks, cracks and scores. If the sprocket teeth show spots where the case hardening has worn through or cracked, replace the sprocket.

Small nicks can be removed using a suitable grinding stone. Inspect shafts for signs of bent or twisted splines and replace any deformed drive axles.

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Torque Guide

Application		Torque Value	
Stub Axle Nut	3389,5 N.m	345,6 kgf.m	2500 lbf-ft
Rim Clamp Nuts	203,4 N.m	20,7 kgf.m	150 lbf-ft
Backing Plate Capscrews	74,6 N.m	7,6 kgf.m	55 lbf-ft
Final Drive Flange Capscrews	230,5 N.m	23,5 kgf.m	170 lbf-ft
Drive Sprocket Capscrews	108,5 N.m	11,1 kgf.m	80 lbf-ft
Bearing Cap Capscrews	108,5 N.m	11,1 kgf.m	80 lbf-ft
Bearing Housing Capscrews	216,9 N.m	22,1 kgf.m	160 lbf-ft
Sprocket Bolts & Lock Nuts	406,7 N.m	41,5 kgf.m	300 lbf-ft

Special Tools

The following tools are recommended when overhauling the standard brakes and tandems. The tools help you to remove and install precision-machined parts.

Champion Tool Part Number	Description
5726	Rear wheel puller plate
5727	Rear wheel puller screw
377	Brake ajusting wrench

Make sure proper tools are available and in good working order. Some tools required in this section may have to be manufactured, and are described within the text of this section.

Disassembly

Fig. 2
Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard onto blocks to raise one tandem. Place adequate blocks under the tandem, then lower the tandem onto the supports. Stop the engine. Turn the isolation switch to the "OFF" position. Apply the parking brake.

Fig. 3
Remove the nuts, rim clamps, tire and the rim.

Fig. 4
Remove the stub axle nut and the washer **(Ref. Fig. 1).**

NOTE

You may find it easier to loosen the nut before raising the machine to support the tandems.

Fig. 5
Attach a safe lifting device to the top wheel stud. Remove the wheel (3) with a rear wheel puller plate (**Special tool No. 5726**) and a rear wheel puller screw (**Special tool No. 5727**) from the stub axle.

NOTE

Check for signs of damage on the brake drum surface. If damage has occurred, replaced the wheel casting.

Fig. 6
Using a hammer and a metal pry bar remove the key (**70**) from the end of the stub axle (**38**).

Fig. 7
Place a container under the tandem drain plug (**41**). Remove the plug and drain the lubricating oil. Clean and install the drain plug.

NOTE

The tandem oil capacity for the short tandems is 30 litres (6.6 Imp. gal, 7.9 U.S. gal) and the long tandems is 32 litres (7.1 Imp. gal, 8.5 U.S. gal).

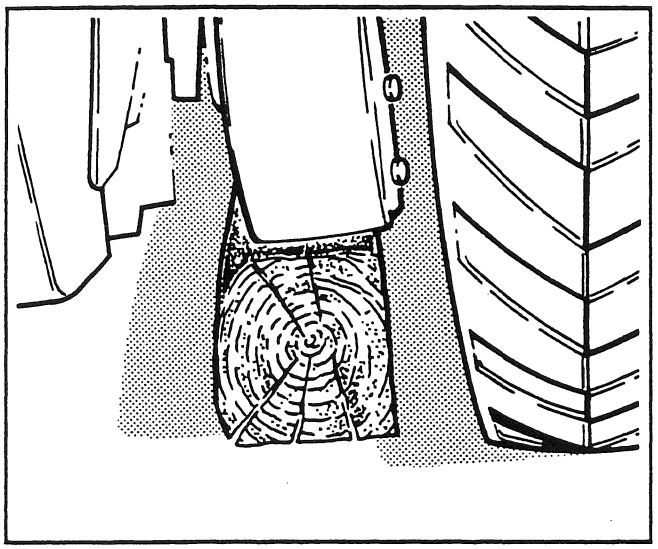
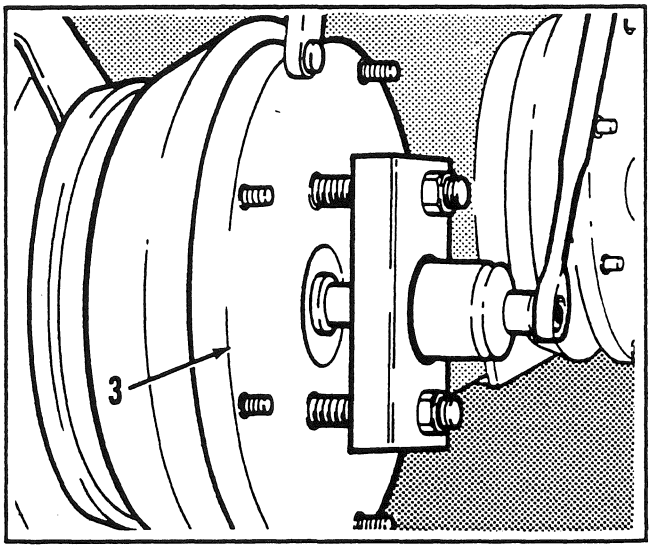


Fig. 2



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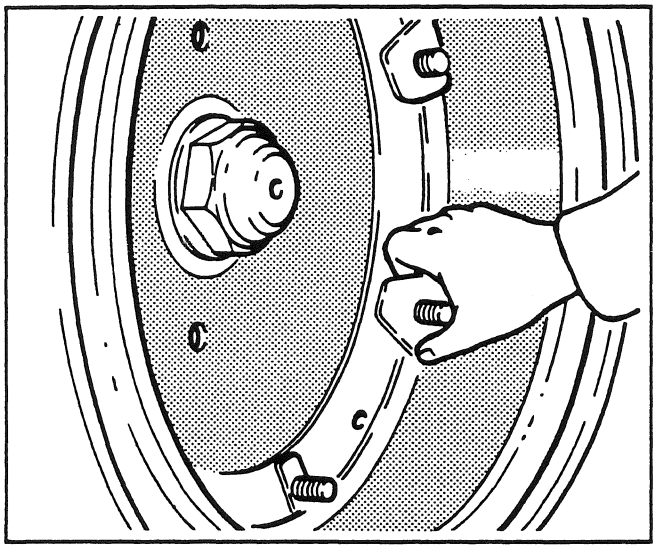


Fig. 3

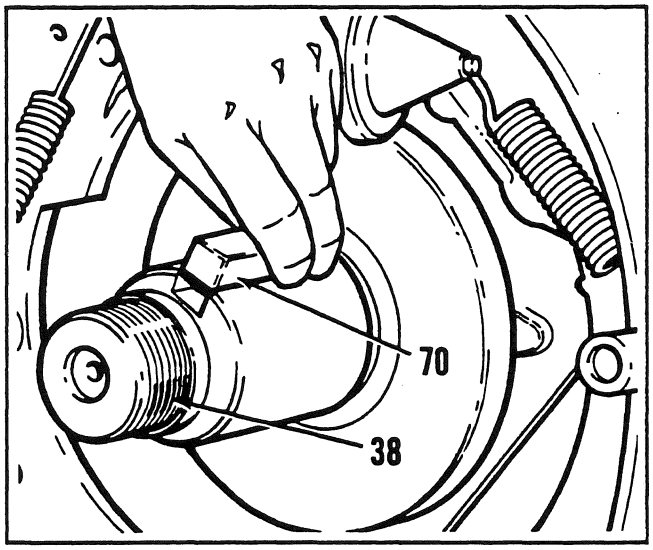
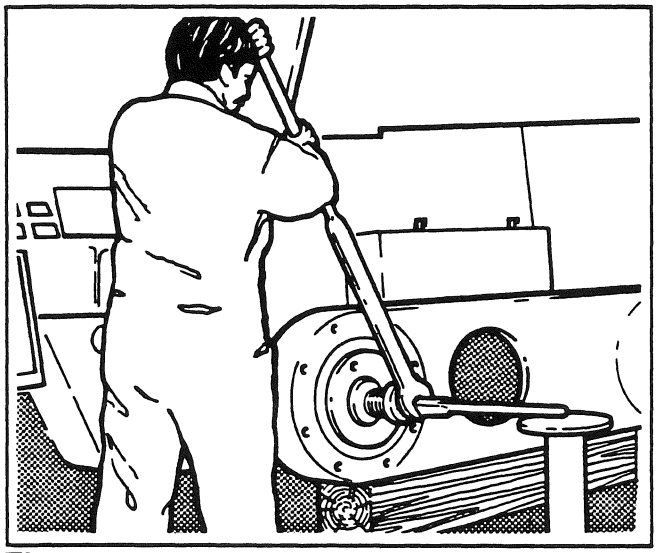


Fig. 6



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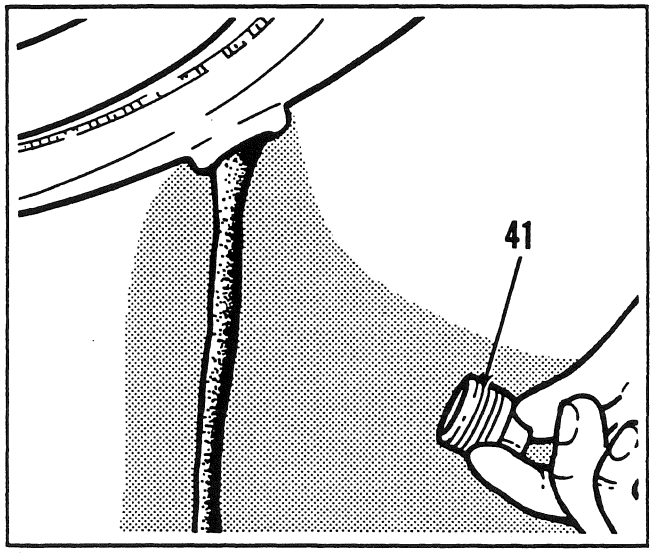

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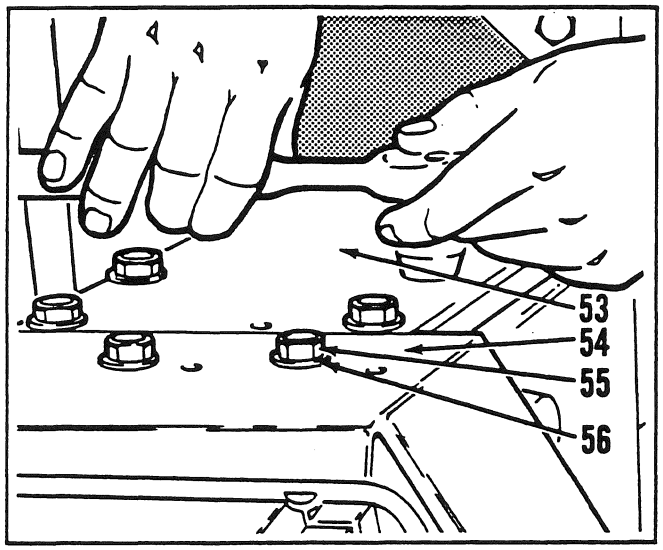

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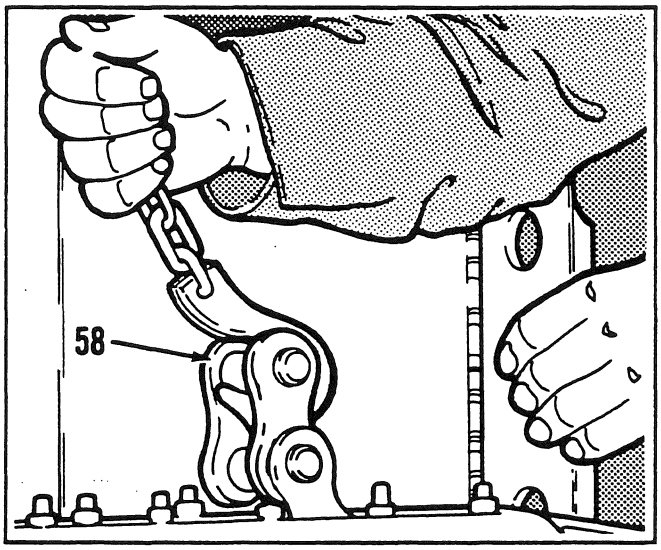

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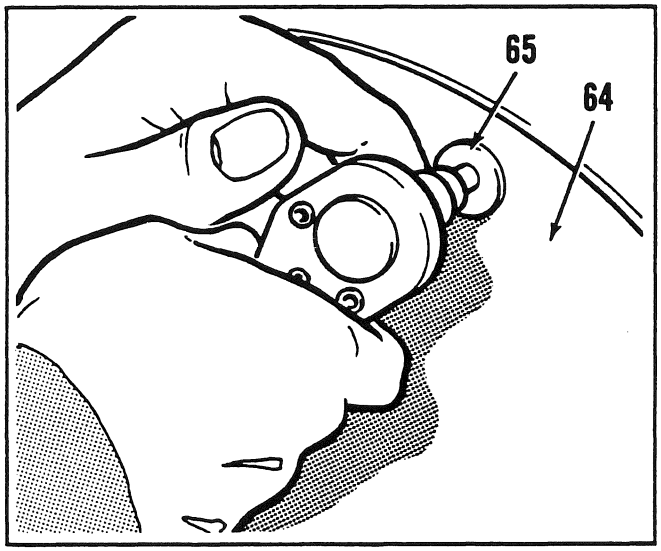

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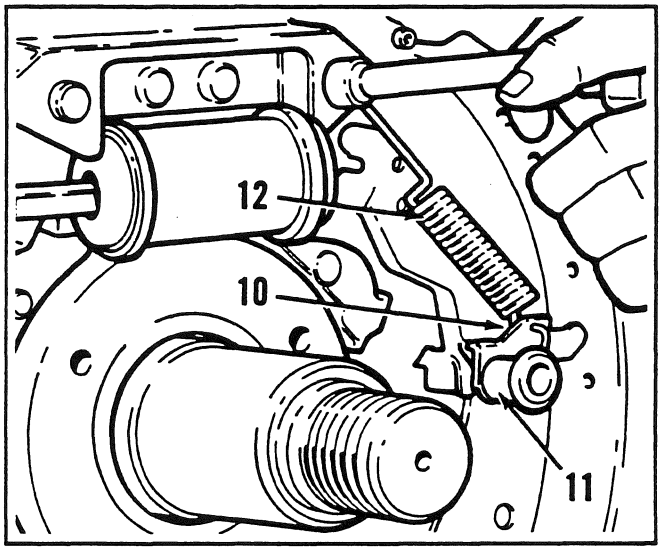

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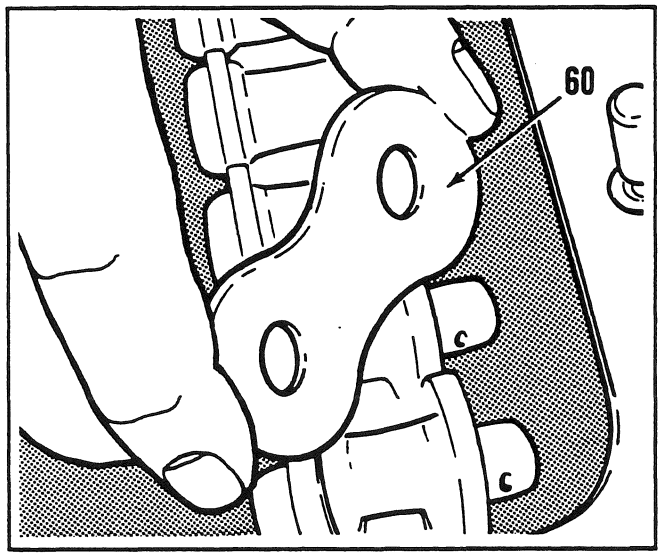


Fig. 10

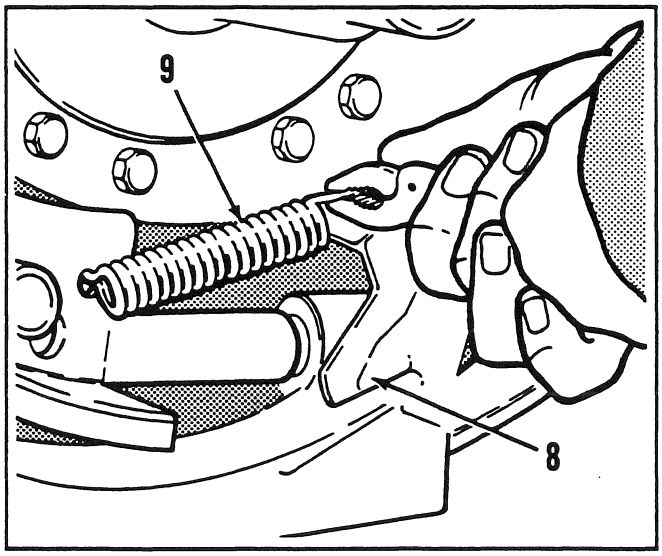


Fig. 13

Disassembly (continued)

Fig. 8
Remove the nuts (**56**) and lock washers (**55**) securing the cover plates and brake line shields. Remove the cover plates (**53**) and brake line shields (**54**) and discard the gasket (**Ref. Fig. 1**).

Fig. 9
Remove the countersunk capscrews (**65**) the side cover plate (**64**) and discard the gasket.(**Ref. Fig.1**)

NOTE

With the grader in neutral release the emergency brake and operate the moldboard to raise the opposite tandem. Turn off the engine and rotate the opposite side tires to turn the tandem chain connector links into position. When the links are accessible throught the inspection ports, start the engine and lower the opposite tandem to the ground. Apply the emergency brake.

Fig. 10
Remove the cotter pins (**Ref. Fig. 1**) and the connector link (**60**) from each chain.

Fig. 11
Using a safe lifting device remove the tandem chains (**58**) through the inspection ports.

NOTE

Although the brakes are left-hand and right-hand assemblies, the disassembly and reassembly procedures remain the same. If both left and right-hand assemblies are removed and disassembled at the same time, take care to keep left and right-hand components separate.

Fig. 12
Using a brake lever, remove the brake shoe return springs (**12**), the auto-adjuster cable (**10**) and the cable guide (**11**).

Fig. 13
Using pliers, remove the adjusting springs (**9**), and the auto-adjuster lever (**8**).

Disassembly (continued)

Fig. 14
Using pliers, push in and rotate the brake shoe hold-down spring cup (**14**) until the slot aligns with the flat end of the hold-down pin (**18**). After this is accomplished, the brake shoe hold-down cups (**14**), springs (**15**)(6 required to be loosened) and the brake shoes (**16,17**) should be removed.

NOTE

Examine the brake shoes for wear. A shoe must be replaced or relined if the rivet head is less than 1,5 mm or 1/16 of an inch below the lining surface.

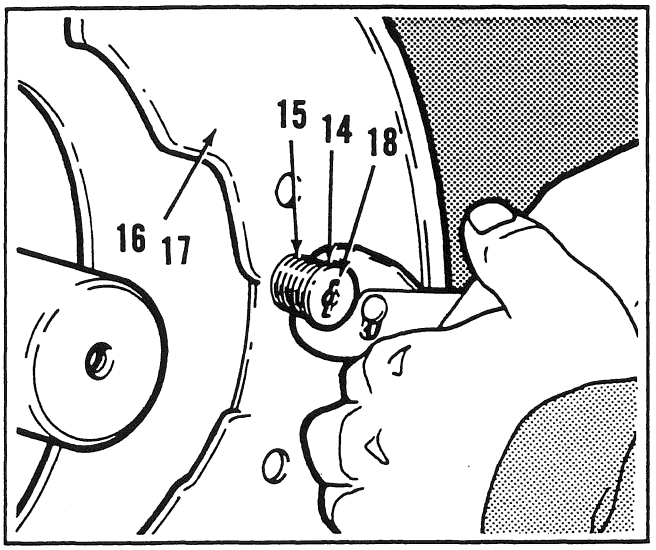
Fig. 15
Remove the hold-down pins (**18**).

Fig. 16
Disconnect the brake line from the wheel cylinder found between the backing plate (**21**) and the stub axle housing (**40**). Plug the brake line and wipe up any spilled fluid.

Fig. 17
Remove the capscrews (**36**) and lockwashers retaining the wheel cylinder (**Ref. Fig. 1**). Remove the wheel cylinder from the backing plate and remove the wheel cylinder links (**Ref. Fig. 1**).

Fig. 18
Disassemble the wheel cylinder on a clean workbench by first removing the metal strap (**25**).

Fig. 19
Remove the boot (**26**).



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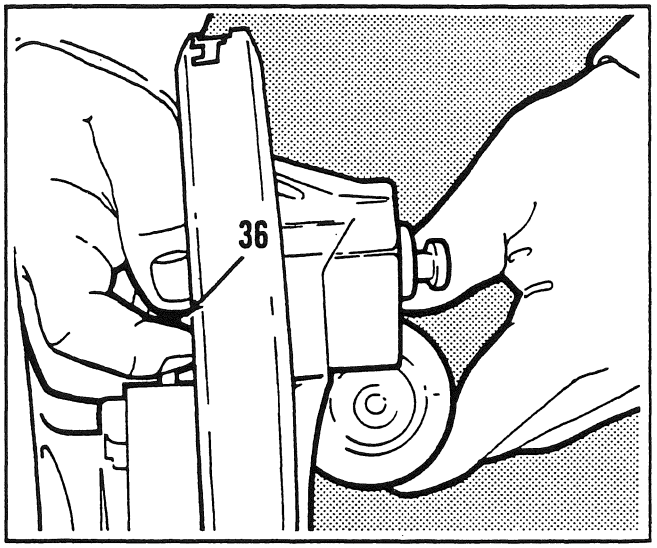

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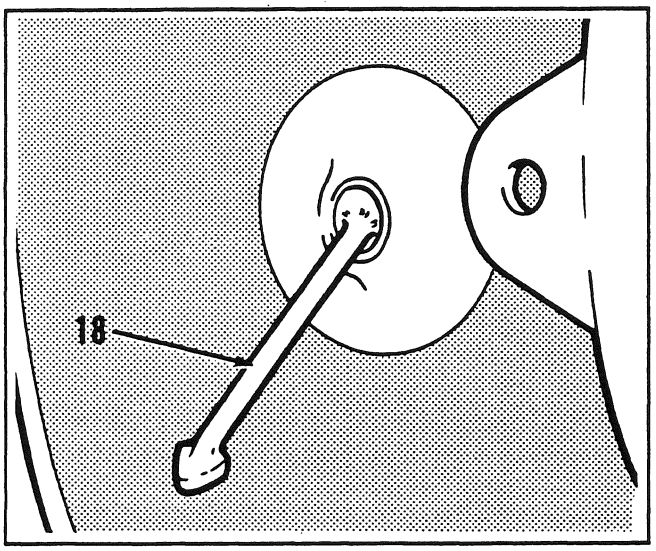

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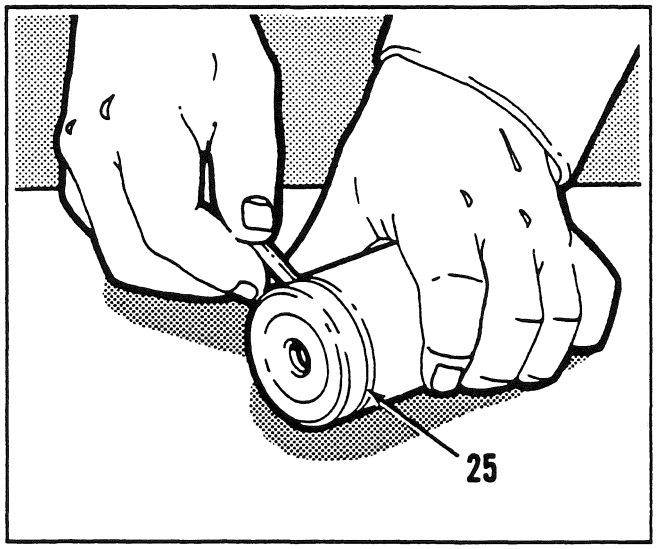

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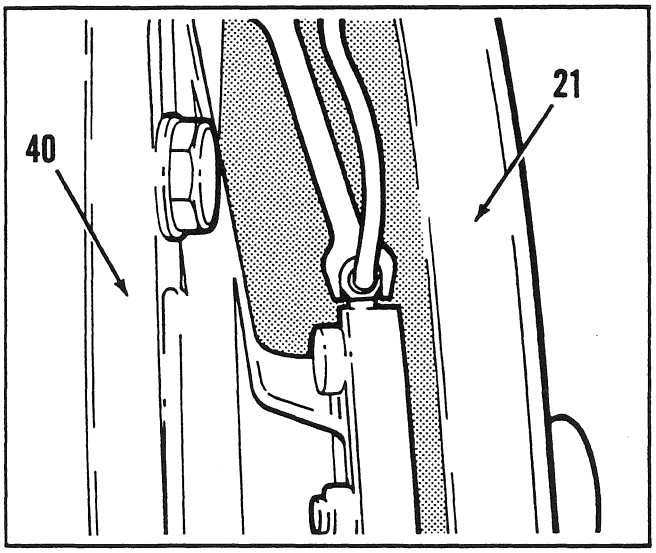

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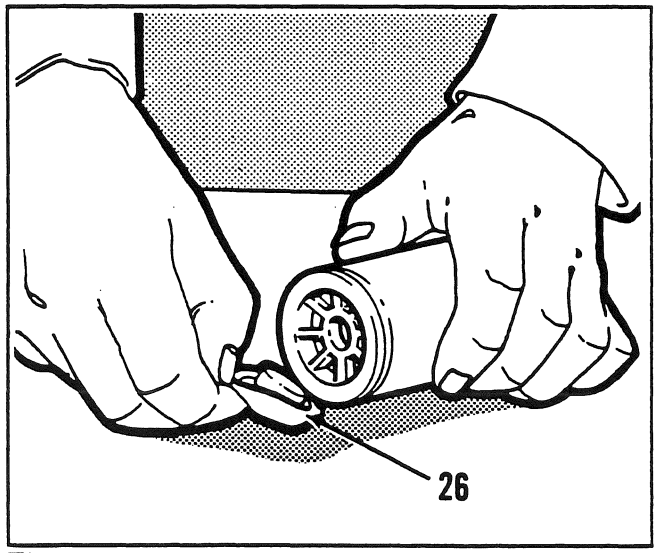

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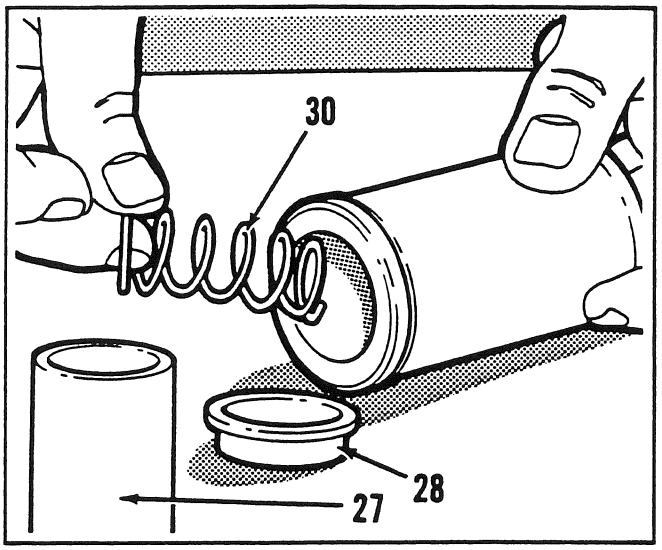

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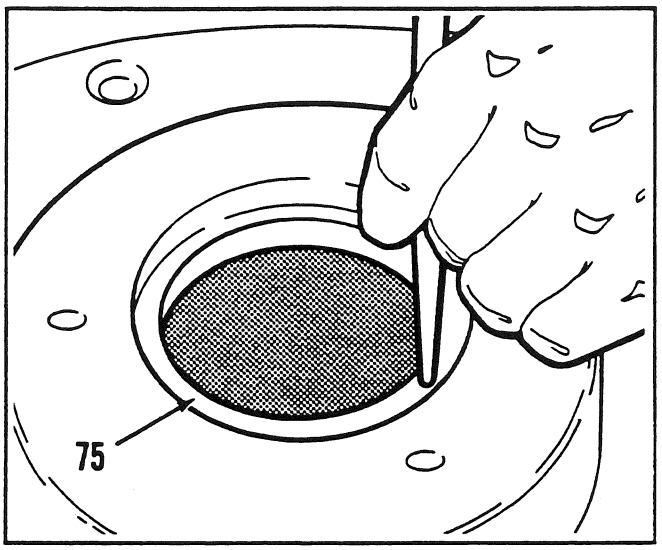

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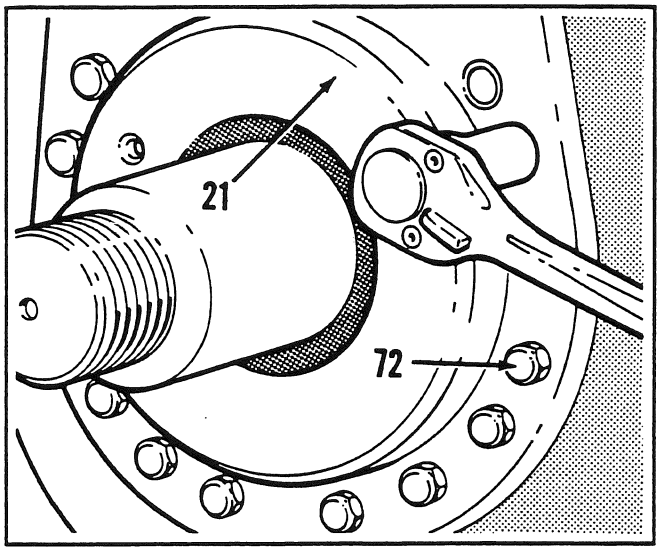

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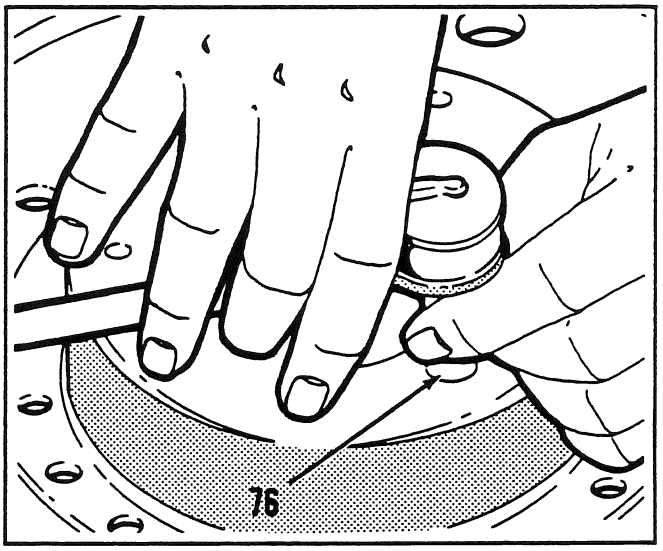

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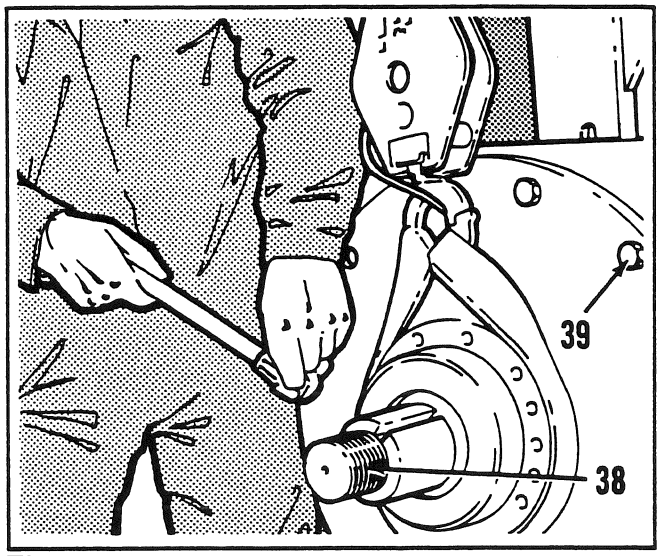

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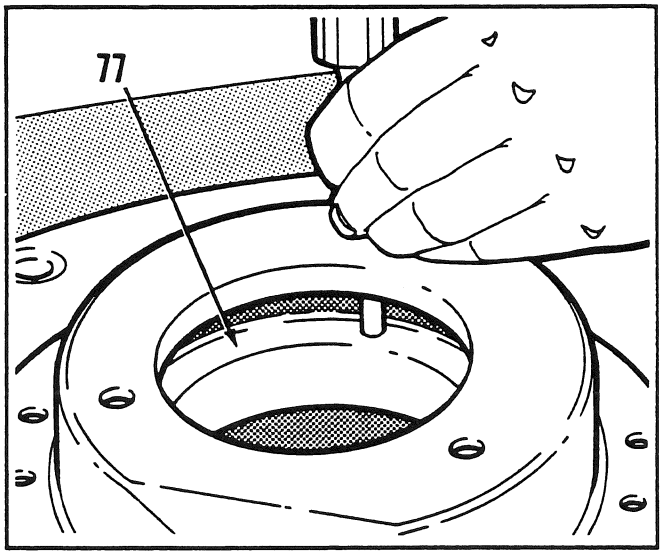


Fig. 25

Disassembly (continued)

Fig. 20
Remove the piston (**27**), piston cup (**28**) and return spring (**30**). Do the same procedure for the other end of the wheel cylinder using instructions from **Fig. 18** to **Fig. 20.**

NOTE

Inspect the boots, spring, piston cups and cylinder links for signs of damage and wear. Also inspect the wheel cylinder casting for scoring. If the scoring is too deep then the cylinder casting cannot be honed properly and should be replaced.

Fig. 21
Remove the capscrews (**72**) and the backing plate (**21**).

Fig. 22
Insert 2 wooden planks through the inspection port of the tandem to support the sprocket (**Ref. Fig. 1**) and stub axle (**38**). Secure a safe lifting device to the bearing housing (**40**) as illustrated and remove the bolts (**39**) retaining the housing. Lift the bearing housing away from the tandem.

Fig. 23
Using a suitable drift and a hammer remove the oil seal (**75**) from the bearing housing (**40**).

Fig. 24
Remove the three socket head set screws (**76**).

Fig. 25
Using a hammer and brass drift remove the bearing cup (**77**).

Disassembly (continued)

Fig. 26
Secure a safe lifting device to the stub axle assembly. Remove the two planks of wood supporting the sprocket and the stub axle (**Ref. Fig. 1**) and lift the stub axle out of the tandem. Use a split-type bearing puller to remove both bearing cones (**Ref. Fig. 1**).

Fig. 27
Remove the nuts (**80**) and bolts (**74**) retaining the sprocket (**73**) to the stub axle (**38**).

Fig. 28
Stand the stub axle (**38**) upright and lift off the sprocket (**73**).

Fig. 29
Remove the capscrews (**48**), washers (**49**) and the bearing cap (**47**) from the bearing flange (**45**).

Fig. 30
Remove the shims (**46**) from the bear-cap (**47**).

Fig. 31
Remove the two socket head capscrews (**50**) retaining the bearing flange (**45**) to the tandem case. Use a hammer and brass drift to remove the assembly.

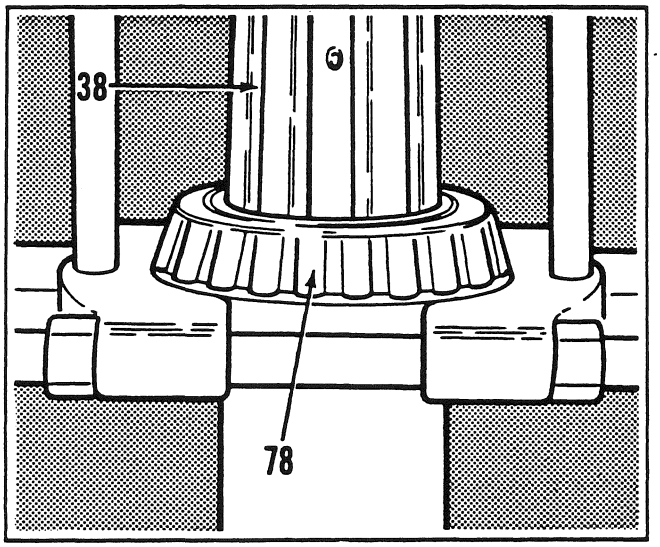


Fig. 26

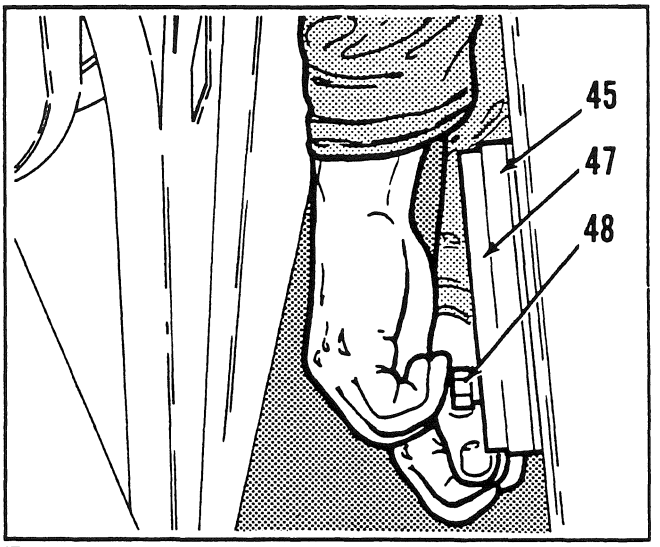


Fig. 29

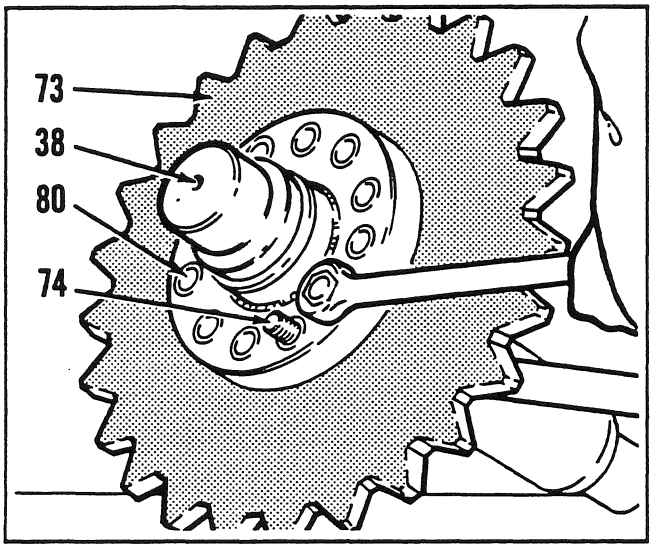
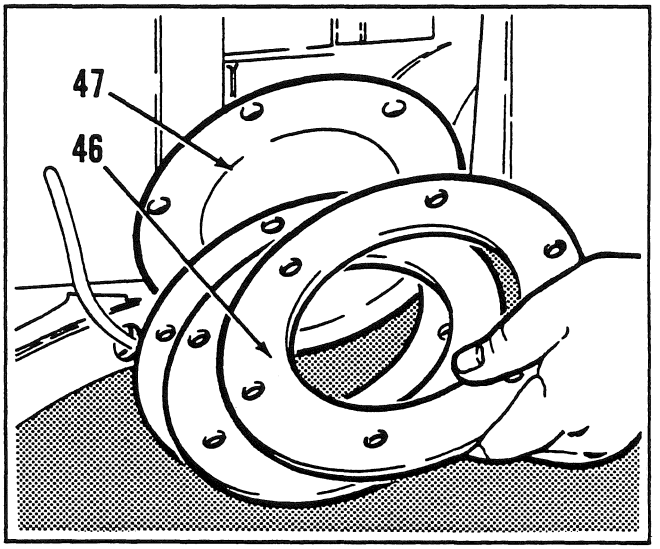


Fig. 27



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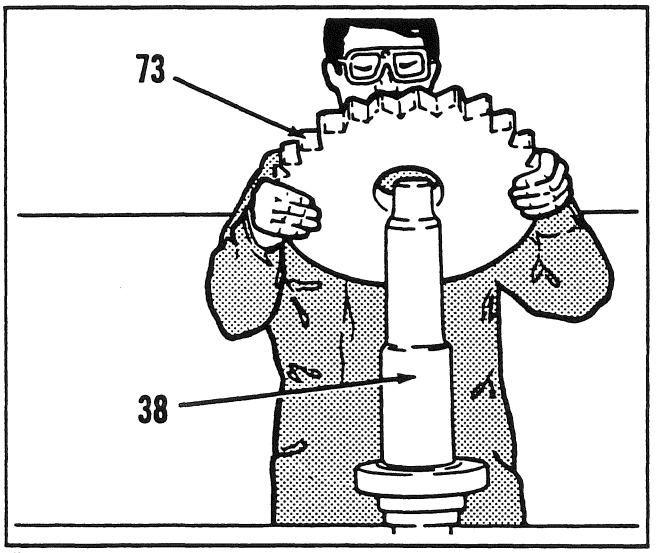

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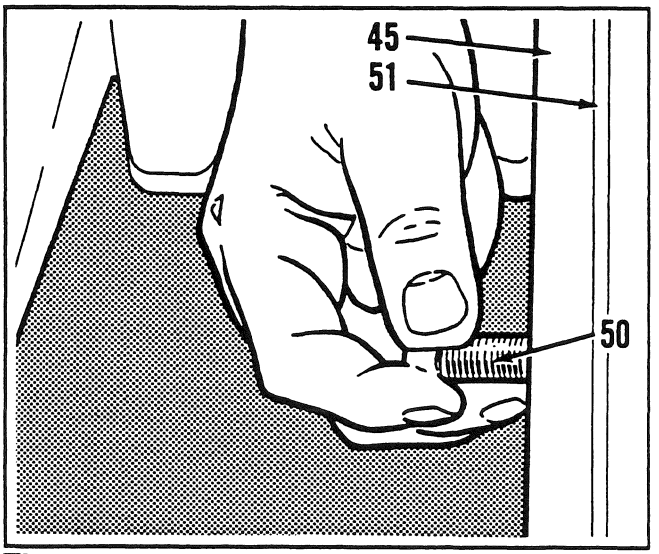
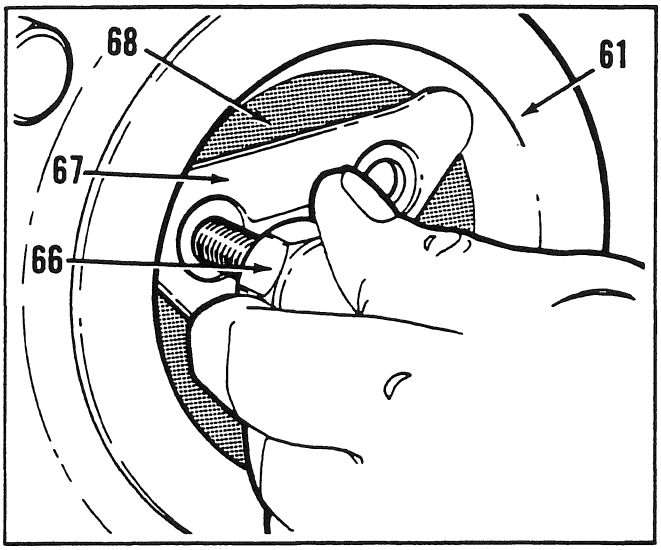


Fig. 31



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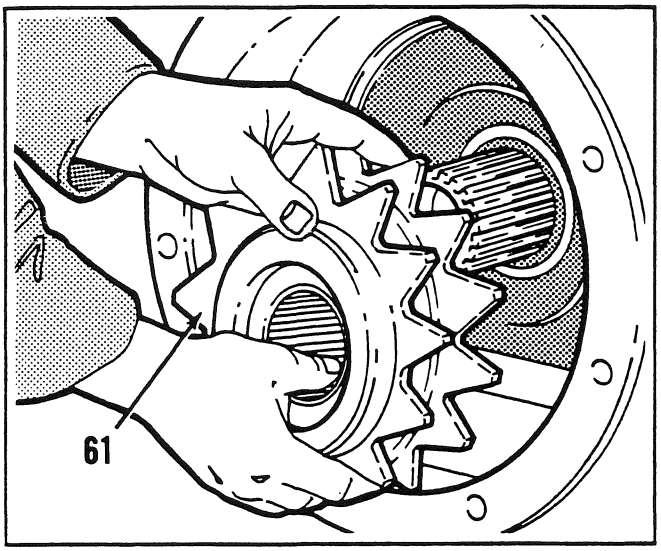


Fig. 33

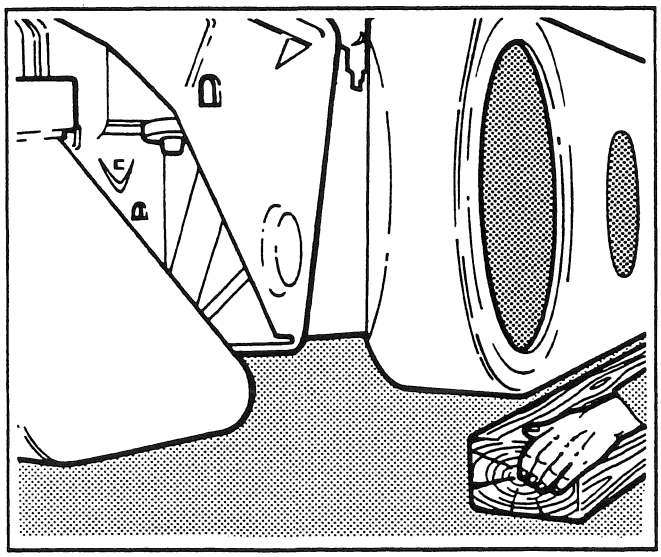


Fig. 34

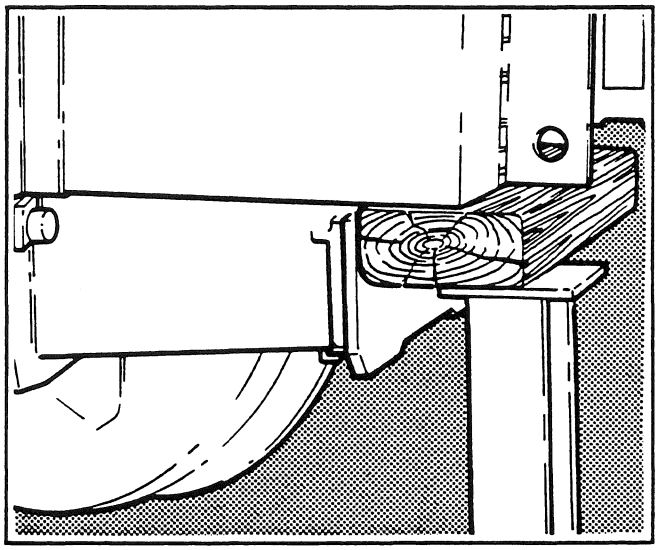


Fig. 35

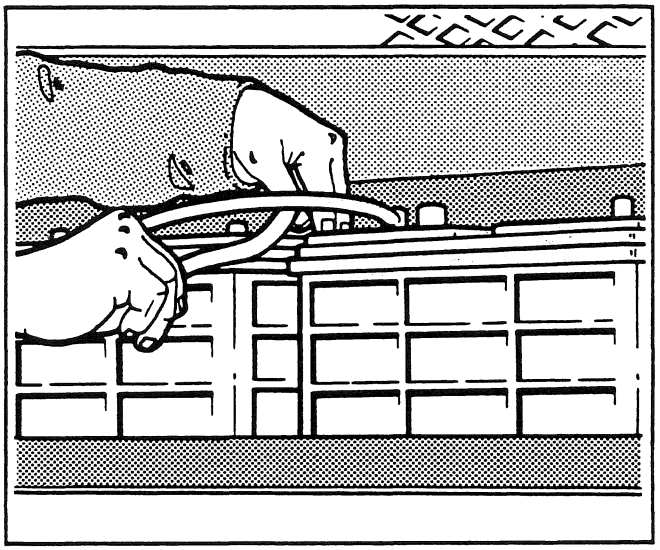


Fig. 36

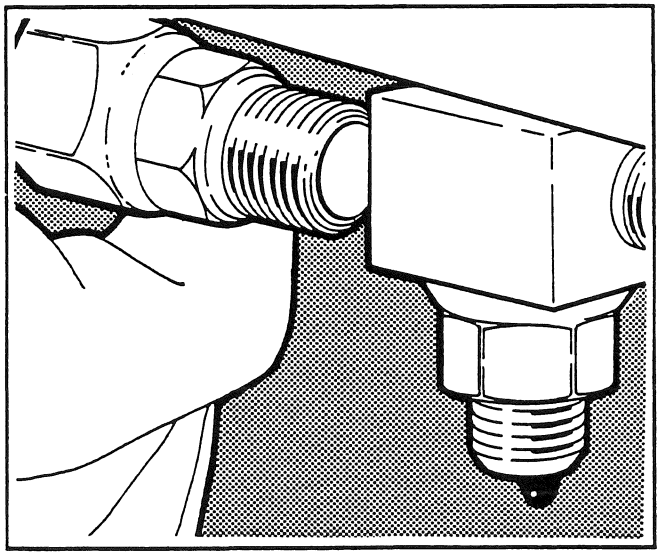


Fig. 37

Disassembly (continued)

Fig. 32
Using a hammer and a drift bend back the three tabs locking the bolts (**66**) securing the drive sprocket (**61**). Remove the bolts, tabwasher (**67**) and the retaining plate (**68**). Discard the tabwasher.

Fig. 33
Remove the drive sprocket (**61**).

Fig. 34
Before removing the tandem, start the engine, release the emergency brake, and lower the moldboard to raise the tandem. Remove the blocks.

Fig. 35
Place safe, adequate stands under the rear frame and lower the grader onto the stands. Shut off the engine and apply the emergency brake.

Fig. 36
When working on the tandem carrying the batteries, remove the battery box cover, disconnect the battery cables and remove the batteries with the battery box.

Fig. 37
Disconnect the brake line at the tee fitting located under the frame near the final drive hanger brackets.

Disassembly (continued)

Fig. 38
Inspect all hydraulic tubes and hoses for leakage and corrosion. Check anchorage points are secure.

Fig. 39
Using a safe lifting device to support the weight of the tandem.

Fig. 40
Remove the capscrews retaining the final drive sleeve to the tandem and lift the tandem away from the drive sleeve.

NOTE

Clean and inspect all bearings for signs of cracking or over heating. Check the sprockets for abnormal tooth wear. Remove and clean the deep reach magnetic plugs from the tandem. Replace any damaged or worn components. Also remove all old gasket eliminator with "liquid chisel" from all tandem openings.

Fig. 41
While the tandem is removed, inspect the seal on the flange sleeve of the final drive. Replace the seal if damage is evident.

Reassembly

Fig. 42
Begin reassembly by applying gasket eliminator, Champion part number **25303** or 'Loctite' 515 to the final drive mounting face. Use a safe lifting device to position the tandem onto the final drive.

Fig. 43
Install special nyloc capscrews retaining the tandem to the final drive flange sleeve. Tighten the bolts uniformly in a diagonal sequence to the specified torque. Perform monthly maintenance checks on these bolts.

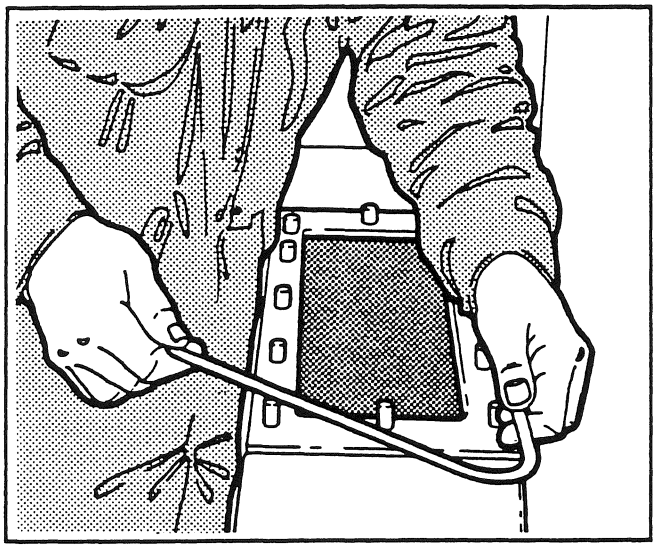


Fig. 38

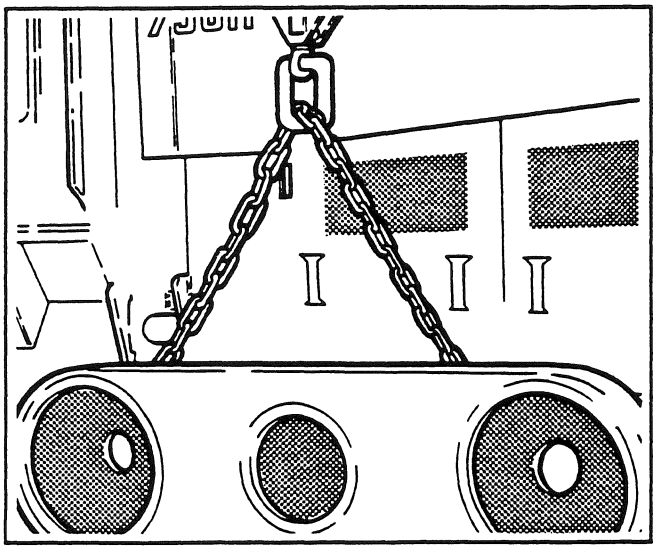


Fig. 39

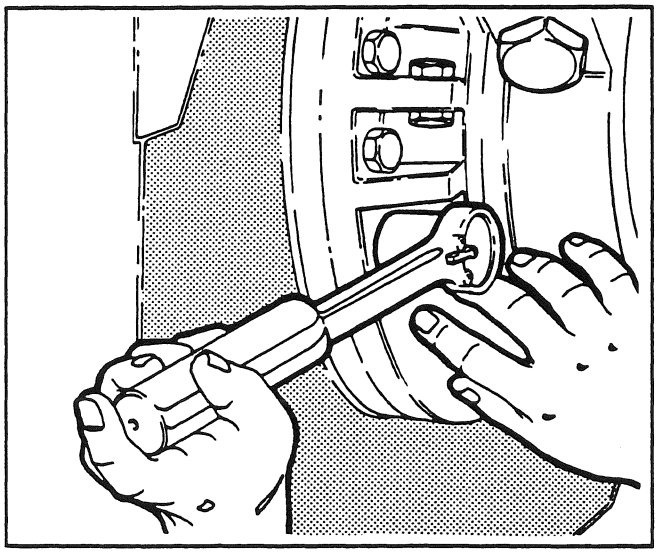


Fig. 40

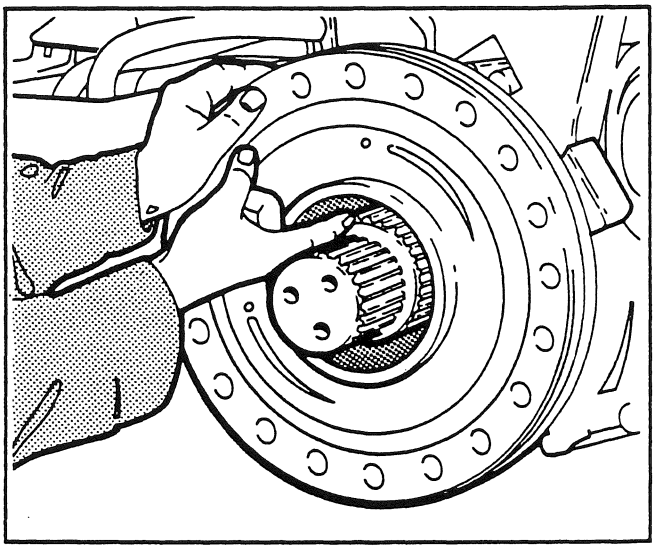
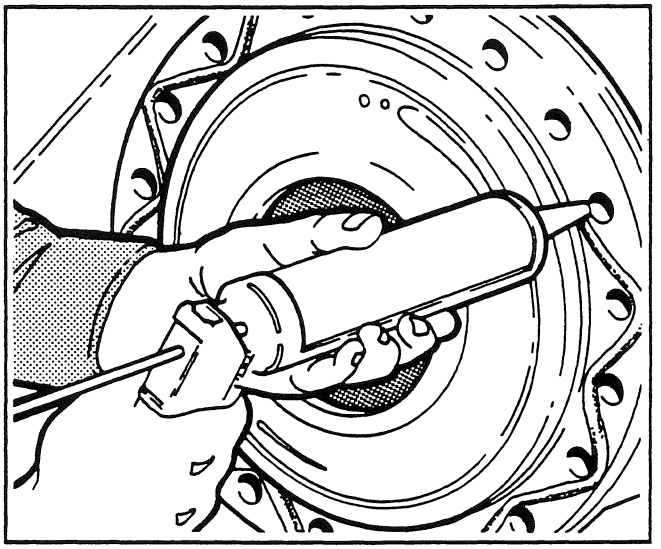


Fig. 41



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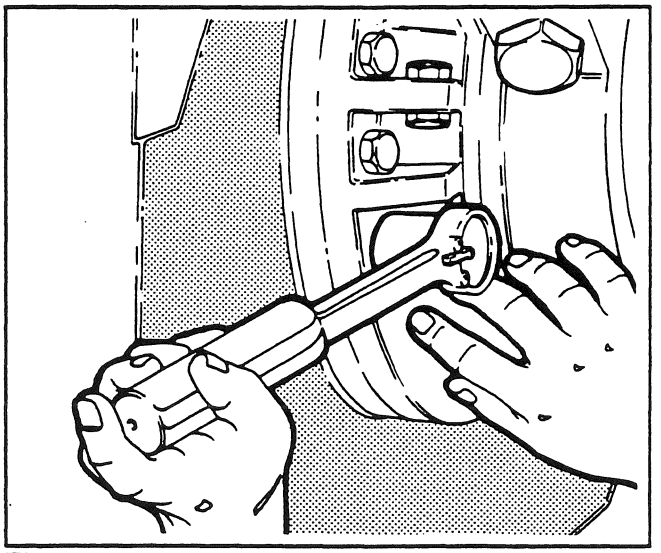

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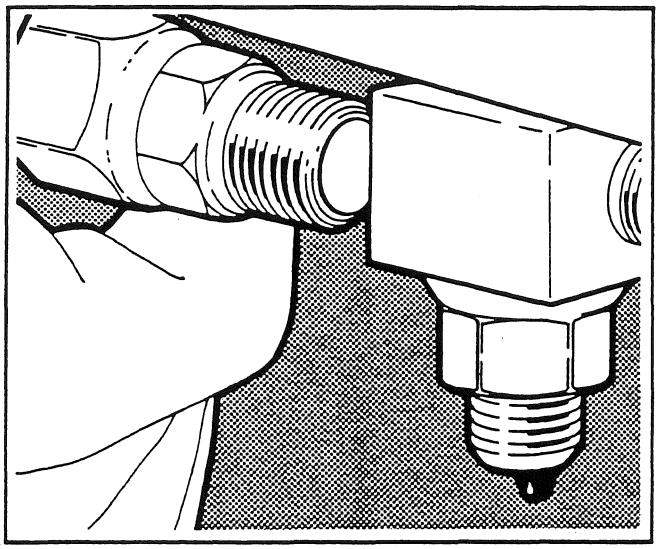

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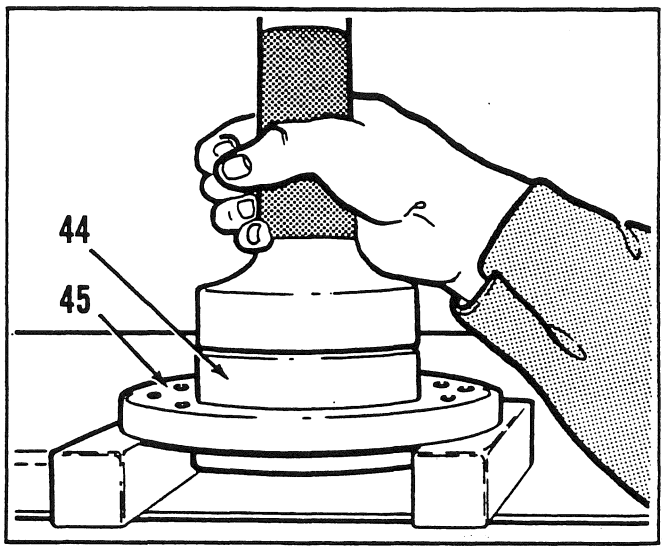

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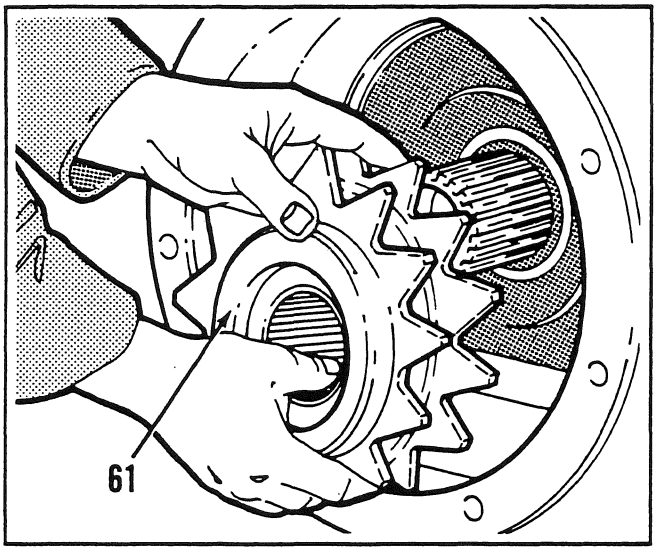

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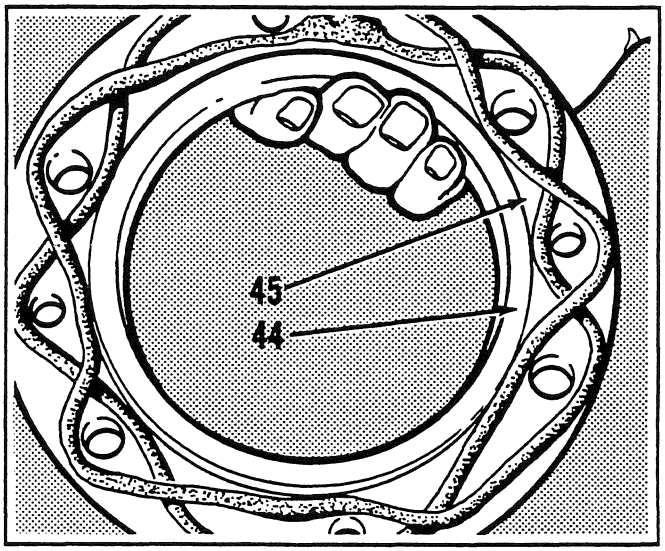

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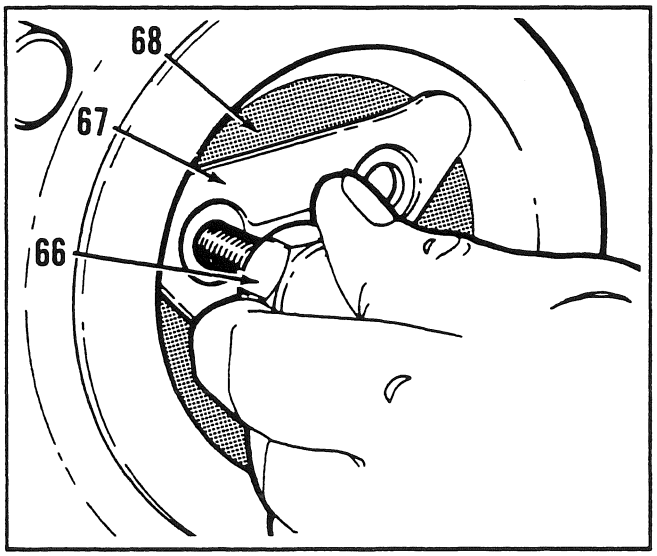

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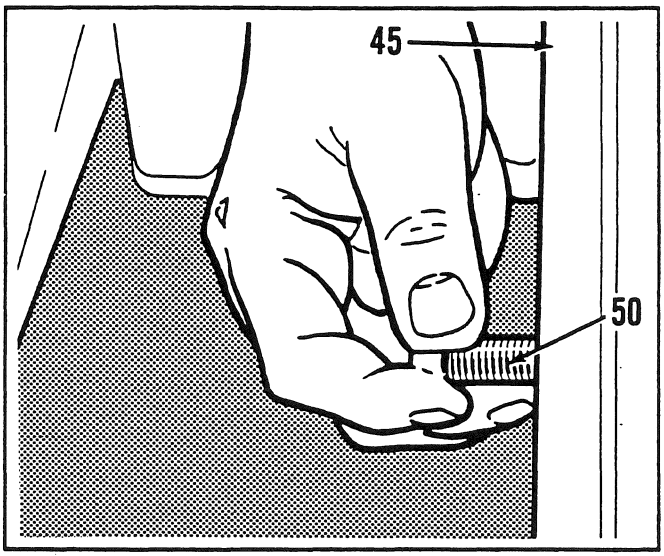


Fig. 49

Reassembly (continued)

Fig. 44
Reconnect the brake line to the tee fitting located under the machine on the frame near the final drive hangers.

Fig. 45
Install the drive sprocket (**61**) onto the drive axle.

Fig. 46
Install the retaining plate (**68**) a new tabwasher (**67**) and the capscrews (**66**).

Fig. 47
Using a press, install the bearing cup (**44**) into the bearing flange (**45**).

Fig. 48
Install a new gasket or use gasket eliminator Champion part number **25303** or 'Loctite' 515 on the bearing flange (**45**) and cup (**44**) assembly and install the assembly.

Fig. 49
Install the socket head capscrews (**50**) that retain the bearing flange (**45**) to the tandem. Tighten these capscrews.

Reassembly (continued)

Fig. 50
Install the bearing cap (**47**), the bolts (**48**), washers (**49**) and tighten them to finger tightness.

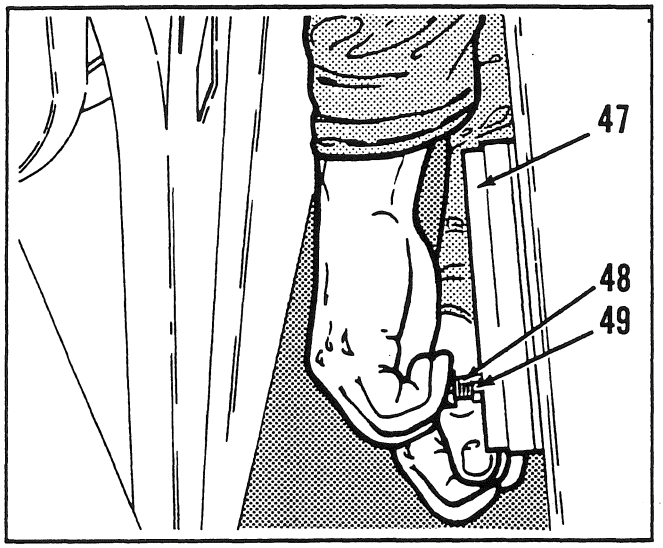
Fig. 51
Stand the stub axle (**38**) upright and install the sprocket (**73**) making sure the beveled surfaces unite. Install the nuts (**74**) and bolts (**Ref. Fig. 1**) and tighten them to the specified torque.

Fig. 52
Heat both bearing cones evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. Install them on the stub axle shaft and lubricate them with tandem oil.

Fig. 53
Apply grease to the bearing cup of the bearing flange. Using a safe lifting device, install the stub axle and retain it with two wooden planks.

Fig. 54
Install the bearing cup in the bearing housing and turn the housing over to insert three socket head capscrews.

Fig. 55
Apply silicone or gasket eliminator to the housing opening. Using a safe lifting device install the bearing housing with the V-notch at the top of the housing. Install the capscrews and remove the wooden planks. Tighten the capscrews in a diagonal sequence to the specified torque.



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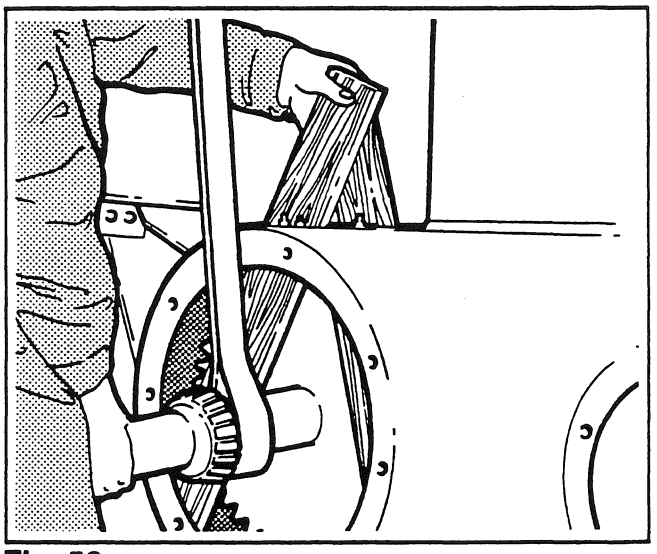
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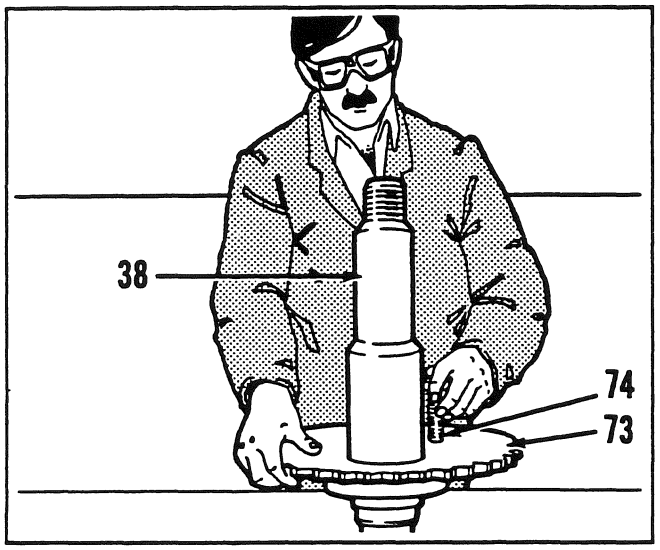

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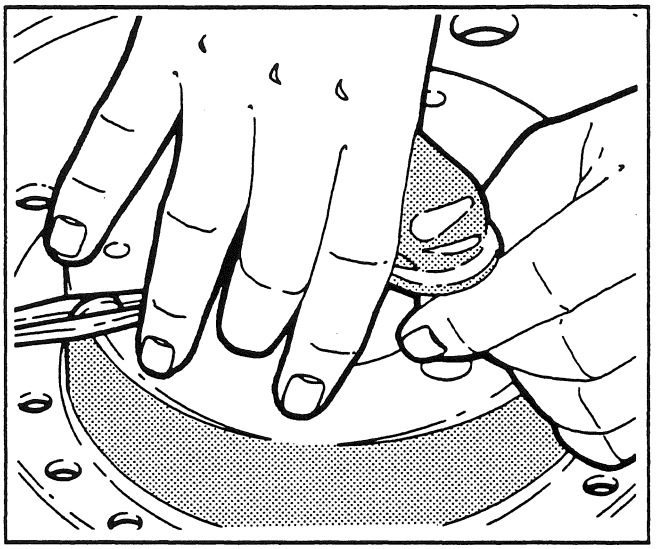
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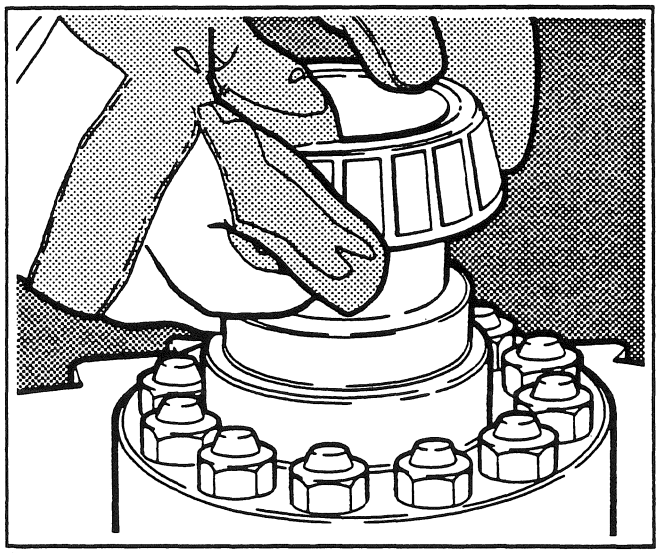
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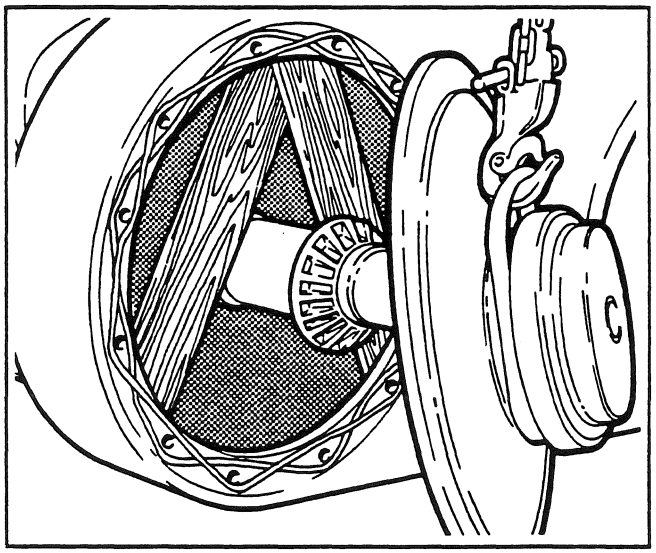
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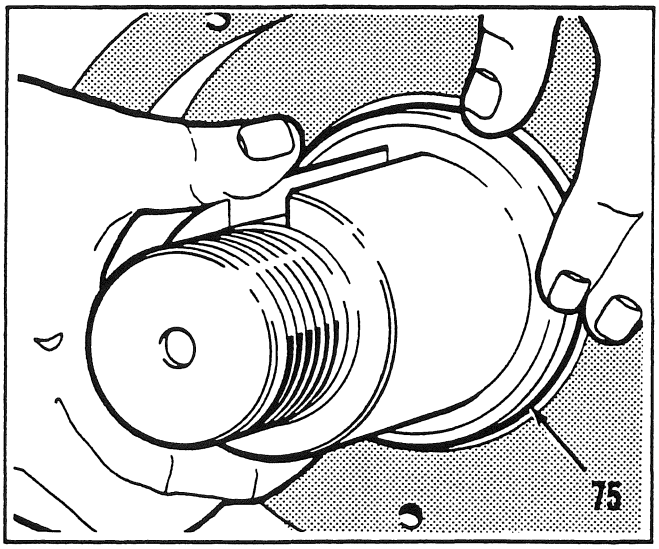

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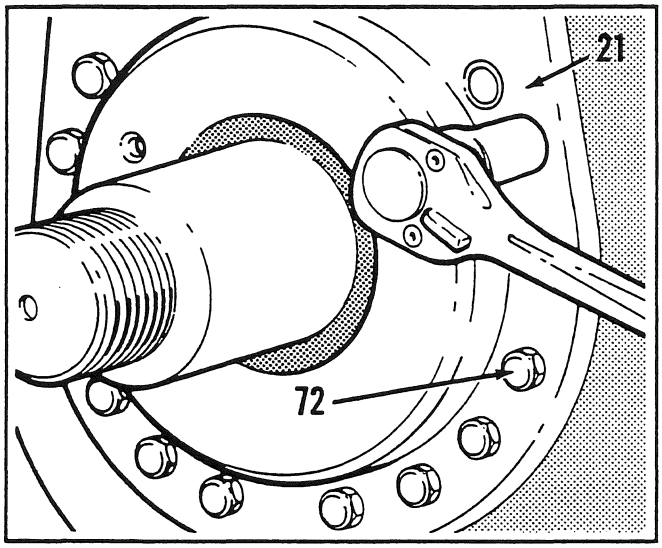

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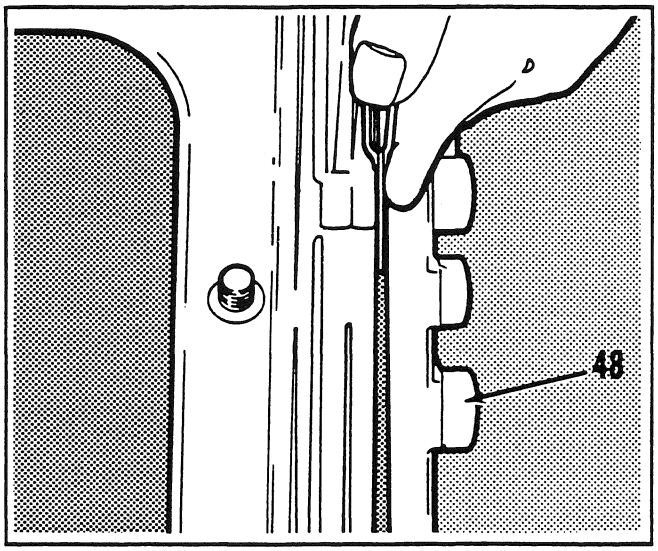

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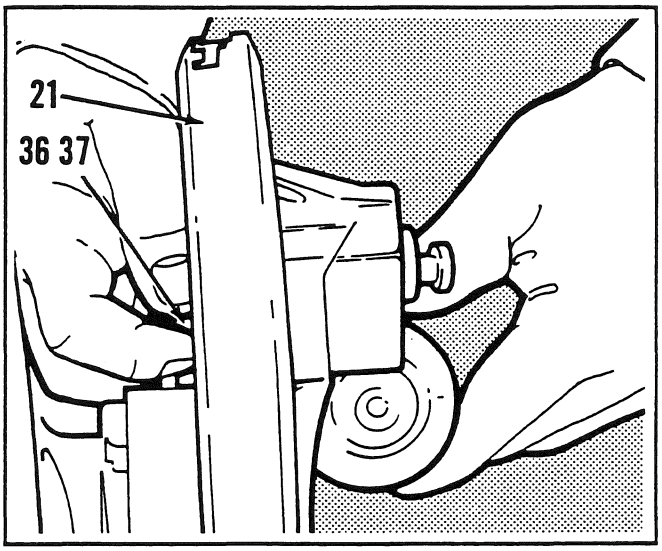

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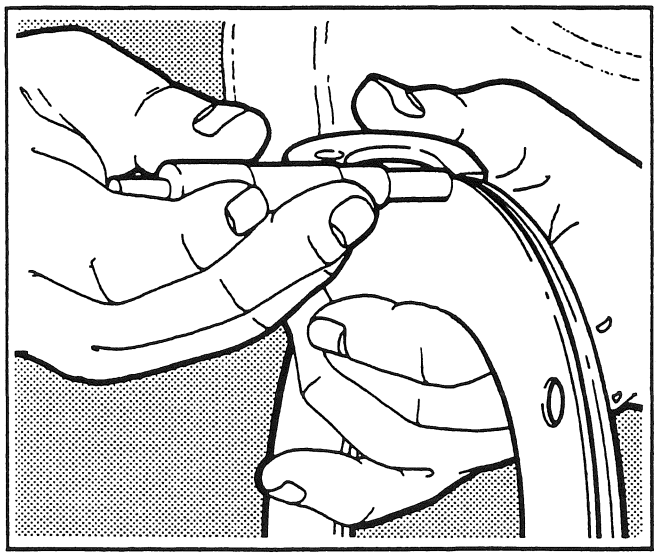

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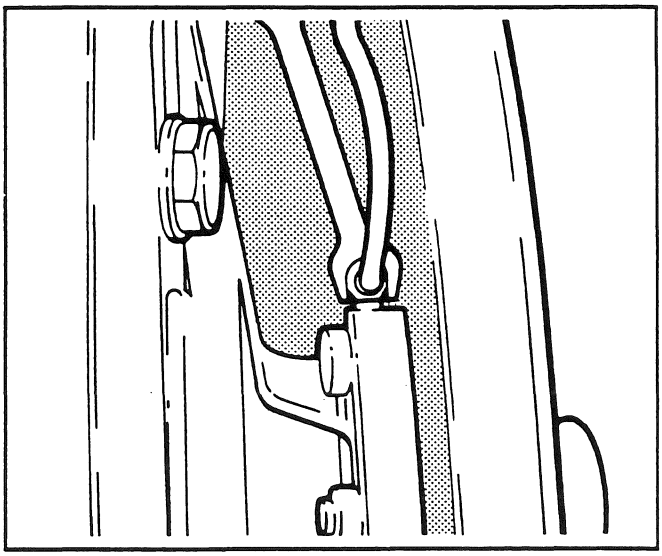


Fig. 61

Reassembly (continued)

Fig. 56
Lubricate and install a new stub axle seal (**75**).

Fig. 57
To set bearing pre-load, tighten the bearing cap capscrews (**48**) until a slight drag occurs when turning the large sprocket seen through the inspection port.
Using a feeler gauge, measure the gap between the bearing cap (**47**) and bearing flange (**45**).

Fig. 58
Using the measuement from Fig. 57, assemble a new shim pack (**46**) and install the bearing cap. Install the capscrews and tighten them to the specified torque. Check the rolling torque by rotating the large sprocket seen through the inspection port. The axle should rotate with a moderate pull. Add or remove shims as required.

Fig. 59
Install the backing plate (**21**) to the bearing housing (**Ref. Fig. 1**).
Install the capscrews (**72**) and tighten them to the specified torque.

Fig. 60
Lubricate all brake wheel cylinder parts with clean fresh brake fluid. Reassemble and mount the wheel cylinder (**Ref. Fig. 1**) to the backing plate (**21**) with capscrews (**36**) and lockwashers (**37**).

Fig. 61
Reconnect the brake line to the wheel cylinder (**Ref. Fig. 1**).

Reassembly (continued)

Fig. 62
Install the hold-down pins (**18**).

Fig. 63
Apply white grease onto the backing plate around the hold-down pins in six places. This will prevent damage to the backing plate.

Fig. 64
Intall the brake shoes (**Ref. Fig. 1**) hold-down springs (**15**) and cups (**14**).

Fig. 65
Install the auto-adjuster lever (**8**) and adjusting screw spring (**9**).

Fig. 66
Install the auto-adjuster cable (**10**), cable guide (**11**) and both brake shoe return springs (**12**).

Fig. 67
Install the key (**70**) on the stub axle (**38**) and align the roll pin in the slot (**Ref. Fig. 1**).

NOTE

Repeat the preceding procedures for the assembly of the other brakes and stub axle assemblies.

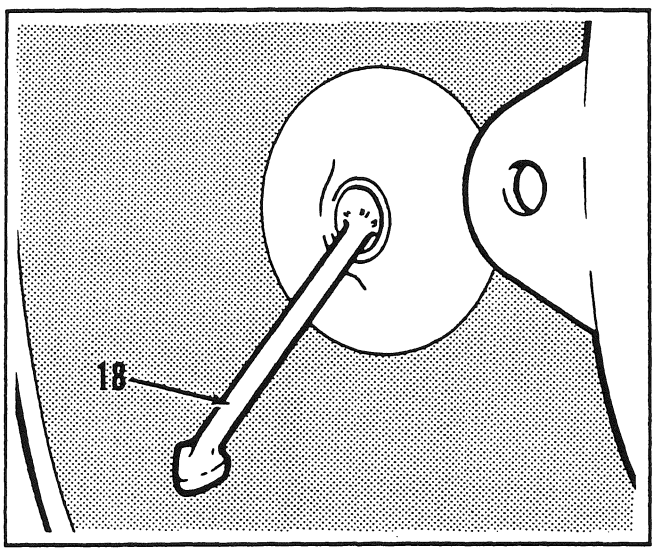
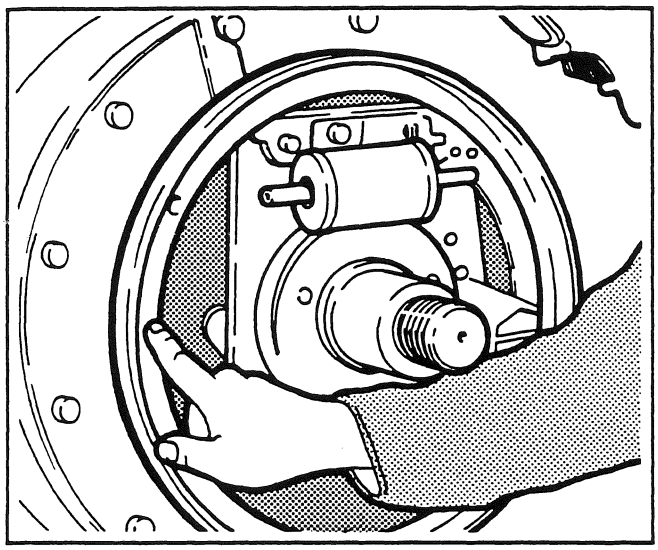


Fig. 62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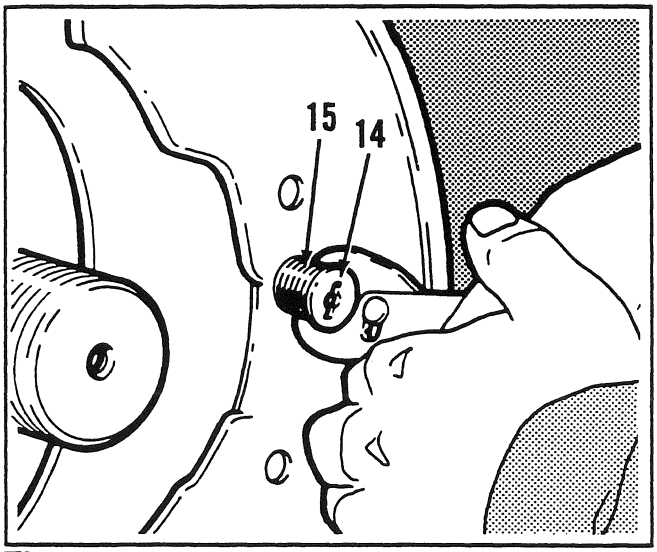

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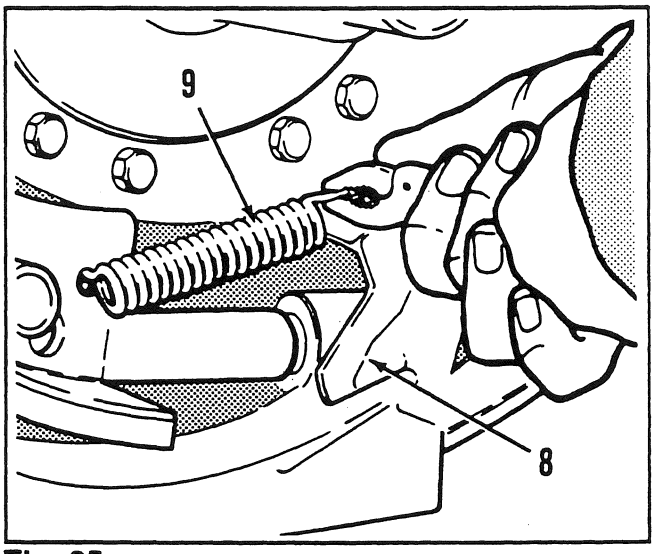

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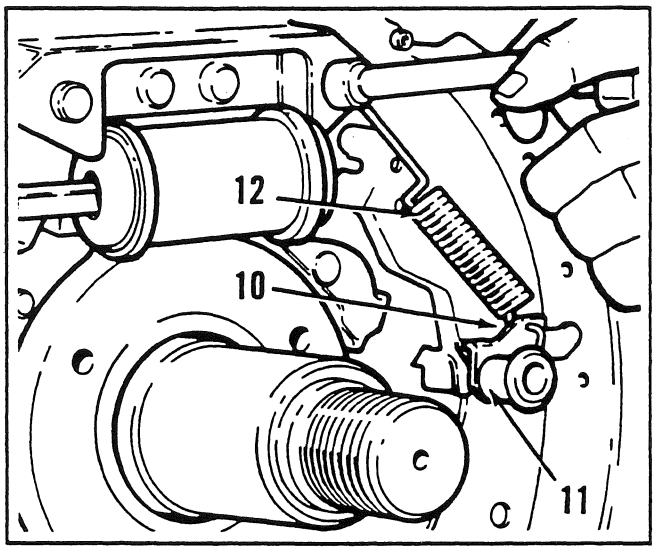

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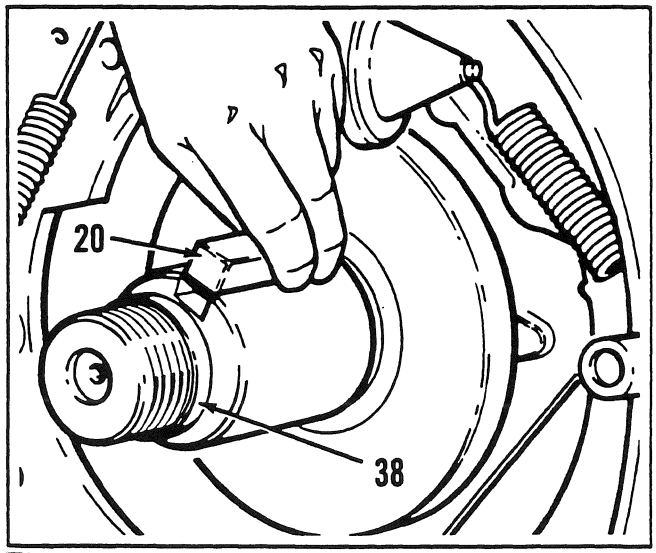

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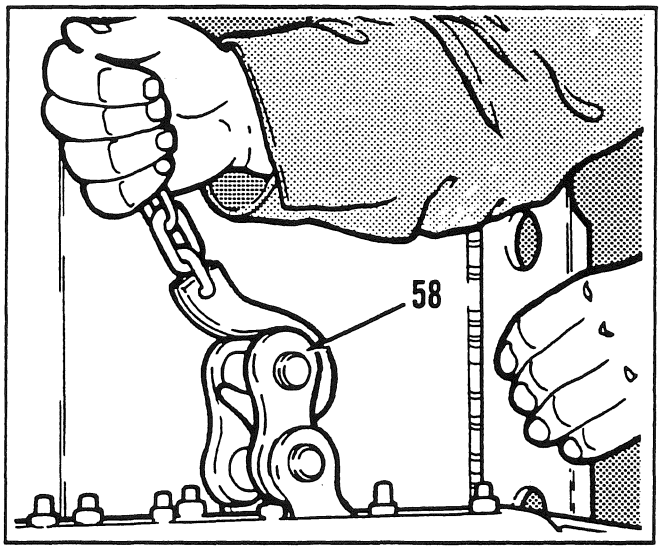

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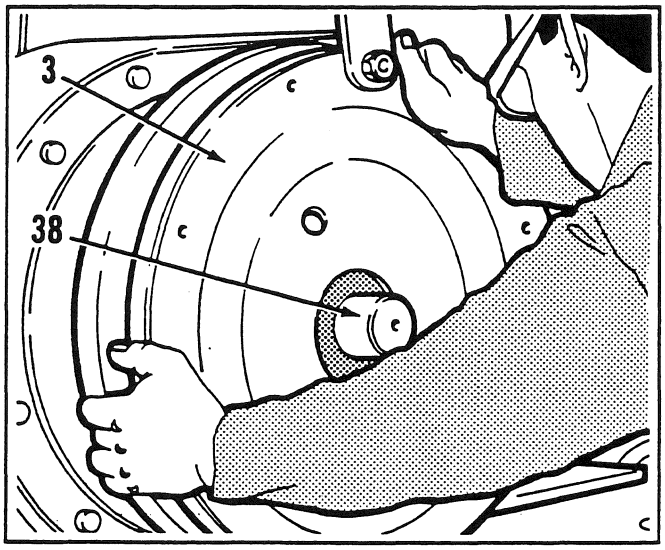

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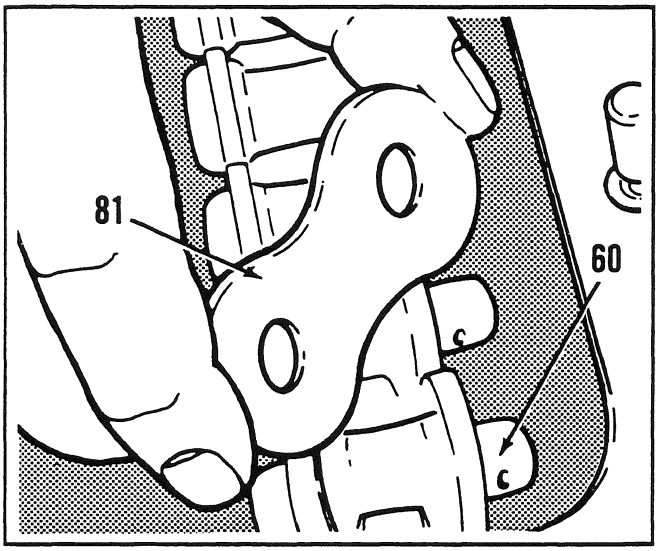

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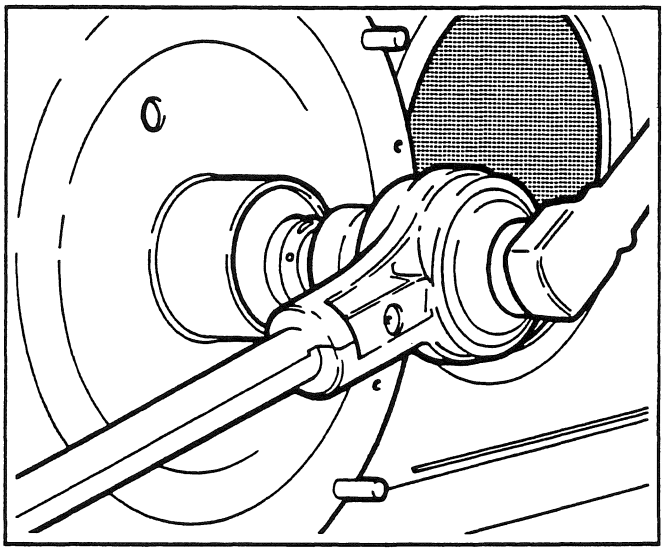

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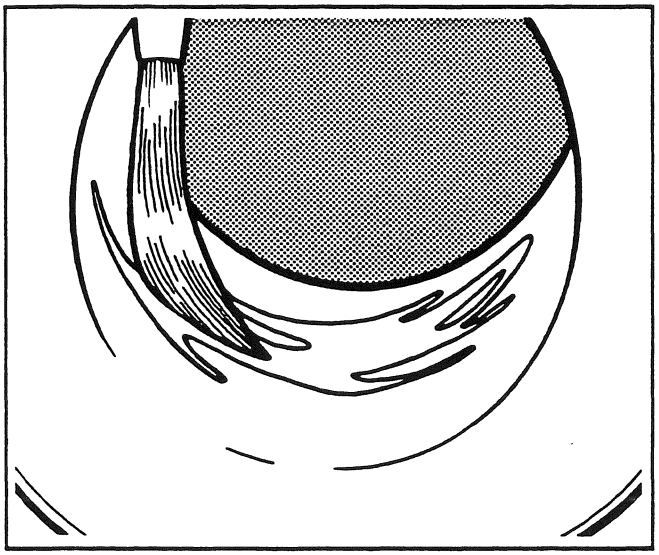

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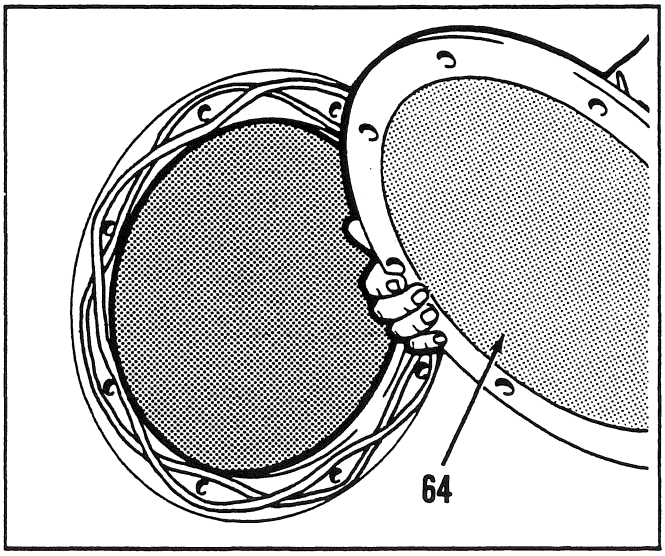


Fig. 73

Reassembly (continued)

Fig. 68
Using a safe lifting device, install lhe tandem chains (**58**) through the inspection ports.

NOTE

The pins of the connecting link and the holes of the side bar provide an interference fit. DO NOT under any circumstances, grind the pins or enlarge the holes.

Fig. 69
Connect the chains (**58**) using a lever and install both halves of the connector links (**60,81**) using new cotter pins (**Ref. Fig. 1**).

Fig. 70
Apply anti-seize compound to the stub axle opening of the wheel housing (**Ref. Fig. 1**).

Fig. 71
Using a safe lifting device, maneuver and install the wheel housing (**3**) and align the key (**Ref. Fig. 1**) of the stub axle (**38**) to the key slot in the wheel housing.

Fig. 72
Install the flat washer (**Ref. Fig.1**) and stub axle nut (**Ref. Fig. 1**) and tighten the nut to the specified torque.

Fig. 73
Apply silicone to the side cover openings of the tandems. Install the cover plate (**64**) with a new gasket (**63**) and retain the plate with eight countersunk head capscrews.
(**Ref. Fig. 1**)

NOTE

Install the tandem plugs and fill the tandems to the level check plug with new tandem oil through the inspection ports. The oil should be changed once a year or every 2000 hours.

Reassembly (continued)

Fig. 74
Apply a gasket sealant to the inspection port openings and install new gaskets (**Ref. Fig. 1**), inspection covers (**53**) and the brake line shields (**54**). Retain the covers and shields with lockwashers (**55**) and nuts (**56**). Tighten to the specified torque.

Adjusting the Brakes

Fig. 75
To adjust the brakes you must remove the rear spring clip cover and rubber plug (**Ref. Fig. 1**). Using an adjusting wrench (**special tool no. 377**) inserted in the lower slot, rotate the star wheel clockwise until the brake shoes contact the brake drum surface. Insert a suitable L-shaped bent rod [3/8 in.(9,5 mm) Dia. x 3 in. (7,6 mm) x 8 in.(20,0 mm) long] into the hole above the slot, depress the auto-adjuster lever until it releases from the star wheel. Using the adjusting wrench, rotate the star wheel counterclockwise **FOUR TEETH ONLY.** Remove both tools and replace the spring clip cover and rubber plug.

Fig. 76
Maneuver the tire and rim onto the wheel and place the rim clamps on the wheel studs and retain them with nuts. Tighten the nuts to the specified torque, in a diagonal sequence. Repeat these procedures for the other wheels.

Bleeding the Brakes

NOTE

The bleeding operation must be performed after the brakes have been adjusted.

Remove the filler cap from the master cylinder. Check the level of fluid and add fresh brake fluid if necessary.

NOTE

For graders equipped with a dual brake system, release the spring clip retaining the reservoir cap. Remove the cap. Replace the cap and secure it with the clip when bleeding of the brakes is completed.

Starting at the rear left-hand brake and connect a clean rubber tube to the bleeder screw and immerse the other end of the tube in a transparent container of clean, air bubble free brake fluid. Depress the brake pedal several times until minimized travel is obtained and maintain the pressure on the pedal. Release the bleeder screw with the tube connected and observe the air bubbles being released into the container. When the bubbles stop emitting into the container, tighten the bleeder screw.

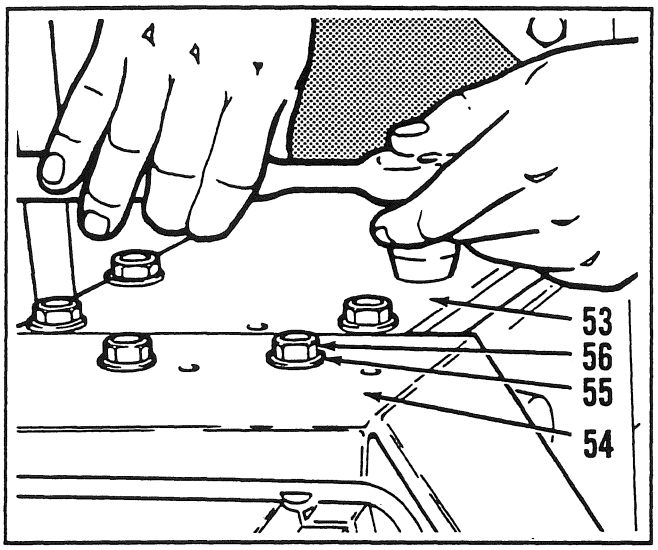


Fig. 74

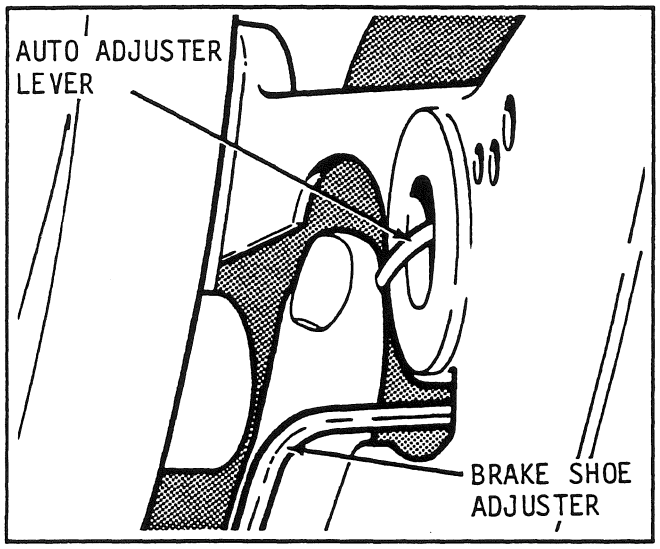


Fig. 75

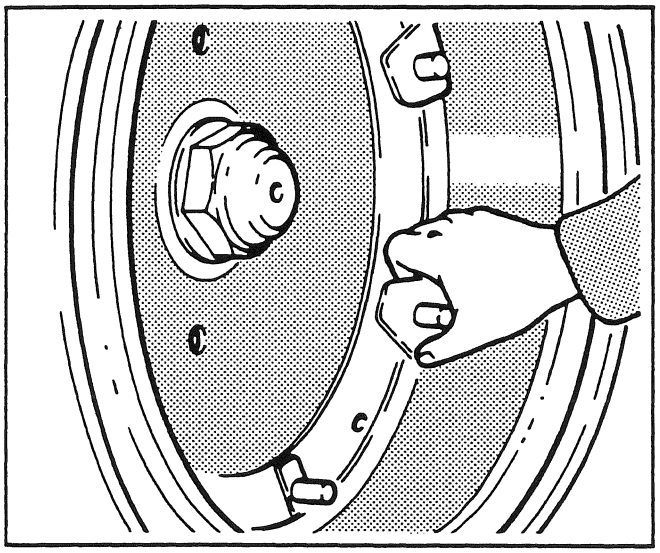


Fig. 76

Bleeding the Brakes (continued)

NOTE

It maybe necessary to repeat the procedures of depressing the brake pedal and releasing the brake screw several times before all the air is removed from the brake line system.

Refill the master brake cylinder to the required level with fresh brake fluid.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD THE BRAKE FLUID CONTAINER BE SHAKEN TO REMOVE TRAPPED AIR BUBBLES. IF AIR BUBBLES REMAIN, ALLOW THE FLUID TO STAND UNTIL ALL OF THE AIR HAS DISSIPATED.

Repeat the preceding instructions for bleeding the brakes in the following sequence. Front left-hand, front right-hand and the rear right-hand brake. When you have completed the bleeding procedure, replace the filler cap on the master cylinder.

Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the rear end of the machine. Remove the supports. Raise the moldboard to lower the rear of the machine onto its wheels.

Road test the grader and check hydraulic brake hoses for leaks.

Bleeding the Brakes (continued)

NOTE

It maybe necessary to repeat the procedures of depressing the brake pedal and releasing the brake screw several times before all the air is removed from the brake line system.

Refill the master brake cylinder to the required fluid level with fresh brake fluid.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD THE BRAKE FLUID CONTAINER BE SHAKEN TO REMOVE TRAPPED AIR BUBBLES. IF AIR BUBBLES REMAIN, ALLOW THE FLUID TO STAND UNTIL ALL OF THE AIR HAS DISSIPATED.

Repeat the preceding instructions for bleeding the brakes in the following sequence. Front left-hand, front right-hand and the rear right-hand brake.

When you have completed the bleeding procedure, replace the filler cap on the master cylinder.

Fig. 76

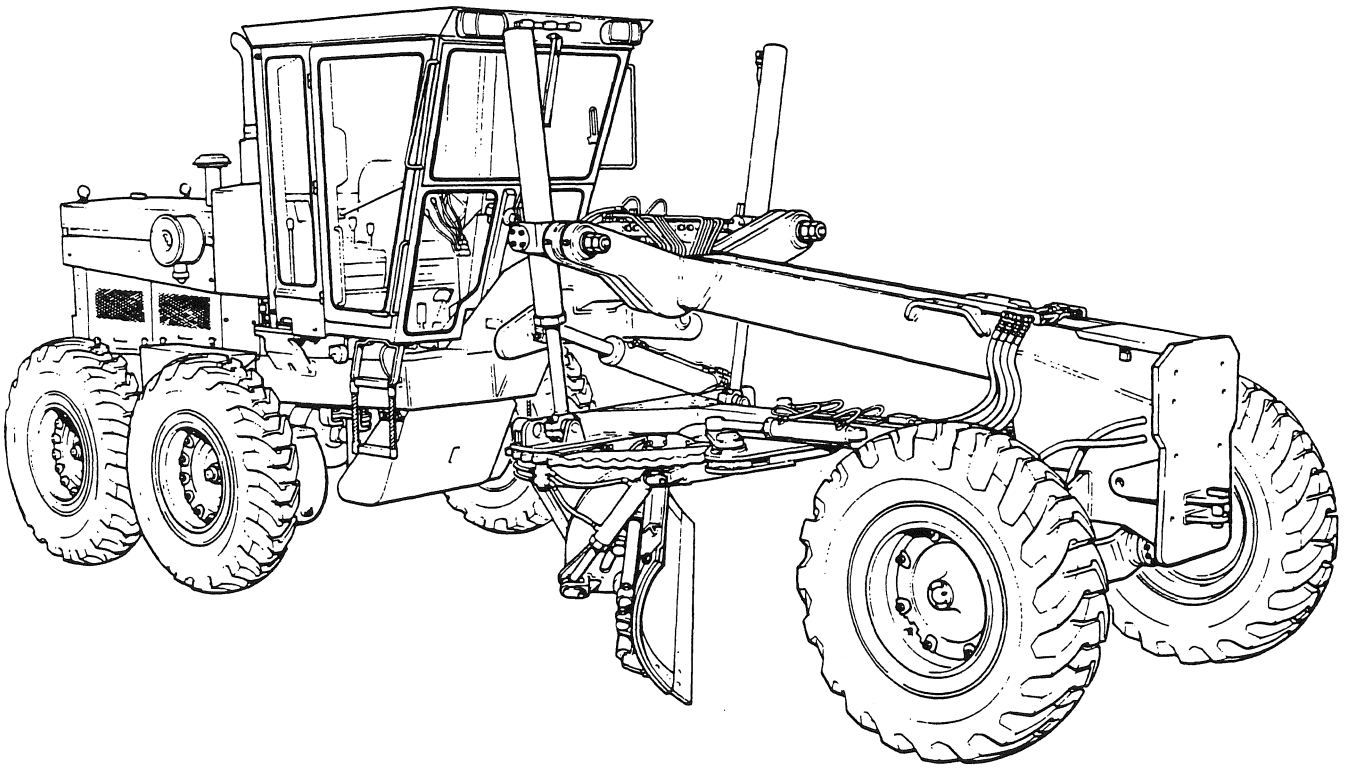
Maneuver the tire and rim onto the wheel and place the rim clamps on the wheel studs and retain them with nuts. Tighten the nuts to the specified torque, in a diagonal sequence. Repeat these procedures for the other wheels.

Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the rear end of the machine. Remove the supports. Raise the moldboard to lower the rear of the machine onto its wheels.

Road test the grader and check hydraulic brake connections for leaks.

SECTION 12

STANDARD BRAKES AND TANDEMS



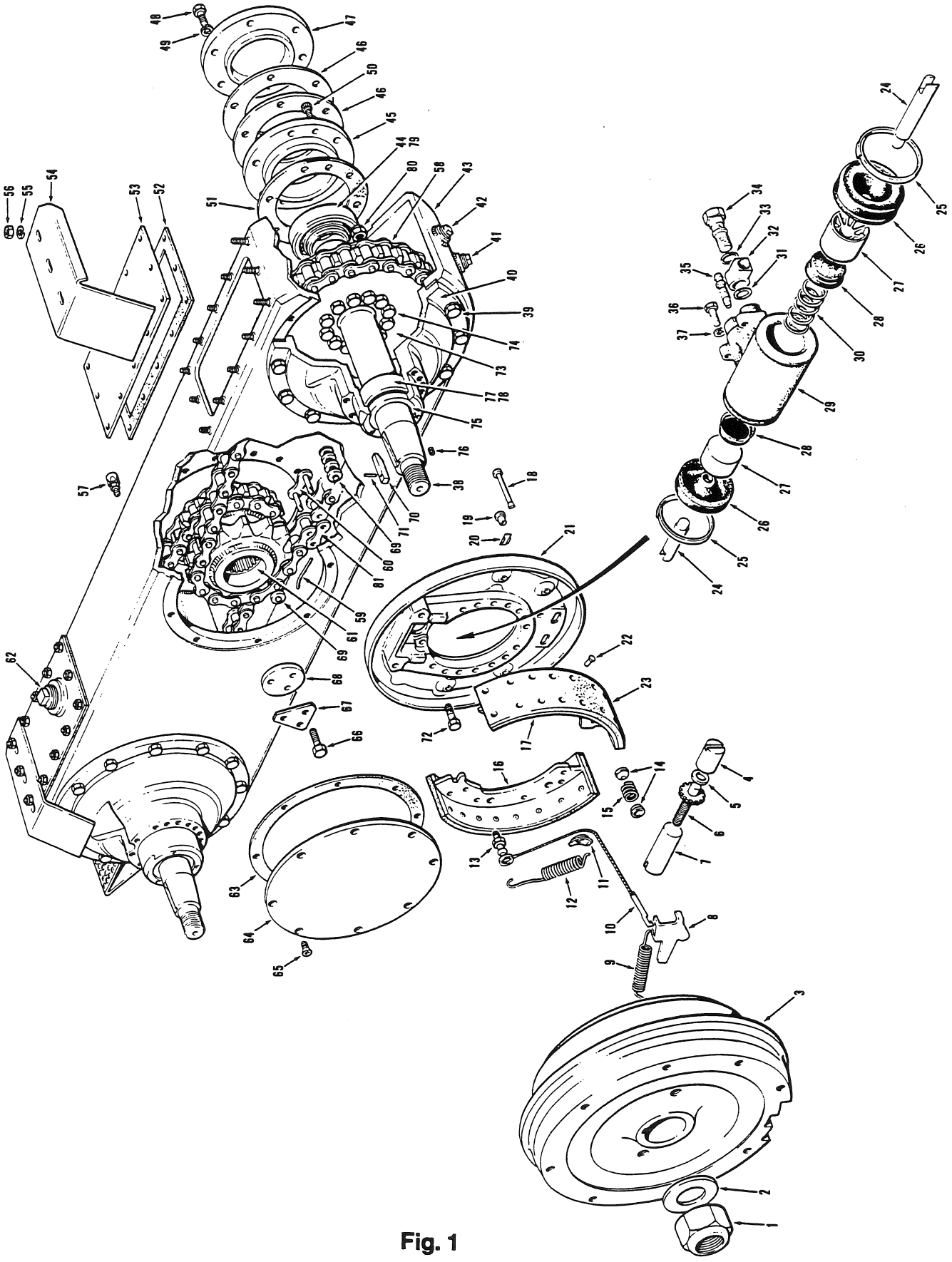


Fig. 1

Item	Description	Item	Description	Item	Description
1	Wheel nut	25	Strap	54	Shield-Brake line
2	Washer	26	Boot	55	Lockwasher
3	Wheel	27	Piston	56	Nut
4	Socket	28	Cup	57	Breather
5	Washer	29	Body	58	Chain-Drive
6	Adjusting screw	30	Spring	59	Cotter Pin
7	Pivot nut	31	Gasket-Inner	60	Link-Chain
8	Lever-Auto adjuster	32	Inlet fitting	61	Sprocket-double drive
9	Spring-Adjuster screw (white)	33	Gasket-Outer	62	Plug-Filler
		34	Bolt	63	Gasket
10	Cable assembly	35	Bleeder screw	64	Side plate cover
11	Cable guide-Auto adjuster	36	Bolt	65	Bolt
		37	Lockwasher	66	Bolt
12	Spring-Shoe return (black)	38	Stub axle	67	Washer-Tab
		39	Bolt and lockwasher	68	Plate-Retaining
13	Pin	40	Bearing housing-Stub axle	69	Plugs-Magnetic
14	Cup			70	Key
15	Spring-Shoe hold down	41	Drain plug	71	Pin-Key
		42	Level plug	72	Capscrews-Backing plate
16	Shoe and lining assembly (L.H.)	43	Tandem case		
		44	Bearing cup	73	Sprocket-Stub axle
17	Shoe and lining assembly (R.H.)	45	Bearing flange	74	Bolt
		46	Shim pack	75	Oil seal
18	Pin	47	Bearing cap	76	Set screws
19	Cover-Probe hole	48	Bolt	77	Bearing cup
20	Cover-Adjusting hole	49	Washer	78	Bearing cone
21	Backing plate	50	Socket head capscrews	79	Bearing cone
22	Rivet	51	Gasket	80	Nut-Sprocket
23	Lining-drilled	52	Gasket	81	Link-Chain
24	Link-Wheel cylinder	53	Cover plate		

Key to Fig. 1

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General

Before starting any service procedure, make sure the work area is clean and safe. A clean work area will reduce the chances of foreign matter entering the brakes and tandem causing damage. For a complete overhaul you will require a suitable lifting device, blocks and safety stands, a wheel puller, and a brake adjusting wrench.

Discard all oil seals, O rings, snap rings, and tabwashers. Clean and inspect brake and tandem components. Refer to the 700 Series Parts Manual when ordering replacement parts.

Refer to Lubrication Specifications detailed in the front of this manual for the recommended brake fluid and tandem lubricants.

ALWAYS PUT THE GRADER IN THE SERVICE POSITION BEFORE ATTEMPTING ANY OVERHAUL, MAINTENANCE OR INSPECTION PROCEDURE.

PARK THE GRADER ON A LEVEL SURFACE AND FULLY LOWER THE MOLDBOARD AND ALL ATTACHMENTS. IF IT IS NECESSARY TO ADJUST OR SERVICE THE MOLDBOARD OR ATTACHMENTS IN A RAISED POSITION, SUPPORT THEM WITH ADEQUATE STANDS OR BLOCKS. APPLY THE PARKING BRAKE. TURN THE IGNITION SWITCH TO THE "OFF" POSITION AND REMOVE THE KEY. OPERATE ALL HYDRAULIC CONTROLS TO ENSURE THAT NO ACCUMULATED PRESSURE REMAINS IN THE HYDRAULIC SYSTEM. INSTALL CHOCKS AT THE FRONT AND REAR WHEELS. TURN THE ISOLATION SWITCH TO THE "OFF" POSITION. THE ISOLATION SWITCH IS INSTALLED BEHIND THE LEFT FRONT ENGINE COVER. ON ARTICULATED MACHINES, INSTALL THE BLOCKING PINS ON BOTH SIDES OF THE HINGE. ALLOW THE ENGINE AND HYDRAULIC SYSTEM TO COOL BEFORE WORKING IN THESE AREAS. THE GRADER IS READY FOR SERVICING.

NOTE

Weights, measures and tolerances appear in Metric (SI), Imperial and U.S. quantities. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

Description and Operation

Four wheel booster brakes are standard equipment on all 700 Series models except models 710 and 710A where two wheel rear mounted booster brakes are standard equipment. Power for the booster cylinder is supplied by oil in the return line of the steering system.

When the brake is depressed, a valve in the booster cylinder is closed and oil pressure builds up (relief), and presses on the push rod of the master cylinder. Brake fluid then is forced into all four wheel cylinders to expand the shoes against the brake drums.

The wheel brakes are self-adjusting drum type brakes. All four shoe sets are adjusted tight against the drums, then backed off four notches on the adjusting wheel. The linings should be replaced when worn to within 1/16 in. (1,59 mm) of the rivet heads retaining them to the shoes.

1/2 in. - 1 in. (12,70 mm. - 25,40 mm.) free travel on the pedal is required to ensure that the booster assembly is fully neutralized when the pedal is released.

The tandem assembly divides the power flow from a single floating drive axle (each side) to two tandem mounted axles and drive wheels. The tandem case is fabricated from steel plate, and is stress relieved before machining. Two plates are used to provide additional stiffness to the tandem assembly. This adds accuracy to the machining, which is done in a single jig, thus eliminating misalignment of the chains. The chains connect a double-drive sprocket on the final drive axle and the driven sprockets on the stub axles.

The shim pack under the inner bearing cap should be gauged so that a definite pre-load is felt when you turn the sprocket by hand. No provision is made for tightening the chains. A certain amount of slack is required and a slight rubbing of the chain on the bottom of the tandem case is normal and no cause for concern. However, a chain which has excessive slack and appears to require tightening may have a pitch of more than 2" (or 1.75" for the 710). If this is the case, it should be replaced as continued use will caused undue wear on the sprockets. For lubrication, the system oil should be changed once per year or every 2000 hours. At the same time, the two magnetic plugs in each tandem should be removed, cleaned and replaced.

Cleaning and Inspection

Cleaning - General

WARNING

ALKALI CLEANING SOLVENTS AND VAPORS ARE EXTREMELY HARMFUL AND CAN CAUSE SERIOUS INJURY TO EYES, LUNGS AND SKIN. ALWAYS WEAR PROTECTIVE CLOTHING, GOGGLES AND RESPIRATOR. USE UTMOST CARE WHEN HANDLING CHEMICALS.

CAUTION

YOU ARE RECOMMENDED TO WEAR COTTON GLOVES WHEN HANDLING BEARINGS. THIS PREVENTS SKIN ACIDS AND PERSPIRATION CONTAMINATING THE RACES AND ROLLING ELEMENTS.

Immerse small parts and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

Cleaning - Bearings

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Cleaning and Inspection (Continued)

Inspection - Oil Seals, O Rings and Snap Rings

Replace all oil seals, O rings and snap rings. Lubricant loss through a worn seal can cause expensive parts of the assembly to fail. Handle sealing components carefully, particularly when being installed. Cutting, scratching or curling of the seal lip seriously reduces efficiency.

Apply a thin coating of 'Permatex No. 2', or equivalent, onto the outer diameter of the oil seal carrier. This ensures an oil-tight fit in the bore. Lubricate all oil seal lips and O rings before installation.

Inspection - Sprockets and Drive Shafts

If crack detection equipment is available, use the process to check parts. Examine teeth of all sprockets for wear, pitting, chipping, nicks, cracks and scores. If the sprocket teeth show spots where the case hardening has worn through or cracked, replace the sprocket.

Small nicks can be removed using a suitable grinding stone. Inspect shafts for signs of bent or twisted splines and replace any deformed drive axles.

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Torque Guide

Application		Torque Value	
Stub Axle Nut	3389,5 N.m	345,6 kgf.m	2500 lbf-ft
Rim Clamp Nuts	203,4 N.m	20,7 kgf.m	150 lbf-ft
Backing Plate Capscrews	74,6 N.m	7,6 kgf.m	55 lbf-ft
Final Drive Flange Capscrews	230,5 N.m	23,5 kgf.m	170 lbf-ft
Drive Sprocket Capscrews	108,5 N.m	11,1 kgf.m	80 lbf-ft
Bearing Cap Capscrews	108,5 N.m	11,1 kgf.m	80 lbf-ft
Bearing Housing Capscrews	216,9 N.m	22,1 kgf.m	160 lbf-ft
Sprocket Bolts & Lock Nuts	406,7 N.m	41,5 kgf.m	300 lbf-ft

Special Tools

The following tools are recommended when overhauling the standard brakes and tandems. The tools help you to remove and install precision-machined parts.

Champion Tool Part Number	Description
5726	Rear wheel puller plate
5727	Rear wheel puller screw
377	Brake ajusting wrench

Make sure proper tools are available and in good working order. Some tools required in this section may have to be manufactured, and are described within the text of this section.

Disassembly

Fig. 2
Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard onto blocks to raise one tandem. Place adequate blocks under the tandem, then lower the tandem onto the supports. Stop the engine. Turn the isolation switch to the "OFF" position. Apply the parking brake.

Fig. 3
Remove the nuts, rim clamps, tire and the rim.

Fig. 4
Remove the stub axle nut and the washer **(Ref. Fig. 1).**

NOTE

You may find it easier to loosen the nut before raising the machine to support the tandems.

Fig. 5
Attach a safe lifting device to the top wheel stud. Remove the wheel (3) with a rear wheel puller plate (**Special tool No. 5726**) and a rear wheel puller screw (**Special tool No. 5727**) from the stub axle.

NOTE

Check for signs of damage on the brake drum surface. If damage has occurred, replaced the wheel casting.

Fig. 6
Using a hammer and a metal pry bar remove the key (**70**) from the end of the stub axle (**38**).

Fig. 7
Place a container under the tandem drain plug (**41**). Remove the plug and drain the lubricating oil. Clean and install the drain plug.

NOTE

The tandem oil capacity for the short tandems is 30 litres (6.6 Imp. gal, 7.9 U.S. gal) and the long tandems is 32 litres (7.1 Imp. gal, 8.5 U.S. gal).

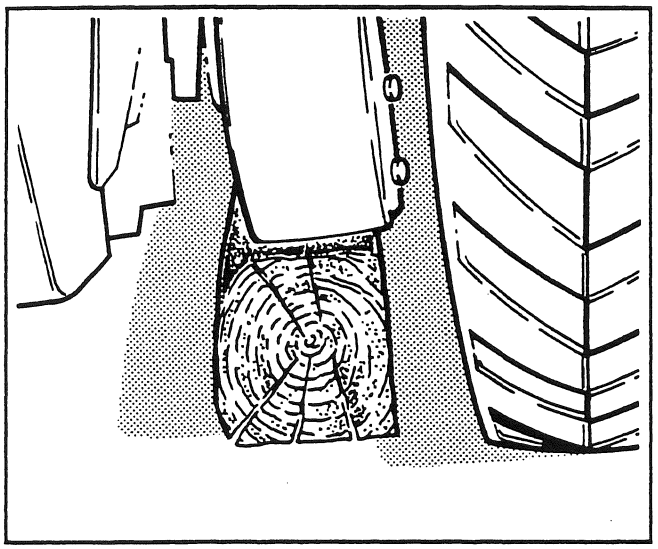
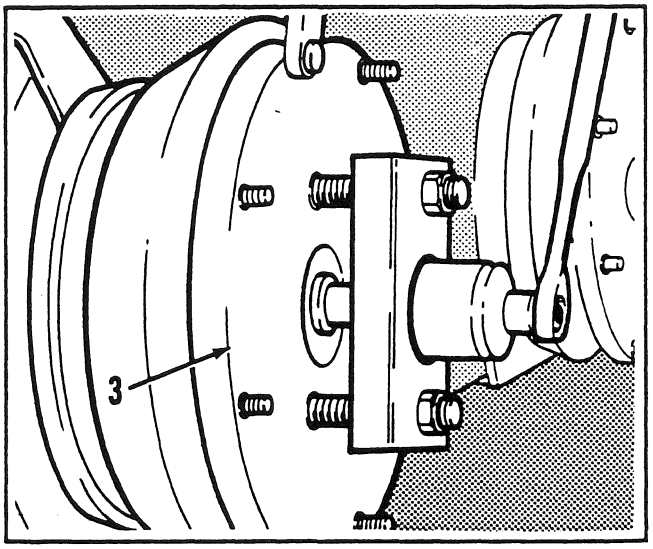


Fig. 2



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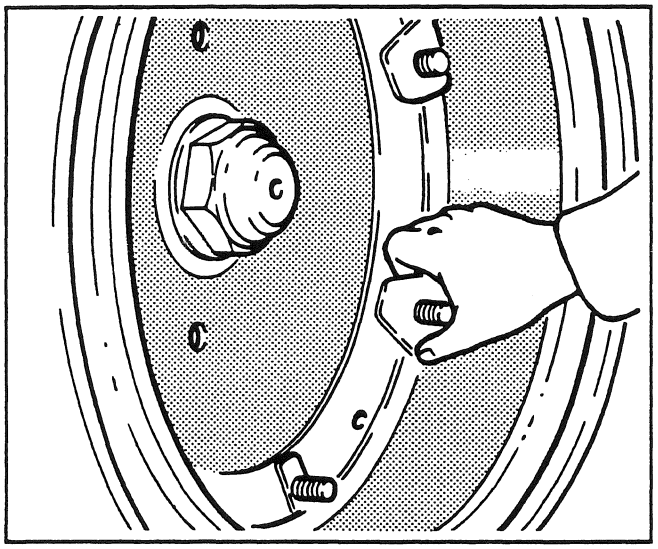
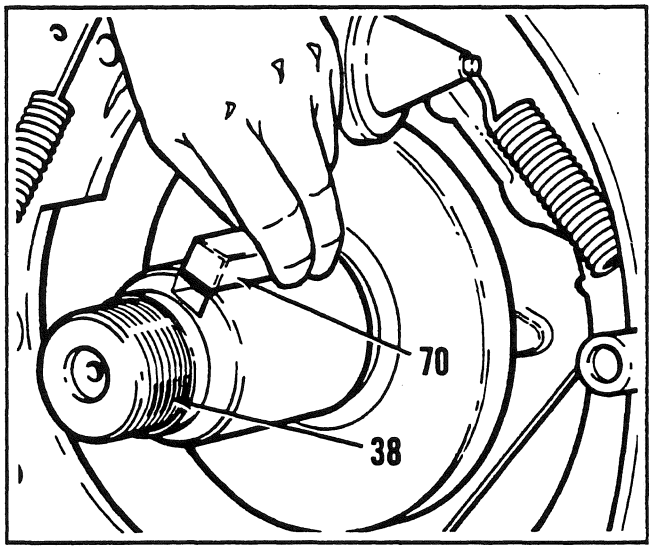


Fig. 3



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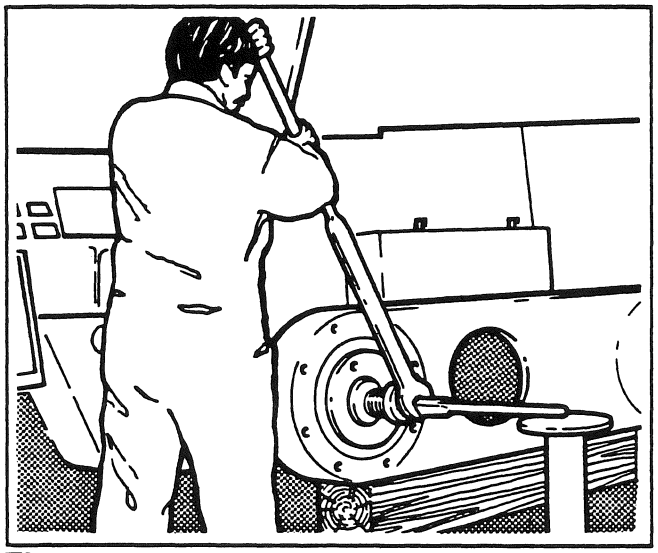

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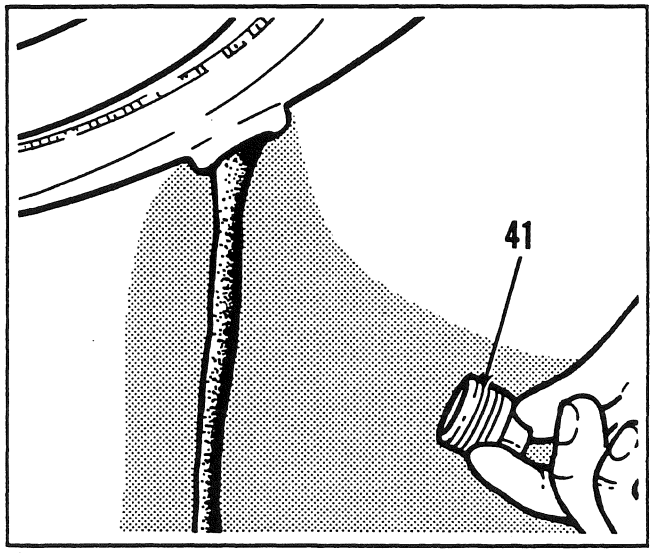

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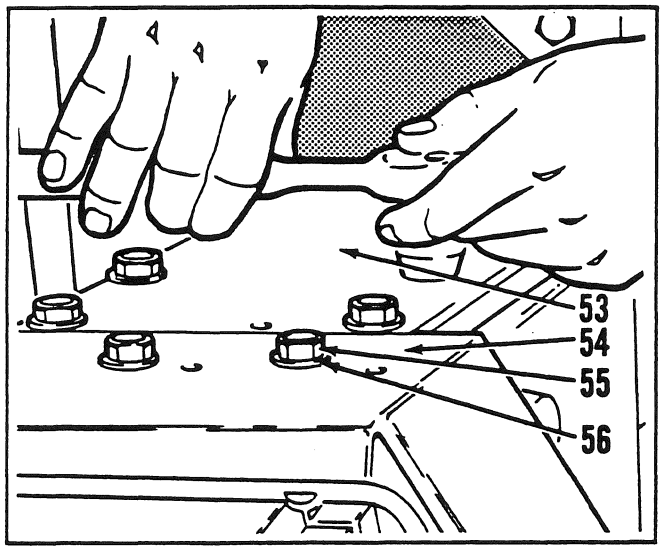

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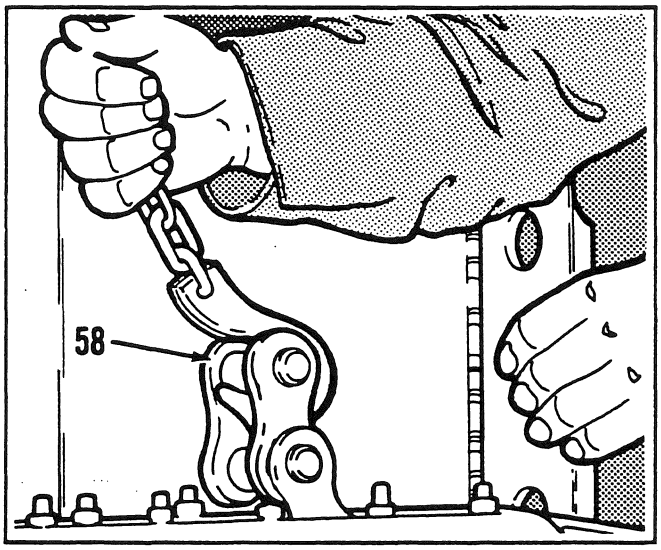

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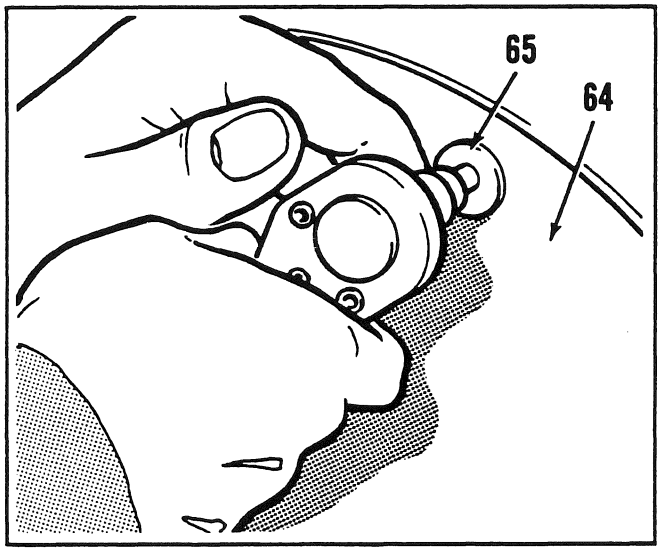

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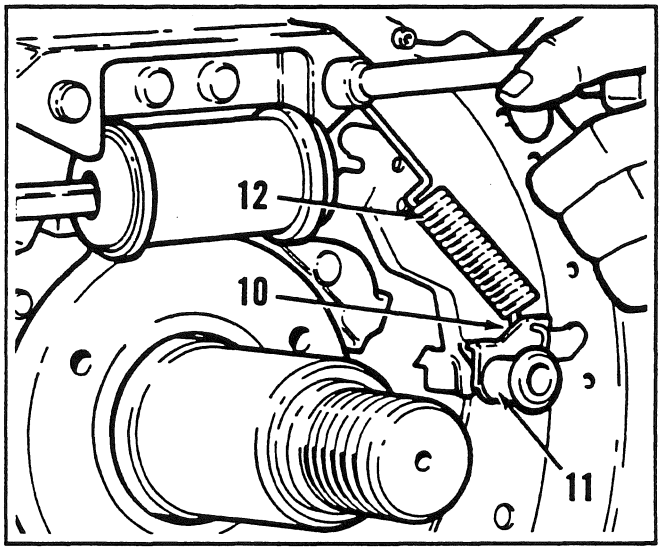

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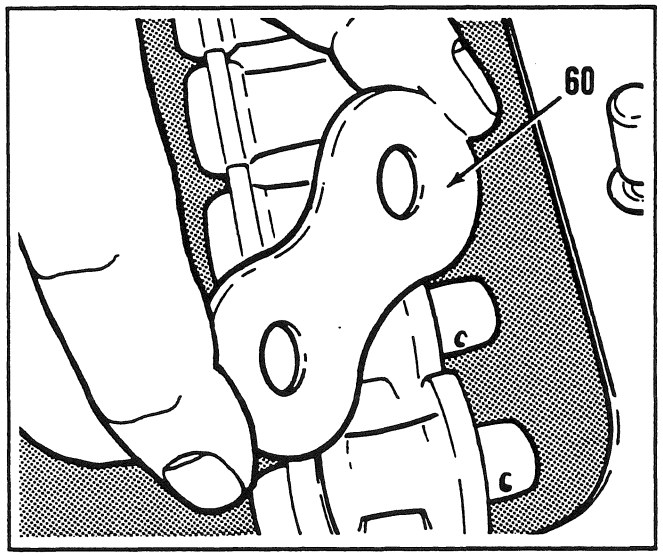

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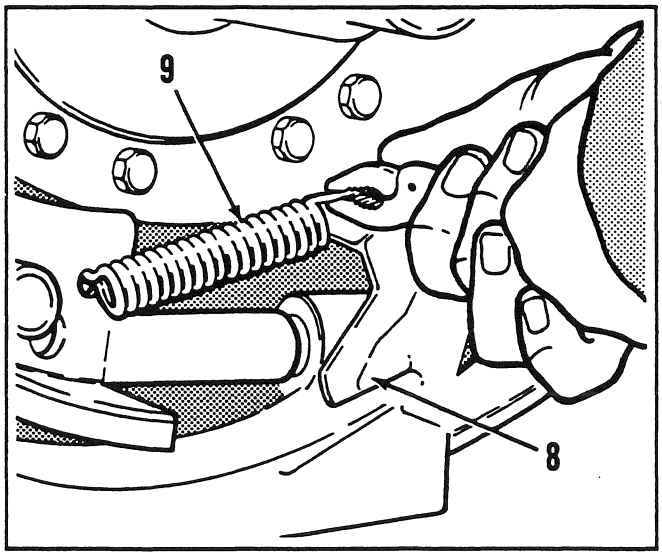


Fig. 13

Disassembly (continued)

Fig. 8
Remove the nuts (**56**) and lock washers (**55**) securing the cover plates and brake line shields. Remove the cover plates (**53**) and brake line shields (**54**) and discard the gasket (**Ref. Fig. 1**).

Fig. 9
Remove the countersunk capscrews (**65**) the side cover plate (**64**) and discard the gasket.(**Ref. Fig.1**)

NOTE

With the grader in neutral release the emergency brake and operate the moldboard to raise the opposite tandem. Turn off the engine and rotate the opposite side tires to turn the tandem chain connector links into position. When the links are accessible throught the inspection ports, start the engine and lower the opposite tandem to the ground. Apply the emergency brake.

Fig. 10
Remove the cotter pins (**Ref. Fig. 1**) and the connector link (**60**) from each chain.

Fig. 11
Using a safe lifting device remove the tandem chains (**58**) through the inspection ports.

NOTE

Although the brakes are left-hand and right-hand assemblies, the disassembly and reassembly procedures remain the same. If both left and right-hand assemblies are removed and disassembled at the same time, take care to keep left and right-hand components separate.

Fig. 12
Using a brake lever, remove the brake shoe return springs (**12**), the auto-adjuster cable (**10**) and the cable guide (**11**).

Fig. 13
Using pliers, remove the adjusting springs (**9**), and the auto-adjuster lever (**8**).

Disassembly (continued)

Fig. 14
Using pliers, push in and rotate the brake shoe hold-down spring cup (**14**) until the slot aligns with the flat end of the hold-down pin (**18**). After this is accomplished, the brake shoe hold-down cups (**14**), springs (**15**)(6 required to be loosened) and the brake shoes (**16,17**) should be removed.

NOTE

Examine the brake shoes for wear. A shoe must be replaced or relined if the rivet head is less than 1,5 mm or 1/16 of an inch below the lining surface.

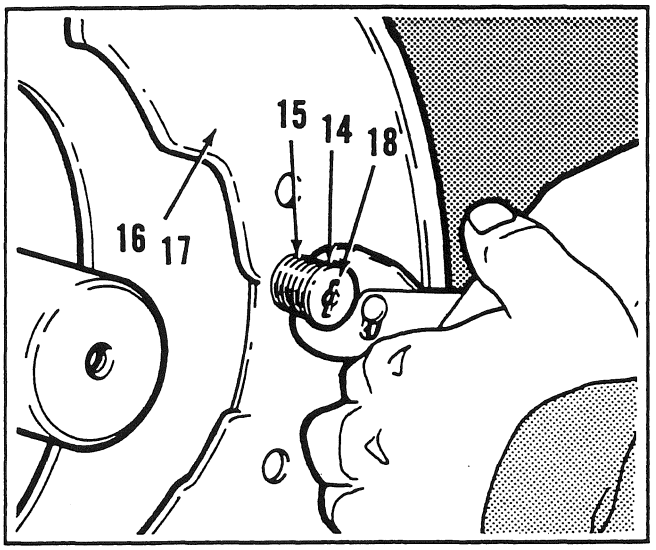
Fig. 15
Remove the hold-down pins (**18**).

Fig. 16
Disconnect the brake line from the wheel cylinder found between the backing plate (**21**) and the stub axle housing (**40**). Plug the brake line and wipe up any spilled fluid.

Fig. 17
Remove the capscrews (**36**) and lockwashers retaining the wheel cylinder (**Ref. Fig. 1**). Remove the wheel cylinder from the backing plate and remove the wheel cylinder links (**Ref. Fig. 1**).

Fig. 18
Disassemble the wheel cylinder on a clean workbench by first removing the metal strap (**25**).

Fig. 19
Remove the boot (**26**).



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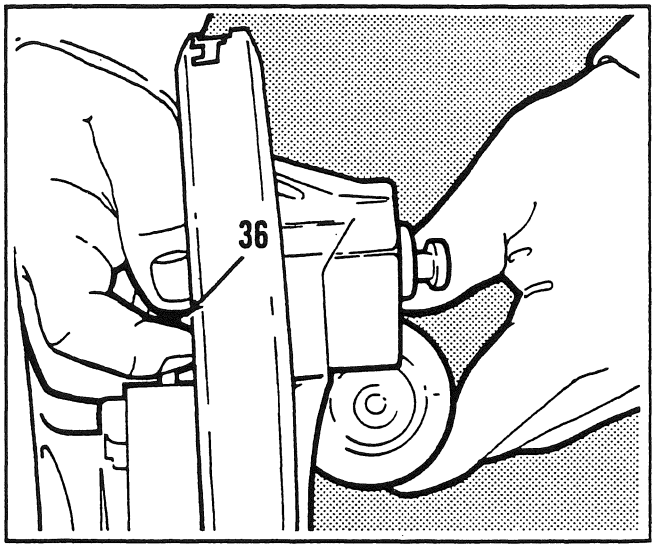

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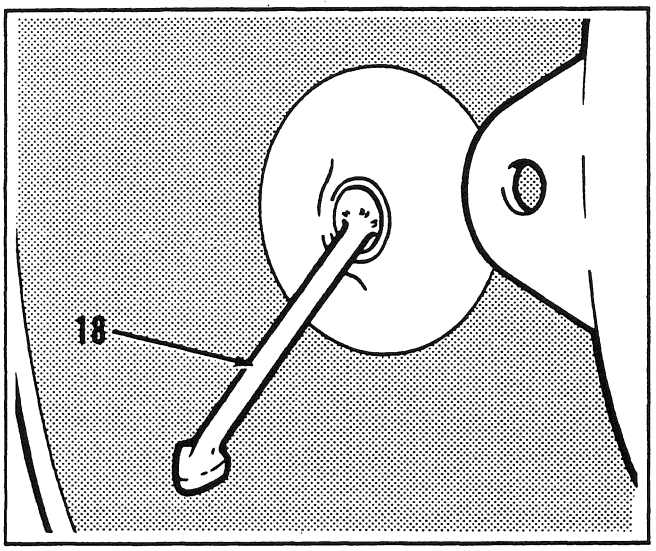

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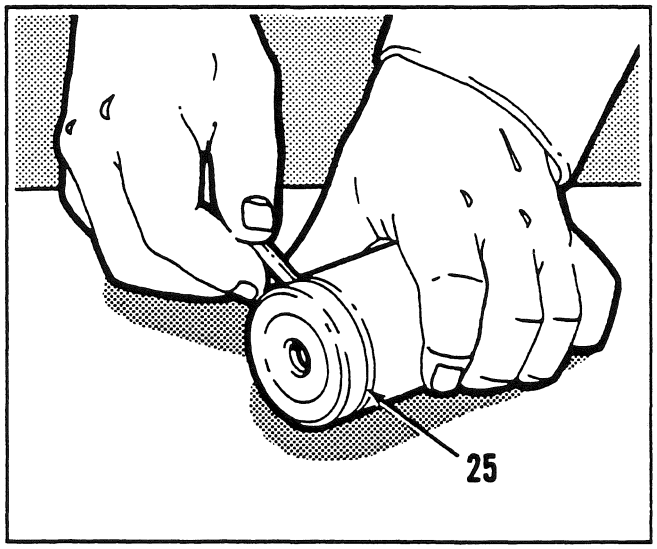

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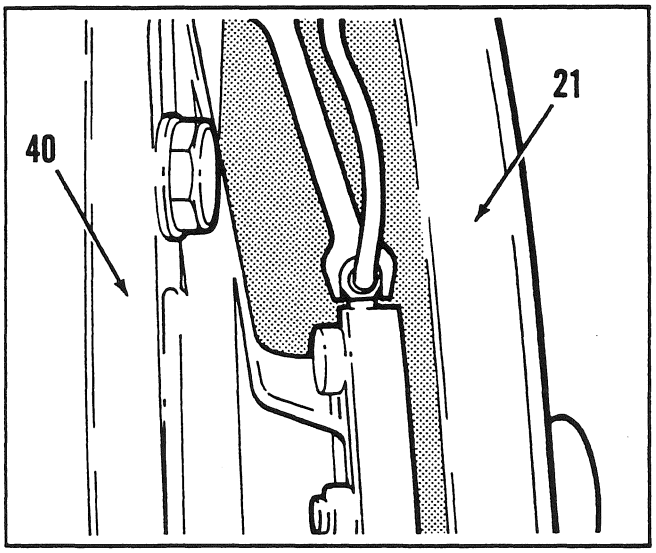

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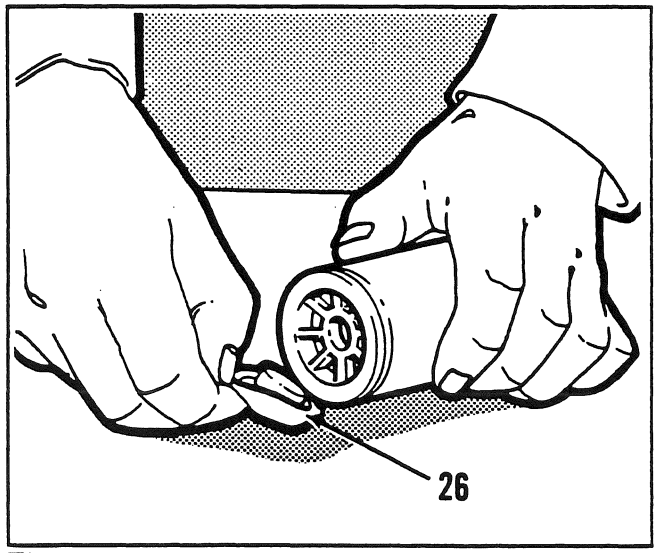

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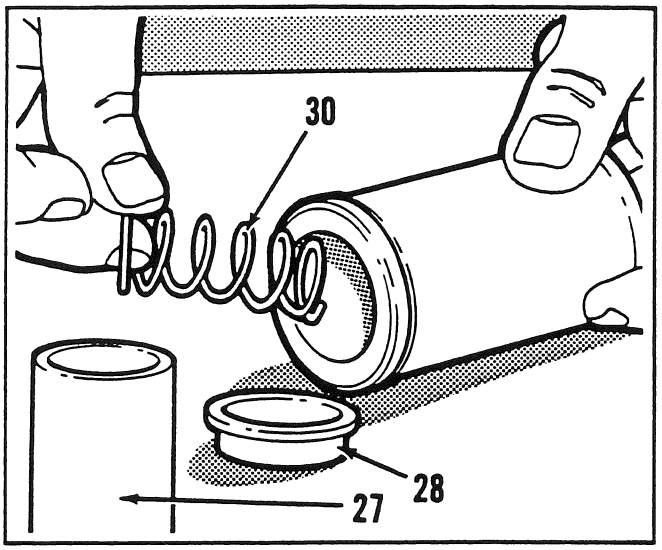

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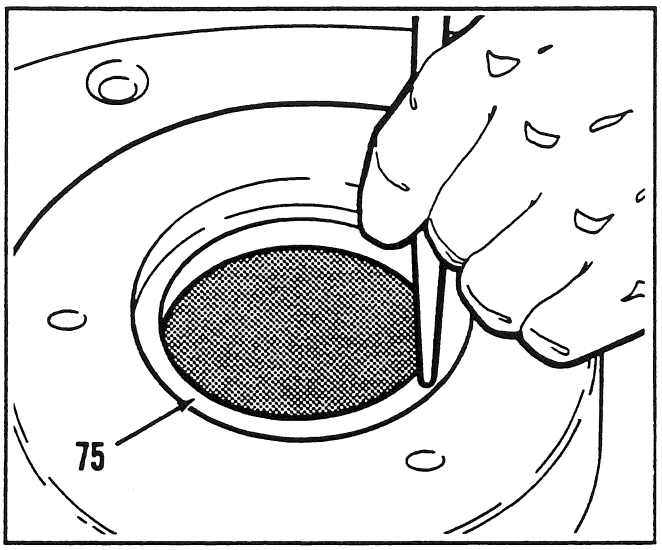

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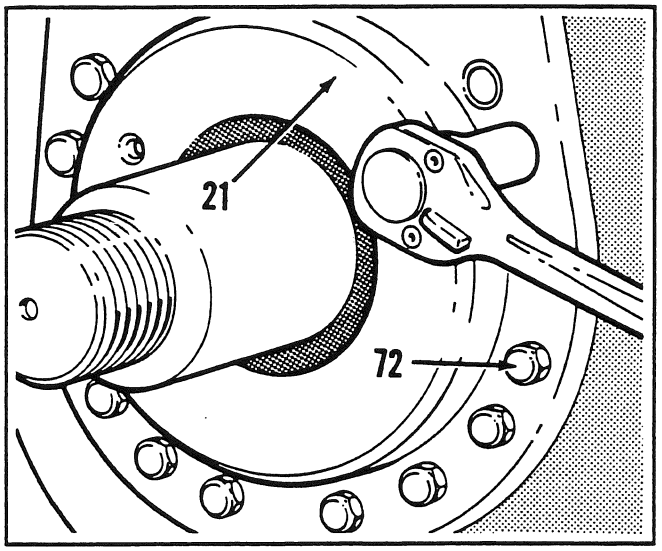

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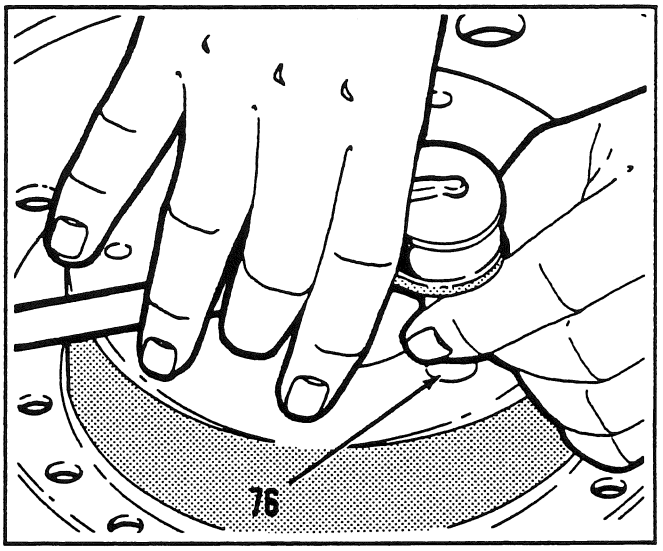

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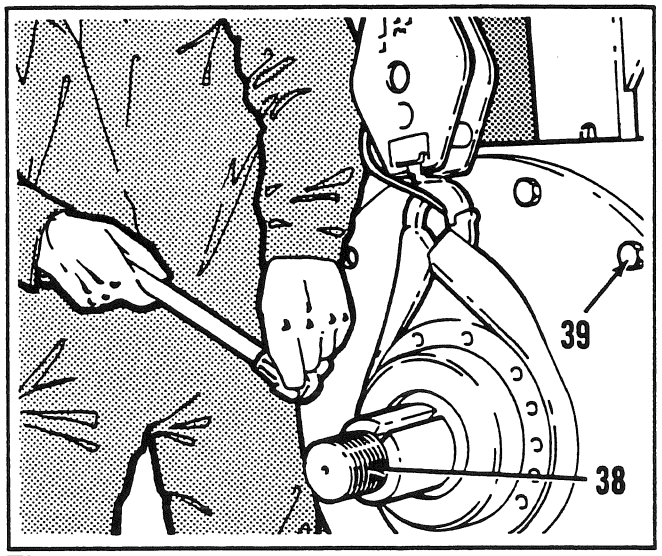

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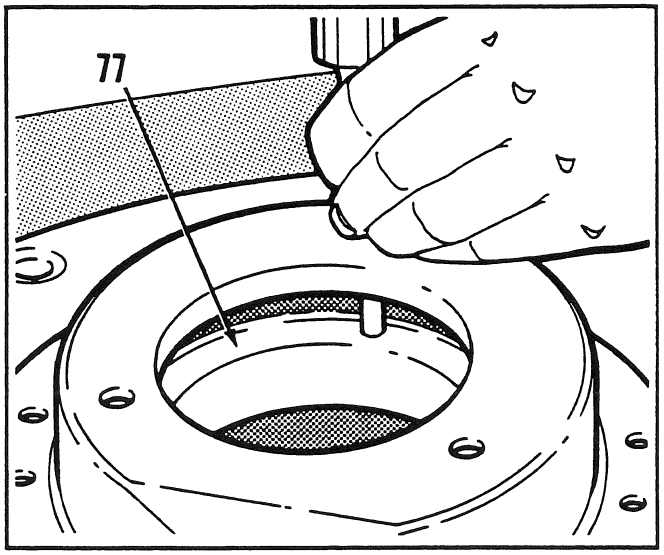


Fig. 25

Disassembly (continued)

Fig. 20
Remove the piston (**27**), piston cup (**28**) and return spring (**30**). Do the same procedure for the other end of the wheel cylinder using instructions from **Fig. 18** to **Fig. 20.**

NOTE

Inspect the boots, spring, piston cups and cylinder links for signs of damage and wear. Also inspect the wheel cylinder casting for scoring. If the scoring is too deep then the cylinder casting cannot be honed properly and should be replaced.

Fig. 21
Remove the capscrews (**72**) and the backing plate (**21**).

Fig. 22
Insert 2 wooden planks through the inspection port of the tandem to support the sprocket (**Ref. Fig. 1**) and stub axle (**38**). Secure a safe lifting device to the bearing housing (**40**) as illustrated and remove the bolts (**39**) retaining the housing. Lift the bearing housing away from the tandem.

Fig. 23
Using a suitable drift and a hammer remove the oil seal (**75**) from the bearing housing (**40**).

Fig. 24
Remove the three socket head set screws (**76**).

Fig. 25
Using a hammer and brass drift remove the bearing cup (**77**).

Disassembly (continued)

Fig. 26
Secure a safe lifting device to the stub axle assembly. Remove the two planks of wood supporting the sprocket and the stub axle (**Ref. Fig. 1**) and lift the stub axle out of the tandem. Use a split-type bearing puller to remove both bearing cones (**Ref. Fig. 1**).

Fig. 27
Remove the nuts (**80**) and bolts (**74**) retaining the sprocket (**73**) to the stub axle (**38**).

Fig. 28
Stand the stub axle (**38**) upright and lift off the sprocket (**73**).

Fig. 29
Remove the capscrews (**48**), washers (**49**) and the bearing cap (**47**) from the bearing flange (**45**).

Fig. 30
Remove the shims (**46**) from the bear-cap (**47**).

Fig. 31
Remove the two socket head capscrews (**50**) retaining the bearing flange (**45**) to the tandem case. Use a hammer and brass drift to remove the assembly.

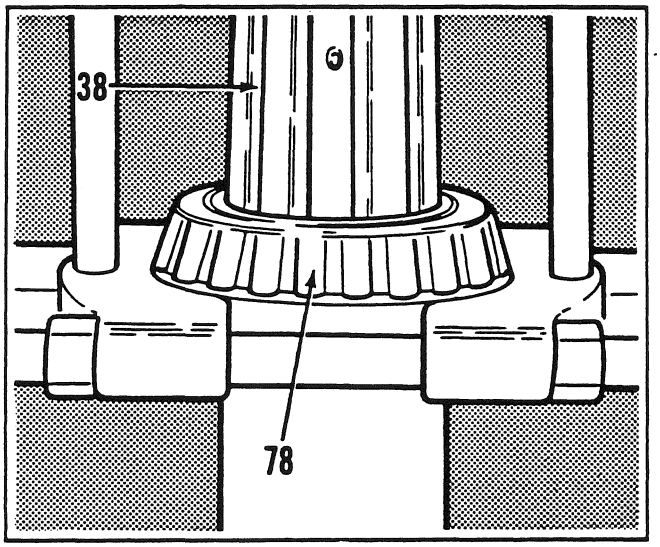
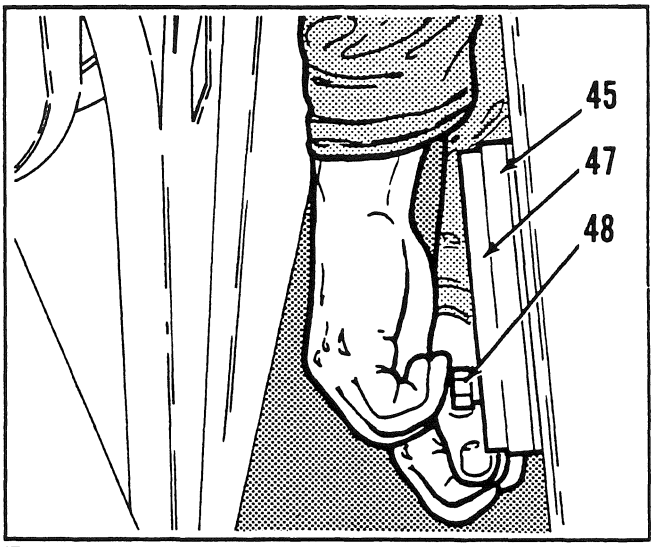


Fig. 26



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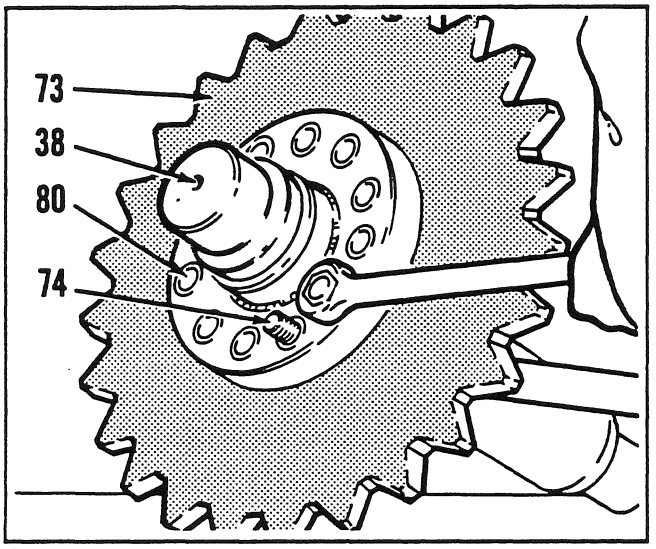

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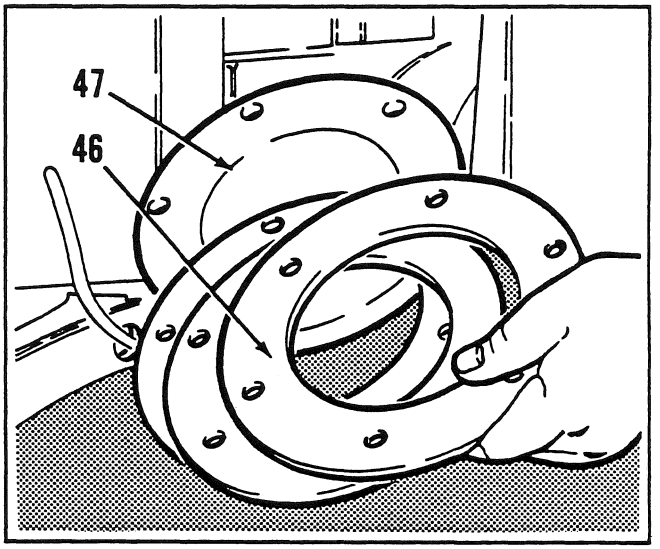


Fig. 30

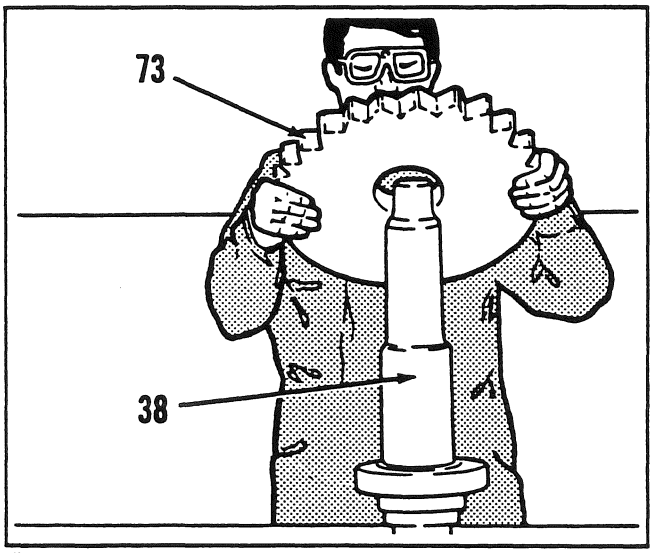


Fig. 28

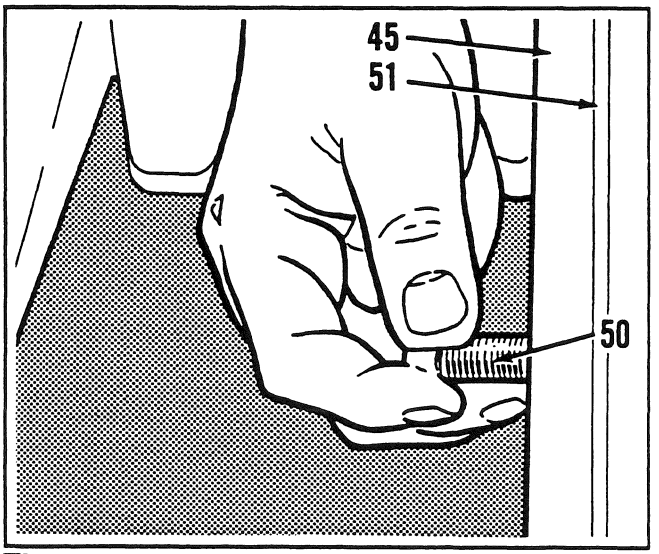
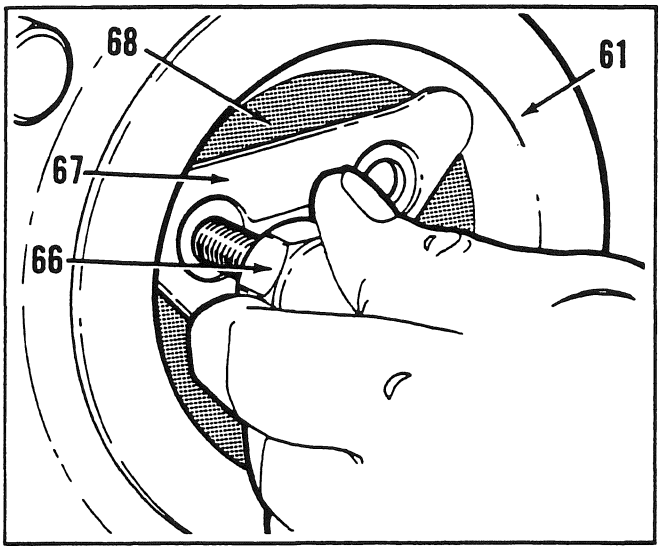


Fig. 31



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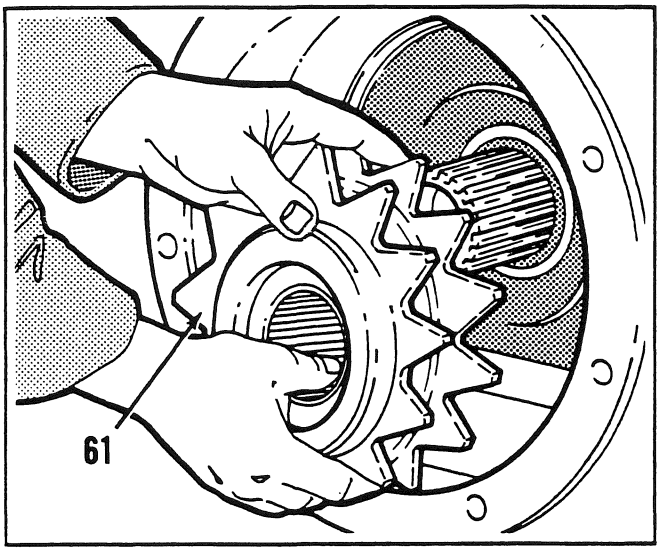


Fig. 33

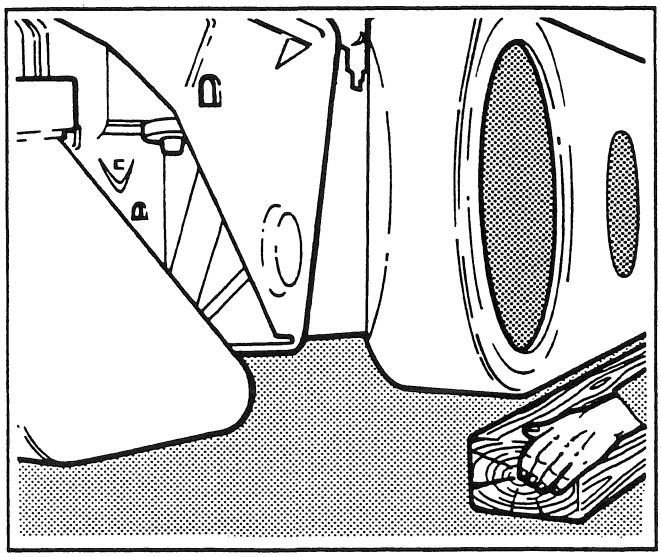


Fig. 34

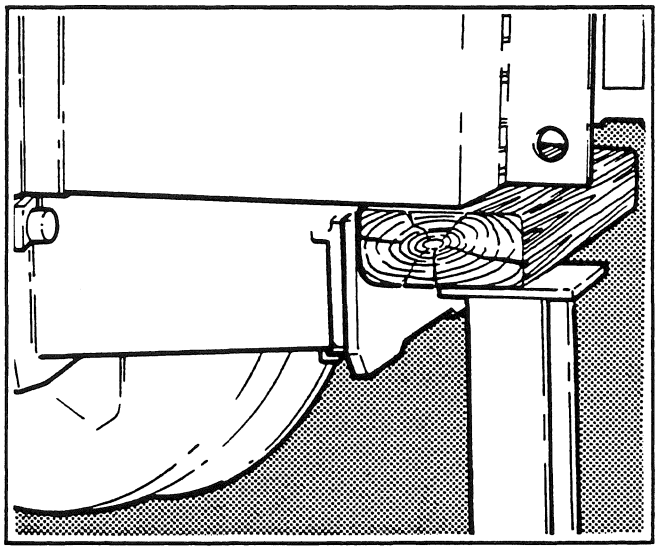
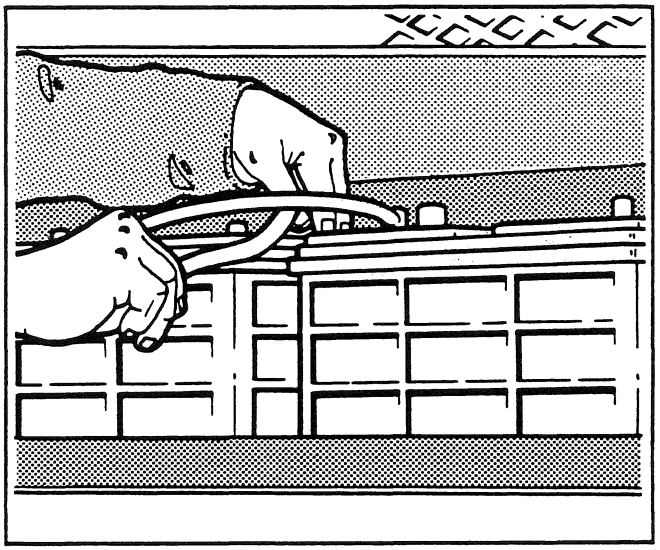


Fig. 35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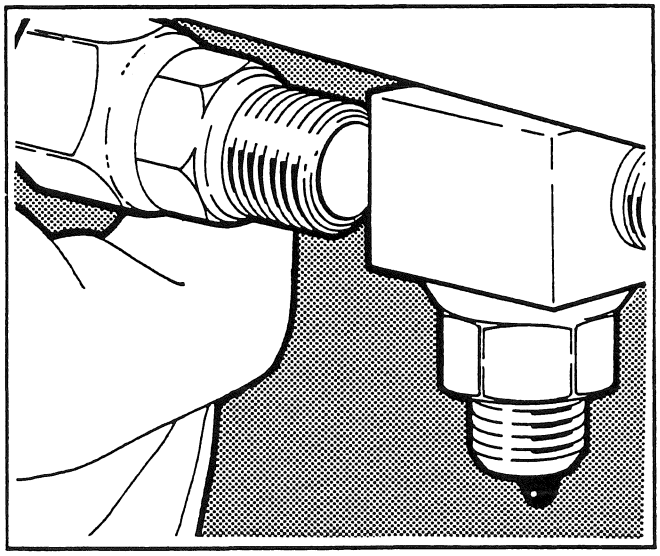


Fig. 37

Disassembly (continued)

Fig. 32
Using a hammer and a drift bend back the three tabs locking the bolts (**66**) securing the drive sprocket (**61**). Remove the bolts, tabwasher (**67**) and the retaining plate (**68**). Discard the tabwasher.

Fig. 33
Remove the drive sprocket (**61**).

Fig. 34
Before removing the tandem, start the engine, release the emergency brake, and lower the moldboard to raise the tandem. Remove the blocks.

Fig. 35
Place safe, adequate stands under the rear frame and lower the grader onto the stands. Shut off the engine and apply the emergency brake.

Fig. 36
When working on the tandem carrying the batteries, remove the battery box cover, disconnect the battery cables and remove the batteries with the battery box.

Fig. 37
Disconnect the brake line at the tee fitting located under the frame near the final drive hanger brackets.

Disassembly (continued)

Fig. 38
Inspect all hydraulic tubes and hoses for leakage and corrosion. Check anchorage points are secure.

Fig. 39
Using a safe lifting device to support the weight of the tandem.

Fig. 40
Remove the capscrews retaining the final drive sleeve to the tandem and lift the tandem away from the drive sleeve.

NOTE

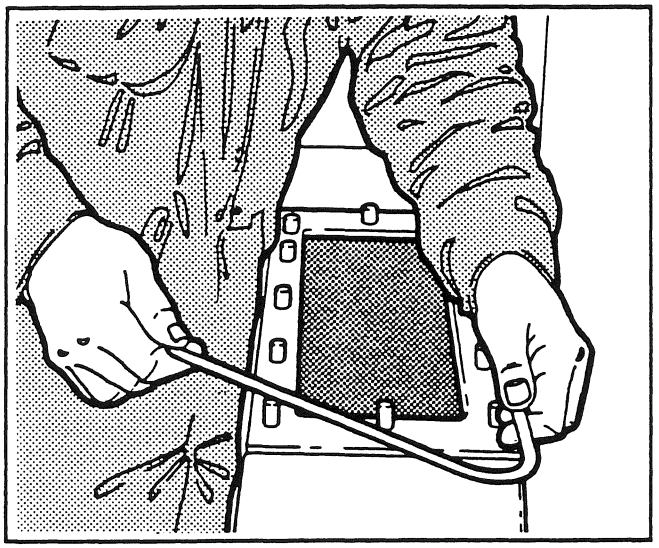
Clean and inspect all bearings for signs of cracking or over heating. Check the sprockets for abnormal tooth wear. Remove and clean the deep reach magnetic plugs from the tandem. Replace any damaged or worn components. Also remove all old gasket eliminator with "liquid chisel" from all tandem openings.

Fig. 41
While the tandem is removed, inspect the seal on the flange sleeve of the final drive. Replace the seal if damage is evident.

Reassembly

Fig. 42
Begin reassembly by applying gasket eliminator, Champion part number **25303** or 'Loctite' 515 to the final drive mounting face. Use a safe lifting device to position the tandem onto the final drive.

Fig. 43
Install special nyloc capscrews retaining the tandem to the final drive flange sleeve. Tighten the bolts uniformly in a diagonal sequence to the specified torque. Perform monthly maintenance checks on these bolts.



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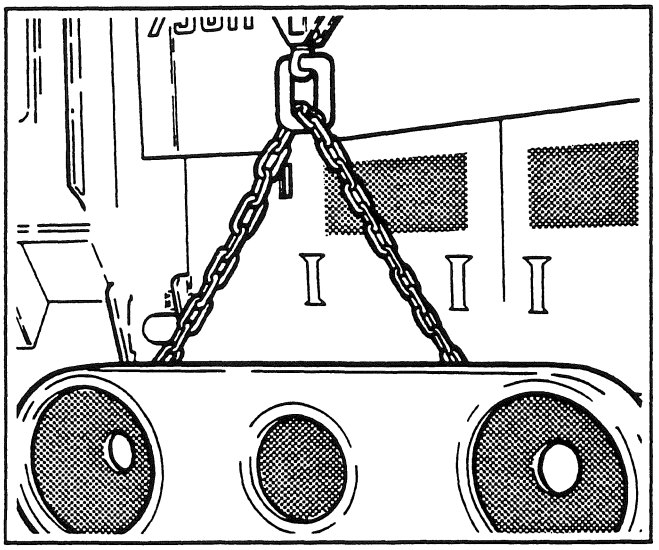

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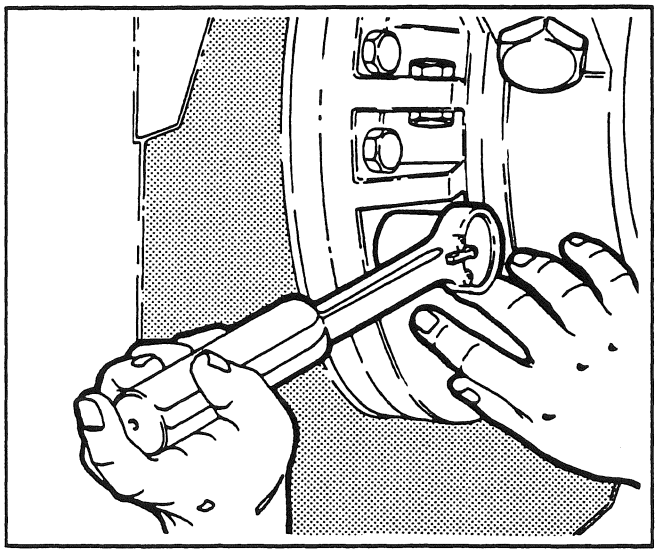

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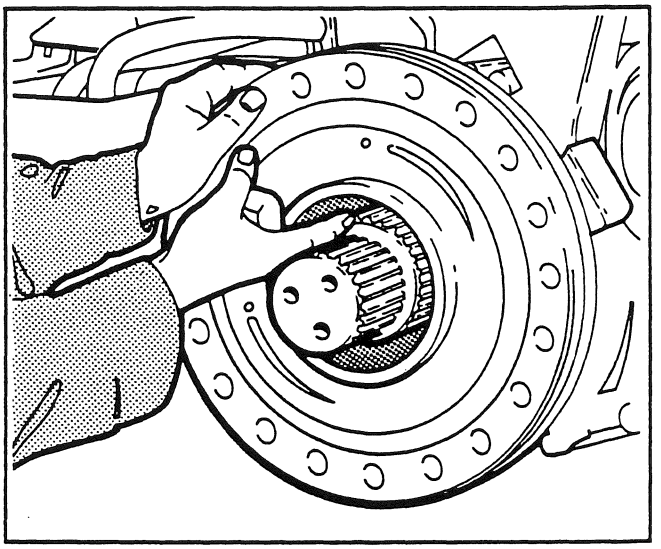
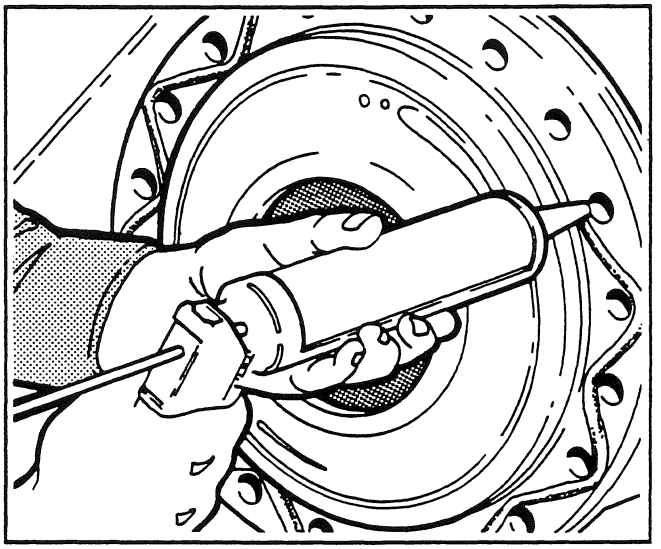


Fig. 41



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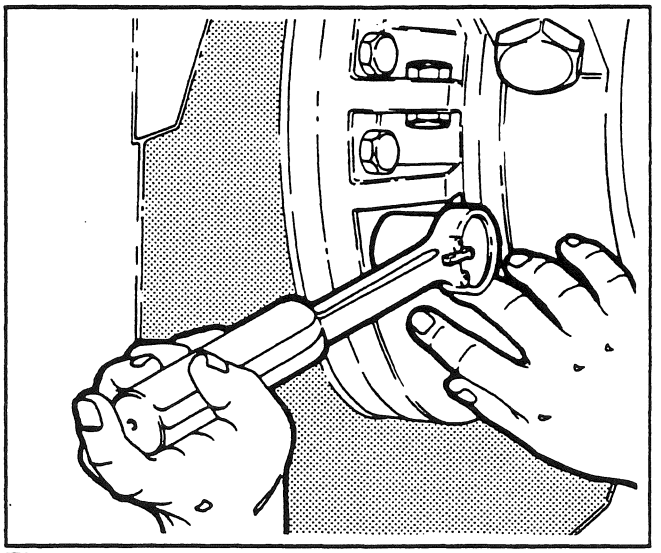
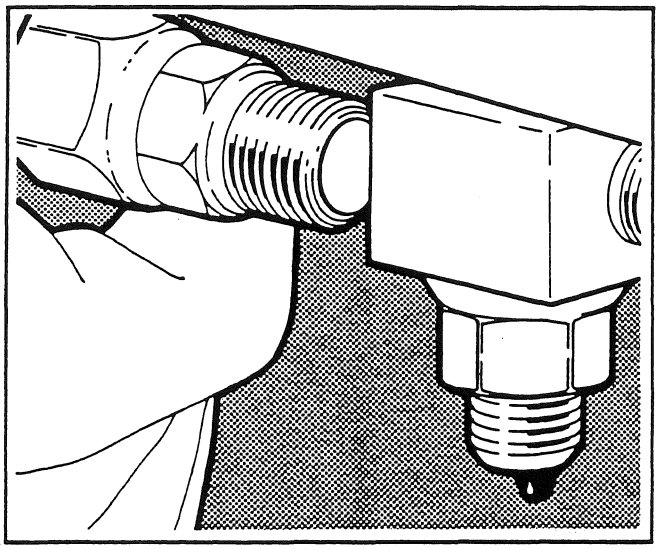


Fig. 43



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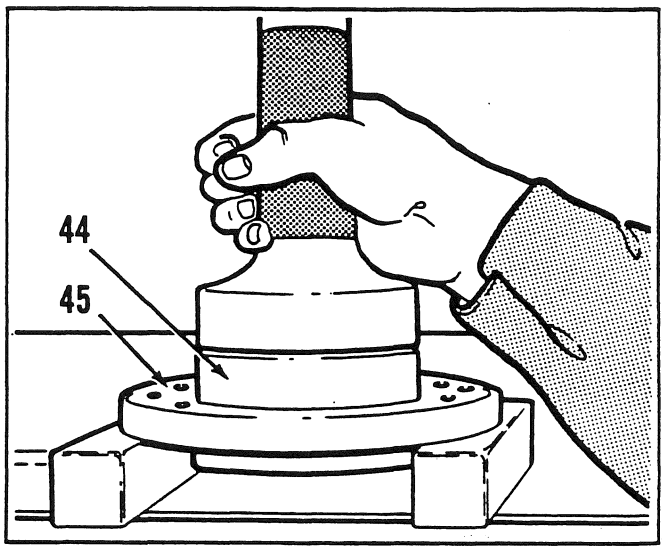

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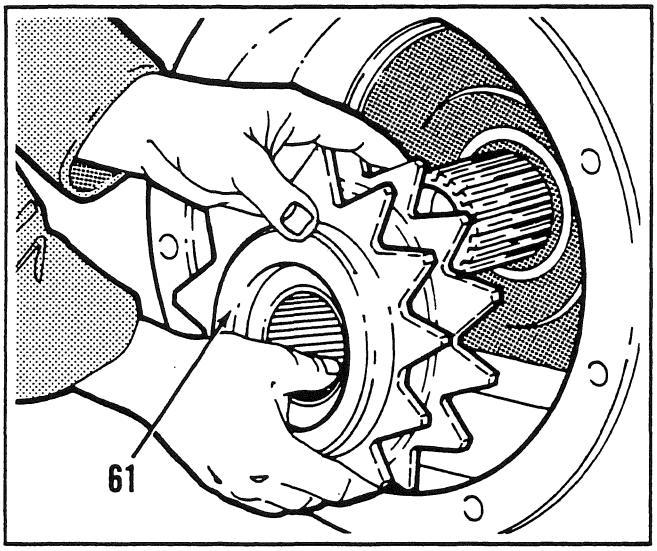

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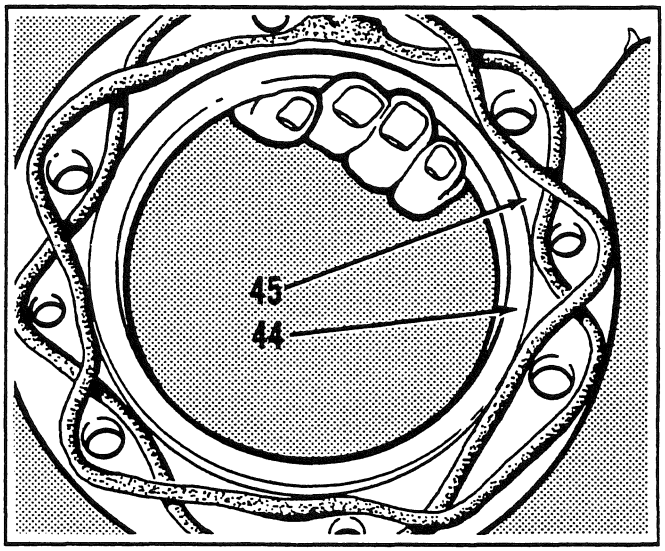

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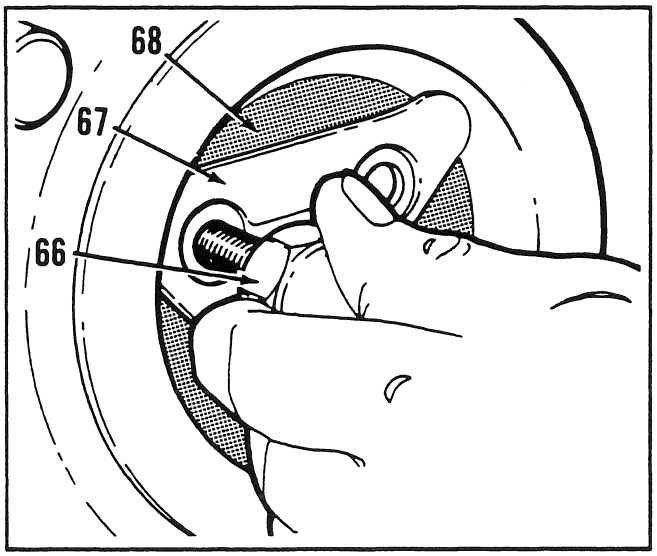


Fig. 46

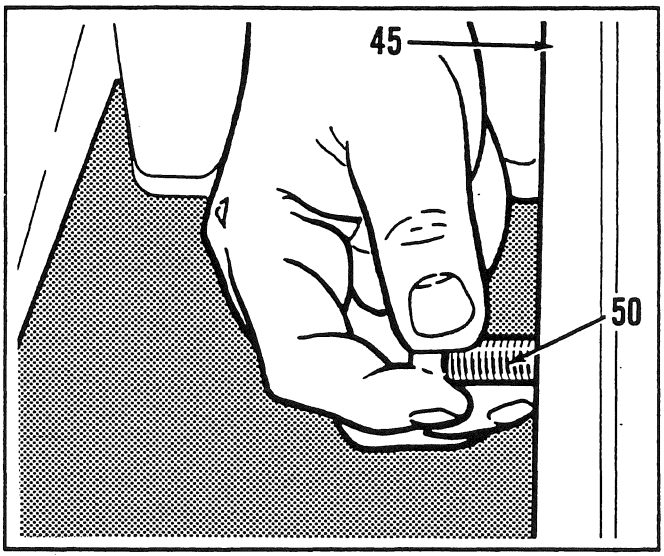


Fig. 49

Reassembly (continued)

Fig. 44
Reconnect the brake line to the tee fitting located under the machine on the frame near the final drive hangers.

Fig. 45
Install the drive sprocket (**61**) onto the drive axle.

Fig. 46
Install the retaining plate (**68**) a new tabwasher (**67**) and the capscrews (**66**).

Fig. 47
Using a press, install the bearing cup (**44**) into the bearing flange (**45**).

Fig. 48
Install a new gasket or use gasket eliminator Champion part number **25303** or 'Loctite' 515 on the bearing flange (**45**) and cup (**44**) assembly and install the assembly.

Fig. 49
Install the socket head capscrews (**50**) that retain the bearing flange (**45**) to the tandem. Tighten these capscrews.

Reassembly (continued)

Fig. 50
Install the bearing cap (**47**), the bolts (**48**), washers (**49**) and tighten them to finger tightness.

Fig. 51
Stand the stub axle (**38**) upright and install the sprocket (**73**) making sure the beveled surfaces unite. Install the nuts (**74**) and bolts (**Ref. Fig. 1**) and tighten them to the specified torque.

Fig. 52
Heat both bearing cones evenly in an oven or oil bath type heater to 121°C (250°F) maximum. **DO NOT** use an induction heater. Install them on the stub axle shaft and lubricate them with tandem oil.

Fig. 53
Apply grease to the bearing cup of the bearing flange. Using a safe lifting device, install the stub axle and retain it with two wooden planks.

Fig. 54
Install the bearing cup in the bearing housing and turn the housing over to insert three socket head capscrews.

Fig. 55
Apply silicone or gasket eliminator to the housing opening. Using a safe lifting device install the bearing housing with the V-notch at the top of the housing. Install the capscrews and remove the wooden planks. Tighten the capscrews in a diagonal sequence to the specified torque.

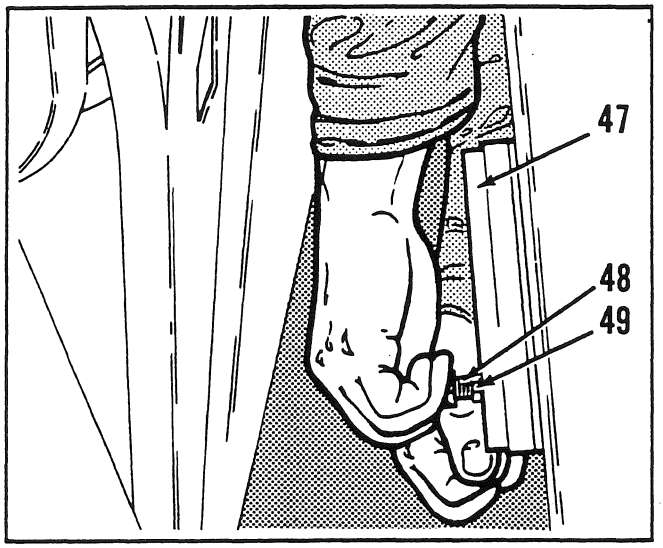


Fig. 50

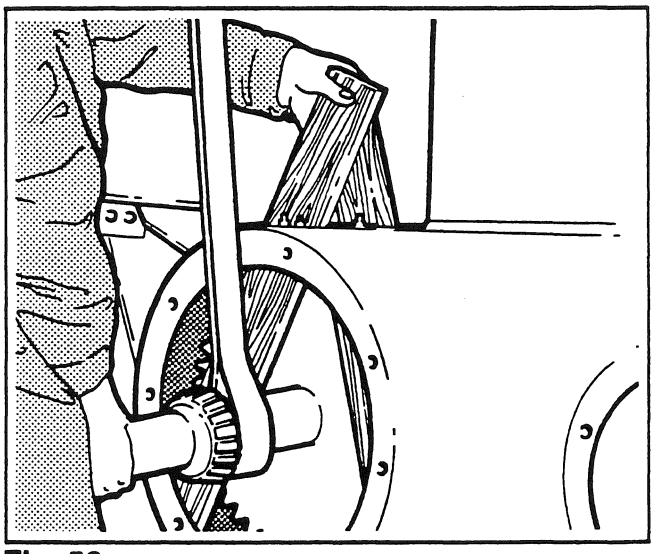


Fig. 53

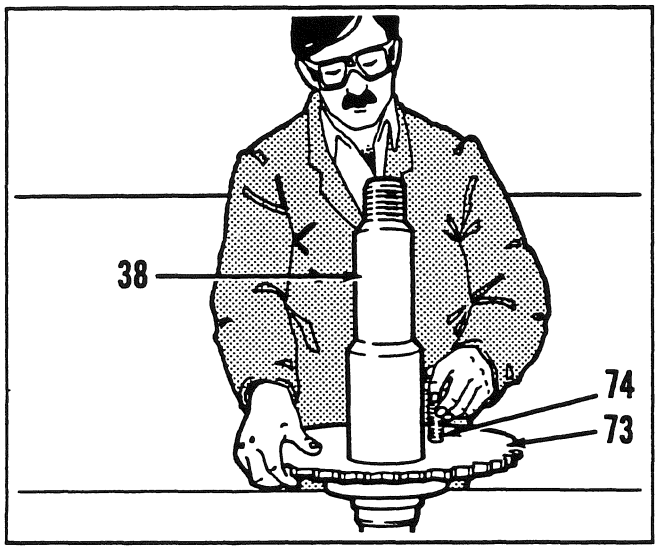
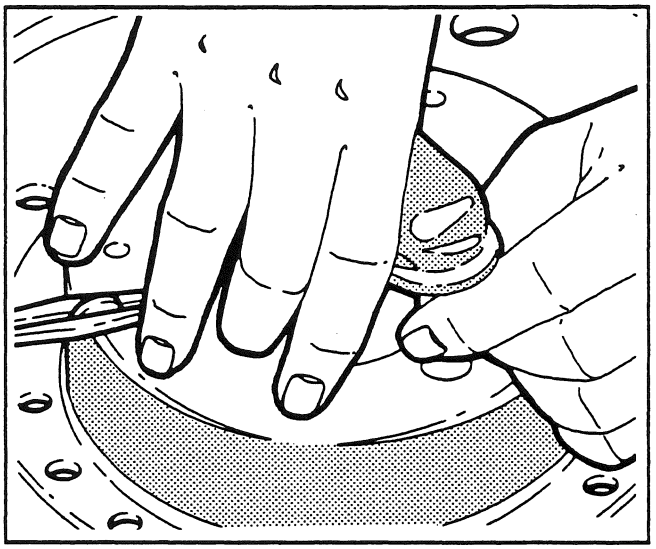


Fig. 51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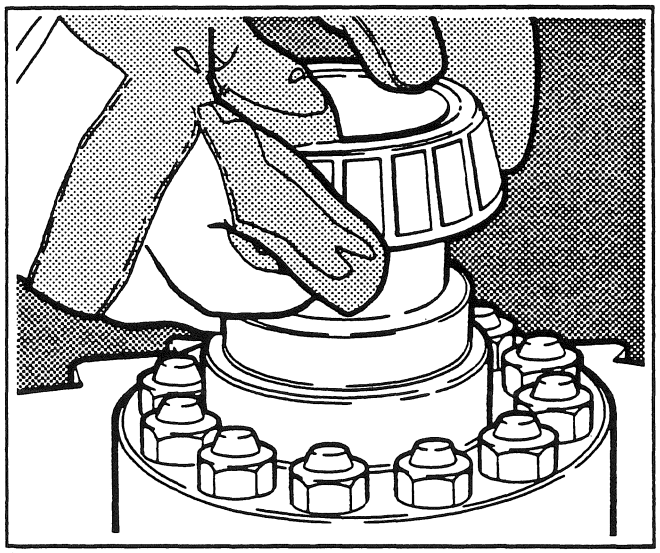
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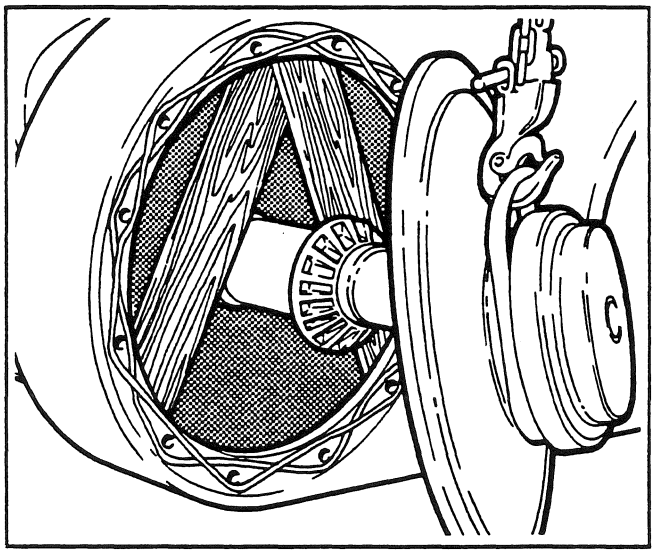
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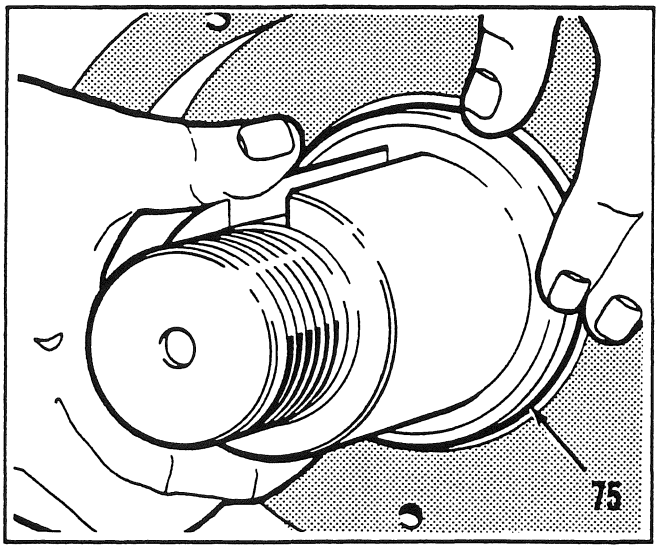

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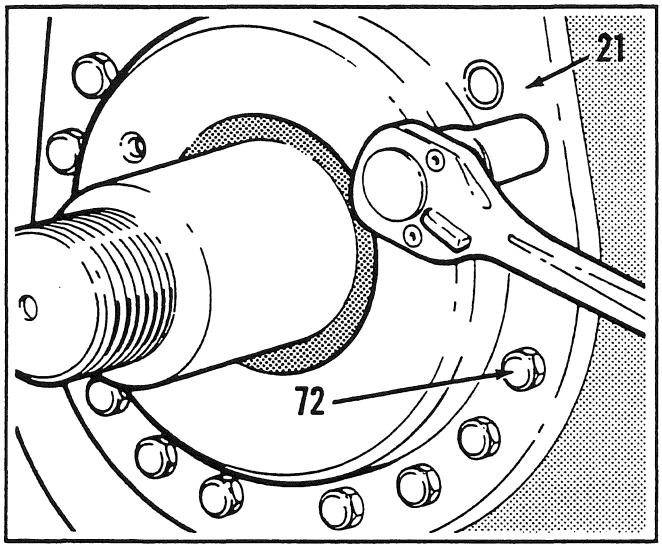

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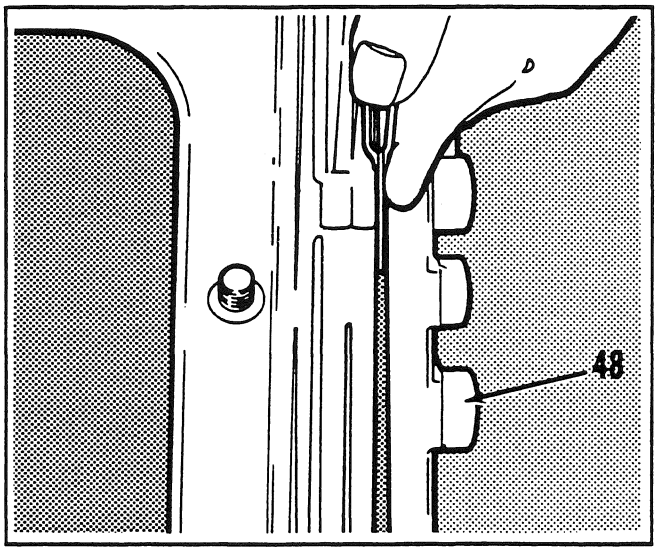

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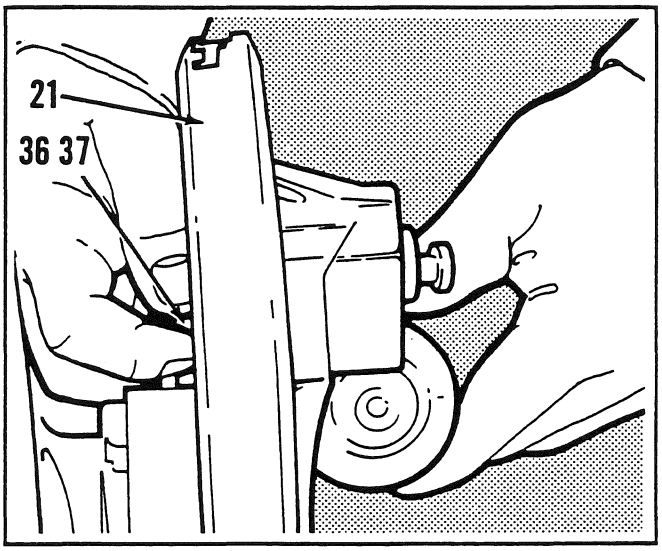

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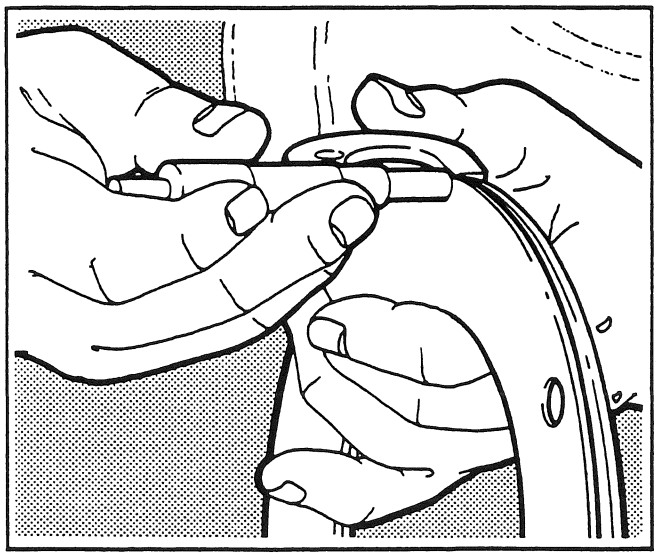


Fig. 58

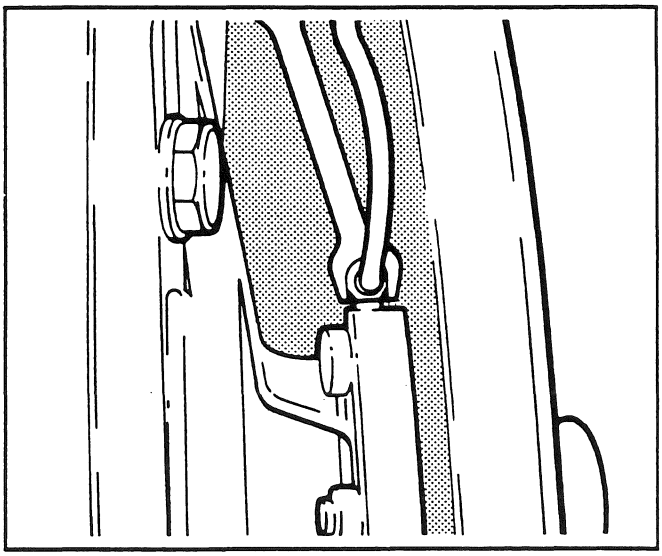


Fig. 61

Reassembly (continued)

Fig. 56
Lubricate and install a new stub axle seal (**75**).

Fig. 57
To set bearing pre-load, tighten the bearing cap capscrews (**48**) until a slight drag occurs when turning the large sprocket seen through the inspection port.
Using a feeler gauge, measure the gap between the bearing cap (**47**) and bearing flange (**45**).

Fig. 58
Using the measuement from Fig. 57, assemble a new shim pack (**46**) and install the bearing cap. Install the capscrews and tighten them to the specified torque. Check the rolling torque by rotating the large sprocket seen through the inspection port. The axle should rotate with a moderate pull. Add or remove shims as required.

Fig. 59
Install the backing plate (**21**) to the bearing housing (**Ref. Fig. 1**).
Install the capscrews (**72**) and tighten them to the specified torque.

Fig. 60
Lubricate all brake wheel cylinder parts with clean fresh brake fluid. Reassemble and mount the wheel cylinder (**Ref. Fig. 1**) to the backing plate (**21**) with capscrews (**36**) and lockwashers (**37**).

Fig. 61
Reconnect the brake line to the wheel cylinder (**Ref. Fig. 1**).

Reassembly (continued)

Fig. 62
Install the hold-down pins (**18**).

Fig. 63
Apply white grease onto the backing plate around the hold-down pins in six places. This will prevent damage to the backing plate.

Fig. 64
Intall the brake shoes (**Ref. Fig. 1**) hold-down springs (**15**) and cups (**14**).

Fig. 65
Install the auto-adjuster lever (**8**) and adjusting screw spring (**9**).

Fig. 66
Install the auto-adjuster cable (**10**), cable guide (**11**) and both brake shoe return springs (**12**).

Fig. 67
Install the key (**70**) on the stub axle (**38**) and align the roll pin in the slot (**Ref. Fig. 1**).

NOTE

Repeat the preceding procedures for the assembly of the other brakes and stub axle assemblies.

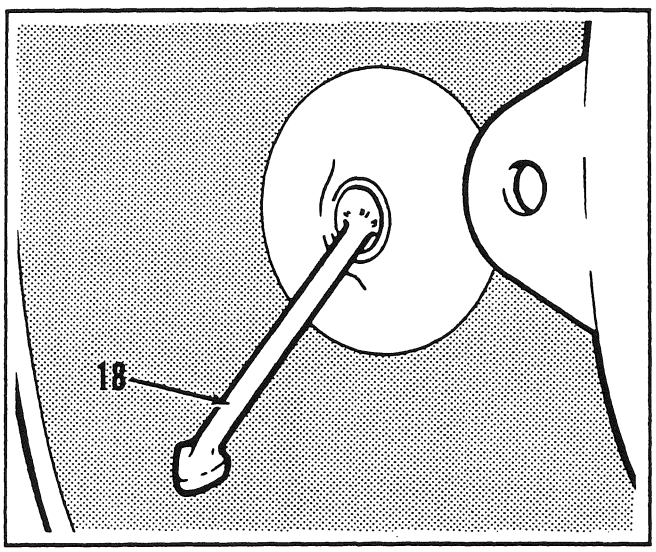


Fig. 62

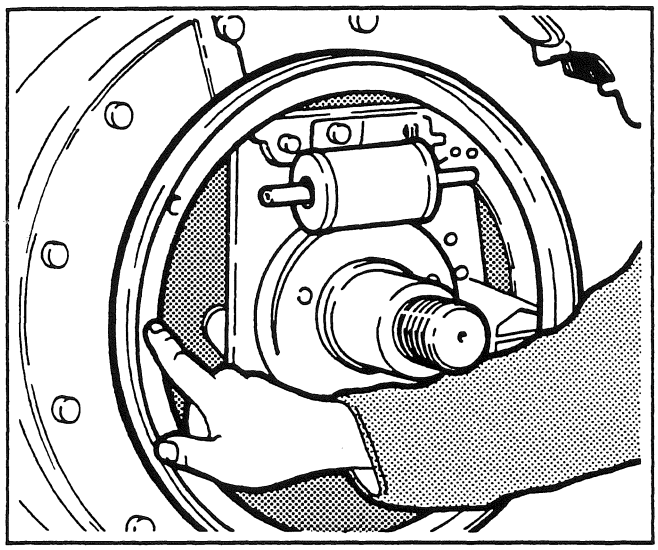


Fig. 63

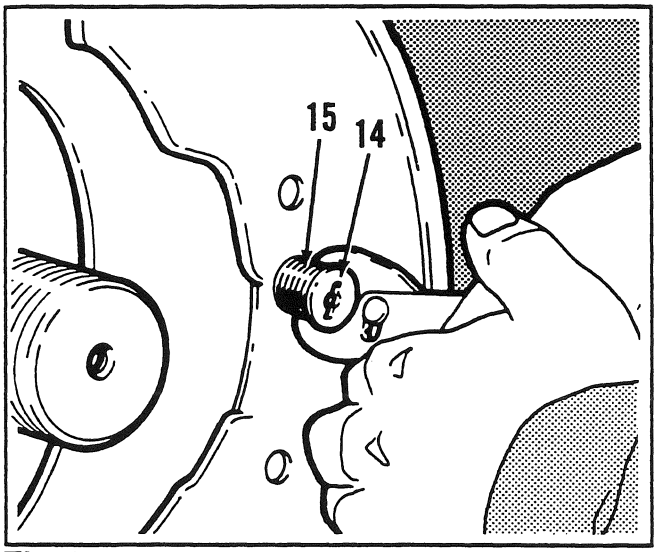


Fig. 64

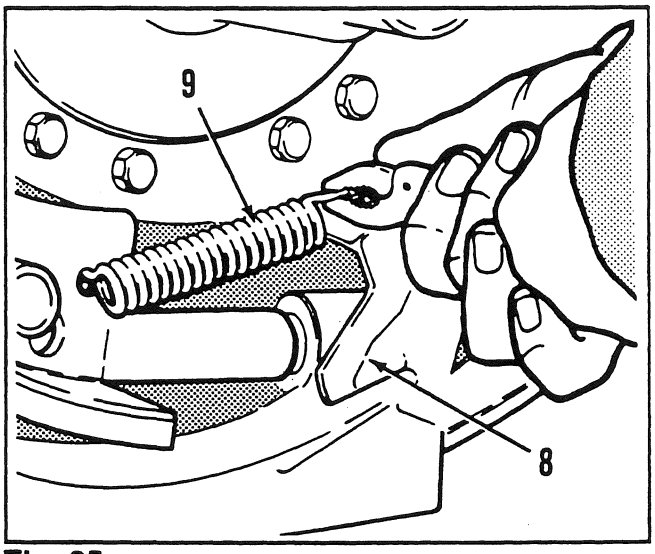


Fig. 65

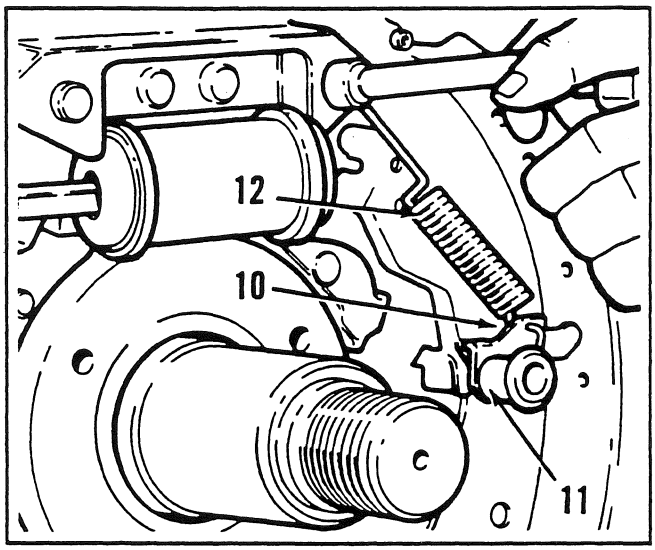
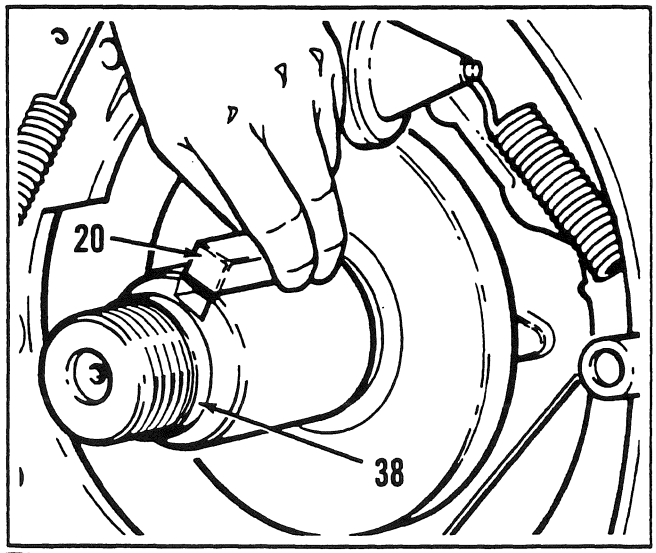


Fig. 66



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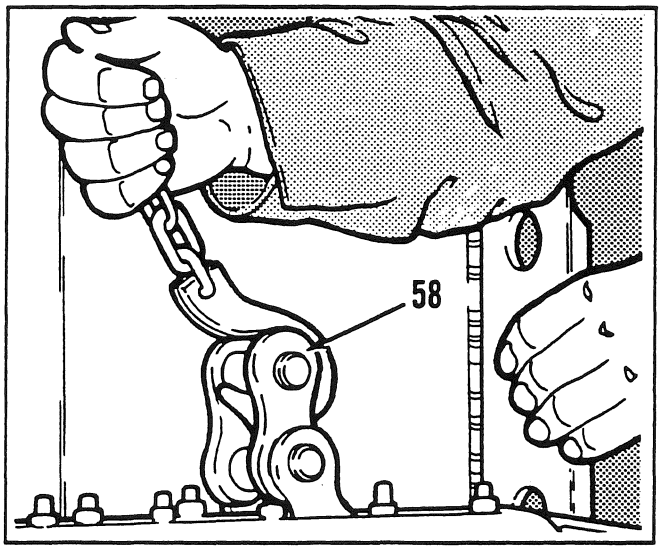

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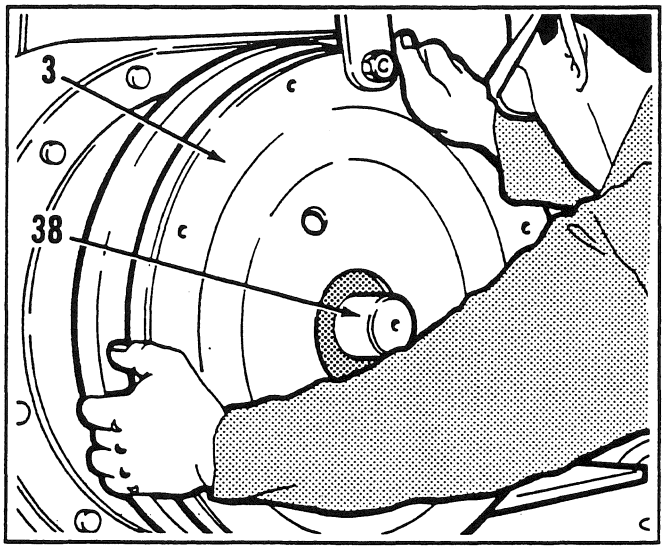

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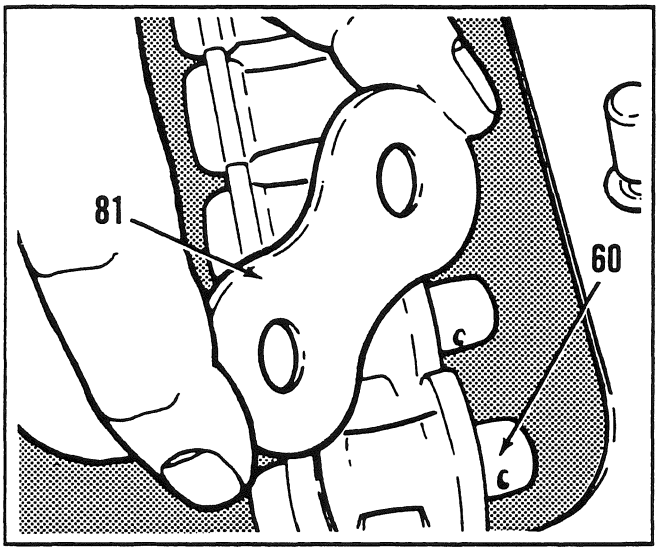

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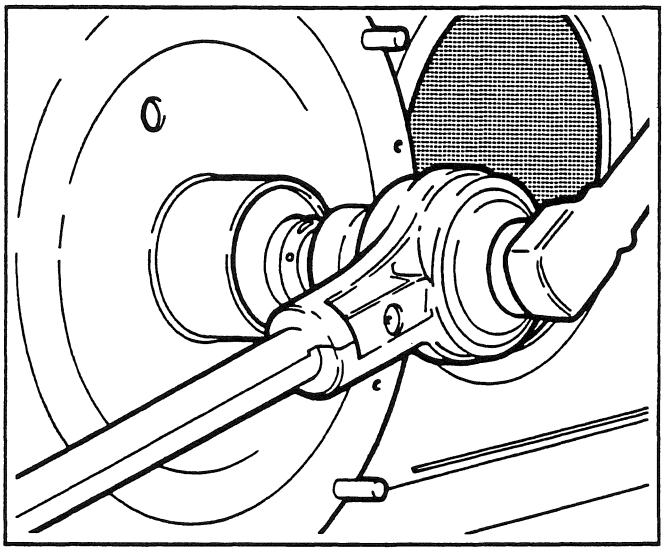

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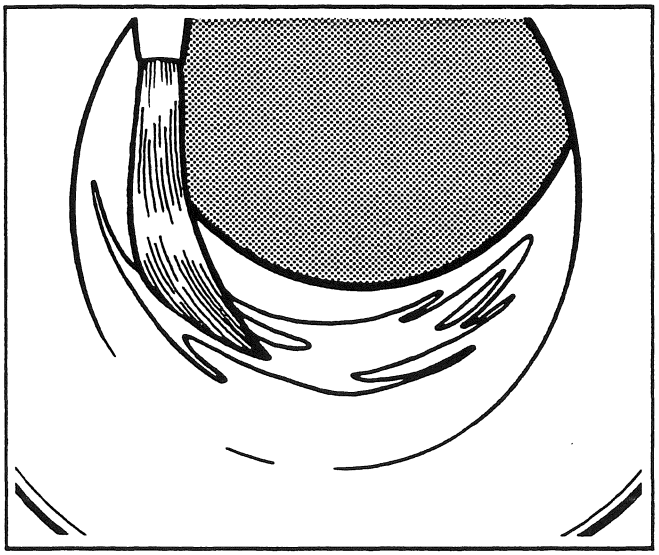

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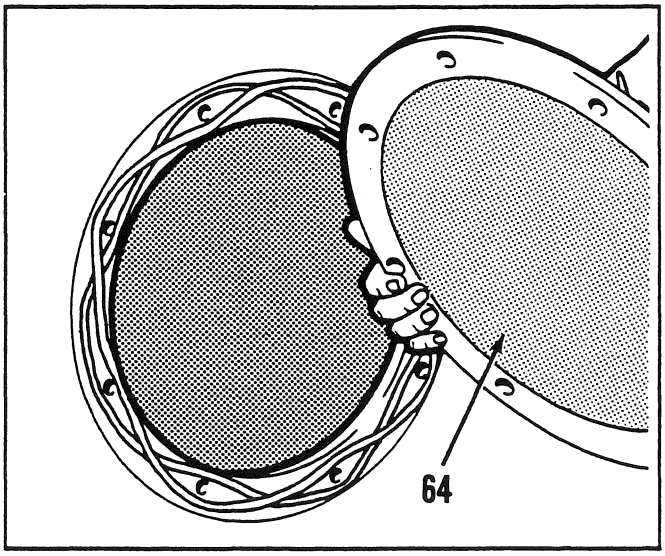


Fig. 73

Reassembly (continued)

Fig. 68
Using a safe lifting device, install lhe tandem chains (**58**) through the inspection ports.

NOTE

The pins of the connecting link and the holes of the side bar provide an interference fit. DO NOT under any circumstances, grind the pins or enlarge the holes.

Fig. 69
Connect the chains (**58**) using a lever and install both halves of the connector links (**60,81**) using new cotter pins (**Ref. Fig. 1**).

Fig. 70
Apply anti-seize compound to the stub axle opening of the wheel housing (**Ref. Fig. 1**).

Fig. 71
Using a safe lifting device, maneuver and install the wheel housing (**3**) and align the key (**Ref. Fig. 1**) of the stub axle (**38**) to the key slot in the wheel housing.

Fig. 72
Install the flat washer (**Ref. Fig.1**) and stub axle nut (**Ref. Fig. 1**) and tighten the nut to the specified torque.

Fig. 73
Apply silicone to the side cover openings of the tandems. Install the cover plate (**64**) with a new gasket (**63**) and retain the plate with eight countersunk head capscrews.
(**Ref. Fig. 1**)

NOTE

Install the tandem plugs and fill the tandems to the level check plug with new tandem oil through the inspection ports. The oil should be changed once a year or every 2000 hours.

Reassembly (continued)

Fig. 74
Apply a gasket sealant to the inspection port openings and install new gaskets (**Ref. Fig. 1**), inspection covers (**53**) and the brake line shields (**54**). Retain the covers and shields with lockwashers (**55**) and nuts (**56**). Tighten to the specified torque.

Adjusting the Brakes

Fig. 75
To adjust the brakes you must remove the rear spring clip cover and rubber plug (**Ref. Fig. 1**). Using an adjusting wrench (**special tool no. 377**) inserted in the lower slot, rotate the star wheel clockwise until the brake shoes contact the brake drum surface. Insert a suitable L-shaped bent rod [3/8 in.(9,5 mm) Dia. x 3 in. (7,6 mm) x 8 in.(20,0 mm) long] into the hole above the slot, depress the auto-adjuster lever until it releases from the star wheel. Using the adjusting wrench, rotate the star wheel counterclockwise **FOUR TEETH ONLY.** Remove both tools and replace the spring clip cover and rubber plug.

Fig. 76
Maneuver the tire and rim onto the wheel and place the rim clamps on the wheel studs and retain them with nuts. Tighten the nuts to the specified torque, in a diagonal sequence. Repeat these procedures for the other wheels.

Bleeding the Brakes

NOTE

The bleeding operation must be performed after the brakes have been adjusted.

Remove the filler cap from the master cylinder. Check the level of fluid and add fresh brake fluid if necessary.

NOTE

For graders equipped with a dual brake system, release the spring clip retaining the reservoir cap. Remove the cap. Replace the cap and secure it with the clip when bleeding of the brakes is completed.

Starting at the rear left-hand brake and connect a clean rubber tube to the bleeder screw and immerse the other end of the tube in a transparent container of clean, air bubble free brake fluid. Depress the brake pedal several times until minimized travel is obtained and maintain the pressure on the pedal. Release the bleeder screw with the tube connected and observe the air bubbles being released into the container. When the bubbles stop emitting into the container, tighten the bleeder screw.

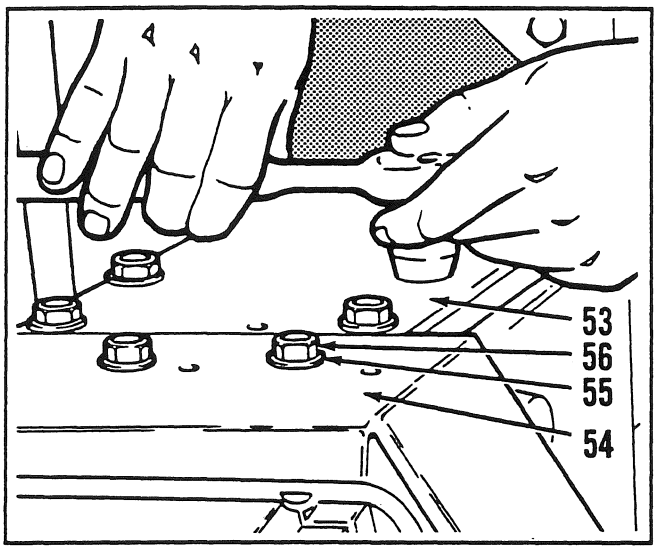


Fig. 74

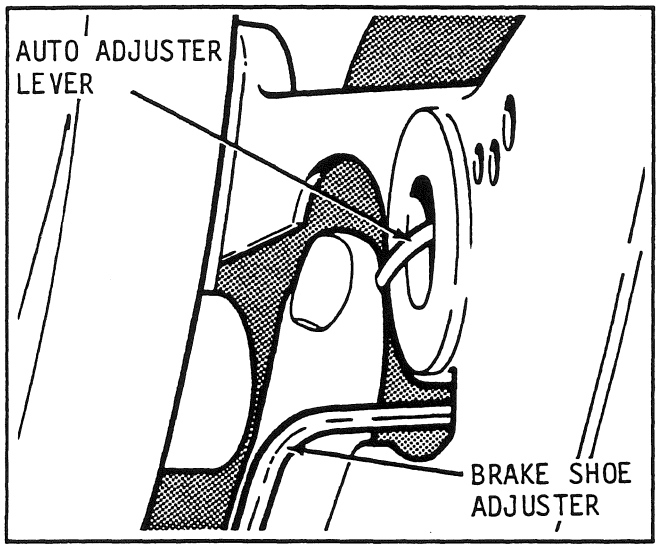


Fig. 75

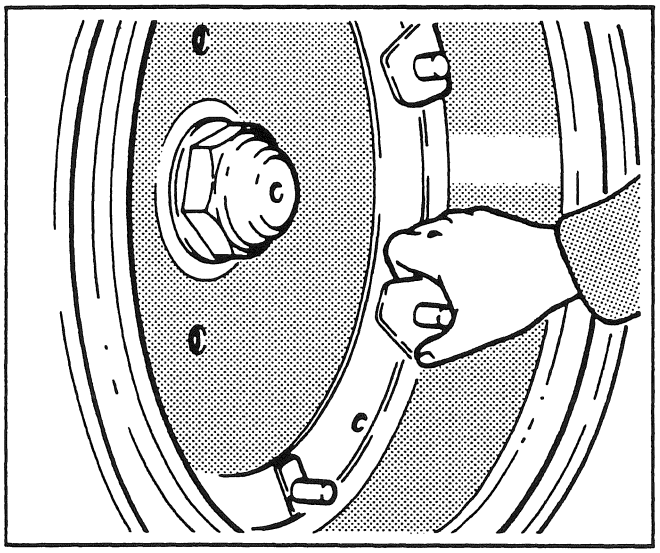


Fig. 76

Bleeding the Brakes (continued)

NOTE

It maybe necessary to repeat the procedures of depressing the brake pedal and releasing the brake screw several times before all the air is removed from the brake line system.

Refill the master brake cylinder to the required level with fresh brake fluid.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD THE BRAKE FLUID CONTAINER BE SHAKEN TO REMOVE TRAPPED AIR BUBBLES. IF AIR BUBBLES REMAIN, ALLOW THE FLUID TO STAND UNTIL ALL OF THE AIR HAS DISSIPATED.

Repeat the preceding instructions for bleeding the brakes in the following sequence. Front left-hand, front right-hand and the rear right-hand brake. When you have completed the bleeding procedure, replace the filler cap on the master cylinder.

Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the rear end of the machine. Remove the supports. Raise the moldboard to lower the rear of the machine onto its wheels.

Road test the grader and check hydraulic brake hoses for leaks.

Bleeding the Brakes (continued)

NOTE

It maybe necessary to repeat the procedures of depressing the brake pedal and releasing the brake screw several times before all the air is removed from the brake line system.

Refill the master brake cylinder to the required fluid level with fresh brake fluid.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD THE BRAKE FLUID CONTAINER BE SHAKEN TO REMOVE TRAPPED AIR BUBBLES. IF AIR BUBBLES REMAIN, ALLOW THE FLUID TO STAND UNTIL ALL OF THE AIR HAS DISSIPATED.

Repeat the preceding instructions for bleeding the brakes in the following sequence. Front left-hand, front right-hand and the rear right-hand brake.

When you have completed the bleeding procedure, replace the filler cap on the master cylinder.

Fig. 76

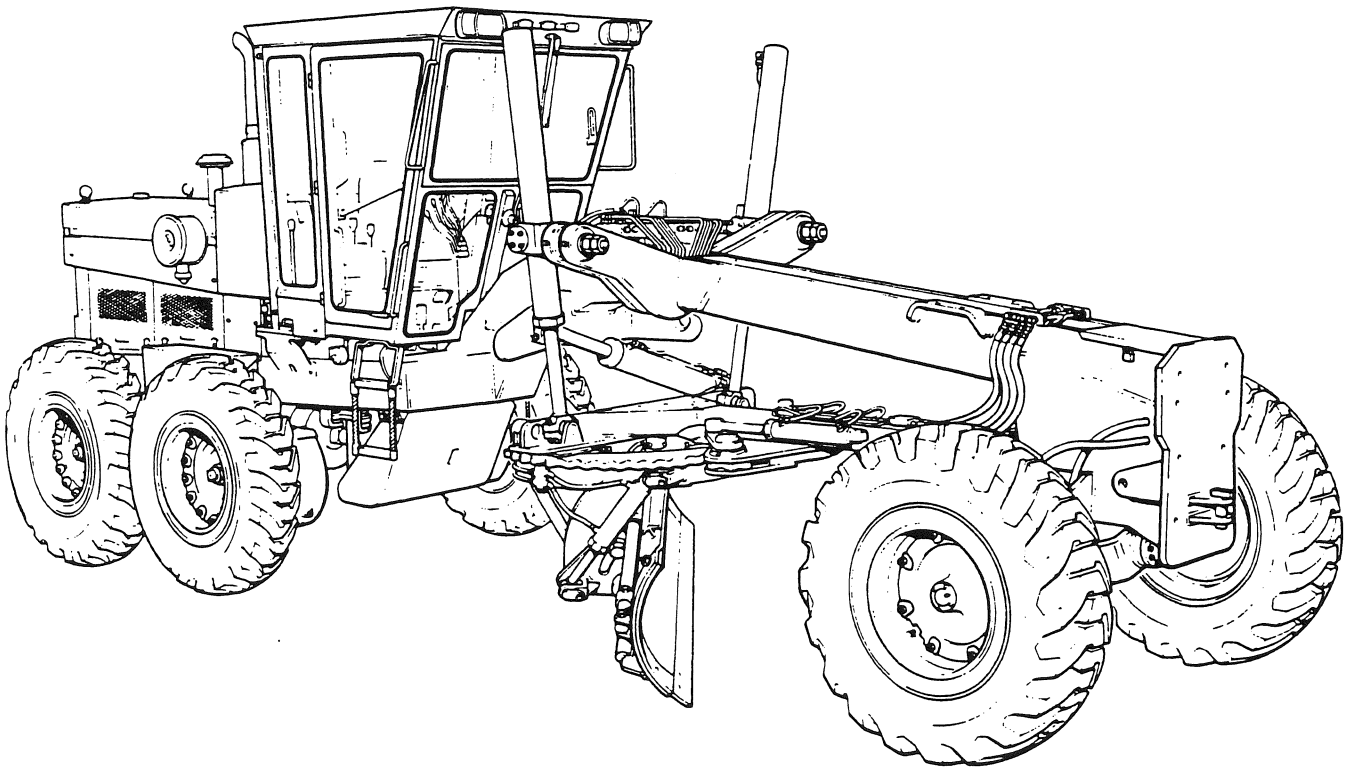
Maneuver the tire and rim onto the wheel and place the rim clamps on the wheel studs and retain them with nuts. Tighten the nuts to the specified torque, in a diagonal sequence. Repeat these procedures for the other wheels.

Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the rear end of the machine. Remove the supports. Raise the moldboard to lower the rear of the machine onto its wheels.

Road test the grader and check hydraulic brake connections for leaks.

SECTION 14

ENGINE REMOVAL AND INSTALLATION



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"USE AS A GUIDE ONLY"

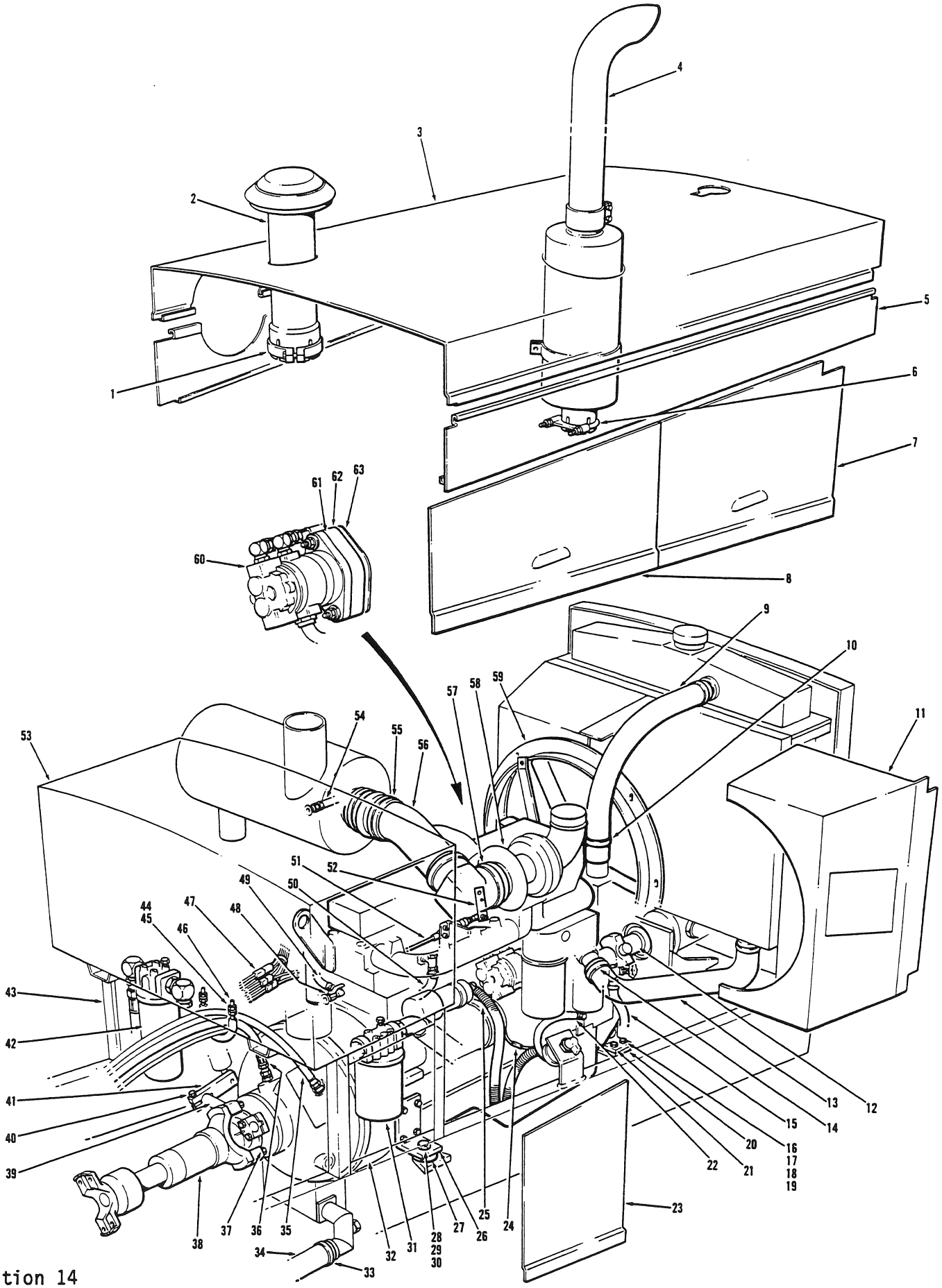
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Fig. 1

Item	Description	Item	Description	Item	Description
1	Clamp	23	Panel	43	Stand
2	Air cleaner extension	24	Articulation solenoid wiring harness	44	Nuts
3	Engine hood	25	Positive cable	45	Lockwashers
4	Muffler/exhaust stack	26	Engine front support	46	U bolt
5	Intermediate panel	27	Rubber mount	47	Wiring harness connectors
6	Clamp	28	Locknuts	48	Fuel feed valve
7	Rear lower panel	29	Bolts	49	Fuel feed hose
8	Front lower panel	30	Plain washers	50	Heater hose
9	Upper radiator hose	31	Primary hydraulic oil filter	51	Accelerator cable
10	Clamp	32	Clutch housing	52	Engine governor arm
11	Left hand shroud	33	Clamp	53	Fuel tank
12	Transmission/steering hydraulic pump driveshaft	34	Drain hose	54	Fuel return hose
13	Lower radiator hose	35	Breather hose	55	Clamp
14	Clamp	36	Lubrication pressure hose	56	Air cleaner duct
15	Heater hose	37	Bolts	57	Clamp
16	Nuts	38	Driveshaft	58	Engine
17	Bolts	39	Shaft	59	Shroud ring
18	Plain washers	40	Bolt	60	Primary hydraulic pump
19	Lockwashers	41	Arm	61	Gasket
20	Pads	42	Transmission hydraulic oil filter	62	Adapter
21	Engine rear support			63	Gasket
22	Ground strap				

Key to Fig. 1

General

A clean work area will reduce the chance of foreign matter entering the hydraulic system.

Make sure proper tools are available and in good working order. You will require a safe lifting device; blocks or proper stands and shop tools.

Refer to the 700 Series Parts Manual for spare parts information. Refer to the Lubrication Specifications in the front of this Shop Manual for lubricant information.

ALWAYS put the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure.

Refer to the SERVICE POSITION details on page (ii) in the front of this Shop Manual.

NOTE

Weights, measures and tolerances are in Metric (SI), Imperial and U.S. quantities. International standards specify the comma to represent the decimal point in all Metric measurements.

NOTE

The terms left hand side and right hand side indicate the directions when in the operator's cab looking toward the front of the grader.

Description

This Shop Manual Section describes how to remove and install the engine.

Depending on your engine model and grader options, you may or may not have to remove the fuel tank and fuel tank stand. Normally, the clutch housing should stay with the engine during this procedure.

Torque Guide

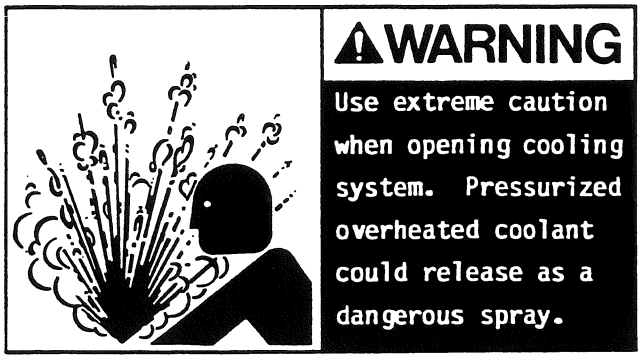
Fig. No.	Application	Torque Value N.m	kgf.m	lbf.ft
Fig. No. 37	Engine rear support retaining nuts	47,5	4,8	35
Fig. No. 38	Engine front support retaining locknuts	379,6	38,7	280
Fig. No. 39	Transmission/steering hydraulic pump driveshaft bolts	31,2	3,2	23
Fig. No. 42	Primary hydraulic pump retaining nuts	77,3	7,9	57
Fig. No. 55	Slave cylinder bracket bolts	17,6	1,8	13
Fig. No. 57	Driveshaft bolts	31,2	3,2	23
Fig. No. 58	Transmission hydraulic oil filter bolts	31,2	3,2	23
Fig. No. 59	Primary hydraulic oil filter bolts	17,6	1,8	13

Engine Removal

Fig. 2

Park the grader on level ground. Place the transmission mode lever in **Neutral.** Lower the moldboard onto wooden blocks. Shut down the engine and place the machine in the **SERVICE POSITION.** Remove the panels (23) below the fuel tank (53). Remove the front (8) and rear (7) lower panels Remove the intermediate panels (5).

Fig. 3



Turn off the heater hose valve on the right hand side of the engine (58). Disconnect the heater hose (50). Cap the open port and hose. Repeat this step for the left hand valve and heater hose (15).

Fig. 4

After disconnecting the left hand heater hose, open the valve and drain the coolant into a container (35 L [7.7 Imp. gal, 9.2 U.S. gal] capacity or more.

Fig. 5

Loosen the clamp (14) and disconnect the lower radiator hose (13). Drain the coolant into a container (35 L [7.7 Imp. gal, 9.2 U.S. gal]) capacity or more.

Fig. 6

Loosen the clamp (6) securing the muffler/exhaust stack (4) to the turbocharger. Remove the nut, bolt and lockwasher retaining the clamp to the brace. Remove the muffler/exhaust stack and immediately cap the turbocharger.

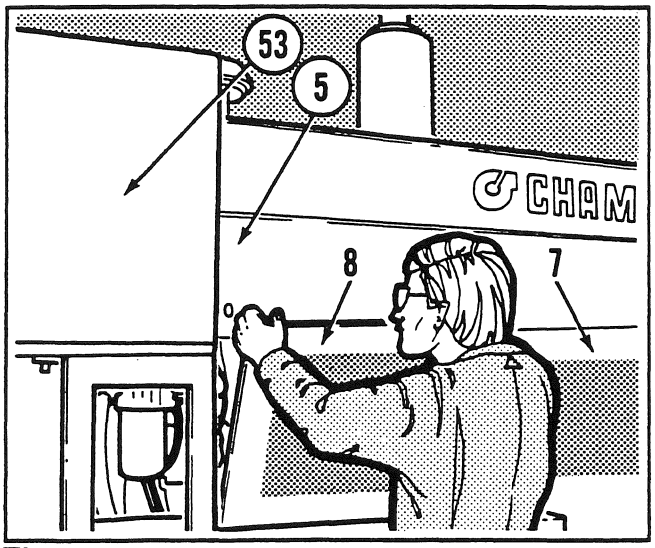


Fig. 2

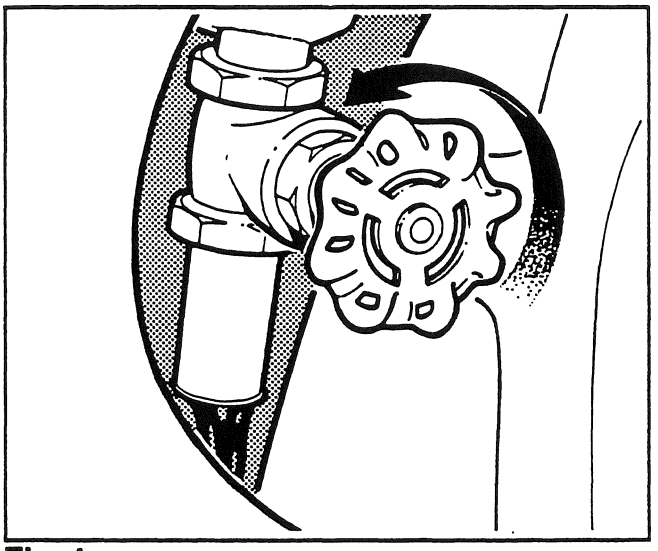


Fig. 4

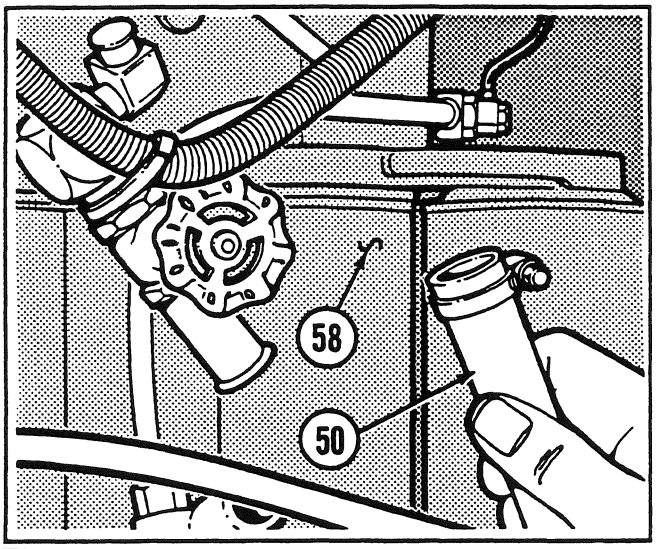


Fig. 3

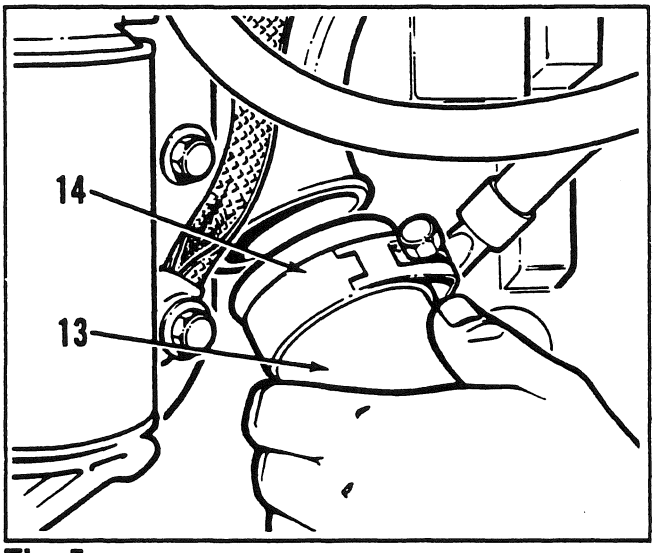


Fig. 5

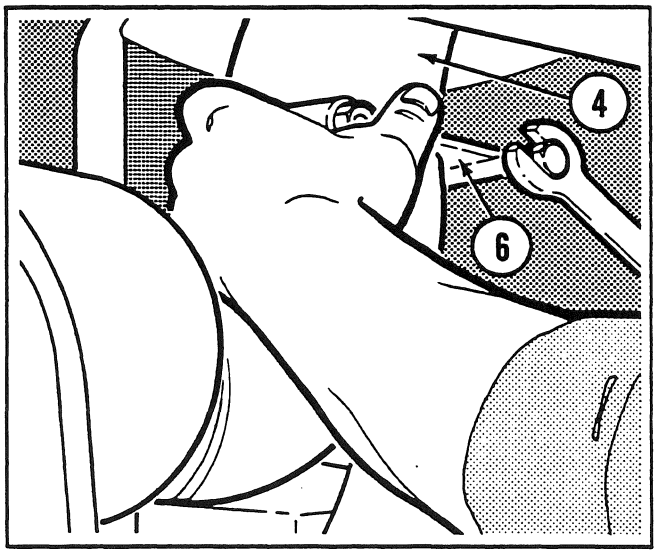


Fig. 6

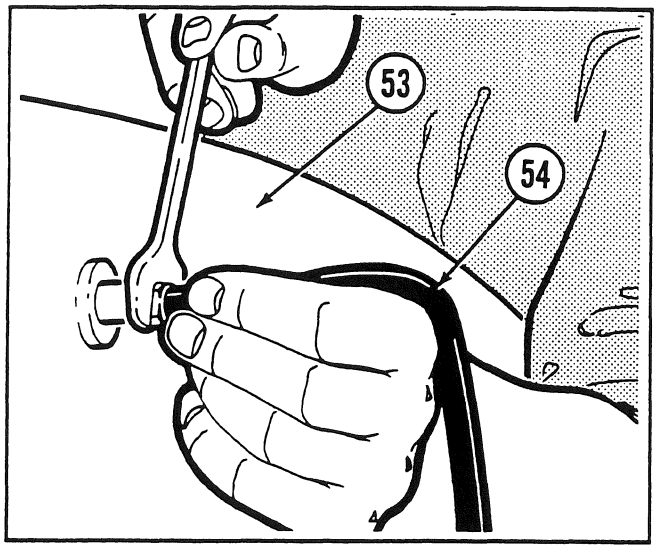
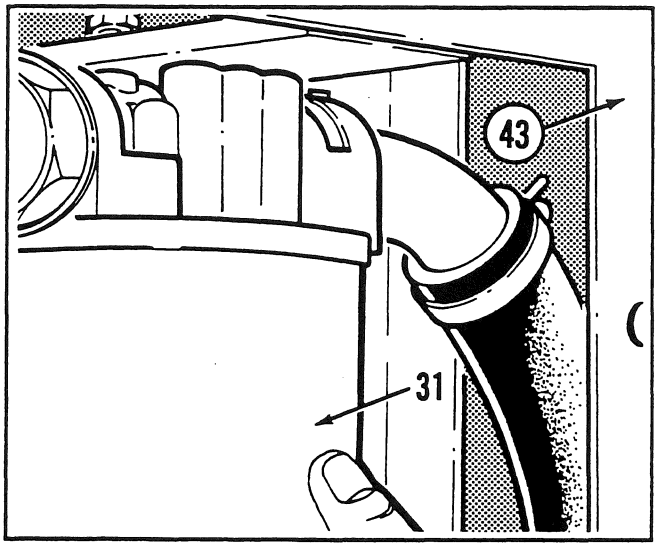


Fig. 7



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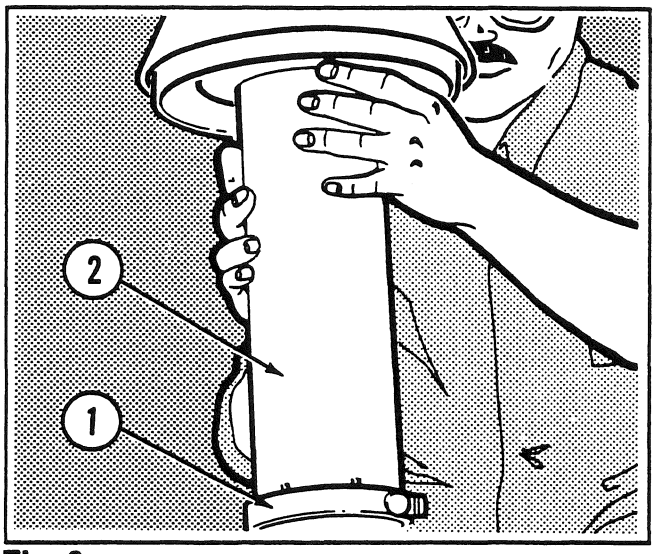

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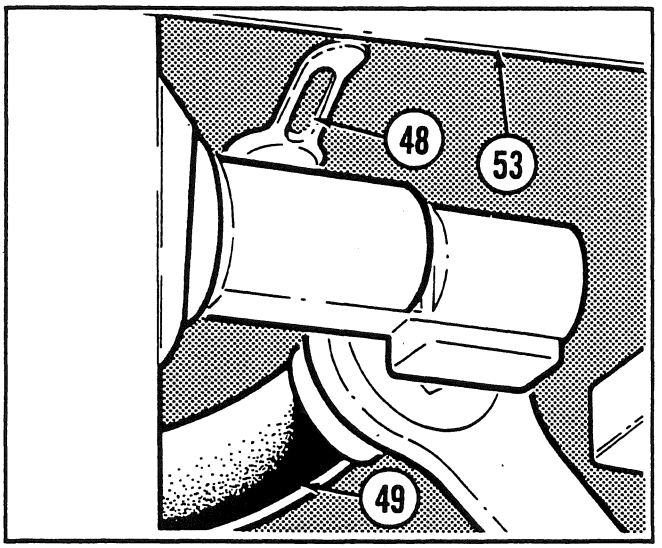

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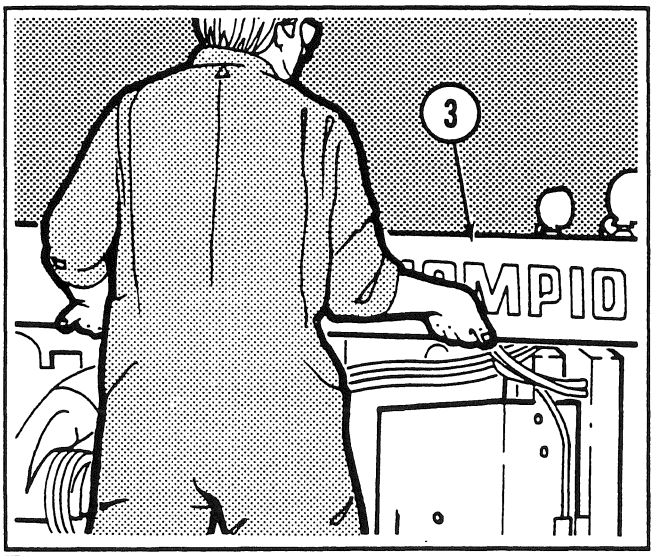

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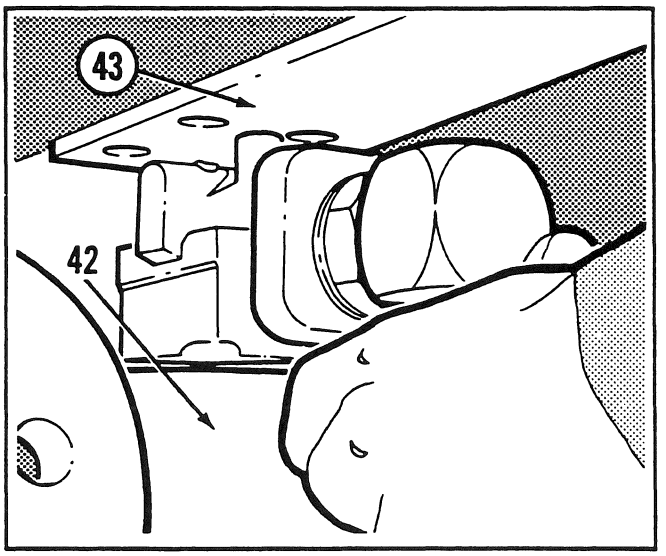


Fig. 12

Engine Removal (Continued)

Fig. 7
Disconnect the fuel return hose (54) from the fuel tank (53). Fuel will leak if the level is above the return port. Immediately cap the open port and hose fitting.

Fig. 8
Loosen the clamp (1) securing the air cleaner extension (2). Remove the extension and immediately cap the air cleaner intake tube.

Fig. 9
Remove the bolts, lockwashers and plain washers retaining the engine hood (3). Remove the hood.

Fig. 10
Remove and discard the plastic ties securing any hoses or wires to the stand (43). Remove the bolts and lockwashers retaining the primary hydraulic oil filter (31). Remove the filter. It is not necessary to disconnect the hoses from the filter.

Fig. 11
Close the fuel feed valve (48) below the fuel tank (53). Disconnect the fuel feed hose (49) and immediately cap the hose and port.

Fig. 12
Remove the bolts and lockwashers retaining the transmission hydraulic oil filter (42) to the stand (43). Remove the filter. It is not necessary to disconnect the hoses from the filter.

Engine Removal (Continued)

Fig. 13
Remove the bolts and lockwashers retaining the slave cylinder bracket to the clutch housing (32). Loosen the bolt (40) retaining the arm (41) on the shaft (39). Remove the slave cylinder and bracket. A Woodruff key prevents the arm turning on the shaft.

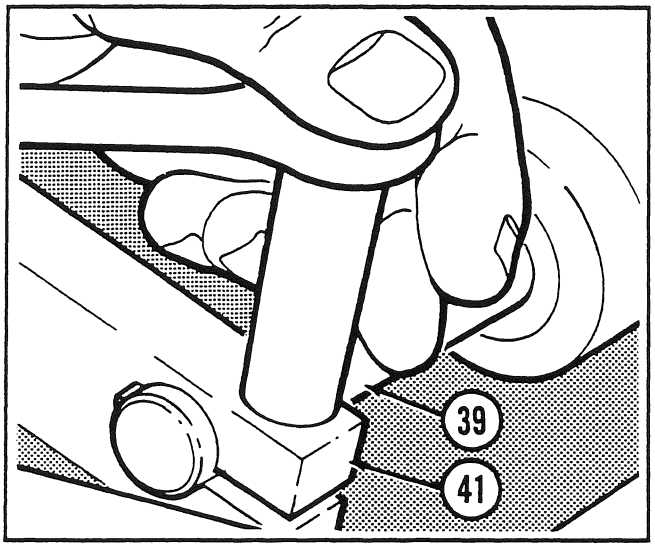
Fig. 14
Remove the clamp retaining the accelerator cable (51). Disconnect the accelerator cable from the engine governor arm (52).

Fig. 15
Remove the nuts and lockwashers retaining the primary hydraulic pump (60) and adapter (62). Remove the pump and adapter. Discard the two gaskets (61 and 63). It is not necessary to disconnect the hoses from the pump.

Fig. 16
Remove the nuts (44), lockwashers (45) and U bolt (46) retaining the hoses and wiring harnesses below the stand (43).

Fig. 17
Loosen the clamp (33) at the clutch housing drain manifold. Disconnect the drain hose (34). Immediately cap the hose and open port.

Fig. 18
Remove the bolts (37) and lockwashers from both ends of the driveshaft (38). Remove the driveshaft. Ensure that the universal joint bearings do not fall off during this procedure.



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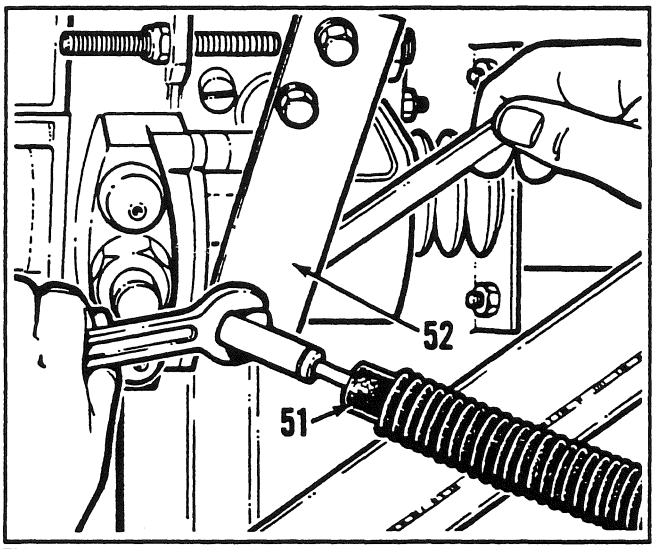

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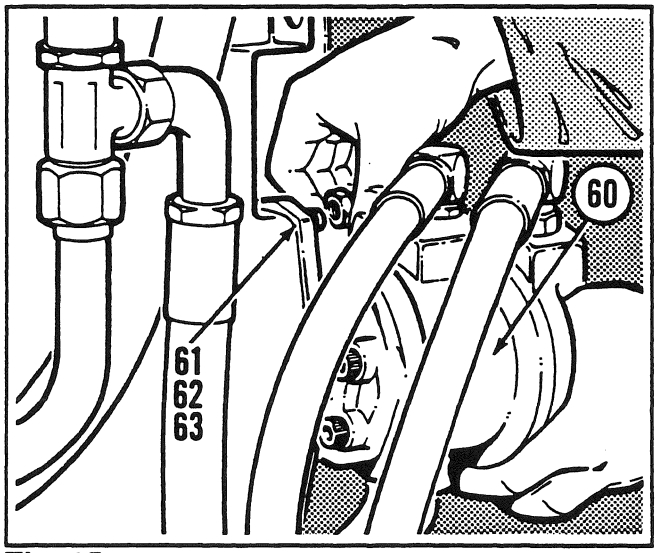

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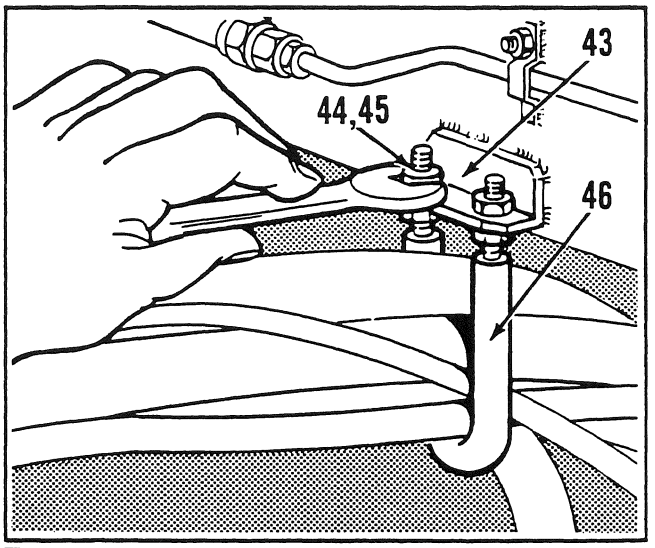

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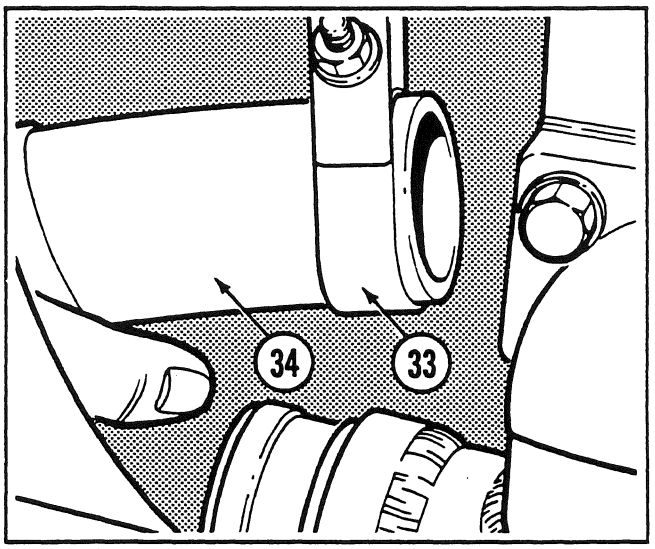

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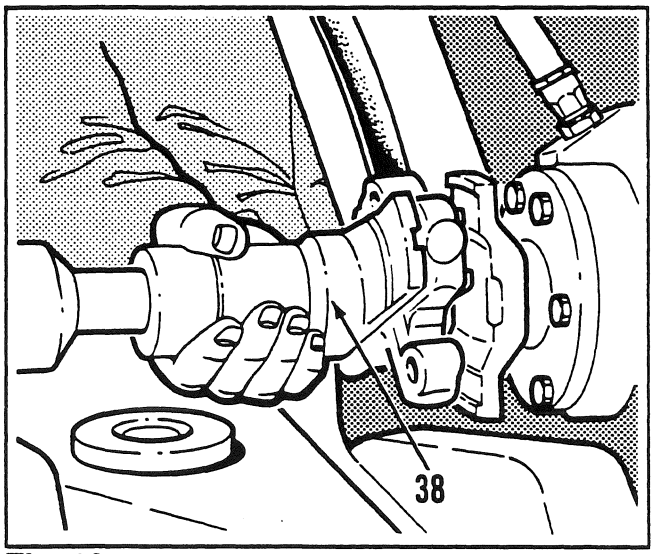

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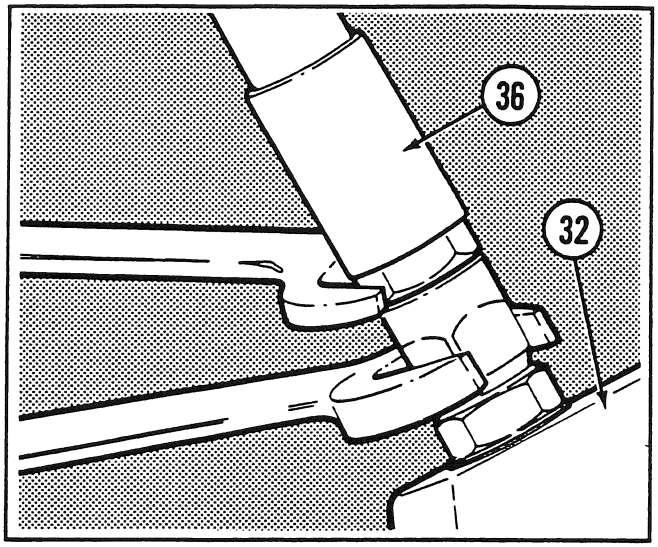

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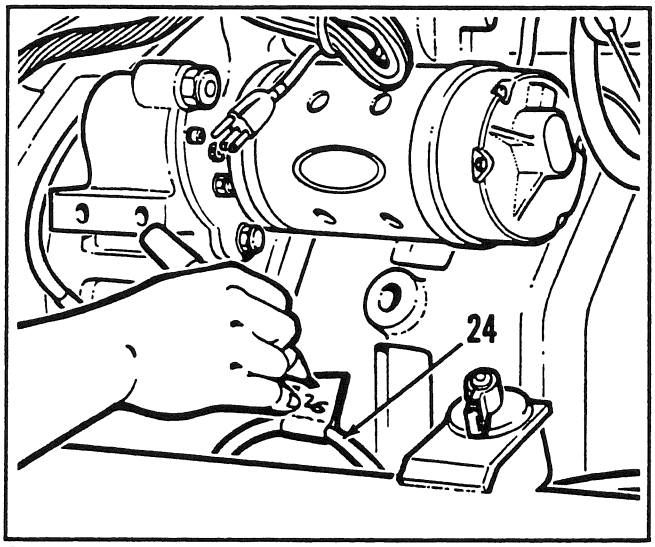

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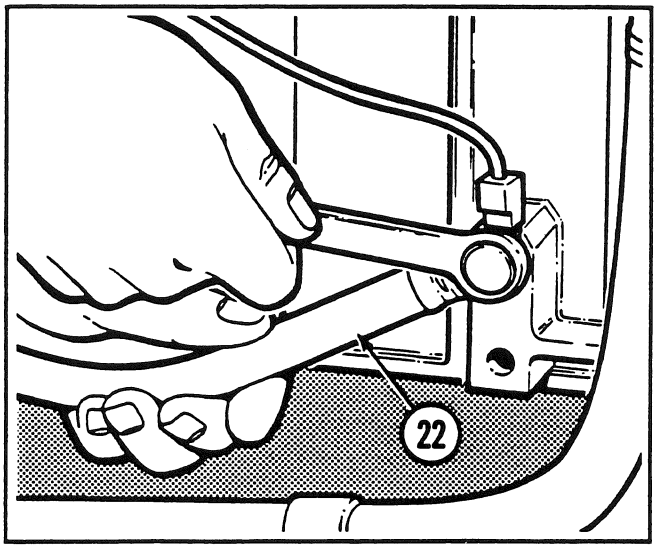
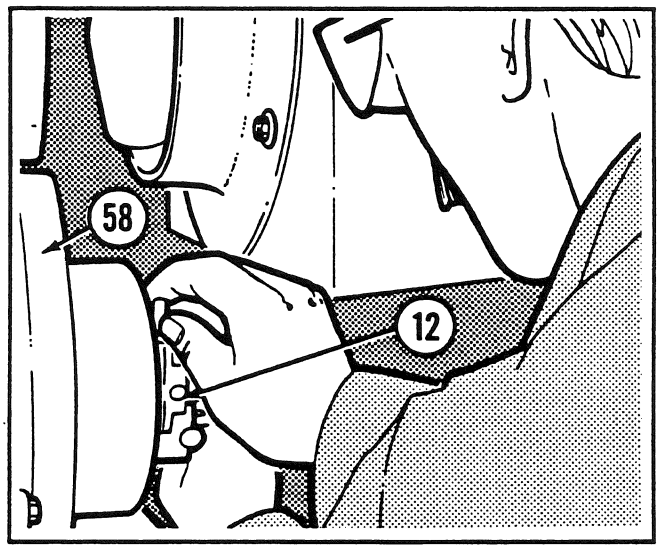


Fig. 20



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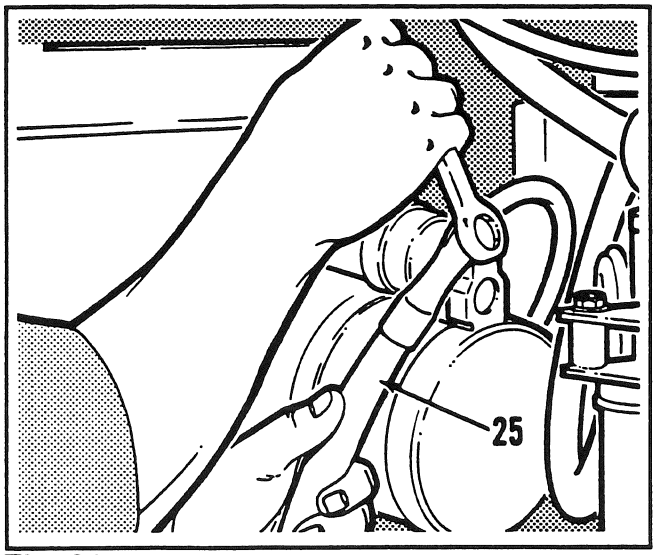

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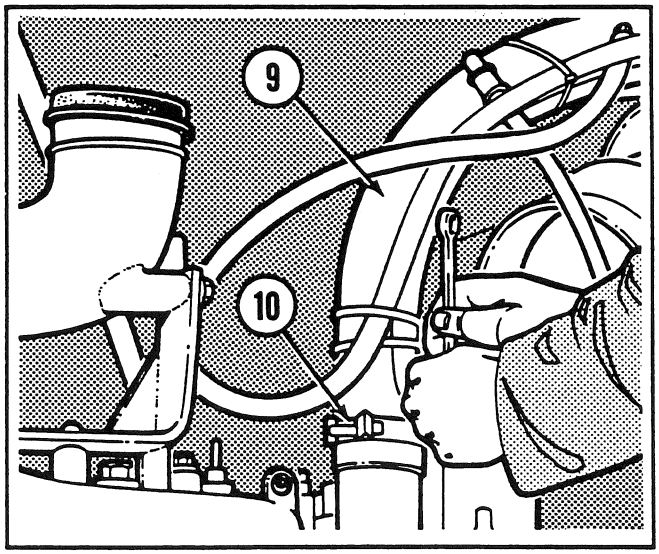


Fig. 24

Engine Removal (Continued)

Fig. 19
Use an appropriate method and identify the breather hose (35) and lubrication pressure hose (36) to prevent confusion during installation. Disconnect the hoses from the clutch housing (32). Immediately cap the open ports and fittings. Remove the heater hose clip from the clutch housing.

Fig. 20
Disconnect the ground strap (22) from the engine cylinder block.

Fig. 21
Disconnect the positive cable (25) from the starter motor.

Fig. 22
Use an appropriate method and identify the wiring harness connectors (47) under the fuel tank (53) to prevent confusion when connected. Disconnect the harnesses. For articulated frame graders, identify the articulation wiring harness (24). Disconnect the harness and remove it from behind the starter motor.

Fig. 23
Remove the bolts and lockwashers retaining the transmission/steering hydraulic pump driveshaft (12) to the pump drive adapter. Slide the driveshaft away from the engine (58).

Fig. 24
Loosen the clamp (10). Disconnect the upper radiator hose (9) from the engine thermostat outlet.

Engine Removal (Continued)

Fig. 25
Remove the bolts and plain washers retaining the shroud ring (59) to the radiator shroud. Remove the shroud ring. Remove only the bolts and plain washers retaining the left hand shroud (11). Remove the left hand shroud.

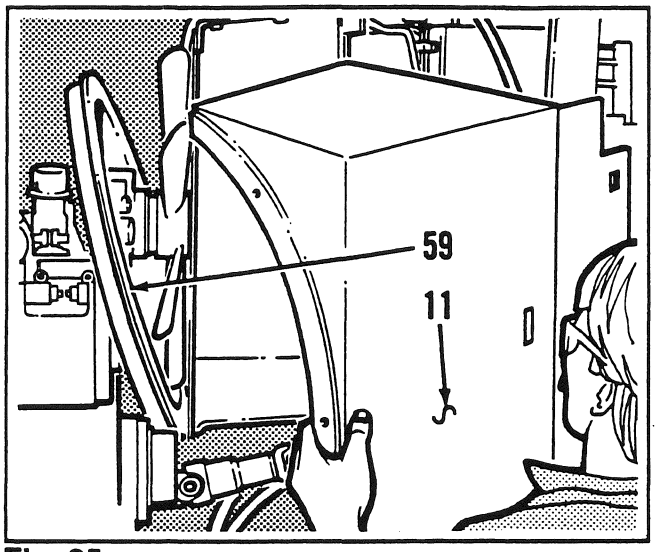
Fig. 26
Loosen the clamps (55 and 57). Remove the air cleaner duct (56) from the engine turbocharger and air cleaner tube. Immediately cap the open ports of the turbocharger, air cleaner tube and duct.

Fig. 27
Attach chains from a safe lifting device to the front and rear lifting eyes on the engine block. **Make sure** you keep the chains taut; remove any slackness in the links.

Fig. 28
Remove the nuts (16), bolts (17), plain washers (18) and lockwashers (19) securing the engine rear support (21) to the frame cross member.

Fig. 29
Remove the locknuts (28), bolts (29) and plain washers (30) securing the engine front supports (26) to the frame brackets. Inspect the locknuts for possible re-use. Locknuts can normally be re-used twice from new. If in doubt, discard the part.

Fig. 30
Raise the engine (58) a little distance using a safe lifting device. Move the engine toward the front of the grader sufficiently enough to remove the transmission/steering hydraulic pump driveshaft (12).



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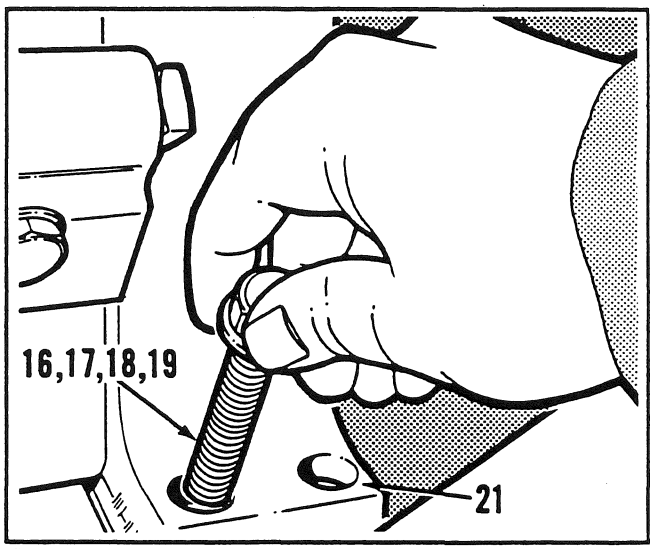


Fig. 28

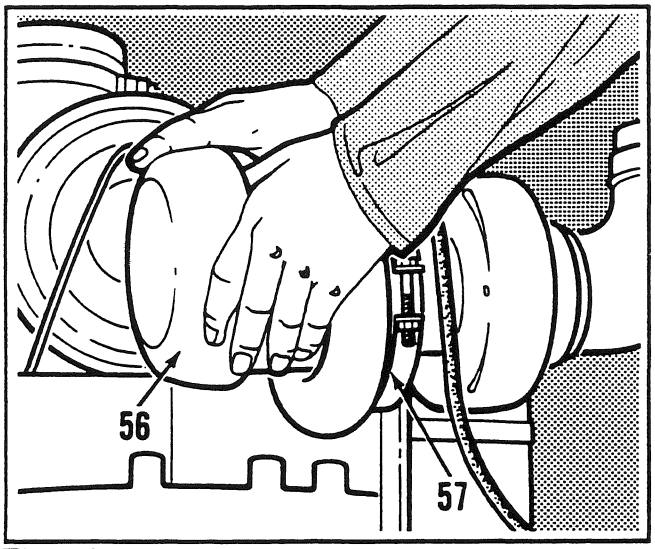


Fig. 26

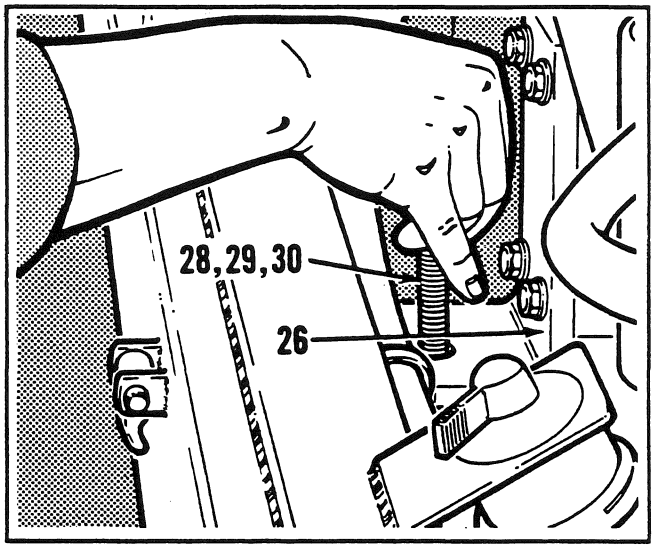


Fig. 29

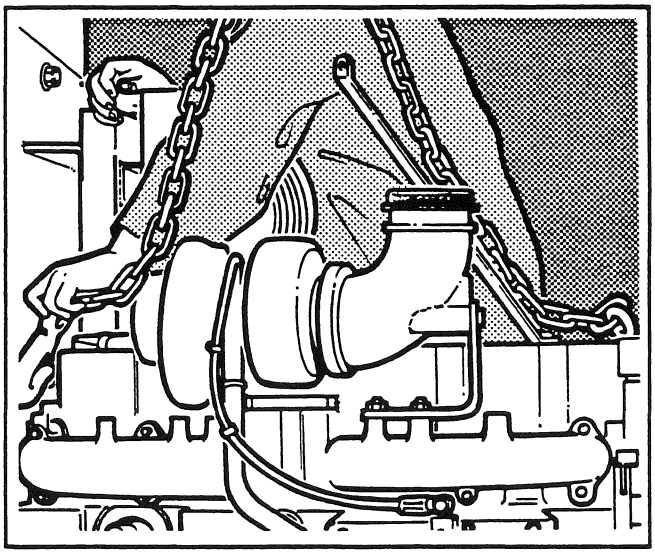


Fig. 27

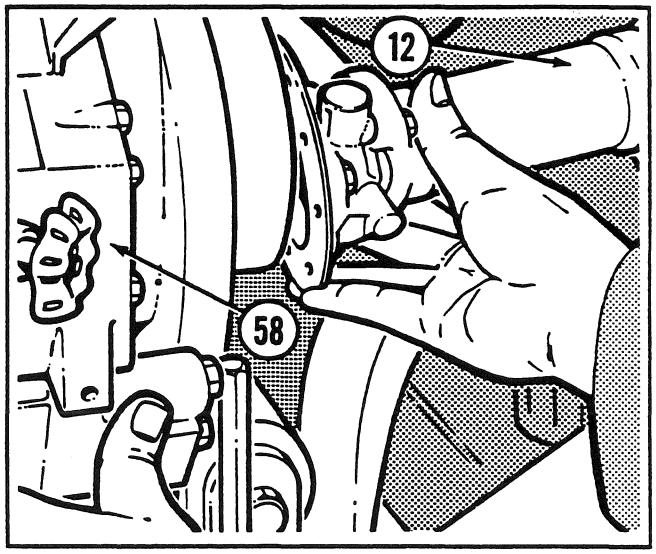


Fig. 30

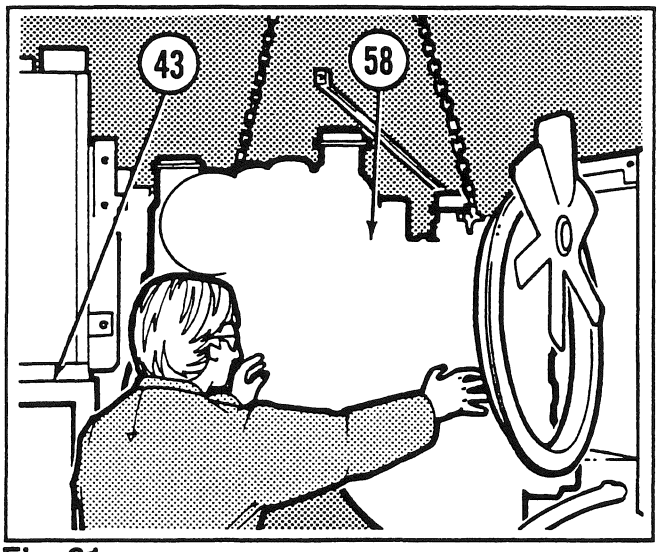


Fig. 31

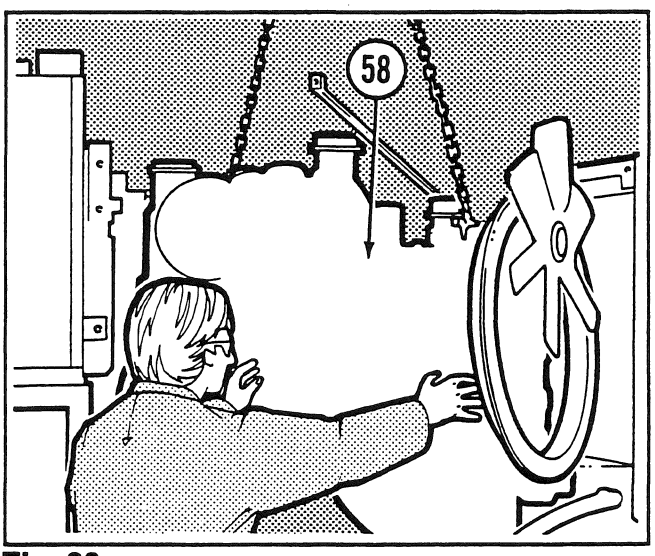


Fig. 33

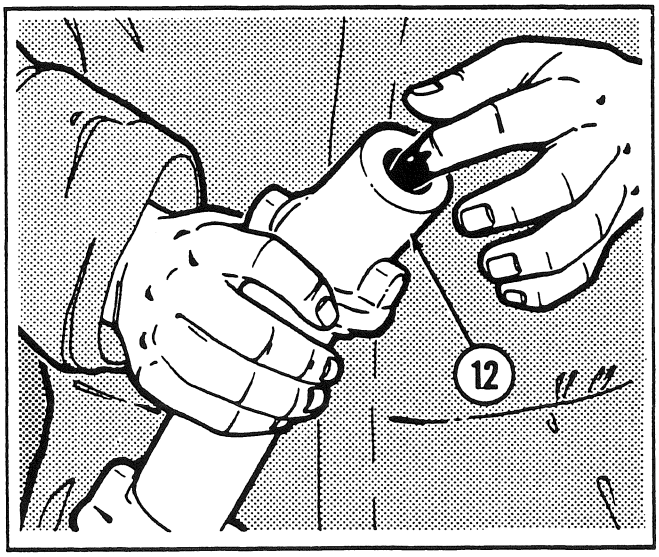


Fig. 32

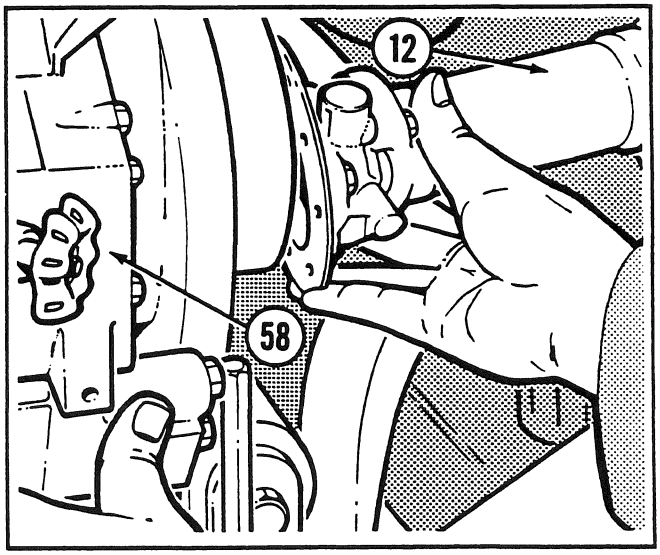


Fig. 34

Engine Removal (Continued)

Fig. 31

NOTE

MAKE SURE the fan does not strike the radiator or shroud; the valve cover does not strike the air cleaner and the engine rear supports do not damage any hoses.

Carefully lift the engine (58) using a safe lifting device. Move the engine backward to prevent the clutch housing (32) striking the stand (43). Slightly turn the engine to the right. Lift the engine. You may have to repeat these maneuvers. Remove the engine and lower onto a safe stand for servicing. **DO NOT** rest directly on the oil pan! Remove the plain washers (30).

Engine Installation

Fig. 32

Before installing the engine (58), inspect the universal joints and splined yoke on the transmission/steering hydraulic pump driveshaft (12). Apply anti-seize compound, Champion part number **30453**, onto the slip yoke splines.

Fig. 33

NOTE

MAKE SURE the fan does not strike the radiator or shroud; the valve cover does not strike the air cleaner and the engine rear supports do not damage any hoses. When lowering the engine, DO NOT rest the oil pan on the cross member!

Inspect the condition of the rubber mounts (27) and pads (20). Replace parts where necessary. Lower the engine (58) into the grader using a safe lifting device. Position the engine so that the front (26) and rear (21) supports align with the pads and brackets on the frame.

Fig. 34

With the engine (58) suspended over the frame brackets and pads (20), install the transmission/steering hydraulic pump driveshaft (12) onto the pump input shaft splines.

Engine Installation (Continued)

Fig. 35
Align the bolt holes in the engine rear supports (21), pads (20) and frame cross member with an appropriate drift.

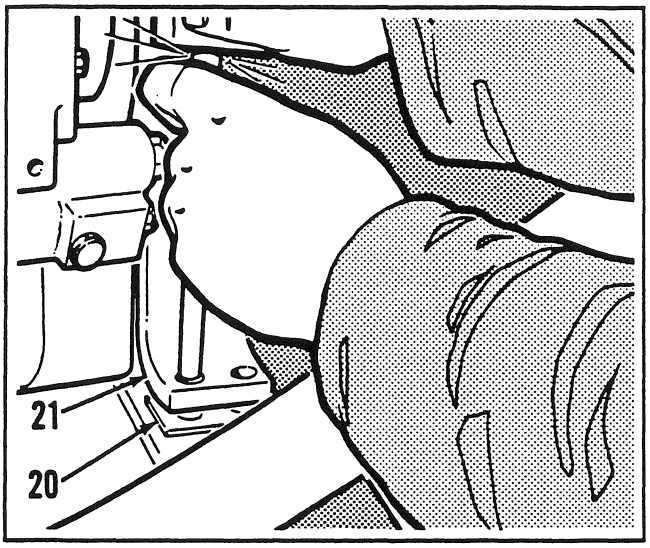
Fig. 36
Place a plain washer (30) on top of one rubber mount (27). Install the bolt (29) through the engine front support (26), washer and rubber mount. Repeat this procedure for the other front support.

Fig. 37
Just before resting the engine (58) on the rubber mounts (27) and pads (20), align the transmission/steering pump driveshaft (12) to the adapter flange. Fully lower the engine. Install the nuts (16), bolts (17), plain washers (18) and lockwashers (19) securing the engine rear support (21) to the frame cross member. Tighten the nuts to the specified torque.

Fig. 38
Install the locknuts (28) and plain washers (30) securing the engine front supports (26) to the frame brackets, refer to text for **Fig. 29.** Tighten the nuts to the specified torque.

Fig. 39
Retain the transmission/steering hydraulic pump driveshaft (12) to the adapter flange with the bolts and lockwashers. Tighten the bolts to the specified torque.

Fig. 40
Install the left hand radiator shroud (11). Retain with the bolts and plain washers. Install the shroud ring (59) onto the radiator shroud. Install the shroud ring bolts and plain washers. Tighten the bolts to finger tightness only.



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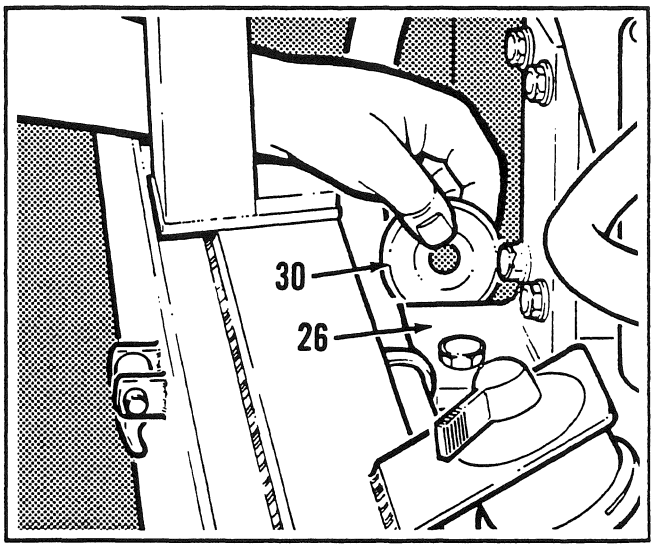

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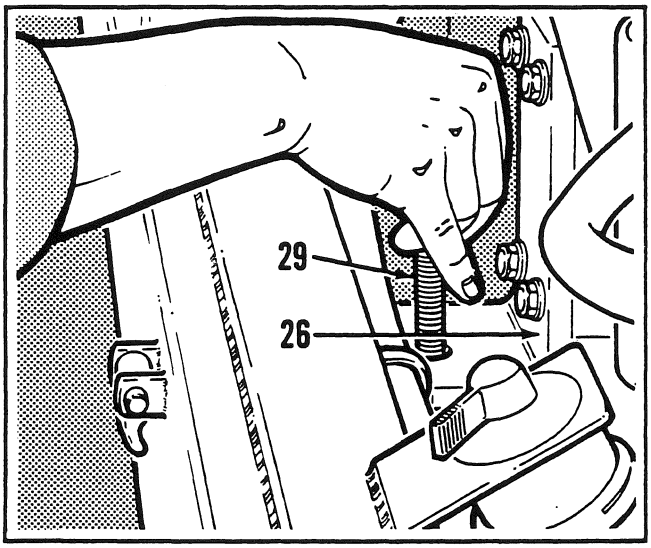

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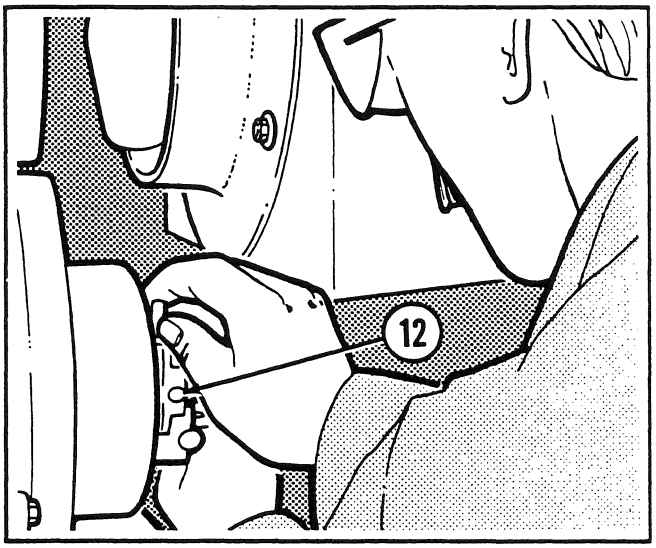

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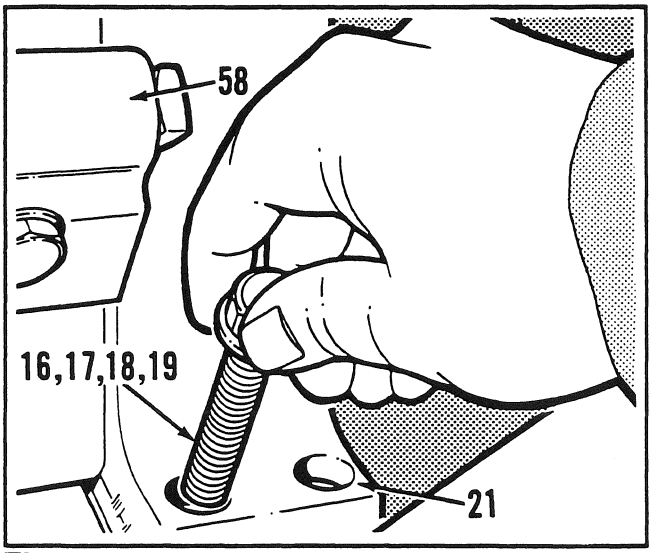

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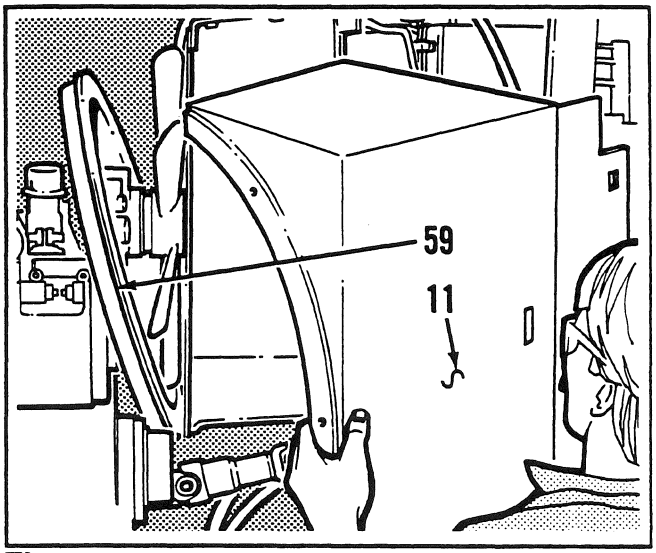

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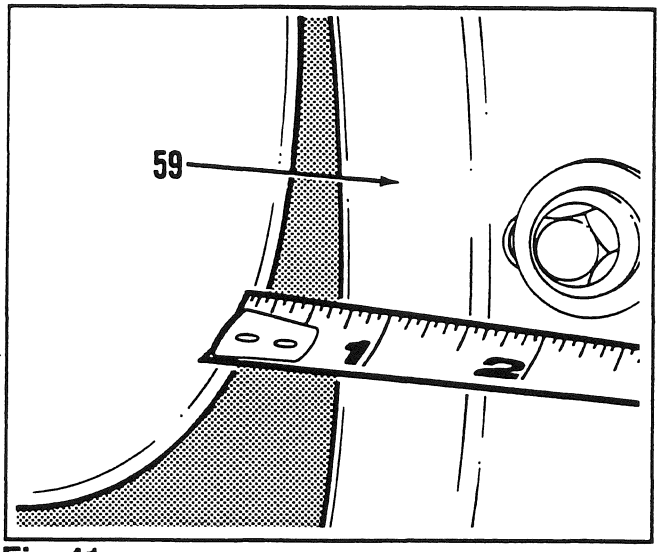

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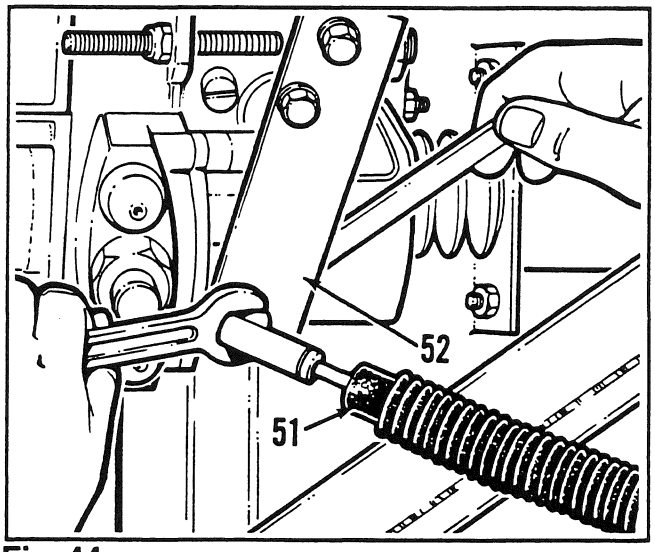

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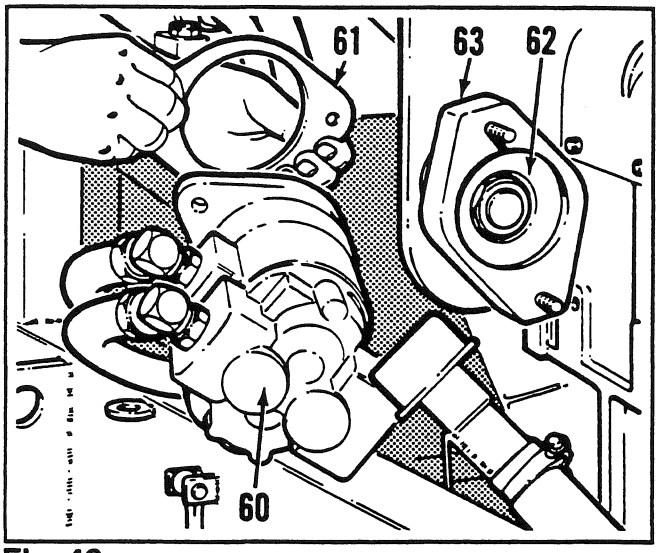

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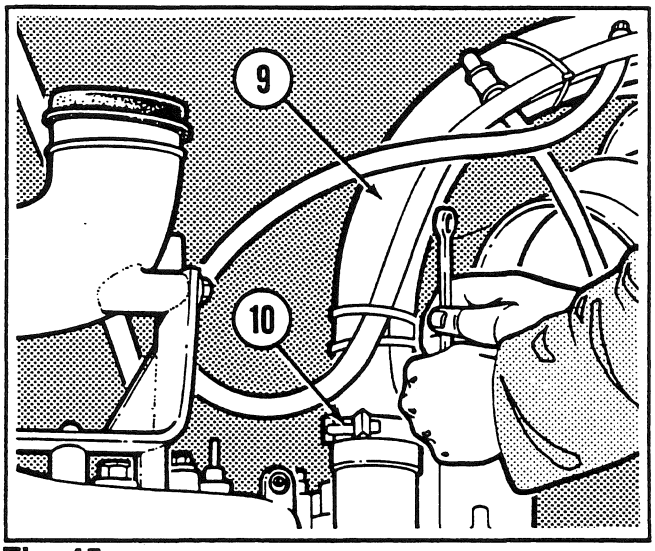

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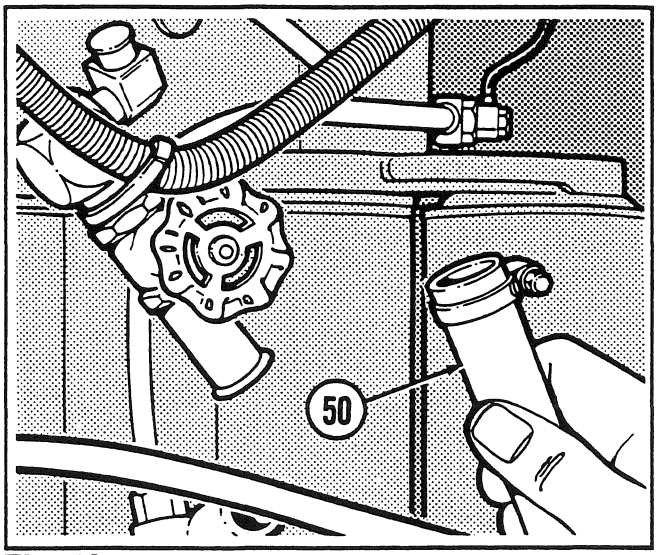


Fig. 43

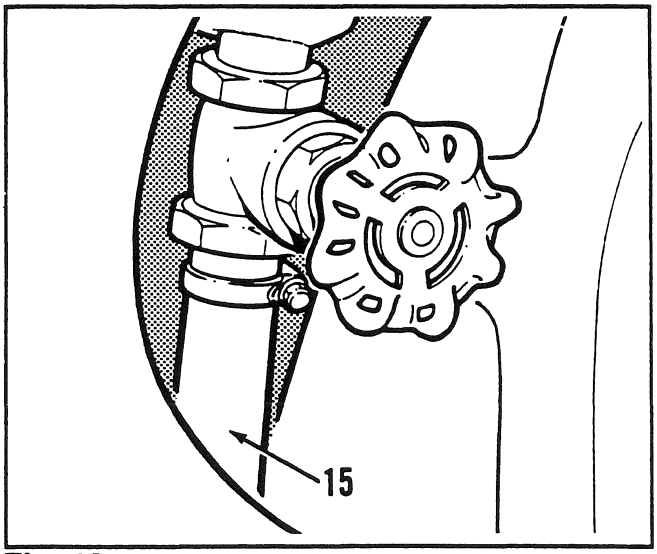


Fig. 46

Engine Installation (Continued)

Fig. 41
Center the shroud ring (59) on the radiator shroud by measuring the distance from the ring to the tip of the fan blades in four places. For maximum suction efficiency, ensure that one third of the fan blade width protrudes inside the shroud ring. When the shroud ring is centered, fully tighten the bolts. On blower fan installations ensure that the fan guard is installed.

Fig. 42
Before installing the primary hydraulic pump (60), install a new CUMMINS gasket (63) between the engine and the adapter (62). Install a new CHAMPION gasket (61) between the adapter and the pump. Install the pump. Make sure that the pump is seated properly. Secure with the nuts and lockwashers. **DO NOT** use the nuts to pull the pump onto the adapter. Tighten the nuts to the specified torque.

Fig. 43
Connect the heater hose (50) to the engine block and tighten the clamp. When the clamp is secure, open the valve.

Fig. 44
Connect the accelerator cable (51) onto the bracket. Tighten the clamp. Connect the linkage to the engine governor arm (52) and secure with the nut.

Fig. 45
Connect the upper raidator hose (9) to the engine thermostat housing and secure with the clamp (10).

Fig. 46
Connect the heater hose (15) to the water pump inlet and tighten the clamp. When the clamp is secure, open the valve.

Engine Installation (Continued)

Fig. 47
Connect the lower radiator hose (13) and secure with the clamp (14).

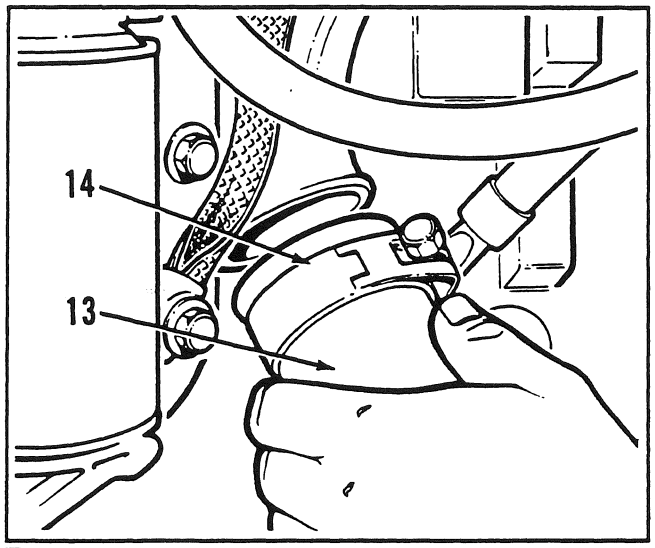
Fig. 48
Connect the articulation solenoid wiring harness (24) if the grader is so equipped. Install the wiring harness behind the starter motor.

Fig. 49
Remove the caps and connect the drain hose (34) to the clutch housing drain manifold. Secure the hose with the clamp (33).

Fig. 50
Connect the positive cable (25) to the starter motor. Secure the cable terminal, but **DO NOT** over-tighten the nut!

Fig. 51
Connect the ground strap (22) to the engine block.

Fig. 52
Remove the caps from the turbocharger inlet, air cleaner tube and air cleaner duct (56). Install the duct and secure with the clamps (55 and 57). Ensure you make a tight and secure installation!



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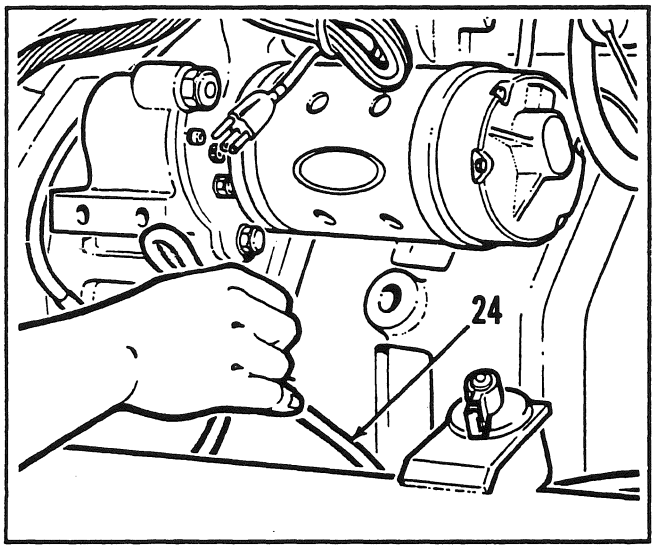

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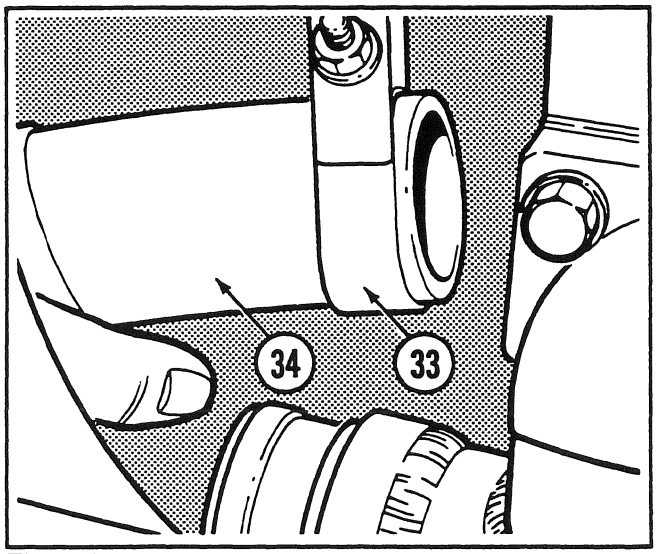

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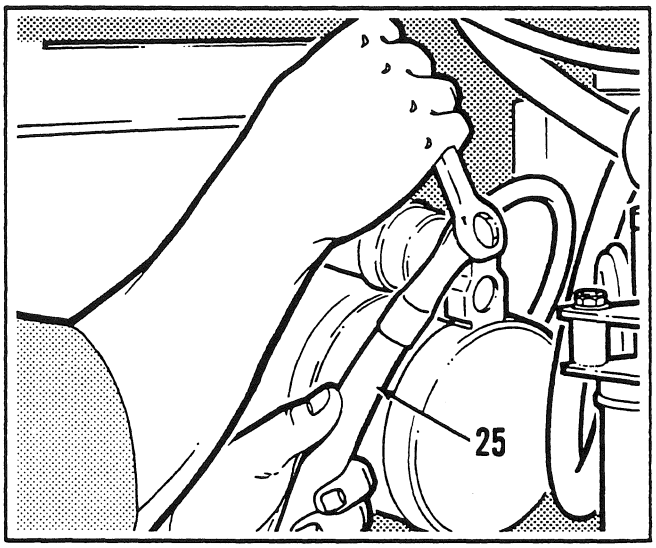

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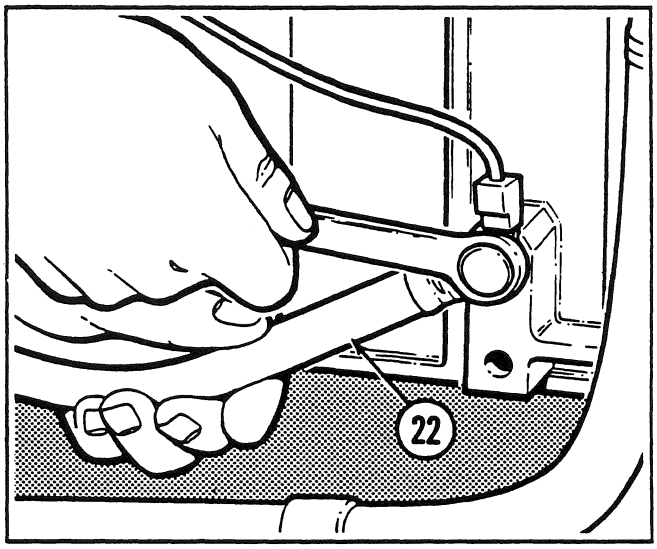

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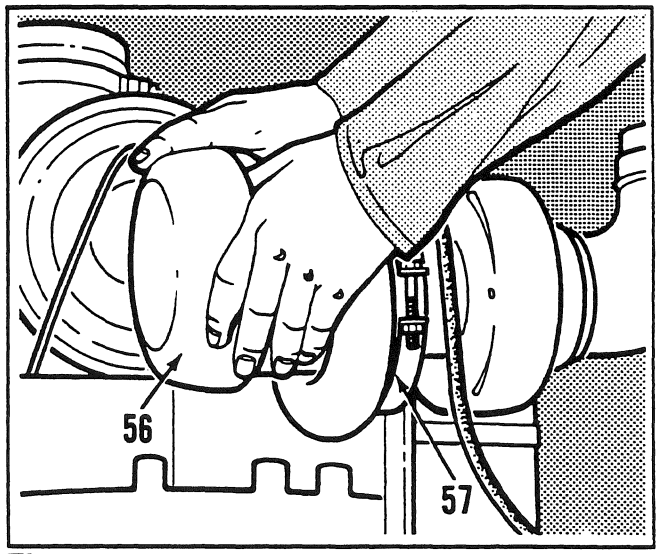

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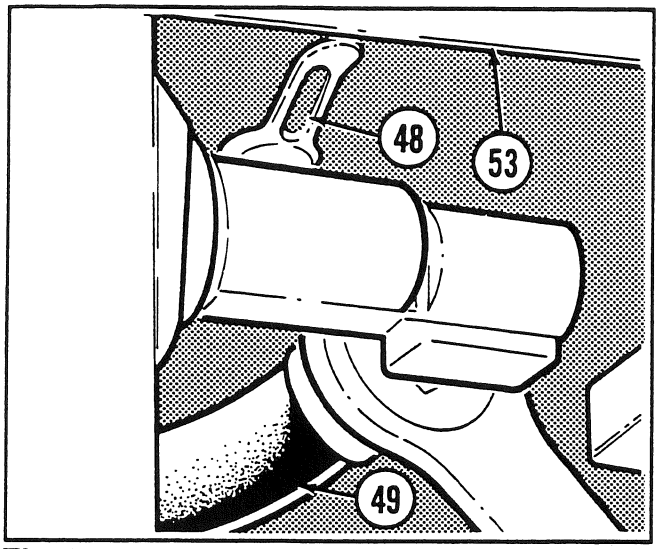

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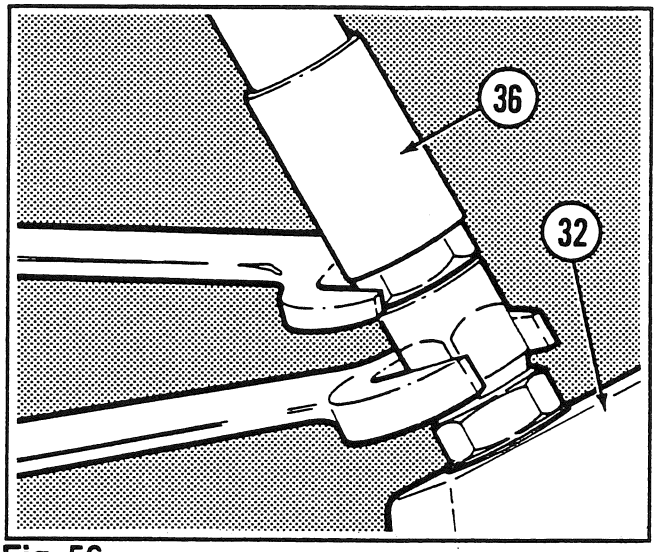

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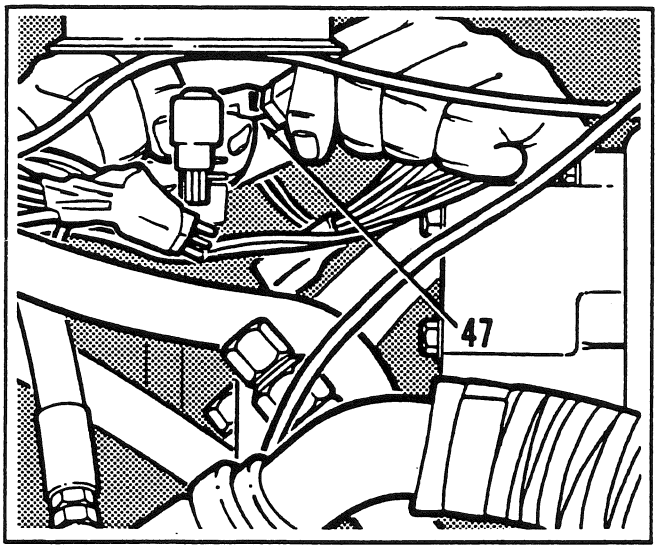

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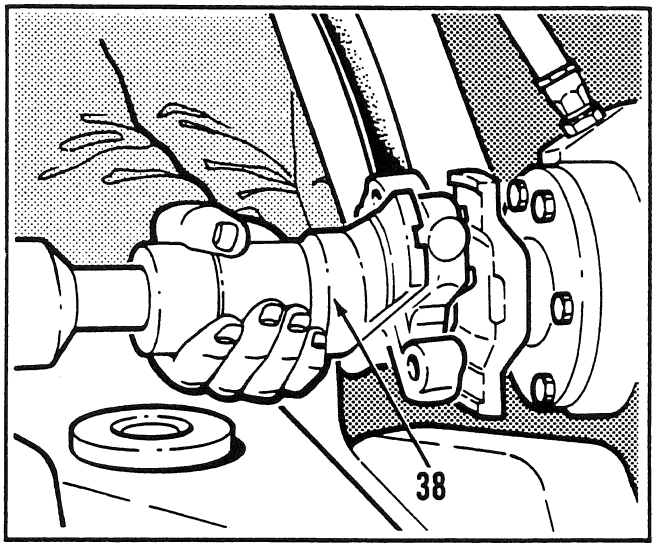

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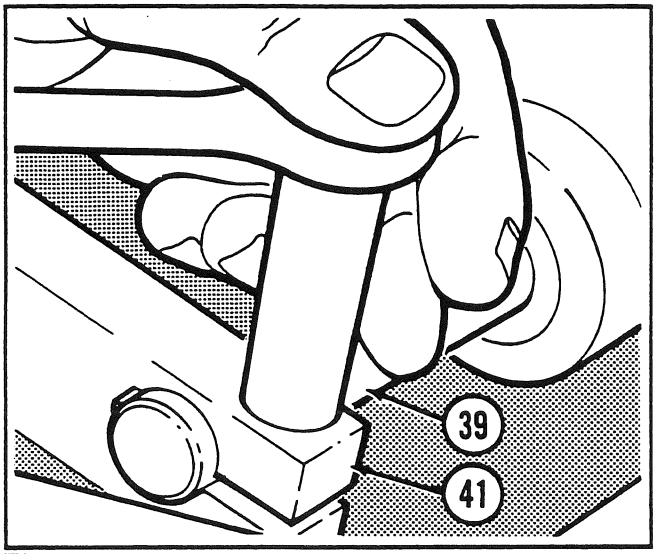

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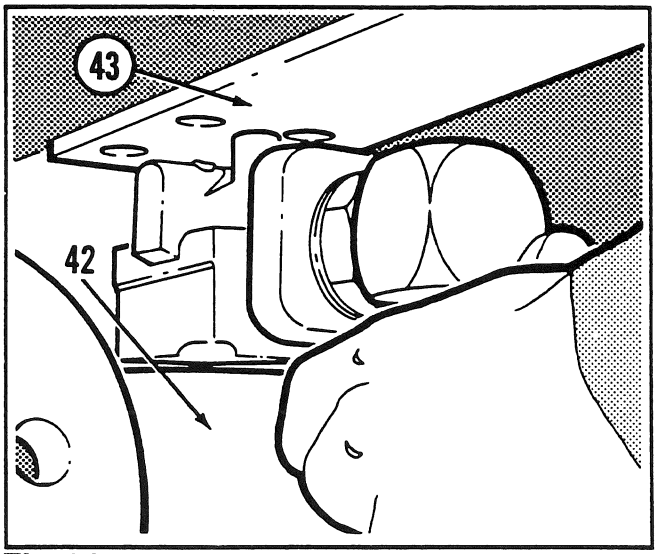


Fig. 58

Engine Installation (Continued)

Fig. 53
Remove the caps and connect the fuel feed hose (49) to the fuel tank (53). Completely open the fuel feed valve (48). Wipe up any fuel that may have leaked or spilled when connecting the hose.

Fig. 54
Check the identification and connect the wiring harness connectors (47) below the fuel tank (53).

Fig. 55
Install the arm (41) on the shaft (39). Make sure that the Woodruff key engages with the key slot in the arm. Tighten the bolt (40) securing the arm on the shaft. Position the slave cylinder bracket on the clutch housing (32) and retain with the bolts and lockwashers. Tighten the bolts to the specified torque.

Fig. 56
On the left hand side of the machine, install the heater hose clip onto the clutch housing (32). Remove the caps and connect both the clutch housing breather hose (35) and the lubrication pressure hose (36). **Make sure** you check the hose identification for correct installation. Securely tighten all hydraulic hose fittings to avoid leakage.

Fig. 57
Before installing the driveshaft (38), inspect the universal joints and the slip joint. If binding occurs, service the driveshaft. Align the universal joints. Install the driveshaft and secure with the bolts (37) and lockwashers. Tighten the bolts to the specified torque.

Fig. 58
Install the transmission hydraulic oil filter (42) under the stand (43) and retain with the bolts and lockwashers. Tighten the bolts to the specified torque.

Engine Installation (Continued)

Fig. 59
Install the primary hydraulic oil filter (31) under the opposite side of the stand (43) and retain with the bolts and lockwashers. Tighten the bolts to the specified torque.

Fig. 60
Install the U bolt (46) retaining the hoses and wiring harnesses below the stand (43). Secure with the nuts (44) and lockwashers (45).

Fig. 61
Place the engine hood (3) in position and lightly tap underneath to seat it properly on the grader. Retain the engine hood with the bolts, lockwashers and plain washers.

Fig. 62
Remove the caps and connect the fuel return hose (54) to the fuel tank (53).

Fig. 63
Remove the cap from the turbocharger port. Install the muffler/exhaust stack (4) and secure with the clamp (6). Tighten the clamp nuts evenly and check to see that the muffler is secure.

NOTE

Make sure that the muffler exhaust outlet points to the rear of the grader when installed.

Install the muffler clamp and secure to the brace.

Fig. 64
Remove the cap from the air cleaner inlet tube. Install the air cleaner extension (2) and secure with the clamp (1).

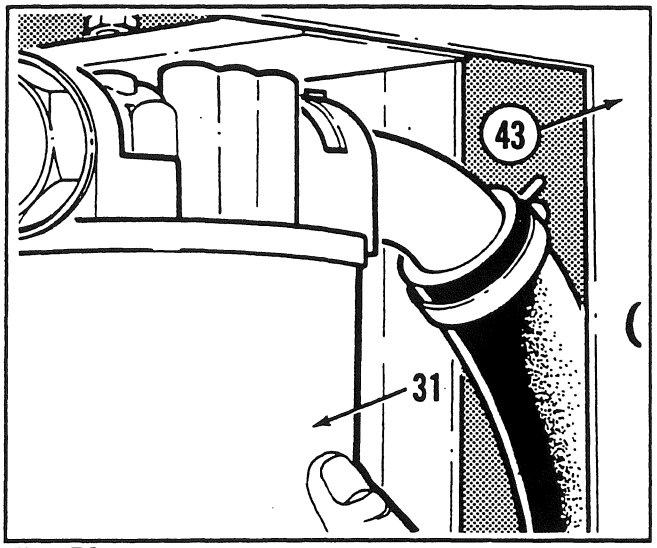


Fig. 59

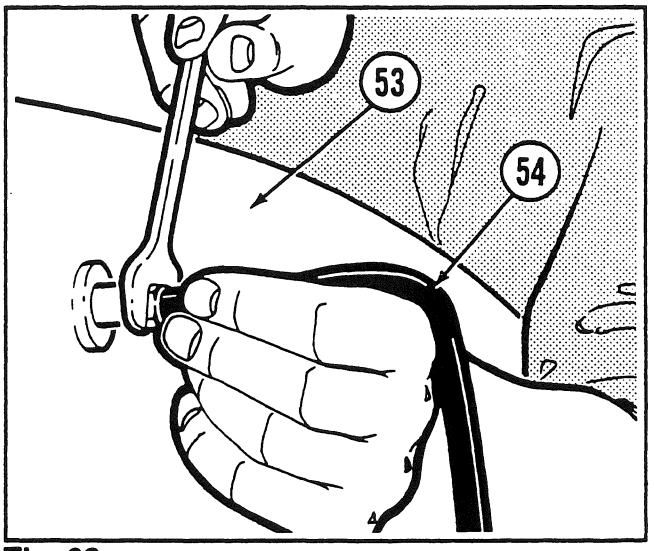
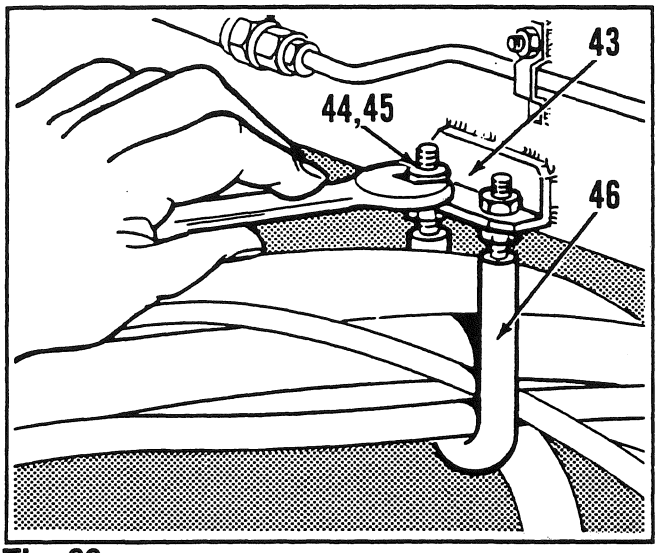


Fig. 62



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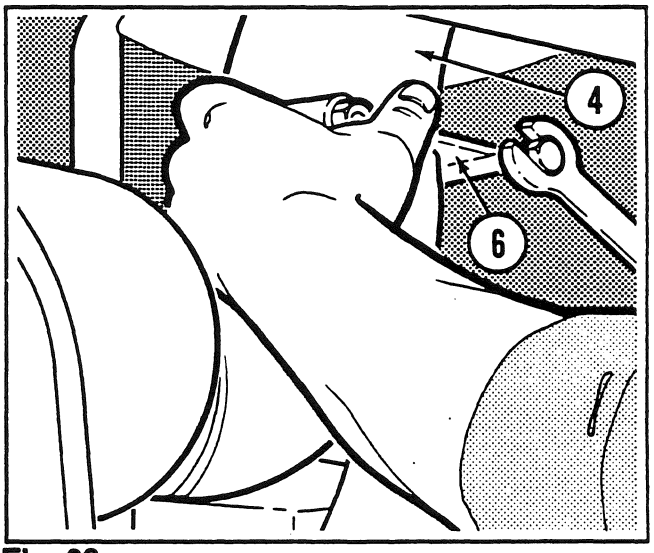

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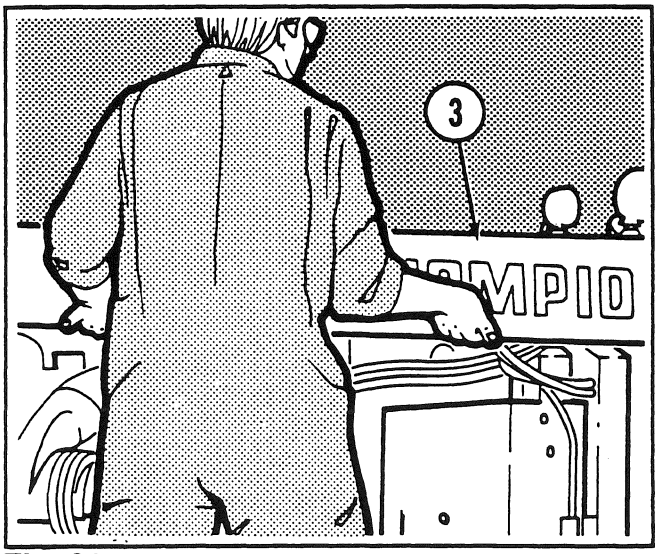

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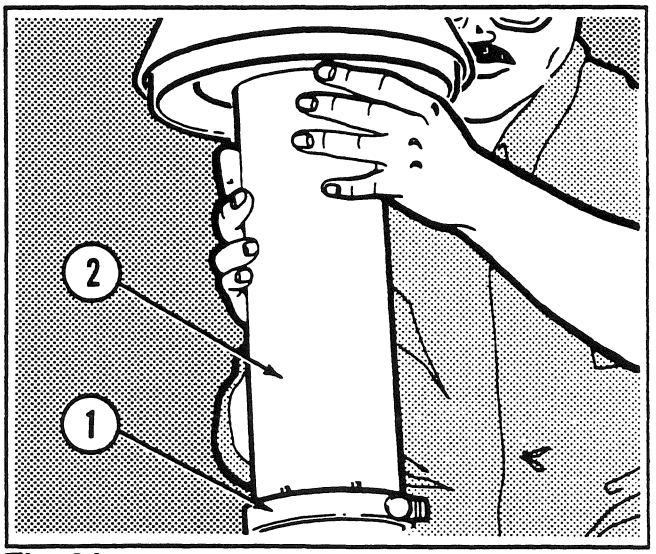
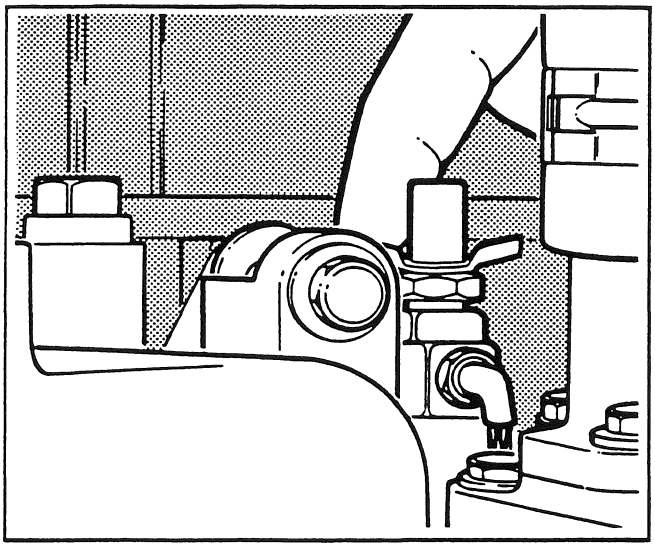


Fig. 64



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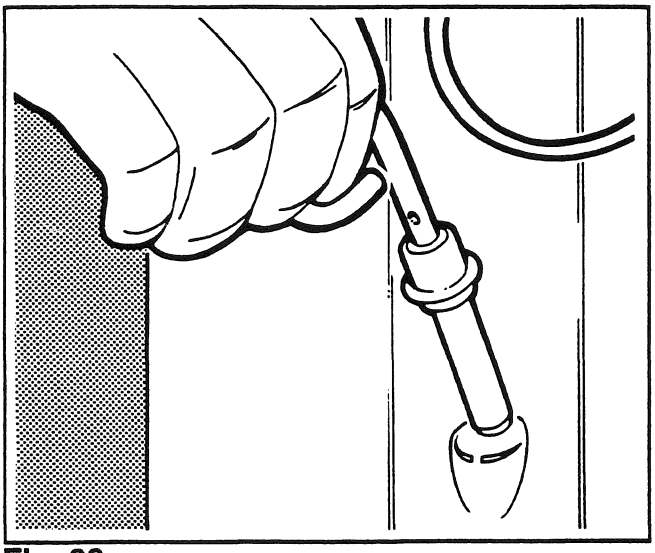

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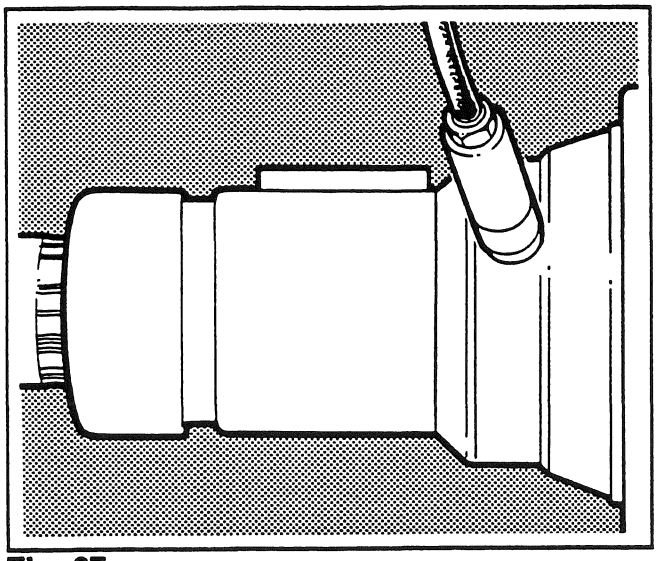

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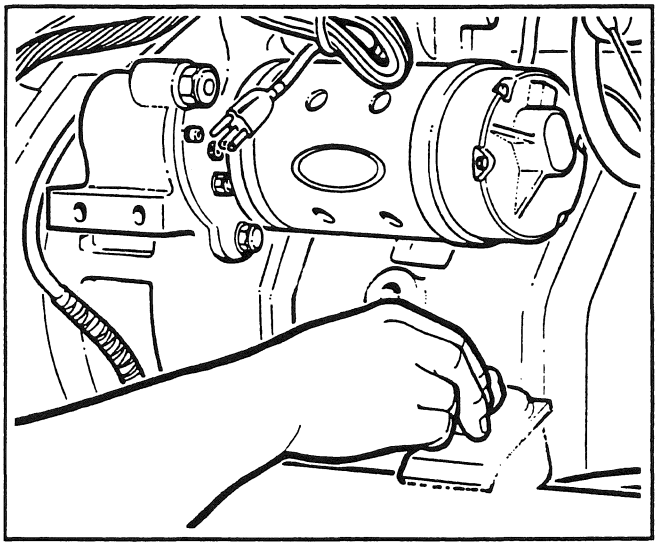

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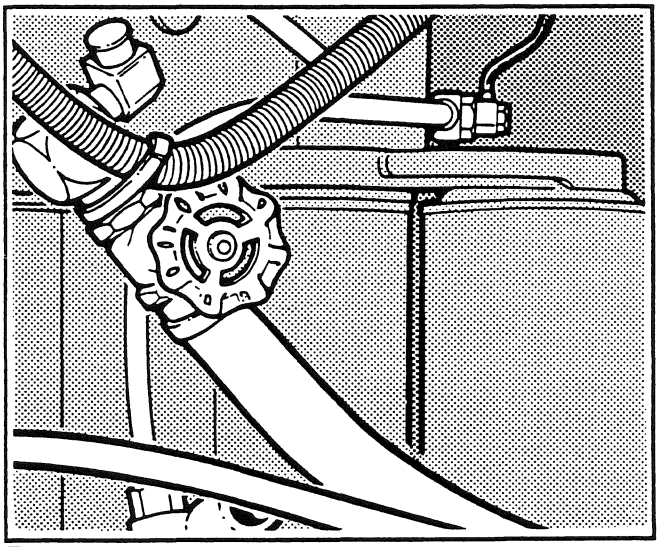


Fig. 69

Engine Installation (Continued)

Fig. 65
On CUMMINS models B and C Series engines, you must open the upper coolant bleed valve to vent air from the coolant passages. Fill the cooling system with fresh, clean coolant. Refer to your CUMMINS engine manual for coolant specifications. **Always** use a low-silica antifreeze containing less than 0.1% silica. When the coolant begins to flow through the bleeder valve, close the valve. Continue to fill the radiator to the "Full" level (refer to your 700 Series Operator's Manual) and install the pressure cap.

Fig. 66
Install a new engine oil filter. Change the engine oil with the type and quantity recommended in the CUMMINS engine manual. Check that the oil is at the correct level using the engine dipstick.

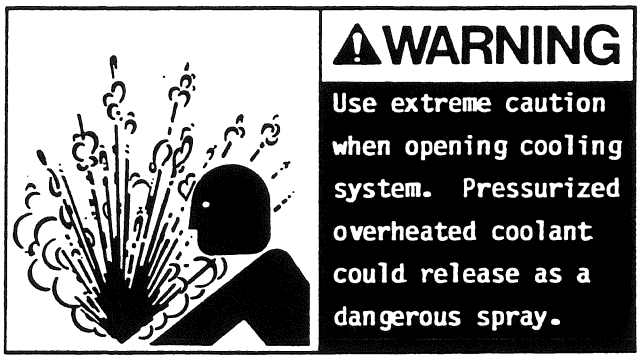
Fig. 67
Lubricate the steering/transmission and driveshaft universal and slip joints with grease recommended in the Lubrication Chart at the front of this Shop Manual.

Fig. 68
Secure all hoses and electrical wiring harnesses with plastic ties. Check that all hose clamps are tight. All hoses must be installed correctly to avoid bending or chafing. Check all electrical wiring harnesses and cable connections before turning the isolation switch "ON". Test the mechanical operation of the accelerator linkage. Refer to your CUMMINS engine manual for details of how to bleed air from the fuel system. Follow the instructions and bleed the fuel system.

Fig. 69
When all your pre-start checks are done, make sure it is safe to start the engine and signal your intention by sounding the horn. If a new or rebuilt engine has been installed, refer to your CUMMINS engine manual for the specific "break-in" procedure. With the engine running, check all hose connections for signs of leakage. When you are satisfied that the engine is running normally, test drive the grader until the engine coolant is at operating temperature. Turn the heater control in the cab to "Hot" during the test drive.

Engine Installation (Continued)

Fig. 70



After reaching operating temperature, shut down the engine and allow to cool. When the radiator has cooled, remove the pressure cap and check the level. Add coolant to the proper level. **DO NOT** add cold coolant to a hot engine!

Fig. 71

Install the panels (23) below the fuel tank (53), intermediate panels (5) and front (8) and rear (7) lower panels.

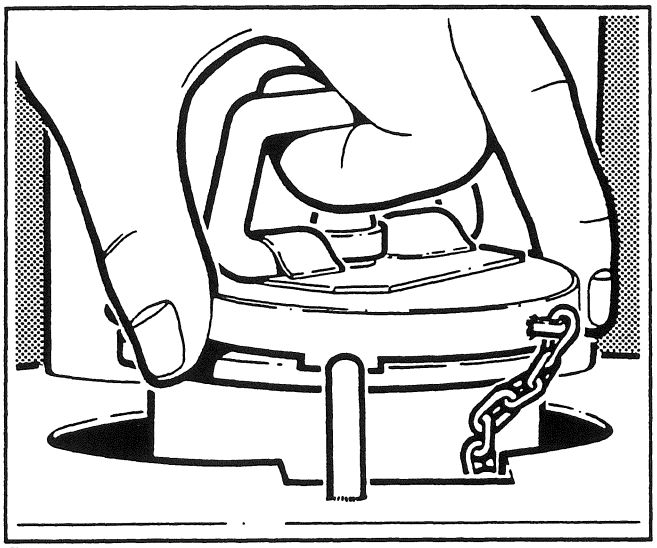


Fig. 70

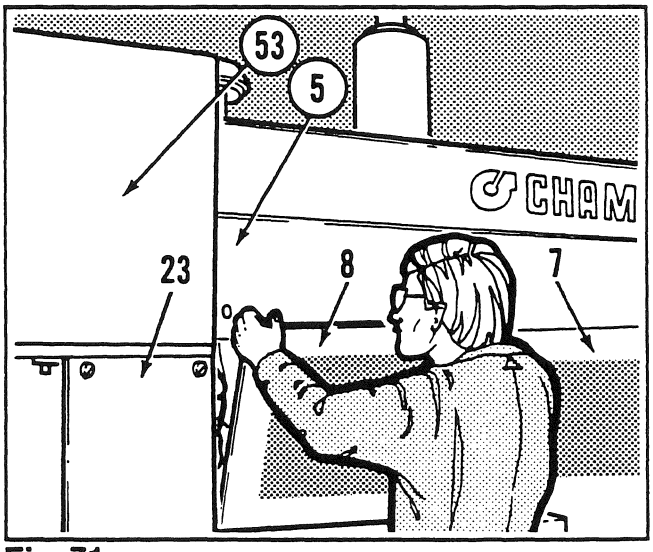
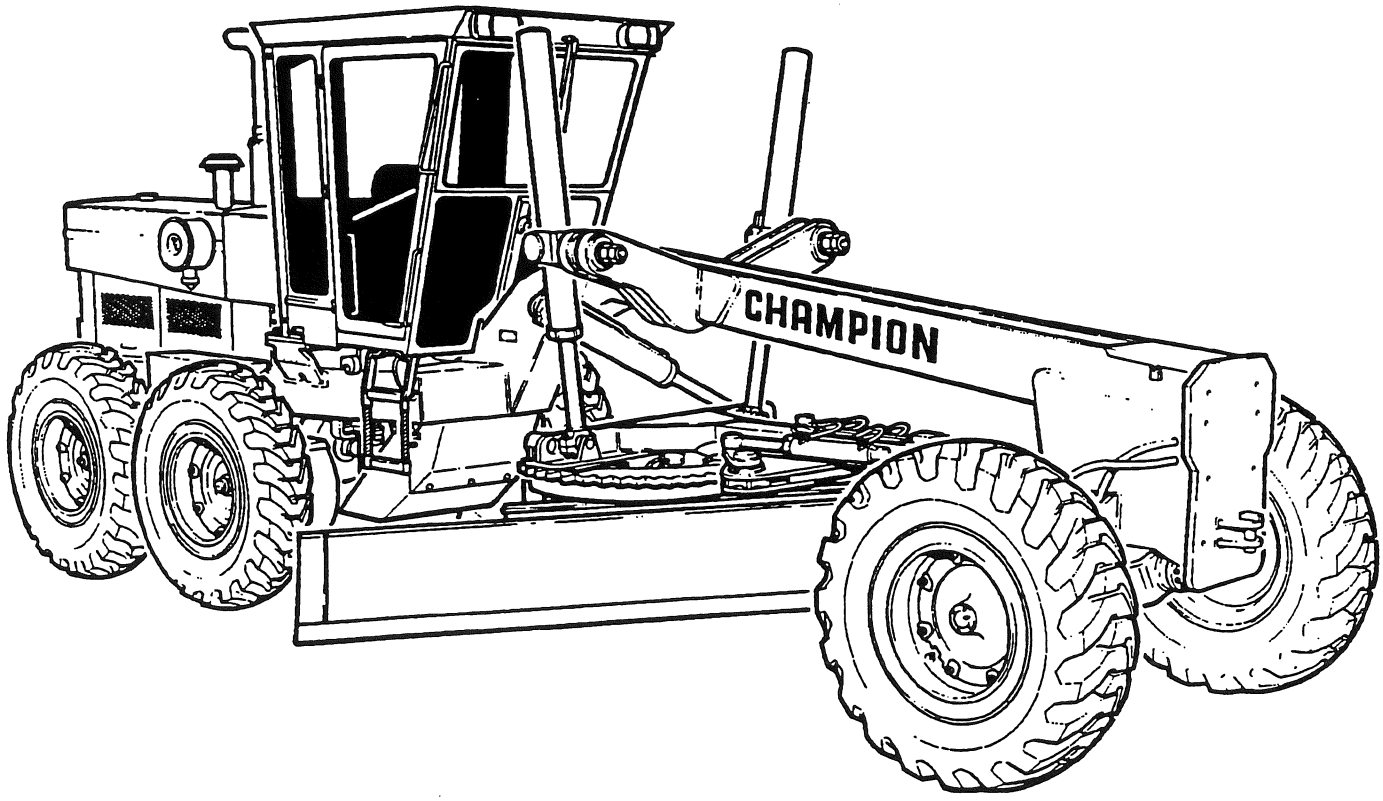


Fig. 71

SECTION 15

HAND BRAKE

Hand Brake Caliper Assembly Mounted on the Transmission Housing
Models: 710 through 740A S/N **16224, 16245** and up
Models: 750 through 780A up to S/N **21006**
U.S. S/N **2012-2** to **2658-2**
Hand Brake Caliper Assembly Mounted on the Frame
Models: 750 through 780A S/N **21007** and up



700 SERIES SHOP MANUAL
HAND BRAKE

Hand Brake Caliper Assembly Mounted on the Transmission Housing
Models: 710 through 740A S/N **16224, 16245** and up
Models: 750 through 780A up to S/N **21006**
U.S. S/N **2012-2** to **2658-2**
Hand Brake Caliper Assembly Mounted on the Frame
Models: 750 through 780A S/N **21007** and up

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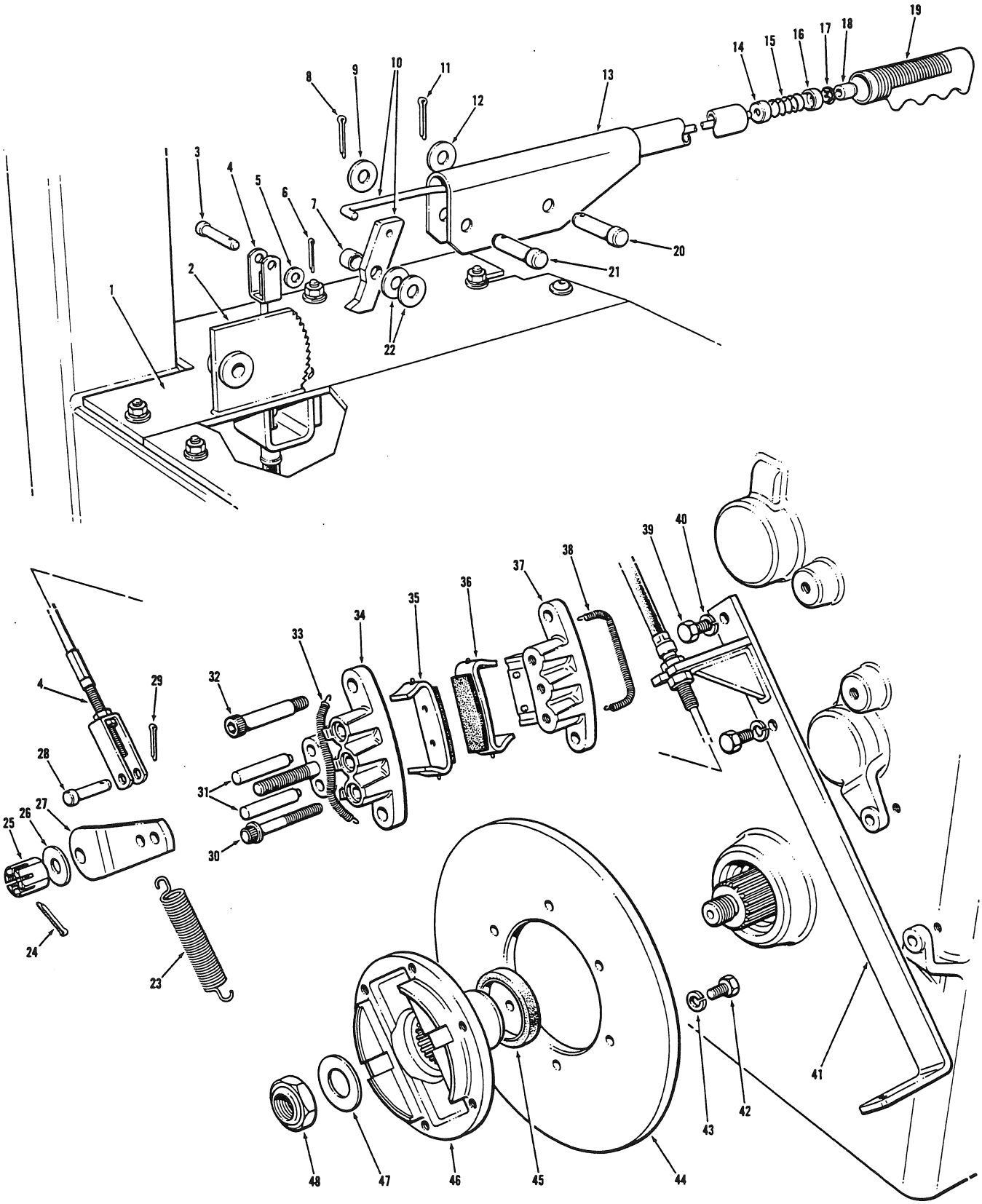


Fig. 1
Models 710 through 740A S/N **16224, 16245** and up
Models 750 through 780A up to S/N **21006**
U.S. S/N **2012-2** to **2658-2**

Item	Description	Item	Description	Item	Description
1	Seat Deck Plate	17	Spring Clip Fastener	33	Spring
2	Ratchet	18	Release Button	34	Casting
3	Clevis Pin	19	Handle Grip	35	Friction Pad Holder
4	Hand Brake Cable	20	Clevis Pin	36	Friction Pad Holder
5	Washer	21	Clevis Pin	37	Casting
6	Cotter Pin	22	Washer	38	Spring
7	Spacer	23	Spring	39	Bolt
8	Cotter Pin	24	Cotter Pin	40	Lockwasher
9	Washer	25	Castle Nut	41	Cable Anchor Bracket
10	Pawl and Pawl Rod	26	Washer	42	Bolt
11	Cotter Pin	27	Operating Cam	43	Lockwasher
12	Washer	28	Clevis Pin	44	Disc
13	Handle	29	Cotter Pin	45	Oil Seal
14	Spacer Washer	30	Bolt	46	Yoke
15	Spring	31	Push Pin	47	Flatwasher
16	Spacer Washer	32	Bolt	48	Locknut

Key to Fig. 1

Models 710 through 740A S/N **16224**, **16245** and up
Models 750 through 780A up to S/N **21006**
U.S. S/N **2012-2** to **2658-2**

General

Make sure proper shop tools are available and in good working order. The brake caliper assembly should be serviced on a clean workbench. Refer to the 700 Series Parts Manual for spare parts information.

Service Position Precaution

Place the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure.

Refer to the SERVICE POSITION details on page (ii) in the front of this Shop Manual.

NOTE: Weights, measures and tolerances are in U.S., Imperial and Metric (SI) quantities. International standards specify the comma as the decimal point in all Metric measurements.

Description

The mechanically actuated, disc type hand brake is mounted on the rear of the transmission housing. Operating the handle in the cab engages and disengages the hand brake caliper assembly.

When applying the hand brake, press the handle release button to disengage the pawl. Pull the handle upward. This action pulls the cable attached to the operating cam.

Two push pins contact the operating cam and one of the friction pad holders. Moving the operating cam forces the push pins and friction pad holder inward against the disc. The second friction pad holder engages the other side of the disc.

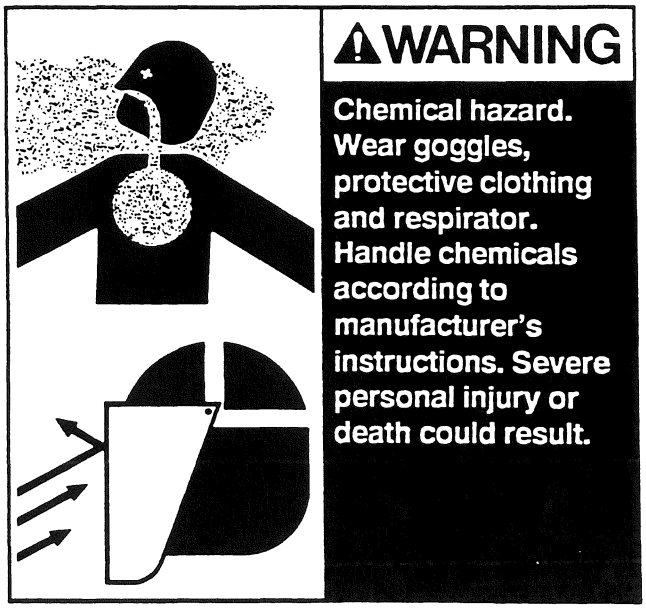
The hand brake should be applied only when the grader is stationary and the transmission is in Neutral mode. However, you can use the hand brake in an emergency. Refer to your 700 Series Operator's Manual for emergency braking procedures.

When releasing the hand brake, press the handle release button to disengage the pawl. Lower the handle. The spring returns the cable and operating cam into their original positions. Similarly, return spring action releases the friction pad holders from the disc.

Do not drive the grader with the cable disconnected. If the grader must be moved during servicing, disconnect the return spring. The brake caliper assembly can engage when the machine is moving and excessive brake drag may result if the return spring is not disconnected.

Cleaning and Inspection

Cleaning



Cleaning *(Continued)*

Immerse small parts into a cleaning solvent. You can use a hot tank system and a mild alkali solvent. Agitate the parts to remove all foreign matter.

NOTE: Do not clean the friction pad holders.

Parts should remain in the solvent long enough to be thoroughly cleaned. In the hot tank system, heated parts help to evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of dirt and solvent.

After rinsing, immediately dry the parts using moisture-free compressed air or lint-free rags.

Inspection

A careful and thorough inspection of all parts is extremely important. Check the brake disc surface condition. Replace the disc if it is badly warped or pitted. The disc should run true to within 0.010 in. (0,25 mm). Check friction pad wear. If the pads are worn to less than 1/32 in. (0,79 mm), replace them. Always replace both pads at the same time.

Torque Guide

Fig. No.	Application	Torque Value		
		lbf.ft	N.m	kgf.m
26	Bolts retaining castings	80 - 90	108 -122	11 - 12
30	Bolts retaining disc to yoke	80	108	11
33	Locknut retaining disc and yoke assembly	120 - 150	163 - 203	17 - 21
34	Bolts retaining lower drive shaft to yoke	80	108	11
35	Shoulder bolts for caliper assembly	32	43	4,5

Hand Brake - Removal and Disassembly

Fig. 2
Park the grader on level ground. Place the transmission mode lever in Neutral. Centralize the circle, drawbar and moldboard assembly using the circle shift and blade lift cylinders. Lower the moldboard onto wooden blocks.

Fig. 3
Shut down the engine and place the machine in the SERVICE POSITION (refer to page (ii) in the front of this Shop Manual). It is particularly important to install chocks at the front and rear tandem wheels. Ensure that the engine cannot be started. Remove and retain the ignition key. Turn the battery isolation switch to the **"OFF"** position.

Fig. 4
Release the hand brake. Remove and discard the cotter pin (29). Remove the clevis pin (28). Disconnect the hand brake cable (4) from the operating cam (27).

Fig. 5
Disconnect the hand brake cable (4) from the cable anchor bracket (41). Remove the bolts (39) and lockwashers (40) retaining the cable anchor bracket. Disconnect the cable anchor bracket from the spring (23).

Fig. 6
Remove the shoulder bolts (32). Remove the brake caliper assembly and place on a clean workbench.

Fig. 7
Remove the plug on the lower left hand side of the transmission housing. Drain the oil into a container (capacity: 14 U.S. gal. [11.6 Imp. gal., 53 L]). Clean and install the plug.

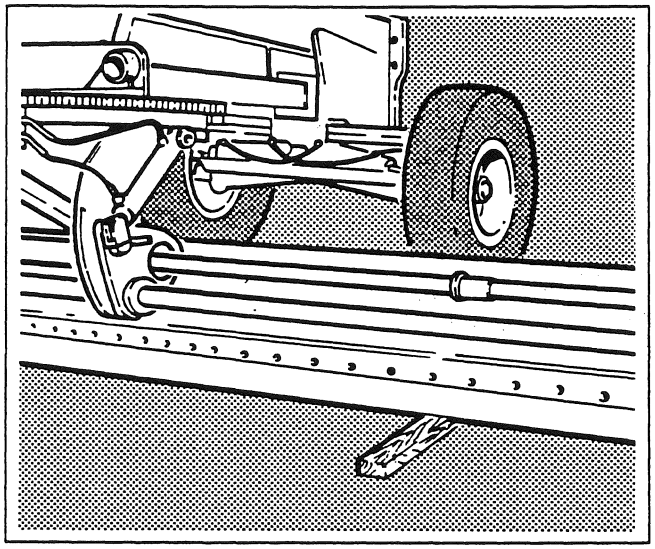


Fig. 2

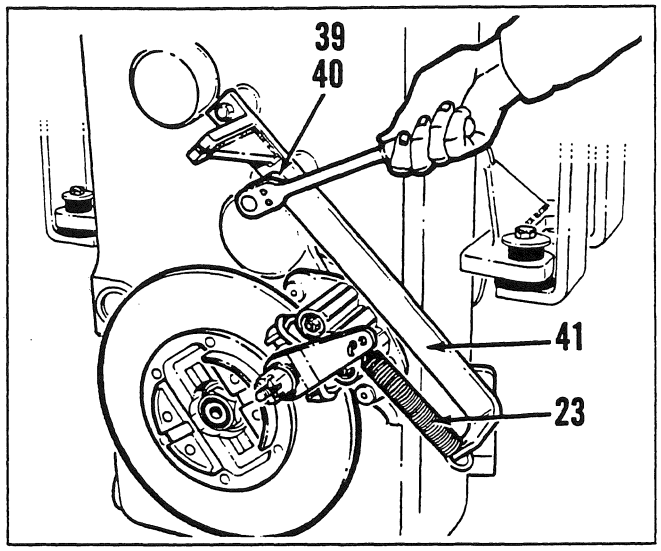


Fig. 5

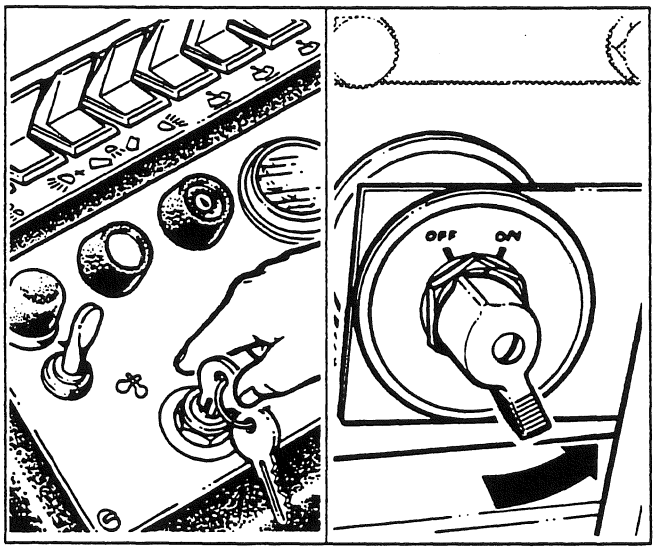


Fig. 3

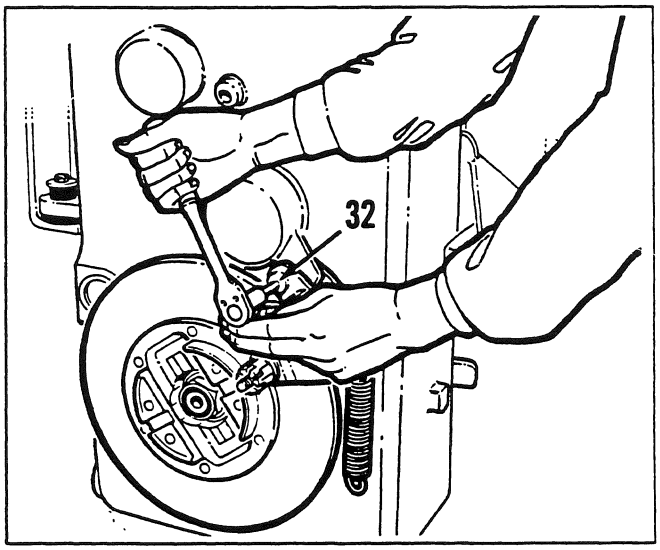


Fig. 6

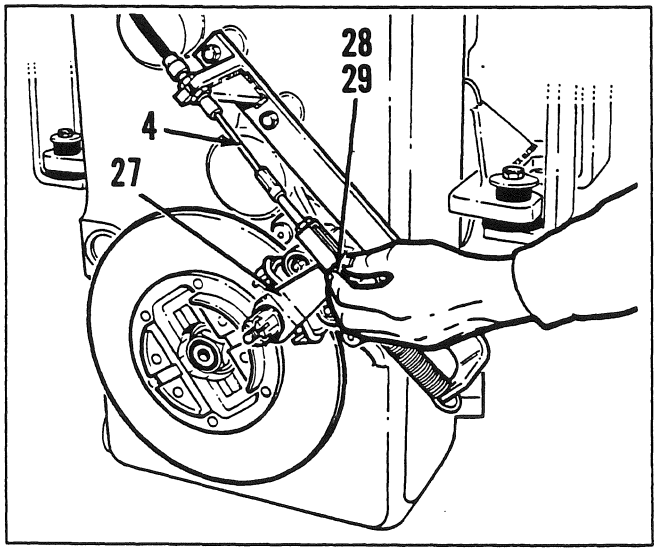


Fig. 4

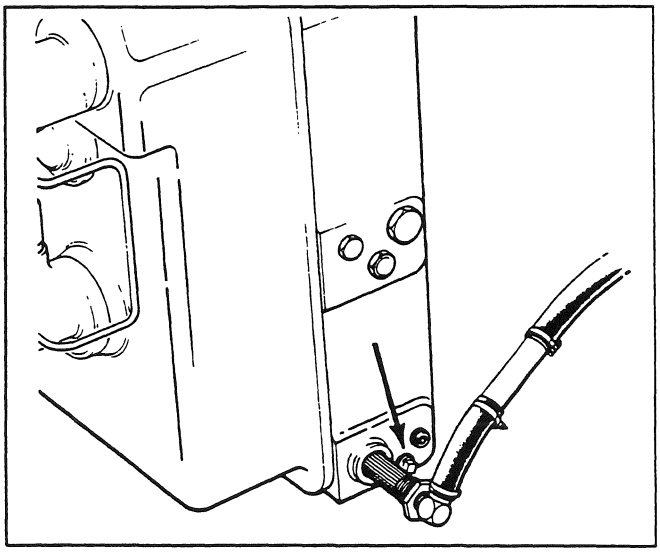


Fig. 7

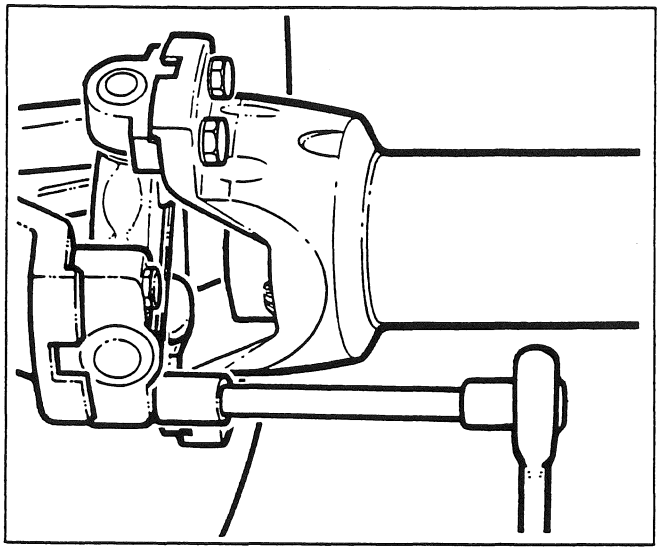


Fig. 8

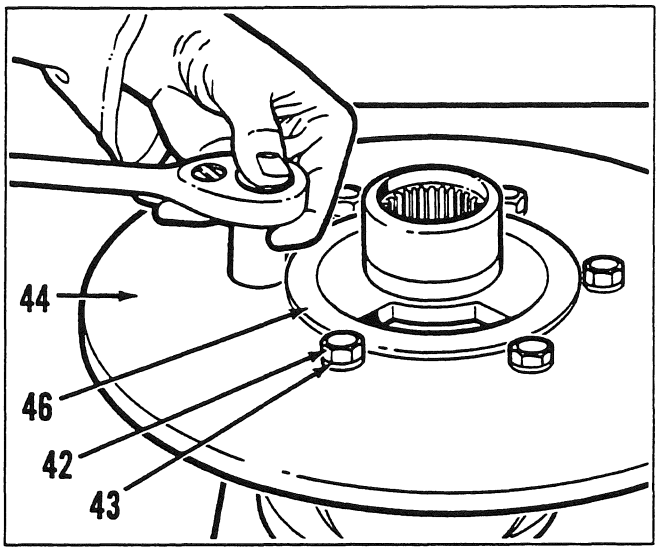


Fig. 11

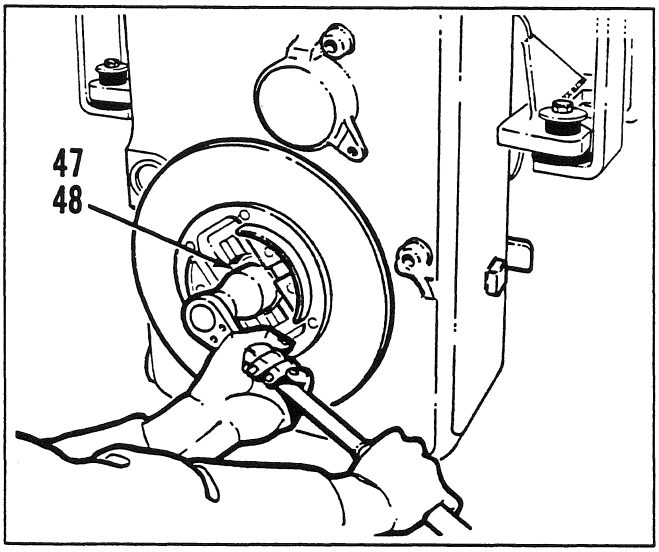


Fig. 9

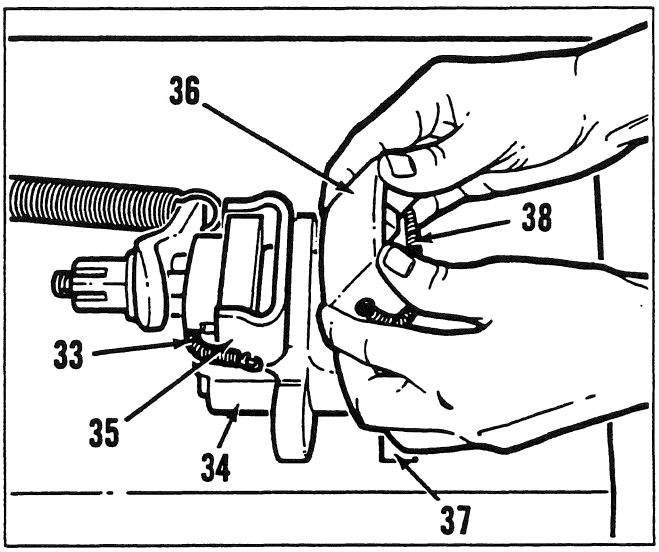


Fig. 12

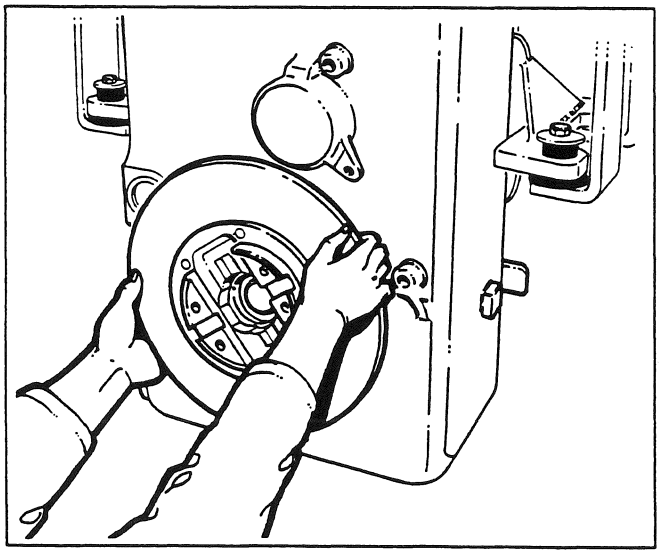


Fig. 10

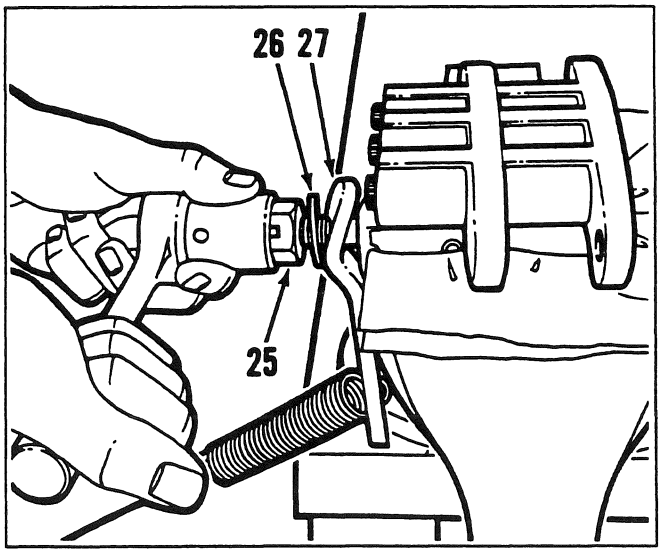


Fig. 13

Hand Brake - Removal and Disassembly *(Continued)*

Fig. 8
Disconnect the lower drive shaft at both yokes. Remove the lower drive shaft.

Fig. 9
Remove the locknut (48) and flatwasher (47) retaining the disc and yoke assembly. Discard the locknut.

Fig. 10

Carefully remove the disc and output yoke assembly. Remove and discard the oil seal (45).

Fig. 11
Clamp the drive shaft flanges of the yoke in a vise with soft jaws. Avoid damaging the disc and oil seal surfaces. Remove the bolts (42) and lockwashers (43) retaining the disc (44) to the yoke (46). Separate the parts.

Fig. 12
Disconnect the springs (33 and 38). Remove the friction pad holders (35 and 36) from the castings (34 and 37).

Fig. 13
Clamp the brake caliper assembly in a vise with soft jaws. Remove and discard the cotter pin (24). Remove the castle nut (25), washer (26) and operating cam (27).

Hand Brake - Removal and Disassembly *(Continued)*

Fig. 14
Remove the two push pins (31) from the casting (34).

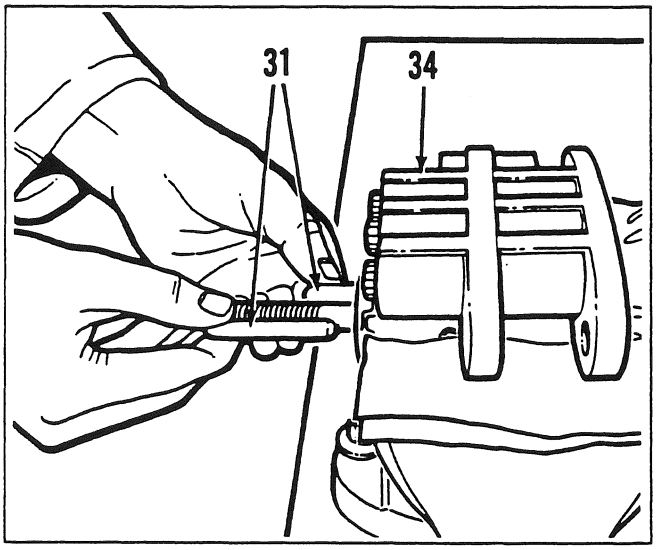
Fig. 15
Remove the bolts (30) retaining the castings (34 and 37). Separate the castings.

Fig. 16
Remove and discard the cotter pin (6). Remove the clevis pin (3), washer (5) and hand brake cable (4) from the handle (13).

Fig. 17
Pry off the release button (18). Remove and discard the handle grip (19).

Fig. 18
Remove and discard the spring clip fastener (17). Remove the spacer washers (14 and 16) and spring (15).

Fig. 19
Remove and discard the cotter pin (11). Remove the clevis pin (20), spacer (7) and washers (12 and 22) from the handle (13).



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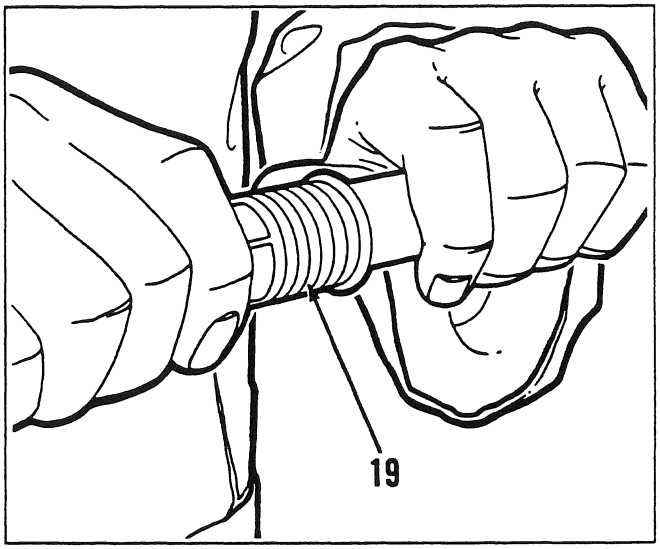

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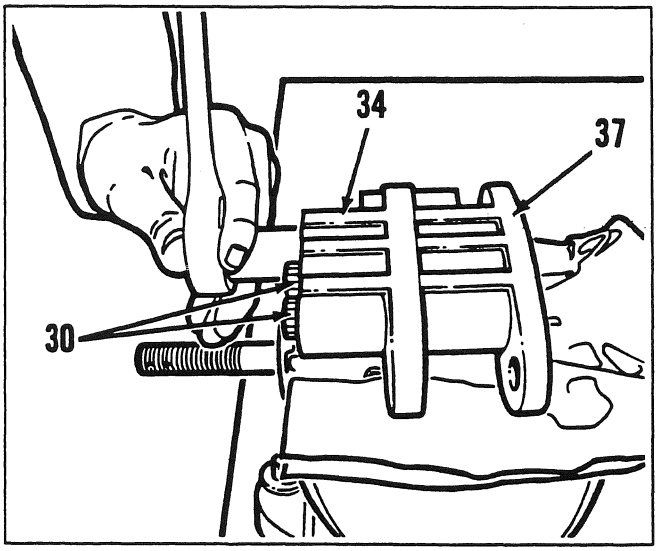


Fig. 15

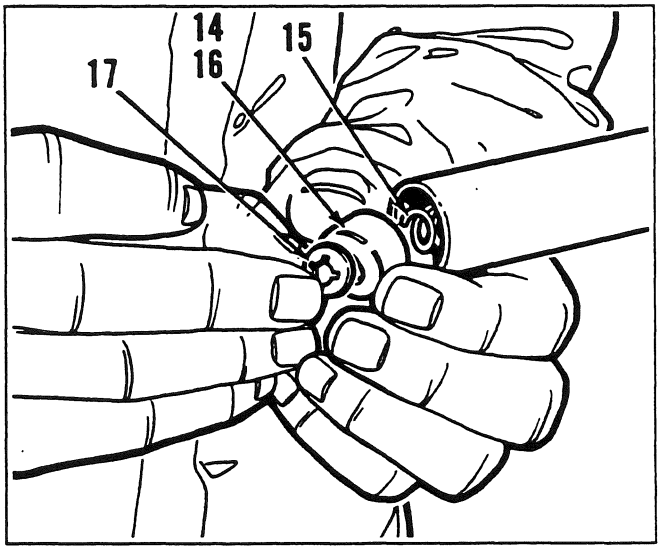


Fig. 18

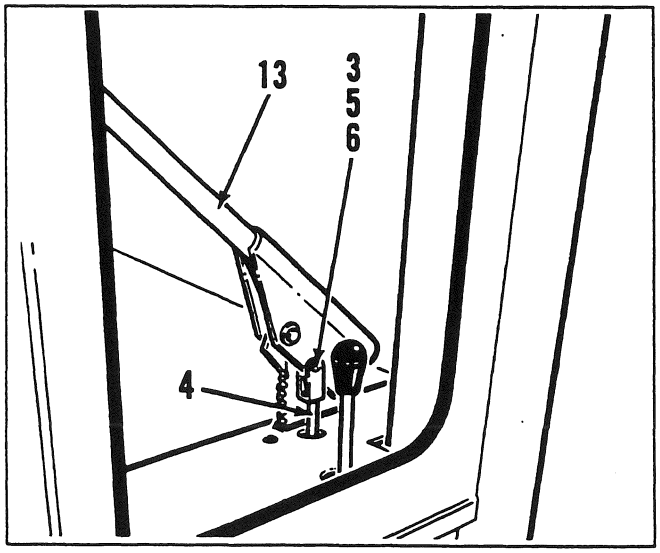


Fig. 16

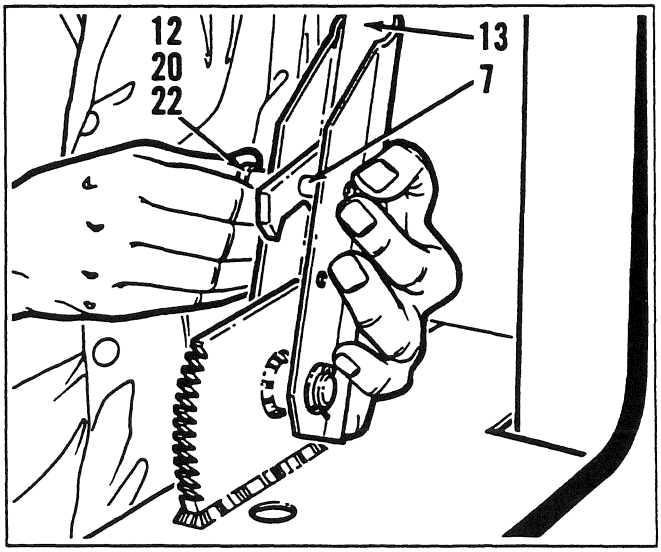


Fig. 19

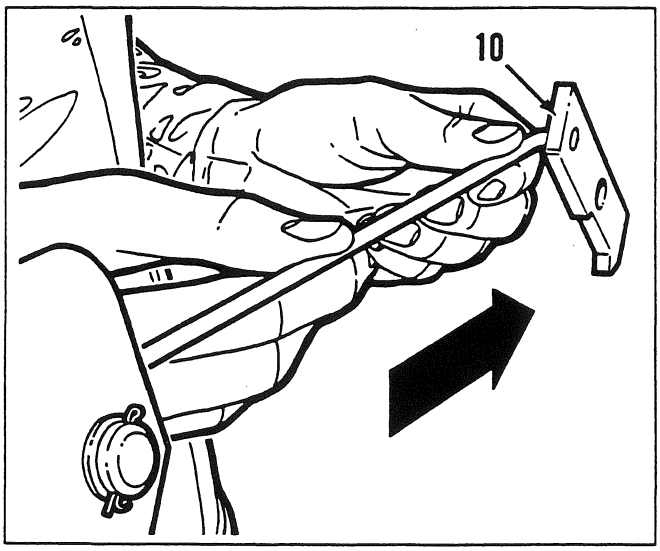


Fig. 20

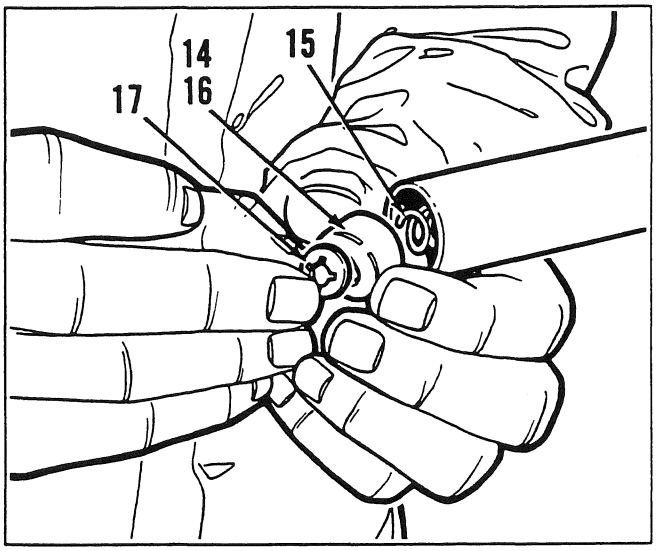


Fig. 23

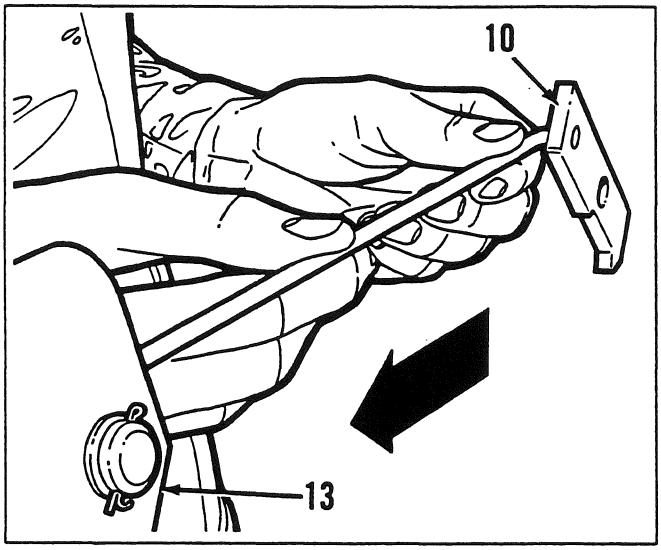
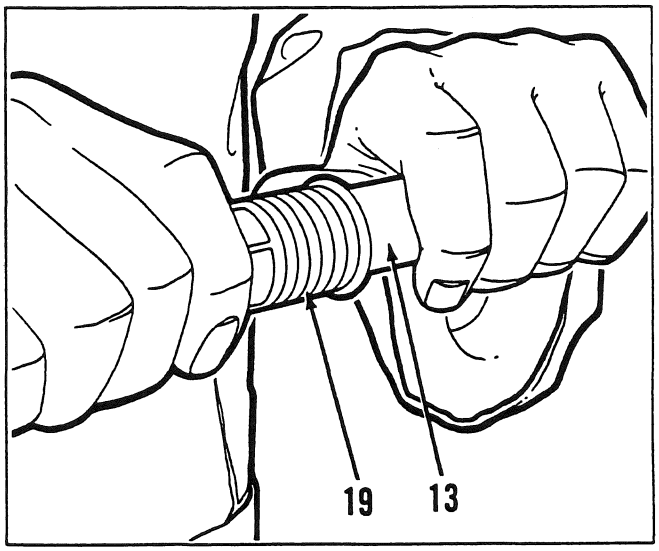


Fig. 21



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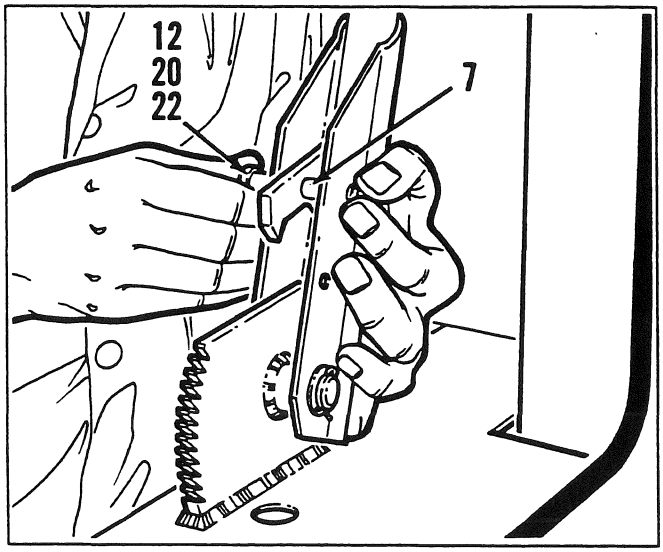

Fig. 22

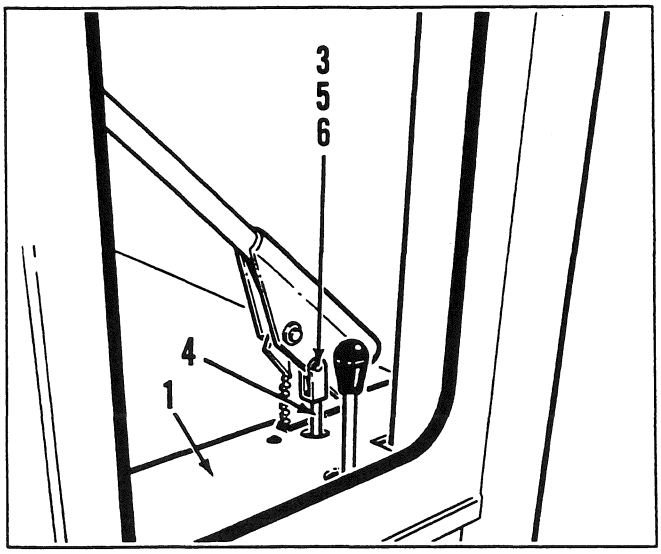

Fig. 25

Hand Brake - Disassembly *(Continued)*

Fig. 20
Remove the pawl and pawl rod (10). Inspect for signs of wear. Inspect the ratchet (2) attached to the left hand seat deck plate (1) for signs of wear. Replace worn parts.

NOTE: These parts are critical for holding the brake in the applied position.

Fig. 23
Install the spacer washer (14), spring (15) and second spacer washer (16). Install a new spring clip fastener (17).

Hand Brake - Assembly and Installation

Fig. 21
Install the pawl and pawl rod (10) into the handle (13).

Fig. 24
Immerse a new handle grip (19) in hot water. When the grip is soft, carefully install on the end of the handle (13). Install the release button (18).

Fig. 22
Install the washers (22), clevis pin (20), spacer (7) and washer (12). Secure the clevis pin with a new cotter pin (11).

Fig. 25
Install the short clevis end of the hand brake cable (4) through the holes in the bracket and left hand seat deck plate (1) until the cable collar abuts the bracket. Install the clevis pin (3) and washer (5) and secure with a new cotter pin (6). Place the handle in the lowest position.

Hand Brake - Assembly and Installation *(Continued)*

Fig. 26
Clamp the castings (34 and 37) in a vise with soft jaws and install the bolts (30). Tighten the bolts to the specified torque.

Fig. 27
Before installing new friction pad holders (35 and 36), check the code stamped on the back of each pad. The first number of the code must be **"5"**. Carefully install the new pad holders - curved edge toward the castings. Ensure the springs (33 and 38) are properly secured in the casting grooves.

Fig. 28
Lubricate the push pins (31) with graphite spray compound, Champion part number **CL 300**. Do not allow graphite spray to contact the friction pads or disc. Install the push pins into the casting (34).

Fig. 29
Lubricate the working surface of the operating cam (27) with graphite spray compound, Champion part number **CL 300**. Do not allow graphite spray to contact the friction pads or disc. Install the operating cam, washer (26) and castle nut (25). Do not install the cotter pin (24).

Fig. 30
Clamp the drive shaft flanges of the yoke (46) in a vise with soft jaws. Avoid damaging the disc and oil seal surfaces. Install the disc (44) and retain with the bolts (42) and lockwashers (43). Tighten the bolts in a diagonal sequence to the specified torque. Ensure that the disc is free of oil and grease.

Fig. 31
Lubricate and install a new oil seal (45). Lubricate the yoke splines. Apply a bead of gasket eliminator, Champion part number **25303**, onto the bearing face of the yoke.

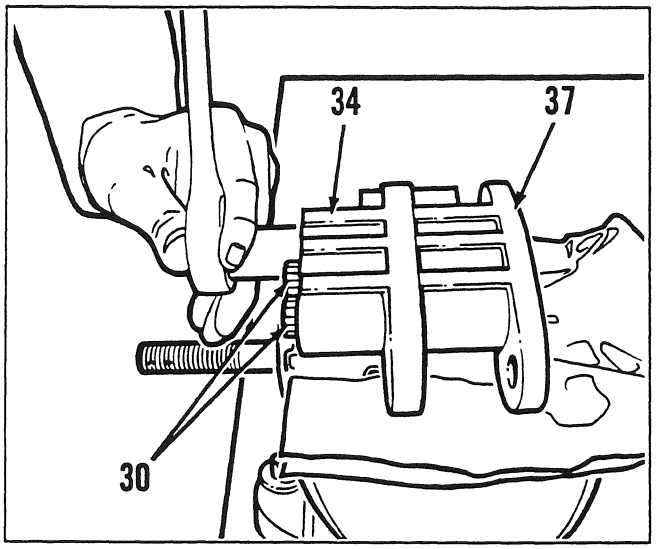

Fig. 26

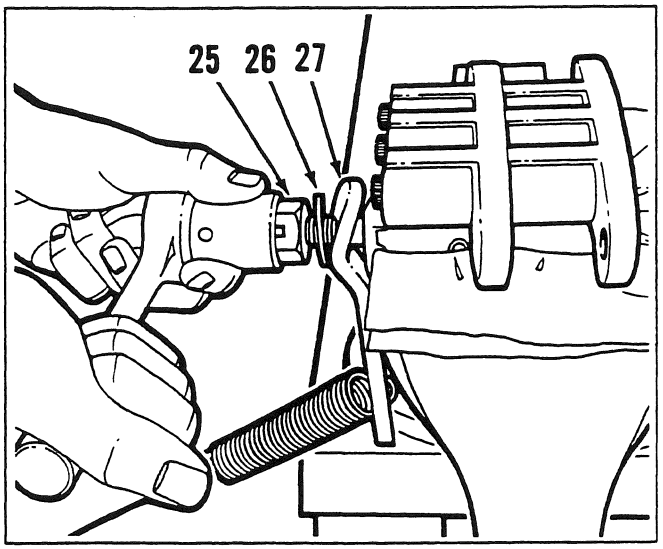

Fig. 29

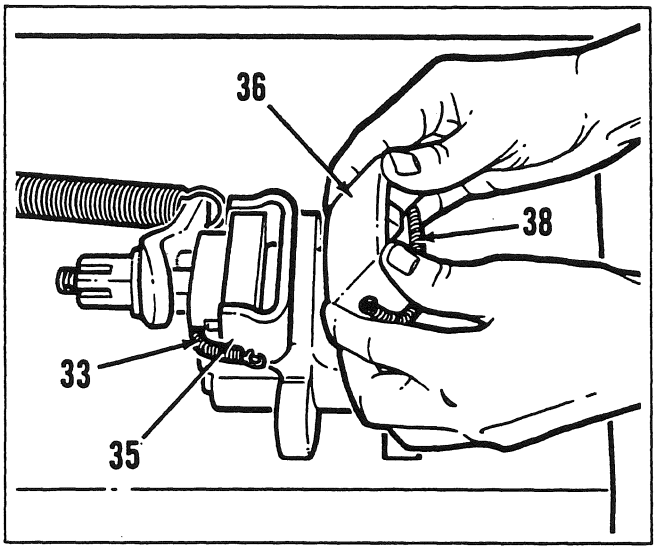

Fig. 27

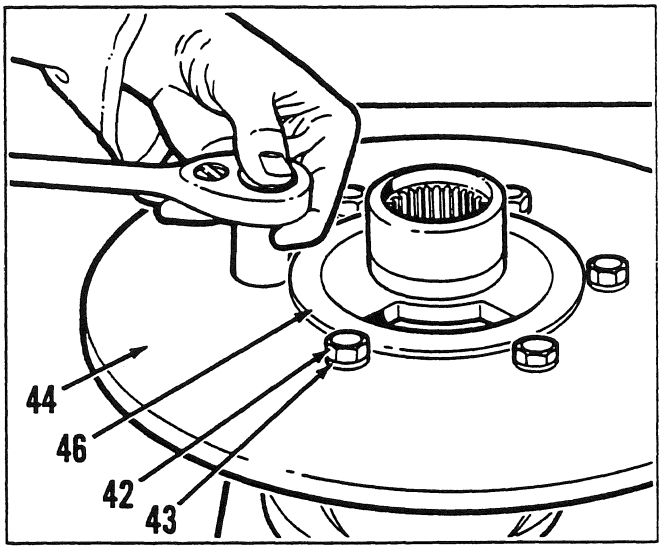

Fig. 30

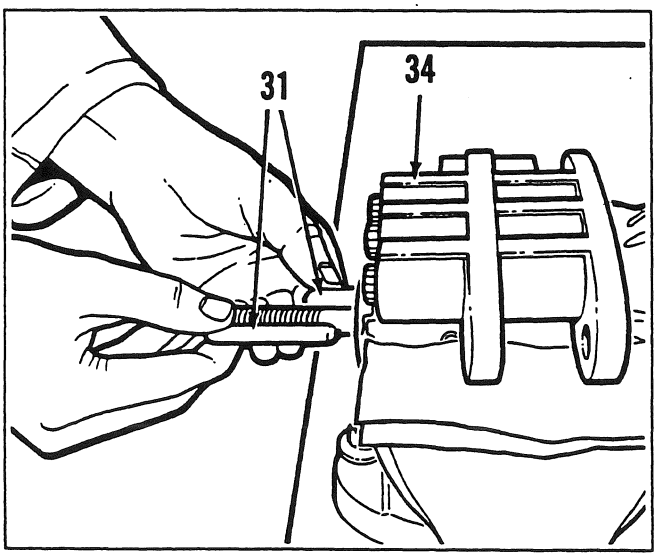

Fig. 28

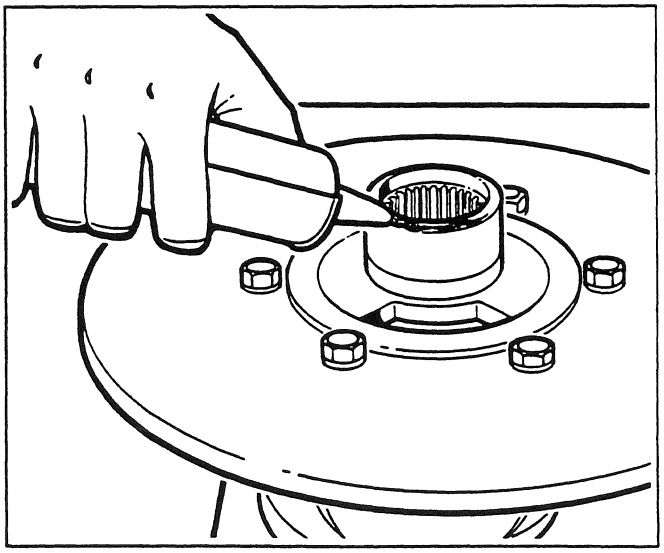
Fig. 31

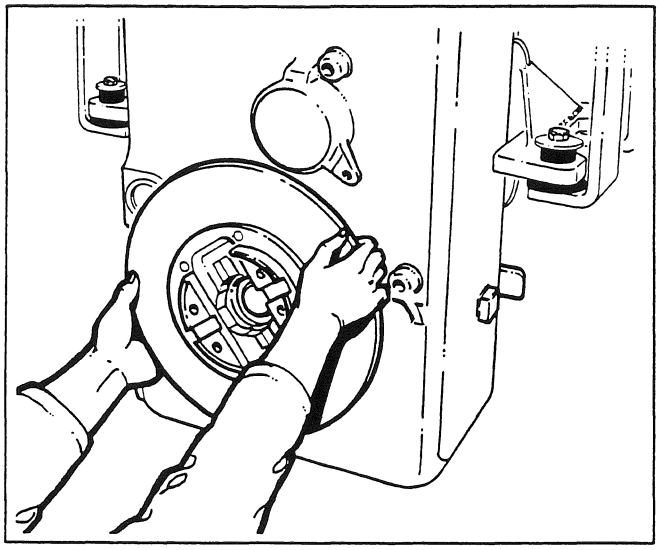

Fig. 32

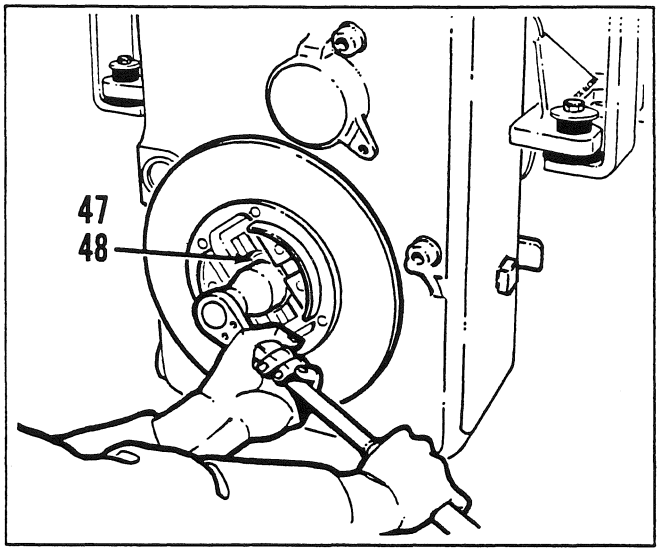

Fig. 33

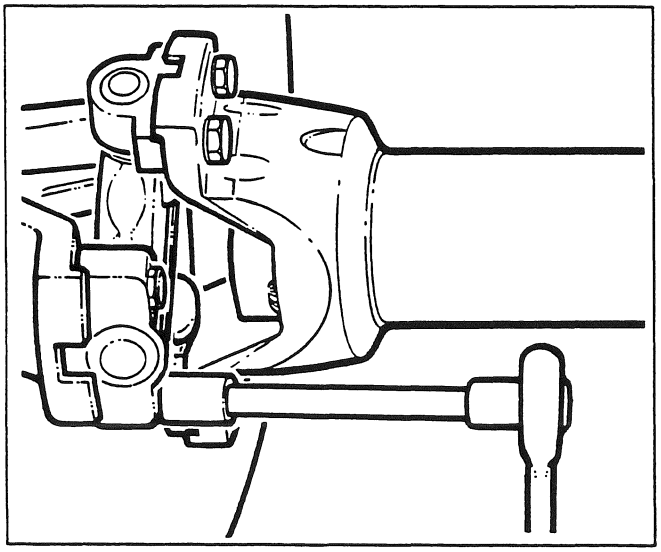

Fig. 34

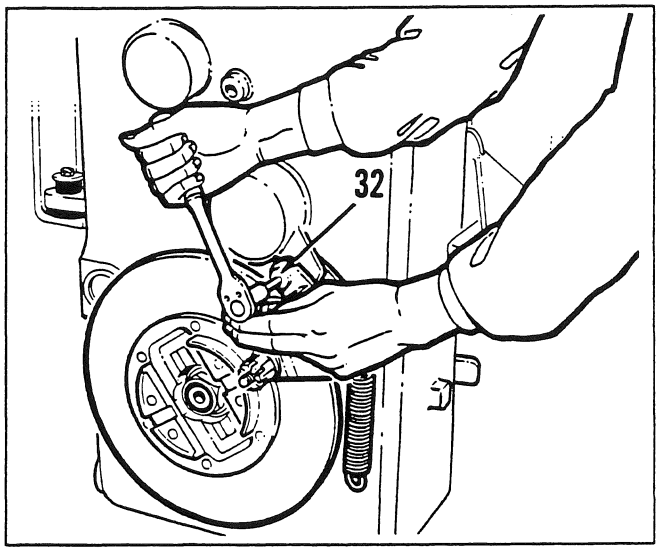

Fig. 35

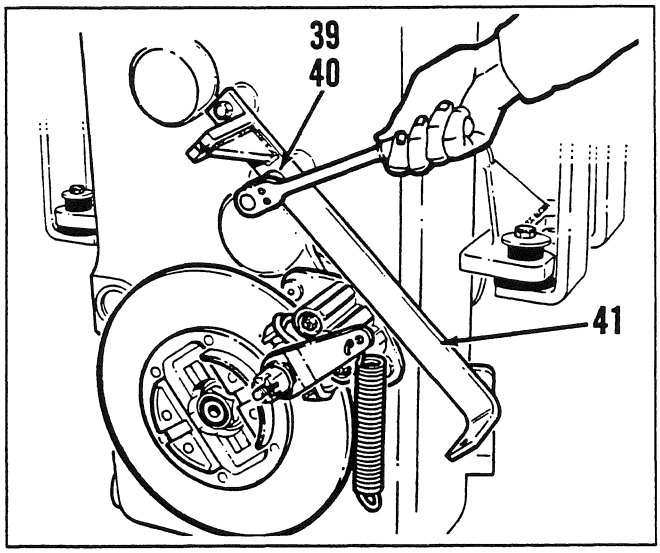

Fig. 36

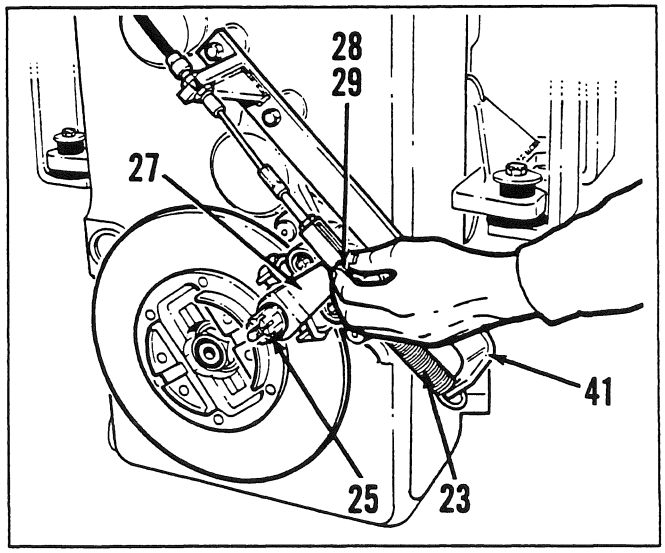

Fig. 37

Hand Brake - Assembly and Installation *(Continued)*

Fig. 32

Carefully install the disc and yoke assembly onto the transmission output shaft.

Fig. 33

Install the flatwasher (47) and new locknut (48). Tighten the locknut to the specified torque. Remove any greasy marks from the disc.

Fig. 34

Ensure that the mating surfaces are clean and without burrs. Connect the lower drive shaft to both yokes. Tighten the capscrews to the specified torque.

Fig. 35

Apply a light coating of anti-seize compound, Champion part number **30453**, onto the shoulder bolts (32). Carefully install the brake caliper assembly onto the transmission case and secure with the shoulder bolts. Tighten the bolts to the specified torque. Check to see if the brake caliper assembly moves freely on the shoulder bolts. If binding occurs, investigate and rectify the problem.

Fig. 36

Install the cable anchor bracket (41) to the transmission case and secure with the bolts (39) and lockwashers (40). Connect the hand brake cable (4) to the cable anchor bracket. Secure the cable nuts at the bracket and clevis to finger tightness only.

Hand Brake - Adjustment and Testing

Fig. 37

Secure the castle nut (25) to finger tightness only while gently rocking the operating cam (27) back and forth to determine the lowest point on the cam. Only the slightest amount of play should exist. Pull the cable at its free end to remove any slack or lost motion. Move the cam in the direction of the cable to cancel any lost motion between the cam and the push pins (31). Adjust the cable clevis to coincide with the outer hole of the cam. Fully tighten all cable nuts. Install the clevis pin (28) and secure with a new cotter pin (29). Connect the spring (23) to the cable anchor bracket (41). Check that the handle locks in all positions. This verifies that the mechanism does not bind. Refill the transmission to the required level with fresh system oil.

Hand Brake - Adjustment and Testing *(Continued)*

Fig. 38

NOTE: Adjust the brake cable before adjusting the caliper assembly.

Loosen the castle nut (25) approximately 1-1/2 to 2-1/2 flats. Align one of the castle nut slots with the hole in the caliper assembly threaded rod. The hand brake lever should move five to six ratchet teeth when the brake is properly adjusted. After making the adjustment, install and secure a new cotter pin (24).

Fig. 39

After adjusting, prepare the grader for a brake function test and engine stall test. Make a visual check around the machine. Ensure all personnel are clearly away from the area of the caliper assembly or drive shafts. Start the engine when it is safe to do so. Move the grader to an appropriate test area and drive the machine forward in eighth gear at full engine rpm for one minute. Stop the grader and shut down the engine. Remove and retain the ignition key. Check the hand brake disc for signs of friction pad drag by carefully determining if the disc is hot. If the friction pads are dragging, remove the castle nut cotter pin. Loosen the castle nut by one flat. Replace and secure the cotter pin.

Fig. 40

The friction pads should be properly burnished as follows. Start the engine when it is safe to do so. Drive the machine forward in third gear and lightly apply the hand brake a few seconds at a time to reduce engine speed. Repeat this procedure four or five times until the braking action becomes more aggressive. Stop the grader and place the machine in the SERVICE POSITION.

Fig. 41

Apply the hand brake until the pawl engages the sixth ratchet tooth. Start the engine when it is safe to do so. Adjust the engine speed to low idle. Depress the clutch pedal. Select third speed forward. Slowly release the clutch pedal - taking approximately two seconds to do so. The engine **must** stall. If the engine does not stall, either re-burnish or re-adjust the caliper assembly. Repeat this procedure until the engine can be made to stall, but without the hand brake being adjusted too tight.

Fig. 42

You are recommended to check the hand brake adjustment and operation every day. After 50 hours and at every 500 hours, check for cable stretch. Refer to **Fig. 37** for instructions of how to adjust the cable.

NOTE: If you have used the hand brake in an emergency to bring the grader to a stop, you must inspect and adjust the brake caliper assembly before moving the grader.

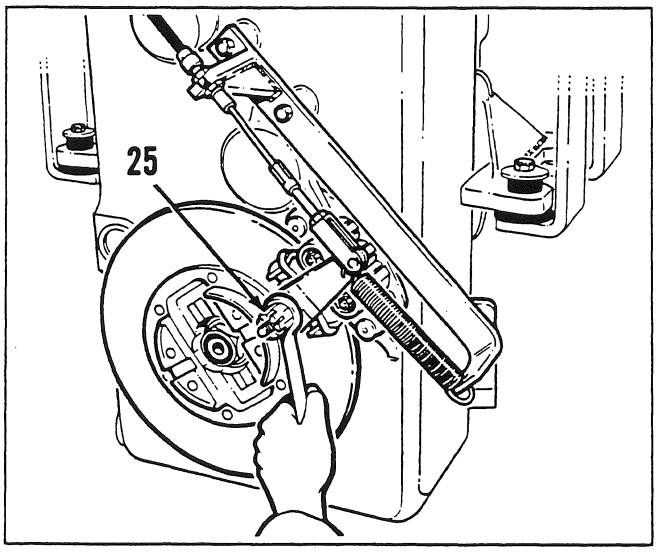

Fig. 38

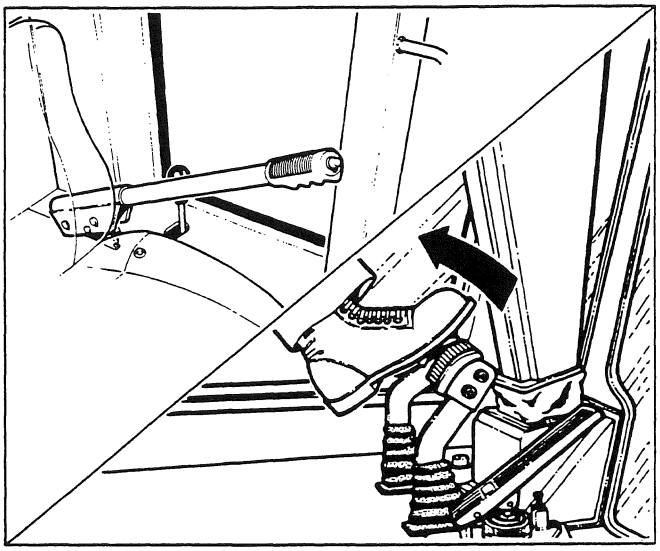

Fig. 41

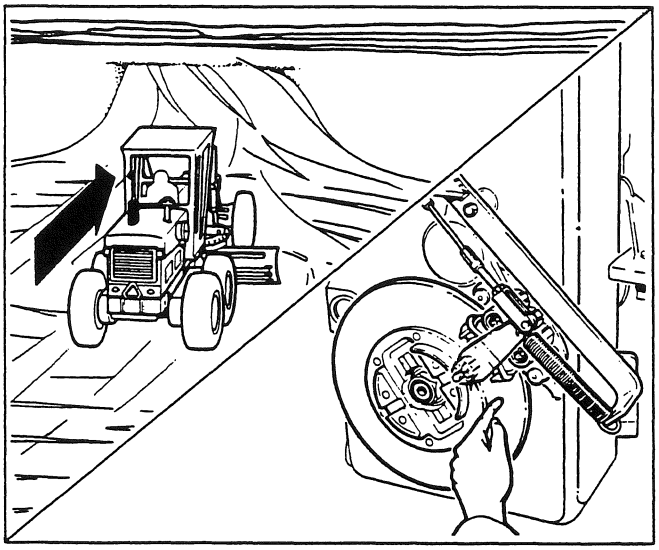

Fig. 39

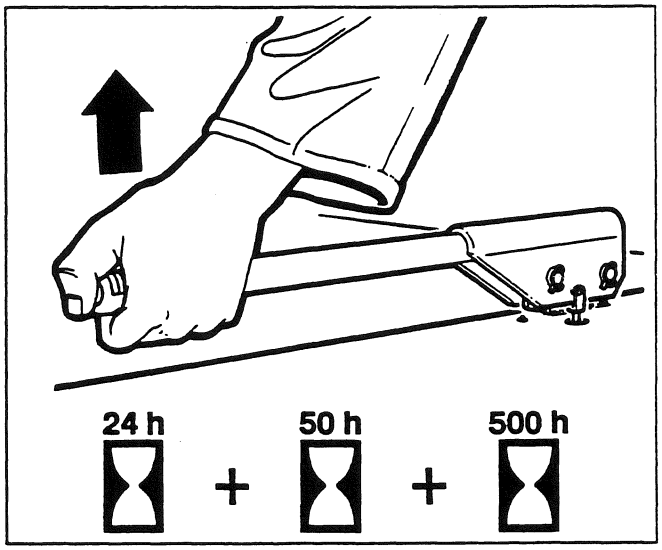

Fig. 42

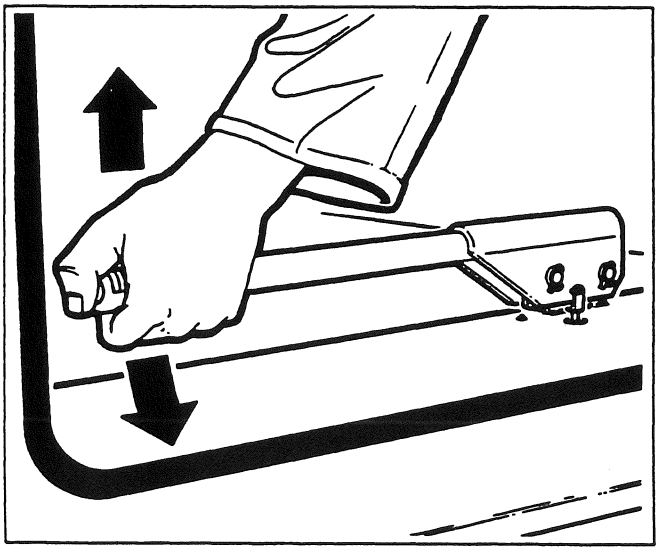

Fig. 40

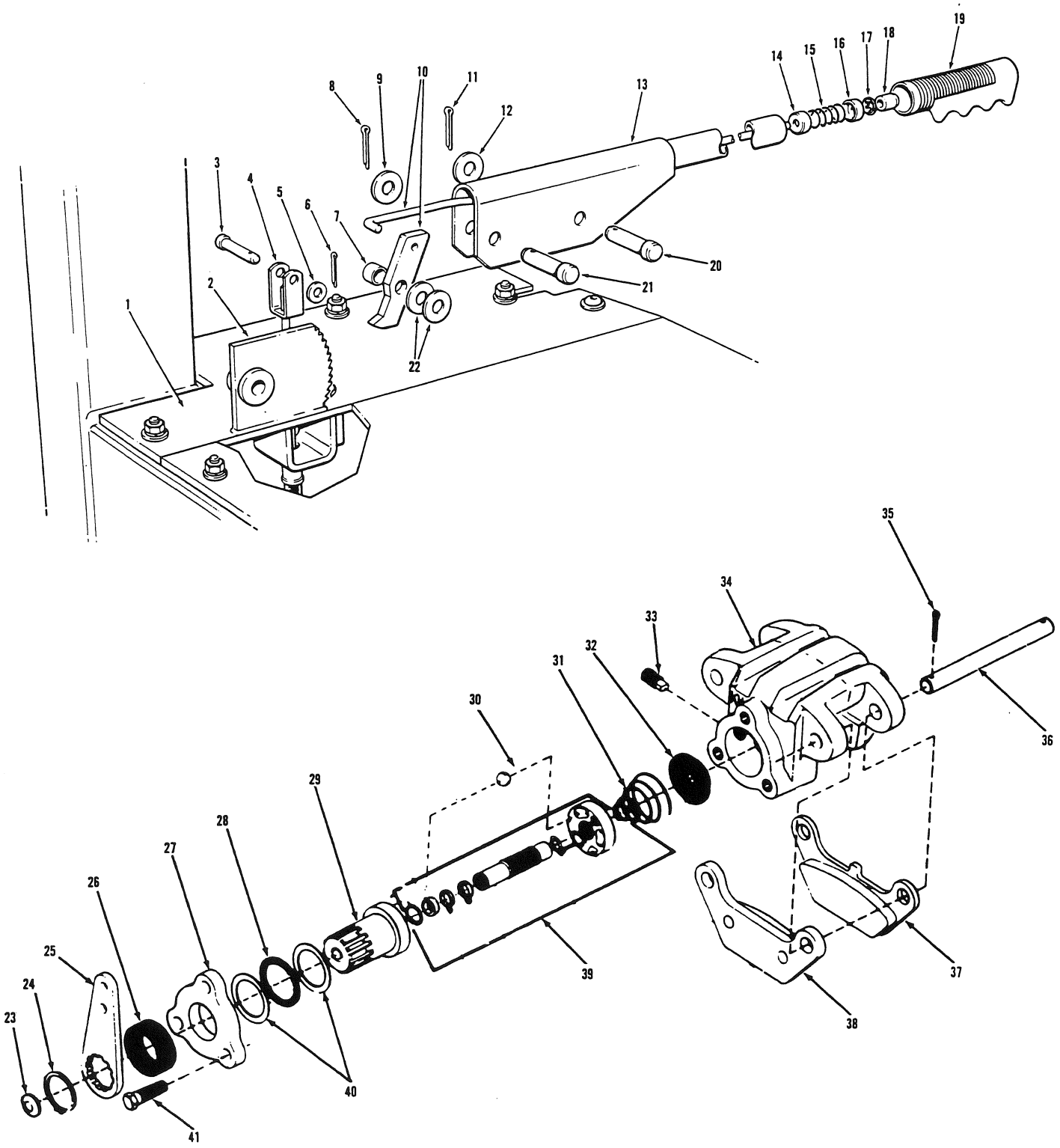

Fig. 43 Models 750 through 780A S/N **21007** and up

Item	Description	Item	Description	Item	Description
1	Seat deck plate	15	Spring	29	Rotor
2	Ratchet	16	Spacer washer	30	Ball
3	Clevis pin	17	Spring clip fastener	31	Conical return spring
4	Hand brake cable	18	Release button	32	Dust boot
5	Washer	19	Handle grip	33	Anti-rotation key
6	Cotter pin	20	Clevis pin	34	Casting
7	Spacer	21	Clevis pin	35	Cotter pin
8	Cotter pin	22	Washers	36	Mounting pin
9	Washer	23	Plastic plug	37	Pad and holder assembly
10	Pawl and pawl rod	24	Snap ring	38	Pad and holder assembly
11	Cotter pin	25	Operating cam	39	Shaft, spring and stator assembly
12	Washer	26	Seal		
13	Handle	27	Cover	40	Thrust washers
14	Spacer washer	28	Thrust bearing	41	Bolt

Key to Fig. 43 Models 750 through 780A S/N **21007** and up

Description (Models 750 through 780A)

The mechanically actuated, disc type hand brake installed on models 750 through 780A is mounted on the final drive input yoke. Operating the handle in the cab engages and disengages the hand brake caliper assembly.

Generally, this type of hand brake caliper works as outlined in **Description** at the front of this Shop Manual section. The design, however, includes a self-adjusting mechanism which is not part of the caliper assembly installed on models 710 through 740A.

Disassembly (Models 750 through 780A)

1. Disconnect the brake cable and return spring from the operating cam (25).

2. Increase the clearance between the pads and the disc to help remove the caliper assembly. Remove the plastic plug (23). Insert a 1/4 in. Allen wrench into the shaft and turn counter-clockwise to increase the clearance.

3. Support the caliper assembly. Remove and discard the cotter pins (35). Remove the mounting pins (36). Carefully remove the casting (34), together with the pad and holder assemblies (37 and 38). Identify the position of each pad for assembly purposes.

4. Place the casting on a clean workbench. Remove and discard the snap ring (24). Remove the operating cam. Remove and discard the seal (26) from the rotor (29).

5. Remove the bolts (41) and cover (27).

6. Remove the rotor from the casting. Remove the thrust bearing (28) and thrust washers (40).

7. Remove the shaft, spring and stator assembly (39).

NOTE: Be aware of loose parts. Remove the three balls (30).

8. Remove the conical return spring (31) from the casting. Remove and discard the dust boot (32).

9. Remove the anti-rotation key (33) from the casting. Place the parts to one side for cleaning and inspection.

Cleaning and Inspection (Models 750 through 780A)

Clean parts with denatured alcohol. Dry the parts using moisture-free compressed air or lint-free rags.

NOTE: Do not clean the pad and holder assemblies.

A careful and thorough inspection of all parts is extremely important. Check the brake disc surface condition. Replace the disc if it is badly warped or pitted. The disc should run true to within 0.010 in. (0,25 mm). Check friction pad wear. If the pads are worn to less than 3/32 in. (2 mm), replace them. Always replace both pads at the same time.

Examine all parts carefully for signs of excessive wear, damage or corrosion. Check the rotor and stator for cracks. Inspect the thrust bearing for wear. Discard broken springs. Check anti-rotation key for wear or damage. Replace defective parts.

Inspect casting bore for scoring, pitting or corrosion. Replace corroded or deeply scored castings. Use crocus cloth to remove light scores and stains.

Individual parts of the shaft, spring and stator assembly are not available separately. Replace the assembly as a complete unit.

Bench check the self-adjusting mechanism for proper operation. Hold the shaft, spring and stator assembly in one hand and the rotor in the other, allowing a space where the balls would be. Holding the stator stationary, turn the rotor counter-clockwise. The shaft should remain stationary. Turn the rotor back to its original position. The shaft should turn out of the stator. This is a test to check the clutch spring and anti-rotation spring for proper grab and slip torque. Replace the shaft, spring and stator assembly if it fails this test.

Assembly (Models 750 through 780A)

1. Install the anti-rotation key (33) into the casting (34). Install the anti-rotation key until the end of the key is approximately 2 in. (5 cm) from the opposite surface of the bore. Retract the key up to one half turn to align the flats parallel to the bore.

2. Apply a coating of molybdenum disulfide grease to the entire bore of the casting.

3. Lubricate and install a new dust boot (32) into the casting bore. Ensure the boot seats properly and is not ripped or torn. Install the conical return spring (31).

4. Apply a coating of molybdenum disulfide grease to the shaft, spring and stator assembly (39), including the keyway and ball pockets. Install the assembly into the casting bore. Install the three balls (30) into the ball pockets.

5. Apply a coating of molybdenum disulfide grease to the shank and ball pockets of the rotor (29). Install the rotor into the casting bore.

6. Apply a coating of molybdenum disulfide grease to the thrust bearing (28) and thrust washers (40). Install the thrust bearing and thrust washers onto the rotor shank.

7. Install the cover (27) and secure with the bolts (41). Torque-tighten the bolts to 70 - 80 lbf.ft (95 - 108 N.m; 9,7 - 11,0 kgf.m).

8. Lubricate and install a new seal (26) over the rotor shank.

9. Install the operating cam (25) and secure with a new snap ring (24).

10. If you are installing the existing pad and holder assemblies (37 and 38), check the identification to ensure correct positioning during installation. If you are installing new pad and holder assemblies, check the numeric code stamped on the ear or on the back of the pad. The first number(s) specifies the type of friction material. Check to see that the new pads have the same friction material type number as the old pads.

11. Place the casting and pad and holder assemblies into position at the bracket. Install the mounting pins (36) and secure with new cotter pins (35).

12. Check to see if the operating cam is positioned as shown in **Fig. 44**. If not, remove the snap ring and reposition the operating cam. Install the snap ring.

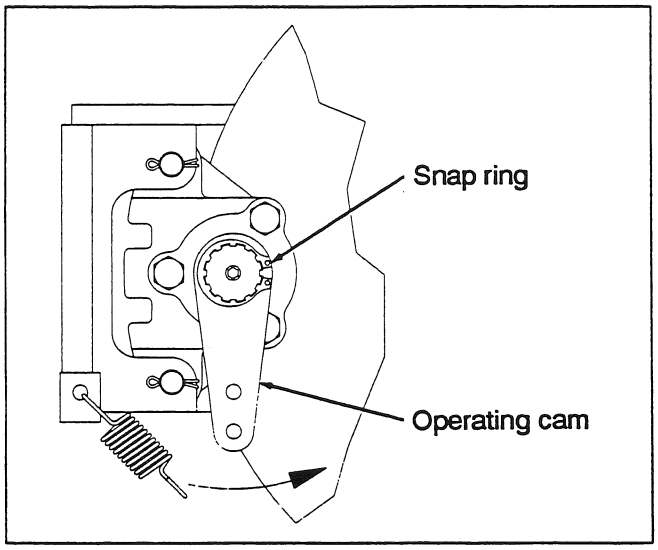

Fig. 44

13. Insert a 1/4 in. Allen wrench into the shaft and turn counter-clockwise until there is a 0.030 in. (0,8 mm) gap between the applying pad and disc (see **Fig. 45**). Install the plastic plug (23).

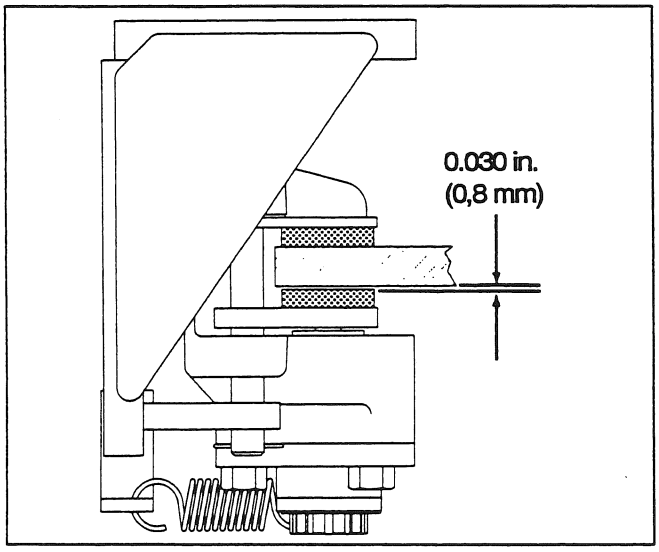

Fig. 45

14. Install and adjust the hand brake cable (4) as described in the following instructions.

Installing and Adjusting Hand Brake Cable (Models 750 through 780A)

1. Move the operating cam counter-clockwise. Only a slight amount of movement should exist.

2. Pull the cable at its free end to remove any slack or lost motion.

3. Adjust the cable clevis to coincide with the outer hole of the operating cam. Fully tighten all cable nuts. Install the clevis pin and secure with a new cotter pin. Install the operating cam return spring.

4. Check that the handle (13) locks in all positions. This verifies that the mechanism does not bind.

Hand Brake Function Test (Models 750 through 780A)

1. After checking the friction pad clearance and adjusting the brake cable, prepare the grader for a brake function test and engine stall test.

2. Make a visual check around the machine. Ensure all personnel are clearly away from the area of the caliper assembly and drive shafts. Signal your intention to start the engine. Start the engine when it is safe to do so.

3. Move the grader to an appropriate test area and drive the machine forward in eighth gear at full engine rpm for one minute. Stop the grader and shut down the engine. Remove and retain the ignition key.

4. Check the hand brake disc for signs of friction pad drag by carefully determining if the disc is hot.

5. If the friction pads are dragging, check the gap between the pads and disc. To adjust the gap, remove the plastic plug. Insert a 1/4 in. Allen wrench into the end of the shaft and turn counter-clockwise until there is a 0.030 in. (0,8 mm) gap between the applying brake pad and disc (see **Fig. 45**). Install the plastic plug.

Burnishing Friction Pads (Models 750 through 780A)

1. New friction pads, or pads showing signs of high temperature wear (as in an emergency stop), should be properly burnished as follows.

2. Start the engine when it is safe to do so. Drive the machine forward in third gear and lightly apply the hand brake a few seconds at a time to reduce the engine speed (see **Fig. 46**).

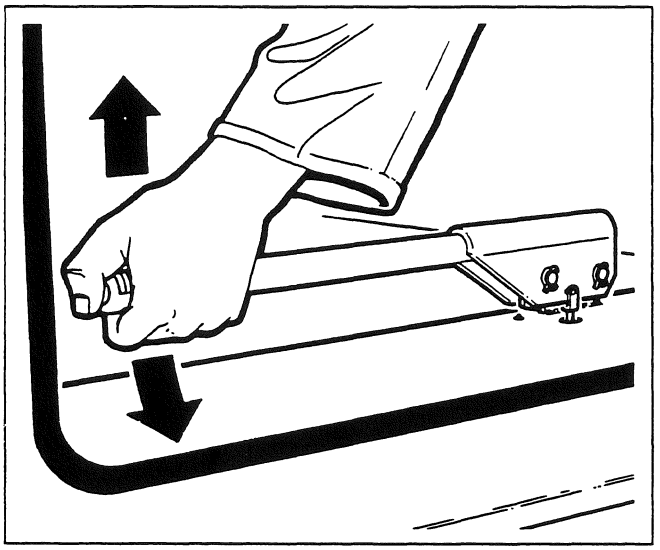

Fig. 46

3. Repeat this procedure four or five times until the braking action becomes more aggressive. Stop the grader and shut down the engine.

Engine Stall Test (Models 750 through 780A)

1. Apply the hand brake until the pawl engages the sixth ratchet tooth.

2. Start the engine when it is safe to do so. Adjust the engine speed to low idle.

3. Depress the clutch pedal. Select third speed forward.

4. Slowly release the clutch pedal - taking approximately two seconds to do so (see **Fig. 47**). The engine must stall. If the engine does not stall, either re-burnish the friction pads or re-adjust the gap between the applying pad and disc.

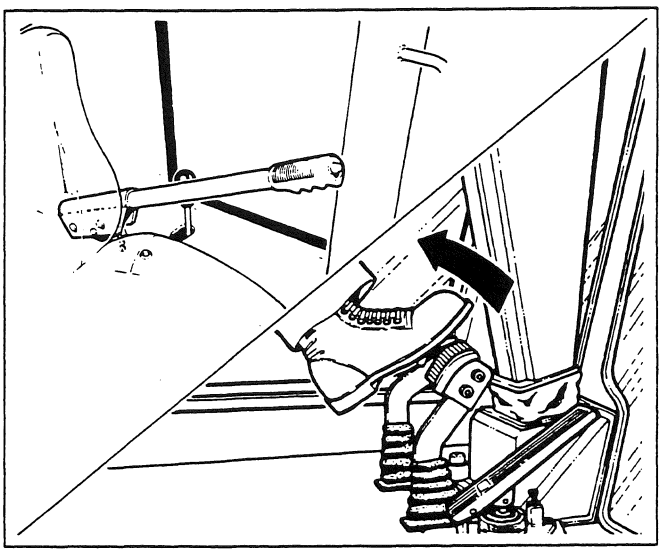

Fig. 47

5. Repeat this procedure until the engine can be made to stall, but without the hand brake being adjusted too tight.

SECTION 16

SERVICE BRAKES MASTER CYLINDER

Applicable to graders S/N **19431**, **19458**, **19565**, **19566**, **19568** to **19578**, **19580** to **19589**, **19591**, **19592**, **19594** to **19610**, **19612** to **19614**, **19616**, **19618** and up.

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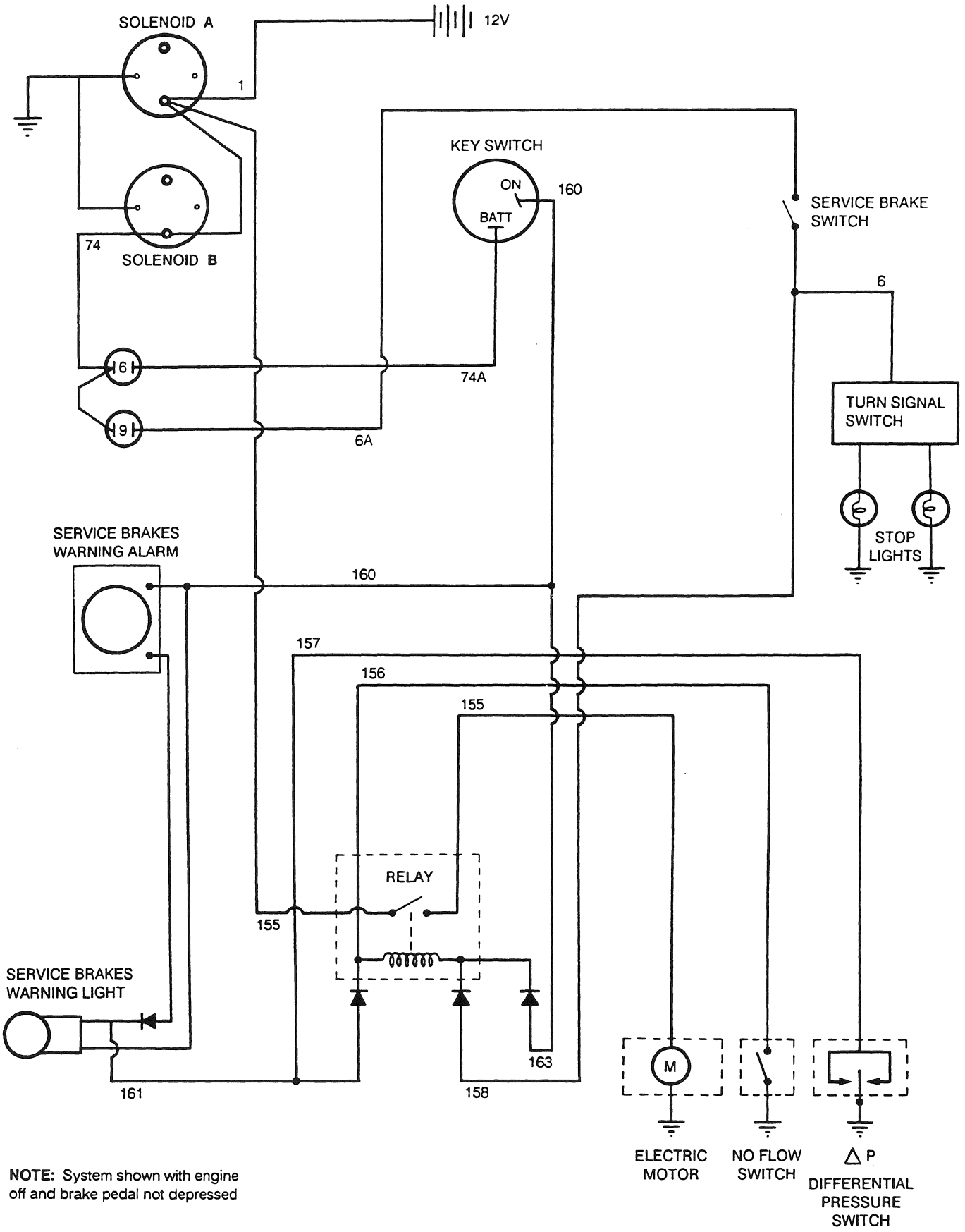
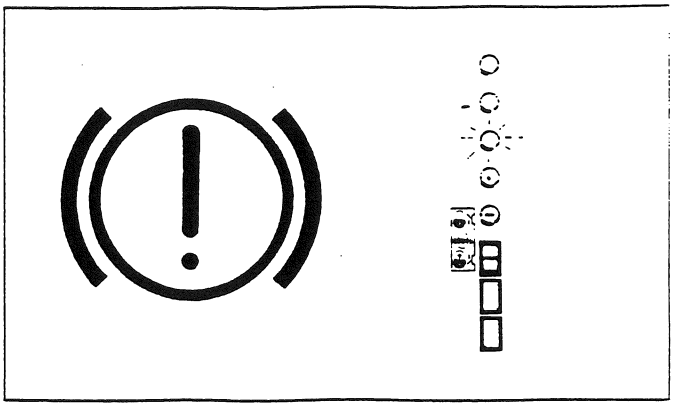


NOTE: System shown with engine off and brake pedal not depressed

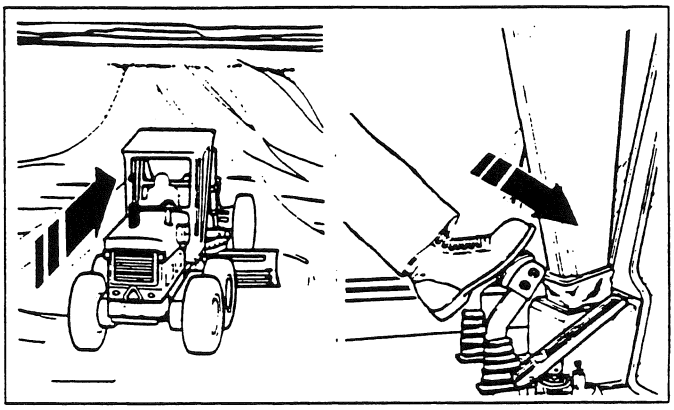
Service Brakes Electrical Schematic - S/N **20830** and up

Service Brakes - General Operation for Graders S/N 20830 and up



- Graders equipped with either drum or oil disc service brakes have an electric motor pump that automatically supplies hydraulic power assist in the event of an engine failure or any situation where hydraulic oil flow is interrupted to the service brake booster.
- This reserve system provides power assisted braking capability at a reduced level and automatically resets when hydraulic flow is restored.
- The brake warning light and alarm energize when there is a loss of hydraulic oil flow.
- The service brake system has two brake circuits. The system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.
- Each of the two circuits function on one front and opposite rear tandem wheel. Should one circuit fail, braking remains effective on all tandem wheels through the tandem chains.
- If only one of the brake circuits is working in the system, the brake warning light and alarm energize when you depress the brake pedal.
- If the brake warning light and alarm energize, the brake system is faulty and must be repaired by a qualified service technician. Do not drive the grader.

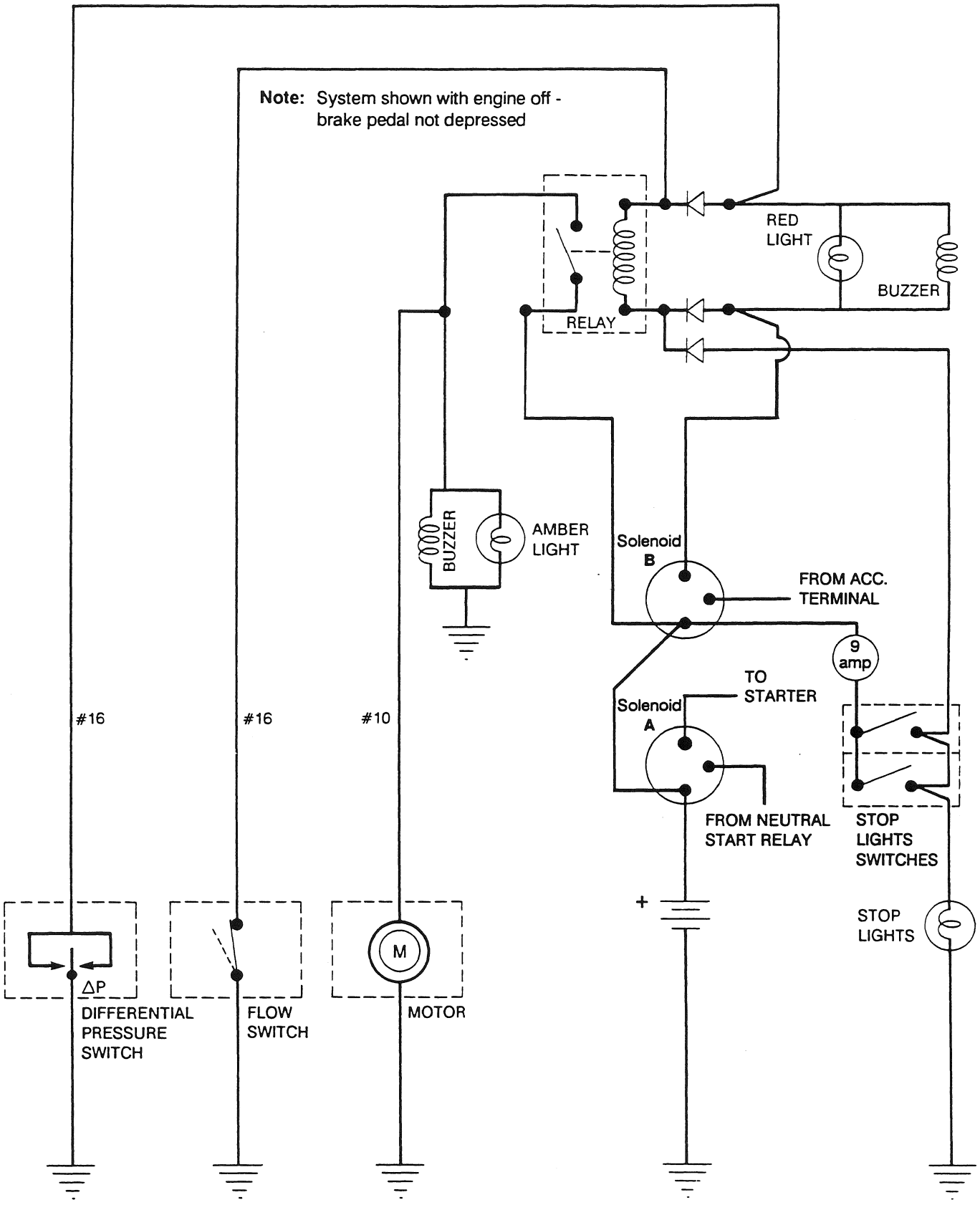
Service Brakes - Brake Function Check for Graders S/N 20830 and up



- Perform this brake function check once every week.
- Check the hand brake operation. Refer to your 700 Series, Series III Operator's Manual.
- Make a visual check around the machine. Ensure all personnel are away from the area. Signal your intention to start the engine. Start the engine when it is safe to do so.
- Back the grader up a slight incline where it is safe to allow the machine to roll forward without power.
- Stop the grader, place the transmission in neutral and apply the hand brake (this should require approximately 60 pounds [27 kg] of effort). Shut down the engine and keep the ignition key in the OFF position.
- Release the hand brake when it is safe to do so. Allow the grader to roll ahead at about 2 to 3 mph (3 to 5 km/h). Apply the service brakes. The grader must stop abruptly.
- If the grader does not stop, use the hand brake to stop the machine. Immediately have the brake system repaired by a qualified service technician.

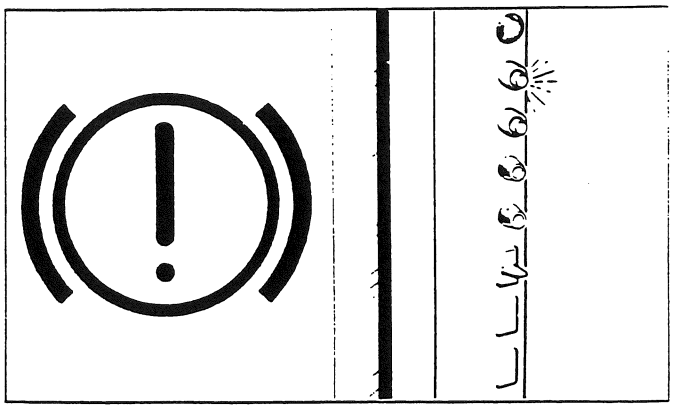
⚠WARNING

Unless you need braking action, do not depress brake pedal when ignition key is in the OFF position. The service brake electric motor pump will energize using battery power only. Subsequent loss of braking effectiveness could result in personal injury or death. Apply the hand brake before shutting down the engine.

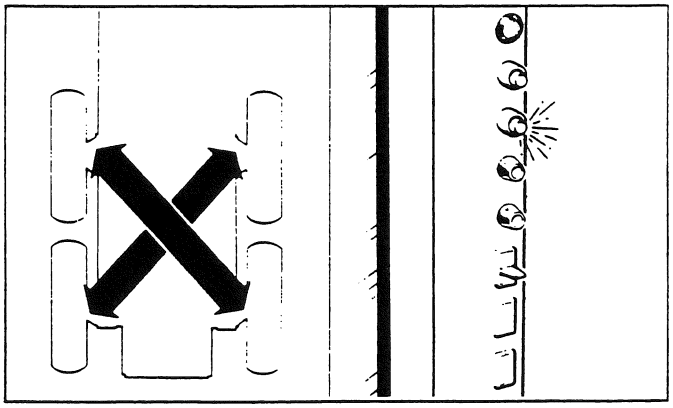


Drum Service Brakes Electrical Schematic - Up to S/N **20829**

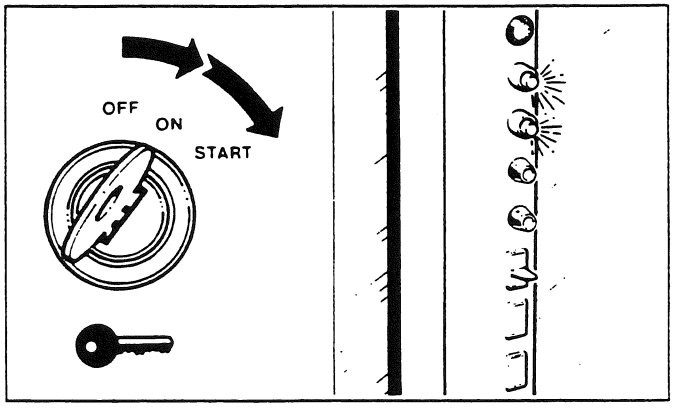
Drum Service Brakes - General Operation for Graders up to S/N 20829



- Graders equipped with drum service brakes have an electric motor pump that automatically supplies hydraulic power assist in the event of an engine failure or any situation where hydraulic oil flow is interrupted to the service brake booster.
- This reserve system provides power assisted braking capability at a reduced level and automatically resets when hydraulic flow is restored.
- The amber warning buzzer light energizes when there is a loss of hydraulic oil flow.



- The drum service brake system has two brake circuits. The system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.
- Each of the two circuits function on one front and opposite rear tandem wheel. Should one circuit fail, braking remains effective on all tandem wheels through the tandem chains.
- If only one of the circuits is working in the system, the red warning buzzer light energizes when you depress the brake pedal.



- If either or both buzzer lights energize, the brake system is faulty and must be repaired by a qualified service technician. Do not drive the grader.

Drum Service Brakes - Brake Function Check for Graders up to S/N 20829

- Turn the battery isolation switch(es) to the ON position.
- Push the brake pedal.
- The amber warning buzzer light should energize. This indicates the master cylinder booster electric motor pump is working.
- Insert the ignition key and turn to the ON position. The red and amber brake warning buzzer lights should energize. If they do not energize, the system is faulty and must be repaired by a qualified service technician. Do not drive the grader.
- Turn the key to the START position. The red and amber brake warning buzzer lights should de-energize when the engine starts. If the brake warning buzzer lights stay energized, the system is faulty and must be repaired by a qualified service technician. Do not drive the grader.

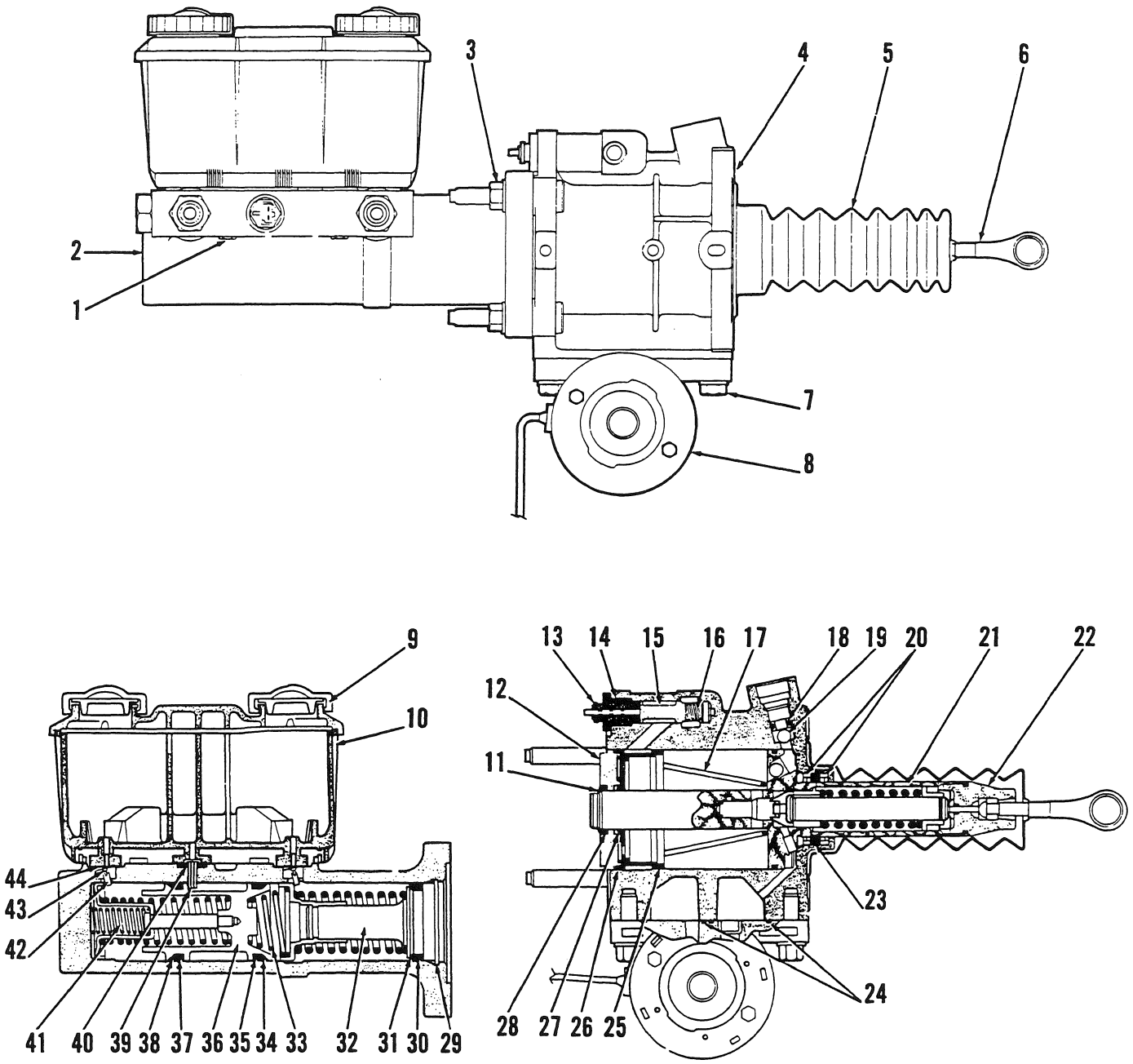

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Fig. 1

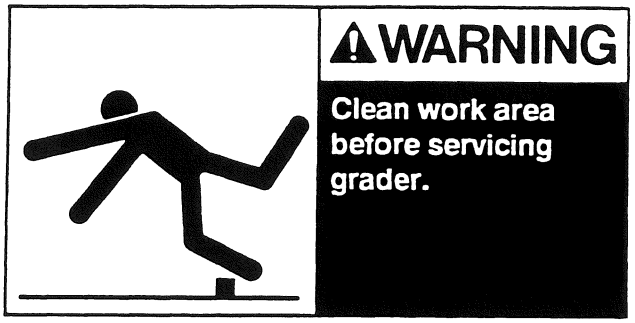
Item	Description	Item	Description	Item	Description
1	Capscrew	15	Flow switch piston	31	O-ring
2	Brake master cylinder	16	Spring	32	Primary piston assembly
3	Nut	17	Piston return spring	33	Primary piston return spring
4	Power booster	18	Inlet check valve	34	O-ring
5	Boot	19	Inlet check ball	35	Back-up ring
6	Threaded push rod, adjustable clevis and nut	20	Oil seal	36	Secondary piston assembly
		21	Power piston shaft	37	Back-up ring
7	Capscrew	22	Input plug	38	O-ring
8	Electric motor pump	23	Spacer	39	Piston stop pin
9	Reservoir cap	24	O-ring	40	O-ring
10	Reservoir	25	O-ring (thin)	41	Secondary piston return spring
11	Snap ring	26	O-ring (thick)		
12	Filter and end cap assembly	27	Oil seal	42	Compensating valve spring
		28	O-ring	43	Compensating valve
13	Flow switch contact	29	Snap ring	44	Compensating valve seal
14	O-ring	30	Back-up ring		

Key to Fig. 1

Torque Guide

Fig. No.	Application	Torque Value lbf.in./lbf.ft	N.m	kgf.m
25	Flow switch contact to booster housing	20 - 40 lbf.in.	2,0 - 4,5	0,2 - 0,5
29	Capscrews retaining electric motor pump to booster	18 - 25 lbf.ft	24 - 34	2,5 - 3,5
47	Capscrews retaining reservoir to cylinder body	170 - 210 lbf.in.	21 - 26	1,9 - 2,4
48	Nuts retaining booster housing to cylinder body	25 - 30 lbf.ft	34 - 41	3,5 - 4,1
49	Bolts retaining master cylinder assembly to frame	16 - 25 lbf.ft	22 - 34	2,2 - 3,5
51	Nut retaining push rod adjustable clevis	90 lbf.ft	122	12

General



Make sure proper shop tools are available and in good working order. The brake master cylinder and power booster assembly should be serviced on a clean workbench.

Refer to the 700 Series Parts Manual P/N **L-3008** or P/N **L-3015** for spare parts information. Champion recommends installing parts contained in the repair kits listed in the Parts Manual.

Service Position Precaution

NOTE: *Always place the grader in the SERVICE POSITION before attempting any overhaul, maintenance or inspection procedure.*

Refer to the SERVICE POSITION procedure on page (ii) in the front of this Shop Manual.

Cleaning and Inspection

Cleaning

For graders equipped with oil disc brakes, thoroughly clean parts with petroleum base fluid (PBF). For graders equipped with drum service brakes, thoroughly clean parts using clean brake fluid. Agitate the parts to remove all foreign matter. Use moisture-free compressed air or lint-free rags to remove dirt and brake fluid.

Inspection

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Description and Operation

The following description is written with permission from Ford Motor Company of Canada, Limited.

Master Cylinder (Fig. 2)

The master cylinder and power booster assembly is installed under the cab on the right-hand side of the grader.

In the released position, both primary and secondary piston actuators contact compensating valve stems that project into the master cylinder bore. This keeps the valves open and allows system fluid in the reservoir to replenish any fluid displaced from the master cylinder.

Initial forward travel of the primary piston moves the primary actuator away from its compensating valve. The valve closes and shuts off the passage between the reservoir section and primary pressure chamber.

Further movement of the primary piston creates a pressure in the primary pressure chamber causing the secondary piston and actuator to move. The secondary actuator moves away from its compensating valve, which closes and shuts off the passage between the reservoir section and secondary pressure chamber. Further movement of the primary piston causes both chambers to build pressure.

When the load on the primary piston is removed, the combined return spring force and fluid pressure in each chamber cause the primary and secondary pistons to return to their original positions. The actuators contact both compensating valve stems and open the passages between the reservoir sections and pressure chambers.

Should the rate of release be great enough to cause a partial vacuum in a pressure chamber, the open compensating valve allows system fluid replenishment in the cylinder bore.

Description and Operation
Master Cylinder (Fig. 2) continued

Any excess system fluid remaining at the end of the stroke due to 'pumping' and/or volume change due to temperature fluctuation is released as the compensating valve ports open.

Power Booster (Fig. 2)

The power booster receives hydraulic fluid pressure through the inlet port. This pressure forces the power piston to move the output push rod against the primary piston and actuator in the master cylinder.

Under normal conditions, depressing the brake pedal forces the input pedal rod against the valve rod and reaction piston. The reaction piston moves forward and closes the pressure valve. Closing the pressure valve reduces the fluid flow into the area in front of the power piston (low pressure chamber). The pressure acting on the large diameter power piston increases and forces the power piston and output push rod forward.

The area between the output push rod O-ring and the primary piston O-ring is vented to the atmosphere. This venting prevents hydraulic fluid mixing with petroleum base fluid (PBF) (oil disc brakes) or brake fluid (drum service brakes) should either or both O-rings start leaking.

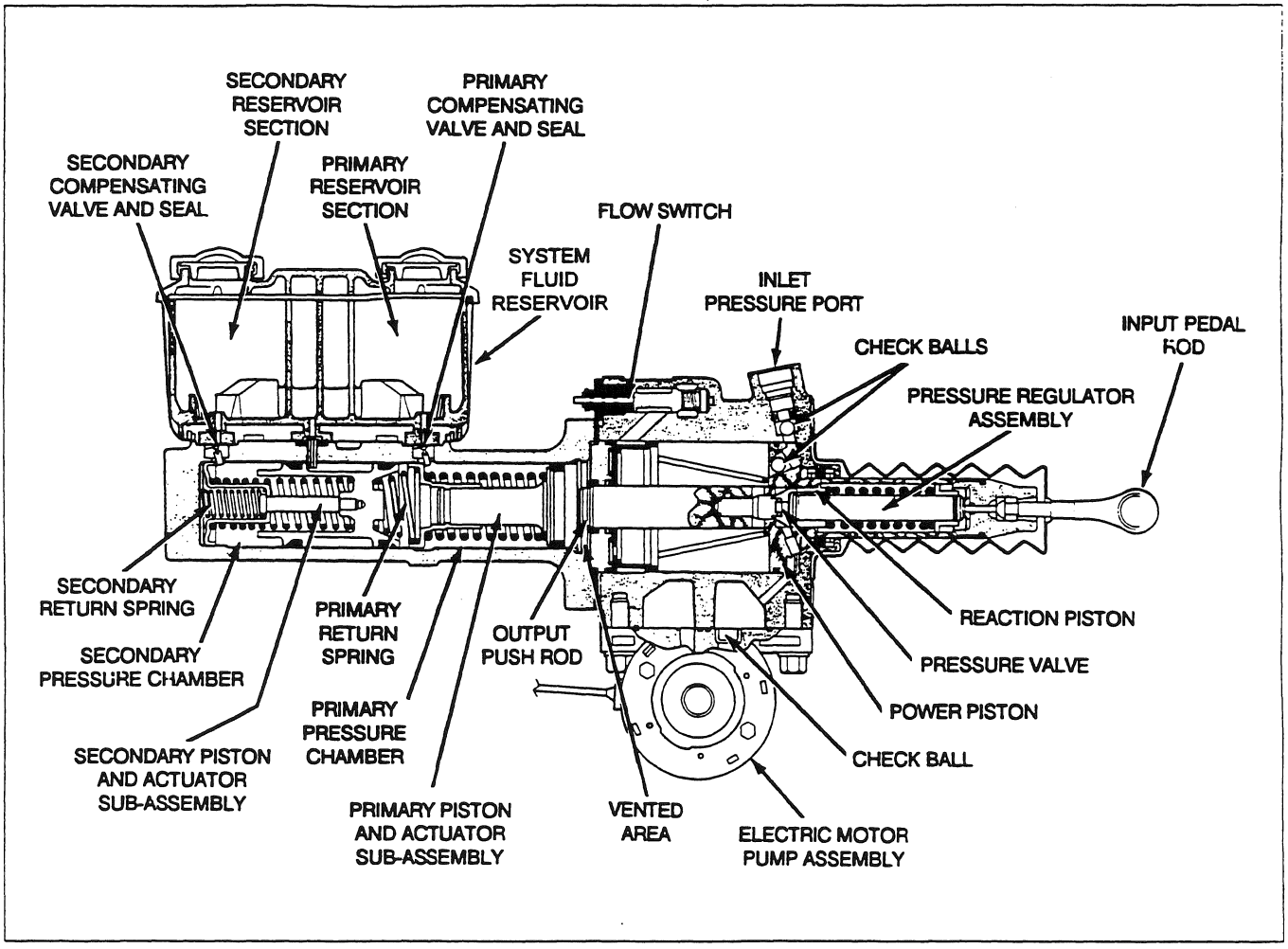


Fig. 2

Description and Operation
Engine Running - No Brake Application (Fig. 3)

System function when hydraulic fluid is supplied to the master cylinder and power booster assembly:

1. Hydraulic fluid flow pressure holds the booster inlet check valve open.
2. Hydraulic fluid passes freely through the pressure valve and into the low pressure chamber.
3. Hydraulic fluid returning to tank holds the flow switch open. Electric motor pump is not energized.
4. No pressure is applied to the power piston and the output push rod is at rest.
5. No action takes place in the master cylinder and no brake application is experienced.

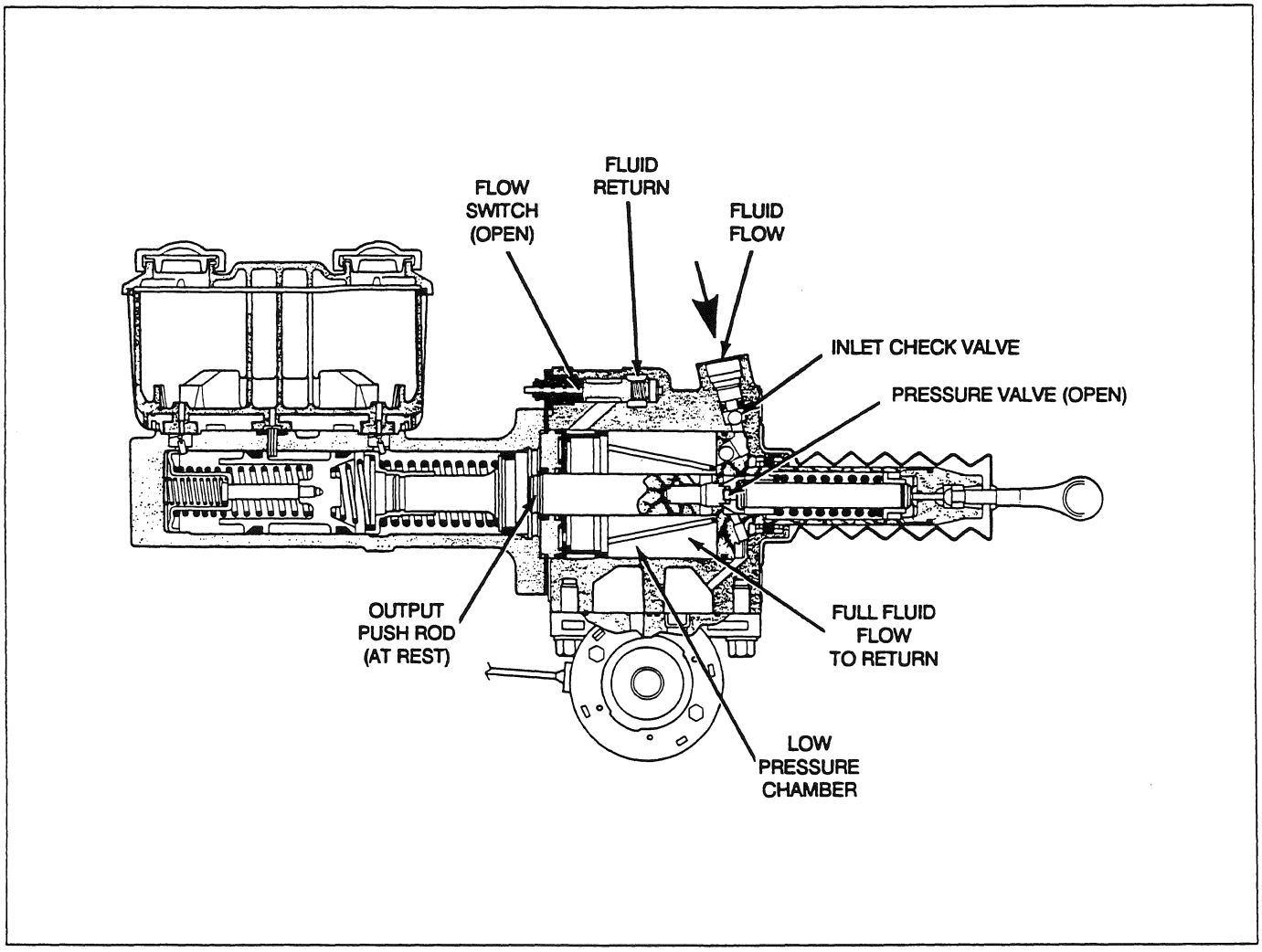


Fig. 3

Description and Operation
Engine Running - Light Brake Application (Fig. 4)

System function when brake pedal is depressed slightly and power assist action begins:

1. Hydraulic fluid flow pressure holds the booster inlet check valve open.
2. The brake pedal push rod begins to close the pressure valve. The restricted fluid flow creates a pressure build up in the high pressure chamber. Pressure build up acting on the power piston becomes power boosted movement to the master cylinder through the output push rod.
3. Hydraulic fluid returning to tank holds the flow switch open. Electric motor pump is not energized.
4. The forward movement of the output push rod forces the primary piston and actuator away from its compensating valve.
5. Hydraulic pressure builds up in the primary braking system and the primary brakes are applied.

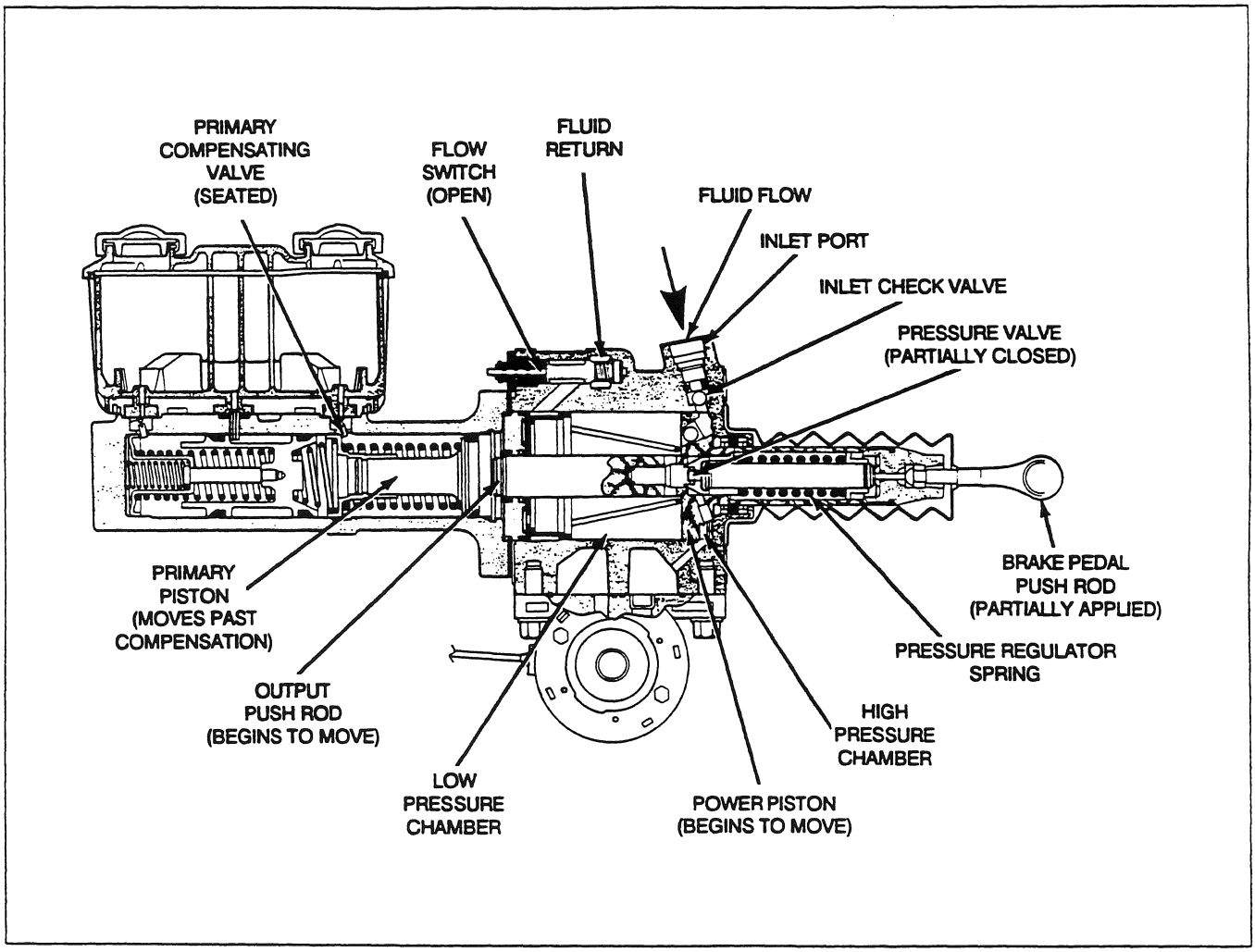


Fig. 4

Description and Operation
Engine Running - Normal Brake Application (Fig. 5)

System function when normally applying the brakes (firm pedal, but not panic):

1. Hydraulic fluid flow pressure holds the booster inlet check valve open.
2. The brake pedal push rod continues to close the pressure valve.
3. Pressure to the power piston is high.
4. The output push rod moves further into the master cylinder.
5. Hydraulic fluid returning to tank holds the flow switch open. Electric motor pump is not energized.
6. Both primary and secondary piston and actuators move past the compensating valves. The primary and secondary braking systems are pressurized.

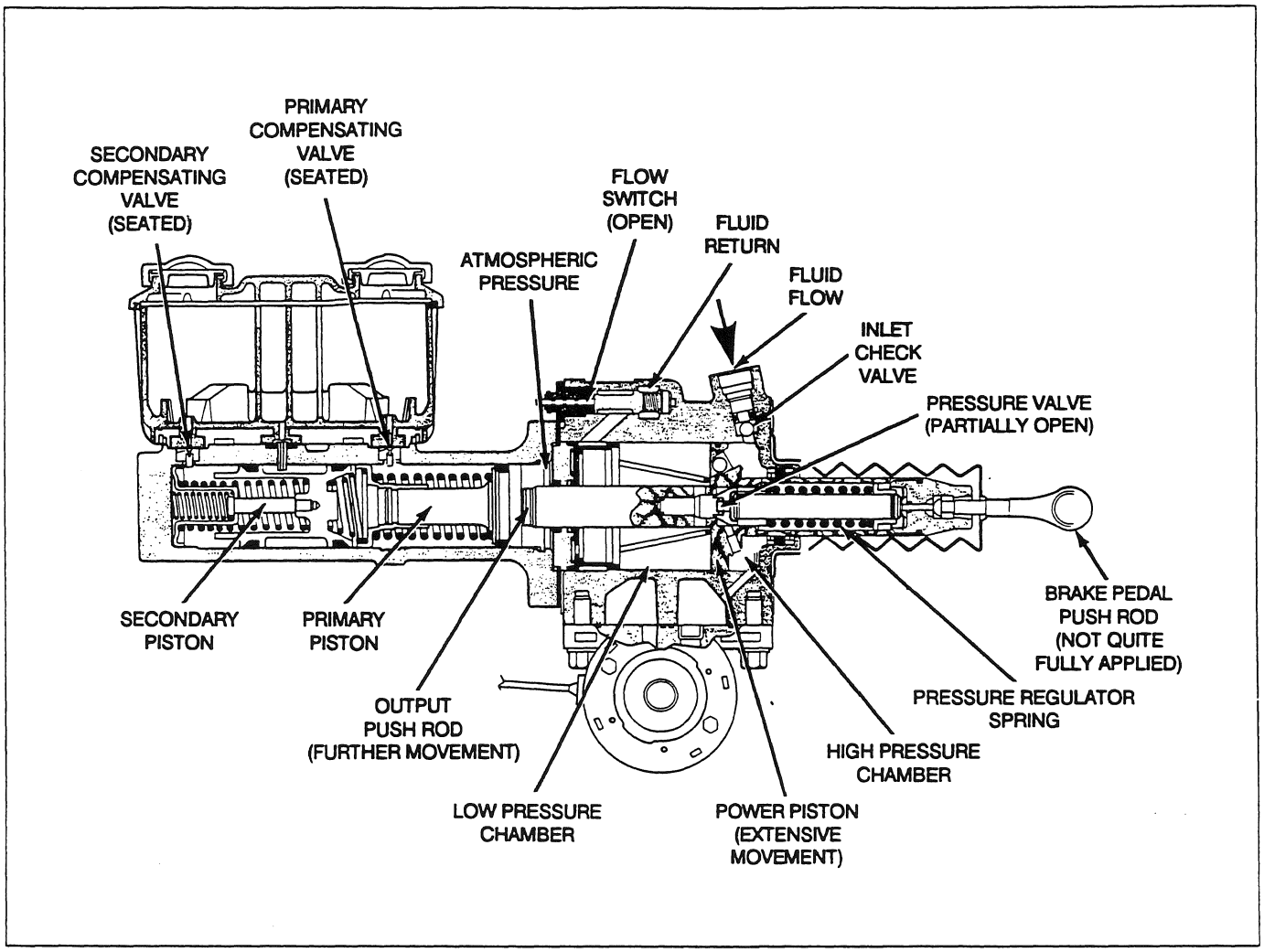


Fig. 5

Description and Operation
Engine Running - Maximum Brake Application (Fig. 6)

System function when brake pedal is fully depressed during an emergency stop:

1. Hydraulic fluid flow pressure holds the booster inlet check valve open.

2. The brake pedal push rod moves inward to virtually fully restrict fluid flow through the pressure valve. Maximum rated pressure build up now acts on the power piston and the movement is transferred to the master cylinder through the output push rod.

3. When the maximum rated pressure is exceeded, the pressure regulator spring compresses. This allows the pressure valve to open slightly and by-pass hydraulic fluid through the pressure valve orifice.

4. Hydraulic fluid returning to tank holds the flow switch open. Electric motor pump is not energized.

5. Both the primary and secondary piston and actuators move to the maximum braking position.

NOTE: *<u>Graders up to S/N **20829** only.</u> Should hard turning and hard braking occur simultaneously, the combined demand of the steering unit and power booster may exceed the capacity of the hydraulic pump to maintain flow. In this situation, the amber warning buzzer light energizes to signify electric motor pump operation. This warning should exist only as long as the above conditions apply.*

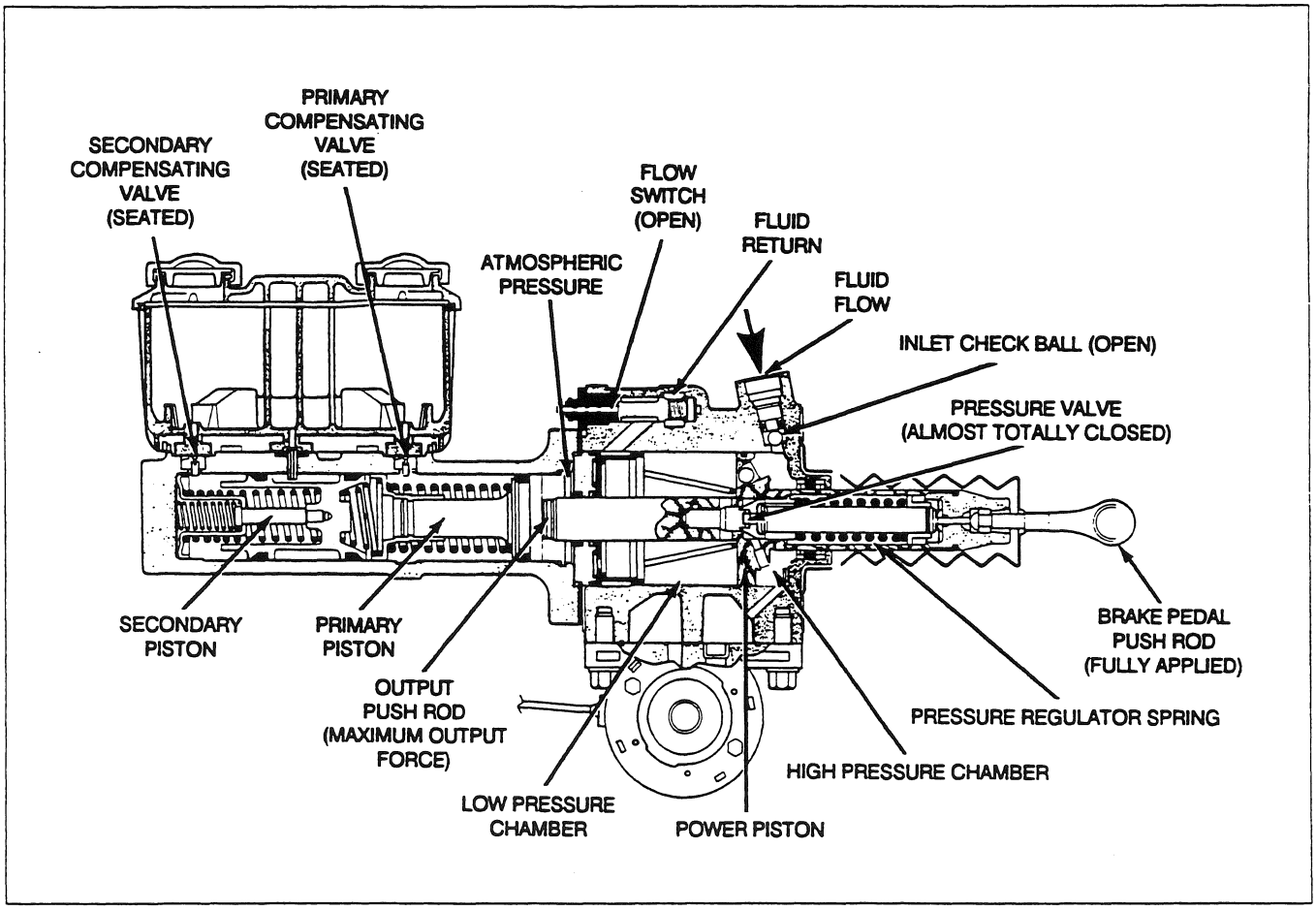


Fig. 6

Description and Operation
Hydraulic Boost Malfunction - Normal Brake Application (Fig. 7)

System function when brake boost is demanded and there is no hydraulic fluid flow due to engine shut down or some other condition which interrupts fluid flow.

1. The booster inlet check valve closes as a result of no fluid flow entering the booster assembly.

2. The flow switch closes since there is no flow to keep it open. This completes the electric circuit to the electric motor pump mounted on the bottom of the power booster housing.

3. The electric motor pump supplies system fluid at a somewhat lower pressure for power braking assist. Therefore, increased pedal effort is required to stop the grader within a specified distance. The brake system is faulty if:
   a) on graders S/N **20830** and up, the brake warning light and alarm energize.
   b) on graders up to S/N **20829**, either or both brake warning buzzer lights energize.
   The brake system must be repaired by a qualified service technician. Do not drive the grader.

4. The master cylinder operates as described in **Description and Operation, Engine Running - Normal Brake Application**. Refer to page 16-12.

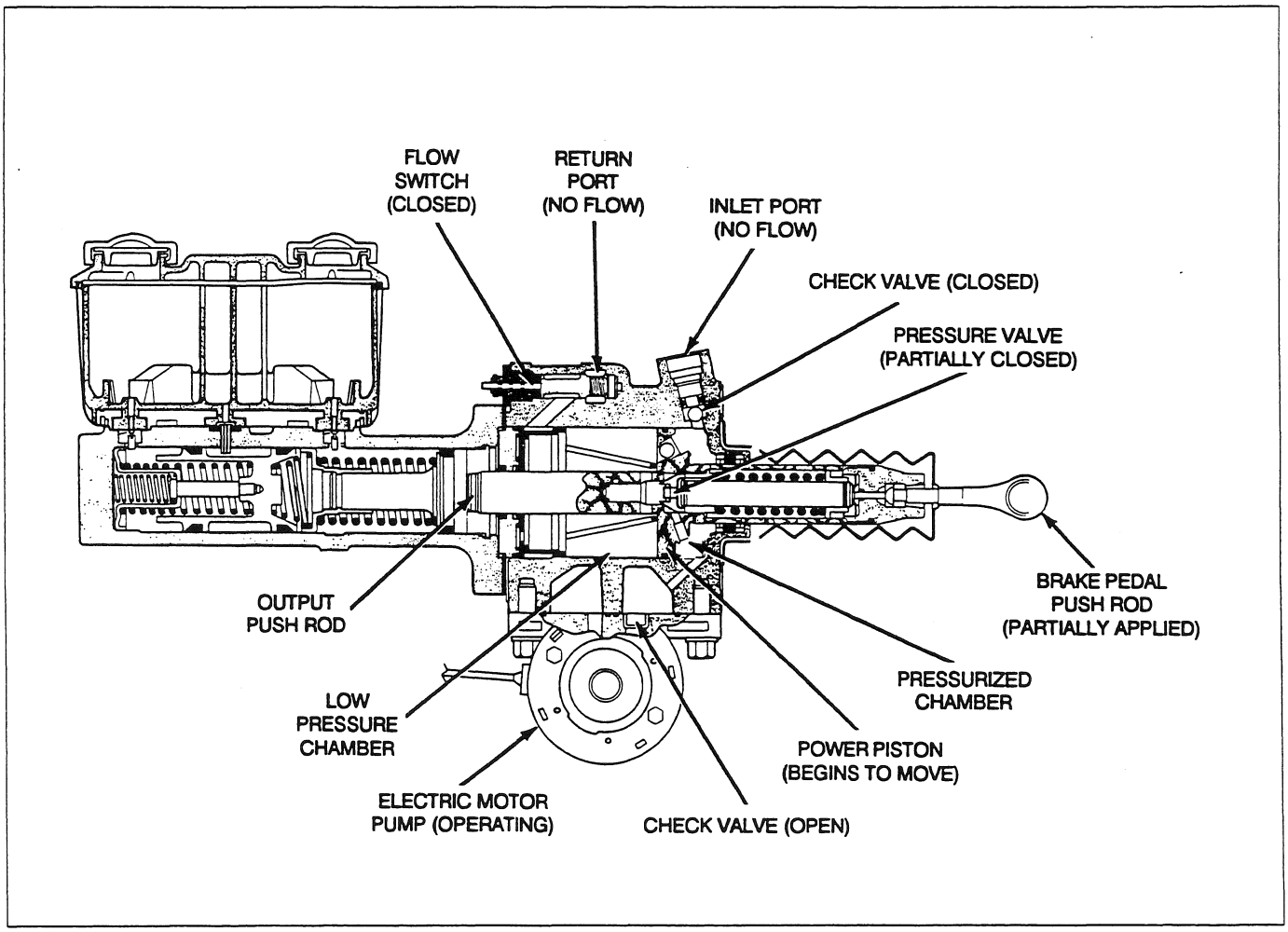


Fig. 7

Description and Operation
Complete Boost Malfunction - Manual Brake Application (Fig. 8)

Should a complete loss of all power assist occur when operating the grader, it is still possible to bring the machine to a controlled stop by manually actuating the master cylinder pistons. **However, brake pedal effort will be greatly increased and the effective stopping distance will be significantly longer.**

The brake system must be repaired by a qualified service technician. Do not drive the grader.

The master cylinder operates as described in **Description and Operation, Engine Running - Normal Brake Application**. Refer to page 16-12.

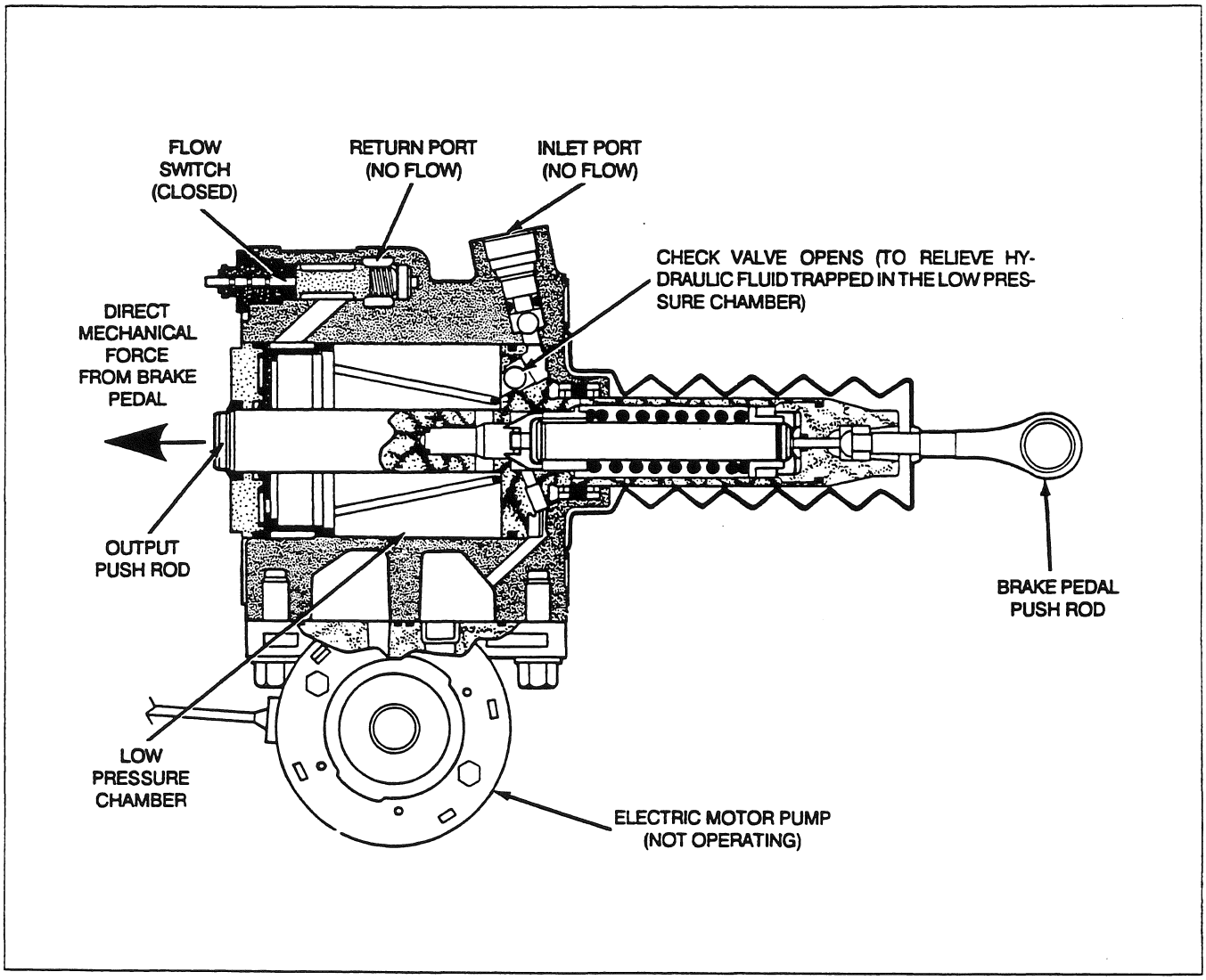


Fig. 8

Master Cylinder and Power Booster Assembly - Removal from Grader

Fig. 9
Shut down the engine and place the machine in the SERVICE POSITION (refer to page (ii) in the front of this Shop Manual). It is important to install chocks at the front and rear tandem wheels. Ensure that the engine cannot be started. Remove and retain the ignition key. Turn the battery isolation switch to the OFF position.

Fig. 10
Remove the clevis pin retaining the push rod adjustable clevis (6) to the pivot plate. Discard the cotter pin. Disconnect the two wires from the harness to the terminal block and flow switch contact. Disconnect the wires from the harness to the terminals of both brake switches and the pressure differential switch.

Fig. 11
Remove the inlet and return hoses from the power booster housing (4). The return hose is installed on a barbed fitting. After loosening the hose clamp, you may have to slit the hose lengthways to assist removal from the fitting. Remove and discard the damaged part of the hose. Plug all open ports. Remove the two brake hoses from the master cylinder (2). Plug all open ports.

Fig. 12
Support the master cylinder and power booster assembly. Remove the capscrews retaining the assembly to the mounting bracket. Remove the assembly and place the master cylinder in a vise with soft jaws to prevent damage to the aluminum housing.

Power Booster - Disassembly

Fig. 13
Remove the nuts (3) retaining the power booster (4) to the master cylinder (2). Carefully remove the power booster and place on a clean workbench. Disconnect the electric motor pump wire from the terminal block.

Fig. 14
Place the power booster (4), with the electric motor pump (8) uppermost, in a vise with soft jaws. Remove the capscrews (7) and the electric motor pump. Remove and discard the two oval O-rings (24). To ensure correct electrical motor positioning during assembly, use a felt-tip marker and draw an arrow showing on which side of the mounting flange the motor is installed.

NOTE: *Approximately three cups of oil will drain from the power booster housing when you remove the electric motor pump. Avoid damaging the mating surfaces during removal.*

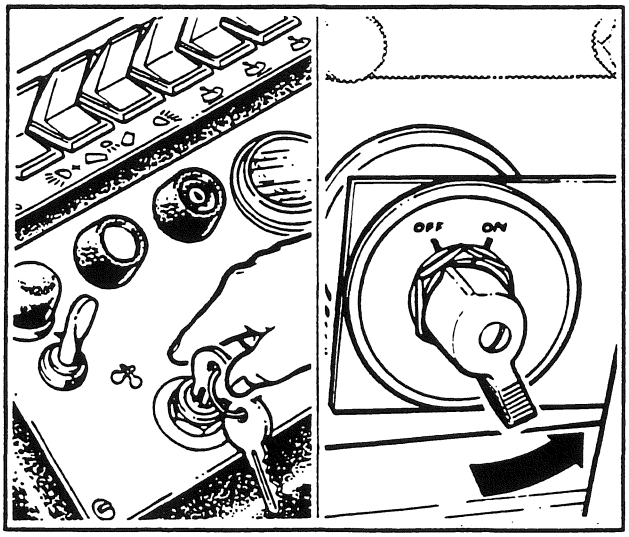


Fig. 9

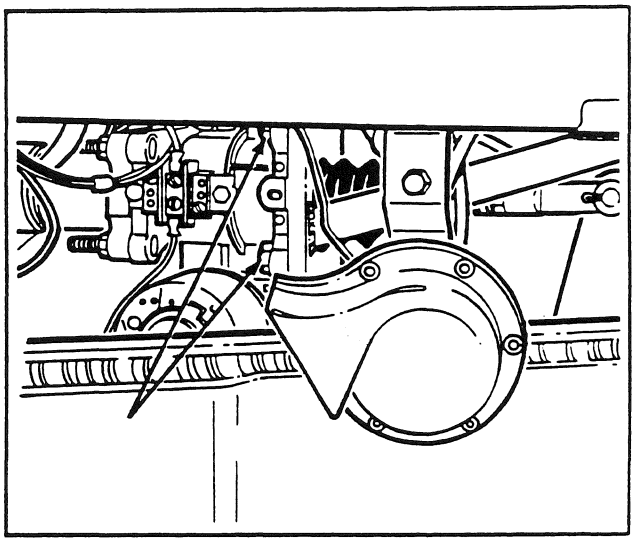


Fig. 12

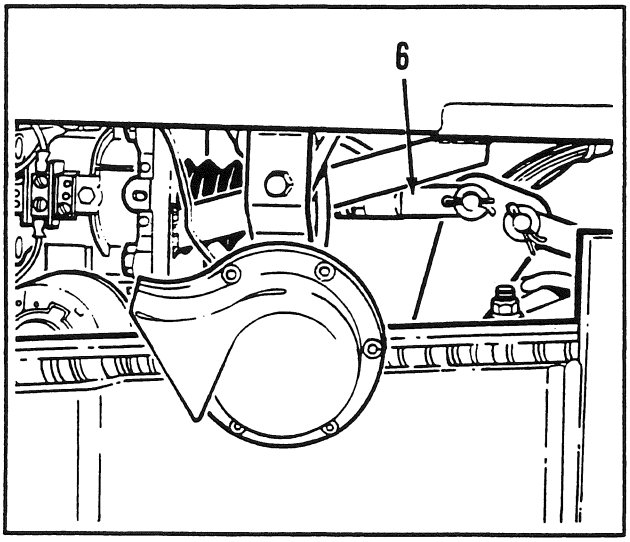


Fig. 10

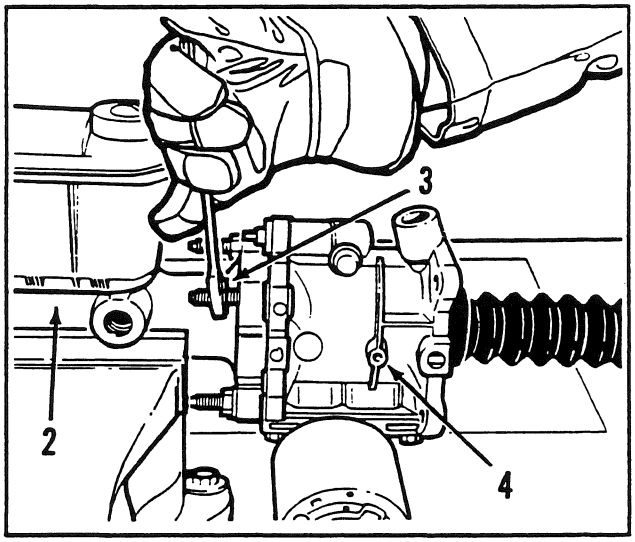


Fig. 13

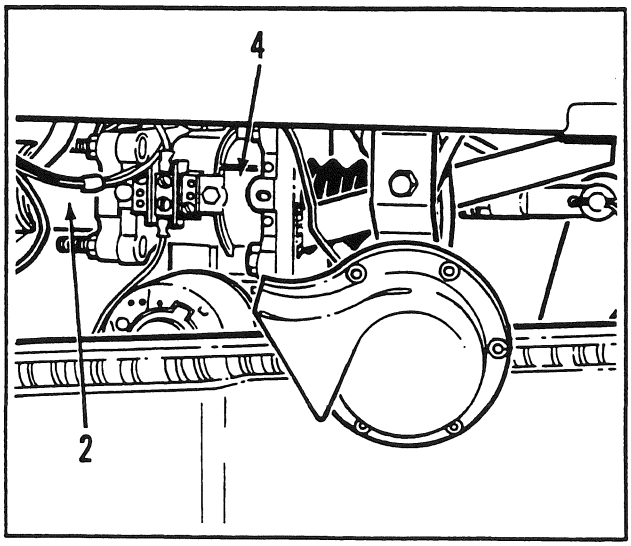


Fig. 11

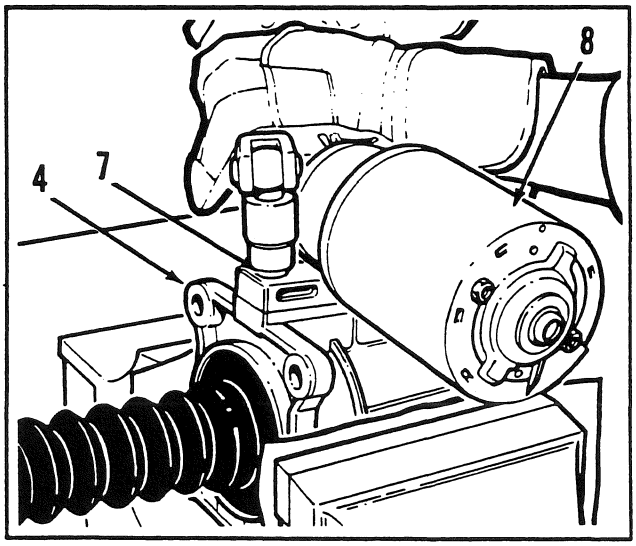


Fig. 14

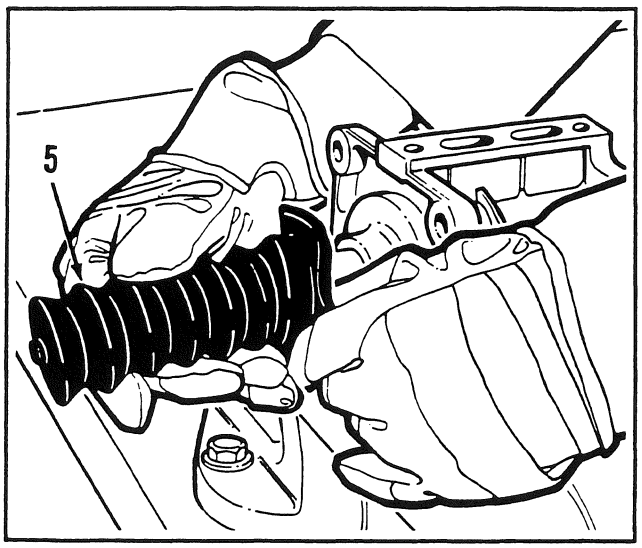


Fig. 15

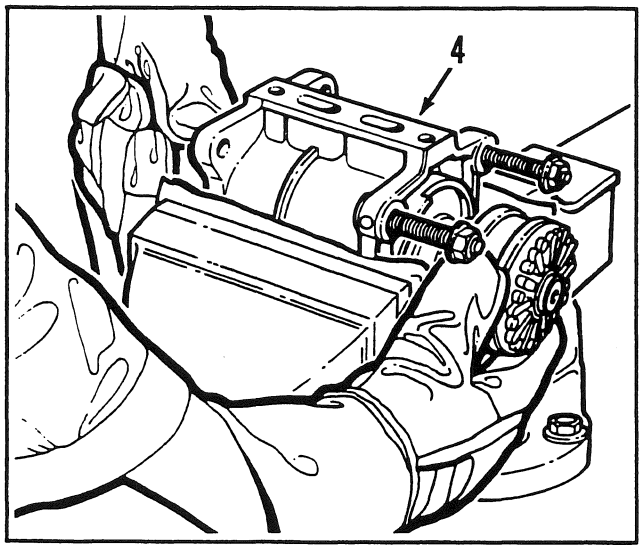


Fig. 16

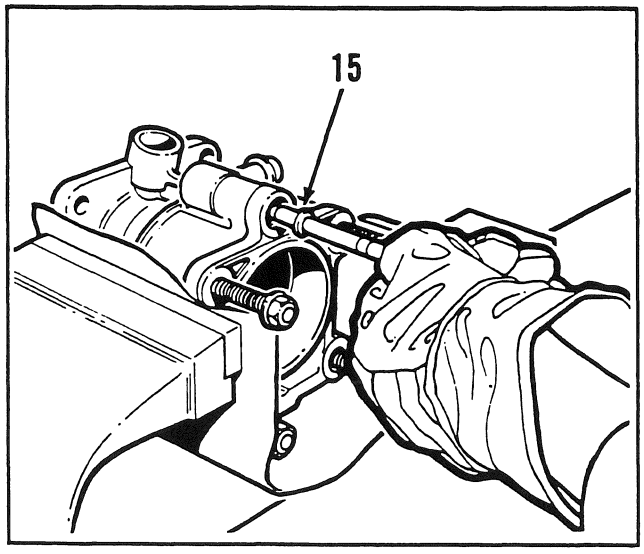


Fig. 17

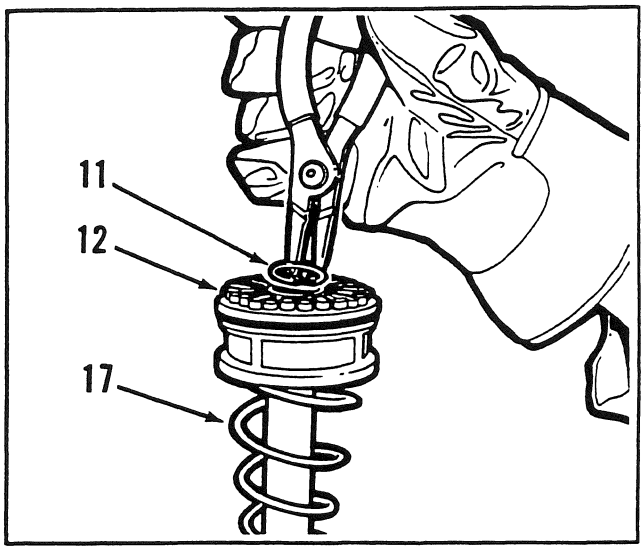


Fig. 18

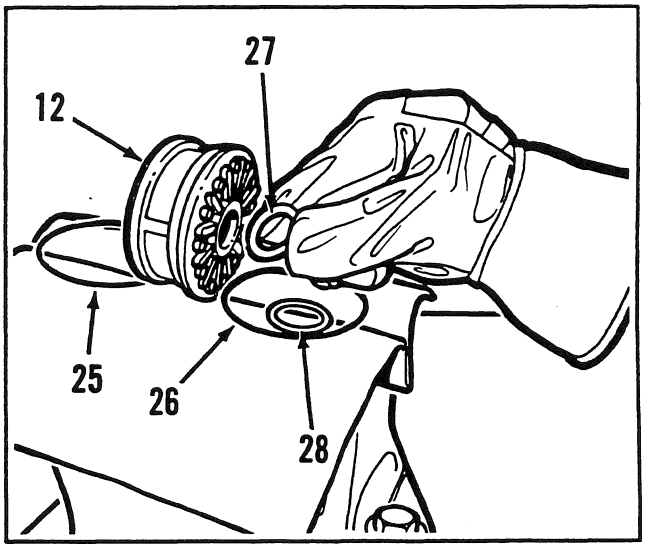


Fig. 19

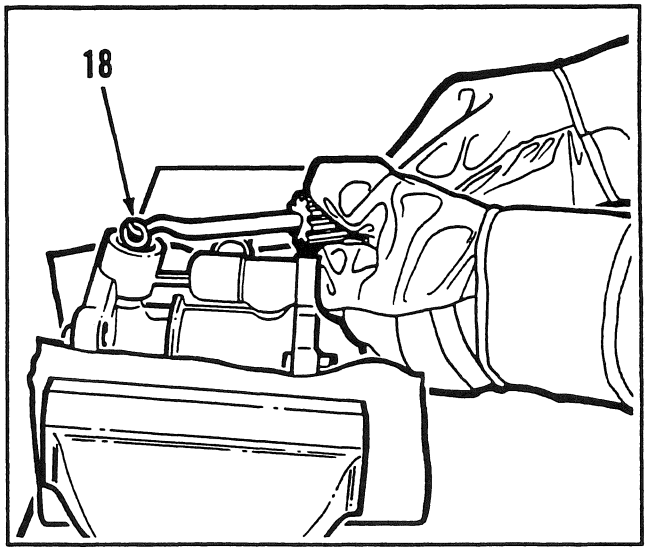


Fig. 20

Power Booster - Disassembly continued

Fig. 15
Remove the locknut and adjustable clevis (6) from the push rod. Remove the boot (5).

Fig. 16
Push the push rod against spring pressure and carefully remove the power piston assembly from the power booster housing (4).

NOTE: *Pull the power piston assembly straight out of the bore to avoid scratching the aluminum surfaces.*

Remove and discard the two oil seals (20) and spacer (23) from the booster housing bore.

Fig. 17
Remove the flow switch contact (13). Remove and discard the O-ring (14). Use a small magnet to remove the flow switch piston (15) and spring (16).

Fig. 18
With the filter and end cap assembly (12) uppermost, clamp the flats of the input plug (22) in a vise with soft jaws. Do not clamp on the power piston shaft (21). Push against the filter and end cap assembly. Remove and discard the snap ring (11). Remove the filter and end cap assembly. Remove the piston return spring (17).

Fig. 19
Remove and discard the O-ring (28) and oil seal (27) from the inside diameter of the filter and end cap assembly (12). Remove and discard the two O-rings (25 and 26) from the outside diameter of the filter and end cap assembly.

Fig. 20
Using an appropriate tool, remove the inlet check valve (18). Use a small magnet to remove the inlet check ball (19). Discard these parts. The power booster disassembly is now complete. Place the parts to one side for cleaning and inspection.

Power Booster - Assembly

Fig. 21
Remove the three largest O-rings from the repair kit. Lubricate and install one thin O-ring (25) and the thickest O-ring (26) in the appropriate external grooves of the filter and end cap assembly (12).

NOTE: *Lubricate all O-rings and oil seals with fresh hydraulic fluid. Do not use brake fluid or petroleum base fluid (PBF).*

Fig. 22
Remove the 1 in. (25 mm) diameter O-ring (28) and the smallest of the three oil seals (27) from the repair kit. Lubricate and install the O-ring and oil seal in the appropriate internal grooves of the filter and end cap assembly (12).

NOTE: *Ensure the lip of the oil seal faces the power piston when the filter and end cap assembly is installed on the power piston shaft. Incorrect oil seal installation will allow pressurized oil to leak from the interior of the power booster housing.*

Fig. 23
Lubricate and carefully install the two identical diameter oil seals (20) and spacer (23) into the bore of the power booster housing (4).

NOTE: *Ensure the lips of both oil seals face the interior of the power booster housing.*

Fig. 24
Remove the inlet check valve (18) and inlet check ball (19) from the repair kit. Lubricate and install the appropriate O-ring from the repair kit on the inlet check valve. Lubricate and install the check ball. Lubricate and fully install the inlet check valve.

Fig. 25
Install the flow switch spring (16). Lubricate and install the flow switch piston (15). Lubricate the appropriate O-ring (14) from the repair kit and install on the flow switch contact (13). Install the flow switch contact and tighten to the specified torque.

Fig. 26
Clamp the flats of the input plug (22) in a vise with soft jaws. Do not clamp on the power piston shaft (21). Install the piston return spring (17), small end first.

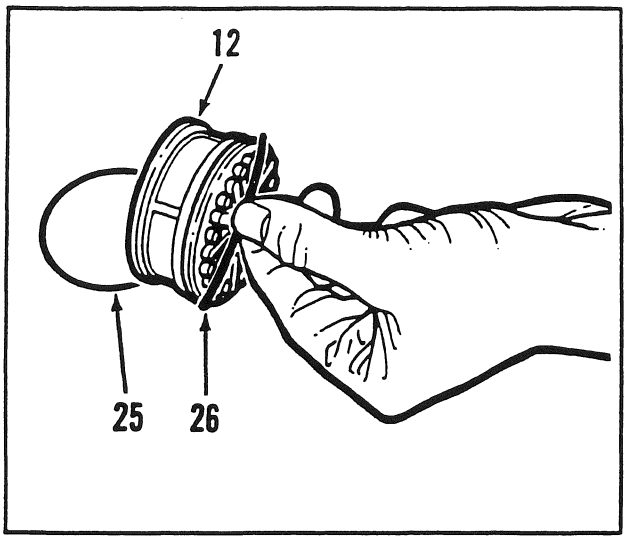


Fig. 21

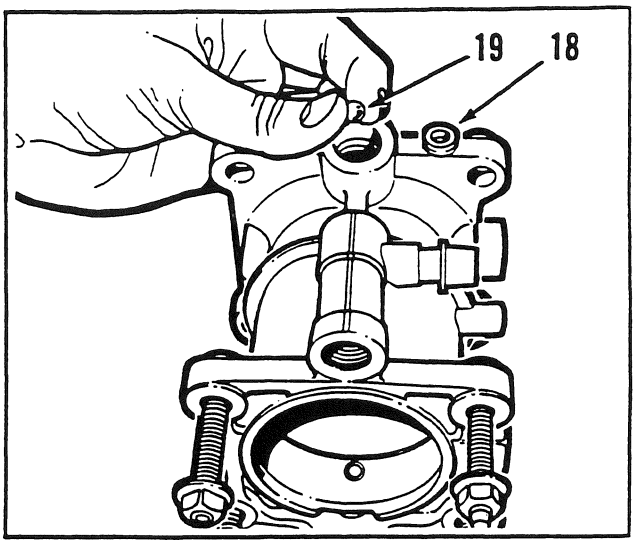


Fig. 24

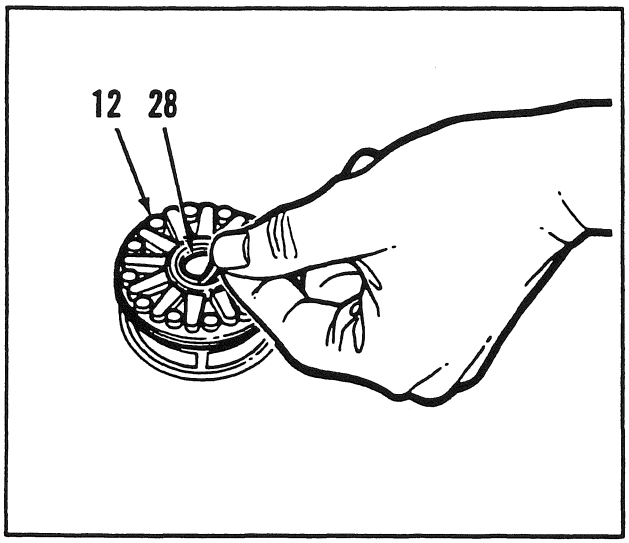


Fig. 22

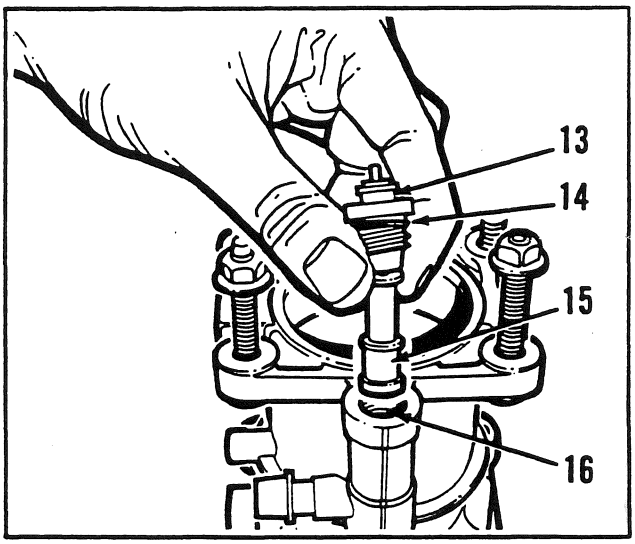


Fig. 25

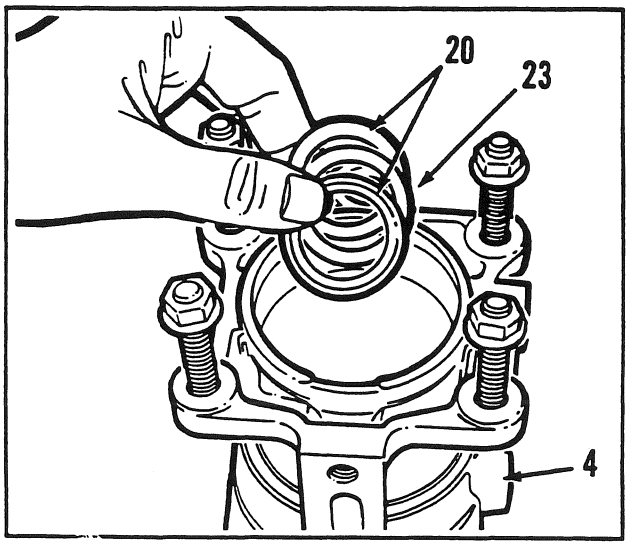


Fig. 2

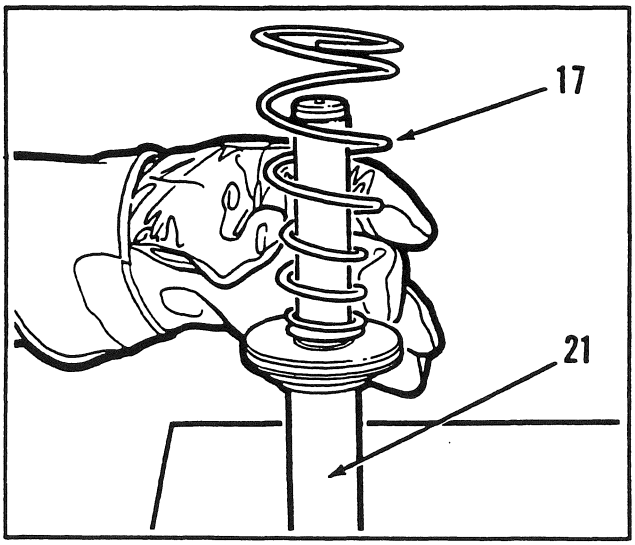


Fig. 26

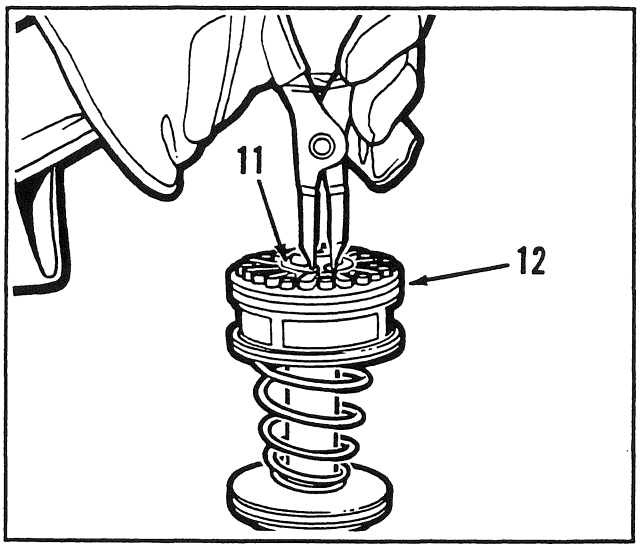


Fig. 27

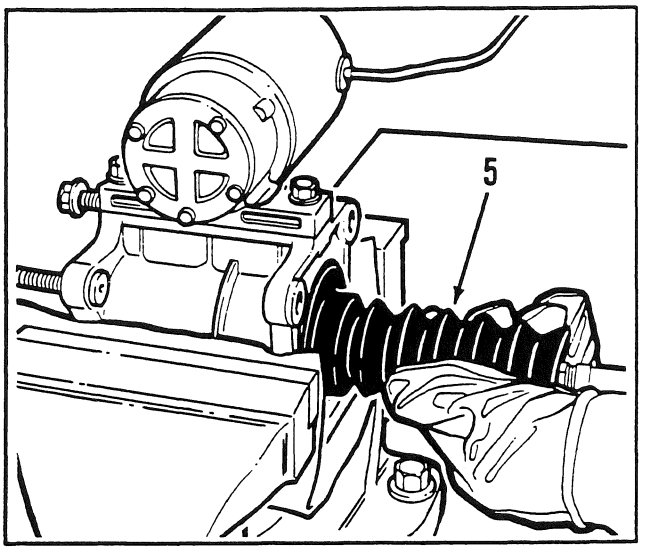


Fig. 30

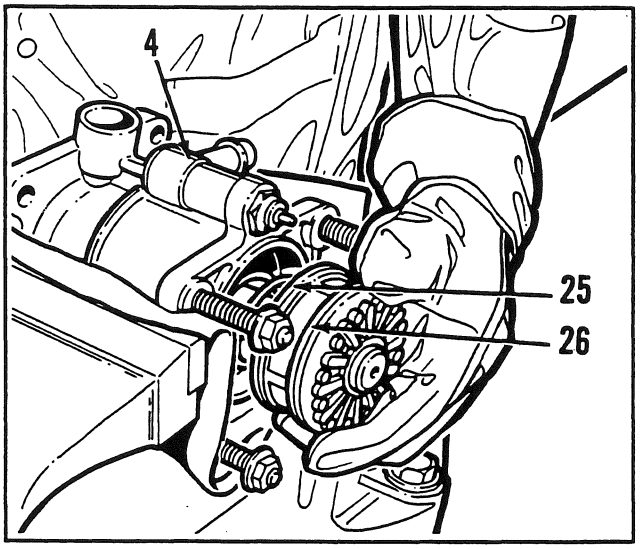


Fig. 28

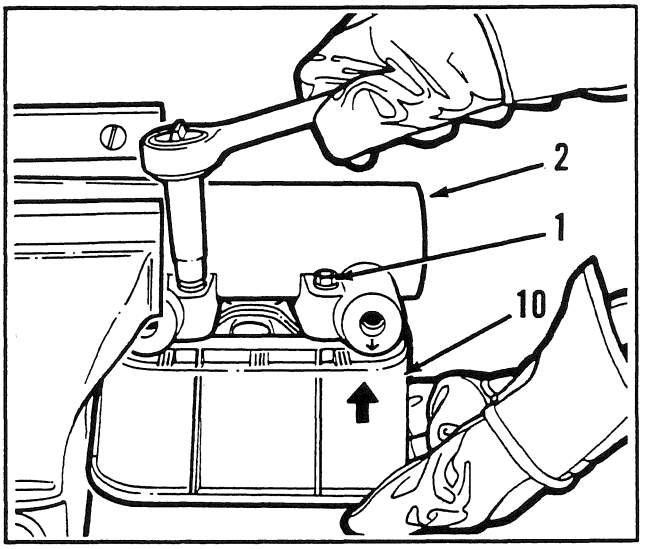


Fig. 31

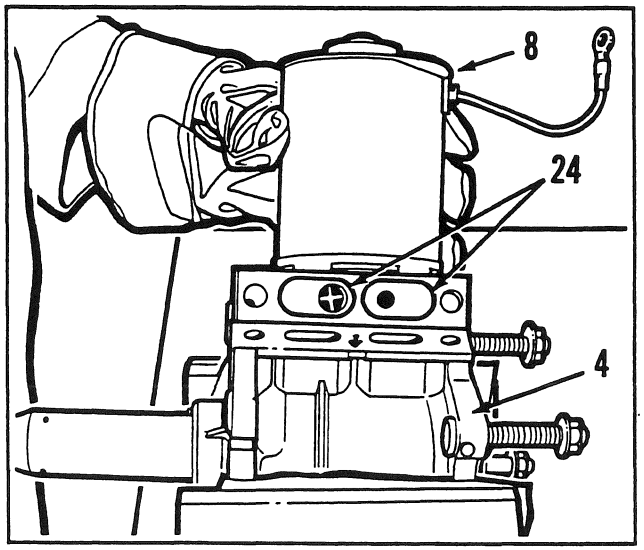


Fig. 29

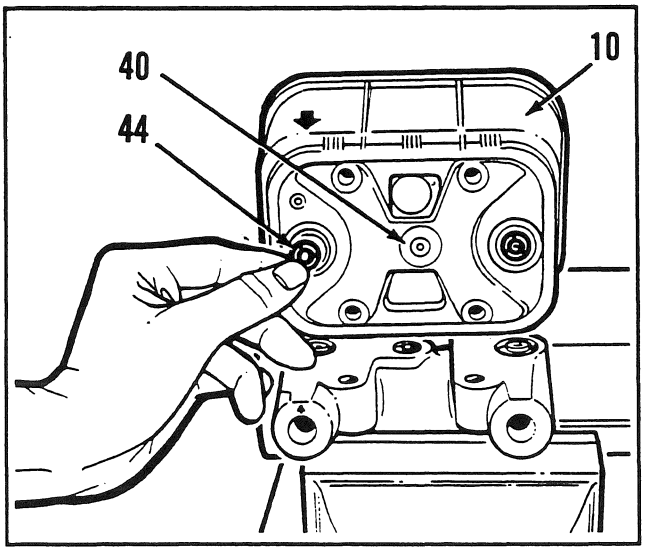


Fig. 32

Power Booster - Assembly continued

Fig. 27
You are recommended to install a protective metal sleeve (also known as a seal bullet) over the end of the output push rod. The sleeve prevents damage when you install the filter and end cap assembly internal oil seal (27) over the snap ring groove.

NOTE: *You can use plastic electrical tape to cover the snap ring groove. Ensure the surface is smooth for easy installation. Remove all traces of tape and adhesive. Clean the shaft with an alcohol solution and apply fresh hydraulic oil.*

Carefully install the filter and end cap assembly (12). Depress the assembly until the snap ring groove is exposed and install a new snap ring (11).

Fig. 28
Lubricate the power piston shaft (21). Generously lubricate the filter and end cap assembly outside diameter. Install the power piston assembly. Use a gentle twisting motion when passing it through the two oil seals (20). Ensure the large O-rings (25 and 26) enter the power booster housing (4) without being pinched.

Fig. 29
Inspect the electric motor pump (8) to verify that the motor pump check ball and retainer are in place.

NOTE: *The electric motor pump can be incorrectly installed. Check the orientation arrow for the proper position of the electric motor.*

Lubricate and install two new oval O-rings (24) into the recesses of the electric motor pump mounting flange. Carefully install the electric motor pump onto the power booster housing (4) and secure with the capscrews (7). Tighten the capscrews to the specified torque.

Fig. 30
Install the boot (5), adjustable clevis (6) and locknut. Connect the electric motor pump wire to the terminal block.

Master Cylinder - Disassembly

Fig. 31
Remove the two reservoir caps (9). Drain and discard the system fluid from the reservoir (10). To ensure correct reservoir positioning during assembly, use a felt-tip marker and draw identification marks on the reservoir and the corresponding side of the master cylinder body (2). Remove the capscrews (1) and reservoir.

Fig. 32
Remove and discard the two compensating valve seals (44) from the bottom of the reservoir (10). Remove and discard the piston stop O-ring (40).

Master Cylinder - Disassembly continued

Fig. 33

Use an appropriate tool and depress the primary piston assembly (32) approximately one inch (25 mm). Spring compression load is between 90 and 130 pounds (41 and 59 kg). Take care not to scratch the bore surface. Remove and discard the two compensating valves (43) and springs (42). Remove and discard the piston stop pin (39) from the master cylinder body (2).

Fig. 34
Remove and discard the snap ring (29) from the master cylinder body bore (2).

Fig. 35
Slowly relieve the compression on the primary piston (32). Remove the primary and secondary piston assemblies from the master cylinder body bore (2).

Fig. 36

You may have to use low pressure compressed air (25 psi; 1,7 bar) to remove the secondary piston assembly (36). Plug the outlet ports, rear compensating valve port and piston stop pin bore. Place the open end of the master cylinder body (2) approximately one inch (25 mm) from a padded surface to stop the piston. Do not place your hands between the master cylinder body and padded surface. Apply compressed air to the front compensating valve port.

Fig. 37
Remove and discard the O-ring (31) on the primary piston assembly (32). Remove and discard the two O-rings (34 and 38) on the secondary piston assembly (36).

NOTE: *Do not remove the back-up rings (30, 35 and 37) on the primary and secondary piston assemblies. Do not disassemble the primary and secondary piston assemblies.*

Remove the secondary piston return spring (41). Remove the primary piston return spring (33). Place the parts to one side for cleaning and inspection.

Master Cylinder - Assembly

Fig. 38
Lubricate the master cylinder bore, primary and secondary piston assemblies and all parts in the repair kit.

NOTE: *For graders equipped with oil disc brakes, use only petroleum base fluid (PBF). For graders equipped with drum service brakes use only SAE J1703, DOT 3 or ISO 4925 specification brake fluid. Do not use hydraulic fluid.*

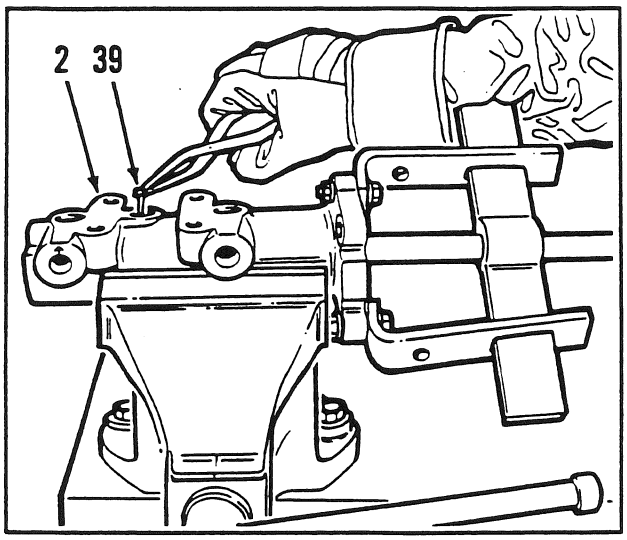


Fig. 33

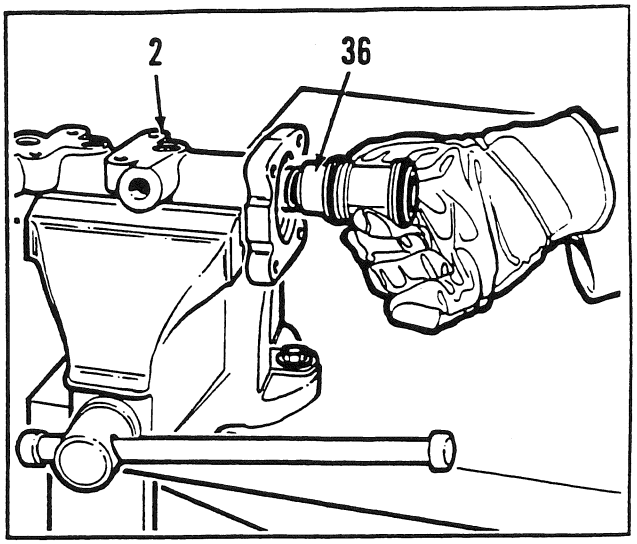
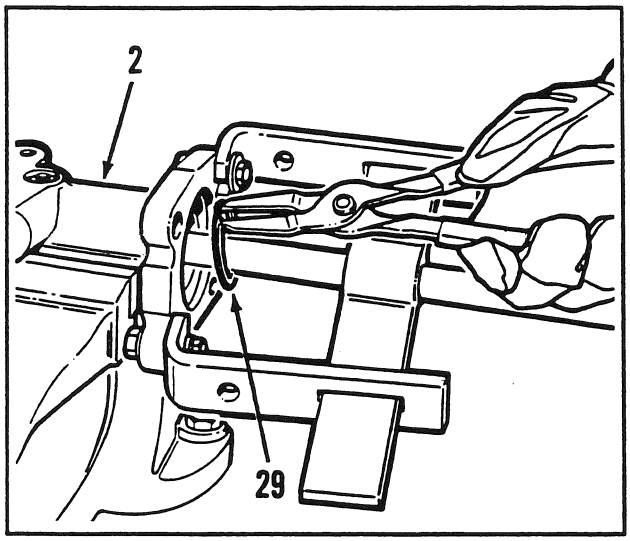


Fig. 36



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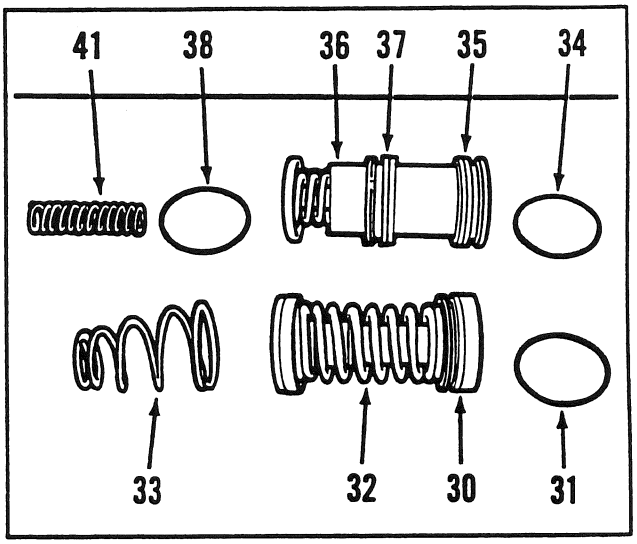

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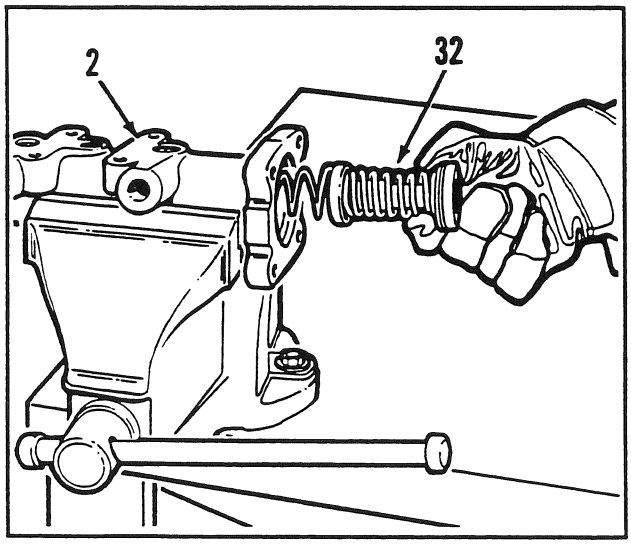

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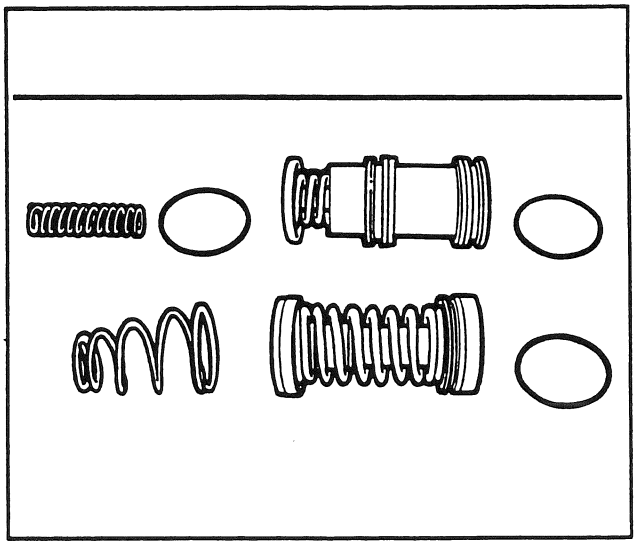

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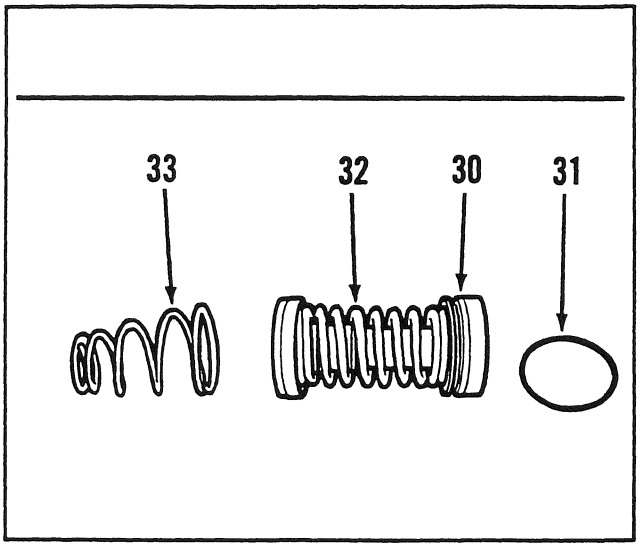

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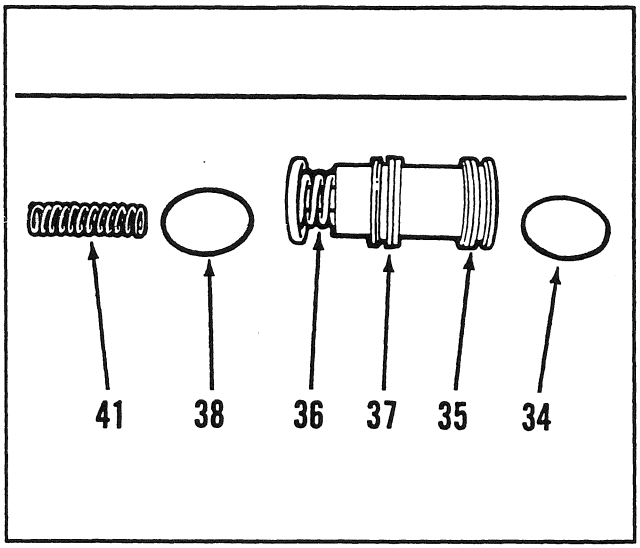

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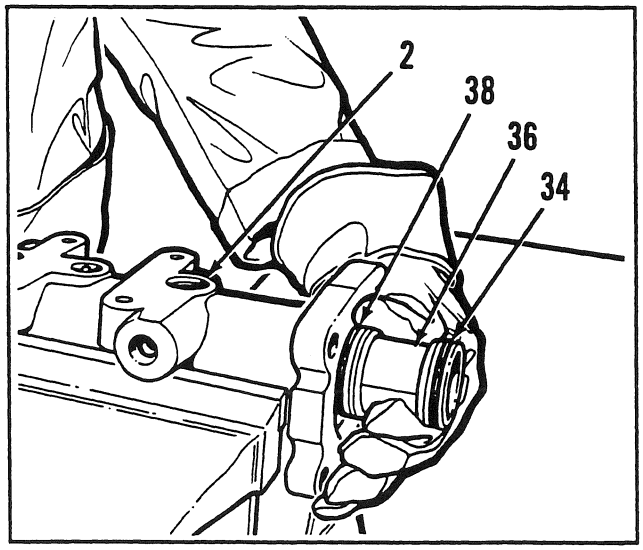

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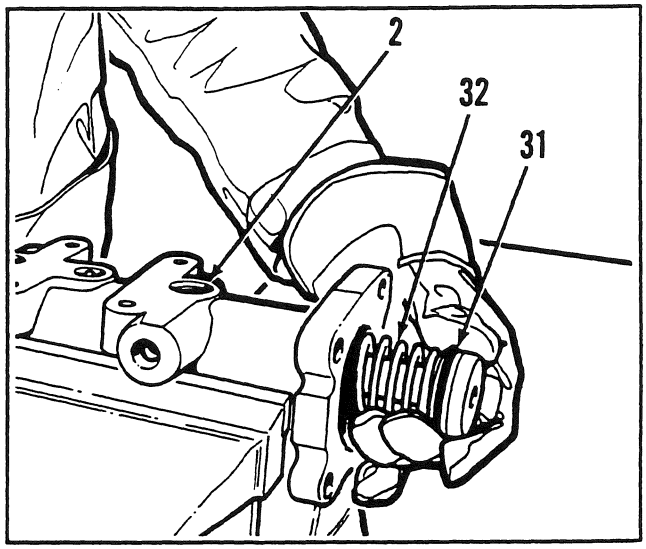

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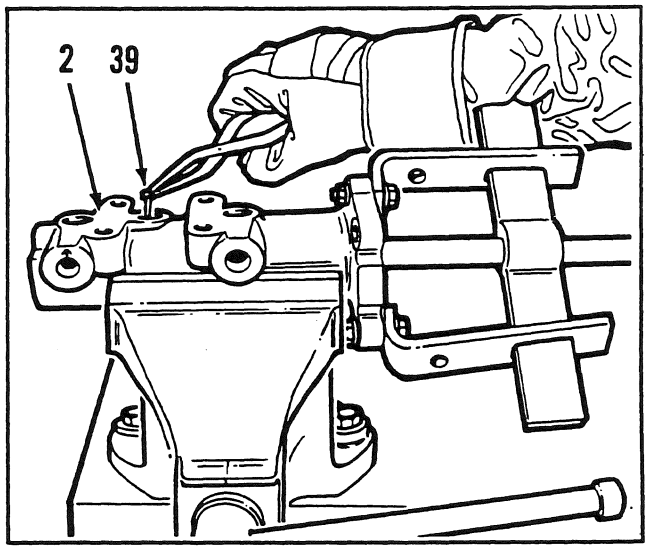

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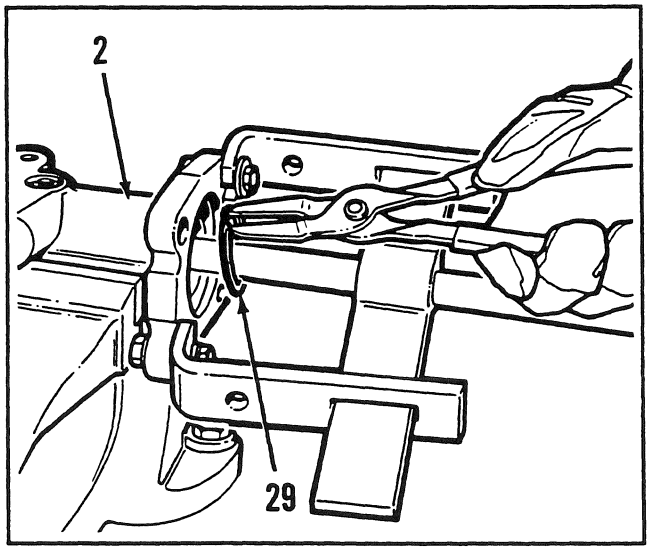

Fig. 44

Master Cylinder - Assembly continued

Fig. 39
Install the large diameter of the primary piston return spring (33) into the primary piston actuator. Install the O-ring (31) on the primary piston assembly (32).

NOTE: *Ensure that you install the O-ring and the back-up ring (30) in the correct position. Refer to Figs. 1 and 39 for positioning.*

Fig. 40
Install the secondary piston return spring (41) into the secondary piston actuator. Install the O-rings (34 and 38) on the secondary piston assembly (36).

NOTE: *Ensure that you install the O-rings and the back-up rings (35 and 37) in the correct position. Refer to Figs. 1 and 40 for positioning.*

Fig. 41
Carefully install the secondary piston assembly (36), spring end first, into the master cylinder body bore (2). Ensure you do not damage the O-rings (34 and 38) during assembly.

Fig. 42
Carefully install the primary piston assembly (32), spring end first, into the master cylinder body bore (2). Ensure you do not damage the O-ring (31) during assembly.

Fig. 43

Adapt a bearing puller to depress the primary piston assembly (32) approximately one inch (25 mm). Spring compression load is between 90 and 130 pounds (41 and 59 kg). Take care not to scratch the bore surface. Lubricate and install a new piston stop pin (39) into the master cylinder body (2).

Fig. 44
Install a new snap ring (29) into the master cylinder body bore (2). Remove the spring compression tool.

Master Cylinder - Assembly continued

Fig. 45
Install two new compensating valves (43) and springs (42) into their recesses in the master cylinder body (2). Install two new compensating valve seals (44) into their recesses in the reservoir (10). Install a new piston stop O-ring (40).

Fig. 46
Place the reservoir (10) into position on the master cylinder (2) as marked during disassembly. Ensure that the compensating valves (43) are free to move. Insert an appropriate clean, metal probe through the reservoir ports and check that the valves can move up and down by 1/16 inch (1,5 mm).

Fig. 47
Install the capscrews (1) and tighten to the specified torque. Install short, flexible tubes from the outlet ports at the branch tee fittings into the reservoir sections. Secure the master cylinder with the front end tilted slightly down. Fill the reservoir sections with petroleum base fluid (PBF)(oil disc brakes) or brake fluid (drum service brakes). Depress and release the primary piston several times using any tool with a smooth, rounded end. Secure the master cylinder with the front end tilted slightly up. Again, depress and release the primary piston several times. Remove the tubes and install the reservoir caps.

NOTE: *Once all air is expelled from the master cylinder, you should not be able to depress the primary piston.*

Fig. 48
To complete the assembly, carefully install the power booster (4) onto the master cylinder (2) and retain with the nuts (3). Tighten the nuts to the specified torque.

Master Cylinder and Power Booster Assembly - Installation to Grader

Fig. 49
Support the master cylinder and power booster assembly. Apply threadlocking compound onto clean threads and install the capscrews retaining the assembly to the mounting bracket. Tighten the capscrews to the specified torque.

Fig. 50
Connect the two brake hoses to the master cylinder (2). Connect the inlet and return hoses to the power booster housing (4).

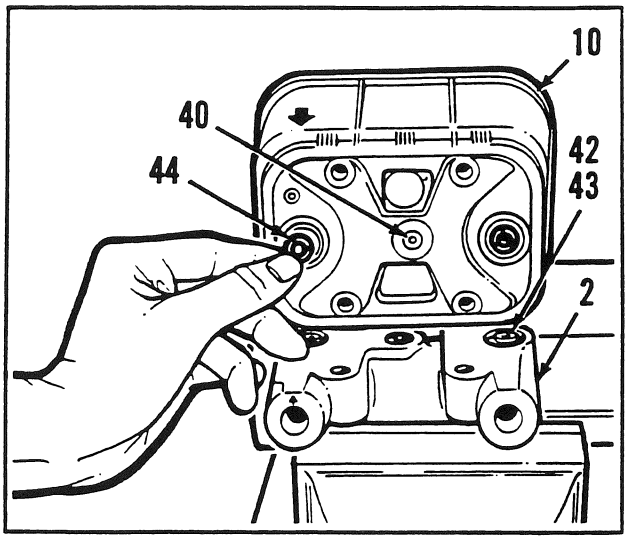

Fig. 45

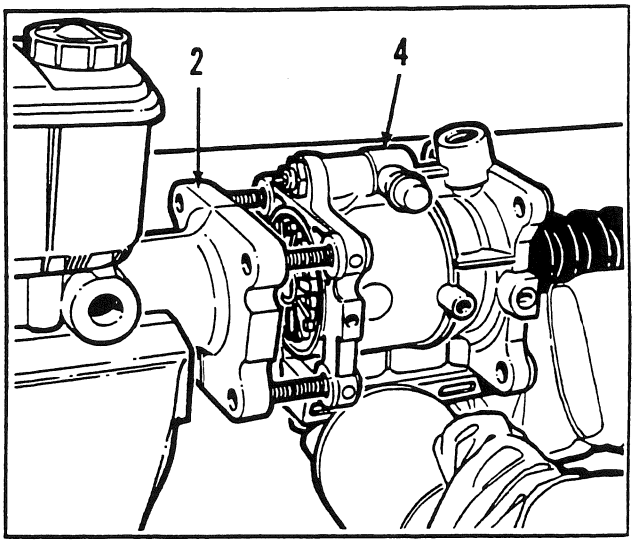

Fig. 48

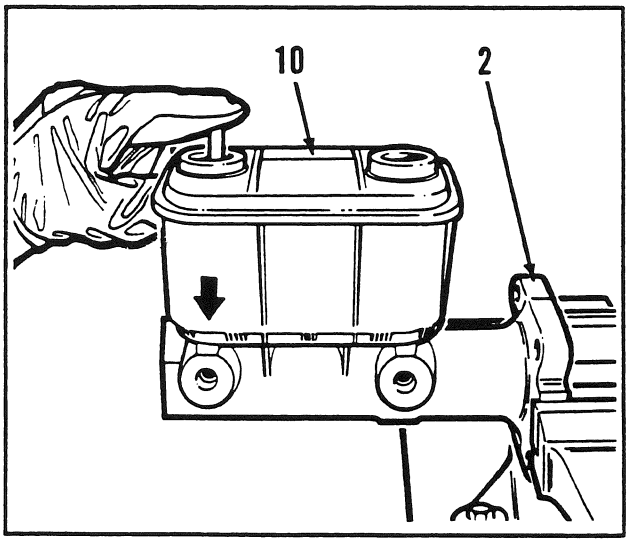

Fig. 46

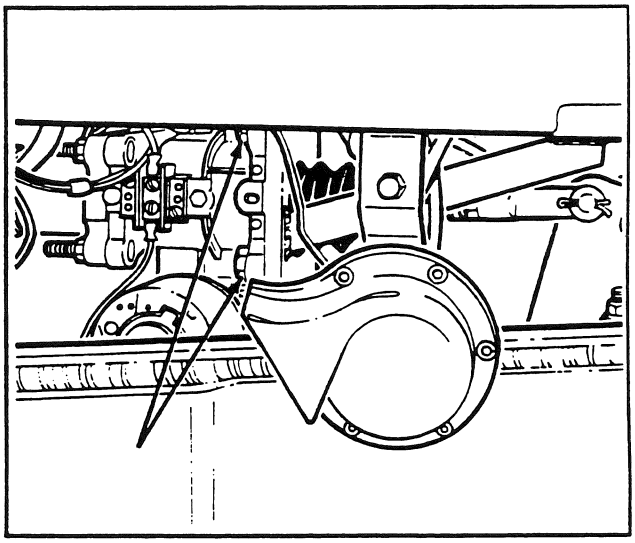

Fig. 49

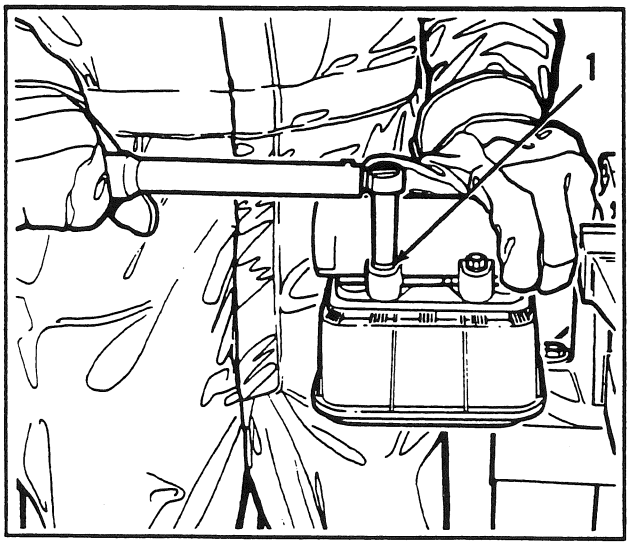

Fig. 47

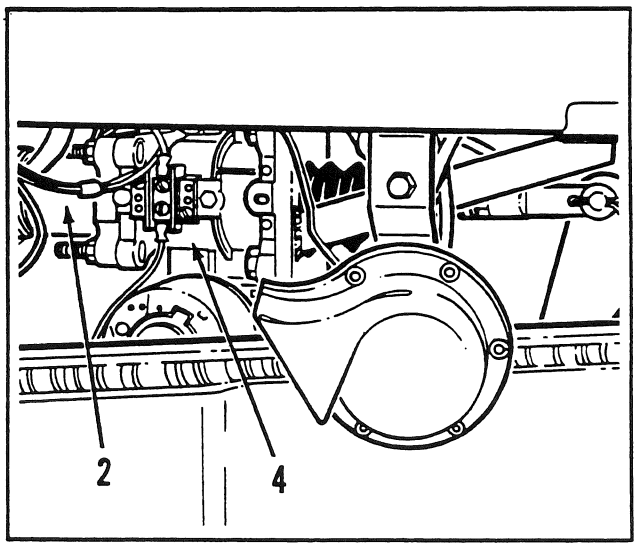

Fig. 50

Master Cylinder and Power Booster Assembly - Installation to Grader continued

Fig. 51

Install the clevis pin retaining the push rod adjustable clevis (6) to the pivot plate. Install and secure a new cotter pin. Tighten the nut to the specified torque. Connect the wire from the harness to the terminal block. Do not connect the wire to the flow switch contact until you have completed the bleeding procedure. Connect the wires from the harness to the terminals of both brake switches and the pressure differential switch.

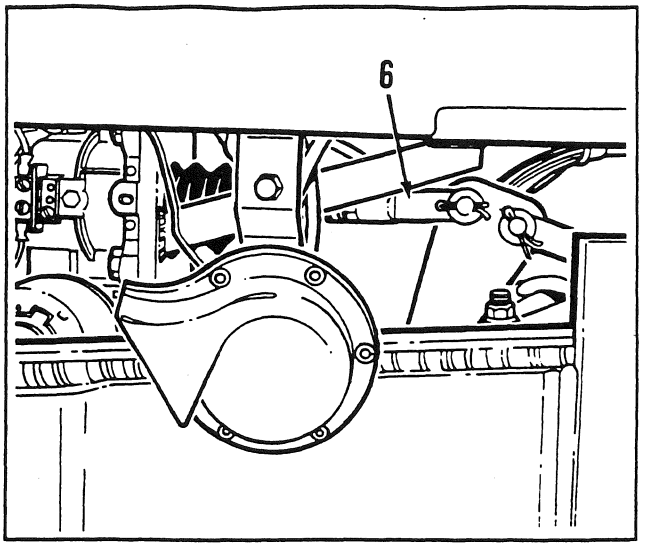

Fig. 51

Master Cylinder and Power Booster Assembly - Bleeding Procedure

The grader should remain in the SERVICE POSITION. Always wear face protection when working over the bleed fittings. Do not use the electric motor pump for the bleeding procedure.

Connect a flexible tube from the bleed fitting on the front left tandem wheel cylinder into a transparent container half full of fresh petroleum base fluid (PBF)(oil disc brakes) or SAE J1703, DOT 3 or ISO 4925 specification brake fluid (drum service brakes). Immerse the tube.

Release the bleed fitting. Slowly depress the brake pedal and wait for five seconds. Slowly release the brake pedal and wait for five seconds. Ensure the tube remains immersed in the fluid.

Repeat this procedure until the air bubbles stop flowing into the container. Tighten the bleed fitting. Check the level in the reservoir sections and replenish with fresh system fluid if required.

Repeat the bleeding procedure at the rear right, front right and rear left tandem wheel cylinders in that sequence. After each bleeding procedure step, check the level in the reservoir sections and replenish with fresh system fluid if required. Install the reservoir caps.

Connect the wire from the harness to the flow switch contact. Ensure a good connection.

NOTE: *Secure the wire to the flow switch contact using a twisting motion until the terminal snaps into place. If disconnected, the system operates in a* ***no flow*** *condition.*

Do not exceed 35 psi (2,4 bar) if you are using pressure bleeding equipment. Follow the pressure bleeding equipment manufacturer's instructions.

Refer to pages 16-3 and 16-5 and perform a brake function test. Road test the service brakes with the grader travelling slowly in low gear.

SECTION 17
OIL DISC BRAKES

GRADER SERIAL NUMBERS
Models 710 thru 740A: 21134 & UP, excluding 21225
Models 750 thru 780A: 21386 & UP

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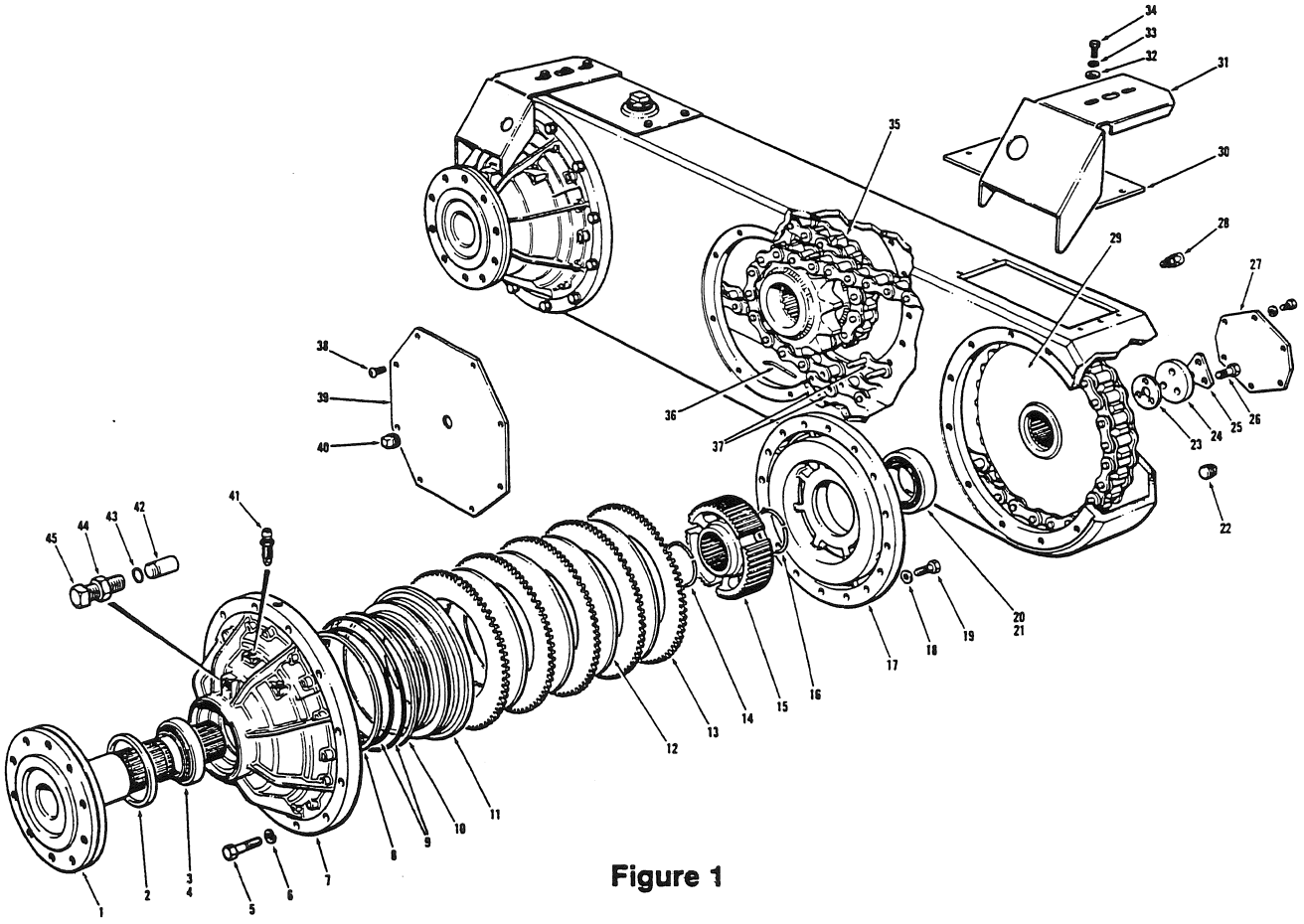


Figure 1

KEY TO FIGURE 1

ITEM	DESCRIPTION
1.	AXLE SHAFT
2.	OIL SEAL
3.	OUTBOARD BEARING CUP
4.	OUTBOARD BEARING CONE
5.	BRAKE HOUSING MOUNTING BOLTS
6.	LOCKWASHERS
7.	BRAKE HOUSING
8.	INNER BACK-UP RING
9.	O-RINGS
10.	OUTER BACK-UP RING
11.	PISTON
12.	FRICTION DISCS
13.	REACTION PLATES
14.	OUTER SNAP RING
15.	HUB
16.	INNER SNAP RING
17.	BACK-UP PLATE
18.	HARDENED WASHERS
19.	BACK-UP PLATE RETAINING BOLTS
20.	INBOARD BEARING CUP
21.	INBOARD BEARING CONE
22.	TANDEM DRAIN PLUG
23.	SHIM PACK
24.	RETAINER PLATE
25.	TAB WASHER
26.	RETAINER PLATE CAPSCREWS
27.	COVER
28.	BREATHER
29.	SPROCKET
30.	INSPECTION COVER
31.	BRAKE LINE SHIELD
32.	FLATWASHERS
33.	LOCKWASHERS
34.	CAPSCREWS
35.	TANDEM DRIVE CHAIN
36.	CONNECTOR PIN
37.	CONNECTOR LINK
38.	SIDE COVER PLATE CAPSCREWS
39.	SIDE COVER PLATE
40.	OIL LEVEL CHECK PLUG
41.	BLEEDER SCREW
42.	ADJUSTING PIN
43.	O-RING
44.	JAM NUT
45.	PISTON TRAVEL LIMITING SCREW

Specifications

Bolt Torque Specifications

	Imperial	Metric
1. Sprocket Retaining Bolts	200 ft.lbs	270 N.m
2. Cover Plate	23 ft.lbs	32 N.m
3. Inspection Cover	23 ft.lbs	32 N.m

Use diagonal tightening pattern for the following:

4. Brake Housing to Tandem	170 ft.lbs	230 N.m
5. Wheel to Axle Bolts	480 ft.lbs	650 N.m
6. Back-up Plate to Brake Housing	100 ft.lbs	135 N.m

Use Loctite 515, Champion P/N 25303, as gasket material to seal the brake housing to the tandem and to seal the threads of the attaching bolts.

Use an RTV Silicone Sealant, Champion P/N 56247, as a gasket material to seal the side cover plate and the inspection covers.

Testing and Adjustments

Bearing Preload Adjustment

Rolling torque of housing without discs and plates installed:

12 - 15 ft.lbs 16.25 - 20 N.m

Piston Travel Adjustment

With Discs and Plates in the clamped position, turn piston travel limiting screw in (item - 45) in the exploded view) until it touches the piston and turn it out 1.5 turns.

Friction Disc Thickness

New	0.133" - 0.139"	3.38 - 3.53 mm
Min.	0.103"	2.62 mm (Grooves Gone)

Reaction Plate Thickness

New	0.120" - 0.125"	3.05 - 3.18 mm
Min.	0.115"	2.92 mm

NOTE: *Quantity of discs and plates in the Brake Units differ between grader models.*

Grader Model	Qty. Friction Discs	Qty. Reaction Plates
710/710A	3	4
720/720A	4	5
730/730-A	4	5
740/740A	5	6
750/750A	5	6
780/780A	5	6

IMPORTANT: The axle shafts and back-up plates used in the brake units differ between grader models. Refer to the parts manual when ordering these components.

Cleaning and Inspection

Cleaning - General

⚠ WARNING

Alkali cleaning solvents and vapors are extremely harmful and can cause serious injury to eyes, lungs and skin. Always wear protective clothing, goggles and respirator. Use utmost care when handling chemicals.

⚠ CAUTION

You are recommended to wear cotton gloves when handling bearings. This prevents skin acids and perspiration contaminating the races and rolling elements.

Immerse small parts and machined components into a mild alkali cleaning solvent. Agitate the parts to remove all foreign matter.

Parts should remain in the solvent long enough to be thoroughly cleaned and heated. This will help evaporate the solvent and rinse water. Thoroughly rinse parts to remove all traces of cleaning solvent.

Cleaning - Bearings

After rinsing, immediately dry the parts using moisture-free compressed air. Lint-free, uncontaminated wiping rags can be used.

Immerse bearings in cleaning solvent. Rinse the cleaned bearings and dry with moisture-free compressed air while rotating them **slowly** by hand. **DO NOT** spin bearings when drying. Lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Inspection - General

A careful and thorough inspection of all parts is extremely important. Replace all parts showing indications of wear or damage.

Inspection - Bearings

Carefully inspect all rollers, cages and cups for wear, nicks or chipping. When replacing bearings, **ALWAYS** install new mating cups and cones. After inspection, lubricate all bearings with system oil; wrap in clean, lint-free cloth or paper and store in a cool, dry place.

Principles of Operation

The Champion Oil Disc Brake System consists of the brake units, a hydraulic brake booster with an integral back-up electric pump, a master cylinder with reservoir and hydraulic brake lines.

The booster is supplied by its own hydraulic pump mounted on the side of the engine. The booster pump is the smallest unit in the pump assembly.

The hydraulic brake booster multiplies the force of the pressed brake pedal and transfers it to the master cylinder. Refer to Section 16 for information about the master cylinder and booster assembly.

The oil disc brake units are supplied with apply fluid from the dual circuit master cylinder. Each of the two outlet ports on the master cylinder use a "T" fitting, connected to flexible brake hoses that divide the apply fluid in a diagonal pattern to the four brake units.

The apply fluid enters the brake unit at the top of the brake housing. In the piston chamber, the fluid moves the piston away from the "piston travel limiting screw" toward the friction disc and reaction plate assembly. As the piston compresses the discs and plates together, the tandem oil is forced out of the friction disc grooves. Braking action results as the friction discs contact the reaction plates.

The friction discs are splined to a hub that is splined to the axle shaft. The wheel and tire assembly is bolted to the axle shaft.

To release the brakes, lift your foot from the brake pedal. The apply fluid pressure will vent to the master cylinder reservoir. The grooves in the rotating friction discs allow the tandem oil to pass between the friction discs and the stationary reaction plates. This allows the plates and discs to separate slightly moving the piston toward the "piston travel limiting screw". Once the piston releases its clamping force, the discs, hub, axle, wheel and tire rotate freely.

Refer to the LUBRICATION SPECIFICATIONS on pages iv and v at the front of this SHOP MANUAL for tandem oil and apply fluid capacities and specifications.

NOTE: *Always place the grader in the service position before attempting any overhaul maintenance or inspection procedure.*

Refer to the SERVICE POSITION procedure on page ii in the front of the shop manual.

To do the following procedures, you will need to start the engine several times. Be sure it is safe to start the engine each time. Remember to remove the keys after you shut the engine off.

⚠ WARNING

USE ONLY petroleum base fluid in the brake reservoir. Other fluids may cause brake failure. Severe personal injury or death could result.

Removal

Fig. 2
Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard onto blocks to raise the desired tandem. Place adequate blocks under the tandem, then lower the tandem onto the supports. Stop the engine. Apply the hand brake. Turn the isolation switch to the "OFF" position.

NOTE: *It may be necessary to loosen the wheel retaining bolts before raising the tandem. DO NOT remove bolts at this stage.*

Fig. 3
Place a container under the tandem drain plug **(22)**. Remove the plug and drain the lubricating oil. Clean and reinstall the drain plug.

Fig. 4
Remove the wheel retaining bolts and the wheels.

Fig. 5
Remove the capscrews **(34)**, lockwashers **(33)**, and flat washers **(32)** securing the cover plates **(30)** and brake line shields **(31)**. Remove the cover plates and brake line shields. (Ref. Fig. 1).

Fig. 6
Remove the tandem side cover plate **(27)**.

Fig. 7
Working through the inspection port on top of tandem, turn the sprocket **(29)** and drive chain **(35)** until the connector link **(37)** is accessible. Remove cotter pins (if applicable) and connector link from the chain.

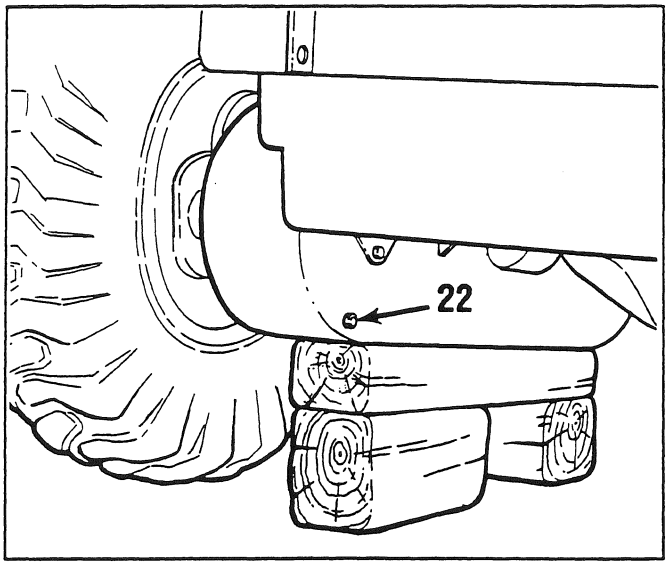
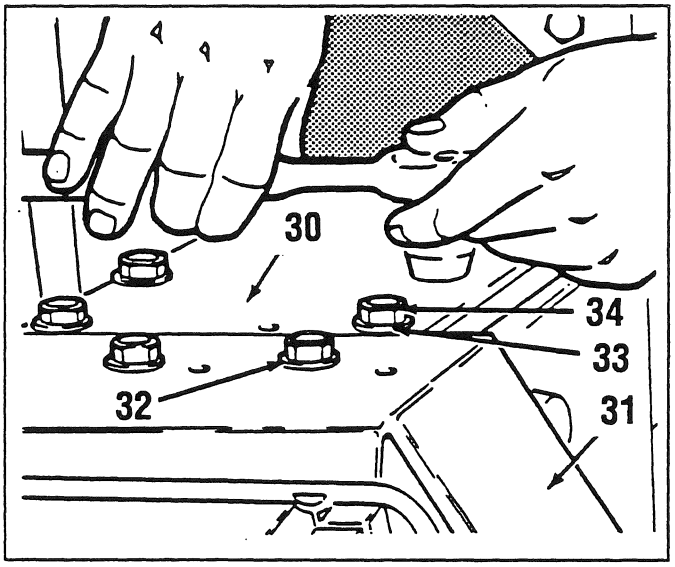


Fig. 2



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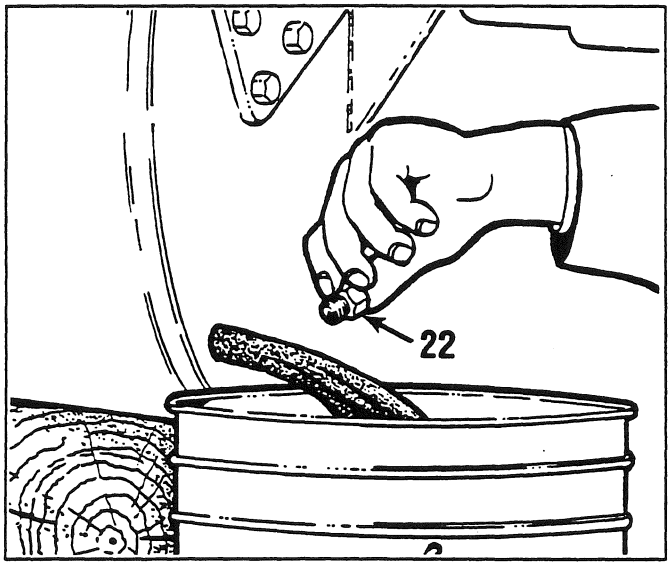
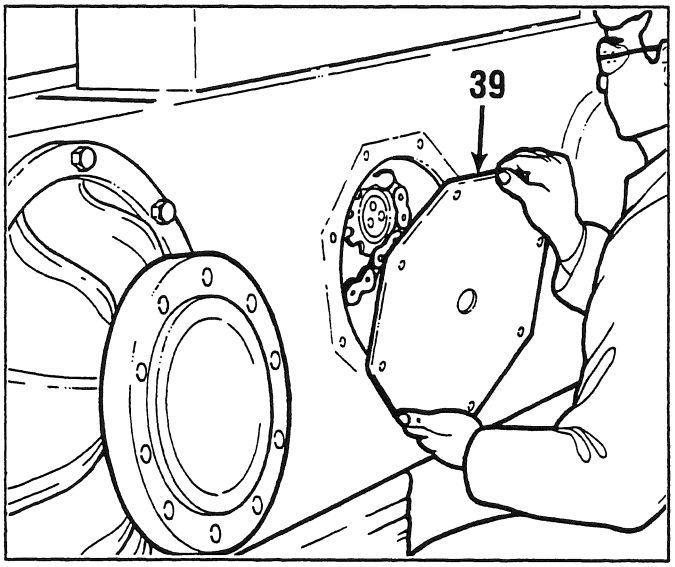


Fig. 3



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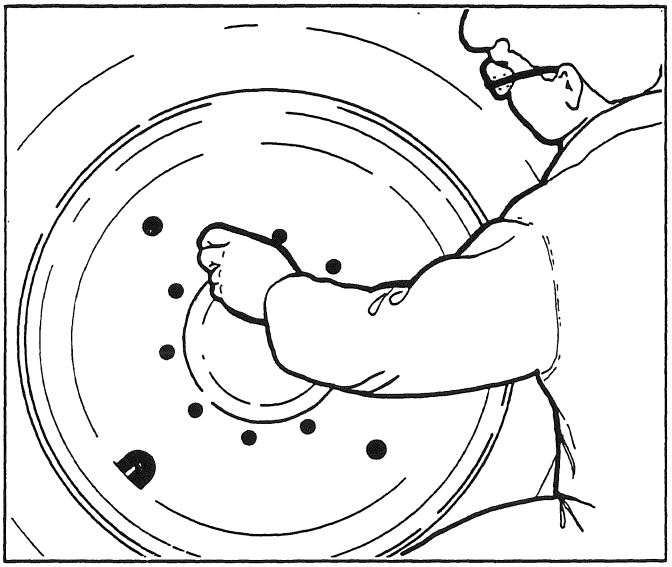

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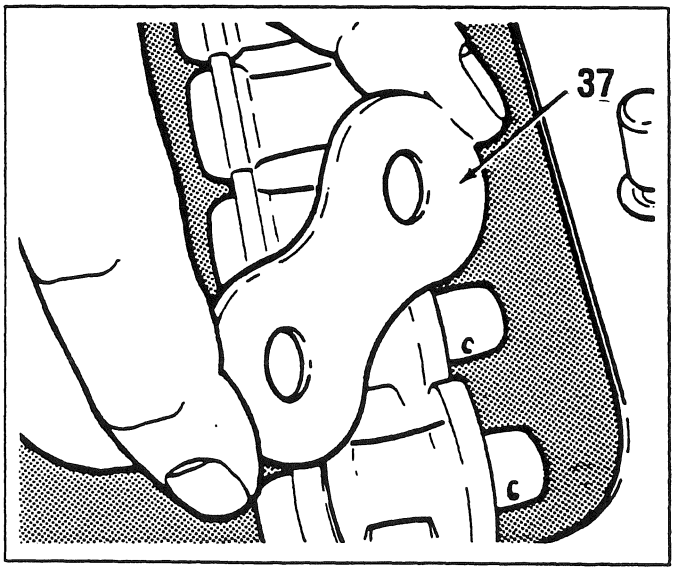

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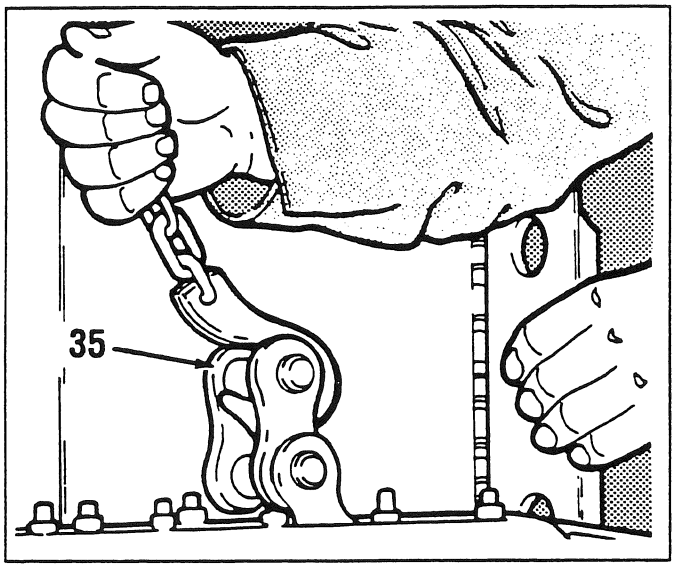

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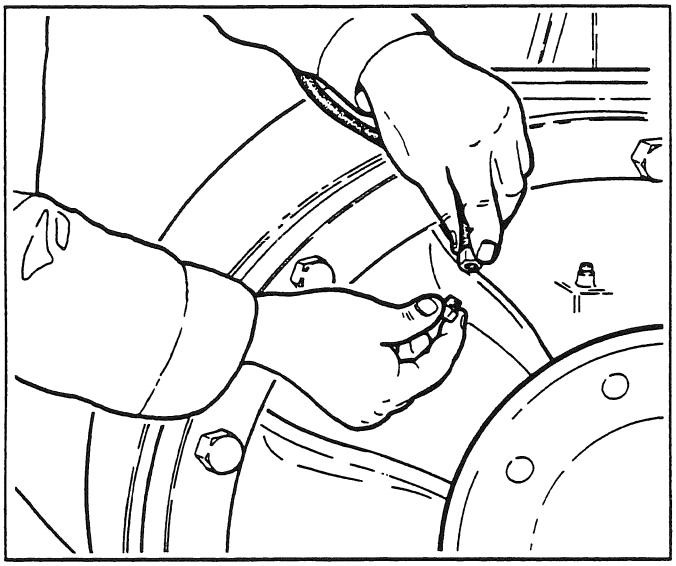

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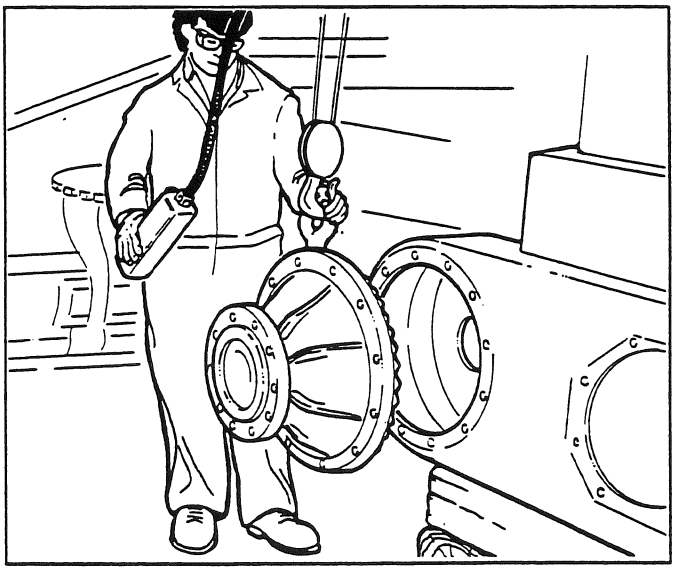

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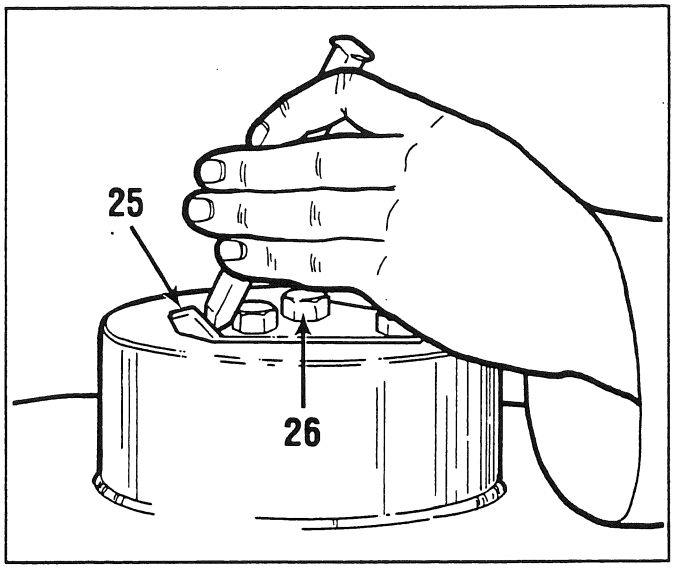

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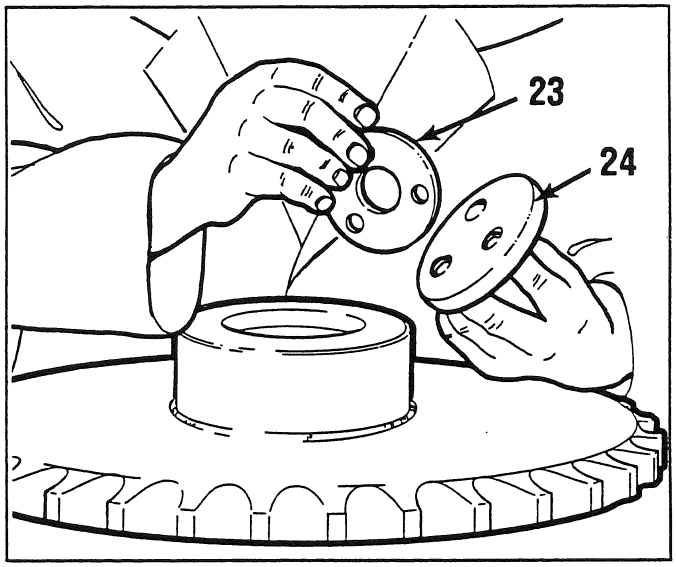

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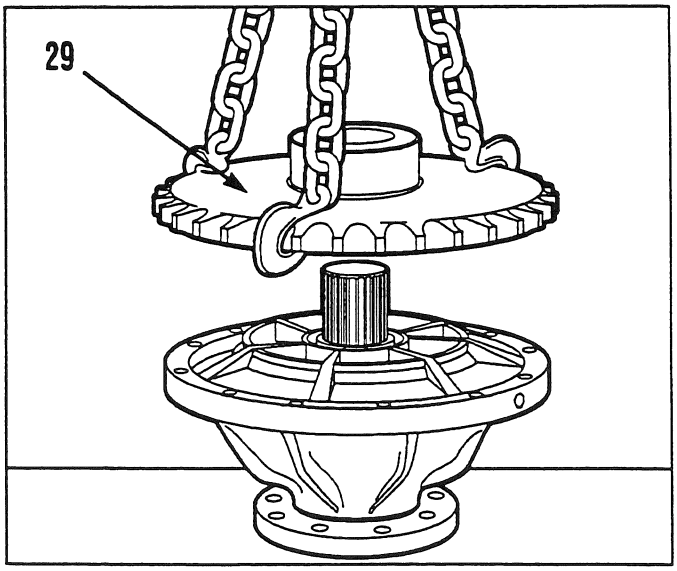


Fig. 13

Fig. 8
Using a safe lifting device, remove the tandem drive chains **(35)** through the inspection port.

Fig. 9
Remove the brake line and plug the open port of the brake line to prevent contamination.

Fig. 10
Attach a safe lifting device. Remove the brake housing mounting bolts **(5)** and lockwashers **(6)**. Remove the brake assembly from the tandem.

Disassembly

Fig. 11
Place the unit, with the wheel mounting flange down, onto a level work surface. Bend back the tabs of the tab washers **(25)**.

Fig. 12
Remove the capscrews, the tab washer **(25)**, the retainer plate **(24)** and the shims **(23)**. Keep the original shims for reinstallation.

Fig. 13
Remove the sprocket **(29)** using a safe lifting device. Note the proper orientation of the sprocket flange for reassembly.

Fig. 14
Remove the back-up plate retaining bolts **(19)** and hardened washers **(18)**. Install a puller assembly. Remove the inboard bearing cone **(21)** and back-up plate, **(17)**. Inspect the bearing cone for damage.

Fig. 15
Place the back-up plate **(17)** in a press and remove the inboard bearing cup **(21)**.

Fig. 16
Remove the inner snap ring **(16)** from the axle shaft **(1)**.

Fig. 17
Remove the hub **(15)** from the axle shaft **(1)**.

Fig. 18
Remove the friction discs **(12)** and the reaction plates, **(13)** from the brake housing **(7)**. Be sure to keep them in order. Inspect each plate and disc as you remove them.

Fig. 19
Using a safe lifting device, remove the brake housing **(7)** from the axle shaft **(1)**.

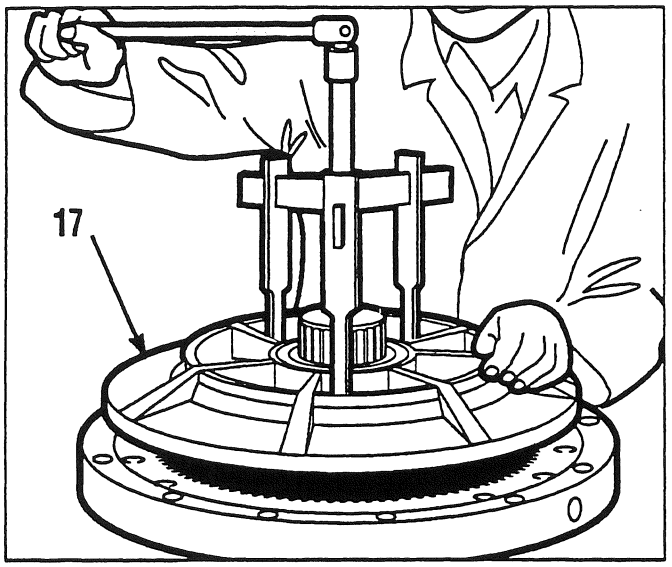


Fig. 14

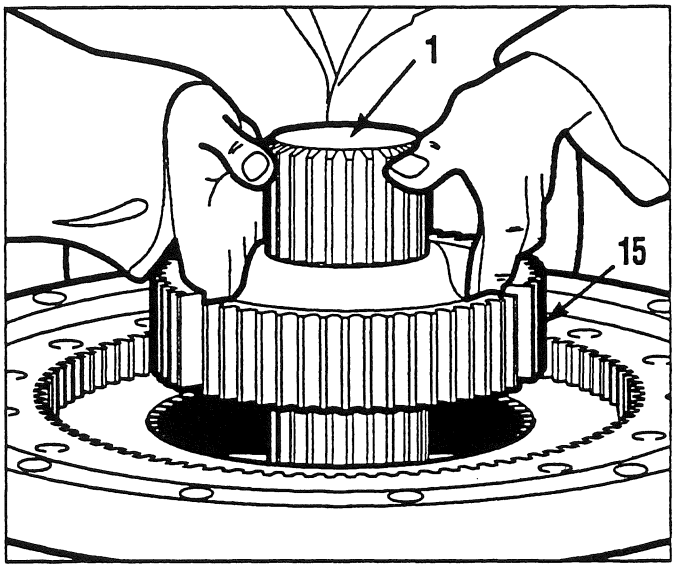
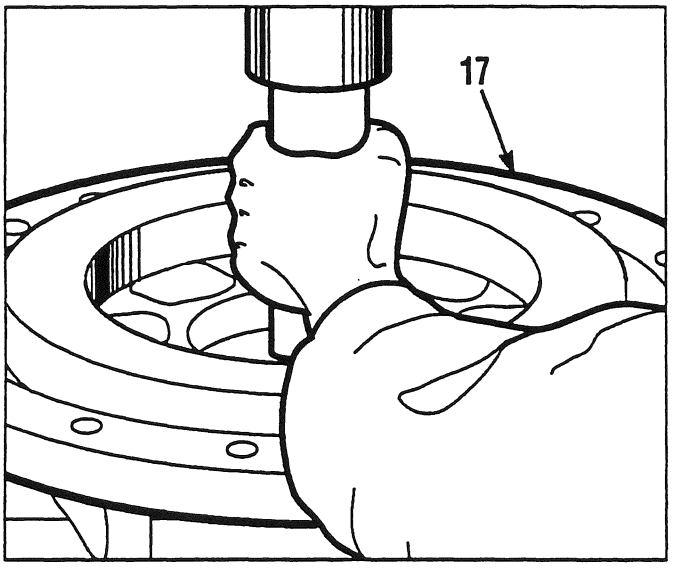


Fig. 17



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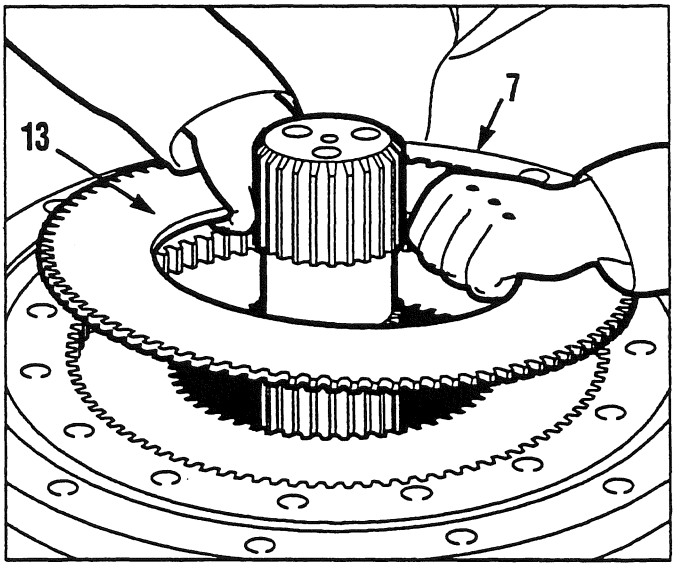
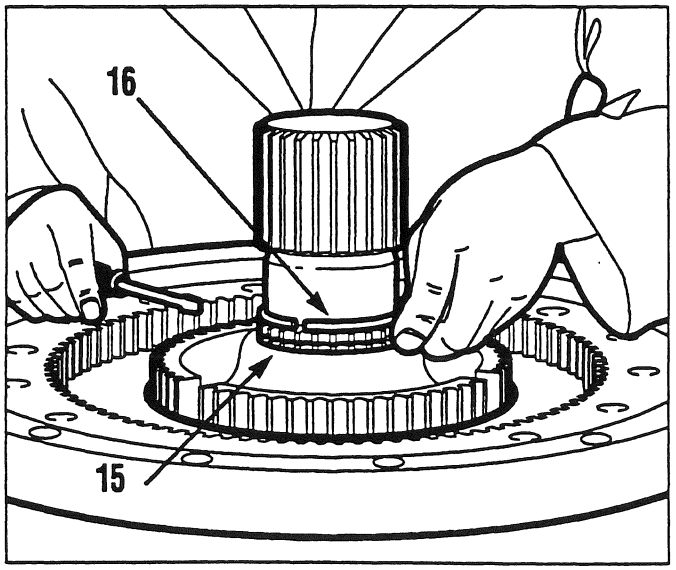


Fig. 18



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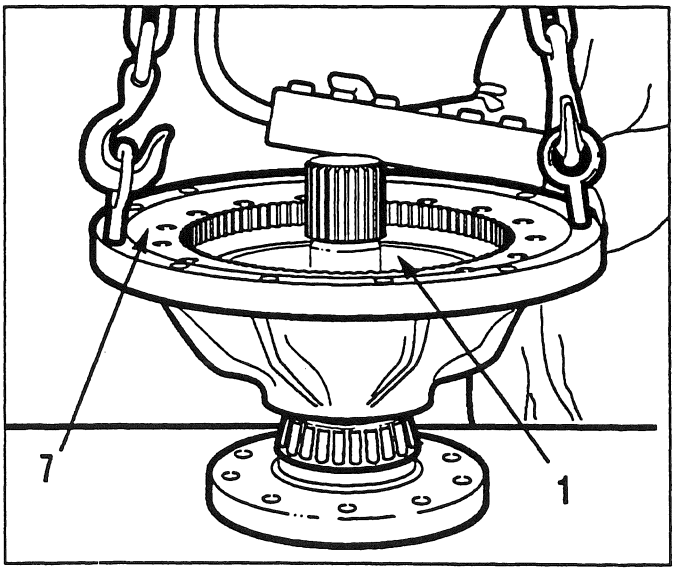

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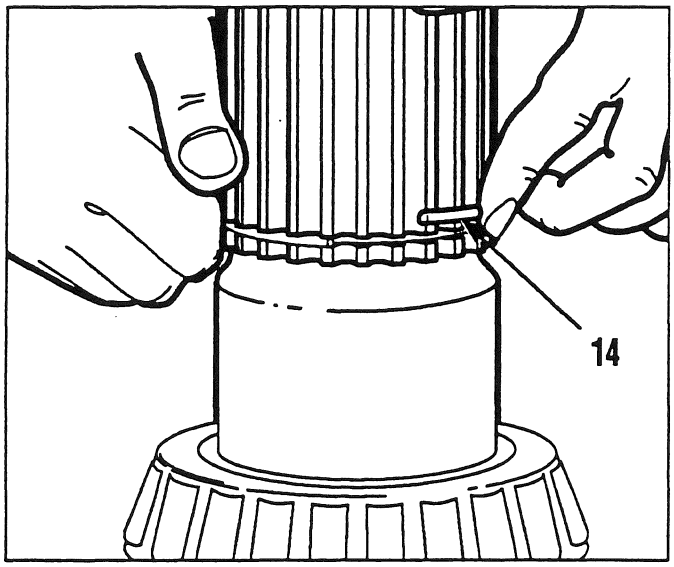


Fig. 20

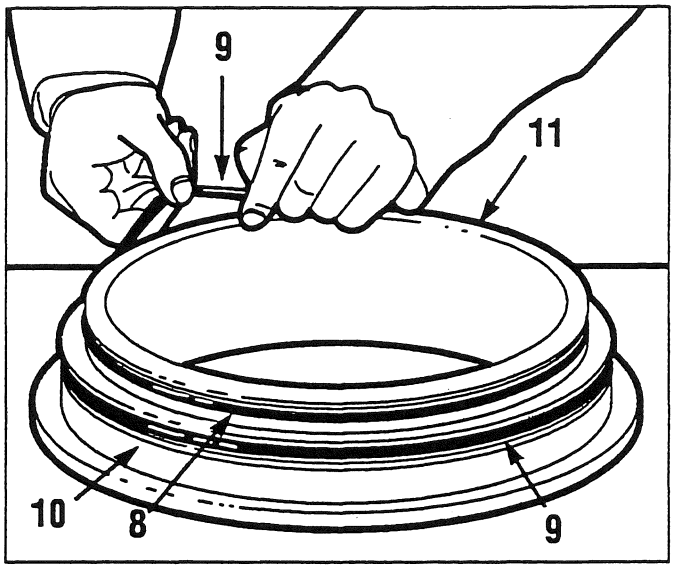
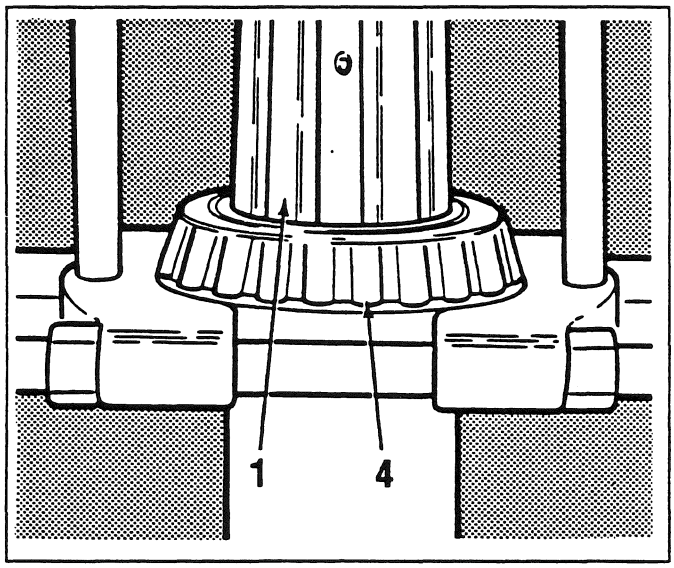


Fig. 23



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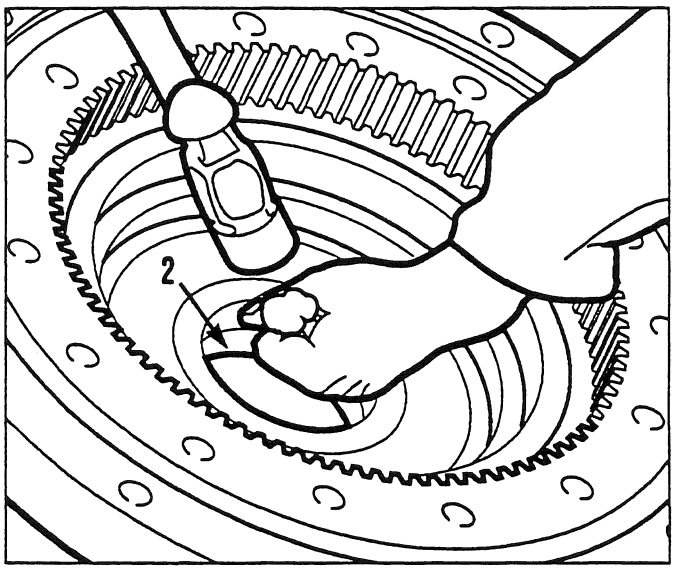

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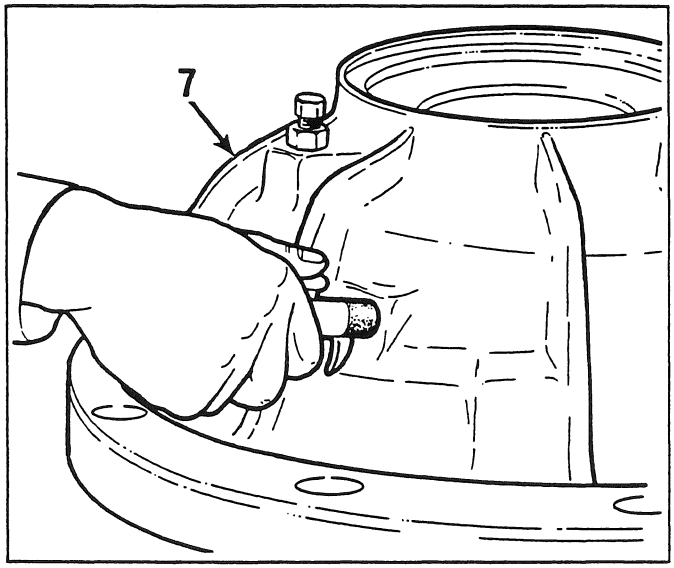


Fig. 22

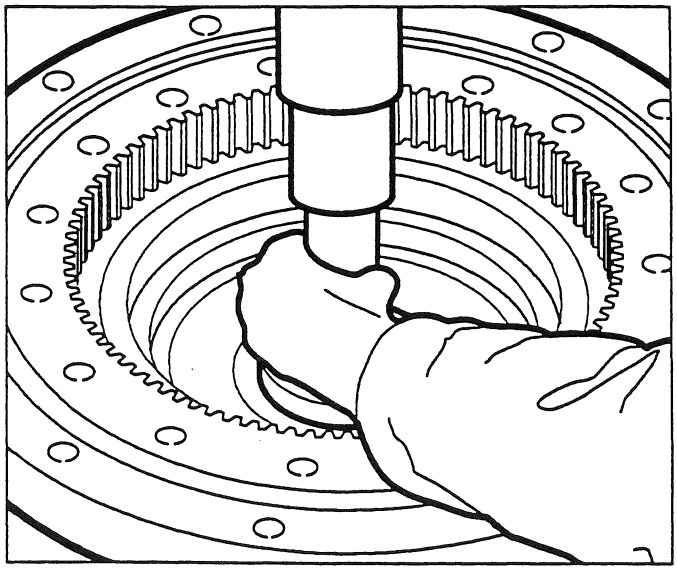


Fig. 25

Fig. 20
Remove the outer wire snap ring (**14**) from the axle shaft (**1**).

Fig. 21
Use a puller to remove the outboard bearing cone (**4**) from the axle shaft. Inspect the bearing for damage. Remove and discard dust shield from shaft if applicable.

Fig. 22
Place the brake housing (**7**) with the large opening down, on a sturdy level work surface. Using a rubber tipped air nozzle, carefully apply shop air pressure until the piston (**11**) releases from the bore.

Fig. 23
Remove and discard the "O"Rings (**9**) and backup rings (**8, 10**) from the piston (**11**).

Fig. 24
Use a hammer and punch to remove the oil seal (**2**).

Fig. 25
Place the housing (**7**) in a press. Remove the outboard bearing cup (**3**).

Fig. 26
Remove the adjusting pin **(42)** and discard the "O" Ring **(43)**.

Fig. 27
Clean and inspect all components including the brake housing **(7)**. DO NOT use solvent to clean the friction discs. Replace any components that show signs of wear or damage.

Reassembly

Fig. 28
Remove any nicks and burrs from the piston **(11)** and the inside of the brake housing. Give special attention to the chamfered edges and openings of the oil passages.

Fig. 29
Use a press to replace the outboard bearing cone **(4)** and the oil seal **(2)** in the brake housing **(7)**.

Fig. 30
Lubricate and install a new "O"Ring **(43)** on the adjusting pin **(42)**. Install the pin into the brake housing **(7)** in hole indicated.

Fig. 31
Lubricate and install new "O"Rings **(9)** and backup rings **(8, 10)** on the piston **(11)**. The back-up rings are to be to the outside and the "O"Rings to the inside.

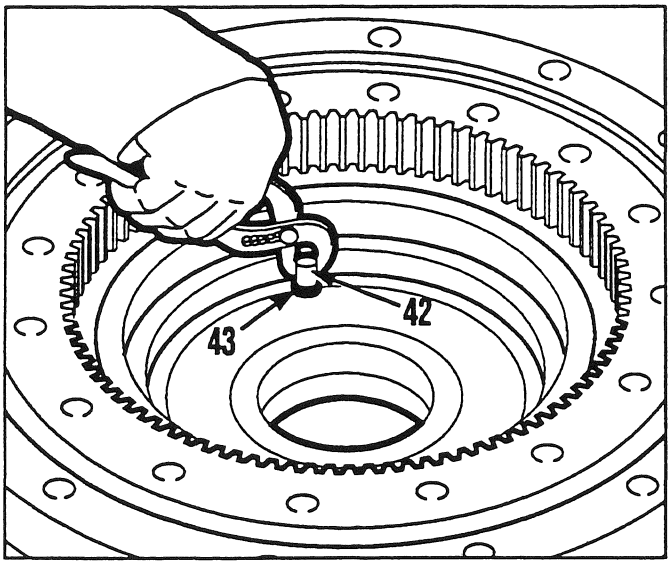


Fig. 26

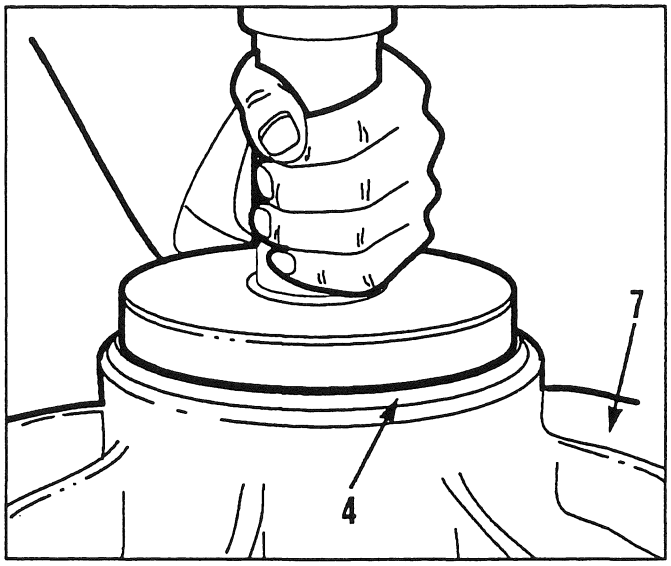


Fig. 29

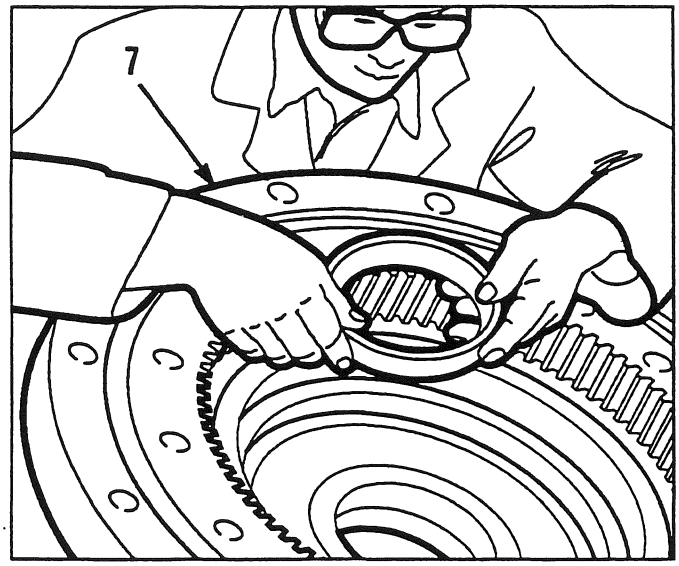


Fig. 27

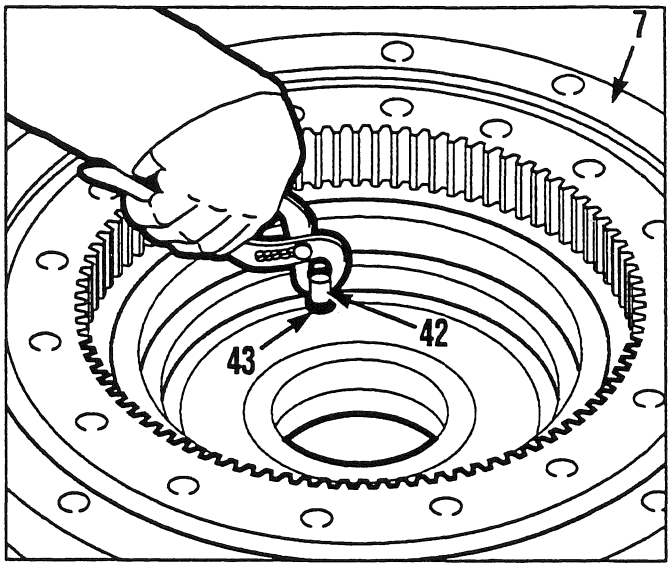


Fig. 30

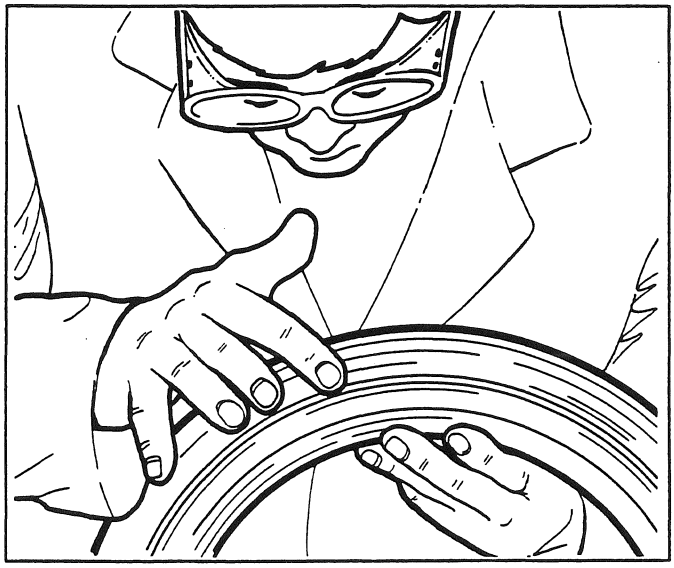
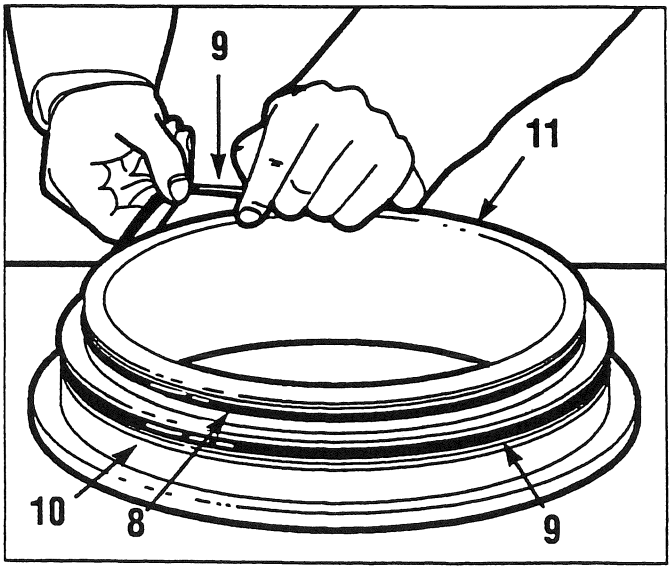


Fig. 28



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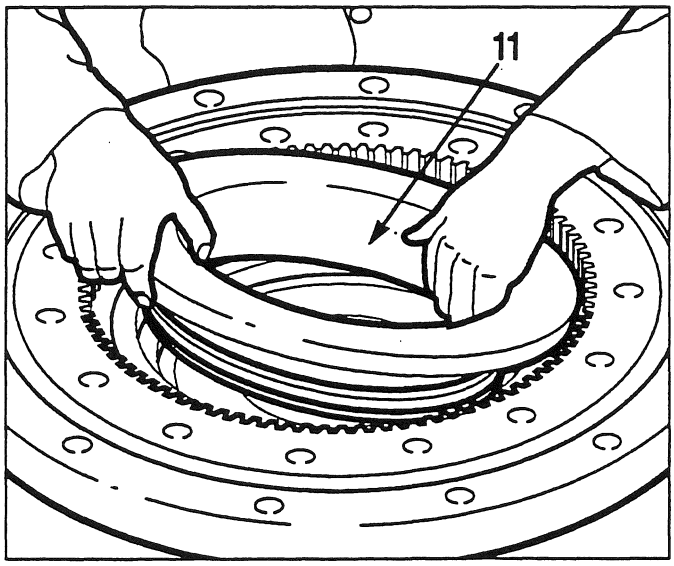


Fig. 32

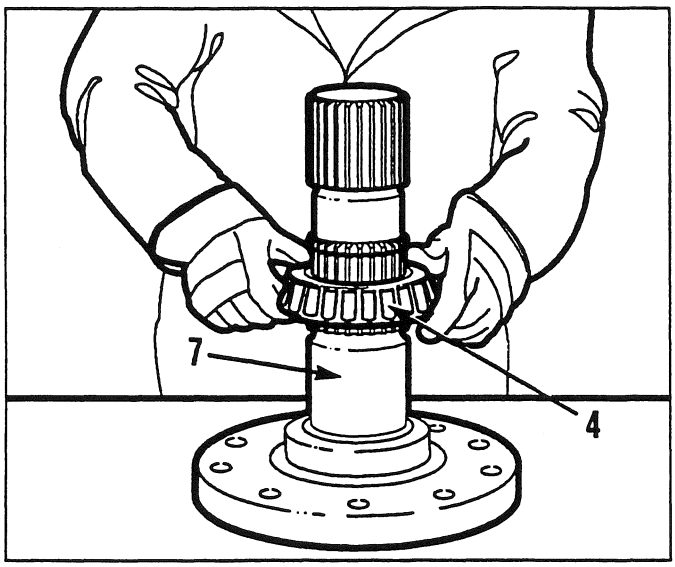


Fig. 33

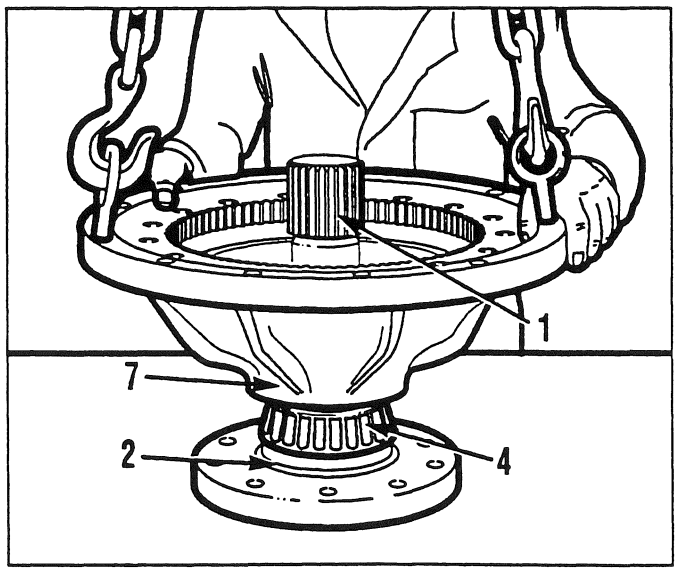


Fig. 34

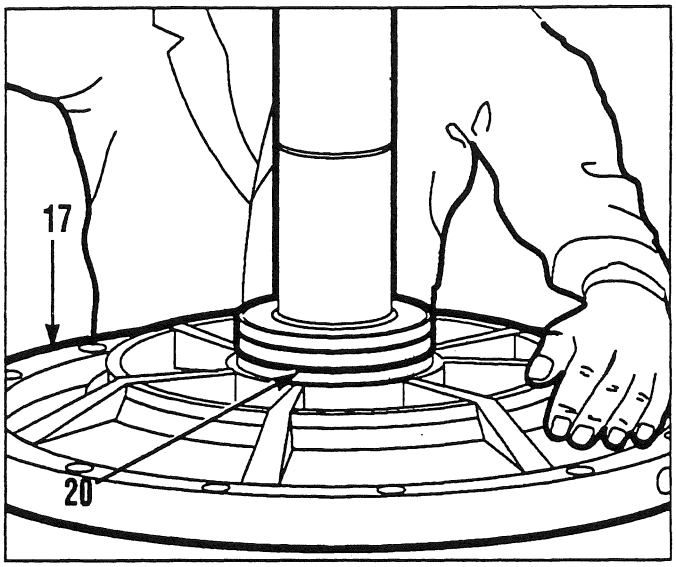


Fig. 35

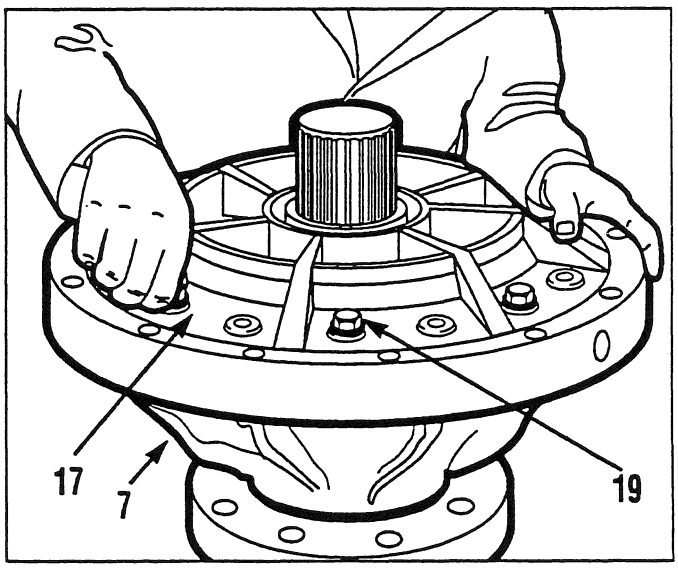


Fig. 36

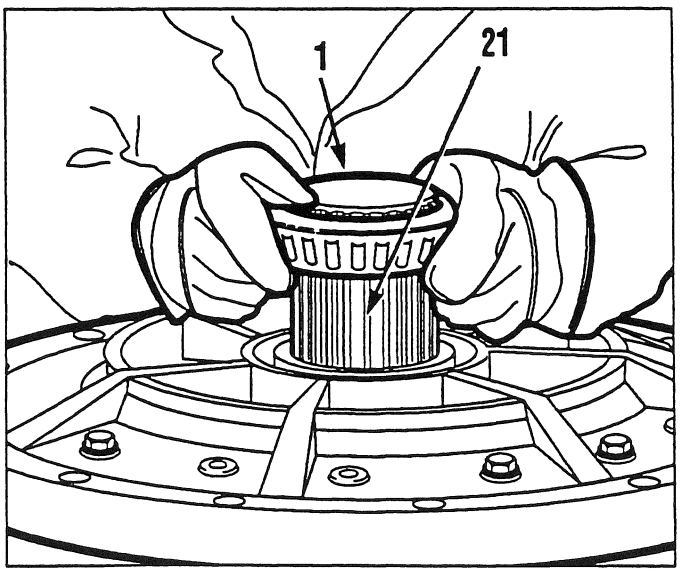


Fig. 37

Fig. 32
Install the piston **(11)** in the piston bore. Both the piston and the bore must be lubricated with oil.

Fig. 33
Stand the axle on its wheel flange end. If applicable, install a new dust seal. Heat the outboard bearing cone **(4)** evenly. For example, use an oil immersion heater. Do not heat above 300°F (149°C). Install it on the axle shaft **(1)**. Be sure to lubricate the bearing with oil.

Fig. 34
Use a safe lifting device to lower the brake housing **(7)** onto the axle shaft **(1)**. Be sure not to damage the oil seal **(2)** or bearing **(3, 4)** while lowering brake housing onto axle shaft.

Fig. 35
Place the back-up plate **(17)** in a press and install the inboard bearing cup **(20)**.

Fig. 36
To set the bearing pre-load, install the backup plate **(17)** on the brake housing **(7)** and install 6 retaining bolts **(19)**.

Fig. 37
Heat the inboard bearing cone **(21)** evenly. Do not heat above 300°F (149°C). Install it on the axle shaft **(1)**. Lubricate the bearing with oil.

Fig. 38
Torque the six retaining bolts **(19)** to the recommended torque .

Fig. 39
Using a safe lifting device, install the sprocket **(29)** on the shaft **(1)**.

Fig. 40
Install the original shims **(23)**, retainer plate **(24)**, and bolts **(26)**.

Fig. 41
Tighten the bolts **(26)** in 50 ft.lb. increments to the recommended torque. Rotate the housing **(7)** during the tightening process to seat the bearings properly.

Fig. 42
Use a dial torque wrench to read the rolling torque of the housing **(7)**. If the rolling torque is below the specification, remove shims from the shim pack **(23)**. If the rolling torque is higher than the specification, add shims until the rolling torque is correct. The bearing pre-load is then established.

Fig. 43
Remove the bolts, retaining plate **(24)** and shims. Be sure to keep this exact shim pack **(23)** for final assembly.

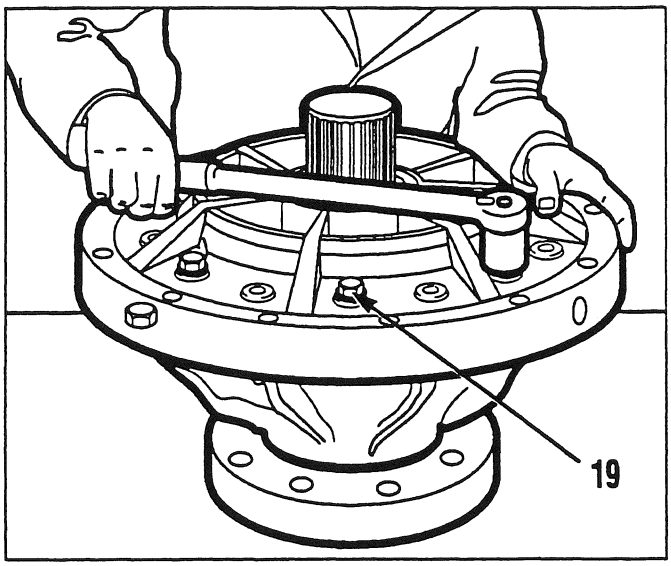


Fig. 38

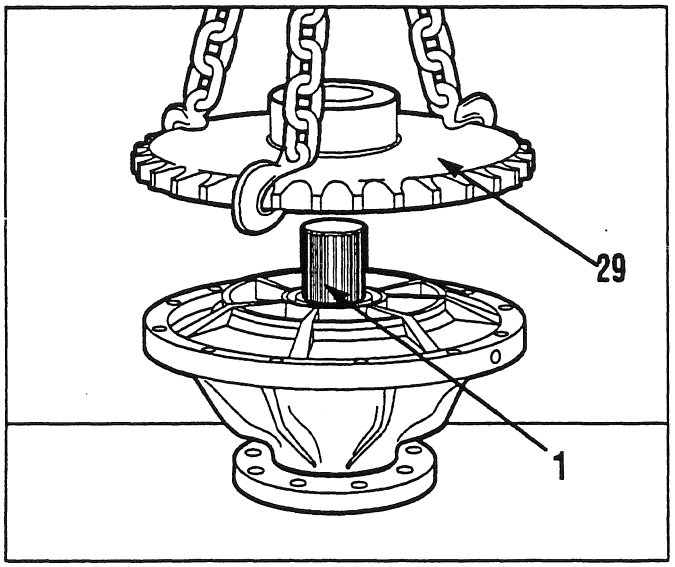


Fig. 39

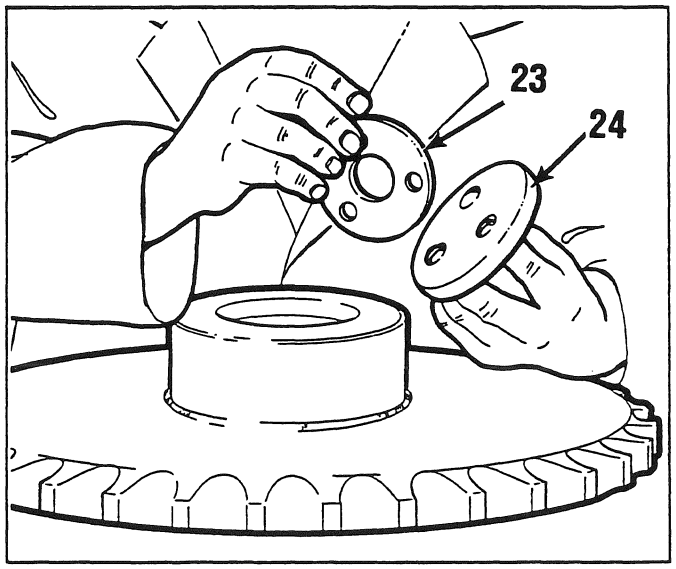


Fig. 40

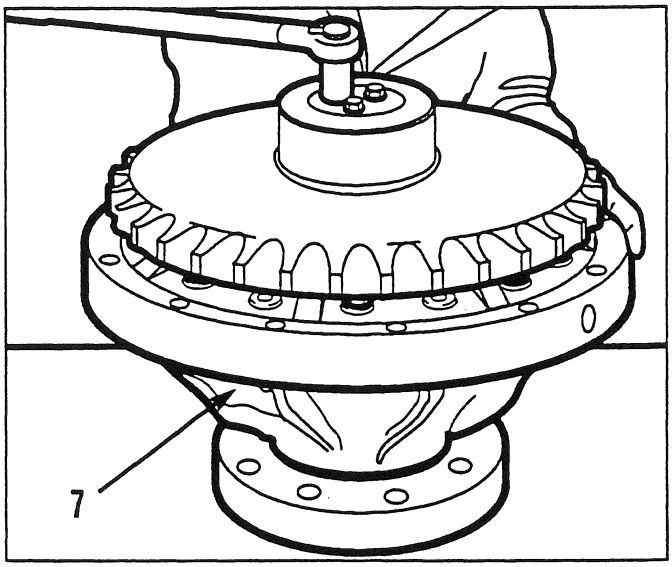


Fig. 41

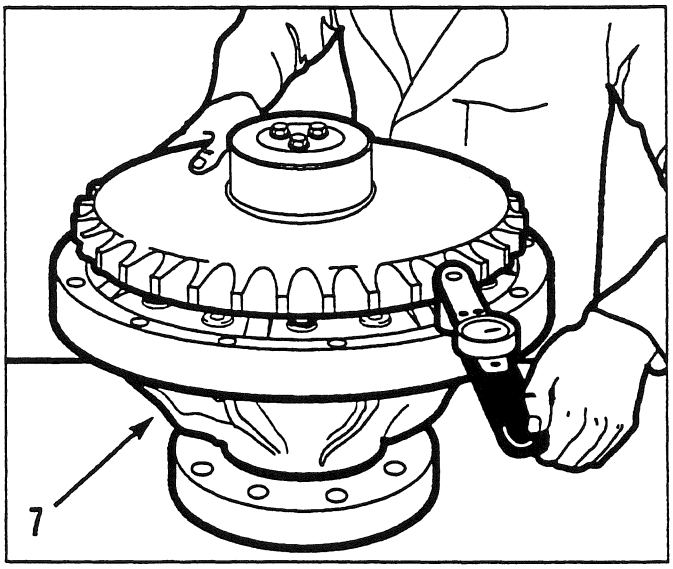


Fig. 42

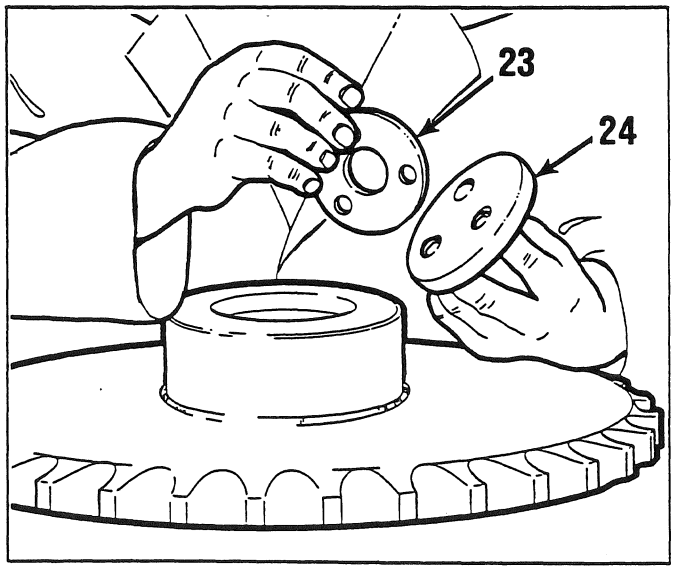


Fig. 43

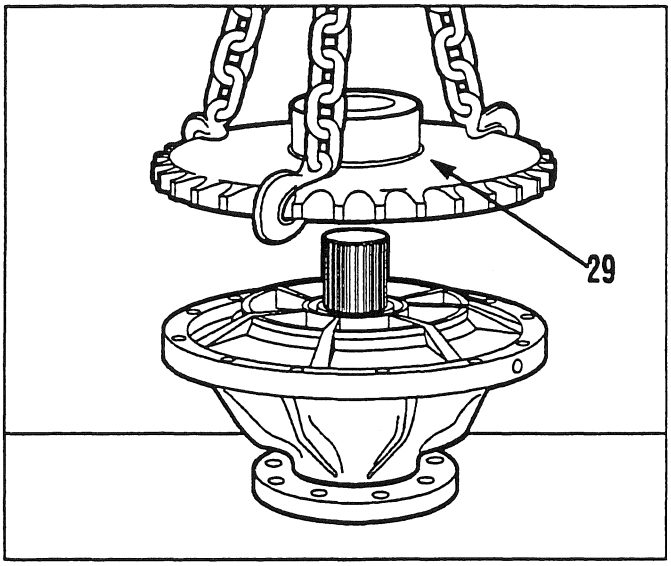
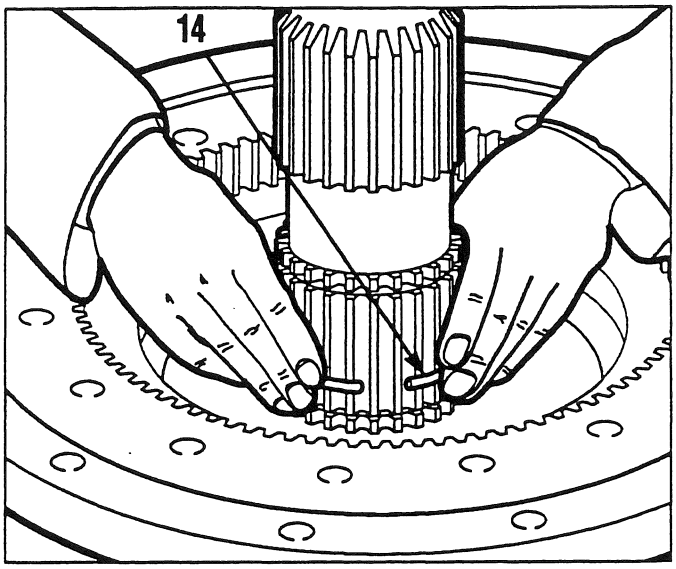


Fig. 44



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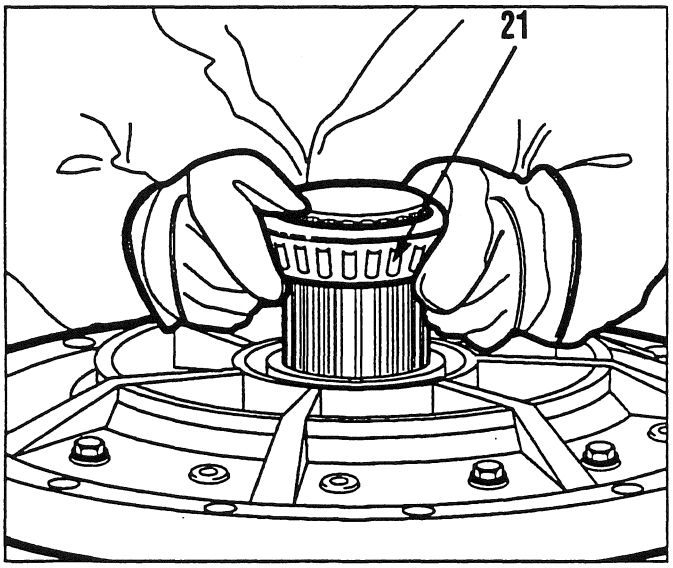

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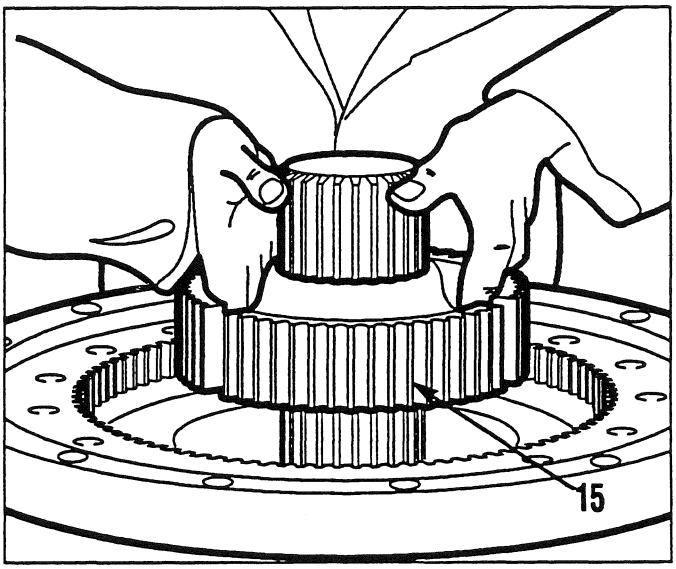


Fig. 48

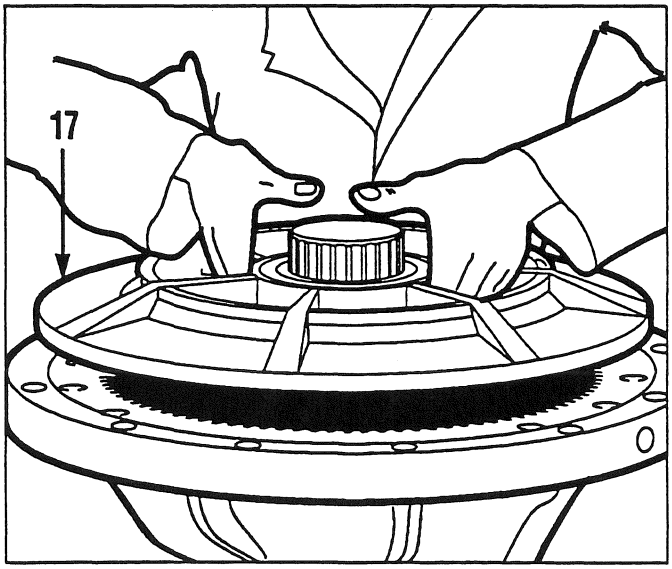


Fig. 46

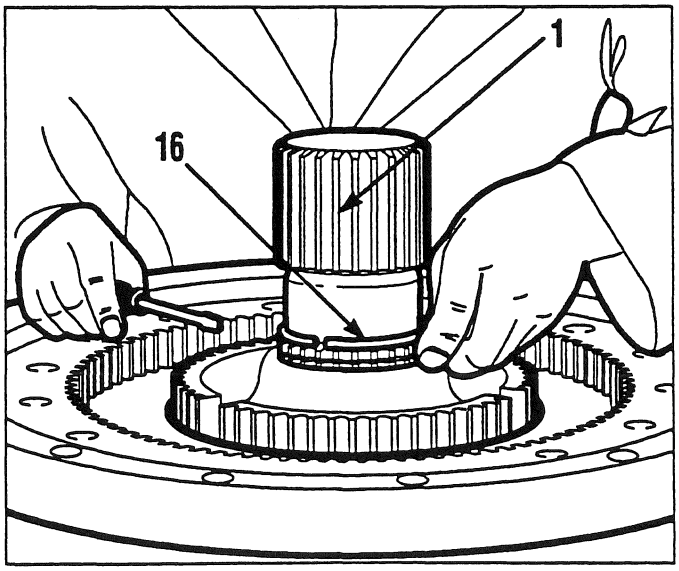


Fig. 49

Fig. 44
Remove the sprocket (**29**).

Fig. 45
Remove the inboard bearing cone (**21**).

Fig. 46
Remove the back-up plate (**17**).

Fig. 47
Install the outer snap ring (**14**).

Fig. 48
Install the hub (**15**).

Fig. 49
Install the inner snap ring (**16**) onto the axle shaft (**1**).

Fig. 50
Install a reaction plate **(13)** first, followed by a friction disc. Install the remainder of the reaction plates and friction discs, alternating discs and plates. You must finish with a reaction plate. Be sure to use the correct number of reaction plates and friction discs. All models use the same part number friction discs and reaction plates. However, the brake units differ in the number of discs and plates with the corresponding back-up plates. See page 17-4 for the proper number of reaction plates and friction discs required for the particular grader you are working on.

Fig. 51
Install the back-up plate **(17)**, hardened washers **(18)** and the retaining bolts **(19)**.

Fig. 52
Heat the inboard bearing cone **(21)** evenly. Do not heat above 300°F (149°C). Install it on the axle shaft **(1)**.

Fig. 53
Tighten the backup plate capscrews to the recommended torque.

Fig. 54
Install the sprocket **(29)**. Make sure the flange is oriented in the original position.

Fig. 55
Install the shim pack **(23)** developed during the bearing pre-load setting procedure described in Fig. 42. Install the retainer plate **(24)**, the tabwasher **(25)**, and the capscrews **(26)**.

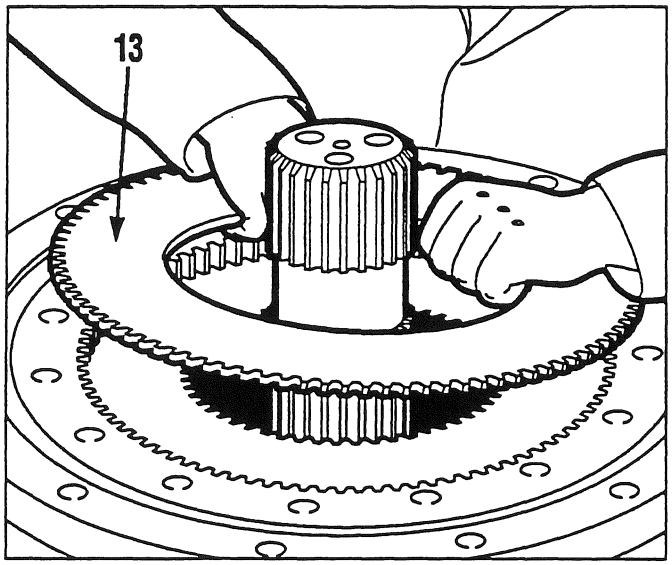


Fig. 50

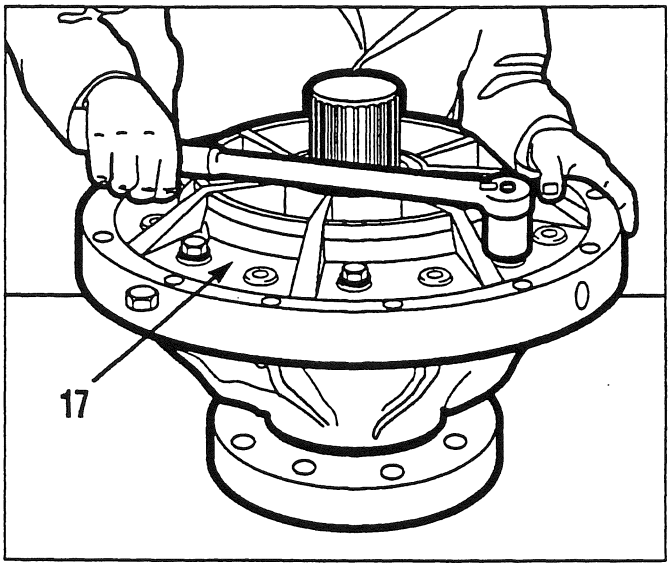


Fig. 53

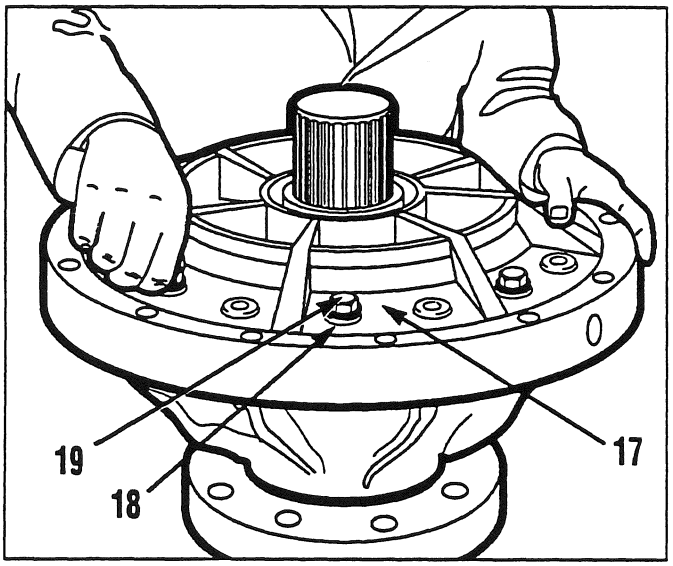


Fig. 51

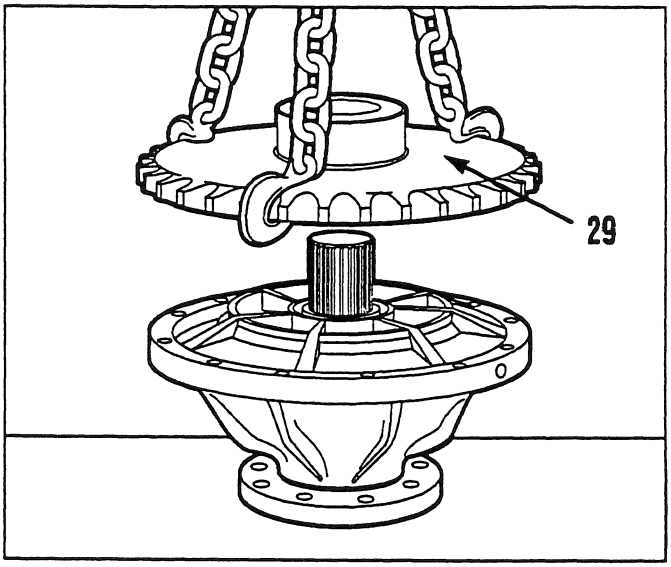


Fig. 54

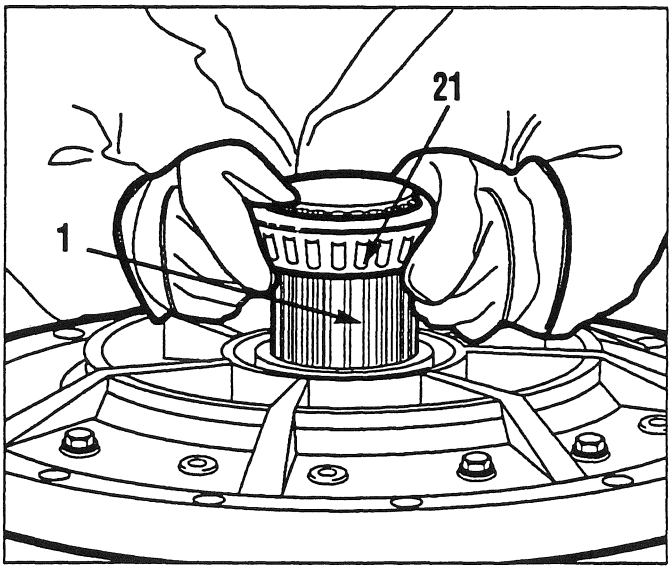


Fig. 52

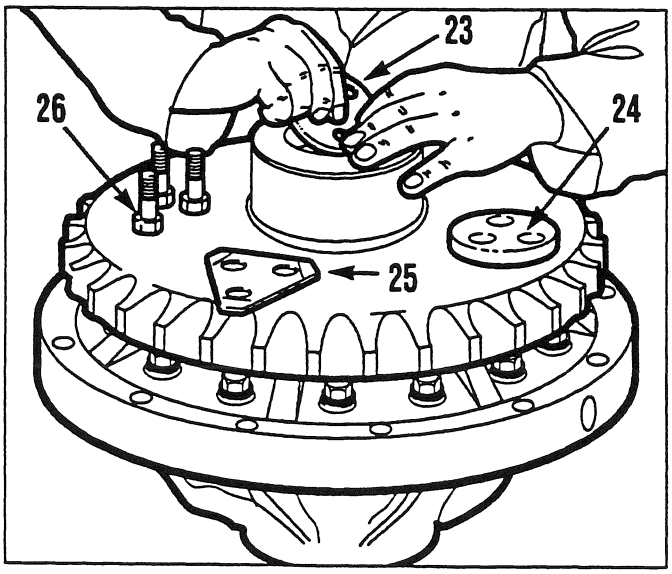


Fig. 55

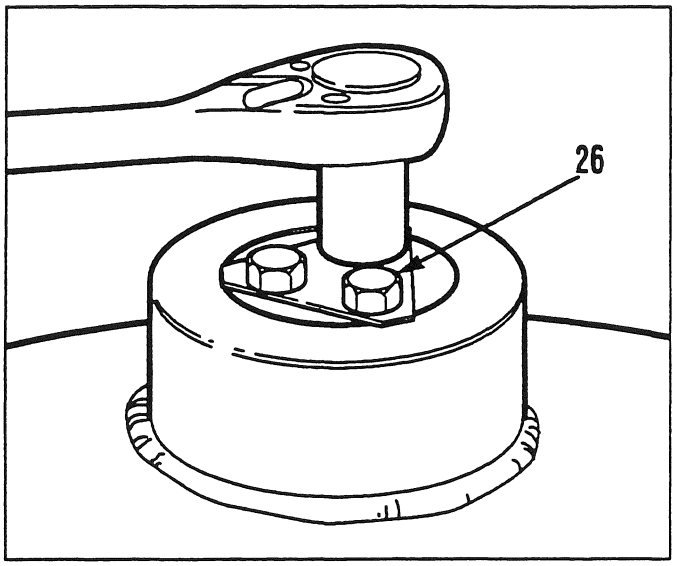


Fig. 56

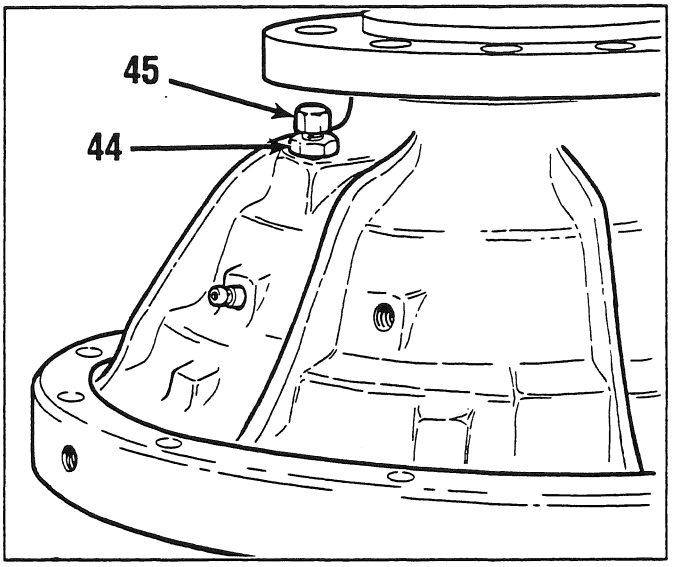


Fig. 59

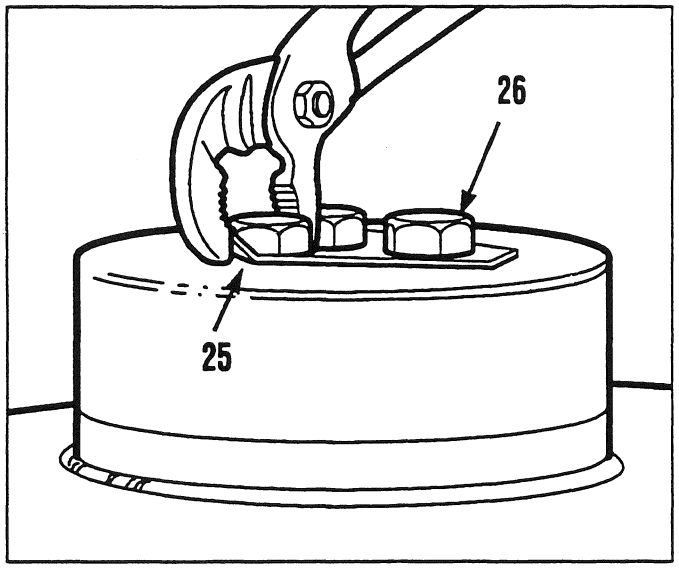


Fig. 57

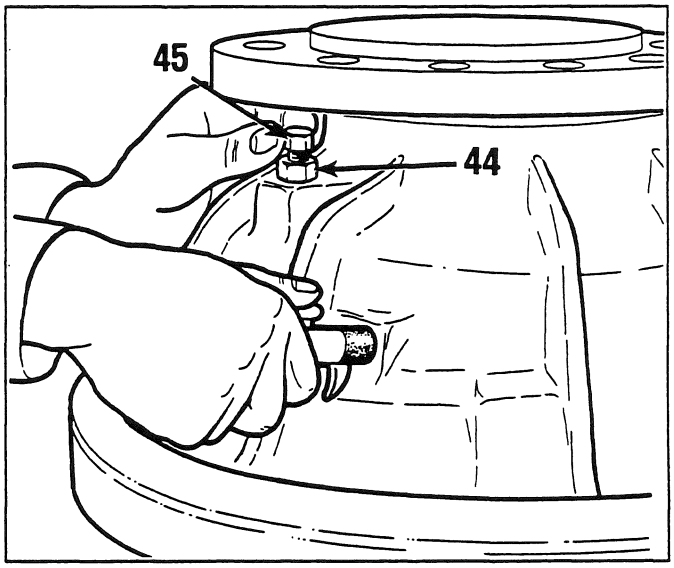


Fig. 60

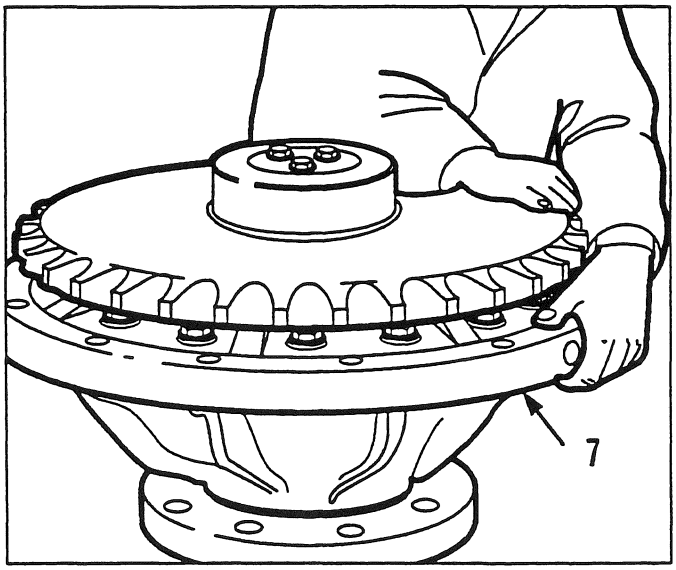


Fig. 58

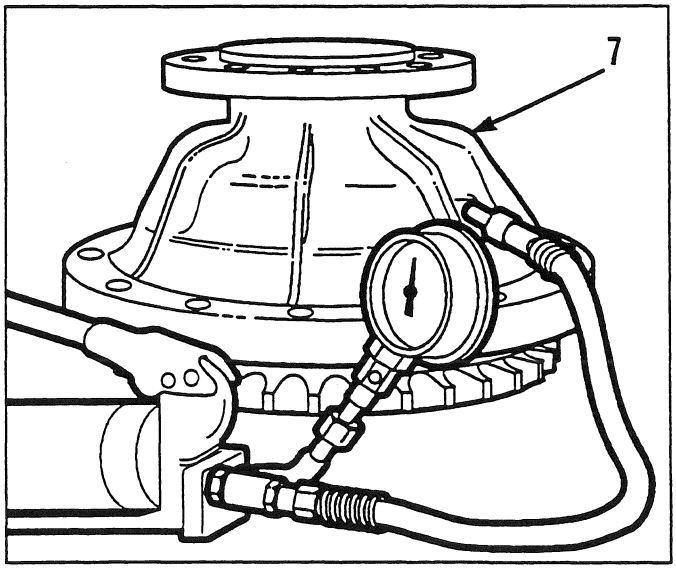


Fig. 61

Fig. 56
Tighten the capscrews **(26)** in 50 ft.lb increments to the recommended torque .

Fig. 57
Bend the tabwasher **(25)** to lock the capscrews **(26)** in place.

Fig. 58
Rotate the brake housing **(7)** to insure that it rotates freely, and that nothing jammed during final assembly.

Bench adjustment

Fig. 59
To adjust the piston travel, assemble the jam nut **(44)** and piston travel limiting screw **(45)**. Start them into the adjusting hole in the brake housing **(7)**.

Fig. 60
Using a rubber tipped air nozzle, apply shop air pressure to the brake line port on the brake housing **(7)** to move the discs into the clamped position. With air pressure applied, turn the piston travel limiting screw **(45)** inwards, until it touches the back of the piston. Turn the adjusting screw outwards the recommended amount and tighten the jam nut.

Fig. 61

Pressure test the assembly. Install a pressure hand pump to the brake line port on the brake housing **(7)**. Apply 100 P.S.I. (690 kPa) and check the assembly for leaks. Increase the pressure to 3,000 P.S.I. (20,700 kPa), and again check for leaks. After the setting and the pressure testing, the unit is ready for reinstallation into the tandem.

Installation

Fig. 62
Remove all traces of silicone from tandem openings. Remove any oil or dirt with solvent.

Fig. 63
Make sure all mating surfaces are clean. Apply silicone sealant to the tandem opening. Silicone should be applied to both sides of the bolt holes.

Fig. 64
Attach an eye bolt to the threaded hole in the brake housing mounting flange. Use a safe lifting device, to position the brake unit in the tandem. Make sure the threaded hole is at the top.

Fig. 65
Apply a Champion approved locking compound and install the capscrews **(34)** and lockwashers. Torque the capscrews to the recommended torque .

Fig. 66
Install the tandem drive chain **(35)** into the tandem.

Fig. 67
Install the connector link **(37)** and secure it with the connector pin **(36)**.

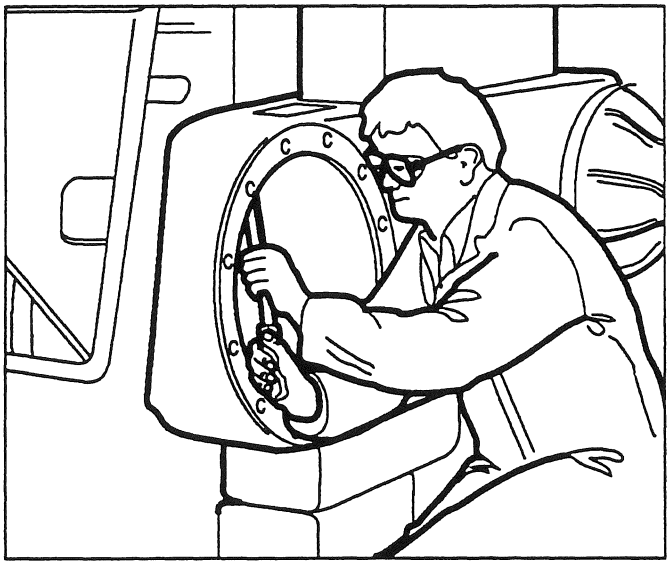


Fig. 62

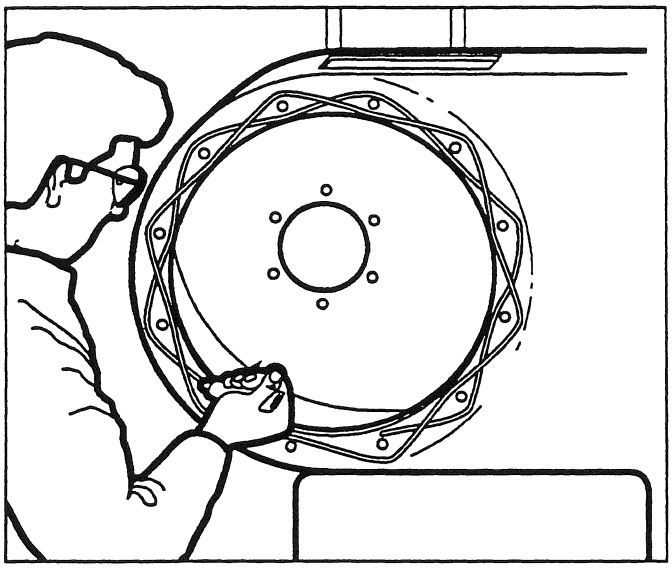


Fig. 63

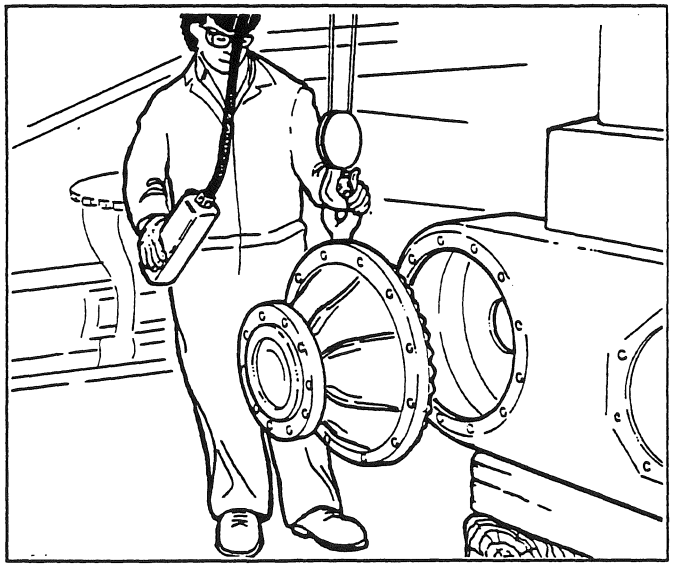


Fig. 64

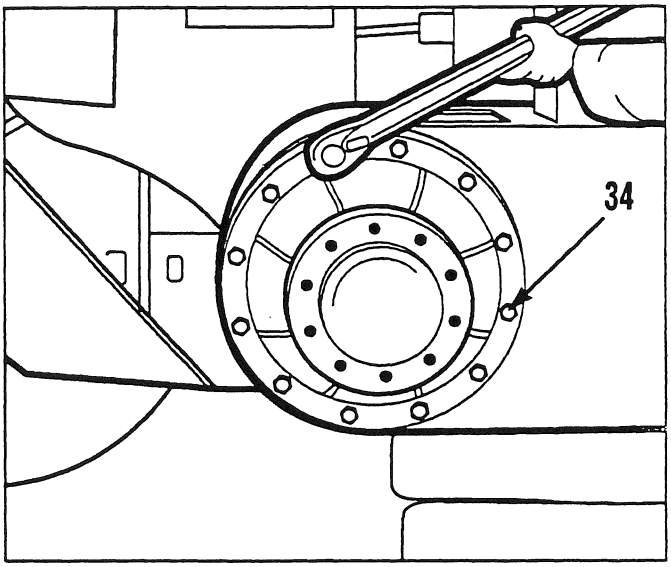


Fig. 65

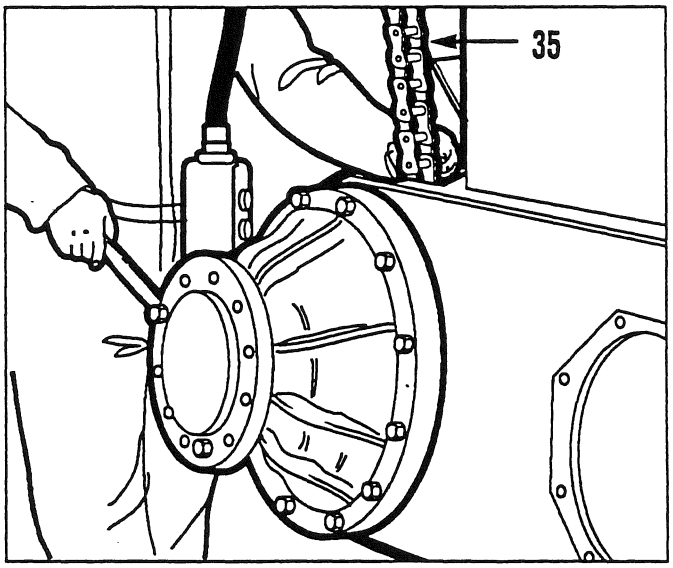


Fig. 66

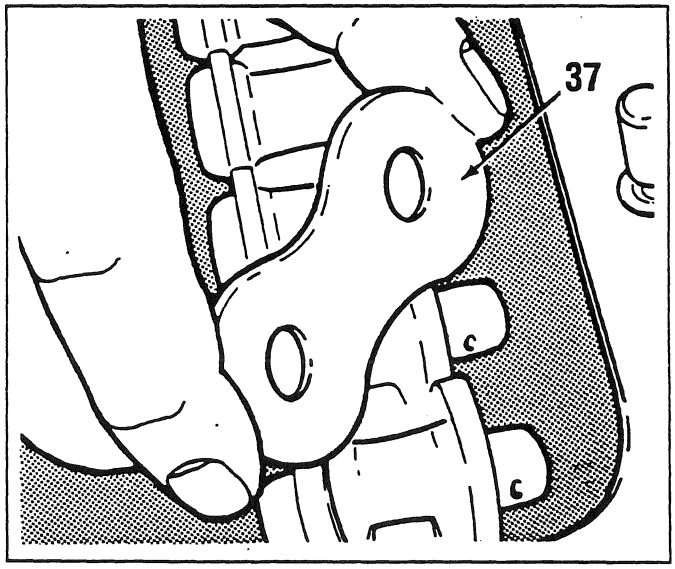


Fig. 67

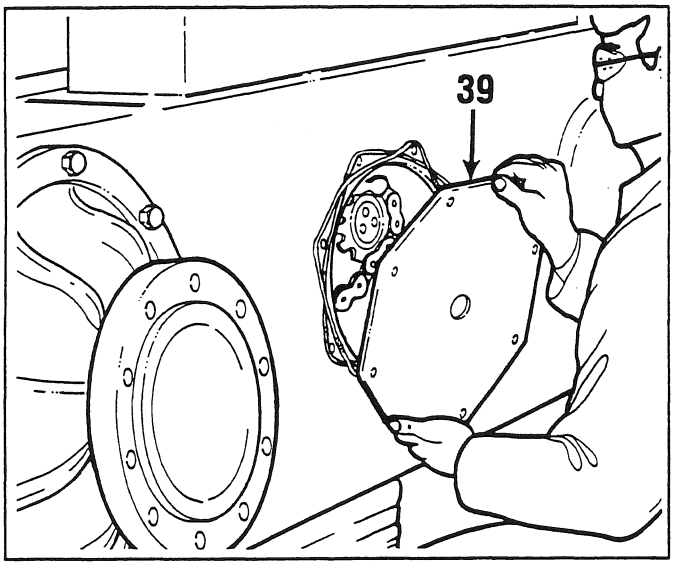


Fig. 68

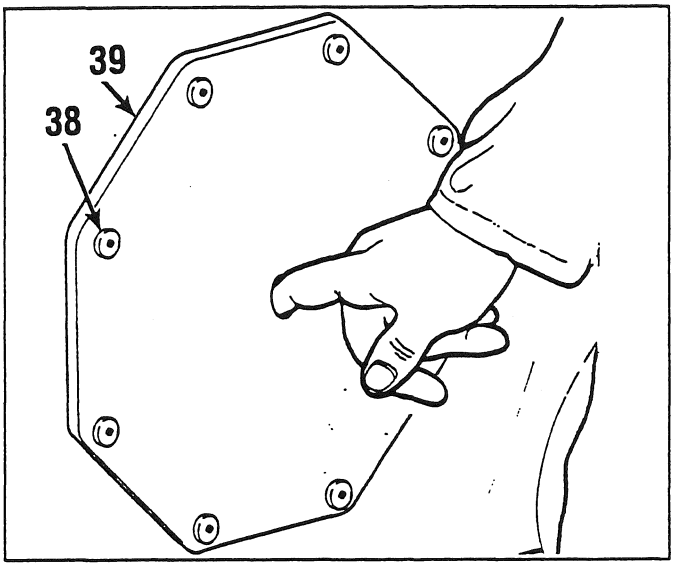


Fig. 71

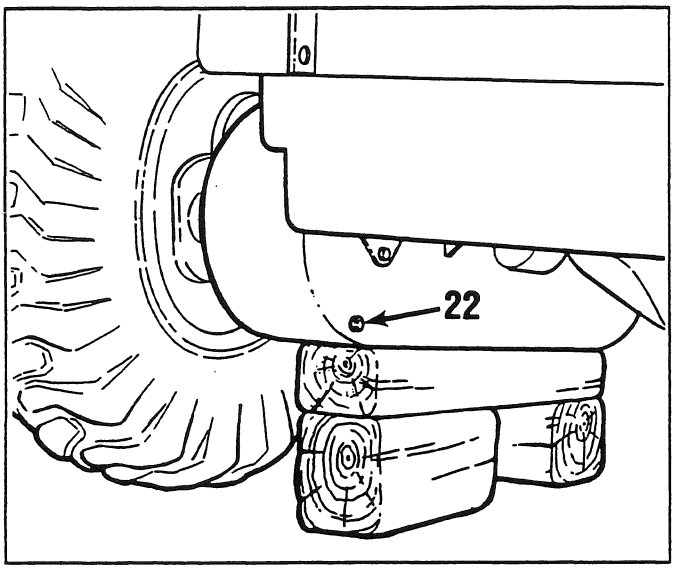


Fig. 69

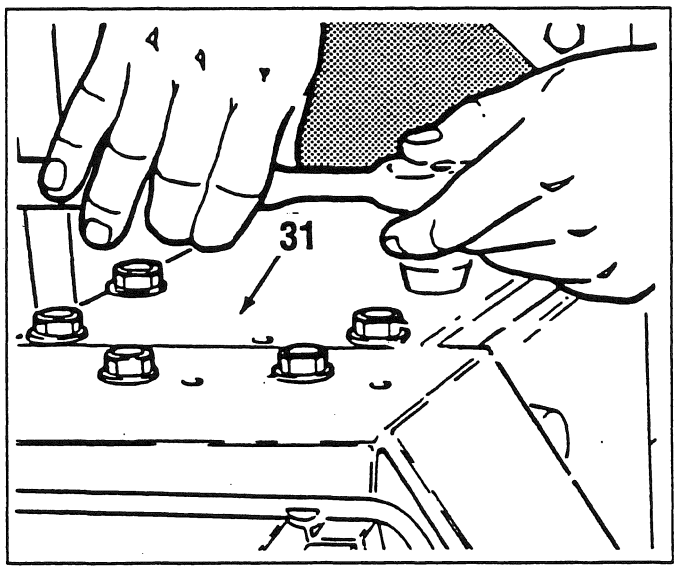


Fig. 72

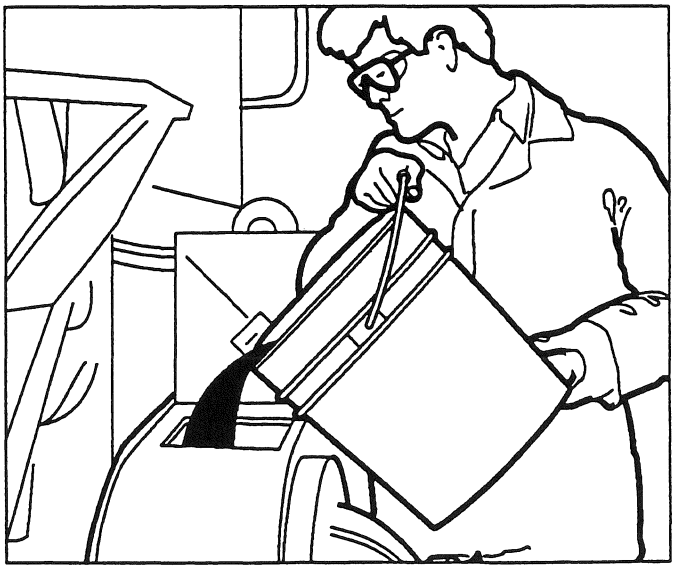


Fig. 70

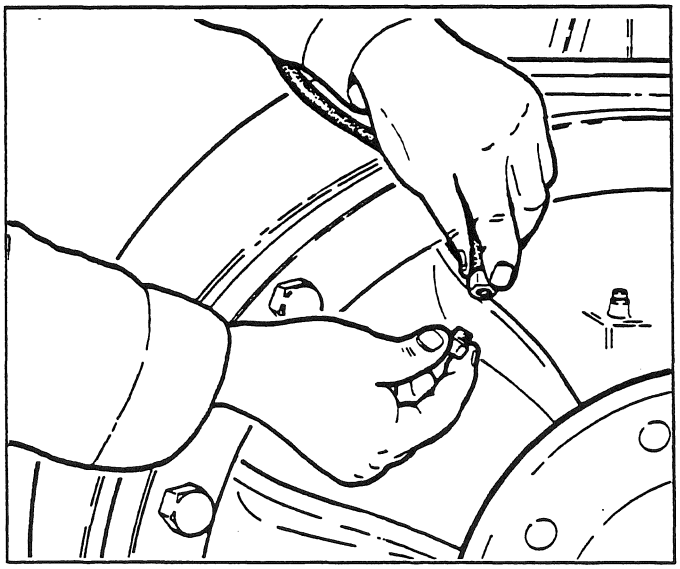


Fig. 73

Fig. 68
Apply silicone sealant to the tandem side opening and side cover plate **(39)**. Install the side cover plate, and torque the capscrews **(38)** to the recommended torque.

Fig. 69
Tighten the tandem drain plug **(22)**.

Fig. 70
Fill the tandem with the recommended oil.

Fig. 71
Check the oil level in the side coverplate **(39)** by removing the oil level check plug **(40)**.

Fig. 72
Apply silicone to the inspection openings and covers. Install the inspection covers **(30)**.

Fig. 73
Connect the brake line to the brake unit. Install the brake guard.

Fig. 74
Install the wheel using the proper retaining bolts.

Tighten the wheel bolts to the recommended torque. Use a diagonal tightening pattern.

Turn the isolation switch to the "ON" position. Start the engine. Lower the moldboard to raise the tandem. Remove the supports. Raise the moldboard to lower the machine onto its wheels. Shut off the engine and return the isolation switch to the "OFF" position.

With the grader parked on a level surface, check the tandem oil level as described in Fig. 71. Adjust oil level if necessary.

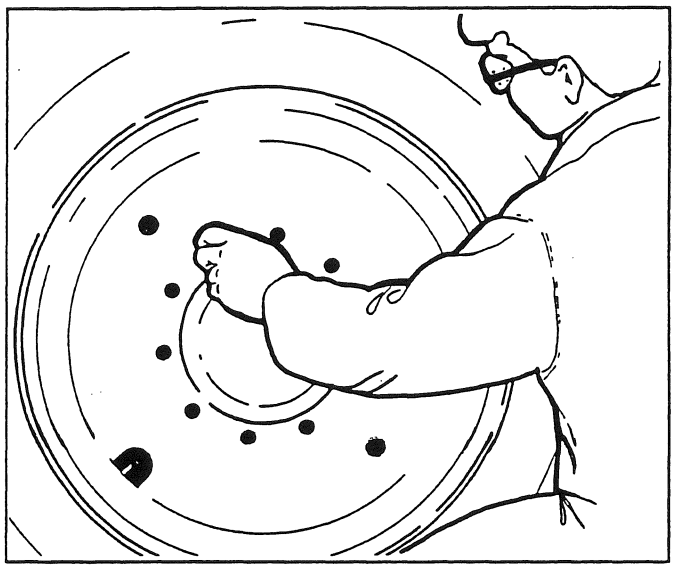


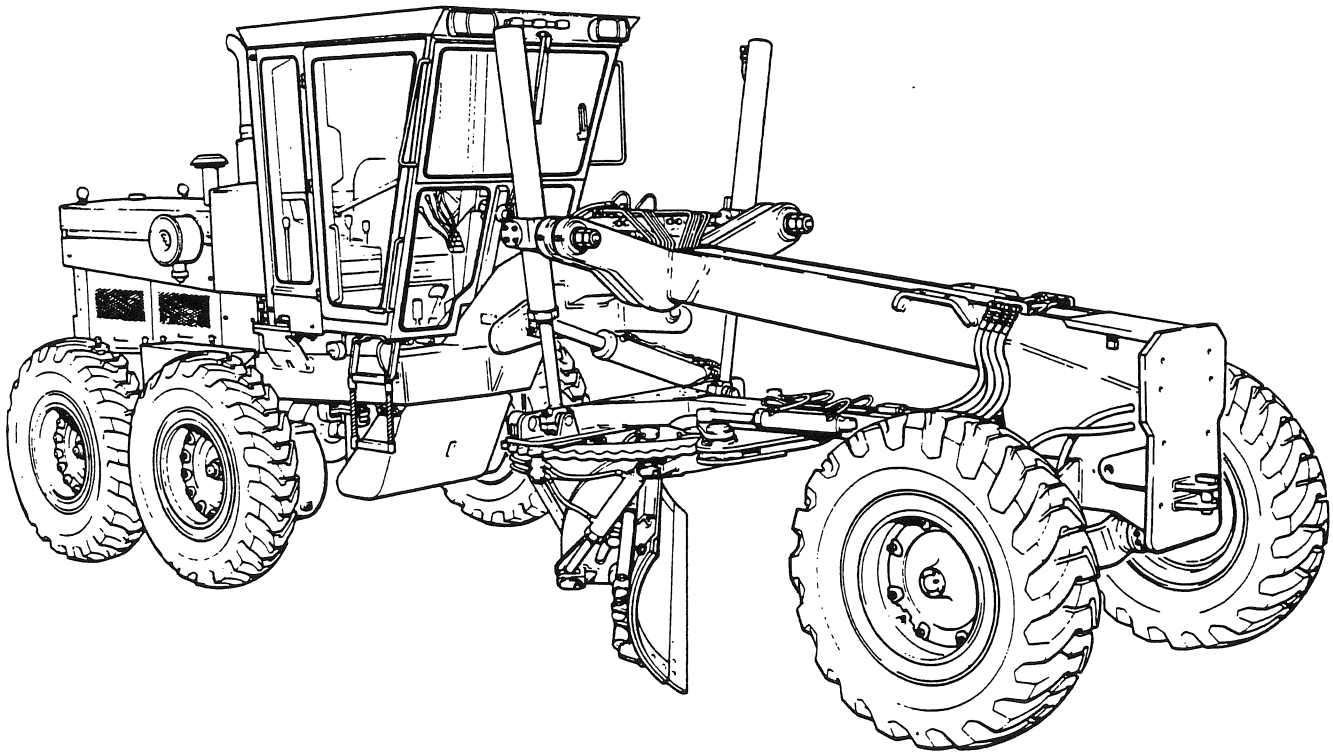
Fig. 74

Bleeding the Brakes

The final procedure is the bleeding of the brakes. See the procedure outlined in the shop manual.

SECTION 21

ATTACHMENTS



GENERAL

Before starting to disassemble or assemble any of the attachments, ensure that suitable lifting tackle and adequate tools are available. Ensure that precautions are taken to prevent dust and dirt entering the hydraulic system when hoses and tubes are disconnected or re-connected (refer to Service Bulletin No. 284).

Refer to Section 19 for details concerning the overhaul of the attachment hydraulic circuits.

When ordering replacement parts, reference should be made to the spare parts manual.

NOTE:
All weights, measures and tolerances are quoted in both Imperial and Metric figures. Following the internationally accepted standard, the decimal point is denoted by a comma in all Metric measurements.

SCARIFIER

1. Removal and Disassembly (Fig. 1).

WARNING:
Before disconnecting any hydraulic hoses or fittings, remove the wedges (24) and tooth shanks (26); then lower the scarifier onto the ground.

The scarifier hydraulic circuit is normally connected to the right hand side of the manifold valve either directly, or through a manually operated selector valve if a front mounted attachment is installed.

NOTE:
On certain machines not equipped with moldboard power tilt, the extreme left hydraulic control valve is used.

2. If the scarifier cylinder is not to be removed, no action on the hydraulic circuit is required. However, if the scarifier cylinder is to be removed, it will be necessary to disconnect the hoses from the fittings on the grader frame nose side plates.

3. After identifying each hose with its corresponding fitting to ensure correct assembly, disconnect the hoses from the frame and cylinder. Plug the open ports.

4. Remove the two hexagon head bolts (8), pal nuts (36) and nuts (37) retaining each ball cap (6). Swing both lift link assemblies onto the ground, and remove the ball cap shims (38).

5. Attach suitable lifting tackle to both drawbars (43). Remove the capscrews (40) and lockwashers (41) retaining the draw pin keepers (42). Remove the two draw pins (39). Drive the grader ahead to disconnect the drawbars from the lugs.

6. Remove the two hexagon head bolts (28), pal nuts (33) and nuts (32) retaining each ball cap (29). Remove the two lift links (34) and ball cap shims (31).

7. Remove the bolt (35), nut (20) and lockwasher (19). Remove the lower ball stud (30), nut (23), lockwasher (22) and flatwasher (21). Lower the drawbar onto the ground.

8. Repeat step 7, preceding, for the other drawbar. Remove the drawbars and scarifier box assembly (25) away from the grader.

9. Remove the hexagon head bolt (5), nut (13) and lockwasher (14) retaining the piston rod to the arm assembly. Remove the hexagon head bolt (1), nut (4) and lockwasher (3) retaining the cylinder (2) to the frame. Remove the cylinder.

10. Remove the two nuts (18) and lockwashers (17) securing each U-bolt (11). Remove the U-bolts and pillow block upper halves (9).

11. Remove the arm assembly. Remove the pillow block lower halves (16), together with the pillow block shims (15).

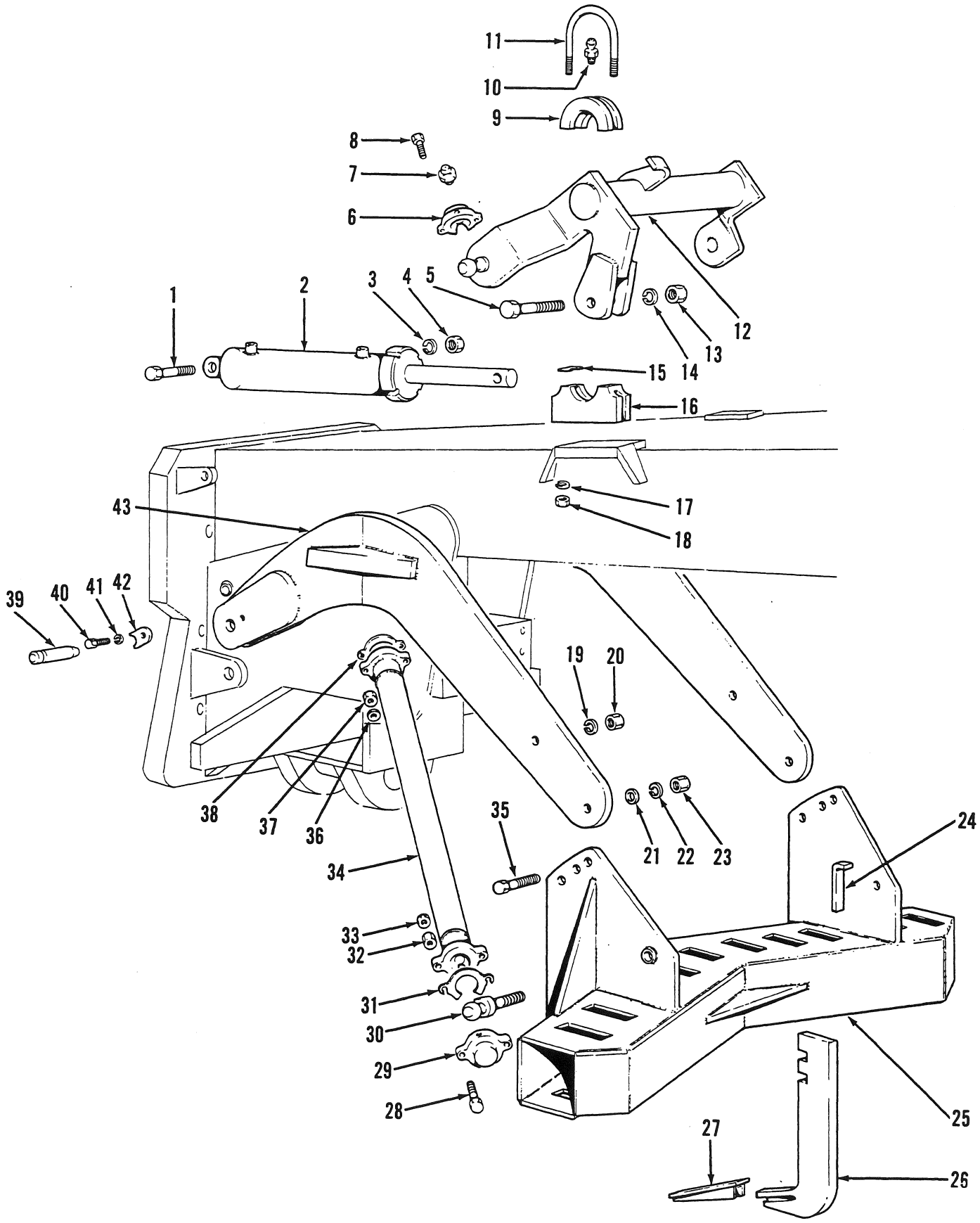

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Figure 1

ATTACHMENTS

REF. NO.	DESCRIPTION
1	3" LG. HEX. BOLT
2	CYLINDER
3	LOCKWASHER
4	NUT
5	3" LG. HEX. BOLT
6	BALL CAP
7	1/8" STRAIGHT GREASE FITTING
8	2 1/2" LG. HEX. BOLT
9	PILLOW BLOCK (UPPER HALF)
10	1/8" STRAIGHT GREASE FITTING
11	U-BOLT
12	ARM ASSY.
13	NUT
14	LOCKWASHER
15	SHIM - PILLOW BLOCK
16	PILLOW BLOCK (LOWER HALF)
17	LOCKWASHER
18	NUT
19	LOCKWASHER
20	NUT
21	FLATWASHER
22	LOCKWASHER
23	NUT
24	WEDGE
25	BOX ASSY.
26	TOOTH SHANK
27	TOOTH TIP
28	2 1/2" LG. HEX. BOLT
29	BALL CAP
30	LOWER BALL STUD
31	SHIM - BALL CAP
32	NUT
33	PAL NUT
34	LIFT LINK
35	3" LG. HEX. BOLT
36	PAL NUT
37	NUT
38	SHIM - BALL CAP
39	DRAW PIN
40	3/8" LG. HEX. CAPSCREW
41	LOCKWASHER
42	DRAW PIN KEEPER
43	DRAWBAR

KEY TO FIG. 1

NOTE:
Additional reinforcing has been incorporated on the drawbars and box assembly -effective serial number 9840. Refer to Service Bulletin No. 291. Also, a travel stop was introduced commencing at serial number 10035. Refer to Service Bulletin No. 296.

12. Assembly and Installation (Fig. 1). Using suitable lifting tackle, hoist the scarifier box assembly (25) and position under the grader frame neck.

13. Using a chain hoist, install the two drawbars (43), and retain to the scarifier box side plates with the hexagon head bolts (35), nuts (20) and lockwashers (19). Install the lower ball studs (30), nuts (23), lockwashers (22) and flatwasher (21). DO NOT tighten the hardware yet.

14. With the aid of the lifting tackle, maneuver the scarifier assembly until the clevis of the drawbars engage with the lugs on the nose plate. Install the two draw pins (39), tapered end first.

15. Liberally apply grease onto the bearing surfaces of the two pillow block lower halves (16). Place the pillow block lower halves into position on their brackets.

16. Install the arm assembly onto the pillow block lower halves. Install the pillow block shims (15) (six per block).

17. Liberally apply grease onto the bearing surfaces of the two pillow block upper halves (9). Install the pillow block upper halves, and secure with the U-bolts (11), nuts (18) and lockwashers (17).

18. Liberally apply grease onto the bearing surfaces of the ball caps (6 and 29), and to the mating parts of the two lift links (34).

19. Install the ball cap shims (38), and engage the lift link with the ball stud on the arm assembly. Install the ball cap and retain with the two hexagon head bolts (8), nuts (37) and pal nuts (36). Repeat this step for the other lift link.

20. Install the ball cap shims (31), and engage the lift link with the ball stud on the scarifier box assembly. Install the ball cap and retain with the two hexagon head bolts (28), nuts (32) and pal nuts (33). Repeat this step for the other lift link.

21. Using suitable lifting tackle, raise and lower the scarifier assembly to determine if there is any presence of binding at the ball studs and pillow blocks. If any binding occurs, add shims as necessary. Tighten all hardware.

22. Hoist the cylinder (2) in position, and engage the clevis of the cylinder with the lug on the nose plate. Retain the cylinder barrel with the hexagon head bolt (1), nut (4) and lockwasher (3). Retain the piston rod with the hexagon head bolt (5), nut (13) and lockwasher (14).

23. Install the draw pin keeper (42), and retain with the hexagon head capscrew (40) and lockwasher (41).

    NOTE:
    For new drawbars, it may be necessary to re-tap the 3/8 inch hole.

24. Re-connect the hydraulic hoses to the frame and cylinder, ensuring that each hose is connected to its corresponding fitting.

25. Install the tooth shanks (26), and retain with the wedges (24). Remove the lifting tackle.

26. Adjustments (Figs. 1 and 2). The pitch of the scarifier (1, Fig. 2) can be adjusted by removing the hexagon head bolts (35, Fig. 1), nuts (20, Fig. 1) and lockwashers (19, Fig. 1), aligning the drawbars with an alternative hole, and replacing the hardware.

27. For tooth working depth adjustment (2, Fig. 2), remove the wedges (24, Fig. 1) and move the tooth shank (26, Fig. 1) to an alternative notch engagement; then replace the wedges.

28. Worn tooth tips (27, Fig. 1) can be removed by drifting on the tip rear face (3, Fig. 2). Install new tips onto the shanks, and drive into position.

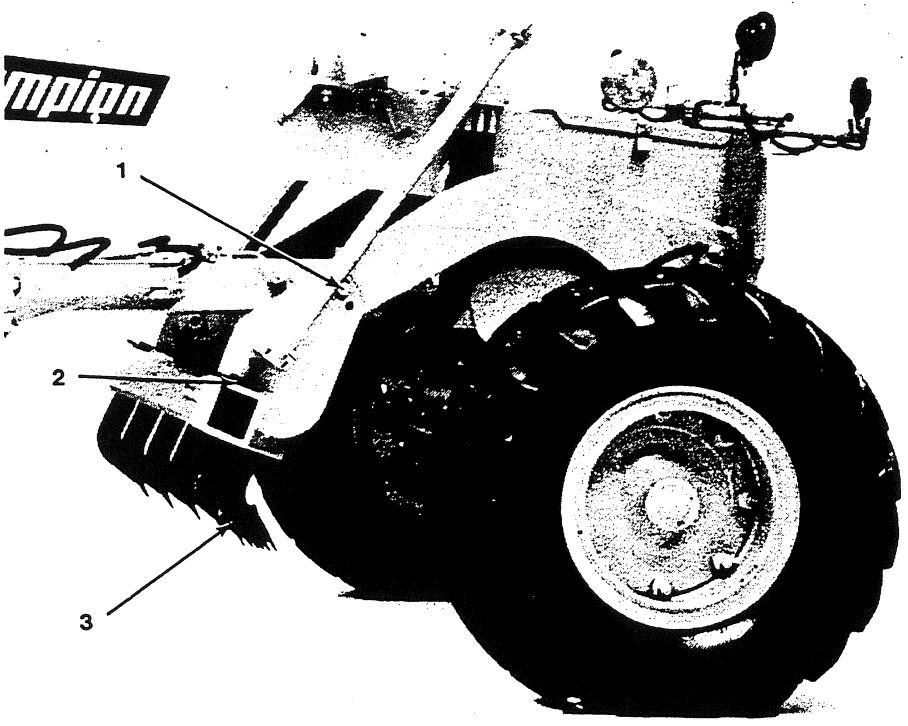

Figure 2

BULLDOZER

1. Removal and Disassembly (Fig. 3).

   WARNING:
   Before disconnecting any hydraulic hoses or fittings, lower the bulldozer blade onto the ground.

   The bulldozer hydraulic circuit is connected to the right hand side of the manifold valve either directly, or through a manually operated selector valve if a scarifier is installed.

2. If the bulldozer cylinder is not to be removed, no action on the hydraulic circuit is required. However, if the bulldozer cylinder is to be removed, it will be necessary to disconnect the hoses from the fittings on the grader nose side plates.

3. After identifying each hose with its corresponding fitting to ensure correct assembly, disconnect the hoses from the frame and cylinder. Plug the open ports.

4. Attach suitable lifting tackle to the bulldozer blade (1, 8 or 10). Remove the klipring fasteners (24 and 25) securing the pins (19 and 22) connecting the upper push arms (2) to the bulldozer blade and the yokes (13 and 14). Remove the pins and upper push arms.

5. Remove the klipring fasteners (25) securing the three pins (22) connecting the push frame (3) to the bulldozer blade. Remove the pins. Hoist the bulldozer blade away from the grader.

6. Remove the klipring fasteners (23) securing the two pins (17 and 18) connecting the lift link (6) to the push frame and yoke (5). Remove the pins and lift link.

7. Remove the klipring fasteners (24) securing the two pins (20) connecting the push frame to the A-frame (7). Remove the pins and the push frame.

8. Attach suitable lifting tackle to the yoke (5). Remove the klipring fasteners (23) securing the two pins (16 and 18) connecting the cylinder (12) to the A-frame and yoke. Remove the pins and cylinder.

9. Arrange the hoist in such a way that the lifting tackle will support the weight of the A-frame. Remove the four hexagon head bolts (30, 31 or 32), nuts (34) and lockwashers (33) retaining the left hand yoke (14) and right hand yoke (13). Remove the yokes and shims (15).

10. WARNING:
    Ensure that the A-frame is securely attached to the lifting tackle.

    Remove the four hexagon head bolts (29), nuts (34) and lockwashers (33). Lower the A-frame onto the ground. Remove the two klipring fasteners (24) securing the pin (21). Remove the pin and yoke. Hoist the A-frame away from the grader. Remove the lifting tackle.

11. Assembly and Installation (Fig. 3). Install the yoke (5) onto the A-frame (7), and retain with the pin (21). Secure the pin with two kliprings (24).

12. Attach suitable lifting tackle to the yoke. Hoist the yoke and A-frame into position on the grader nose plate. Install four hexagon head bolts (29), nuts (34) and lockwashers (33).

13. Place the cylinder (11) in position, and retain with the pins (18 and 16) at the yoke and the A-frame. Secure each pin with two kliprings (23). Remove the lifting tackle.

14. Install the left hand yoke (14), right hand yoke (13) and shims (15). Retain each yoke with two hexagon head bolts (30, 31 or 32), nuts (34) and lockwashers (33).

15. Place the push frame (3) into position at the A-frame attachment points. Install the two pins (20), and secure with the kliprings (24).

16. Install the lift link (6) between the push frame and yoke, and retain with the two pins (17 and 18). Secure each pin with two kliprings (23).

17. Attach suitable lifting tackle to the bulldozer blade (1, 8 or 10) and place into position at the push frame attachment points. Install the three pins (22), and secure with the kliprings (25).

18. Install the two upper push arms (2) at the right and left hand yokes. Install the two pins (19), and secure with the kliprings (24).

19. Connect the upper push arms with the bulldozer blade brackets. Install the two pins (22), and secure with the kliprings (25). Remove the lifting tackle.

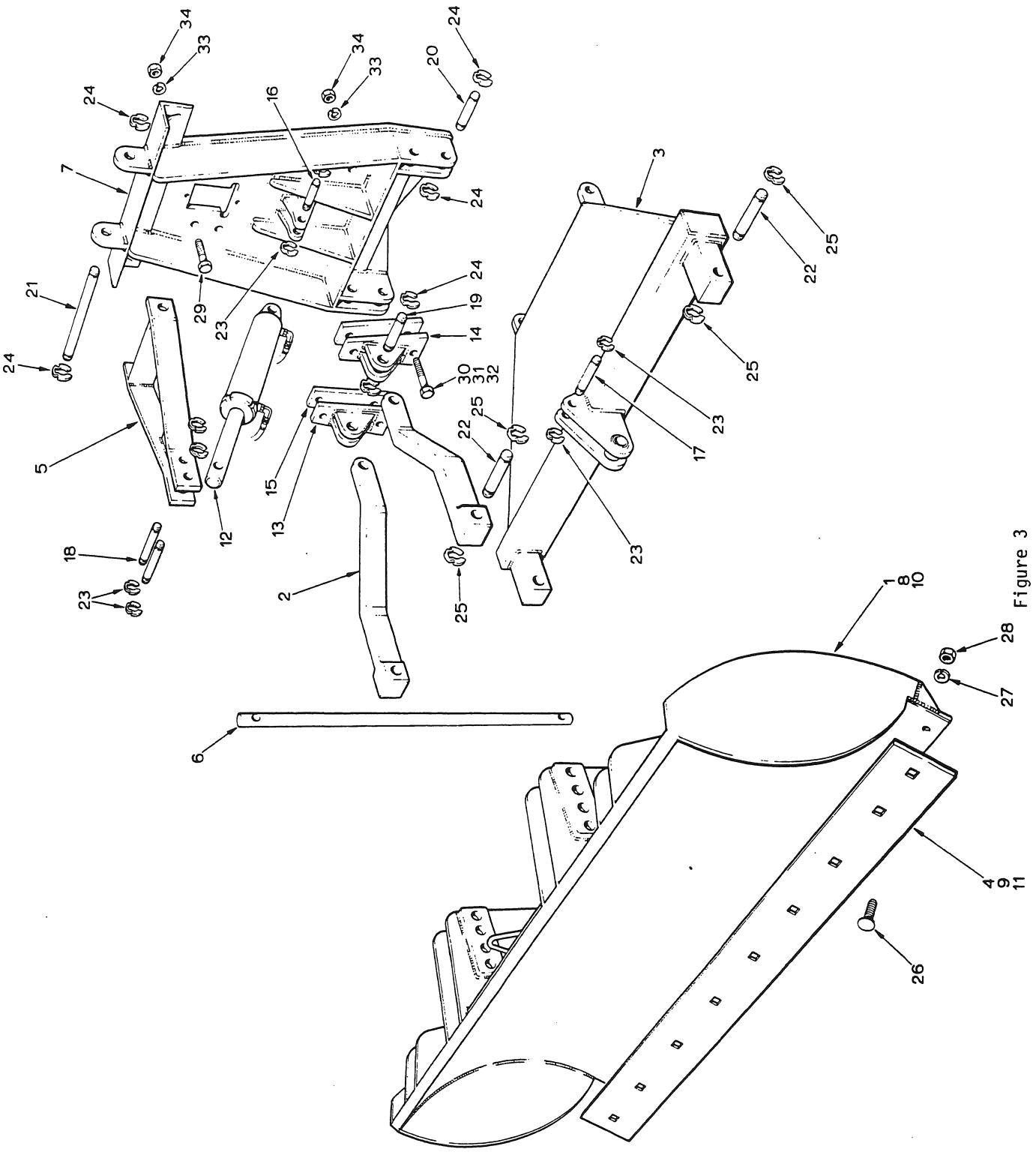
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Figure 3

REF. NO.	DESCRIPTION
1	8 FT. BULLDOZER BLADE
2	UPPER PUSH ARM
3	PUSH FRAME
4	8 FT. EDGE
5	YOKE
6	LIFT LINK
7	A-FRAME
8	9 FT. BULLDOZER BLADE
9	9 FT. EDGE
10	10 FT. BULLDOZER BLADE
11	10 FT. EDGE
12	CYLINDER
13	YOKE - R.H.
14	YOKE - L.H.
15	SHIM
16	1" DIA. X 4 1/4" LG. PIN
17	1" DIA. X 4 1/2" LG. PIN
18	1" DIA. X 5 3/4" LG. PIN
19	1 1/4" DIA. X 4 1/4" LG. PIN
20	1 1/4" DIA. X 5" LG. PIN
21	1 1/4" DIA. X 19" LG. PIN
22	1 1/2" DIA. X 8 1/4" LG. PIN
23	KLIPRING FASTENER
24	KLIPRING FASTENER
25	KLIPRING FASTENER
26	2 1/2" LG. CARRIAGE BOLT
27	LOCKWASHER
28	NUT
29	4 1/2" LG. HEX. HD. BOLT
30	6 1/2" LG. HEX. HD. BOLT
31	7" LG. HEX. HD. BOLT
32	8 1/2" LG. HEX. HD. BOLT
33	LOCKWASHER
34	NUT

KEY TO FIG. 3

20. Re-connect the hydraulic hoses to the frame and cylinder, ensuring that each hose is connected to its corresponding fitting.

21. Adjustments (Figs. 3 and 4). The blade pitch can be varied by removing the upper push arm pins, tilting the blade to the desired angle; then installing the pins in the nearest alternative holes (1, Fig. 4).

22. Worn edges (4, 9 or 11, Fig. 3) can be replaced by removing the required quantity of carriage bolts (26, Fig. 3), nuts (28, Fig. 3), and lockwashers (27, Fig. 3); then removing the edge.

23. Install a new edge, and retain with the carriage bolts, nuts and lockwashers.

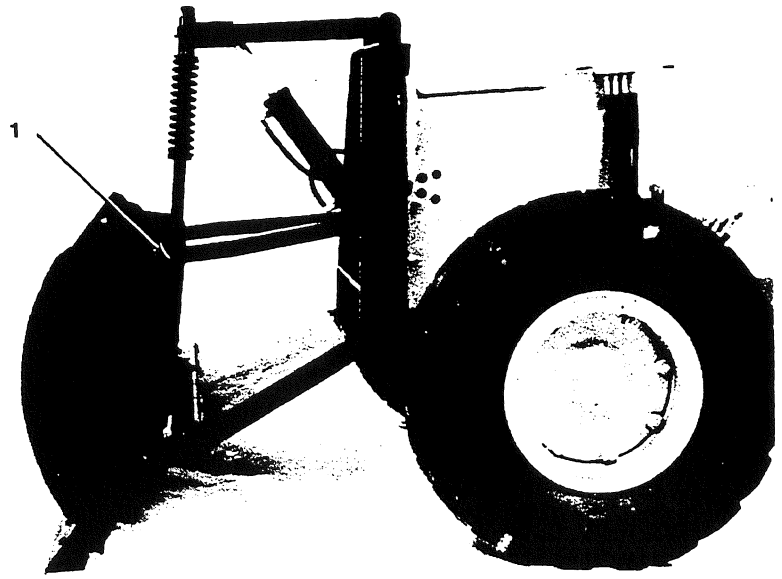

Figure 4

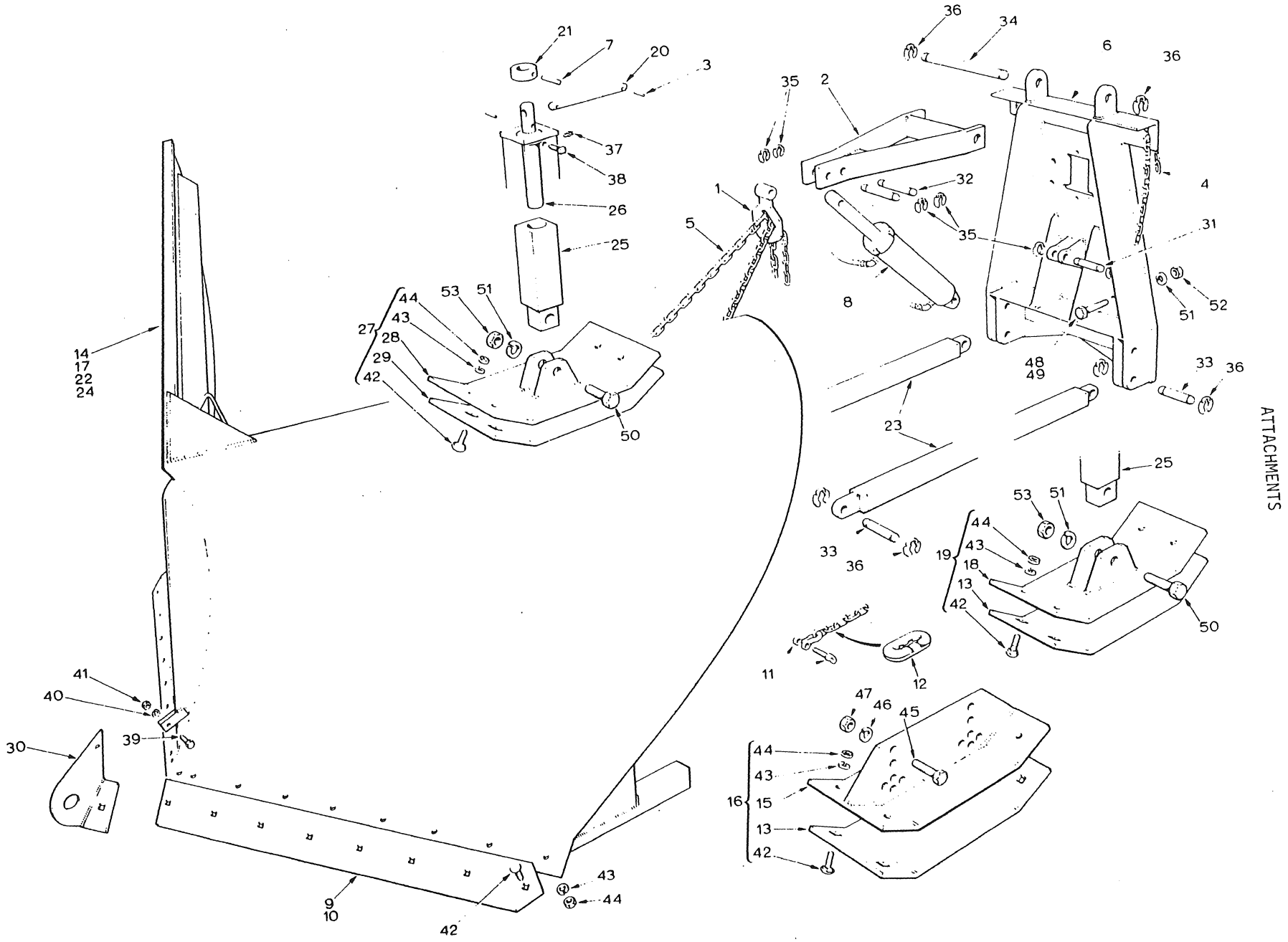
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Figure 5

REF. NO.	DESCRIPTION
1	SPADE
2	YOKE
3	1/4" X 1 1/4" LG. ROLL PIN
4	CHAIN - 90" LG.
5	CHAIN - 150" LG.
6	A-FRAME
7	3/8" X 2" LG. ROLL PIN
8	CYLINDER
9	EDGE - 9 FT. PLOW
10	EDGE - 10 FT. PLOW
11	SHACKLE
12	SPLICE LINK
13	OUTER SHOE
14	9 FT. V-PLOW - STANDARD SHOE TYPE
15	INNER SHOE
16	SHOE ASSY. - STANDARD
17	9 FT. V-PLOW - ADJUSTABLE SHOE TYPE
18	INNER SHOE
19	SHOE ASSY. - REAR
20	HANDLE - ADJUSTING SCREW
21	STOP RING
22	10 FT. V-PLOW - STANDARD SHOE TYPE
23	PUSH ROD
24	10 FT. V-PLOW -ADJUSTABLE SHOE TYPE
25	SWIVEL EXTENSION
26	ADJUSTING SCREW
27	SHOE ASSY. - FRONT
28	INNER SHOE
29	OUTER SHOE
30	NOSE PIECE
31	1" DIA. X 4 1/4" LG. PIN
32	1" DIA. X 5 3/4" LG. PIN
33	1 1/4" DIA. X 5" LG. PIN
34	1 1/4" DIA. X 19" LG. PIN
35	KLIPRING FASTENER
36	KLIPRING FASTENER
37	STRAIGHT GREASE FITTING
38	1 1/2" LG. SQ. HD. SET SCREW
39	2" LG. HEX. HD. BOLT
40	LOCKWASHER
41	NUT
42	2 1/4" LG. CARRIAGE BOLT
43	LOCKWASHER
44	NUT
45	2 1/2" LG. HEX. HD. BOLT
46	LOCKWASHER
47	NUT
48	4 1/2" LG. HEX. HD. BOLT
49	6 1/2" LG. HEX. HD. BOLT
50	4" LG. HEX. HD. BOLT
51	LOCKWASHER
52	NUT
53	NUT

KEY TO FIG. 5

V-PLOW (CHAIN LIFT)

1. Removal and Disassembly (Fig. 5).

   WARNING:
   Before disconnecting any hydraulic hoses or fittings, lower the V-plow onto the ground.

   The V-plow hydraulic circuit is connected to the right hand side of the manifold valve either directly, or through a manually operated selector valve if a scarifier is installed.

2. If the V-plow cylinder is not to be removed, no action on the hydraulic circuit is required. However, if the V-plow cylinder is to be removed, it will be necessary to disconnect the hoses from the fittings on the grader nose side plates.

3. After identifying each hose with its corresponding fitting to ensure correct assembly, disconnect the hoses from the frame and cylinder. Plug the open ports.

4. Attach suitable lifting tackle to the V-plow blade (14, 17, 22 or 24). Remove the chains (4 and 5) from the spade (1) and the A-frame. Remove the klipring fasteners (36) securing the pins (33) connecting the push rods (23) to the V-plow blade frame. Remove the pins. Hoist the V-plow blade away from the grader.

5. Remove the klipring fasteners (36) securing the pins (33) connecting the push rods to the A-frame (6). Remove the pins and the push rods.

6. Attach suitable lifting tackle to the yoke (2). Remove the klipring fasteners (35) securing the pin (32) connecting the spade to the yoke. Remove the pin and spade.

7. Remove the klipring fasteners (35) securing the two pins (31 and 32) connecting the cylinder (8) to the A-frame and yoke. Remove the pins and cylinders.

8. Arrange the hoist in such a way that the lifting tackle will support the weight of the A-frame. Remove the eight hexagon head capscrews (48 or 49), nuts (52) and lockwashers (51). Lower the A-frame onto the ground. Remove the two klipring fasteners (36) securing the pin (34). Remove the pin and the yoke. Hoist the A-frame away from the grader. Remove the lifting tackle.

9. Assembly and Installation (Fig. 5). Install the yoke (2) onto the A-frame (6), and retain with the pin (34). Secure the pin with two klipprings (36).

10. Attach suitable lifting tackle to the yoke. Hoist the yoke and A-frame into position on the grader nose plate. Install the eight hexagon head bolts (48 or 49), nuts (52) and lockwashers (51).

11. Place the cylinder (8) in position, and retain with the pins (32 and 31) at the yoke and the A-frame. Secure each pin with two kliprings (35). Remove the lifting tackle.

12. Install the spade (1), and retain with the pin (32). Secure the pin with two kliprings (35).

13. Place the push rods (23) into position at the A-frame attachment points. Install the two pins (33), and secure with the kliprings (36).

14. Attach suitable lifting tackle to the V-plow blade (14, 17, 22 or 24) and place into position at the push rod attachment points. Install the two pins (33), and secure with the kliprings (36). Install the four chains (4 and 5), to the spade and the A-frame. Remove the lifting tackle.

15. Re-connect the hydraulic hoses to the frame and cylinder, ensuring that each hose is connected to its corresponding fitting.

16. Adjustments (Figs. 5, 6 and 7). The plow shoes should be adjusted so that the edges of the plow are high enough to prevent scraping the road surface (1, Fig. 6). Two types of shoe adjustment are available as follows:

    a. Standard Shoes. Four standard shoes (16, Fig. 5) - two front, two rear are retained on the V-plow blade frame by two hexagon head bolts (45, Fig. 5), nuts (47, Fig. 5) and lockwashers (46, Fig. 5) per shoe. Adjustment is effected by raising the V-plow blade off the ground, removing the hardware, selecting the new position and installing the hardware into the alternative holes. Lower the blade.

    b. Optional Shoes. Three shoes - one front (27, Fig. 5), two rear (19, Fig. 5) - are available as an optional arrangement, and are connected to an adjustment screw and swivel assembly by one hexagon head bolt (50, Fig. 5), nut (53, Fig. 5) and lockwasher (51, Fig. 5) per shoe. Adjustment is effected by raising the V-plow blade off the ground and turning the adjusting screw handle (20, Fig. 5) until the desired height is obtained. Lower the blade.

17. If the V-plow blade tends to tip to one side or the other when being raised or lowered, remove any slack in the chains (4, Fig. 5) by adjusting at the A-frame slots. Similarly, remove any slack in the chains (5, Fig. 5) by adjusting at the spade slots until a level movement is obtained (1, Fig. 7).

18. Worn edges (9 or 10, Fig. 5) can be replaced by removing the required quantity of carriage bolts (42, Fig. 5), nuts (44, Fig. 5) and lockwashers (43, Fig. 5); then removing the edges.

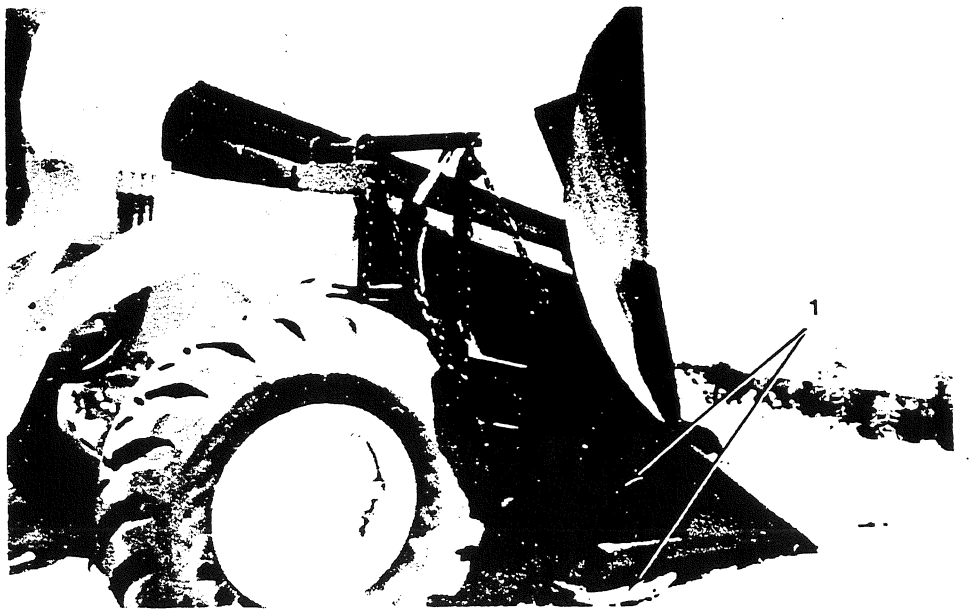

Figure 6

19. Install a new edge, and retain with the carriage bolts, nuts and lockwashers.

20. Worn outer shoes (13 and 29, Fig. 5) can be replaced by removing the required quantity of carriage bolts (42, Fig. 5), nuts (44, Fig. 5) and lockwashers (43, Fig. 5); then removing the outer shoe.

21. Install a new outer shoe, and retain with the carriage bolts, nuts and lockwashers.

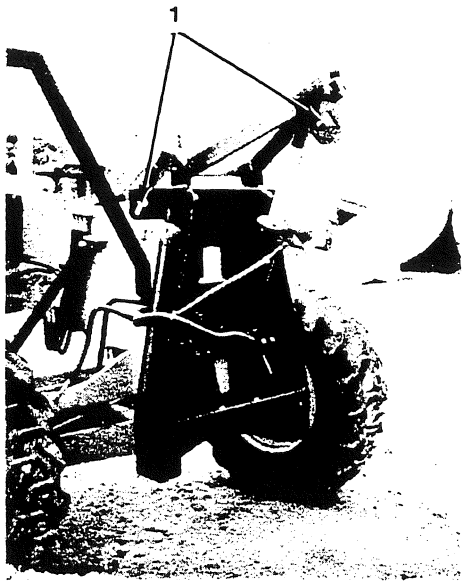

Figure 7

V-PLOW (DOWN PRESSURE)

1. Removal and Disassembly (Fig. 8).

   WARNING:
   Before disconnecting any hydraulic hoses or fittings, lower the V-plow blade onto the ground.

   The V-plow hydraulic circuit is connected to the right hand side of the manifold valve either directly, or through a manually operated selector valve if a scarifier is installed.

2. If the V-plow cylinder is not to be removed, no action on the hydraulic circuit is required. However, if the V-plow cylinder is to be removed, it will be necessary to disconnect the hoses from the fittings on the grader nose side plates.

3. After identifying each hose with its corresponding fitting to ensure correct assembly, disconnect the hoses from the frame and cylinder. Plug the open ports.

4. Attach suitable lifting tackle to the V-plow blade (19, 22, 27 or 28). Remove the klipring fasteners (43 and 42) securing the pins (40 and 37) connecting the upper push arms (1) to the V-plow blade frame and the yokes (12 and 13). Remove the pins and upper push arms.

5. Remove the klipring fasteners (43) securing the three pins (40) connecting the push frame (2) to the V-plow blade frame. Remove the pins. Hoist the V-plow blade away from the grader.

6. Remove the two kliprings (41) securing the pin (36). Remove the lift link (4) from the push frame. Remove the nut and jam nut (65) and two flatwashers (64). Remove the lift link, together with the spring (16) and collar (6).

7. Remove the klipring fasteners (42) securing the two pins (38) connecting the push frame to the A-frame (9). Remove the pins and the push frame.

8. Attach suitable lifting tackle to the yoke (3). Remove the two hexagon head bolts (59), nuts (62) and lockwashers (61). Lower the cylinder (11). Remove the two yoke extensions (7), together with the sleeve (5).

9. Remove the two kliprings (41) securing the pin (35). Remove the pin and cylinder.

10. Arrange the hoist in such a way that the lifting tackle will support the weight of the A-frame. Remove the four hexagon head bolts (56, 57 or 58), nuts (62) and lockwashers (61) retaining the left hand yoke (13) and right hand yoke (12). Remove the yokes and shims (17).

11. WARNING:
    Ensure that the A-frame is securely attached to the lifting tackle.

    Remove the four hexagon head bolts (55), nuts (62) and lockwashers (61). Lower the A-frame onto the ground. Remove the two klipring fasteners (42) securing the pin (39). Remove the pin and the yoke. Hoist the A-frame away from the grader. Remove the lifting tackle.

12. Assembly and Installation (Fig. 8). Install the yoke (3) onto the A-frame (9), and retain with the pin (39). Secure the pin with two kliprings (42).

13. Attach suitable lifting tackle to the yoke. Hoist the yoke and A-frame into

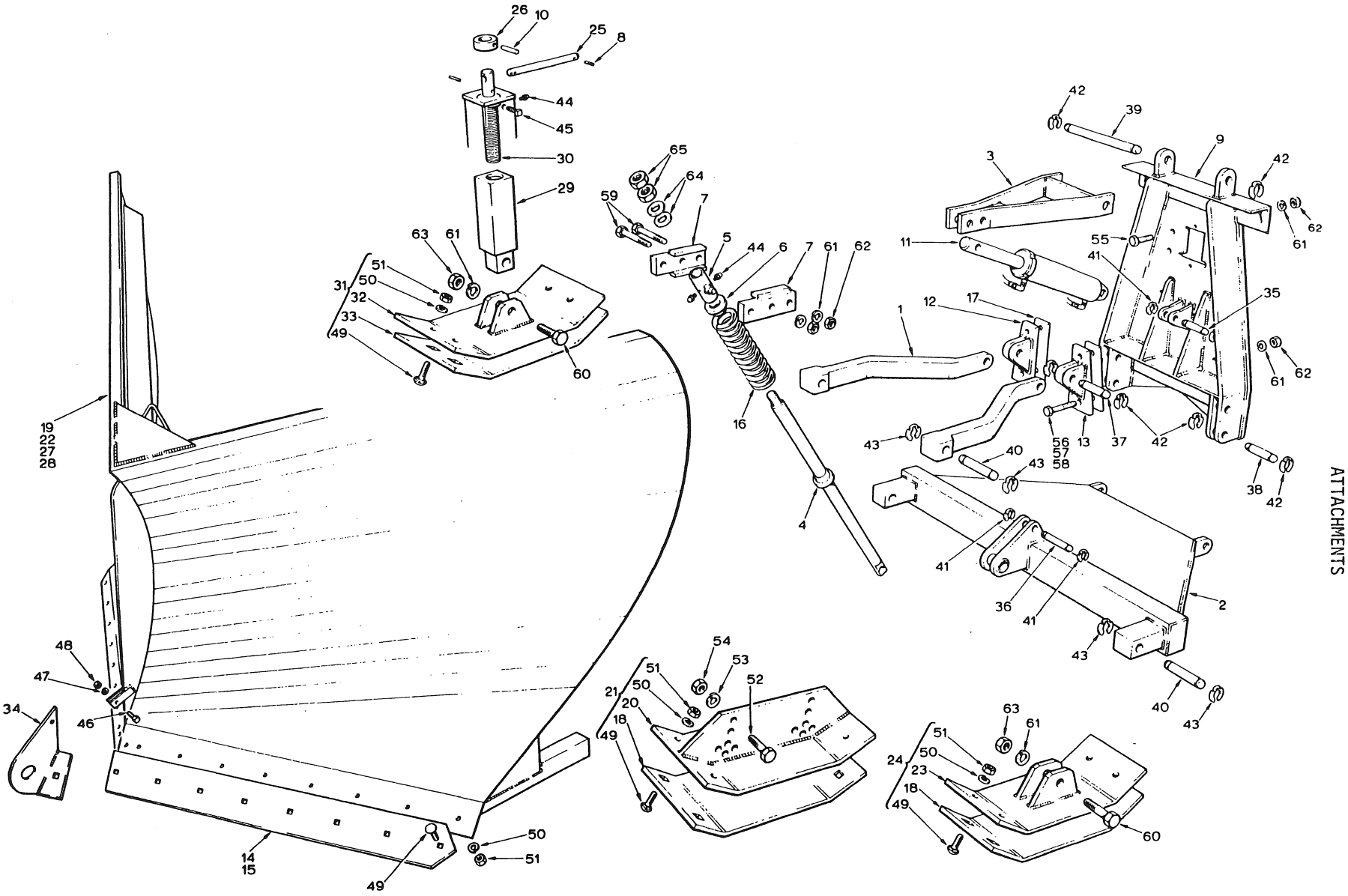
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Figure 8

REF. NO.	DESCRIPTION
1	UPPER PUSH ARM
2	PUSH FRAME
3	YOKE
4	LIFT LINK
5	SLEEVE
6	COLLAR
7	YOKE EXTENSION
8	1/4" X 1 1/4" LG. ROLL PIN
9	A-FRAME
10	3/8" X 2" LG. ROLL PIN
11	CYLINDER
12	YOKE - R.H.
13	YOKE - L.H.
14	EDGE - 9 FT. PLOW
15	EDGE - 10 FT. PLOW
16	SPRING
17	SHIM
18	OUTER SHOE
19	9 FT. V-PLOW - STANDARD SHOE TYPE
20	INNER SHOE
21	SHOE ASSY. - STANDARD
22	9 FT. V-PLOW - ADJUSTABLE SHOE TYPE
23	INNER SHOE
24	SHOE ASSY. - REAR
25	HANDLE - ADJUSTING SCREW
26	STOP RING
27	10 FT. V-PLOW - STANDARD SHOE TYPE
28	10 FT. V-PLOW - ADJUSTABLE SHOE TYPE
29	SWIVEL EXTENSION
30	ADJUSTING SCREW
31	SHOE ASSY. - FRONT
32	INNER SHOE
33	OUTER SHOE

REF. NO.	DESCRIPTION
34	NOSE PIECE
35	1" DIA. X 4 1/4" LG. PIN
36	1" DIA. X 4 1/2" LG. PIN
37	1 1/4" DIA. X 4 1/4" LG. PIN
38	1 1/4" DIA. X 5" LG. PIN
39	1 1/4" DIA. X 19" LG. PIN
40	1 1/2" DIA. X 8 1/4" LG. PIN
41	KLIPRING FASTENER
42	KLIPRING FASTENER
43	KLIPRING FASTENER
44	STRAIGHT GREASE FITTING
45	1 1/2" SQ. HD. SET SCREW
46	2" LG. HEX. HD. BOLT
47	LOCKWASHER
48	NUT
49	2 1/4" CARRIAGE BOLT
50	LOCKWASHER
51	NUT
52	2 1/2" LG. HEX. HD. BOLT
53	LOCKWASHER
54	NUT
55	4 1/2" LG. HEX. HD. BOLT
56	6 1/2" LG. HEX. HD. BOLT
57	7" LG. HEX. HD. BOLT
58	8 1/2" LG. HEX. HD. BOLT
59	8" LG. HEX. HD. BOLT
60	4" LG. HEX. HD. BOLT
61	LOCKWASHER
62	NUT
63	NUT
64	FLATWASHER
65	NUT

KEY TO FIG. 8

position on the grader nose plate. Install the four hexagon head bolts (55), nuts (62) and lockwashers (61).

14. Place the cylinder at its position on the A-frame, and retain with the pin (35). Secure the pin with two kliprings (41).

15. Lower the yoke. Install the two yoke extensions (7), together with the sleeve (5) - engaging the trunnion pins in the front holes. Align the cylinder piston rod with the rear holes of the yoke. Install the two hexagon head bolts (59), nuts (62) and lockwashers (61).

16. Install the left hand yoke (13), right hand yoke (12) and shims (17). Retain each yoke with two hexagon head bolts (56, 57 or 58), nuts (62) and lockwashers (61).

17. Place the push frame (2) into position at the A-frame attachment points. Install the two pins (38) and secure with the kliprings (42).

18. Install the spring (16) and collar (6) onto the lift link (4). Insert the lift link through the sleeve, and secure with the nut and jam nut (65) and two flatwashers (64). Install the lower end of the lift link at the push frame, and retain with the pin (36). Secure the pin with two kliprings (41).

19. Attach suitable lifting tackle to the V-plow blade (19, 22, 27 or 28), and place into position at the push frame attachment points. Install the three pins (40), and secure with the kliprings (43).

20. Install the two upper push arms (1) at the right and left hand yokes. Install the two pins (37), and secure with the kliprings (42).

21. Connect the upper push arms with the V-plow blade frame. Install the two pins (40), and secure with the kliprings (43). Remove the lifting tackle.

22. Re-connect the hydraulic hoses to the frame and cylinder, ensuring that each hose is connected to its corresponding fitting.

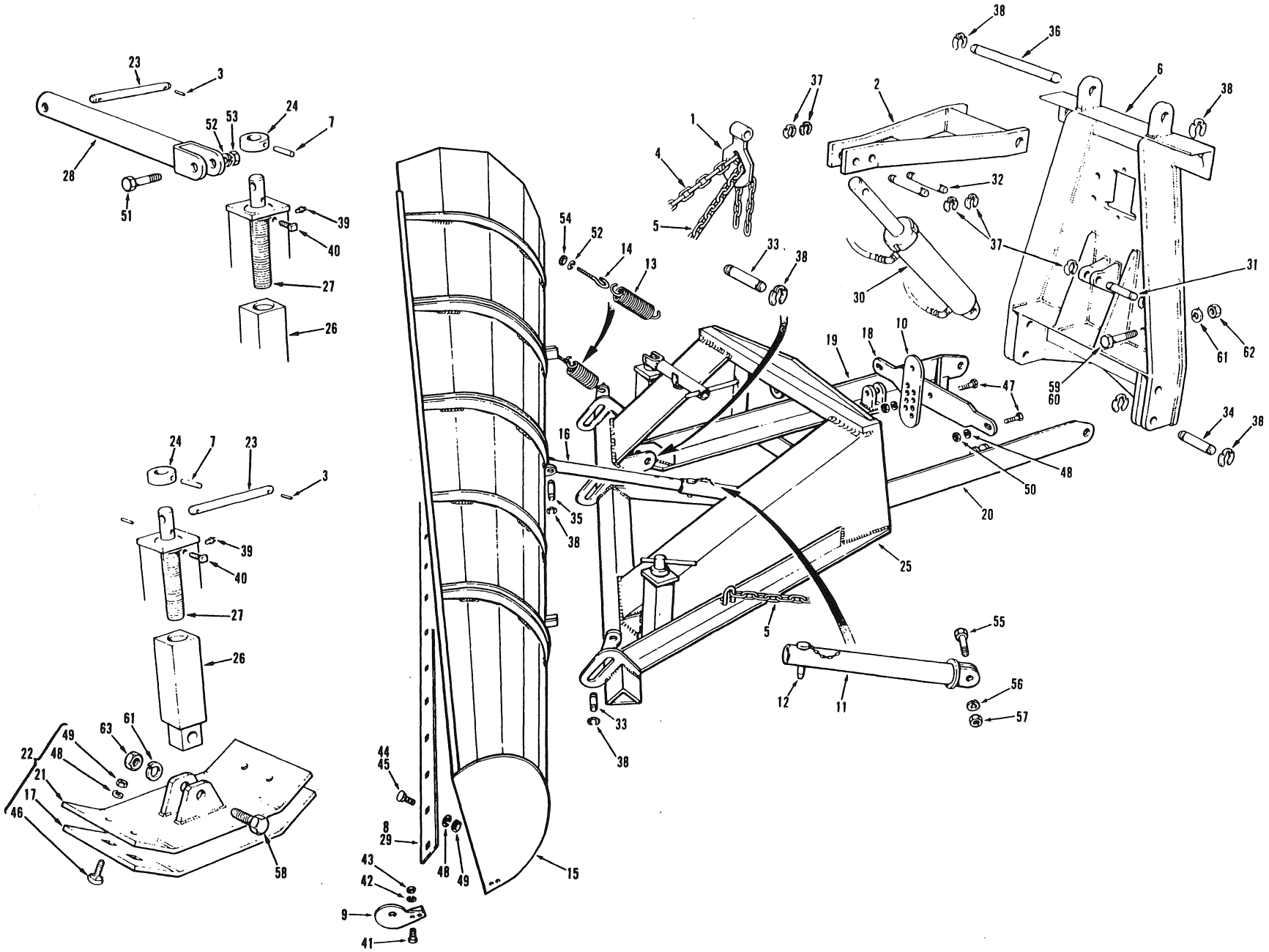
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Figure 9

REF. NO.	DESCRIPTION
1	SPADE
2	YOKE
3	1/4" DIA. X 1 1/4" LG. ROLL PIN
4	CHAIN - 72" LG.
5	CHAIN - 84" LG.
6	A-FRAME
7	3/8" DIA. X 2" LG. ROLL PIN
8	EDGE
9	NOSE PIECE
10	STABILIZER BAR
11	ADJUSTING LINK - OUTER
12	SHEAR PIN
13	SPRING
14	EYE BOLT
15	MOLDBOARD
16	ADJUSTING LINK - INNER
17	OUTER SHOE
18	CROSS BAR
19	SHORT PUSH ROD - R.H.
20	LONG PUSH ROD - L.H.
21	INNER SHOE
22	SHOE ASSY. - ADJUSTABLE
23	HANDLE - ADJUSTING SCREW
24	STOP RING
25	PUSH FRAME
26	SWIVEL EXTENSION
27	ADJUSTING SCREW
28	SCREW EXTENSION
29	EDGE
30	CYLINDER
31	1" DIA. X 4 1/4" LG. PIN
32	1" DIA. X 5 3/4" LG. PIN
33	1 1/4" DIA. X 4 1/2" LG. PIN
34	1 1/4" DIA. X 5" LG. PIN
35	1 1/4" DIA. X 5 1/4" LG. PIN
36	1 1/4" DIA. X 19" LG. PIN
37	KLIPRING FASTENER
38	KLIPRING FASTENER
39	STRAIGHT GREASE FITTING
40	1 1/2" LG. SQ. HD. SET SCREW
41	1 3/4" LG. HEX. HD. BOLT
42	LOCKWASHER
43	NUT
44	2" LG. CARRIAGE BOLT
45	2" LG. PLOW BOLT
46	2 1/4" LG. CARRIAGE BOLT
47	2 1/2" LG. HEX. HD. BOLT
48	LOCKWASHER
49	NUT
50	NUT
51	2 3/4" LG. HEX. HD. BOLT
52	LOCKWASHER
53	NUT
54	NUT
55	3" LG. HEX. HD. BOLT
56	LOCKWASHER
57	NUT
58	4" LG. HEX. HD. BOLT
59	4 1/2" LG. HEX. HD. BOLT
60	6 1/2" LG. HEX. HD. BOLT
61	LOCKWASHER
62	NUT
63	NUT

KEY TO FIG. 9

23. Adjustments (Fig. 8). The plow shoes should be adjusted so that the edges of the plow are high enough to prevent scraping the road surface. Two types of shoe adjustments are available as follows:

    a. Standard Shoes. Four standard shoes (21) - two front, two rear - are retained on the V-plow blade frame by two hexagon head bolts (52), nuts (54) and lockwashers (53) per shoe. Adjustment is effected by raising the V-plow blade off the ground, removing the hardware, selecting the new position and installing the hardware into the alternative holes. Lower the blade.

    b. Optional Shoes. Three shoes - one front (31), two rear (24) - are available as an optional arrangment, and are connected to an adjustment screw and swivel assembly by one hexagon head bolt (60), nut (63) and lockwasher (61) per shoe. Adjustment is effected by raising the V-plow blade off the ground and turning the adjusting screw handle (25) until the desired height is obtained. Lower the blade.

24. Worn edges (14 or 15) can be replaced by removing the required quantity of carriage bolts (49), nuts (51) and lockwashers (50); then removing the edges.

25. Install a new edge, and retain with the carriage bolts, nuts and lockwashers.

26. Worn outer shoes (18 and 33) can be replaced by removing the required quantity of carriage bolts (49), nuts (51) and lockwashers (50); the removing the outer shoe.

27. Install a new outer shoe, and retain with the carriage bolts, nuts and lockwashers.

ONE-WAY PLOW

1. Removal and Disassembly (Fig. 9).

    WARNING:
    Before disconnecting any hydraulic hoses or fittings, lower the one-way plow onto the ground.

    The one-way plow hydraulic circuit is connected to the right hand side of the manifold valve either directly, or through a manually operated selector valve if a scarifier is installed.

2. If the one-way plow cylinder is not to be removed, no action on the hydraulic circuit is required. However, if the one-way plow cylinder is to be removed, it will be necessary to disconnect the hoses from the fittings on the grader nose side plates.

3. After identifying each hose with its corresponding fitting to ensure correct assembly, disconnect the hoses from the frame and cylinder. Plug the open ports.

4. Attach suitable lifting tackle to the one-way snow plow blade (15). Remove the two kliprings (38) securing the pin (35) connecting the inner adjusting link (16) to the snow plow blade frame bracket. Remove the nuts (54) and lockwashers (52) securing the eyebolts (14) and springs (13).

5. Remove the kliprings (38) securing the pins (33) connecting the push frame (25) to the snow plow blade frame. Remove the pins. Hoist the one-way snow plow blade away from the grader.

6. Remove the kliprings (38) securing the pins (34) connecting the long and short push bars (20 and 19) to the A-frame (6). Remove the pins. Remove the two chains (4, 5) from the spade (1). Hoist the push frame away from the grader.

7. Remove the hexagon head bolt (55), nut (57) and lockwasher (56) securing the outer adjusting link (11) to the push frame. The inner and outer adjusting links can be separated by removing the shear pin (12).

8. Remove the hexagon head bolt (47), nut (50) and lockwasher (48) securing the stabilizer bar (18) to the vertical adjustment bar (10). Remove the hexagon head bolt, nut and lockwasher securing the vertical adjustment bar to the push frame.

9. Remove the two hexagon head bolts (47), nuts (50) and lockwashers (48) securing the stabilizer bar to the long and short push bars. Remove the kliprings (38) securing the pins (33) connecting the push bars to the push frame. Remove the pins and push bars.

10. Attach suitable lifting tackle to the yoke (2). Remove the klipring fasteners (37) securing the pin (32) connecting the spade to the yoke. Remove the pin and spade.

11. Remove the klipring fasteners (32) securing the two pins (31 and 32) connecting the cylinder (30) to the A-frame and yoke. Remove the pins and cylinder.

12. WARNING:
Ensure that the A-frame is securely attached to the lifting tackle.

Arrange the hoist in such a way that the lifting tackle will support the weight of the A-frame. Remove the eight hexagon head bolts (59 or 60), nuts (62) and lockwashers (61). Lower the A-frame onto the ground. Remove the two klipring fasteners (38) securing the pin (36). Remove the pin and the yoke. Hoist the A-frame away from the grader. Remove the lifting tackle.

13. Assembly and Installation (Fig. 9). Install the yoke (2) onto the A-frame (6), and retain with the pin (36). Secure the pin with two kliprings (38).

14. Attach suitable lifting tackle to the yoke. Hoist the yoke and A-frame into position on the grader nose plate. Install the eight hexagon head bolts (59 or 60), nuts (62) and lockwashers (61).

15. Place the cylinder (30) in position, and retain with the pins (31 and 32) at the yoke and the A-frame. Secure each pin with two kliprings (37). Remove the lifting tackle.

16. Install the spade (1), and retain with the pin (32). Secure the pin with two kliprings (37).

17. Place the long and short push bars (20 and 19) (left hand side and right hand side, respectively) into position at the push frame. Install the two pins (33), and secure with the kliprings (38).

18. Install the stabilizer bar (18), and secure to the push bars with the two hexagon head capscrews (47), nuts (50) and lockwashers (48).

19. Install the vertical adjustment bar (10), and secure with the hexagon head bolt (47), nut (50) and lockwasher (48). Secure the stabilizer bar to the vertical adjustment bar with the hexagon head bolt, nut and lockwasher.

20. Insert the inner adjusting link (16) into the outer adjusting link (11), and secure with the shear pin (12). Secure the outer adjusting link to the push frame with the hexagon head bolt (55), nut (57) and lockwasher (56).

21. Attach suitable lifting tackle to the push frame (25) and place in position at the A-frame attachment points. Install the two pins (34), and secure with the kliprings (38). Remove the lifting tackle.

22. Attach the hoist to the one-way snow plow blade (15) and place into position at the push frame attachment points. Install the three pins (33), and secure with the kliprings (38).

23. Install the eyebolts (14) and springs (13), and secure with the nuts (54) and lockwashers (52). Install the two chains (4, 5) into the slots of the spade. Secure the inner adjusting link with the pin (35), and install the two kliprings (38). Remove the lifting tackle.

24. Re-connect the hydraulic hoses to the frame and cylinder, ensuring that each hose is connected to its corresponding fitting.

25. Adjustments (Figs. 9 and 10). The plow shoes should be adjusted so that the edge of the plow is high enough to prevent scraping the road surface.

26. Two shoes (22, Fig. 9) are connected to an adjustment screw and swivel assembly by one hexagon head bolt (58, Fig. 9), nut (63, Fig. 9) and lockwasher (61, Fig. 9) per shoe. Adjustment is effected by raising the one-way plow blade off the ground and turning the adjusting screw handle (23, Fig. 9) until the desired height is obtained (4, Fig. 10). Lower the blade.

27. The blade pitch can be varied by removing the shear pin connecting the inner and outer adjusting link, tilting the blade to the desired angle; then installing the shear pin in the alternative hole (3, Fig. 10).

28. If the one-way plow tends to tip to one side or the other when being raised or lowered, remove any slack in the chains by adjusting at the spade slots until a level movement is obtained (1, Fig. 10).

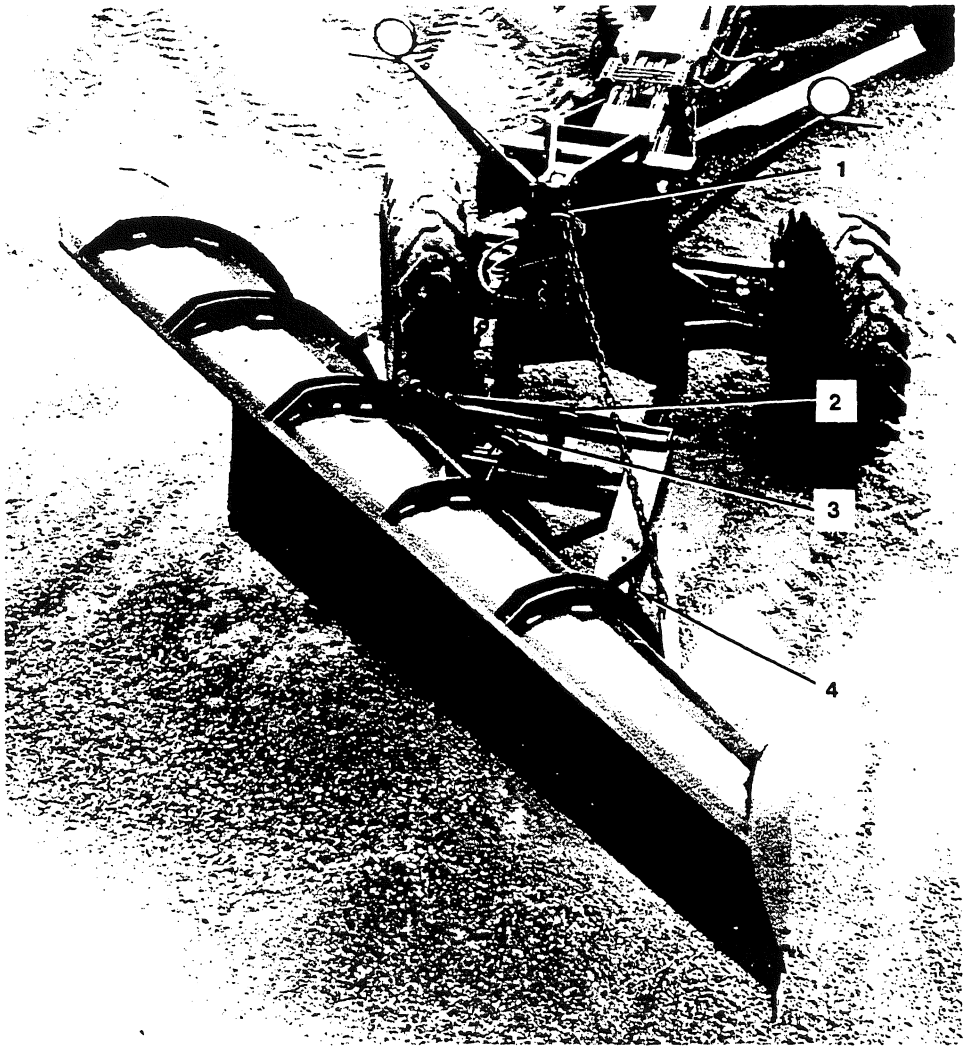


Figure 10

29. To accommodate for differences in tire sizes, position the stabilizer bar to suit these conditions, and install the hardware in the appropriate hole of the vertical adjustment bar (2, Fig. 10).

30. A worn edge (8 or 29, Fig. 9) can be replaced by removing the quantity of carriage bolts (44 and 45, Fig. 9), nuts (49, Fig. 9) and lockwashers (48, Fig. 9); then removing the edge.

31. Install a new edge, and retain with the carriage bolts, nuts and lockwashers.

32. Worn outer shoes (17, Fig. 9) can be replaced by removing the required quantity of carriage bolts (46, Fig. 9), nuts (49, Fig. 9) and lockwashers (48, Fig. 9); then removing the outer shoe.

33. Install a new outer shoe, and retain with the carriage bolts, nuts and lockwashers.

RIPPER

1. Removal and Disassembly (Fig. 11).

    WARNING:
    Before disconnecting any hydraulic hoses or fittings, lower the ripper onto the ground.

    The ripper is controlled by a single solenoid valve mounted on the rear of the grader. Identify and disconnect the hoses from the cylinders, and the hose from the solenoid valve to the pressure relief valve located beneath the hydraulic tank.

2. Identify and disconnect the pressure hose, from the solenoid valve to the manifold valve supply hose, at the union fitting. Connect the manifold valve supply hose to the tee fitting at the pressure relief valve. Remove the electrical connections to the solenoid valve, and temporarily attach the wire harness to the grader frame.

3. Attach suitable lifting tackle to both sides of the ripper box (1). Remove and discard the cotter pins (18), and remove the flatwashers (24). Remove the ripper tooth pins (14) (two per tooth). Remove the ripper teeth (1).

4. Remove the hexagon head capscrews (22) and lockwashers (23) retaining the pins (10 and 11). Remove the pins, and hoist the ripper box away from the grader.

5. Attach suitable lifting tackle to both sides of the lower pull arm (7). Remove the hexagon head capscrews (22) and lockwashers (23) retaining the pins (10 and 13). Remove the pins, and hoist the lower pull arm away from the grader. Inspect the bearing bushes (15 and 16) for serviceability. Replace faulty bushings.

6. Remove the two roll pins (17) and the flatwashers (24) retaining the upper control rods (8) on the ripper mounting bracket pins. Remove the upper control rods. Inspect the bearing bushings (16) for serviceability. Replace faulty bushings.

7. Remove the hexagon head capscrews (22) and lockwashers (23) retaining the pins (12). Remove the pins and cylinders (9).

8. Attach suitable lifting tackle to the mounting brackets (4 and 5). Remove the hexagon head bolts (19), nuts (21) and lockwashers (20) (four per bracket). Hoist the mounting brackets away from the grader.

9. Assembly and Installation (Fig. 11).

    CAUTION:
    When lubricating the bearing bushings in the ripper assembly, apply only a light smear of premium quality lithium-based grease; containing up to 3% molybdenum disulphide, or a silicone-based grease.

10. Attach suitable lifting tackle to the mounting brackets (4 and 5). Place the brackets into their positions on the grader frame, and retain with the hexagon head bolts (19), nuts (21) and lockwashers (20) (four per bracket).

    NOTE:
    Do not tighten the hardware yet.

11. Install the two cylinders (9), and retain to the mounting brackets with the pins (12), hexagon head capscrews (22) and lockwashers (23).

12. Attach suitable lifting tackle to the lower pull arm (7). Lubricate the lower pull arm bearing bushings (15 and 16). Place the lower pull arm into its position with the mounting brackets, and retain with the two pins (13), hexagon head capscrews (22) and lockwashers (23). Raise the lower pull arm, and engage the piston rod yokes. Install the two pins (10), hexagon head capscrews (22) and lockwashers (23).

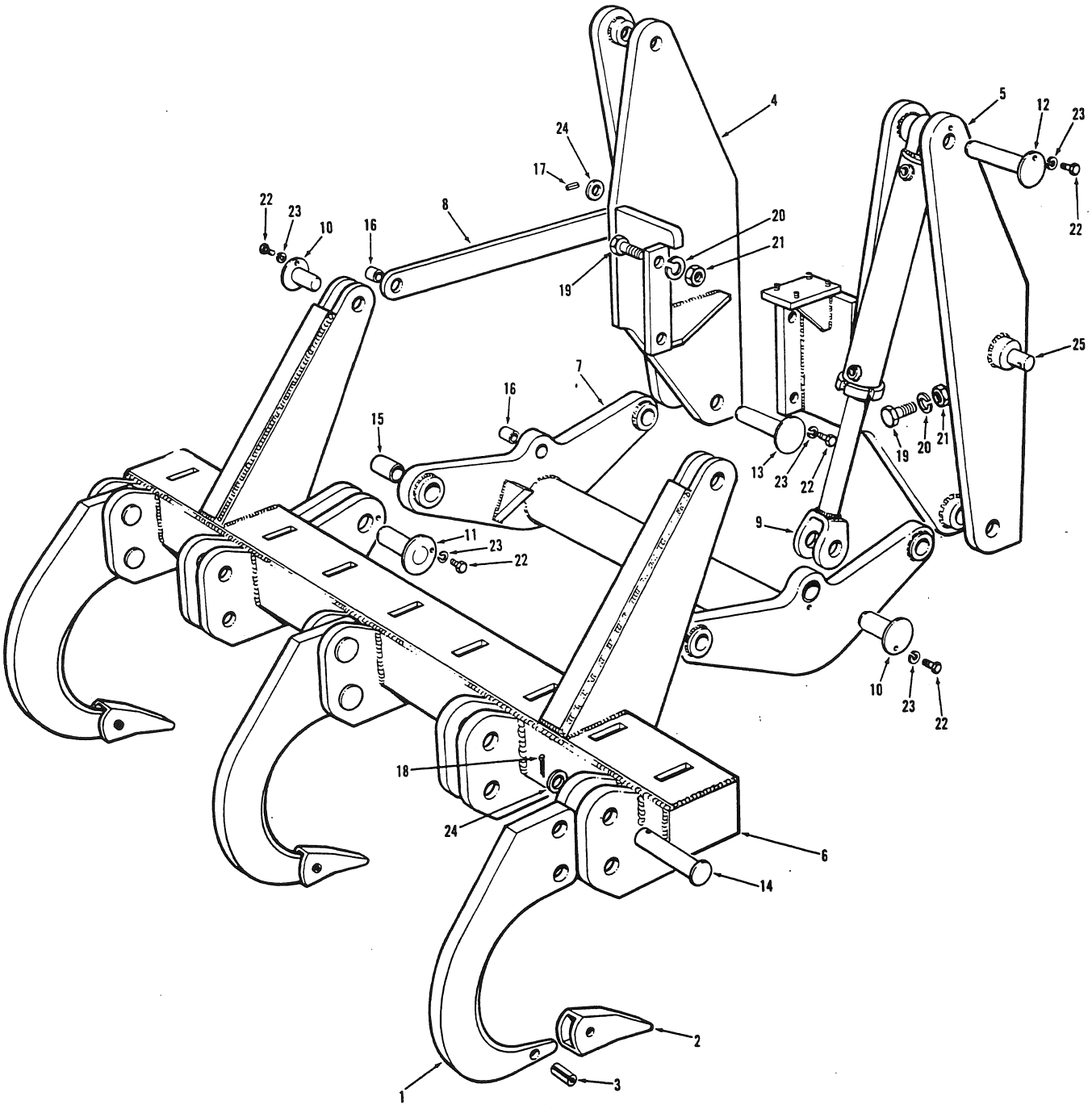


Figure 11

KEY TO FIG. 11

REF. NO.	DESCRIPTION
1	SHANK
2	POINT
3	PIN
4	MOUNTING BRACKET - L.H.
5	MOUNTING BRACKET - R.H.
6	RIPPER BOX
7	LOWER PULL ARM ASSY.
8	CONTROL ROD ASSY.
9	CYLINDER
10	1 1/2" DIA. PIN
11	2" DIA. PIN
12	1 1/2" DIA. PIN
13	2" DIA. PIN
14	TOOTH PIN
15	BUSHING
16	BUSHING
17	ROLL PIN
18	COTTER PIN
19	4" LG. HEX. HD. BOLT
20	LOCKWASHER
21	NUT
22	3/4" LG. HEX. HD. BOLT
23	LOCKWASHER
24	FLATWASHER
25	PIVOT STUD

13. Attach suitable lifting tackle to the ripper box (6). Place the ripper box into its position with the lower pull arms, and retain with the two pins (11), hexagon head capscrews (22) and lockwashers (23).

14. Lubricate the bearing bushings (16) in the two upper control rods. Raise the ripper box, and install the upper control rods. Retain the rods with the pins (10), hexagon head capscrews (22) and lockwashers (23). Install the flatwashers (24) and roll pins (17).

15. Install the ripper tooth shanks (1), and retain with the pins (14), flatwashers (24) and new cotter pins (18) (two per tooth).

16. Fully tighten the mounting bracket hardware.

17. Disconnect the manifold valve supply hose at the pressure relief valve tee fitting. Re-connect the manifold valve supply hose to the pressure hose from the solenoid valve, at the union fitting.

18. Re-connect the hose from the solenoid valve to the pressure relief valve, and the hoses to the cylinder. Install the electrical connections to the solenoid valve.

19. Raise the lower the ripper, and ensure that no binding occurs in the linkage.

20. Adjustments (Figs. 11 and 12). The pitch of the ripper can be adjusted manually by removing the two roll pins and flatwashers, moving the upper control rods to engage an alternative hole with the pins, and installing the flatwashers and roll pins (1. Fig. 12).

21. Worn tooth points (2, Fig. 11) can be replaced by driving out the pin (3, Fig. 11) and removing the point (2, Fig. 12).

    NOTE:
    The optional shank shield can be removed and replaced, if necessary.

22. Install a new point, and retain with the pin.

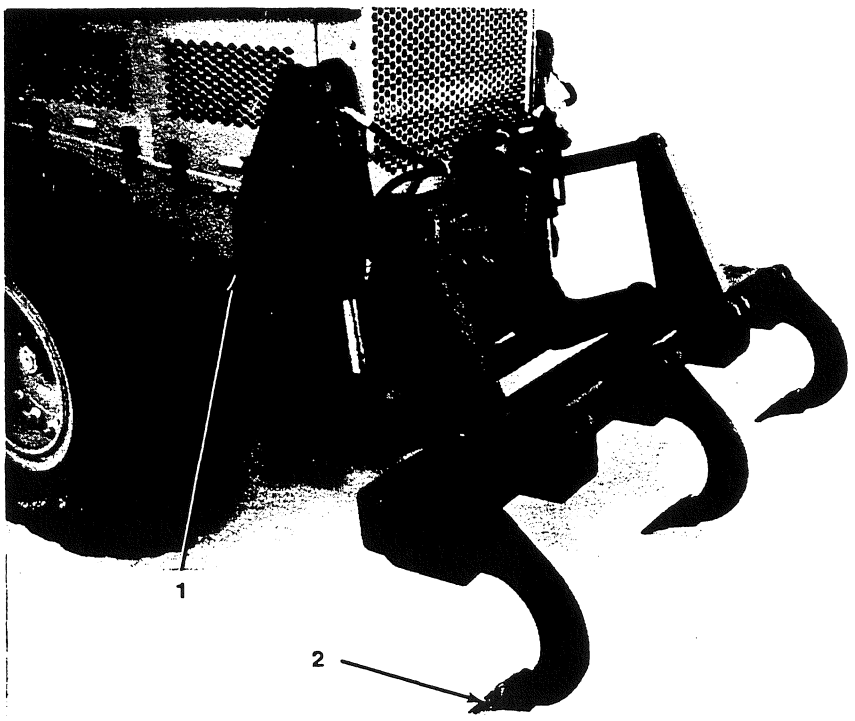


Figure 12

WINDROW ELIMINATOR

1. Removal and Disassembly (Fig. 13).

   WARNING:
   Before disconnecting any hydraulic hoses or fittings, lower the windrow eliminator onto the ground.

   The windrow eliminator is controlled by a single solenoid valve mounted on the rear of the grader. Identify and disconnect the hoses from the cylinder, and the hose from the solenoid valve to the pressure relief valve located beneath the hydraulic tank.

2. Identify and disconnect the pressure hose, from the solenoid valve to the manifold valve supply hose, at the union fitting. Connect the manifold valve supply hose to the tee fitting at the pressure relief valve. Remove the electrical connections to the solenoid valve, and temporarily attach the wire harness to the grader frame.

3. Attach suitable lifting tackle to the two pull tubes (46). Remove and discard the two cotter pins (54). Remove the two flatwashers (78) and headed pins (3). Remove the two chains (81) from the chain plates (41). Remove the windrow eliminator from the grader.

4. To remove the A-frame (39) and components, proceed as follows:

   a. Remove the hexagon head bolt (74), nut (75) and lockwasher (76) retaining each swivel (19). Remove the swivels.
   b. Remove and discard the cotter pin (54), and remove the flatwasher (78) and headed pin (2) retaining each chain plate. Remove the chain plates.
   c. Remove the two hexagon head bolts (73), nuts (75) and pal nuts (77) retaining the cylinder (21). Remove the cylinder, and discard the pal nuts.
   d. Remove and discard the two cotter pins (54), and remove the flatwashers (78) and headed pins (1) retaining the lifting arm (40). Remove the lifting arm.
   e. Attach suitable lifting tackle to the A-frame. Remove the eight hexagon head bolts (67), nuts (64) and lockwashers (65) retaining the A-frame to the grader frame. Carefully remove the A-frame, together with the two adapter plates. Hoist the A-frame away from the grader.

5. Remove the two linch pins (26), and remove the adjustable drag link assembly.

6. Release the two shackles (4) securing the chains. Remove the shackles and chains. The chains, springs (20) and hook bars (28) are available as replacement parts.

7. Release the jam nut (72) and square head set screw (71) securing each pull collar (12). Carefully remove the two pull tubes from the tube and strap brackets (49), at the same time, retrieving the pull collars.

8. Release the jam nut (72) and square head set screw (71) securing each lift collar (45). Remove the lift collars.

9. To disassemble the tube and strap bracket assembly, proceed as follows:

   a. Remove and discard the cotter pin (54), and remove the flatwasher (78) and headed pin (11). Remove the tube and strap bracket from the main rib plate (50).
   b. Remove the hexagon head bolt (57), nut (58) and lockwasher (59) retaining the pivot pin (13). Remove the pivot pin and the main rib plate.
   c. Remove the hexagon head bolts (66), nuts (64) and lockwashers (65) retaining the upper bracket (15) and lower bracket (14). Remove the brackets.

10. To disassemble the wheel adjustment spindle assembly, proceed as follows:

    a. Remove the roll pins (44) retaining the two positioning washers (43).
    b. Rotate the adjusting spindle (84) counter-clockwise, and remove from the nut housing (85). The handle (55) and collar (23) can be disassembled by removing the hexagon head bolts (55 and 57), nuts (58) and lockwashers (59). Retrieve the positioning washers.
    c. Remove the two hexagon head bolts (63), nuts (64) and lockwashers (65) retaining the nut housing to the moldboard assembly (7), and remove the nut housing. Inspect the two scraper seals (86) for serviceability. Replace defective seals.
    d. Remove the two hexagon head bolts (63), nuts (64) and lockwashers (65) retaining the lower spindle guide (24), and remove the guide.

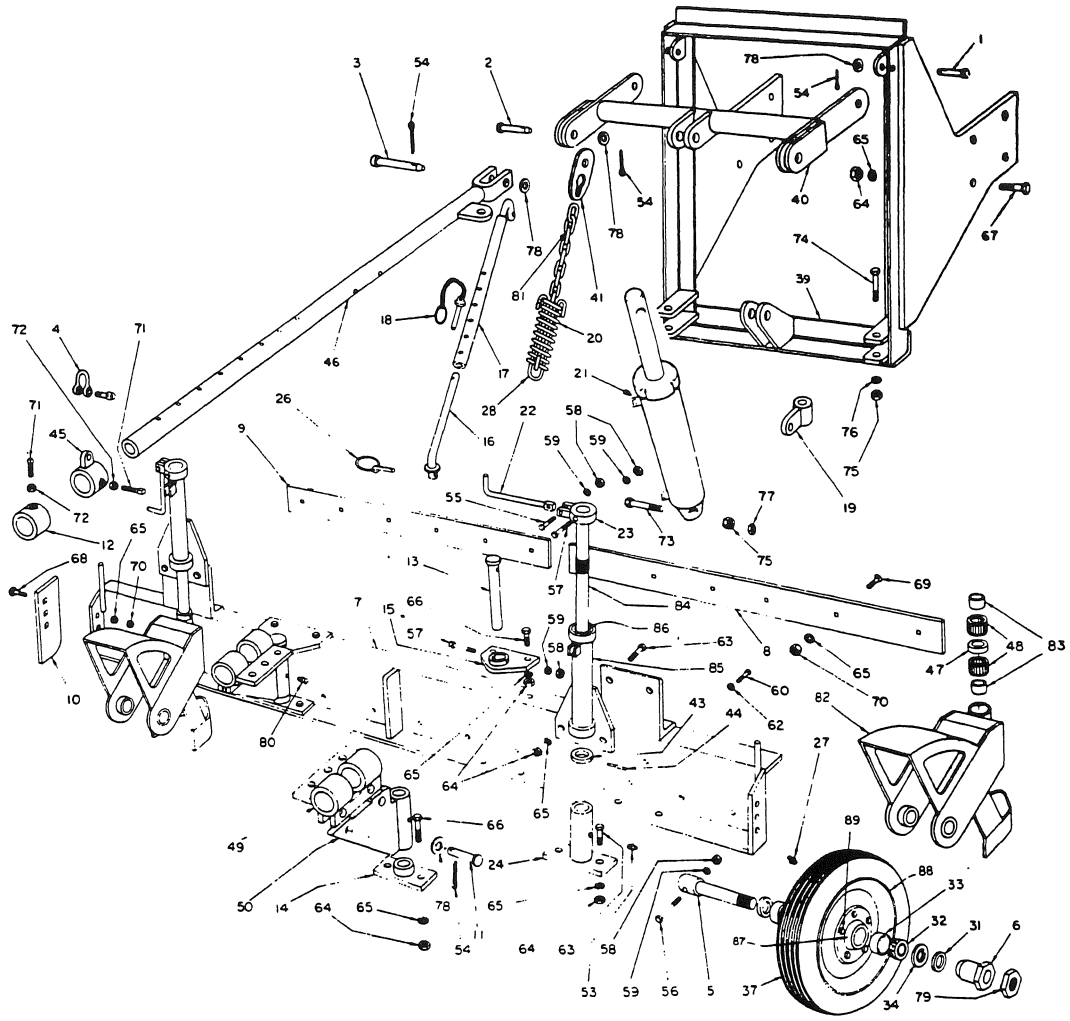


Figure 13

11. To disassemble the wheel axle and swivel housing assemblies, proceed as follows:

    a. Remove the pal nuts (79), adjusting sleeve (6) and spacer (31).
    b. Remove the hexagon head bolt (56), nut (58) and lockwasher (59) retaining the axle (5). Remove the axle, spacer, swivel housing (82) and wheel.
    c. Remove and inspect the two seals (34), bearing cones (32) and bearing cups (33) for serviceability. Replace faulty bearing and seals.
    d. Using a suitable drift, carefully remove the needle bearing inner races (83) and cages (48), together with the spacer (47). Inspect the bearings for serviceability. Replace faulty bearings.

12. Assembly and Installation (Fig. 13). To assemble the wheel axle and swivel housing assemblies, proceed as follows:

    a. Lubricate the bearing cones (32) and bearing cups (33) with grease. Carefully install the bearings into the wheel hub bore, followed by the two seals (34).

    b. Place the wheel at its position in the swivel housing (82), and install the axle (5) and spacer (31), taking care not to damage the seals. Retain the axle with the hexagon head bolt (56), nut (58) and lockwasher (59).

    c. Install the spacer. Install the adjusting sleeve (6), and tighten sufficiently to maintain free-running of the wheel bearings; then install and tighten the pal nut (79).

    d. Using a suitable drift, install the needle bearing inner races (83) and cages (48), together with the spacer (47).

REF. NO.	DESCRIPTION
1	HEADED PIN
2	HEADED PIN
3	HEADED PIN
4	SHACKLE
5	AXLE
6	ADJUSTING SLEEVE
7	MOLDBOARD ASSEMBLY
8	7 FT. CUTTING EDGE
9	6 FT. CUTTING EDGE
10	END SHOE
11	HEADED PIN
12	PULL COLLAR
13	PIVOT PIN
14	LOWER BRACKET
15	UPPER BRACKET
16	INNER ARM
17	OUTER ARM
18	LOCK PIN
19	SWIVEL
20	SPRING
21	LIFT RAM
22	HANDLE
23	COLLAR
24	LOWER SPINDLE GUIDE
26	LINCH PIN
27	SPECIAL "LUBRIGUARD" GREASE FITTING
28	HOOK BAR
31	SPACER
32	CONE
33	CUP
34	SEAL
37	TIRE & TUBE
39	A-FRAME
40	LIFTING ARM
41	CHAIN PLATE
43	POSITIONING WASHER
44	ROLL PIN
45	LIFT COLLAR
46	PULL TUBE
47	SPACER
48	NEEDLE BEARING
49	TUBE & STRAP BRACKET
50	MAIN RIB PLATE
53	GREASE FITTING
54	1/4" X 1 1/2" LG. COTTER PIN
55	2" LG. HEX. HD. BOLT
56	2 1/4" LG. HEX. HD. BOLT
57	2 1/2" LG. HEX. HD. BOLT
58	NUT
59	LOCKWASHER
60	1" LG. HEX. HD. BOLT
62	LOCKWASHER
63	1 1/2" LG. HEX. HD. BOLT
64	NUT
65	LOCKWASHER
66	1 3/4" LG. HEX. HD. BOLT
67	2" LG. HEX. HD. BOLT
68	1 3/4" LG. CARRIAGE BOLT
69	1 3/4" LG. CARRIAGE BOLT
70	NUT
71	2" LG. SQUARE HEAD SET SCREW
72	JAM NUT
73	4" LG. HEX. HD. BOLT
74	5" LG. HEX. HD. BOLT
75	NUT
76	LOCKWASHER
77	PAL NUT
78	FLATWASHER
79	PAL NUT
80	90 DEGREE GREASE FITTING
81	CHAIN - 12 LINKS
82	SWIVEL HOUSING
83	INNER RACE
84	ADJUSTING SPINDLE
85	NUT HOUSING
86	SCRAPER SEAL
87	HUB
88	RIM
89	BOLT

KEY TO FIG. 13

13. To assemble the wheel adjustment spindle assembly, proceed as follows:

    a. Install the lower spindle guide (24) and retain with the two hexagon head bolts (63), nuts (64) and lockwashers (65).
    b. Install the nut housing (85), and retain with the two hexagon head bolts (63), nuts (64) and lockwashers (65).
    c. Place the wheel and swivel housing assembly into position between the lower spindle guide and nut housing. Insert the adjusting spindle (84) into the nut housing. Before the spindle passes through the swivel housing bore, install the two positioning washers (43), one above and one below the bore.
    d. Rotate the adjusting spindle in a clockwise direction until the roll pin holes in the spindle align with the holes in the positioning washers. Retain the washers with the roll pins (44).

14. To assemble the tube and strap bracket assembly, proceed as follows:

    a. Install the upper bracket (15) and lower bracket (14), and retain with the hexagon head bolts (66), nuts (64) and lockwashers (65).
    b. Place the main rib plate (50) into position, and install the pivot pin (13). Retain the pivot pin with the hexagon head bolt (57), nut (58) and lockwasher (59).

c. Install the tube and strap bracket (49), and retain with the headed pin (11). Install the flatwasher (78) and a new cotter pin (54).

15. Install the two lift collars (45) on the pull tubes (46). Insert the pull tubes into the tube and strap bracket assemblies; at the same time, introducing the pull collars (12).

16. Install the two chains (81) and shackles (4), and secure to the lift collars.

17. Install the adjustable drag link assembly, and secure with the two linch pins (26).

18. To install the A-frame (39) and components, proceed as follows:

a. Attach suitable lifting tackle to the A-frame, and hoist into position at the grader frame. Install the two adapter plates between the A-frame and the brackets. Retain the A-frame with with the eight hexagon head bolts (67), nuts (64) and lockwashers (65).

b. Place the lifting arm (40) into position, and retain to the A-frame with the two headed pins (1), flatwashers (78) and new cotter pins (54).

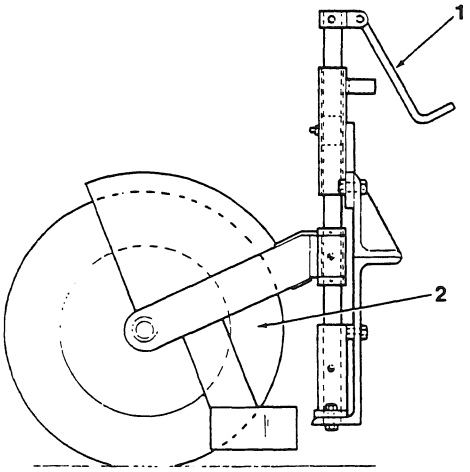
c. Install the cylinder (21) and retain with the two hexagon head bolts (73), nuts (75) and new pal nuts (77).

d. Install the two chain plates (41), and retain with the headed pins (2), flatwashers (78) and new cotter pins (54).

e. Install the two swivels (19), and retain with the hexagon head bolts (74), nuts (75) and lockwashers (76).

19. Attach suitable lifting tackle to the pull tubes, and place in position at the A-frame swivels. Retain the pull tubes with the headed pins (3), flatwashers (78) and new cotter pins (54).

20. Position the moldboard assembly in the working position, and secure the pull collars with the square head set screws (71) and jam nuts (72).



SECTION A-A

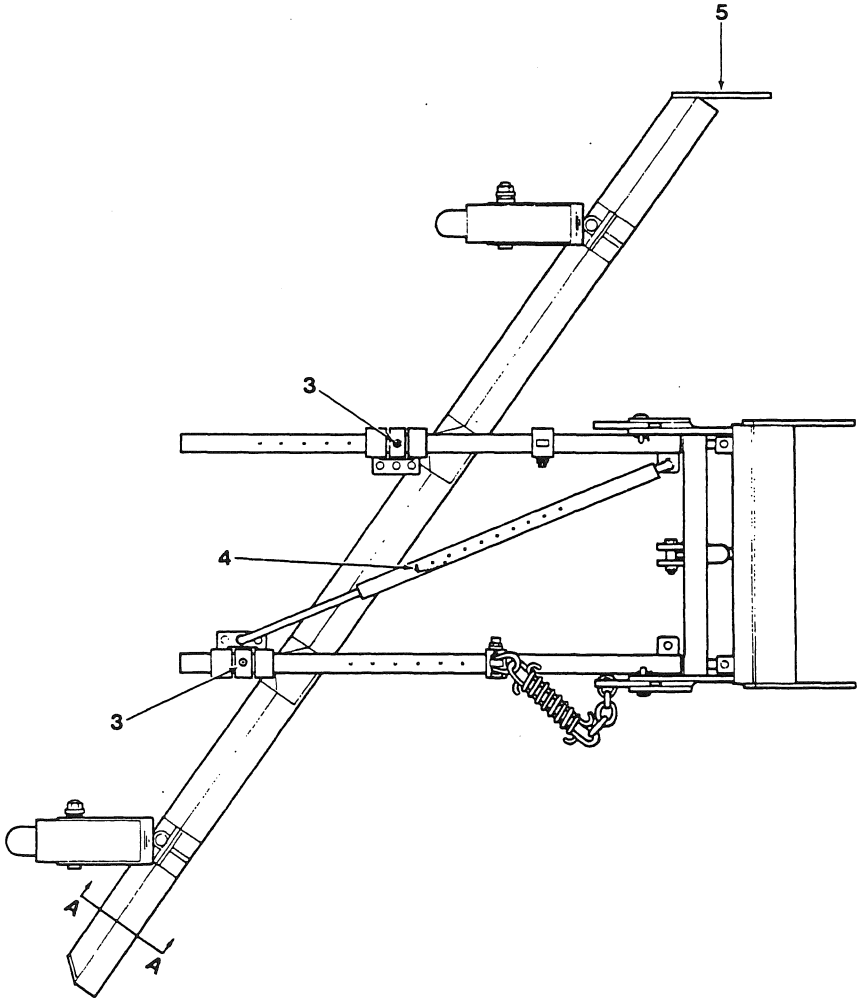


Figure 14

21. Arrange the lift collars in an offset configuration (refer to Fig. 14) and secure with the square head set screws (71) and jam nuts (72). Install the chains in the chain plates.

22. Disconnect the manifold valve supply hose at the pressure relief valve tee fitting. Re-connect the manifold valve supply hose to the pressure hose from the solenoid valve, at the union fitting.

23. Re-connect the hose from the solenoid valve to the pressure relief valve, and the hoses to the cylinder. Install the electrical connections to the solenoid valve.

24. Raise and lower the windrow eliminator, and ensure that no binding occurs in the linkage.

25. Adjustments (Fig. 14). Various adjustments are available depending upon the prevailing working conditions. The adjustments are as follows:

    a. Moldboard Height. Remove the adjusting spindle handle (1) from the clip, and turn the handle to raise or lower the wheel (2). The moldboard will be raised or lowered accordingly. Secure the handle in the clip. Repeat for the other wheel.
    b. Moldboard Angle. The moldboard angle can be varied by raising the attachment, releasing the pull collar set screws (3) and removing the adjusting link assembly lock pin (4). Move the moldboard to the desired angle, install the lock pin and secure the set screws. If the moldboard angle has been adjusted from one extreme to the other, remove the three carriage bolts, nuts and lockwashers retaining the end shoe (5) and install on the opposite end of the moldboard. Also, alternate the offset position of the lift collars, and adjust the chain tension accordingly.
    c. Moldboard Reach. The complete attachment can be angled to either side of the grader by releasing the adjusting link assembly lock pin (4) and extending or retracting the inner arm inside the outer arm until the desired amount of reach is obtained. Install the lock pin. The pull tubes will remain parallel.

26. Worn edges can be replaced by removing the required quantity of carriage bolts, nuts and lockwashers, then removing the edges.

27. Install new edges, and retain with the carriage bolts, nuts and lockwashers.

FRONT MOUNTED WING

1. Removal and Disassembly (Figs. 15, 16 and 17).

    WARNING:
    Before disconnecting any hydraulic hoses or fittings, lower the wing blade onto the ground.

    The rear lift and slide cylinders are controlled by a double bank solenoid valve mounted on the rear mast, and the front lift cylinder is controlled by a single bank solenoid valve mounted on the front mast.

2. Hydraulic oil is transmitted from the primary hydraulic circuit to the double bank solenoid valve; then directed to the single bank solenoid valve and the manifold valve.

3. When removing the rear mast, disconnect both hoses at the solenoid valve. Plug the valve fittings.

    NOTE:
    A plumbing revision incorporates a tube at one of the valve connections:- effective serial number 9884 onwards.

    Remove one hose (hose and tube for the latest configuration) at the tube on the frame. Loop the other hose, and connect to the tube on the frame; thus allowing oil to flow to the front mast solenoid valve.

4. When removing the front mast, disconnect both hoses at the solenoid valve. Plug the valve fittings. Remove the hose at the tube leading to the manifold valve. Loop the other hose, and connect to the tube leading to the manifold valve.

5. Remove the electrical connections to the solenoid valves, and temporarily attach the wire harnesses to the grader frame.

6. WARNING:
    It is essential that reliable, heavy-duty lifting tackle is available when removing the front mounted wing masts and blade.

    Attach the lifting tackle to the wing blade (90, 92, 114 or 115, Fig. 15). Remove the two hexagon head bolts (94, Fig. 15), nuts (96, Fig. 15) and lockwashers (95, Fig. 15) retaining the knuckles (76, Fig. 15) to the wing blade. Remove and discard the cotter

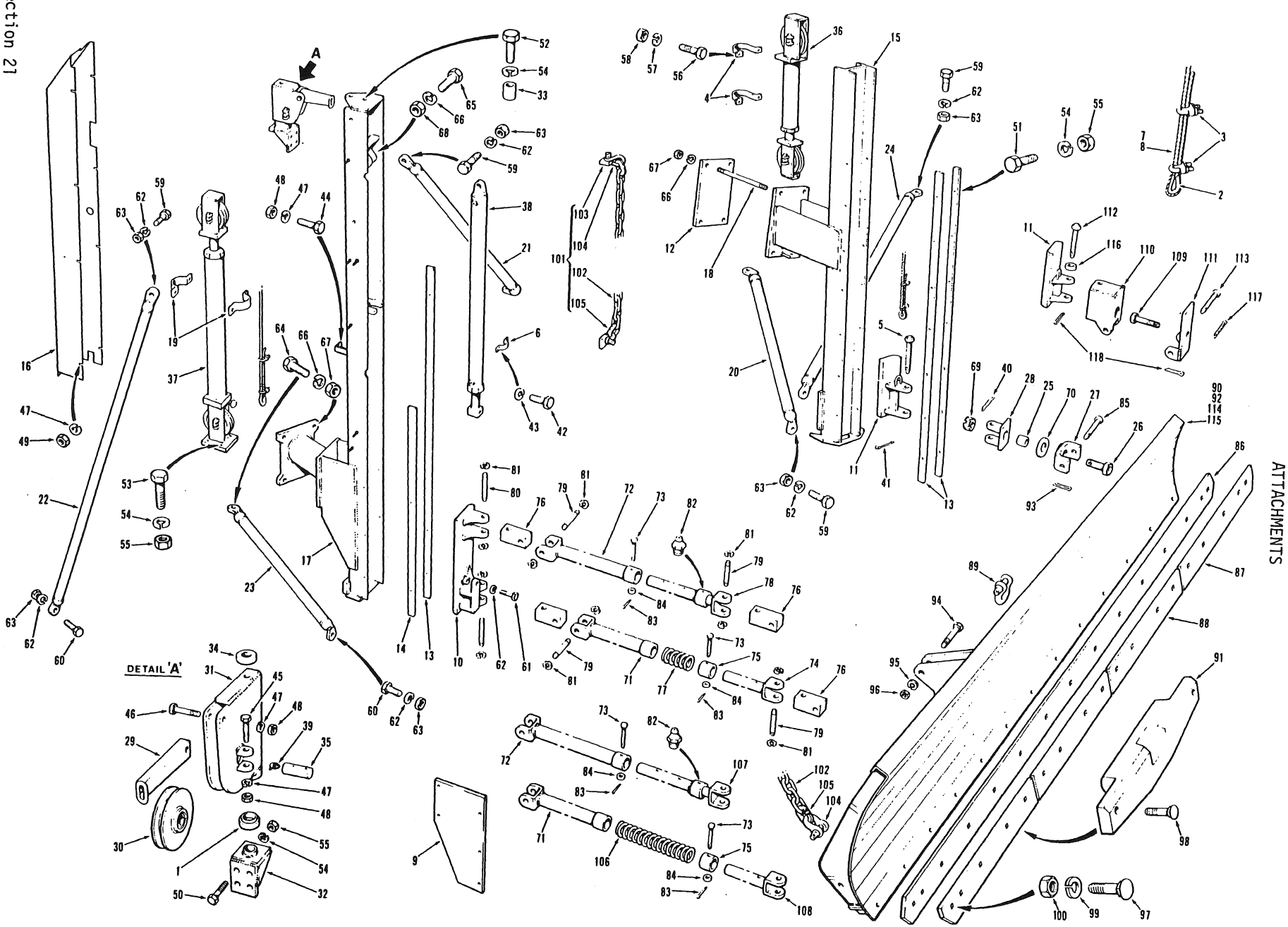


Figure 15

REF. NO.	DESCRIPTION
	FRONT & REAR MAST INSTALLATION
1	THRUST BEARING
2	THIMBLE
3	CABLE CLAMP
4	CLAMP
5	PIN
6	CLAMP
7	CABLE 25' LG. - FRONT MAST
8	CABLE 52' LG. - REAR MAST
9	ICE SHIELD - LOWER
10	SLIDE ASSY. - REAR MAST
11	SLIDE ASSY. - FRONT MAST
12	MOUNTING BRACKET
13	SLIDE GUIDE - LONG
14	SLIDE GUIDE - SHORT
15	FRONT MAST
16	ICE SHIELD
17	REAR MAST
18	TIE BOLT
19	CLAMP
20	FRONT MAST BRACE - LOWER
21	REAR MAST BRACE - FWD.
22	REAR MAST BRACE - AFT.
23	REAR MAST BRACE - LOWER
24	FRONT MAST BRACE - FWD.
25	SPACER
26	SWIVEL PIN
27	MOUNTING SWIVEL
28	HINGE
29	CABLE GUIDE
30	SHEAVE ASSY.
31	SWIVEL HOUSING
32	BRACKET
33	SPACER BUSHING
34	SPACER COLLAR
35	SHEAVE PIN
36	LIFT CYLINDER - FRONT MAST
37	LIFT CYLINDER - REAR MAST
38	SLIDE CYLINDER
39	45° GREASE FITTING
40	COTTER PIN
41	COTTER PIN
42	1" LG. HEX. HD. BOLT
43	LOCKWASHER
44	1 1/2" LG. HEX. HD. BOLT
45	2" LG. HEX. HD. BOLT
46	2 1/2" LG. HEX. HD. BOLT
47	LOCKWASHER
48	NUT
49	NUT
50	1 1/2" LG. HEX. HD. BOLT
51	1 3/4" LG. HEX. HD. BOLT
52	2 1/4" LG. HEX. HD. BOLT
53	2" LG. HEX. HD. BOLT
54	LOCKWASHER
55	NUT
56	1 3/4" LG. HEX. HD. BOLT
57	LOCKWASHER
58	NUT
59	2 1/2" LG. HEX. HD. BOLT
60	3" LG. HEX. HD. BOLT
61	4" LG. HEX. HD. CAPSCREW
62	LOCKWASHER
63	NUT
64	3 1/2" LG. HEX. HD. CAPSCREW
65	4" LG. HEX. HD. BOLT
66	LOCKWASHER
67	NUT
68	NUT
69	JAM NUT
70	FLATWASHER
	STAND-OFF ARMS INSTALLATION-STANDARD
71	OUTER SLEEVE - LOWER ARM
72	OUTER SLEEVE - UPPER ARM
73	SHEAR PIN
74	INNER SLEEVE - LOWER ARM
75	COLLAR
76	KNUCKLE
77	SPRING
78	INNER SLEEVE - UPPER ARM
79	1" DIA. X 5" LG. PIN
80	1" DIA. X 6" LG. PIN
81	KLIPRING FASTENER
82	STRAIGHT GREASE FITTING
83	COTTER PIN
84	FLATWASHER
	WING INSTALLATION - STANDARD
85	PIN
86	WING EDGE
87	WING EDGE - OUTER - CARBIDE TIPPED
88	WING EDGE - INNER - CARBIDE TIPPED
89	SHACKLE
90	WING - DRILLED FOR STANDARD EDGE
91	WING SHOE
92	WING - DRILLED FOR CARBIDE EDGE
93	COTTER PIN
94	5 1/2" LG. HEX. HD. BOLT
95	LOCKWASHER
96	NUT
97	2" LG. PLOW BOLT
98	3 1/2" LG. PLOW BOLT
99	LOCKWASHER
100	NUT
101	WING SAFETY CHAIN ASSY.
102	CHAIN 33" LG.
103	LUG
104	SHACKLE
105	SPLIT LINK
	PARTS APPLICABLE FOR OPTIONAL TRIP WING INSTALLATION
106	SPRING
107	INNER SLEEVE - UPPER ARM
108	INNER SLEEVE - LOWER ARM
109	WING BOLT
110	SWIVEL ASSY.
111	HINGE PLATE
112	SWIVEL PIN
113	PIVOT PLATE PIN
114	TRIP WING - DRILLED FOR STD. EDGE
115	TRIP WING - DRILLED FOR CARBIDE EDGES
116	SPACER WASHER
117	COTTER PIN
118	COTTER PIN

KEY TO FIG. 15

pin (93, Fig. 15) retaining the pin (85, Fig. 15), and remove the pin. Disconnect the shackle (89, Fig. 15) and remove the cable (8, Fig. 15). Hoist the blade away from the grader. Remove the lifting tackle.

NOTE:
For machines equipped with the optional trip wing installation, remove and discard the cotter pin (118, Fig. 15) retaining the pivot plate pin (113, Fig. 15), and remove the pin. Remove and discard the cotter pin (117, Fig. 15) retaining the hexagon head bolt (109, Fig. 15). Remove the bolt and hinge plate (111, Fig. 15).

7. Attach the lifting tackle to the front mast (15, Fig. 15). Remove the hexagon head bolts (59, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15) retaining the lower front mast brace (20, Fig. 15) and forward front mast brace (24, Fig. 15). Remove the braces.

8. Remove the four nuts (67, Fig. 15) and lockwashers (66, Fig. 15) retaining the front mast to the mounting bracket tie bolts (18, Fig. 15). Carefully hoist the front mast away from the grader. Remove the mounting bracket (12, Fig. 15) and tie bolts. Remove the lifting tackle.

9. Remove the kliprings (81, Fig. 15) securing the two attachment pins (80, Fig. 15) connecting the knuckles (76, Fig. 15) to the rear mast slide (10, Fig. 15). Remove both the upper and lower stand-off arms.

10. Attach the lifting tackle to the rear mast (17, Fig. 15). Remove the hexagon head bolts (59, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15) retaining the forward rear mast brace (21, Fig. 15). Remove the hexagon head bolts (59 and 60, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15) retaining the aft rear mast brace (22, Fig. 15). Remove the hexagon head bolts (60 and 64, Fig. 15), nuts (63 and 67, Fig. 15) and lockwashers (67 and 66, Fig. 15) retaining the lower rear mast brace (23, Fig. 15). Remove the braces.

11. Remove the four hexagon head bolts (64, Fig. 15), nuts (67, Fig. 15) and lockwashers (66, Fig. 15) retaining the rear mast support to the grader frame. Carefully hoist the rear mast away from the grader. Remove the lifting tackle.

12. To disassemble the front mast and components, proceed as follows:

a. Remove the cable clamps (3, Fig. 15) securing the cable ends (7, Fig. 15). Release the two thimbles (2, Fig. 15), and remove the cable.

b. Attach lifting tackle to the lift cylinder (36, Fig. 15). Remove the cylinder plumbing. Remove the four hexagon head bolts (56, Fig. 15), nuts (58, Fig. 15) and lockwashers (57, Fig. 15) retaining the two clamps (4, Fig. 15). Remove the clamps and cylinder.

c. Remove the hexagon head bolts (3 and 19, Fig. 16), nuts (1 and 17, Fig. 16) and lockwashers (2 and 18, Fig. 16) retaining the sheave pins (7 and 15, Fig. 16). Remove the sheave pins and sheaves (5, 6 and 16, Fig. 16). Remove the two hexagon head capscrews (11, Fig. 16), lockwashers (12, Fig. 16) and flatwashers (13, Fig. 16), and remove the ice scraper (10, Fig. 16).

d. Remove the seven hexagon head bolts (51, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15) retaining each slide guide (13, Fig. 15), and remove the guides.

e. Remove and discard the cotter pin (41, Fig. 15) retaining the pin (5, Fig. 15), and remove the hinge assembly from the slide (11, Fig. 15). Remove the slide.

f. Remove and discard the cotter pin (40, Fig. 15) retaining the hexagon head bolt (26, Fig. 15). Remove the bolt and jam nut (69, Fig. 15), and separate the hinge (28, Fig. 15), spacer (25, Fig. 15), flatwasher (70, Fig. 15) and mounting swivel (27, Fig. 15).

NOTE:
For machines equipped with the optional trip wing installation, remove and discard the cotter pin (118, Fig. 15) retaining the swivel pin (112, Fig. 15). Remove the swivel pin, spacer washer (116, Fig. 15) and swivel assembly (110, Fig. 15). Remove the slide (11, Fig. 15).

13. To disassemble the rear mast and components, proceed as follows:

a. Remove the eight nuts (49, Fig. 15) and lockwashers (47, Fig. 15) retaining the ice shield (16, Fig. 15), and remove the ice shield.

b. Remove the cable clamps (3, Fig. 15) securing the cable ends (8, Fig. 15). Release the two thimbles (2, Fig. 15), and remove the cable.

c. Remove the two hexagon head bolts (44, Fig. 15), nuts (48, Fig. 15) and lockwashers (47, Fig. 15) retaining the two clamps (19, Fig. 15).

d. Attach lifting tackle to the lift cylinder (37, Fig. 15). Remove the cylinder plumbing. Remove the four hexagon head bolts (53, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15) retaining the cylinder base plate. Remove the cylinder.

e. Remove the hexagon head bolts (3 and 18, Fig. 17), nuts (1 and 16, Fig. 17) and lockwashers (2 and 17, Fig. 17) retaining the sheave pins (6 and 13, Fig. 17). Remove the sheave pins and sheaves (5 and 12, Fig. 17). Remove the two hexagon head capscrews (11, Fig. 17), lockwashers (10, Fig. 17) and flatwashers (9, Fig. 17), and remove the ice scraper (8, Fig. 17).

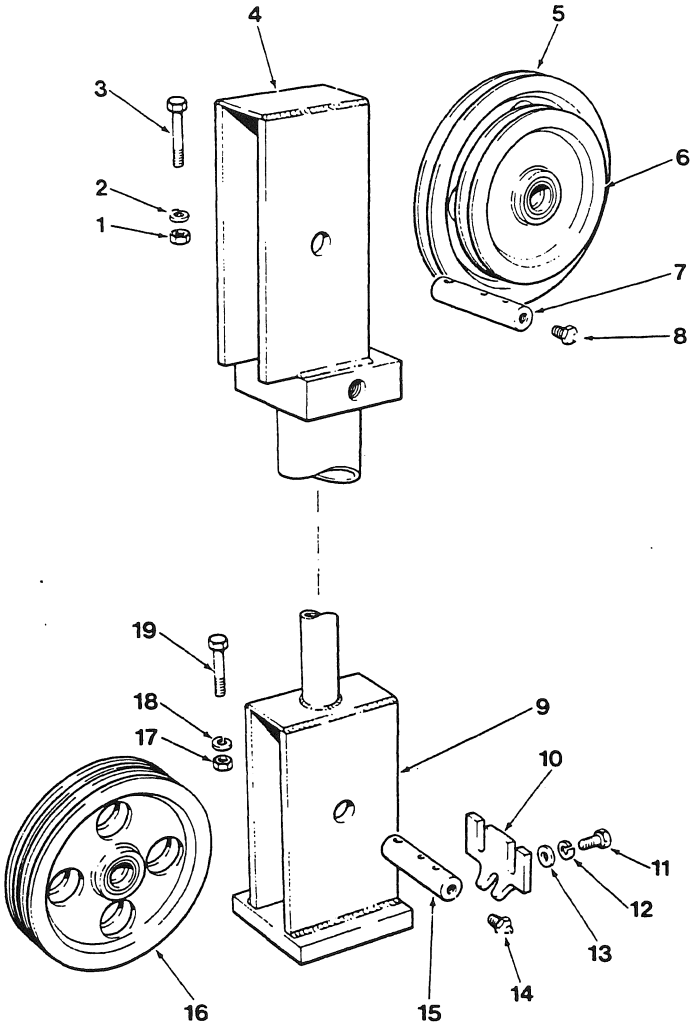


Figure 16

KEY TO FIG. 16

REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
1	NUT	11	1" LG. HEX. HD. CAPSCREW
2	LOCKWASHER	12	LOCKWASHER
3	2 1/4" LG. HEX. HD. BOLT	13	FLATWASHER
4	UPPER SHEAVE HOUSING	14	STRAIGHT GREASE FITTING
5	SHEAVE - 9 1/2" O.D.	15	SHEAVE PIN
6	SHEAVE - 7" O.D.	16	SHEAVE - 8 1/2" O.D.
7	SHEAVE PIN	17	NUT
8	STRAIGHT GREASE FITTING	18	LOCKWASHER
9	LOWER SHEAVE HOUSING	19	2 1/4" LG. HEX. HD. BOLT
10	ICE SCRAPER		

f. Remove the hexagon head capscrew (61, Fig. 15) and lockwasher (62, Fig. 15) retaining the slide cylinder piston rod to the slide. Remove the cylinder plumbing. Remove the hexagon head capscrews (42, Fig. 15) and lockwashers (43, Fig. 15) retaining the clamp (6, Fig. 15). Remove the hexagon head bolt (65, Fig. 15), nut (68, Fig. 15) and lockwasher (66, Fig. 15) retaining the slide cylinder (38, Fig. 15) to the rear mast lugs. Remove the cylinder.

g. Remove the twelve hexagon head bolts (51, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15) retaining the long and short slide guides (13 and 14, Fig. 15), and remove the guides. Remove the slide.

h. Remove the hexagon head capscrew (52, Fig. 15), lockwasher (54, Fig. 15) and spacer washer (33, Fig. 15). Remove the four hexagon head bolts (50, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15) retaining the swivel housing bracket (32, Fig. 15). Remove the bracket, together with the swivel housing assembly, spacer collar (34, Fig. 15) and thrust bearing (1, Fig. 15). Inspect the thrust bearing for serviceability. Replace a faulty bearing.

i. Remove the hexagon head bolt (46, Fig. 15), nut (48, Fig. 15) and lockwasher (47, Fig. 15) securing the cable guide (29, Fig. 15), and remove the guide.

j. Remove the hexagon head bolt (45, Fig. 15), nut (48, Fig. 15) and lockwasher (47, Fig. 15) retaining the sheave pin (35, Fig. 15). Remove the sheave pin and sheave (30, Fig. 15) from the swivel housing (31, Fig. 15).

k. <u>All D700 series graders before serial number 9950 only:</u>

Remove the hardware retaining the ice shield (9, Fig. 15) to the mast, and remove the ice shield.

l. For machines equipped with the optional wing safety chain assembly (101, Fig. 15), remove the two shackles (104, Fig. 15) at the lugs (103, Fig. 15), and remove the chain (102, Fig. 15). The chain can also be removed at the two split links (105, Fig. 15).

14. To disassemble the upper and lower stand-off arms, proceed as follows:

a. Remove the kliprings (81, Fig. 15) securing the attachment pins (79, Fig. 15) connecting the knuckles (76, Fig. 15) to the inner sleeves (78 and 74, or 107 and 108, Fig. 15) and the outer sleeves (72 and 71, Fig. 15).

b. Remove and discard the cotter pins (83, Fig. 15) retaining the shear pins (73, Fig. 15). Remove the shear pins and flatwashers (84, Fig. 15), and separate the inner and outer sleeves.

c. Remove the collar (75, Fig. 15) and spring (77 or 106, Fig. 15).

15. <u>Assembly and Installation</u> (Figs. 15, 16 and 17). To assemble the upper and lower stand-off arms, proceed as follows:

a. Install the collar (75, Fig. 15) and spring (77 or 106, Fig. 15) onto the lower stand-off arm inner sleeves (74 or 108, Fig. 15). Retain the collar with the shear pin (73, Fig. 15), flatwasher (84, Fig. 15) and a new cotter pin (83, Fig. 15).

b. Insert the inner sleeves into the outer sleeves (72 and 71, Fig. 15). Retain the inner and outer sleeves of the upper stand-off arms with the shear pin (73, Fig. 15), flatwasher (84, Fig. 15) and a new cotter pin (83, Fig. 15).

c. Install the knuckles (76, Fig. 15), and retain with the attachment pins (79, Fig. 15). Secure the attachment pins with the kliprings (81, Fig. 15).

16. To assemble the rear mast and components, proceed as follows:

a. Install the sheave (30, Fig. 15) into the swivel housing (31, Fig. 15), and retain with the sheave pin (35, Fig. 15). Retain the sheave pin with the hexagon head bolt (45, Fig. 15), nut (48, Fig. 15) and lockwasher (47, Fig. 15).

b. Install the cable guide (29, Fig. 15), and secure with the hexagon head bolt (46, Fig. 15), nut (48, Fig. 15) and lockwasher (47, Fig. 15).

c. Install the swivel housing bracket (32, Fig. 15), and retain with the four hexagon head bolts (50, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15).

d. Install the swivel housing assembly, together with the thrust bearing (1, Fig. 15) and spacer collar (34, Fig. 15). Retain the swivel housing with the hexagon head capscrew (52, Fig. 15), lockwasher (54, Fig. 15) and spacer washer (33, Fig. 15).

e. Install the slide (10, Fig. 15). Install the long and short slide guides (13 and 14, Fig. 15), and retain with the twelve hexagon head bolts (51, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15).

f. Place the slide cylinder (38, Fig. 15) into position on the rear mast, and retain to the lugs with the hexagon

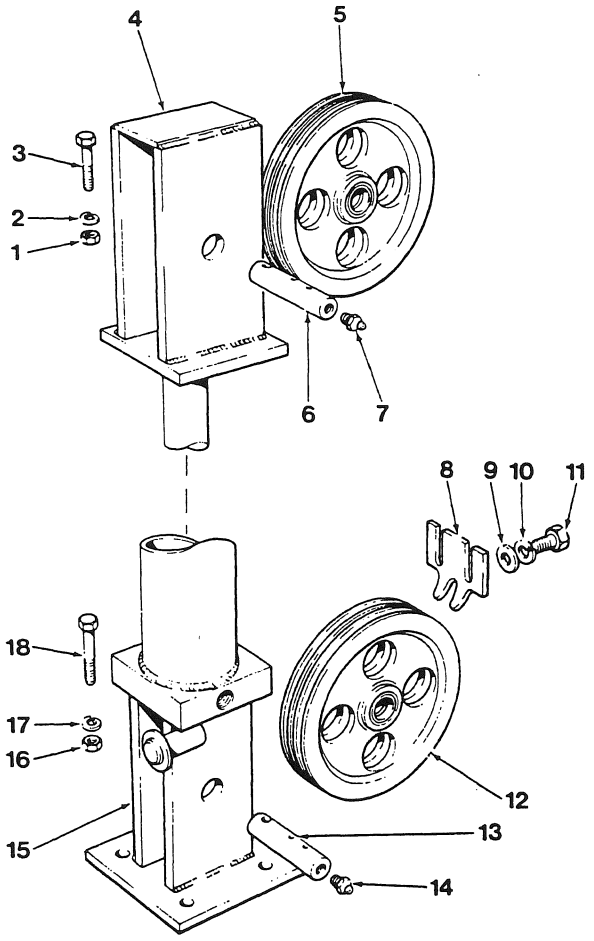


Figure 17

REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
1	NUT	10	LOCKWASHER
2	LOCKWASHER	11	1" LG. HEX. HD. CAPSCREW
3	2 1/4" LG. HEX. HD. BOLT	12	SHEAVE - 8 1/2" O.D.
4	UPPER SHEAVE HOUSING	13	SHEAVE PIN
5	SHEAVE - 8 1/2" O.D.	14	STRAIGHT GREASE FITTING
6	SHEAVE PIN	15	LOWER SHEAVE HOUSING
7	STRAIGHT GREASE FITTING	16	NUT
8	ICE SCRAPER	17	LOCKWASHER
9	FLATWASHER	18	2 1/4" LG. HEX. HD. BOLT

KEY TO FIG. 17

head bolt (65, Fig. 15), nut (68, Fig. 15) and lockwasher (66, Fig. 15). Install the clamp (6, Fig. 15), and retain with the two hexagon head capscrews (42, Fig. 15) and lockwashers (43, Fig. 15). Retain the slide cylinder piston rod to the slide with the hexagon head capscrew (61, Fig. 15) and lockwasher (62, Fig. 15). Install the cylinder plumbing.

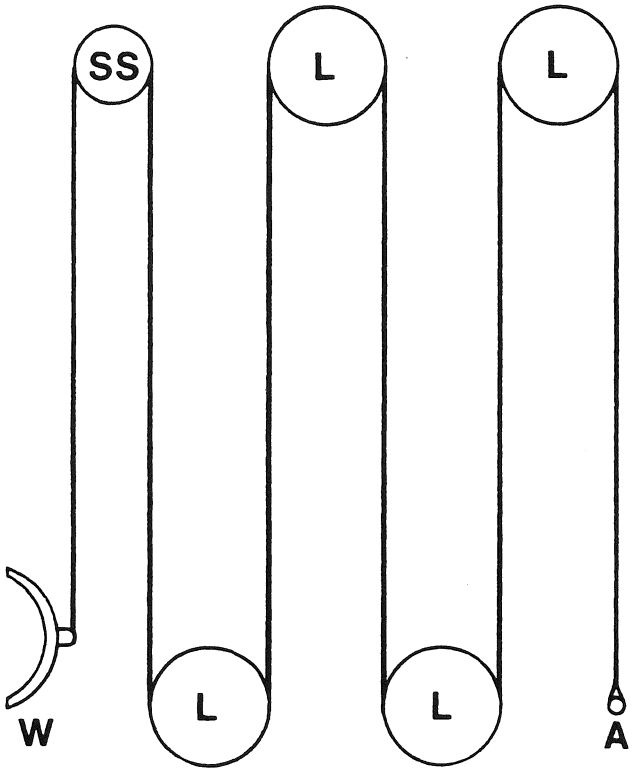
g. Install the sheaves (5 and 12, Fig. 17) into the sheave housings, and retain with the sheave pins (6 and 13, Fig. 17). Retain the pins with the hexagon head bolts (3 and 18, Fig. 17), nuts (1 and 16, Fig. 17) and lockwashers (2 and 17, Fig. 17). Install the ice scraper (8, Fig. 17), and retain with the two hexagon head capscrews (11, Fig. 17), lockwashers (10, Fig. 17) and flatwashers (9, Fig. 17).

h. Install the lift cylinder (37, Fig. 15), and retain the base plate with the four hexagon head bolts (53, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15). Install the cylinder plumbing.

i. Install the clamps (19, Fig. 15), and retain with the two hexagon head bolts (44, Fig. 15), nuts (48, Fig. 15) and lockwashers (47, Fig. 15).

j. Install a thimble (2, Fig. 15) at one end of the cable (8, Fig. 15), and install on the anchor pin. Install two cable clamps (3, Fig. 15) (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).

k. Thread the cable around the sheaves as shown in Fig, 18. Install a thimble on the other end of the cable. Install the cable clamps (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).



A ANCHOR
SS SWIVEL SHEAVE
L LARGE SHEAVE
W WING BLADE

Figure 18

l. Install the ice shield (16, Fig. 15), and retain to the mast with the eight nuts (49, Fig. 15) and lockwashers (47, Fig. 15).

m. <u>All D700 series graders before serial number 9950 only:</u>

Install the ice shield (9, Fig. 15) to the mast, and retain with the hardware.

n. For machines equipped with the optional wing safety chain assembly (101, Fig. 15), install the chain (102, Fig. 15) and secure either at the two split links (105, Fig. 15), or the two shackles (104, Fig. 15) at the lugs (103, Fig. 15).

17. To assemble the front mast and components, proceed as follows:

a. Install the mounting swivel (27, Fig. 15), flatwasher (70, Fig. 15), spacer (25, Fig. 15) and hinge (28, Fig. 15) onto the hexagon head bolt (26, Fig. 15). Retain the bolt with the jam nut (69, Fig. 15), and secure with a new cotter pin (40, Fig. 15).

<u>NOTE:</u>
For machines equipped with the optional trip wing installation, install the swivel assembly (110, Fig. 15) to the slide (11, Fig. 15), and retain with the swivel pin (112, Fig. 15) and spacer washer (116, Fig. 15). Secure the swivel pin with a new cotter pin (118, Fig. 15).

b. Install the mounting swivel assembly onto the slide (11, Fig. 15), and retain with the pin (5, Fig. 15). Secure the pin with a new cotter pin (41, Fig. 15).

c. Place the slide assembly into position in the mast channel. Install the two slide guides (13, Fig. 15), and retain with the fourteen hexagon head bolts (51, Fig. 15), nuts (55, Fig. 15) and lockwashers (54, Fig. 15).

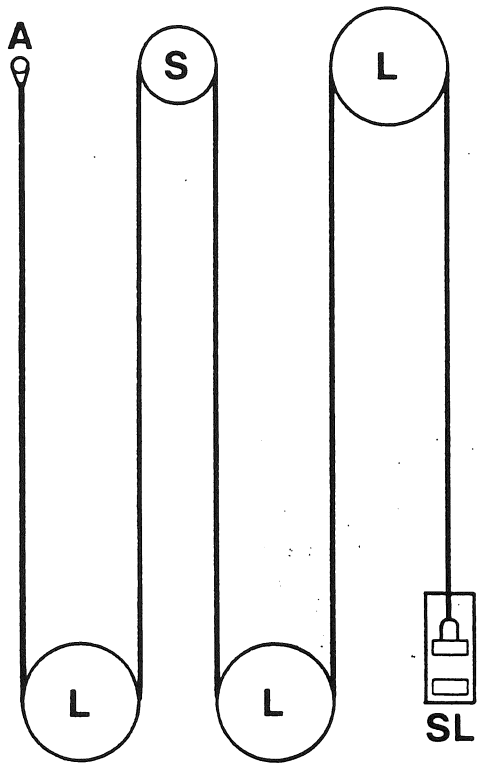
d. Install the sheaves (5, 6 and 16, Fig. 16) and sheave pins (7 and 15, Fig. 16). Retain the sheave pins with the hexagon head bolts (3 and 19, Fig. 16), nuts (1 and 17, Fig. 16) and lockwashers (2 and 18, Fig. 16). Install the ice scraper (10, Fig. 16), and retain with the two hexagon head capscrews (11, Fig. 16), lockwashers (12, Fig. 16) and flatwashers (13, Fig. 16).

e. Attach suitable lifting tackle to the lift cylinder (36, Fig. 15) and place into position on the mast. Install the clamps (4, Fig. 15), and retain with the four hexagon head bolts (56, Fig. 15), nuts (58, Fig. 15) and lockwashers (57, Fig. 15). Remove the lifting tackle. Install the cylinder plumbing.

f. Install a thimble (2, Fig. 15) at one end of the cable (7, Fig. 15), and install on the anchor pin. Install

the cable clamps (3, Fig. 15) (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).

g. Thread the cable around the sheaves as shown in Fig. 19. Install a thimble at the other end of the cable, and install on the slide U-bolt. Install two cable clamps (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).



A	ANCHOR
S	SMALL SHEAVE
L	LARGE SHEAVE
SL	SLIDE

Figure 19

18. WARNING:
It is essential that reliable heavy-duty lifting tackle is available when installing the front mounted wing masts and blade.

Attach the lifting tackle to the rear mast (17, Fig. 15), and place into position at the grader frame. Install the four hexagon head bolts (64, Fig. 15), nuts (67, Fig. 15) and lockwashers (66, Fig. 15) retaining the mast support.

19. Install the forward rear mast brace (21, Fig. 15), and retain with the hexagon head bolts (59, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15). Install the aft rear mast brace (22, Fig. 15), and retain with the hexagon head bolts (59 and 60, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15). Install the lower rear mast brace (23, Fig. 15), and retain with the hexagon head bolts (60 and 64, Fig. 15), nuts (63 and 67, Fig. 15) and lockwashers (67 and 66, Fig. 15).

20. Place the upper and lower stand-off arms into position at the rear mast slide (10, Fig. 15). Connect the knuckles (76, Fig. 15) to the slide, and retain with the two attachment pins (80, Fig. 15). Secure the pins with the kliprings (81, Fig. 15). Remove the lifting tackle.

21. Attach the lifting tackle to the front mast (15, Fig. 15), and place into position at the grader frame. Install the mounting bracket (12, Fig. 15) and tie bolts (18, Fig. 15). Install the four nuts (67, Fig. 15) and lockwashers (66, Fig. 15).

22. Install the forward front mast brace (24, Fig. 15) and lower front mast brace (20, Fig. 15), and retain with the hexagon head bolts (59, Fig. 15), nuts (63, Fig. 15) and lockwashers (62, Fig. 15). Remove the lifting tackle.

23. Attach the lifting tackle to the wing blade (90, 92, 114 or 115, Fig. 15). Place into position at the upper and lower stand-off arms, and retain with the hexagon head bolts (94, Fig. 15), nuts (96, Fig. 15) and lockwashers (95, Fig. 15). Install the pin (85, Fig. 15) to connect the wing blade and front mast swivel. Secure the pin with a new cotter pin (93, Fig. 15). Install the cable (8, Fig. 15), and retain with the shackle (89, Fig. 15).

NOTE:
For machines equipped with the optional trip wing installation, install the hinge plate (111, Fig. 15), and retain with the hexagon head bolt (109, Fig. 15). Secure the bolt with a new cotter pin (117, Fig. 15). Connect the swivel (110, Fig. 15) to the hinge plate with the pivot plate pin (113, Fig. 15). Secure the pin with a new cotter pin (118, Fig. 15).

Remove the lifting tackle.

24. After installing the front mast, disconnect the hose at the tube leading to the manifold valve. Install the original hose at the tube leading to the manifold valve. Re-connect both hoses to the solenoid valve.

25. After installing the rear mast, disconnect the hose at the tube on the frame. Install the original hose (hose and tube for the latest configuration) at the tube on the frame. Re-connect both hoses to the solenoid valve.

26. Install the electrical connections to the solenoid valve.

27. Adjustments (Figs. 15 and 20). The amount of wing blade angle and pitch can be varied by adjusting the inner sleeves within the outer sleeves of the stand-off arms. Remove the cotter pins and shear pins, adjust the inner sleeves, and install the shear pins in the nearest alternative hole. Secure with the cotter pins (2, Fig. 20). Wing blade front end height adjustment is achieved by selecting an alternative hole in the blade strengthening plate (1, Fig. 20).

28. Worn edges (86, 87 or 88, Fig. 15) can be replaced by removing the required quantity of carriage bolts (97, Fig. 15), nuts (100, Fig. 15) and lockwashers (99, Fig. 15), then removing the edges.

29. Install new edges, and retain with the carriage bolts, nuts and lockwashers.

30. Worn wing shoes (91, Fig. 15) can be replaced by removing the required quantity of carriage bolts (98, Fig. 15), nuts (100, Fig. 15) and lockwashers (99, Fig. 15), then removing the shoes.

31. Install new shoes, and retain with the carriage bolts, nuts and lockwashers.

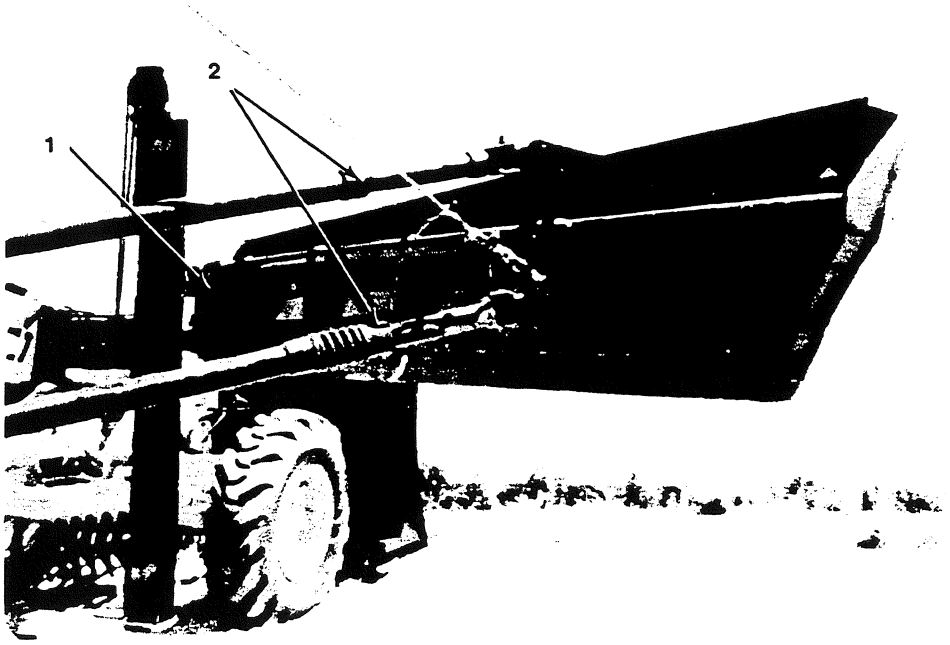


Figure 20

REAR MOUNT WING

1. Removal and Disassembly (Figs. 21, 22 and 23).

   WARNING:
   Before disconnecting any hydraulic hoses or fittings, lower the wing blade onto the ground.

   D700 series graders:- effective serial numbers up to 9007, 9011 to 9026, 9029, 9031 to 9049, 9051 to 9057 and 9098 to 9107:

   The rear lift and slide cylinders, and front lift cylinder are controlled by a triple bank solenoid valve mounted on the rear mast.

2. Hydraulic oil is transmitted from the primary hydraulic circuit to the triple bank solenoid valve; then directed to the manifold valve.

3. When removing the rear mast, disconnect the supply and return hoses at the solenoid valve. Plug the valve fittings. Remove one hose at the tee fitting. Loop the other hose, and connect to the tee fitting; thus allowing oil to flow to the manifold valve.

4. When removing the front mast, disconnect both hoses at the cylinder tube fittings. Plug the tube fittings. Remove one hose at the tube on the frame. Loop the other hose, and connect to the tube on the frame.

5. Remove the electrical connections to the solenoid valves, and temporarily attach the wire harnesses to the grader frame.

6. D700 series graders:- effective serial numbers 9008, 9010, 9027, 9030, 9050, 9058 to 9060, 9110 to 9882 and 9884 onwards:

   The rear lift and slide cylinders are controlled by a double bank solenoid valve mounted on the rear mast, and the front lift cylinder is controlled by a single bank solenoid valve mounted on the grader frame.

7. Hydraulic oil is transmitted from the primary hydraulic circuit to the double bank solenoid valve; then directed to the single bank solenoid valve and the manifold valve.

8. When removing the rear mast, disconnect the two tubes at the solenoid valve and the primary hydraulic plumbing. Plug the valve fittings. Connect the hose leading to the front mast plumbing and manifold valve to the tee fitting at the pressure relief valve.

9. Remove the electrical connections to the solenoid valve, and temporarily attach the wire harnesses to the grader frame.

10. When removing the front mast, disconnect both hoses at the cylinder tube fittings. Plug the tube fittings. Remove one hose at the solenoid valve fitting. Loop the other hose, and connect to the open fitting on the solenoid valve.

11. There is no need to remove the electrical connections to the solenoid valve.

12. WARNING:
    It is essential that reliable, heavy-duty lifting tackle is available when removing the rear mounted wing masts and blade.

    Attach the lifting tackle to the wing blade (91, 93, 115 or 116, Fig. 21). Remove the two hexagon head bolts (95, Fig. 21), nuts (97, Fig. 21) and lockwashers (96, Fig. 21) retaining the knuckles (77, Fig. 21) to the wing blade. Remove and discard the cotter pin (94, Fig. 21) retaining the pin (86, Fig. 21), and remove the pin. Disconnect the shackle (90, Fig. 21) and remove the cable (8, Fig. 21). Hoist the blade away from the grader. Remove the lifting tackle.

    NOTE:
    For machines equipped with the optional trip wing installation, remove and discard the cotter pin (119, Fig. 21) retaining the pivot plate pin (114, Fig. 21), and remove the pin. Remove and discard the cotter pin (118, Fig. 21) retaining the hexagon head bolt (110, Fig. 21). Remove the bolt and hinge plate (112, Fig. 21).

13. Attach the lifting tackle to the front mast (12, Fig. 21). Remove the hexagon head bolts (56 and 61, Fig. 21), nuts (60 and 64, Fig. 21) and lockwashers (59 and 63, Fig. 21) retaining the lower front mast brace (19, Fig. 21). Remove the hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21) retaining the front mast brace (21, Fig. 21). Remove the braces.

14. Remove the four hexagon head bolts (61, Fig. 21), nuts (64, Fig. 21) and lockwashers (63, Fig. 21) retaining the front mast support to the grader frame. Carefully hoist the front mast away from the grader. Remove the lifting tackle.

15. Remove the kliprings (82, Fig. 21) securing the two attachment pins (81, Fig. 21) connection the knuckles (77, Fig. 21) to the rear mast slide (10, Fig. 21). Remove both the upper and lower standoff arms.

16. Attach the lifting tackle to the rear mast (9, Fig. 21). Remove the hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21) retaining the forward rear mast brace (20, Fig. 21). Remove the hexagon head bolts (57 and 66, Fig. 21), nuts (60 and 69, Fig. 21) and lockwashers (59 and 68, Fig. 21) retaining the rear mast brace (11, Fig. 21). Remove the braces.

17. Remove the four hexagon head bolts (67, Fig. 21), nuts (69, Fig. 21) and lockwashers (68, Fig. 21) retaining the rear mast support to the grader frame. Carefully hoist the rear mast away from the grader. Remove the lifting tackle.

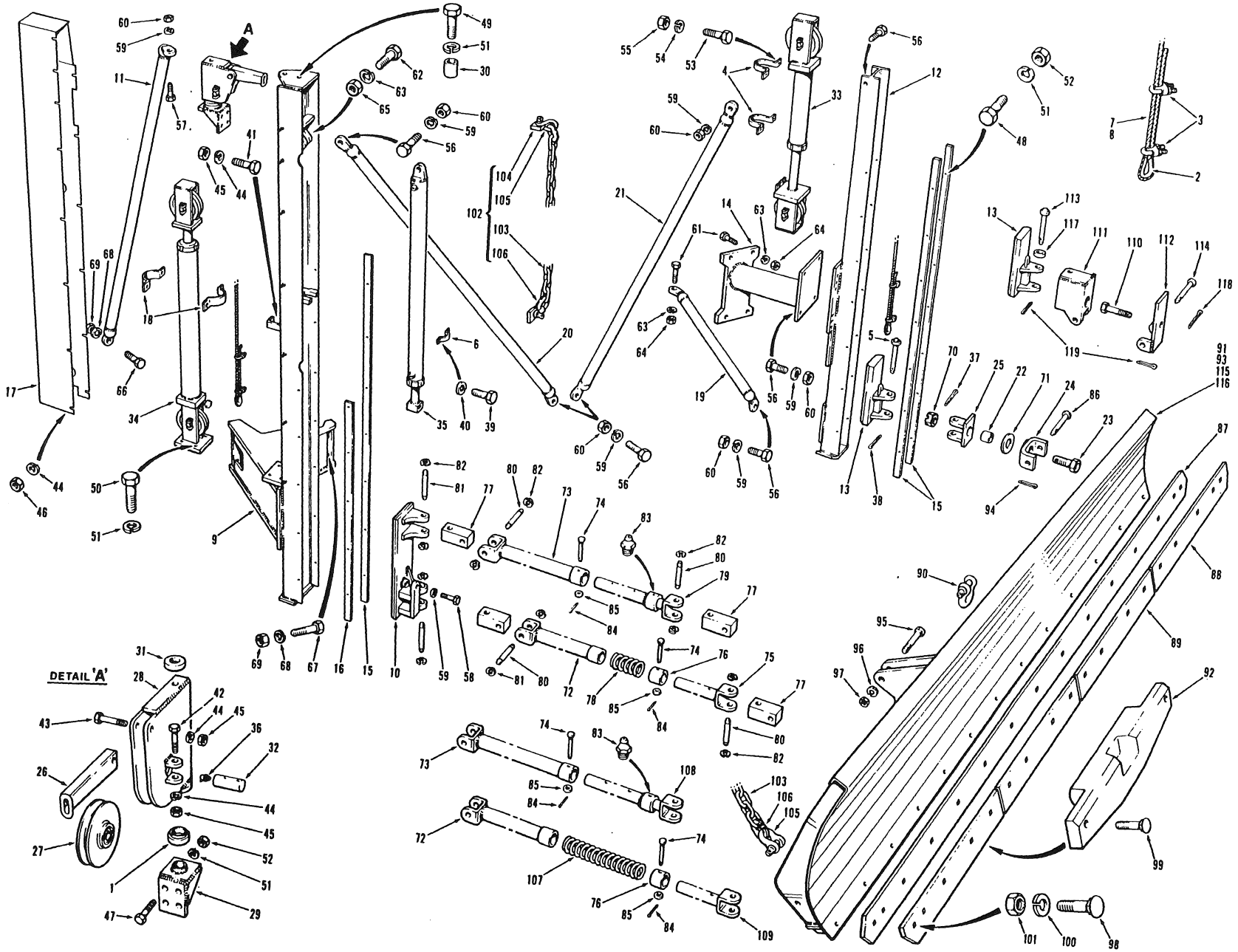


Figure 21

REF. NO.	DESCRIPTION
	FRONT & REAR MAST INSTALLATION
1	THRUST BEARING
2	THIMBLE
3	CABLE CLAMP
4	CLAMP
5	PIN
6	CLAMP
7	CABLE 25' LG. - FRONT MAST
8	CABLE 52' LG. - REAR MAST
9	REAR MAST
10	SLIDE ASSY. - REAR MAST
11	REAR MAST BRACE
12	FRONT MAST
13	SLIDE ASSY. - FRONT MAST
14	MAST MOUNTING BRACKET
15	SLIDE GUIDE - LONG
16	SLIDE GUIDE - SHORT
17	ICE SHIELD
18	CLAMP
19	FRONT MAST BRACE - LOWER
20	REAR MAST BRACE - FWD.
21	FRONT MAST BRACE
22	SPACER
23	SWIVEL PIN
24	MOUNTING SWIVEL
25	HINGE
26	CABLE GUIDE
27	SHEAVE ASSY.
28	SWIVEL HOUSING
29	BRACKET
30	SPACER BUSHING
31	SPACER COLLAR
32	SHEAVE PIN
33	LIFT CYLINDER - FRONT MAST
34	LIFT CYLINDER - REAR MAST
35	SLIDE CYLINDER
36	45° GREASE FITTING
37	COTTER PIN
38	COTTER PIN
39	1" LG. HEX. HD. BOLT
40	LOCKWASHER
41	1 1/2" LG. HEX. HD. BOLT
42	2" LG. HEX. HD. BOLT
43	2 1/2" LG. HEX. HD. BOLT
44	LOCKWASHER
45	NUT
46	NUT
47	1 1/2" LG. HEX. HD. BOLT
48	1 3/4" LG. HEX. HD. BOLT
49	2 1/4" LG. HEX. HD. BOLT
50	1 3/4" LG. HEX. HD. BOLT
51	LOCKWASHER
52	NUT
53	1 3/4" LG. HEX. HD. BOLT
54	LOCKWASHER
55	NUT
56	2 1/2" LG. HEX. HD. BOLT
57	3" LG. HEX. HD. BOLT
58	4" LG. HEX. HD. BOLT
59	LOCKWASHER
60	NUT
61	1/2" LG. HEX. HD. BOLT
62	4" LG. HEX. HD. BOLT
63	LOCKWASHER
64	NUT
65	NUT
66	4" LG. HEX. HD. BOLT
67	4 1/2" LG. HEX. HD. BOLT
68	LOCKWASHER
69	NUT
70	JAM NUT
71	FLATWASHER
	STAND-OFF ARMS INSTALLATION-STANDARD
72	OUTER SLEEVE - LOWER ARM
73	OUTER SLEEVE - UPPER ARM
74	SHEAR PIN
75	INNER SLEEVE - LOWER ARM
76	COLLAR
77	KNUCKLE
78	SPRING
79	INNER SLEEVE - UPPER ARM
80	1" DIA. X 5" LG. PIN
81	1" DIA. X 6" LG. PIN
82	KLIPRING FASTENER
83	STRAIGHT GREASE FITTING
84	COTTER PIN
85	FLATWASHER
	WING INSTALLATION - STANDARD
86	PIN
87	WING EDGE
88	WING EDGE - OUTER - CARBIDE TIPPED
89	WING EDGE - INNER - CARBIDE TIPPED
90	SHACKLE
91	WING - DRILLED FOR STANDARD EDGE
92	WING SHOE
93	WING - DRILLED FOR CARBIDE EDGES
94	COTTER PIN
95	5 1/2" LG. HEX. HD. BOLT
96	LOCKWASHER
97	NUT
98	2" LG. PLOW BOLT
99	3 1/2" LG. PLOW BOLT
100	LOCKWASHER
101	NUT
102	WING SAFETY CHAIN ASSY.
103	CHAIN - 33" LG.
104	LUG
105	SHACKLE
106	SPLIT LINK
	PARTS APPLICABLE FOR OPTIONAL TRIP WING INSTALLATION
107	SPRING
108	INNER SLEEVE - UPPER ARM
109	INNER SLEEVE - LOWER ARM
110	WING BOLT
111	SWIVEL ASSY.
112	HINGE PLATE
113	SWIVEL PIN
114	PIVOT PLATE PIN
115	TRIP WING - DRILLED FOR STD. EDGE
116	TRIP WING - DRILLED FOR CARBIDE EDGES
117	SPACER WASHER
118	COTTER PIN
119	COTTER PIN

KEY TO FIG. 21

18. To disassemble the front mast and components, proceed as follows:

    a. Remove the four cable clamps (3, Fig. 21) securing the cable ends (7, Fig. 21). Release the two thimbles (2, Fig. 21), and remove the cable.
    b. Attach lifting tackle to the lift cylinder (33, Fig. 21). Remove the cylinder plumbing. Remove the four hexagon head bolts (53, Fig. 21), nuts (55, Fig. 21) and lockwashers (54, Fig. 21) retaining the two clamps (4, Fig. 21). Remove the clamps and cylinder.
    c. Remove the hexagon head bolts (3 and 19, Fig. 22), nuts (1 and 17, Fig. 22) and lockwashers (2 and 18, Fig. 22) retaining the sheave pins (7 and 15, Fig. 22). Remove the sheave pins and sheaves (5, 6 and 16, Fig. 22). Remove the two hexagon head capscrews (11, Fig. 22), lockwashers (12, Fig. 22) and flatwashers (13, Fig. 22), and remove the ice scraper (10, Fig. 22).

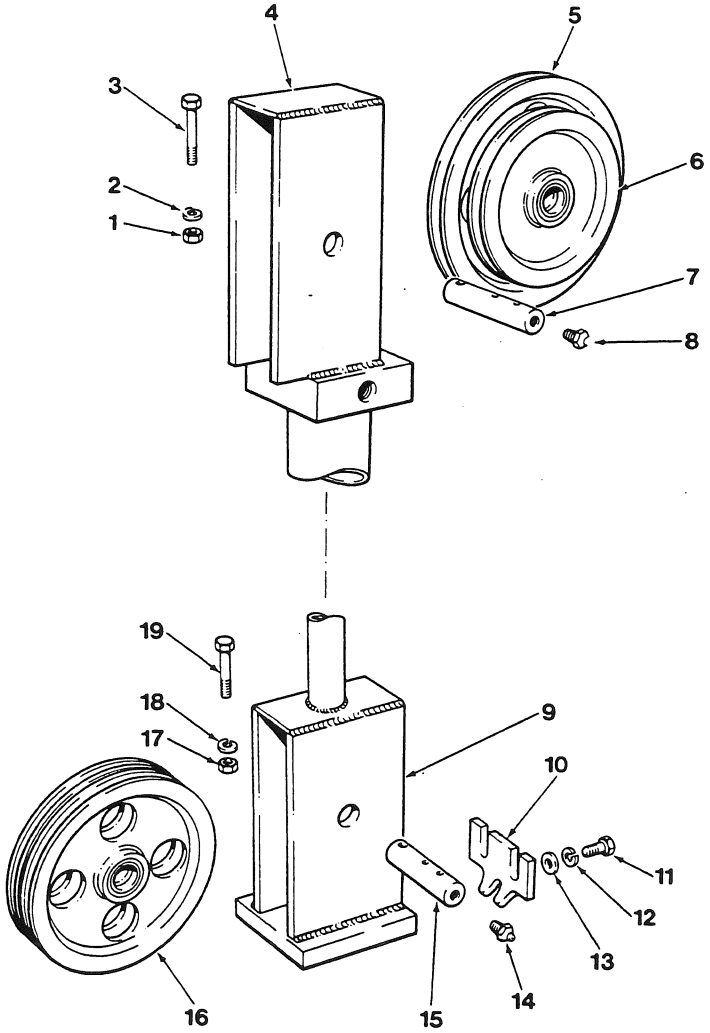


Figure 22

    d. Remove the seven hexagon head bolts (48, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21) retaining each slide guide (15, Fig. 21), and remove the guides.
    e. Remove and discard the cotter pin (38, Fig. 21) retaining the pin (5, Fig. 21), and remove the hinge assembly from the slide (13, Fig. 21). Remove the slide.
    f. Remove and discard the cotter pin (37, Fig. 21) retaining the hexagon head bolt (23, Fig. 21). Remove the bolt and jam nut (70, Fig. 21), and separate the hinge (25, Fig. 21), spacer (22, Fig. 21), flatwasher (71, Fig. 21) and mounting swivel (24, Fig. 21).

    NOTE:
    For machines equipped with the optional trip wing installation, remove and discard the cotter pin (119, Fig. 21) retaining the swivel pin (113, Fig. 21). Remove the swivel pin, spacer washer (117, Fig. 21) and swivel assembly (111, Fig. 21). Remove the slide (13, Fig. 21).

19. To disassemble the rear mast components, proceed as follows:

    a. Remove the eight nuts (46, Fig. 21) and lockwashers (44, Fig. 21) retaining the ice shield (17, Fig. 21), and remove the ice shield.
    b. Remove the cable clamps (3, Fig. 21) securing the cable ends (8, Fig. 21). Release the two thimbles (2, Fig. 21), and remove the cable.

REF. NO.	DESCRIPTION
1	NUT
2	LOCKWASHER
3	2 1/4" LG. HEX. HD. BOLT
4	UPPER SHEAVE HOUSING
5	SHEAVE - 9 1/2" O.D.
6	SHEAVE - 7" O.D.
7	SHEAVE PIN
8	STRAIGHT GREASE FITTING
9	LOWER SHEAVE HOUSING
10	ICE SCRAPER
11	1" LG. HEX. HD. CAPSCREW
12	LOCKWASHER
13	FLATWASHER
14	STRAIGHT GREASE FITTING
15	SHEAVE PIN
16	SHEAVE - 8 1/2" O.D.
17	NUT
18	LOCKWASHER
19	2 1/4" LG. HEX. HD. BOLT

KEY TO FIG. 22

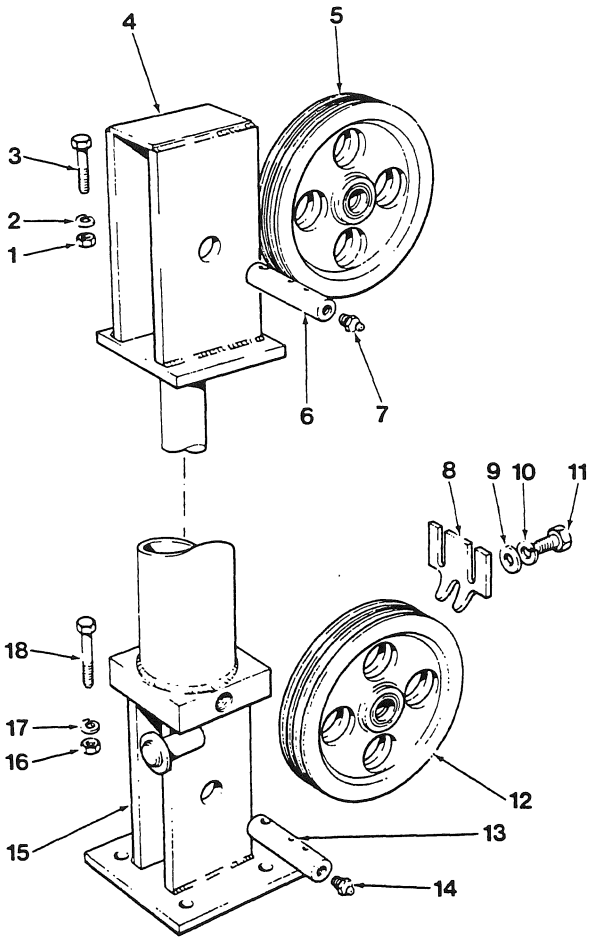


Figure 23

REF. NO.	DESCRIPTION
1	NUT
2	LOCKWASHER
3	2 1/4" LG. HEX. HD. BOLT
4	UPPER SHEAVE HOUSING
5	SHEAVE - 8 1/2" O.D.
6	SHEAVE PIN
7	STRAIGHT GREASE FITTING
8	ICE SCRAPER
9	FLATWASHER
10	LOCKWASHER
11	1" LG. HEX. HD. CAPSCREW
12	SHEAVE - 8 1/2" O.D.
13	SHEAVE PIN
14	STRAIGHT GREASE FITTING
15	LOWER SHEAVE HOUSING
16	NUT
17	LOCKWASHER
18	2 1/4" LG. HEX. HD. BOLT

KEY TO FIG. 23

c. Remove the two hexagon head bolts (41, Fig. 21), nuts (45, Fig. 21) and lockwashers (44, Fig. 21) retaining the two clamps (18, Fig. 21).

d. Attach lifting tackle to the lift cylinder (34, Fig. 21). Remove the cylinder plumbing. Remove the four hexagon head bolts (50, Fig. 21) and lockwashers (51, Fig. 21) retaining the cylinder base plate. Remove the cylinder.

e. Remove the hexagon head bolts (3 and 18, Fig. 23), nuts (1 and 16, Fig. 23) and lockwashers (2 and 17, Fig. 23) retaining the sheave pins (6 and 13, Fig. 23). Remove the sheave pins and sheaves (5 and 12, Fig. 23). Remove the two hexagon head capscrews (11, Fig. 23), lockwashers (10, Fig. 23) and flatwashers (9, Fig. 23), and remove the ice scraper (8, Fig. 23).

f. Remove the hexagon head capscrew (58, Fig. 21) and lockwasher (59, Fig. 21) retaining the slide cylinder piston rod to the slide. Remove the cylinder plumbing. Remove the two hexagon head capscrews (39, Fig. 21) and lockwashers (40, Fig. 21) retaining the clamp (6, Fig. 21). Remove the hexagon head bolt (62, Fig. 21), nut (65, Fig. 21) and lockwasher (63, Fig. 21) retaining the slide cylinder (35, Fig. 21) to the rear mast lugs. Remove the cylinder.

g. Remove the twelve hexagon head bolts (48, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21) retaining the long and short slide guides (15 and 16, Fig. 21), and remove the guides. Remove the slide.
h. Remove the hexagon head capscrew (49, Fig. 21), lockwasher (51, Fig. 21) and spacer washer (30, Fig. 21). Remove the four hexagon head bolts (47, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21) retaining the swivel housing bracket (29, Fig. 21). Remove the bracket, together with the swivel housing assembly, spacer collar (31, Fig. 21) and thrust bearing (1, Fig. 21). Inspect the thrust bearing for serviceability. Replace a faulty bearing.
i. Remove the hexagon head bolt (43, Fig. 21), nut (45, Fig. 21) and lockwasher (44, Fig. 21) securing the cable guide (26, Fig. 21), and remove the guide.
j. Remove the hexagon head bolt (42, Fig. 21), nut (45, Fig. 21) and lockwasher (44, Fig. 21) retaining the sheave pin (32, Fig. 21). Remove the sheave pin and sheave (27, Fig. 21) from the swivel housing (28, Fig. 21).
k. Remove the four hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21) retaining the mast mounting bracket (14, Fig. 21).
l. <u>D700 series graders:- effective serial numbers 9008, 9010, 9027, 9030, 9050, 9058 to 9060, 9110 to 9882 and 9884 onwards:</u>

   Remove the hardware retaining the solenoid valve ice shield to the mast, and remove the ice shield.
m. For machines equipped with the optional wing safety chain assembly (102, Fig. 21), remove the two shackles (105, Fig. 21) at the lugs (104, Fig. 21), and remove the chain (103, Fig. 21). The chain can also be removed at the two split links (106, Fig. 21).

20. To disassemble the upper and lower stand-off arms, proceed as follows:

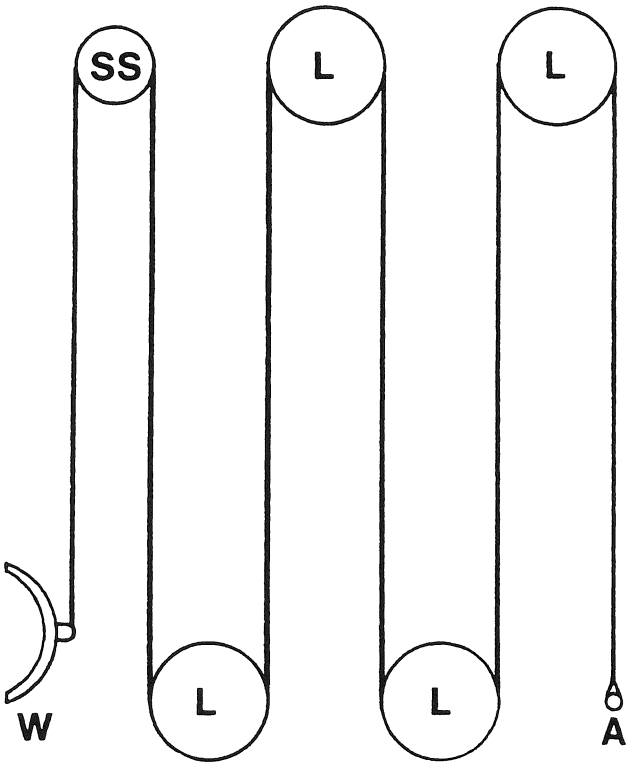
a. Remove the kliprings (82, Fig. 21) securing the attachment pins (80, Fig. 21) connecting the knuckles (77, Fig. 21) to the inner sleeves (79 and 75, or 108 and 109, Fig. 21) and the outer sleeves (73 and 72, Fig. 21).
b. Remove and discard the cotter pins (84, Fig. 21) retaining the shear pins (74, Fig. 21). Remove the shear pins and flatwashers (85, Fig. 21), and separate the inner and outer sleeves.
c. Remove the collar (76, Fig. 21) and spring (78 or 107, Fig. 21).

21. <u>Assembly and Installation</u> (Figs. 21, 22 and 23). To assemble the upper and lower stand-off arms, proceed as follows:

a. Install the collar (76, Fig. 21) and spring (78 or 107, Fig. 21) onto the lower stand-off arm inner sleeves (75 or 109, Fig. 21). Retain the collar with the shear pin (74, Fig. 21), flatwasher (85, Fig. 21) and a new cotter pin (84, Fig. 21).
b. Insert the inner sleeves into the outer sleeves (73 and 72, Fig. 21). Retain the inner and outer sleeves of the upper stand-off arms with the shear pin (74, Fig. 21), flatwasher (85, Fig. 21) and a new cotter pin (84, Fig. 21).
c. Install the knuckles (77, Fig. 21), and retain with the attachment pins (80, Fig. 21). Secure the attachment pins with the kliprings (82, Fig. 21).

22. To assemble the rear mast and components, proceed as follows:

a. Install the sheave (27, Fig. 21) into the swivel housing (28, Fig. 21), and retain with the sheave pin (32, Fig. 21). Retain the sheave pin with the hexagon head bolt (42, Fig. 21), nut (45, Fig. 21) and lockwasher (44, Fig. 21).
b. Install the cable guide (26, Fig. 21), and secure with the hexagon head bolt (43, Fig. 21), nut (45, Fig. 21) and lockwasher (44, Fig. 21).
c. Install the swivel housing bracket (29, Fig. 21), and retain with the four hexagon head bolts (47, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21).
d. Install the swivel housing assembly, together with the thrust bearing (1, Fig. 21) and spacer collar (31, Fig. 21). Retain the swivel housing with the hexagon head capscrew (49, Fig. 21), lockwasher (51, Fig. 21) and spacer washer (30, Fig. 21).
e. Install the slide (10, Fig. 21). Install the long and short slide guides (15 and 16, Fig. 21), and retain with the twelve hexagon head bolts (48, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21).
f. Place the slide cylinder (35, Fig. 21) into position on the rear mast, and retain to the lugs with the hexagon



A	ANCHOR
SS	SWIVEL SHEAVE
L	LARGE SHEAVE
W	WING BLADE

Figure 24

head bolt (62, Fig. 21), nut (65, Fig. 21) and lockwasher (63, Fig. 21). Install the clamp (6, Fig. 21), and retain with the two hexagon head capscrews (39, Fig. 21) and lockwashers (40, Fig. 21). Retain the slide cylinder piston rod to the slide with the hexagon head head capscrew (58, Fig. 21) and lockwasher (59, Fig. 21). Install the cylinder plumbing.

g. Install the sheaves (5 and 12, Fig. 23) into the sheave housings, and retain with the sheave pins (6 and 13, Fig. 23). Retain the pins with the hexagon head bolts (3 and 18, Fig. 23), nuts (1 and 16, Fig. 23) and lockwashers (2 and 17, Fig. 23). Install the ice scraper (8, Fig. 23), and retain with the two hexagon head capscrews (11, Fig. 23), lockwashers (10, Fig. 23) and flatwashers (9, Fig. 23).

h. Install the lift cylinder (34, Fig. 21), and retain the base plate with four hexagon head bolts (50, Fig. 21), and lockwashers (51, Fig. 21). Install the cylinder plumbing.

i. Install the two clamps (18, Fig. 21), and retain with the two hexagon head bolts (41, Fig. 21), nuts (45, Fig. 21) and lockwashers (44, Fig. 21).

j. Install a thimble (2, Fig. 21) at one end of the cable (8, Fig. 21), and install on the anchor pin. Install the cable clamps (3, Fig. 21) (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).

k. Thread the cable around the sheaves as shown in Fig. 24. Install a thimble on the other end of the cable. Install the cable clamps (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).

l. Install the ice shield (17, Fig. 21), and retain to the mast with the eight nuts (46, Fig. 21) and lockwashers (44, Fig. 21).

m. Place the mast mounting bracket (14, Fig. 21) into position, and retain with the four hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21).

n. <u>D700 series graders:- effective serial numbers 9008, 9010, 9027, 9030, 9050, 9058 to 9060, 9110 to 9882 and 9884 onwards:</u>

Install the solenoid valve ice shield to the mast, and retain with the hardware.

o. For machines equipped with the optional wing safety chain assembly (102, Fig. 21), install the chain (103, Fig. 21) and secure either at the two split links (106, Fig. 21), or the two shackles (105, Fig. 21) at the lugs (104, Fig. 21).

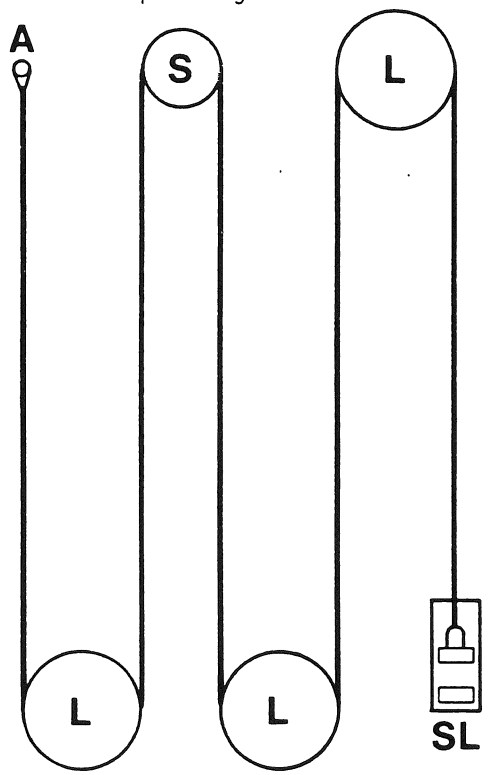
23. To assemble the front mast and components, proceed as follows:

a. Install the mounting swivel (24, Fig. 21), flatwasher (71, Fig. 21), spacer (22, Fig. 21) and hinge (25, Fig. 21) onto the hexagon head bolt (23, Fig. 21). Retain the bolt with the jam nut (70, Fig. 21), and secure with a new cotter pin (37, Fig. 21).

<u>NOTE:</u>

For machines equipped with the optional trip wing installation, install the swivel assembly (111, Fig. 21) to the slide (13, Fig. 21), and retain with the swivel pin (113, Fig. 21) and spacer washer (117, Fig. 21). Secure the swivel pin with a new cotter pin (119, Fig. 21).

b. Install the mounting swivel assembly onto the slide (13, Fig. 21), and retain with the pin (5, Fig. 21). Secure the pin with a new cotter pin (38, Fig. 21).
c. Place the slide assembly into position in the mast channel. Install the two slide guides (15, Fig. 21), and retain with the fourteen hexagon head bolts (48, Fig. 21), nuts (52, Fig. 21) and lockwashers (51, Fig. 21).
d. Install the sheaves (5, 6 and 16, Fig. 22) and sheave pins (7 and 15, Fig. 22). Retain the sheave pins with the hexagon head bolts (3 and 19, Fig. 22), nuts (1 and 17, Fig. 22) and lockwashers (2 and 18, Fig. 22). Install the ice scraper (10, Fig. 22), and retain with the two hexagon head capscrews (11, Fig. 22), lockwashers (12, Fig. 22) and flatwashers (13, Fig. 22).
e. Attach suitable lifting tackle to the lift cylinder (33, Fig. 21) and place into position on the mast. Install the two clamps (4, Fig. 21), and retain with the four hexagon head bolts (53, Fig. 21), nuts (55, Fig. 21) and lockwashers (54, Fig. 21). Remove the lifting tackle. Install the cylinder plumbing.



A ANCHOR
S SMALL SHEAVE
L LARGE SHEAVE
SL SLIDE

Figure 25

f. Install a thimble (2, Fig. 21) at one end of the cable (7, Fig. 21), and install on the anchor pin. Install the cable clamps (3, Fig. 21) (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).
g. Thread the cable around the sheaves as shown in Fig. 25. Install a thimble at the other end of the cable, and install on the slide U-bolt. Install the cable clamps (nuts on the opposite side to the cable dead end), and torque-tighten the nuts to 65 ft/lb (8,9 kg/m).

24. WARNING:
It is essential that reliable, heavy-duty lifting tackle is available when installing the rear mounted wing masts and blade.

Attach the lifting tackle to the rear mast (9, Fig. 21), and place into position at the grader frame. Install the four hexagon head bolts (67, Fig. 21), nuts (69, Fig. 21) and lockwashers (68, Fig. 21) retaining the mast support.

25. Install the forward rear mast brace (20, Fig. 21), and retain with the hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21). Install the rear mast brace (11, Fig. 21), and retain with the hexagon head bolts (57 and 66, Fig. 21), nuts (60 and 69, Fig. 21) and lockwashers (59 and 68, Fig. 21).

26. Place the upper and lower stand-off arms into position at the rear mast slide (10, Fig. 21). Connect the knuckles (77, Fig. 21) to the slide, and retain with the two attachment pins (81, Fig. 21). Secure the pins with the kliprings (82, Fig. 21). Remove the lifting tackle.

27. Attach the lifting tackle to the front mast (12, Fig. 21), and place into position at the grader frame. Install the four hexagon head bolts (61, Fig. 21), nuts (64, Fig. 21) and lockwashers (63, Fig. 21).

28. Install the front mast brace (21, Fig. 21), and retain with the hexagon head bolts (56, Fig. 21), nuts (60, Fig. 21) and lockwashers (59, Fig. 21). Install the lower front mast brace (19, Fig. 21), and retain with the hexagon head bolts (56 and 61 Fig. 21), nuts (60 and 64, Fig. 21) and lockwashers (59 and 63, Fig. 21). Remove the lifting tackle.

29. Attach the lifting tackle to the wing blade (91, 93, 115 or 116, Fig. 21). Place into position at the upper and lower stand-off arms, and retain with the hexagon head bolts (95, Fig. 21), nuts (97, Fig. 21) and lockwashers (96, Fig. 21). Install the pin (86, Fig. 21) to connect the wing blade and front mast swivel. Secure the pin with a new cotter pin (94, Fig. 21). Install the cable (8, Fig. 21), and retain with the shackle (90, Fig. 21).

    NOTE:
    For machines equipped with the optional trip wing installation, install the hinge plate (112, Fig. 21), and retain with the hexagon head bolt (110, Fig. 21). Secure the bolt with a new cotter pin (118, Fig. 21). Connect the swivel (111, Fig. 21) to the hinge plate with the pivot plate pin (114, Fig. 21). Secure the pin with a new cotter pin (119, Fig. 21).

    Remove the lifting tackle.

30. D700 series graders:- effective serial numbers up to 9007, 9011 to 9026, 9029, 9031 to 9049, 9051 to 9057 and 9098 to 9107:

    After installing the front mast, disconnect the looped hose. Install the second hose to the tube on the frame. Reconnect both hoses to the cylinder tube fittings.

31. After installing the rear mast, disconnect the looped hose. Install the second hose at the tee fitting. Re-connect both hoses at the solenoid valve.

32. Install the electrical connections to the solenoid valve.

33. D700 series graders:- effective serial numbers 9008,9010, 9027, 9030, 9050, 9058 to 9060, 9110 to 9882 and 9884 onwards:

    After installing the front mast, disconnect the looped hose. Install the second hose at the solenoud valve. Reconnect both hoses to the cylinder tube fittings.

34. After installing the rear mast, disconnect the hose leading to the front mast plumbing and manifold valve at the tee fitting. Re-connect the two tubes to the solenoid valve and the primary hydraulic plumbing.

35. Install the electrical connections to the solenoid valve.

36. Adjustments (Figs. 21 and 26). The amount of wing blade angle and pitch can be varied by adjusting the inner sleeves within the outer sleeves of the stand-off arms. Remove the cotter pins and shear pins, adjust the inner sleeves, and install the shear pins in the nearest alternative hole (1, Fig. 26). Secure with the cotter pins. Wing blade front end height adjustment is achieved by selecting an alternative hole in the blade strengthening plate (2, Fig. 26).

37. Worn edges (87, 88 or 89, Fig. 21) can be replaced by removing the required quantity of carriage bolts (98, Fig. 21), nuts (101, Fig. 21) and lockwashers (100, Fig. 21), then removing the edges.

38. Install new edges, and retain with the carriage bolts, nuts and lockwashers.

39. Worn wing shoes (92, Fig. 21) can be replaced by removing the required quantity of carriage bolts (99, Fig. 21), nuts (101, Fig. 21) and lockwashers (100, Fig. 21), then removing the shoes.

40. Install new shoes, and retain with the carriage bolts, nuts and lockwashers.

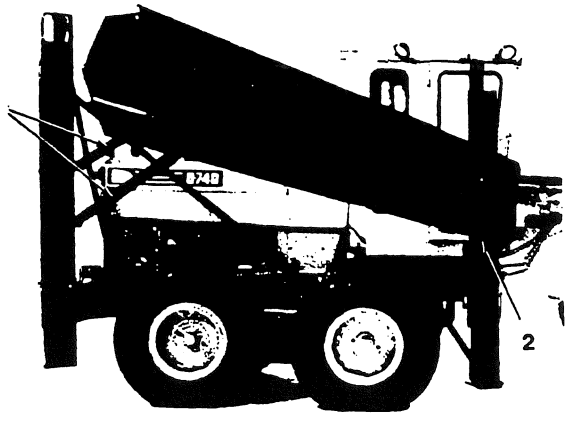
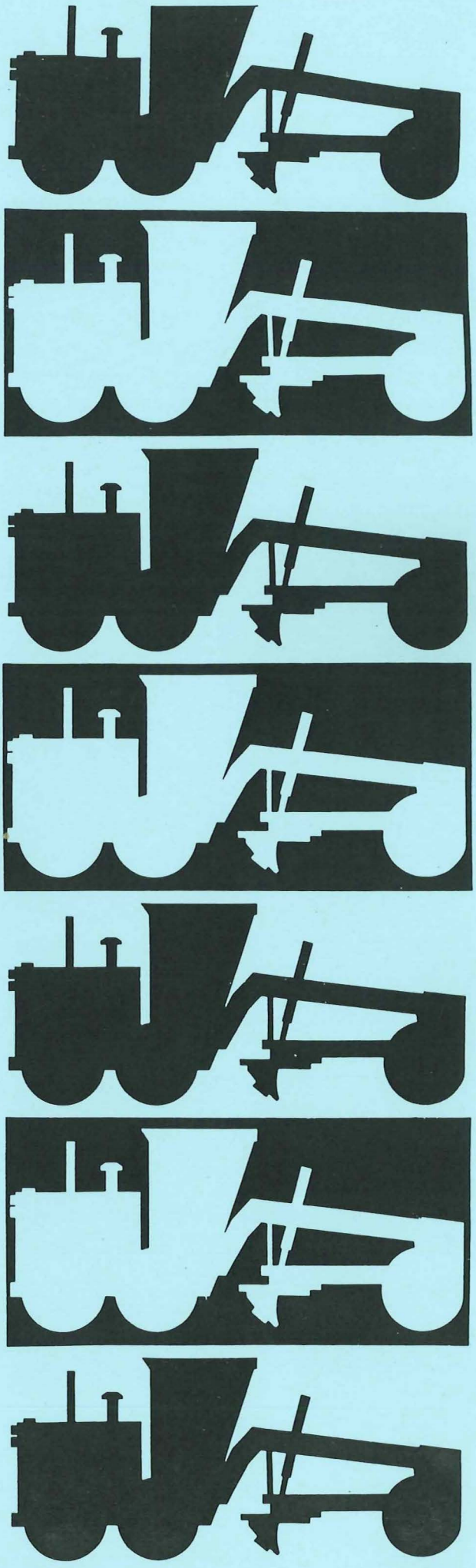


Figure 26

CHAMPION
ROAD MACHINERY



SERVICE TRAINING MANUAL

S/N 16245 to 20604

U.S. S/N 2021-2 to 2658-2

700 SERIES
SERVICE TRAINING MANUAL

INTRODUCTION

This Service Training Manual has been prepared only to assist service personnel and others in understanding the basic theory and integration of the various systems which are used on a Champion motor grader.

For safety warnings, torque specifications, special tools and service procedures reference should be made to the Shop Manual only.

This manual generally applies to Motor Graders serial numbers 16224, 16245 and up. U.S. serial numbers 2021-2 and up.

Service Training Manual
Index

MAINTENANCE CHECKLIST

Machine maintenance should be set up as a routine and followed every time the unit is started.

DAILY CHECKS

The following points must be serviced or checked daily before putting the machine to work.

1. Hydraulic Oil Level
2. Engine Oil Level
3. Radiator Coolant Level

4. Air Cleaner Restriction Indicator
5. Fuel Level/Drain Fuel Sump
6. Transmission Oil Level

7. Tire Pressure
8. Lubricate Circle and Slide Rails with Graphite or Recommended Lubricants

Walk around inspection for loose nuts, bolts, belts and for oil leaks or operational damage.

WEEKLY CHECKS

The following points must be serviced or checked weekly.

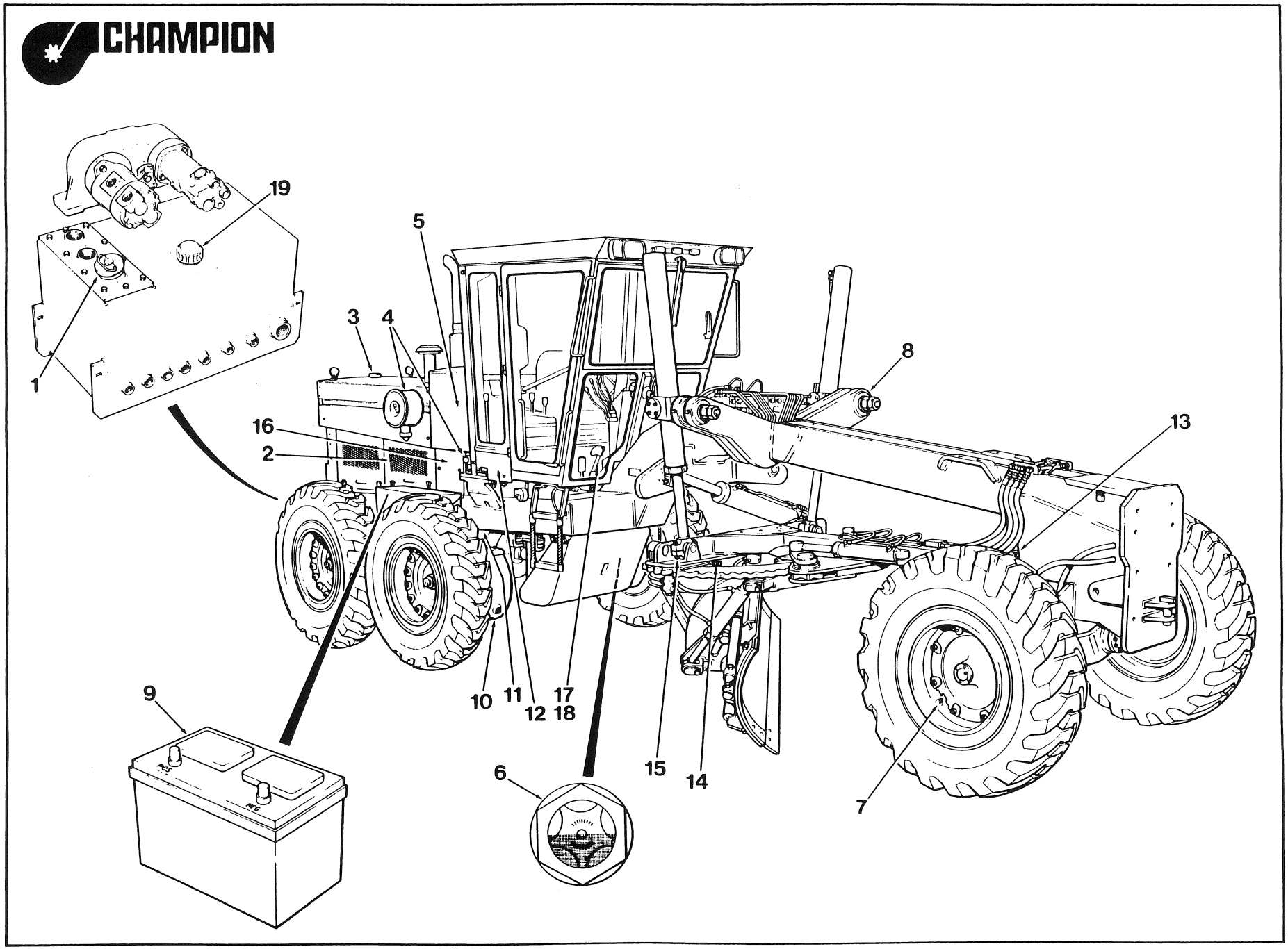
5. Drain Fuel Water Separator
8. Grease Fittings Per Lube Chart
9. Battery Electrolyte Level (If Maintenance Type)
10. Tandem Oil Level
11. Final Drive Oil Level
12. Clutch and/or Brake Master Cylinder Level
13. Drawbar Ball Stud Adjustment
14. Circle Adjustment
15. Split Ball Cap Adjustments
16. Check Clutch Slave Cylinder Adjustment

Walk around inspection.

MONTHLY CHECKS

Bolts and nuts in areas of stress should be checked with a torque wrench along with the following:

4. Check Air Cleaner Elements and Induction System
8. Grease Fittings Per Lube Chart
17. Clutch and/or Brake Pedal Adjustment
18. Clutch Brake Adjustment
19. Clean Hydraulic Tank Breather


CHAMPION
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700 SERIES OPERATOR'S MANUAL
LUBRICATION SPECIFICATIONS

APPLICATION	CAPACITY	LEVEL CHECK INTERVAL	FILTER CHANGE INTERVAL	LUBRICANT CHANGE INTERVAL	LUBRICANT
TRANSMISSION SYSTEM	53 litres 14 gallons	Daily	500 hours	500 hours clean suction screen	DEXRON II
HYDRAULIC SYSTEM	159 litres 42 gallons	Daily	500 hours	1000 hours or 12 months clean suction screens (2)	SAE 10W ISO Grade 32 DEXRON II
FINAL DRIVE MODELS 720 - 760 DOUBLE REDUCTION	34 litres 9 gallons	Weekly	–	2000 hours or 12 months	SAE 80W/90 SAE 75W/90 SAE 85W/140 (API GL-5 spec.)
FINAL DRIVE MODEL 710 SINGLE REDUCTION	19 litres 5 gallons	Weekly	–	2000 hours or 12 months	SAE 80W/90 SAE 75W/90 SAE 85W/140 (API GL-5 spec.)
TANDEMS MODELS 720 - 760 (EACH)	32 litres 8.5 gallons	Weekly	–	2000 hours or 12 months clean 2 magnetic drain plugs	SAE 10W ISO Grade 32 DEXRON II
TANDEMS MODEL 710 (EACH)	30 litres 8 gallons	Weekly	–	2000 hours or 12 months clean 2 magnetic drain plugs	SAE 10W ISO Grade 32 DEXRON II
TANDEMS OIL DISC BRAKES ALL MODELS (EACH)	100 litres 26.5 gallons	Weekly	–	1500 hours clean 2 magnetic drain plugs	Tractor Hydraulic Fluid to SAE 10W Specification
PUMP DRIVE GEARBOX (IF INSTALLED)	1,0 litre 0.26 gallons	Weekly	–	1000 hours	SAE 80W/90 SAE 75W/90 SAE 85W/140 (API GL5 spec.)
ALL WHEEL DRIVE SYSTEM HYDRAULIC SYSTEM	38 litres 10 gallons	Daily	1000 hours	2000 hours or 12 months	SAE 10W ISO Grade 32 DEXRON II
ALL WHEEL DRIVE SYSTEM PLANETARY REDUCTION UNIT	1,5 litre 0.39 gallons	Weekly	–	First 50 hours, then 1000 hours or 12 months	SAE 80W/90 SAE 75W/90 SAE 85W/140 (API GL-5 spec.)
BRAKE FLUID	–	Weekly	–	–	SAE J1703, Nov. 83 DOT 3
FRONT WHEEL BEARINGS	–	–	–	500 hours	Refer to Lubrication Chart
ALL GREASE FITTINGS	–	–	–	–	Refer to Lubrication Chart

ALL GALLON MEASUREMENTS ARE IN U.S. UNITS

ALL GEAR OILS MUST MEET U.S. MILITARY MIL-L 2105C AND API-GL-5 SPECS.

FOR ALTERNATIVE LUBRICANTS, CONSULT YOUR CHAMPION DEALER

FOR ENGINE, REFER TO ENGINE MANUAL

CHAMPION MOTOR GRADERS

CIRCULATE TO:

PARTS MANAGER_____

SALES MANAGER_____

RETURN TO:

SERVICE MANAGER_____

PRODUCT SUPPORT BULLETIN No. 493 (Revised)

SUBJECT: Transmission Oils (Replaces Bulletin No. 493 of March, 1989) **January, 1990**

The following recommendations apply to model **9135, 9138, 9150** and **8400** transmissions.

Temperature Range	Oil Recommendation
32° F to 122° F (0° C to 50° C)	SAE 30 high quality engine oil (API CD or CE) qualified to Allison C-3 and TO-2 specifications
-4° F to 104° F (-20° C to 40° C)	SAE 10W high quality engine oil (API CD or CE) qualified to Allison C-3 and TO-2 specifications
-22° F to 104° F (-30° C to 40° C)	SAE 5W20 high quality engine oil (API CD or CE) qualified to Allison C-3 and TO-2 specifications
-31° F to 104° F (-35° C to 40° C)	SAE 0W30 (semi-synthetic) high quality engine oil (API CD or CE) qualified to Allison C-3 and TO-2 specifications
Below -31°F (-35°C)	See **Cold Weather Operation** below

When changing the transmission oil, you must choose the correct oil from the chart above according to the temperature range in which the grader is operating.

From grader serial number **19670**, the transmission is filled with SAE 10W high quality engine oil during manufacture unless otherwise specified. At the next lubricant change, Champion recommends you refill all existing grader transmissions with the appropriate oil shown in the chart above. You should change the transmission oil every 1000 hours.

Champion also recommends changing the oil as soon as possible in all model 730 and larger graders equipped with 8400 transmissions and operating in heavy work environments.

Cold Weather Operation

When operating in temperatures below -31° F (-35° C), you can use the recommended oils provided the following conditions apply:

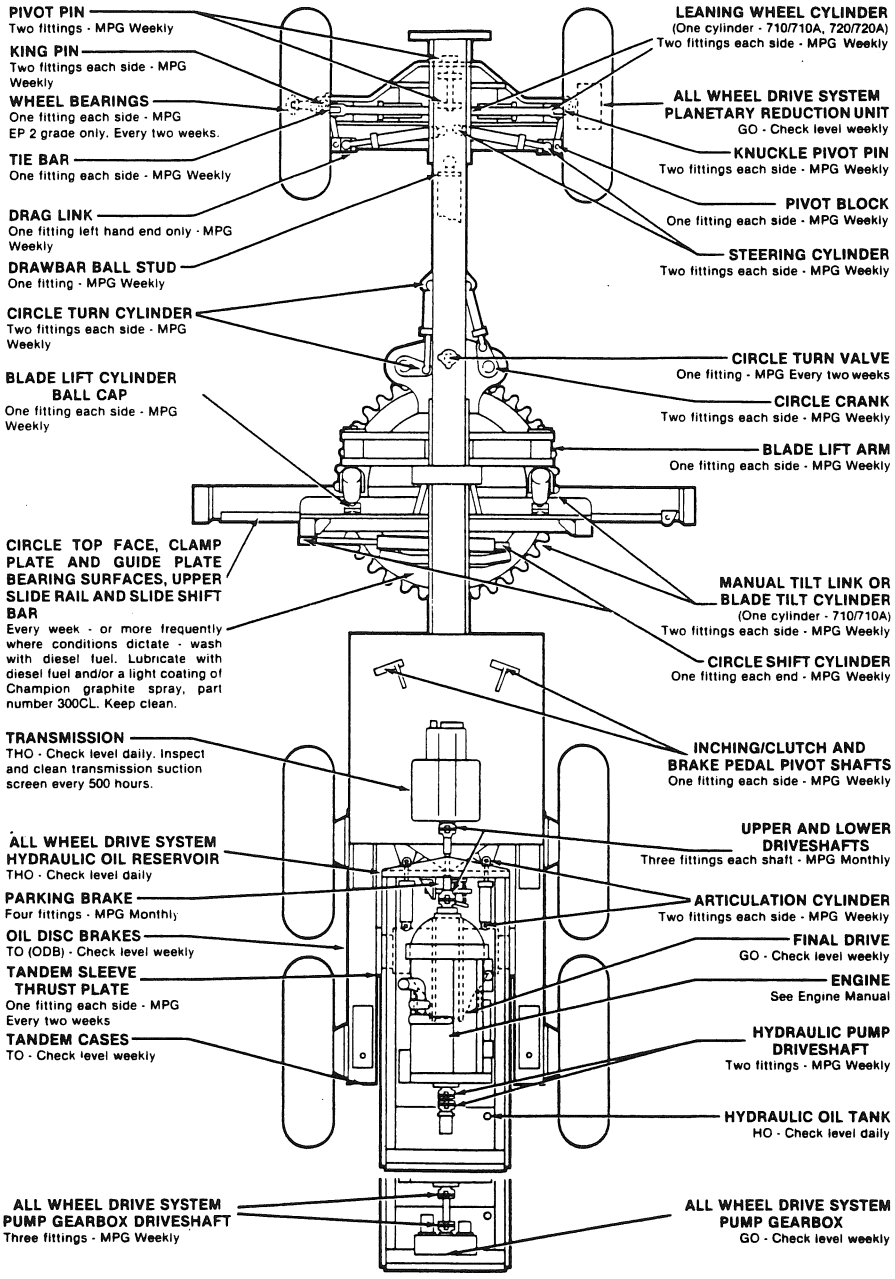
a) Before start up, the oil is preheated to a temperature above the minimum value in the applicable range.

b) The operating temperature stays above the minimum value in the applicable range.

Failure to comply with these recommendations or procedures may result in a malfunction or reduced life of the transmission, engine clutch or hydraulic pump.

This Product Support Bulletin advises you of a product improvement/maintenance suggestion
and does not imply that its contents are subject to a campaign program

700 SERIES LUBRICATION CHART



NOTE: Daily inspection intervals are from four to twenty-four hours of operation.
Lubrication intervals at 50 hours or weekly; whichever occurs first.
Lubrication intervals at 250 hours or monthly; whichever occurs first.

During the daily walk around inspection, examine all greased joints for traces of clean grease. Champion recommends increasing the greasing frequency for graders operating in extremely dusty or wet conditions; also if dry joints are apparent.

LUBRICANTS	RECOMMENDED LUBRICANT		
	FROM -40°C (-40°F) TO 10°C (50°F)	FROM -20°C (-4°F) TO 30°C (86°F)	FROM 30°C (86°F) AND UP
GO - GEAR OIL	SAE 75W/90	SAE 80W/90	SAE 85W/140
MPG - MULTI-PURPOSE GREASE LITHIUM SOAP BASE EXTREME PRESSURE	EP 1* or EP 0*	EP 2	
	* Front Wheel Bearings:- EP 2 Grease for all Temperatures		
HO - HYDRAULIC OIL	DEXRON II	SAE 10W, ISO Grade 32	
TO - TANDEM OIL	SAE 10W, ISO Grade 32 DEXRON II		
TO (ODB) - TANDEM OIL OIL DISC BRAKES ONLY	Tractor Hydraulic Fluid to SAE 10W Specification		
THO - TRANSMISSION HYDRAULIC OIL	DEXRON II		

43531

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FRONT AXLE

1. Front Wheel
2. Spindle Nuts
3. Hub Cap
4. Tab Washer
5. Wheel Bearings
6. Back-up Ring
7. V-ring Seal
8. Spindle
9. Key Pin
10. Radius Arm
11. Adjusting Pin
12. Pivot Block
13. Steering Yoke
14. Lock Nut
15. Steering Drag Link
16. King Pin Bearings
17. Thrust Bearing
18. Seal
19. Knuckle Pin Bearings
20. Rear Pivot Pin Bushing
21. Axle Pivot Pin
22. Knuckle Pin Lock
23. R.H. Steering Cylinder
24. R.H. Leaning Wheel Cylinder*
25. Leaning Wheel Tie Bar
26. L.H. Steering Cylinder
27. L.H. Leaning Wheel Cylinder
28. Shim Pack
29. Front Bearing Cap
30. Front Pivot Pin Bushing
31. Axle Frame

The front axle of a motor grader must perform several functions such as: steering, oscillation, providing front wheel lean, and carrying heavy front-mounted attachments. The Champion front axle is designed to do all these things and provide long life with a minimum of maintenance.

Both the kingpin and knuckle pin are supported by needle bearings and require only recommended lubrication. The kingpin is a uniform diameter and turns with the spindle. Thrust loads are transmitted to the spindle from the knuckle by a roller thrust bearing. The knuckle is hardened in the areas carrying bearings. The knuckle pin is secured to the knuckle by a knuckle pin lock and is torqued to 75 ft./lb. The keypin nut which locks the kingpin to the knuckle is also torqued to 75 ft./lb.

The front axle bearings have grease fittings in the hub caps. Lubricate the bearings according to the lubrication chart. Lube until fresh grease is pushed out past the V-ring seal on the inside of the wheel. Repacking front wheel bearings is not required.

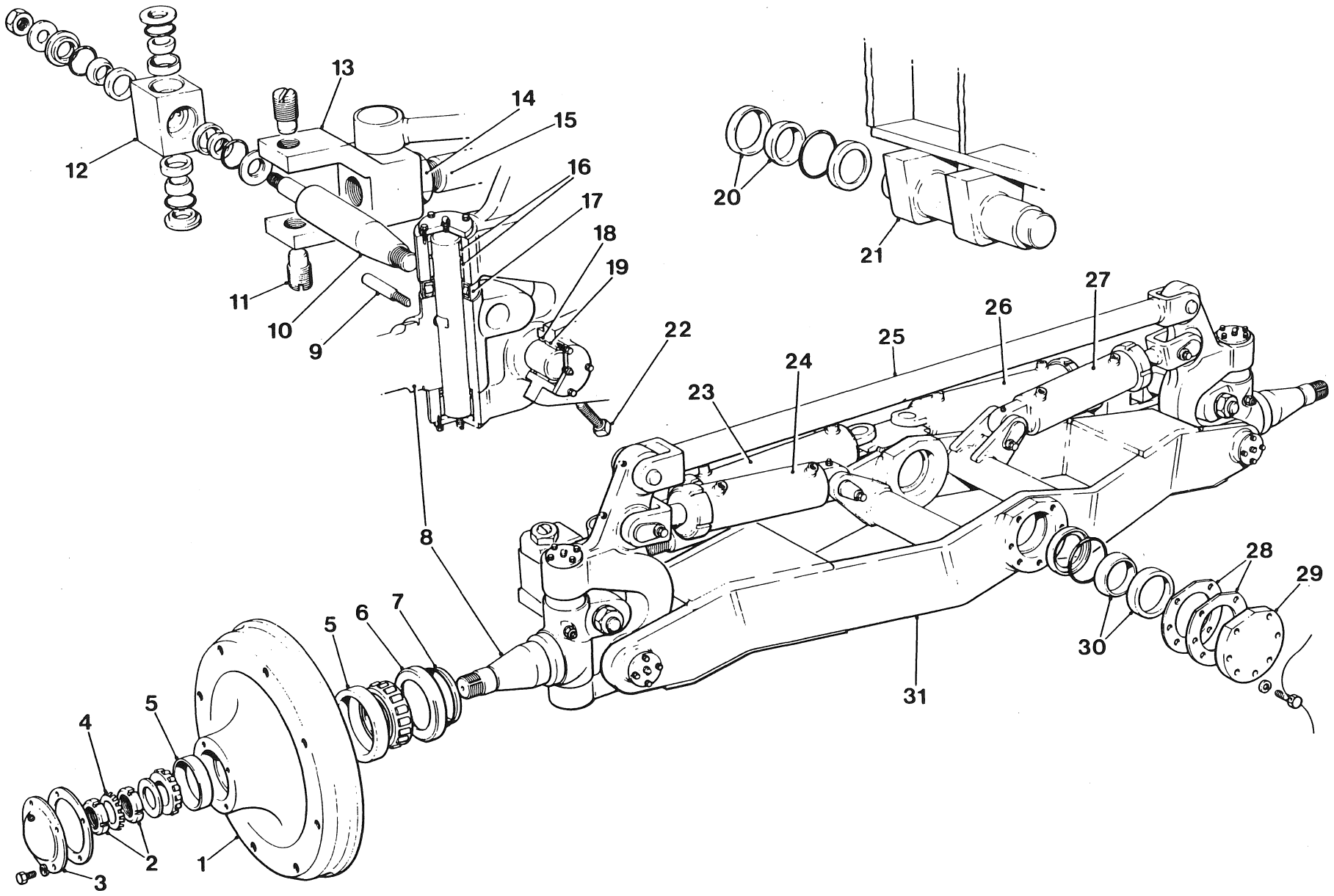
The front axle pivot pin bearing preload should be checked every 250 hours by raising the front end off the ground and pulling or standing on one wheel to move it down. It should take at least 150 lbs. to move the wheel down. If less force is required a shim should be removed from behind the front bearing cap to bring it back to specification.

Also at 250 hours check, by moving the steering wheel, for any free play between pivot block and steering yoke. To remove any free play tighten both upper and lower adjusting pins.

The final adjustment required is toe-in. This procedure is described on the following two pages.

*Optional on some models

CHAMPION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LEANING WHEEL AND TOE-IN ADJUSTMENT

1. Steering Drag Link
2. Steering Cylinder
3. Leaning Wheel Cylinder
4. Leaning Wheel Knuckle
5. Leaning Wheel Tie Bar
6. Axle Pivot Stops

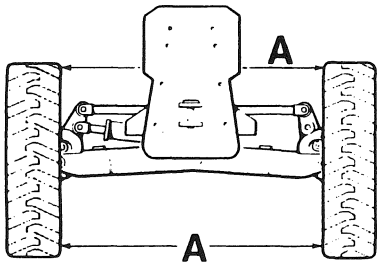
A. Camber - 1° positive
B. Toe-In Rear Measurement
C. Toe-In Front Measurement

The front axle assembly is designed around three basic functions. Oscillation of the whole assembly under the grader main frame allows the wheels to travel over uneven ground with minimal amount of the movement being transferred to the main frame. It also allows one wheel to ride a windrow as shown The blade will move or spread the windrow and the main frame remains level because the driving wheels are on the graded surface.

The leaning wheel function allows the wheels to lean 18 degrees right or left to offset loads on the moldboard. It gives better stability while grading on slopes by allowing the operator to keep the wheels vertical. It also gives better cornering ability by reducing the turning radius.

The third function is steering and it is directly affected by the other two. The front wheels steer 44 degrees right and left of centre.

Caster and 1° positive camber have been built into the front axle assembly and cannot be adjusted as indicated by Dimension "A." Toe-In as indicated in Fig. 2 is 1/2"-5/8". By loosening the lock nut on the right hand end of the steering drag link, the link can be rotated to attain the required adjustment. Measurements are taken from the tire centre line as shown, at spindle level. Dimensions "C" must therefore be 1/2"-5/8" shorter than "B."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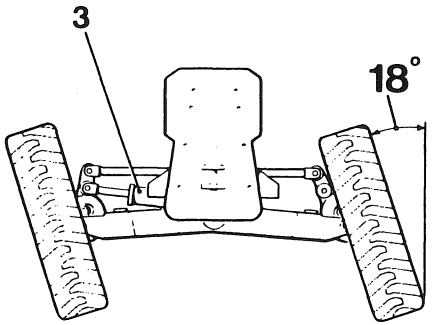
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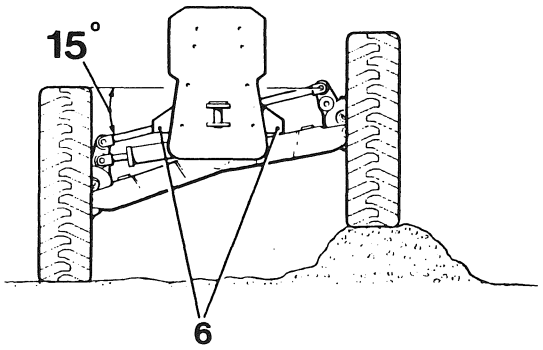
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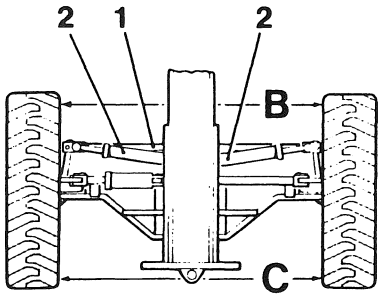
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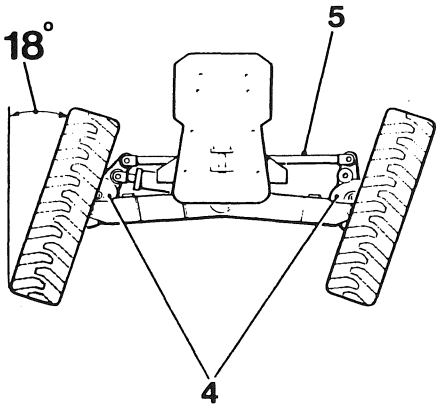
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STEERING SYSTEM
720-760

1. Main Hydraulic Tank
2. Steering Pump
3. Priority Port
4. Secondary Port
5. Brake Master Cylinder
6. Hydraulic Filter
7. Clutch Master Cylinder
8. Flow Divider
9. Steering Wheel
10. Steering Unit
11. Cushion Valve
12. L.H. Steering Cylinder
13. Steering Drag Link
14. Front Axle
15. R.H. Steering Cylinder

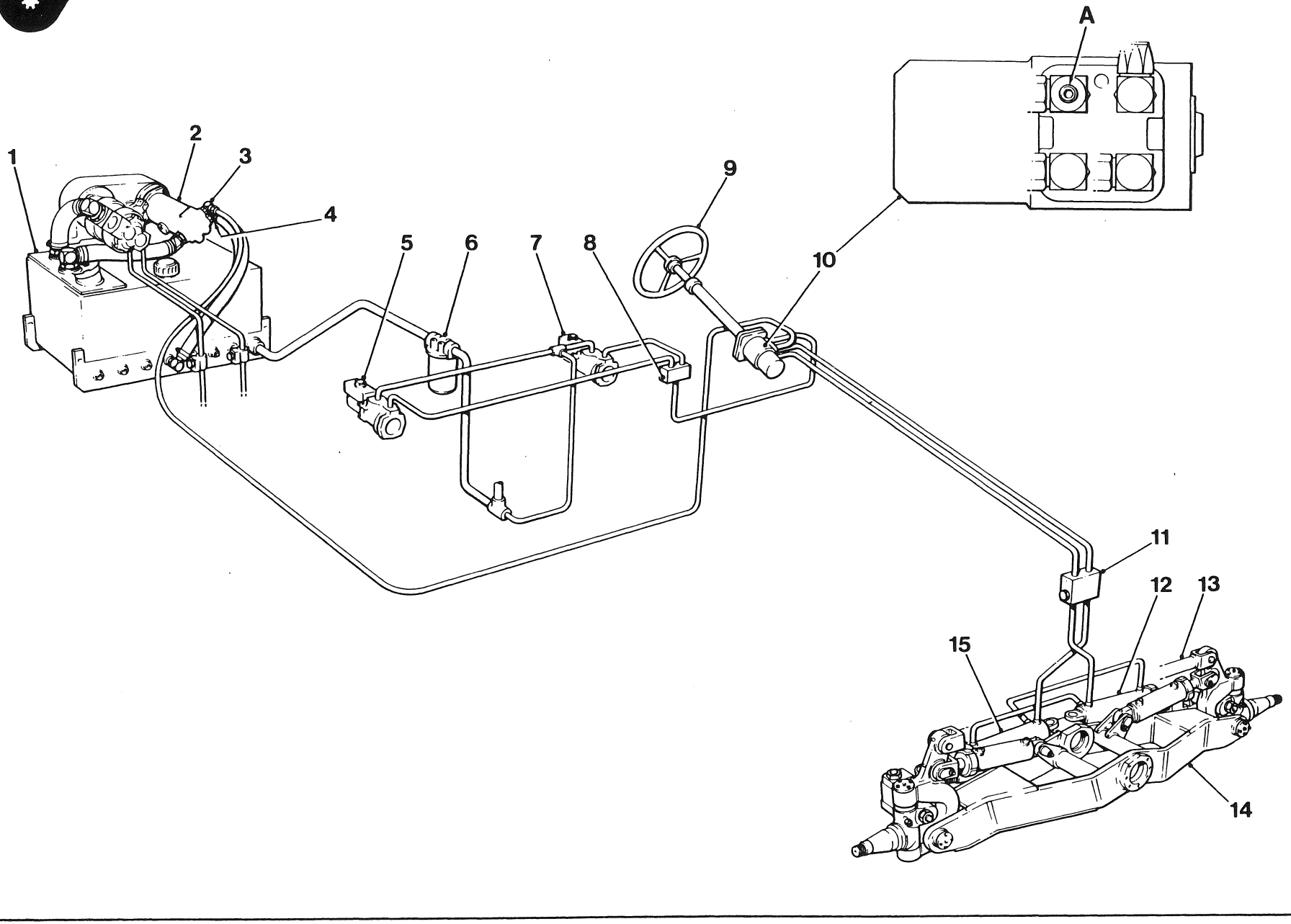
Oil is drawn from the hydraulic tank through the suction screen to the steering pump. This steering pump has a capacity of 25 U.S. GPM @ 2100 RPM. When the engine is idling full steering control is maintained. However, since the steering unit has a maximum capacity of 12 U.S. GPM, a priority flow valve is incorporated into the steering pump to limit the flow to 12 GPM. The remainder of the oil flow produced by the pump is ported directly back to the tank.

A relief valve incorporated into the pumping housing protects the system with a full open maximum pressure setting of 2200 PSI.

Oil follows the circuit forward to the steering unit which directs the flow to the cylinders or simply ports it to return if it is not required. Two hydraulic cylinders convert the oil flow to mechanical power to turn the front wheels. To protect the mechanism a cushion valve interconnects the two lines when the pressure in one reaches 1150-1200 PSI @ full flow or as low as 800 PSI at minimum flow.

Downstream from the steering unit a 50/50 flow divider splits the return flow to operate the clutch and brake boosters. Built into each booster is a relief valve which protects them at a maximum setting of 290-310 PSI. Effective on grader serial number 16806 (Canada) and 2412-2 (U.S.A.) and up, the clutch booster and flow divider was eliminated as standard equipment. Following this change, the entire steering oil return flow was directed to the brake booster. After flowing through the boosters the steering oil joins the main hydraulic oil flow through the filter into the tank.

The relief valve pressure, cushion valve pressure or the brake and clutch boost pressure can be checked at the test port A.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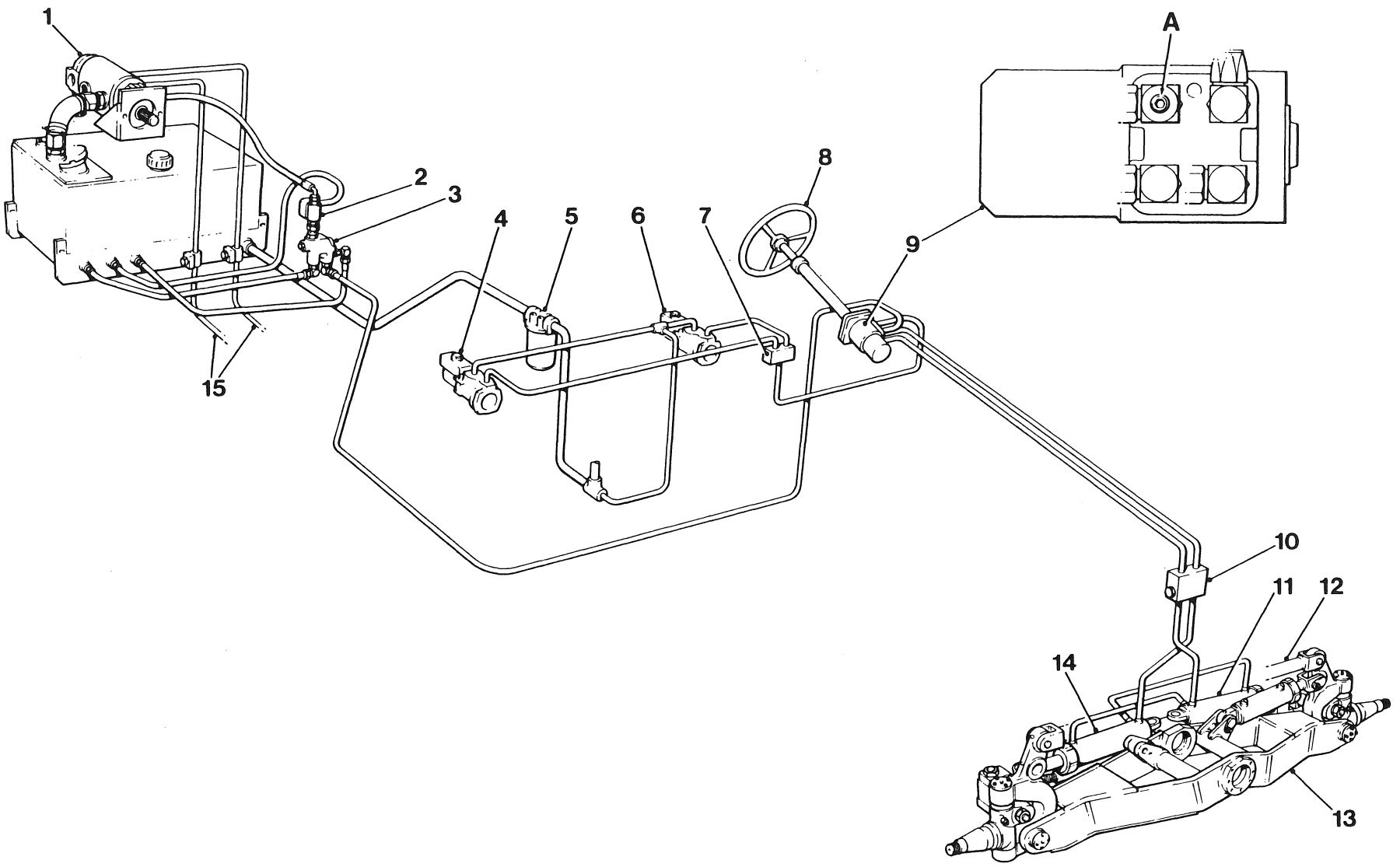
STEERING SYSTEM
710/710A

1. Steering Pump Section
2. Relief Valve
3. Priority Valve
4. Brake Master Cylinder
5. Return Filter
6. Clutch Master Cylinder
7. Flow Divider
8. Steering Wheel
9. Steering Unit
10. Cushion Valve
11. L.H. Steering Cylinder
12. Steering Draglink
13. Front Axle
14. R.H. Steering Cylinder
15. To Main Hydraulic Circuit
16. Priority Valve Relief Line (not installed on U.S. manufactured graders)

The 710 steering system is the same as 720-760 models steering system except as noted below.

Pressure oil is supplied by the front section of the triple section pump. It supplies 25 GPM at 2500 RPM. To reduce flow at higher RPM's and still maintain full performance at low RPM, a priority valve is used. On 710 s this priority valve is remote mounted, just ahead of the main hydraulic tank. As an added safety feature, a relief valve is used between the hydraulic pump and priority valve. Both oil relieved at high pressure and excess oil from the priority valve are routed back to the hydraulic tank. At this point the regulated 12 GPM oil flow goes to the steering unit and follows the same route as on 720-760 models.

The relief valve pressure, cushion valve pressure or the brake and clutch boost pressure can be checked at the test port A.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PUMP DRIVE ASSEMBLY
720-760

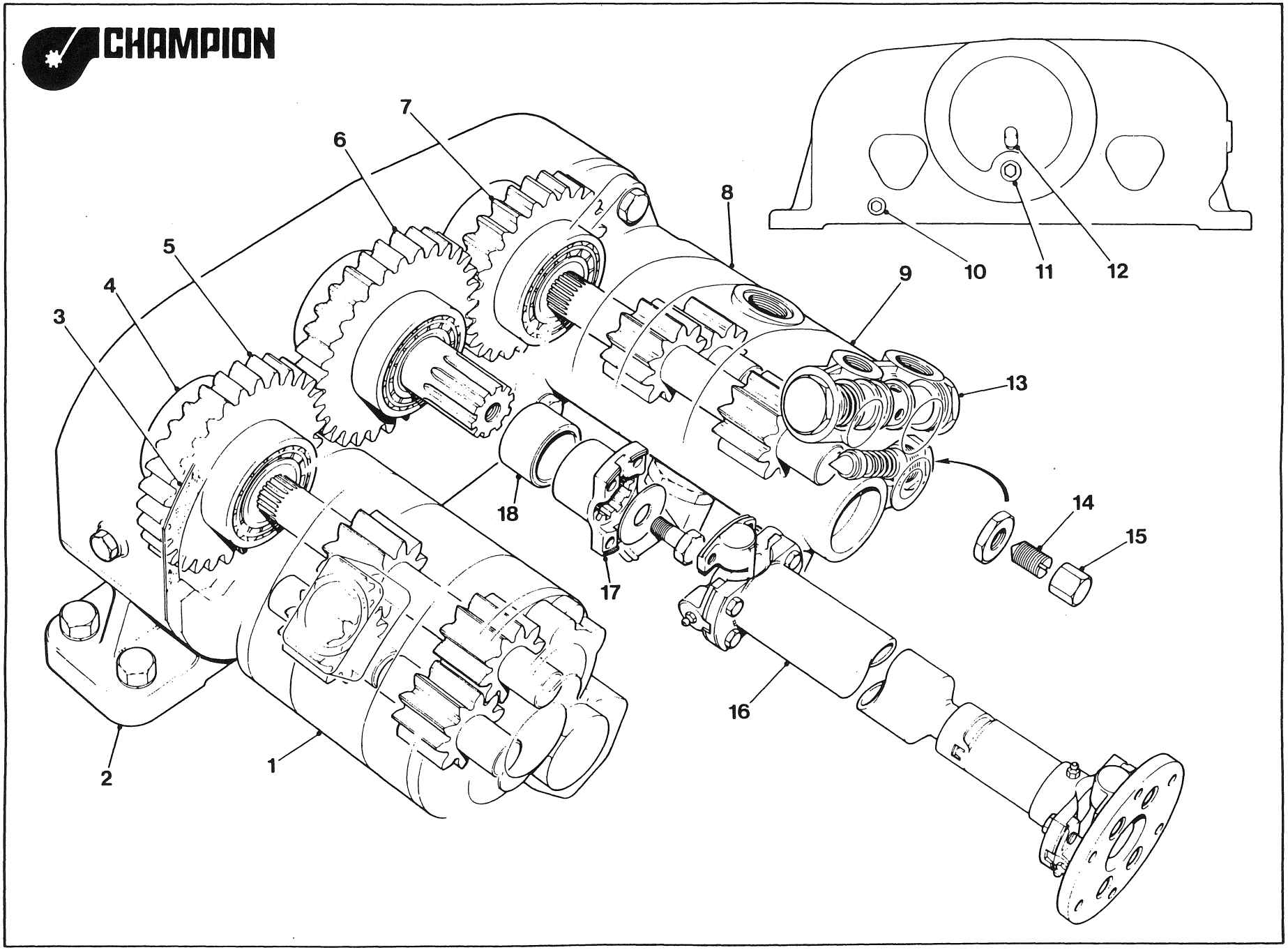
1. Hydraulic Pump
2. Pump Drive Case
3. Shims
4. Support Bearing
5. Hydraulic Pump Gear
6. Drive Gear
7. Steering Pump Gear
8. Transmission Pump Section
9. Steering Pump Section
10. Oil Drain Plug
11. Oil Level Plug
12. Breather
13. Priority Flow Valve
14. Relief Valve Adjusting Screw
15. Adjusting Screw Cover
16. Drive Shaft
17. Input Yoke
18. Spacer

Supporting the gears inside the gearbox allows the serviceman to change hydraulic pumps with greater ease. The pump gears are straddle mounted on tapered roller bearings adjusted to .001" to .005" end float through the shim packs located under the front bearing caps. The center drive shaft is designed and adjusted to the same specifications. The shim pack is at the rear of this shaft.

Splined shafts join the pumps to the gears eliminating keyways and keys. While all capacities remain the same, the pumps are not interchangeable with previous installations.

The drive shaft capacity is increased. The input yoke is splined to the gearbox input shaft and retained with a capscrew. The slip-joint is between the universal joints. Grease fittings for the crosses are in the ends rather than the center of the cross for easier lubrication.

The gearbox has its own oil sump and is lubricated with gear oil to be checked weekly and changed every 2,000 hours.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MAIN HYDRAULIC SYSTEM

1. Main Hydraulic Tank
2. Hydraulic Suction Line
3. Pump Drive Assembly
4. Main Hydraulic Pump
5. Breather Cap
6. Main Hydraulic Relief Valves
7. Rigid Circuit (If Applicable)
8. Electric Solenoid Valve
9. Thermal Relief Valve
10. Hydraulic Return Filter
11. Control Console
12. Main Manifold
13. Counterbalance Valve (720 to 760)
14. Blade Lift Cylinder
15. Hydraulic Hoses
16. Cushion Valve
17. Circle Timing Valve
18. Swivel Connector
19. Articulation Cylinder
20. Suction Screen
21. Inspection Cover
22. Dipstick/Inlet Strainer

Oil is supplied from the hydraulic tank through a suction strainer to a tandem section gear type pump. On 720 - 760 graders this pump is driven by a pump drive gearbox that also drives the steering/transmission pump. Each section of the hydraulic pump supplies 20 GPM at 2100 RPM.

710 s use two sections of a three section gear pump which is driven directly by a drive shaft from the engine. Each of these two sections supplies 17 GPM at 2500 RPM. The third section supplies oil for steering and brake boost units (A).

Two relief valves are mounted directly to the front of the hydraulic tank. They regulate pressure in each separate line to 1900 PSI at 2100 RPM when measured at the manifold test ports. Pressure oil is supplied to two 4-section manifold valves by two separate lines (C).

Oil returns (B) through a 10 micron spin-on type return filter and to the hydraulic reservoir. This filter is directly below the fuel tank on left side of grader. The filter must be changed every 500 hours and the hydraulic fluid, Shell Tellus 32 or Dexron II, should be replaced every 1000 hours or annually (whichever comes first). At the same time the suction screens should be removed and cleaned.

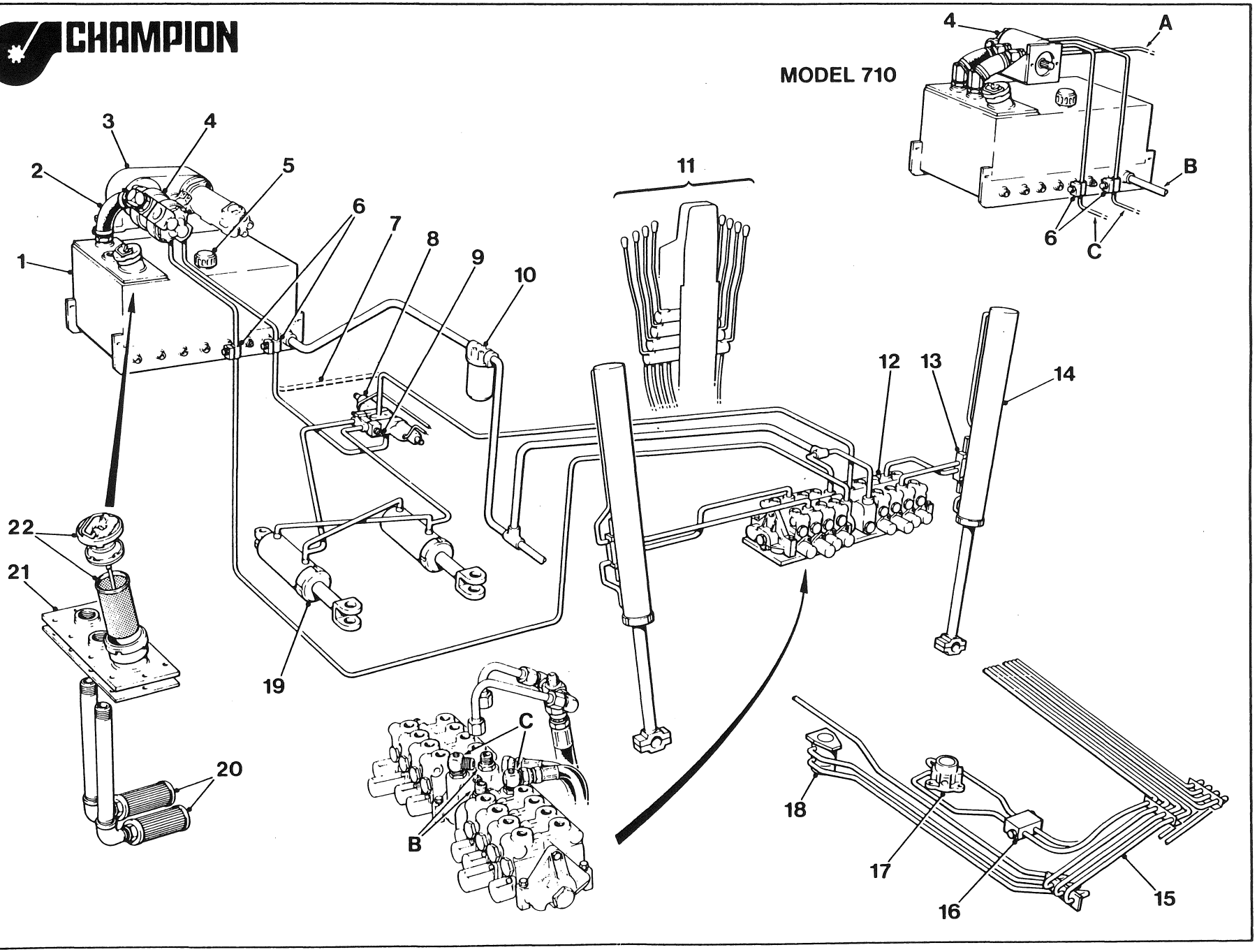
If the unit has articulation, two articulation cylinders are used to operate the articulation hinge. These cylinders are connected to each other in parallel — as one extends the other retracts. The articulation circuit, however, is in series with the rest of the hydraulic system. Oil leaving the cylinders continues to the main manifold, not directly to return.

To articulate, the operator moves a self-centering toggle switch mounted on the wheel lean lever. This sends electrical current to one solenoid on the electric solenoid valve. This valve is mounted near the final drive on the left hand side of the grader. Energizing the solenoid pulls the valve spool to one side allowing oil flow to the head end of one articulation cylinder and the rod end of the other. This articulates the machine.

Thermal relief and cross over relief valves are incorporated into the electric solenoid valve to protect the system from excessive pressure.

CHAMPION

MODEL 710



MAIN RELIEF VALVE

1. Valve Body
2. Valve Seat
3. Valve Piston
4. "O-Ring" Seal
5. Piston Seal
6. Valve Cartridge
7. Cap
8. Shim

The main relief valves limit the pressure in the hydraulic system to protect system components. The two relief valves are located directly on the front of the hydraulic reservoir and are teed into each supply line from the pumps. When pressure in the system exceeds the relief valve setting the valve piston moves off its seat opening a passage directly into the hydraulic reservoir.

To check a relief valve: **A)** Place a 0-2500 PSI gauge in one of the test ports on the inlet section of the manifold valve. **B)** When a cylinder in that section is "bottomed-out" the gauge will show the relief setting of that relief valve. **C)** To set the valve to the specified 1750 PSI (± 100 PSI), remove the cap and add shims to increase the pressure and remove shims to decrease pressure. Replace the cap. **(D)** Recheck pressure (step B).

Repeat steps (A-D) for the other section of the Twin Flow hydraulic system and its relief valve.

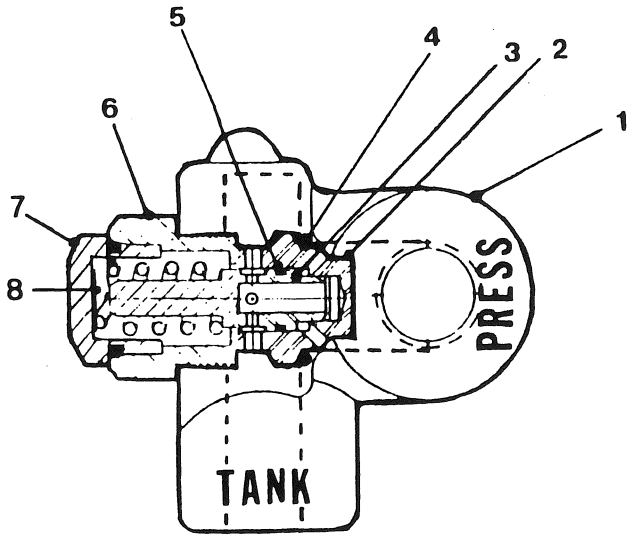
CUSHION VALVE

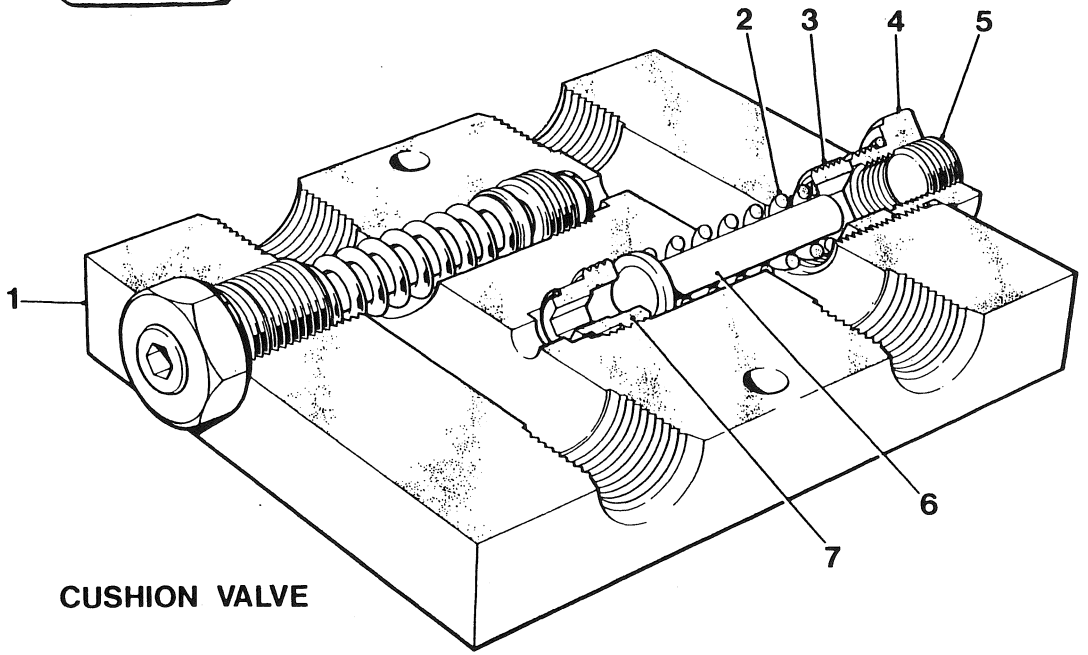
1. Valve Body
2. Spring
3. Adjusting Screw
4. O-Ring Cap
5. Gauge Port
6. Poppet
7. Poppet Seat

The cushion valve is a cross over relief valve used in the Champion hydraulic steering circuit and the circle turn circuit to protect these systems from excess pressure caused by shock loads. As the pressure reaches the preset level of the valve, the poppet pushed against the spring, moves away from its seat and oil is free to bypass into the other line. The hydraulic steering cushion valve pressure is set at 1200 PSI and the circle turn cushion valve is set at 2200 PSI.

CHAMPION

MAIN RELIEF VALVE





CUSHION VALVE

COUNTERBALANCE VALVE

(Not required on the 710 Blade Lift)

1. Valve Body
2. Check Valve Assembly
3. Pilot Piston
4. Check Valve Seat
5. Pilot Poppet
6. Check Poppet
7. Spring Seat
8. Spring
9. End Cap
10. Thermal Relief

The counter balance valve is a pilot operated check valve found in the hydraulic blade lift and leaning wheel circuits. It is used to prevent cavitation, to lock oil into the cylinders and prevent blade lift and leaning wheel cylinder drift. Oil being directed to one end of the cylinder pushes the check poppets against the spring and oil is free to flow into the cylinder. Oil at the other end of the cylinder is locked in and pressure builds back to the pilot piston. The pilot piston is pushed across to the pilot poppet which is moved off its seat and oil is free to flow from the other end of the cylinder. The poppet assembly has been tapered to enable smooth accurate hydraulic control of these circuits. A thermal relief has been incorporated into the valve to allow for thermal expansion within the cylinders. If this expansion causes cylinder pressures to exceed 3000 PSI a small amount of oil will be vented to manifold port P-1 or P-2.

THE POWER TILT LOCK VALVE

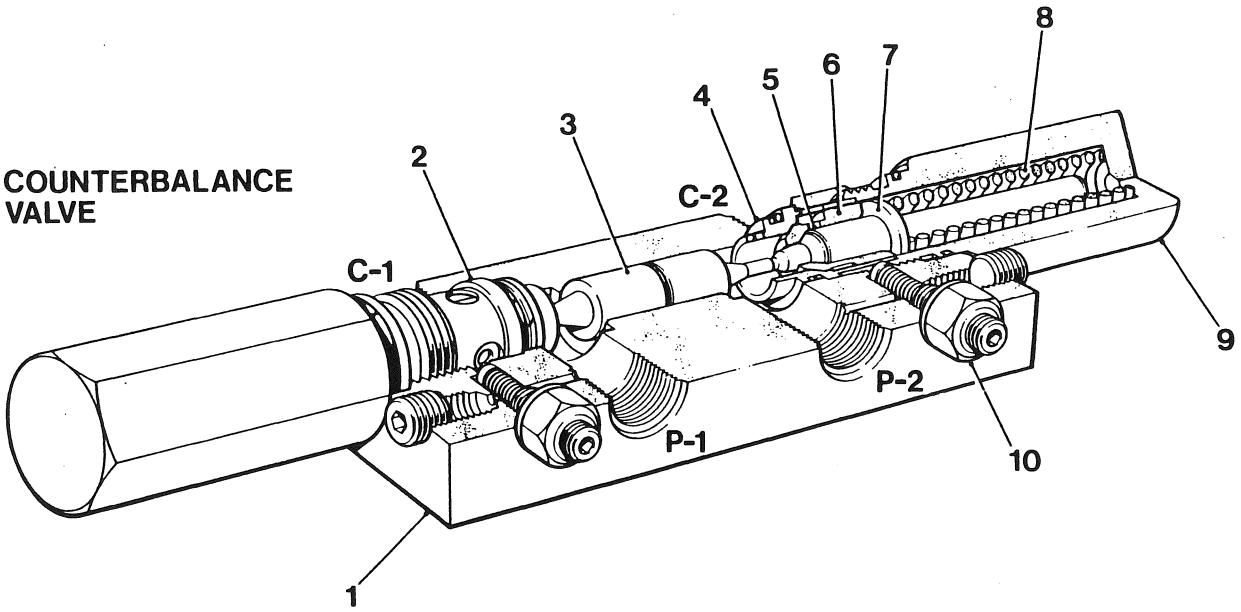
(Not required on the 710)

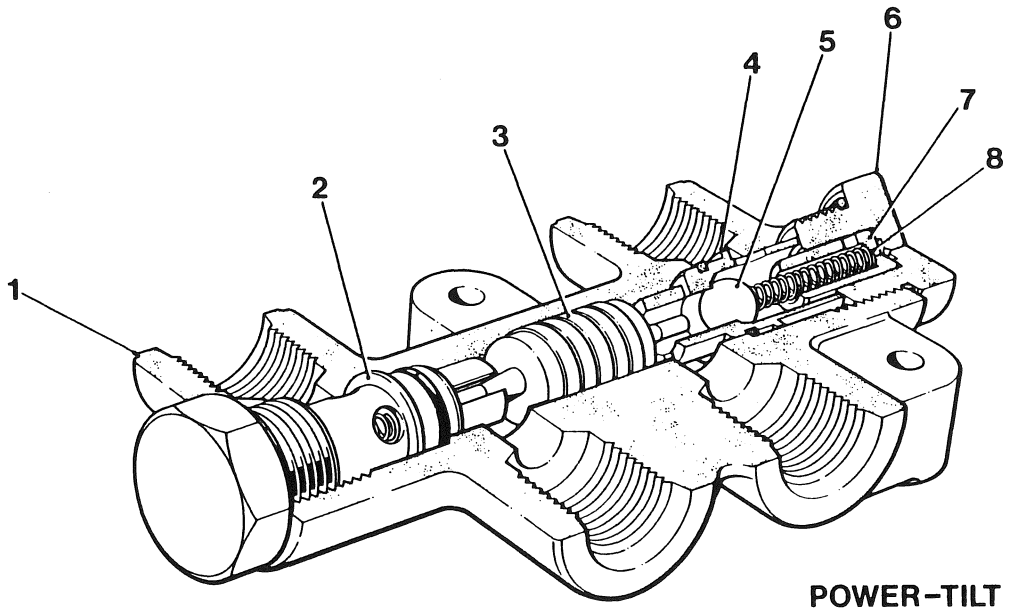
1. Valve Body
2. Check Valve
3. Pilot Piston
4. Check Valve Seat
5. Check Ball
6. O-Ring Cap
7. Spring Seat
8. Spring

The power tilt lock valve is a pilot operated check valve, used in the hydraulic moldboard power tilt circuit to prevent moldboard drift due to control valve leakage. Oil being directed to one end of the cylinder pushes the check ball off its seat and moves the pilot piston to unseat the other check ball allowing oil to flow out of the cylinder. When the control valve is in neutral both check valves are closed locking oil in both ends of the cylinder.

CHAMPION

COUNTERBALANCE VALVE





POWER-TILT LOCK VALVE

CIRCLE DRAWBAR AND MOLDBOARD ASSEMBLY

1. Moldboard
2. Slide Shift Cylinder
3. Lower Slide Casting
4. Power Tilt Cylinder *
5. Circle
6. Circle Draglink Anchor
7. Stirrup
8. Blade Lift Cylinder
9. Stirrup Nut/Locknut
10. Fixed Point Hi-Lift Arm
11. Circle Draglink Cylinder
12. Guide Plate
13. Clamp Plate
14. Timing Valve
15. Circle Turn Cylinders
16. Drawbar **
17. Drawbar Ball Stud
18. Ball Stud Shims
19. Upper Slide Plate

The circle, drawbar, moldboard assembly is the working area of the grader. Long life and good performance depend on proper adjustment, lubrication and maintenance of this assembly. Carefully follow the lubrication chart and operator's manual to perform these tasks.

Lubrication consists of greasing all fittings in this area at the proper interval. Lubrication is required on the circle top surface, inner surface and underside where the clamp plates support the circle. Recommended lubrication is a coating of spray graphite dampened with diesel fuel. Grease or molycoat may be used with some operating conditions. Fresh lubricant should be applied only after cleaning the surface with diesel fuel. Diesel fuel will clean away abrasives and softens dried lubricants.

To keep the blade properly adjusted, all excessive "free play" must be taken out of the assembly. This may be done by the removal of shims from the clamp plates, drawbar ball studs, and cylinder ball clamps. Excessive "free play" may be removed from the slide rails by replacing worn slide castings and plates. For exact adjustments refer to the operator's manual or shop manual.

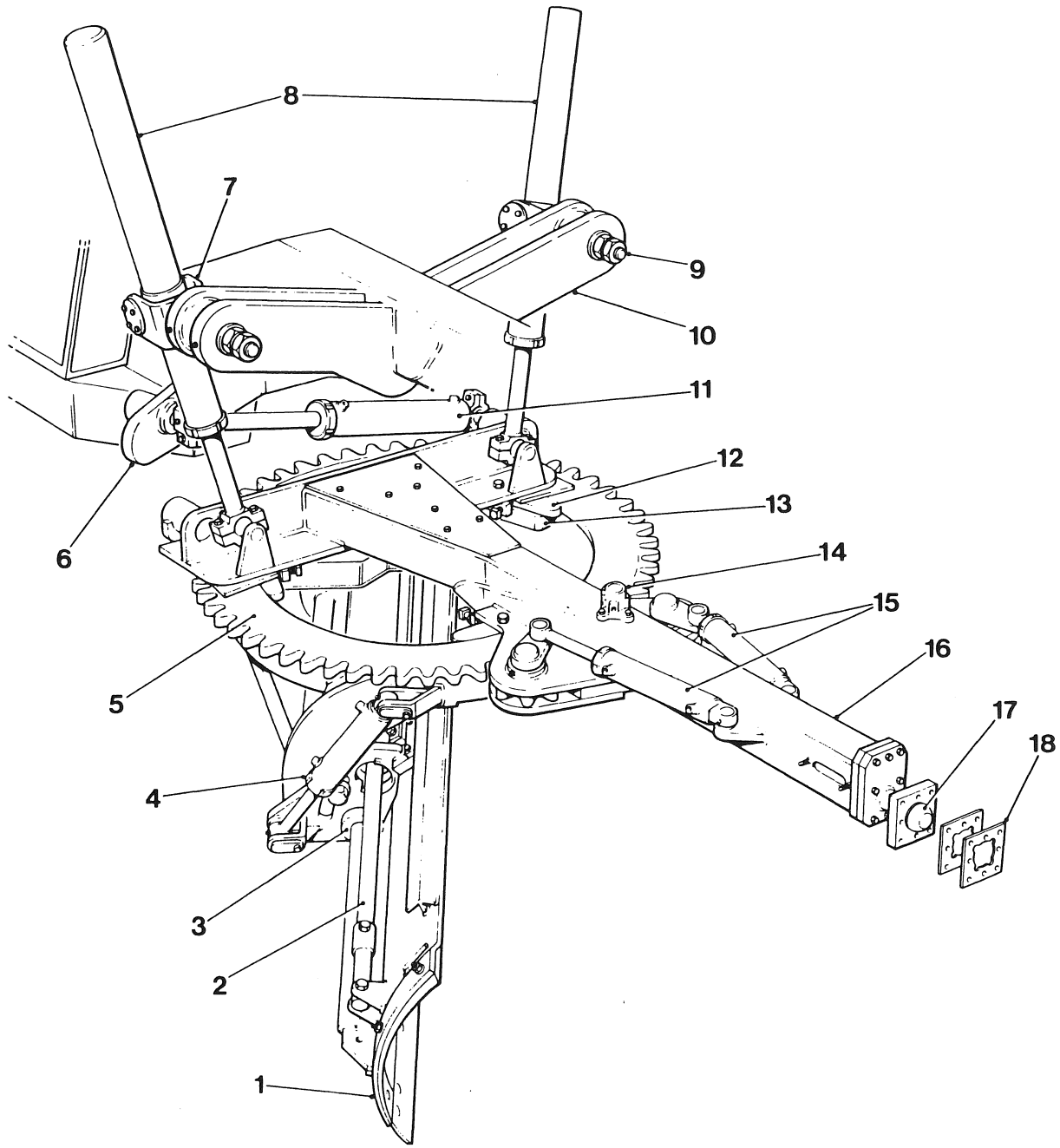
To properly position the circle, the guide plates are used. These are set such that two of the three plates are tight against the circle and the third has 1/16" clearance. There must also be 1/16"-1/8" root clearance between the circle teeth and the drive pinions.

Any visible movement of the stirrup shank or trunion ring bushings (7) indicate a need for adjustment. The nut on the stirrup shank is torqued to 50 ft/lb and the lock nut is then tightened to 400 lb/ft. The trunion ring bushings have a preload sufficient to require a pull of 10 to 16 lbs on the top of the cylinder to move the cylinder in the stirrup. This preload can be adjusted by adding or removing shims.

*710's use only one center-mounted tilt cylinder.

**710 drawbars differ slightly in shape.

CHAMPION



CIRCLE TIMING

1. Circle Timing Valve
2. Pinion Shaft Lock Nut
3. Timing Valve Pinion
4. Left Hand Cylinder
5. Drawbar
6. Right Hand Cylinder
7. Moldboard
8. Circle

A. Side Dimension
B. Tooth Clearance
C. Vertical Clearance
D. Horizontal Clearance

The Champion grader uses two hydraulic cylinders to turn the circle. For satisfactory operation and long life, the circle must be properly adjusted and kept that way. Now and then, for one reason or another, the circle will not turn and as part of the corrective steps, re-timing is necessary.

To time the circle, there is a procedure consisting of three steps. This procedure must be followed each time the timing is checked.

STEP 1

Centre the circle to the drawbar.

Measure from the inside lip of the circle to the side of the swivel joint under the drawbar on both sides. These measurements should be approximately equal as indicated by dimension "A." Now check the drive pinion-to-circle tooth contact. There should be 1/16" to 1/8" (1,59-3,18 mm) root clearance on both sides as indicated by dimension "B." This should position the timing pinion with enough backlash to allow it to move slightly.

STEP 2

Position the cylinders and cranks.

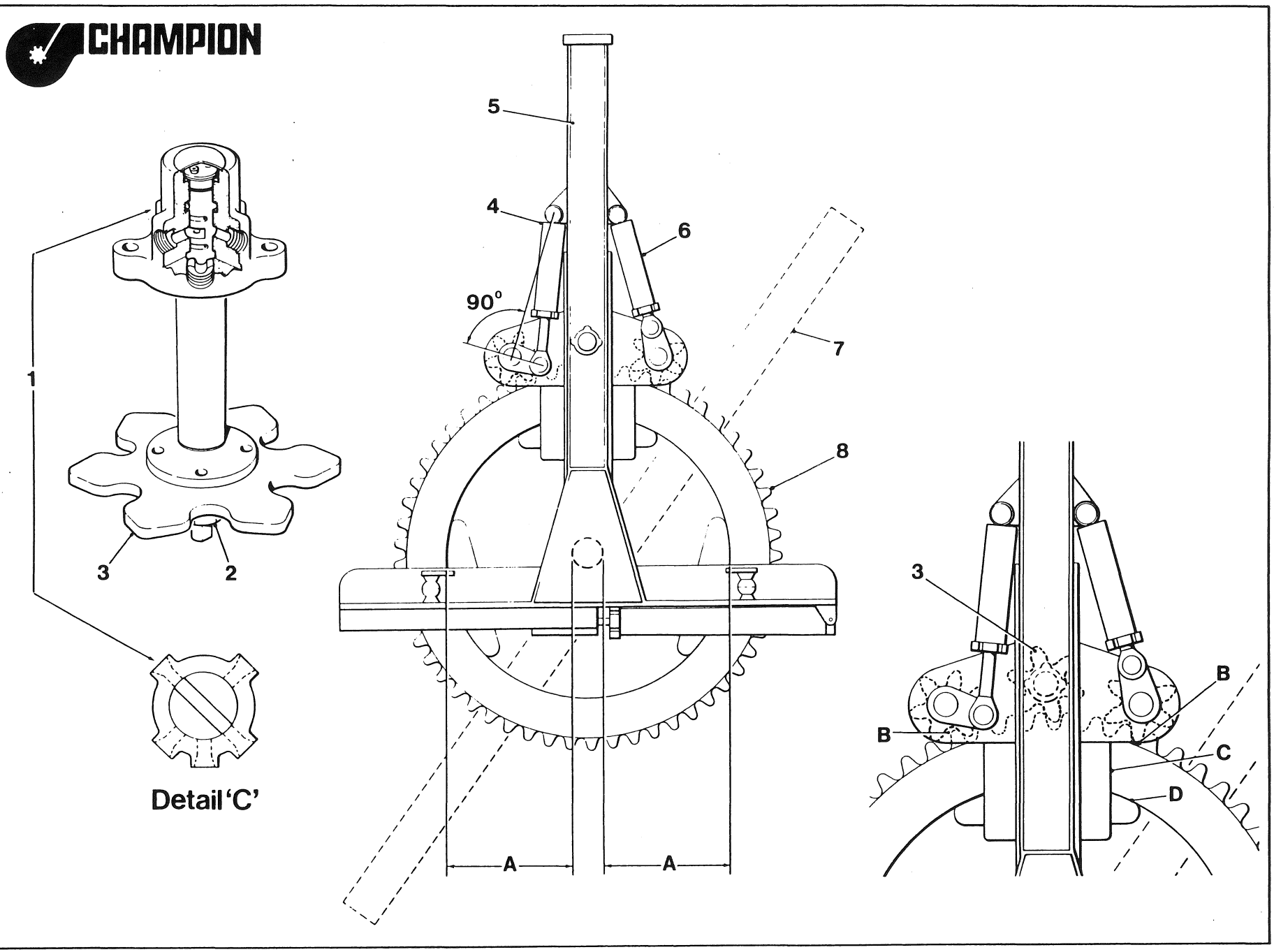
Set the right hand cylinder and crank so that a straight line will intersect all three pivot points. Set the left hand cylinder and crank so that a straight line, drawn between the centre of the cylinder anchor and the centre of the crank shaft, and a straight line through the centre of both pivots on the crank will describe a 90° angle.

STEP 3

Set the timing valve.

Remove the fitting from the port immediately to the right of the two lines leading to the control valve. This port must be completely closed off by the spool inside as shown by detail "C." Ensure that the retainer nut is tight. Replace the fitting.

Excepting damage to other components or systems, the circle will now turn if the procedure has been followed correctly.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TURNING THE CIRCLE

1. Timing Valve Body
2. Timing Valve Spool
3. L.H. Turn Cylinder
4. R.H. Turn Cylinder
5. Circle Turn Cranks

In this series of illustrations we have shown what happens with the control lever pushed forward to turn the circle clockwise out of the timing position.

The top illustration shows the components in their relative positions for the circle timing exercise we just completed: R.H. cylinder is fully retracted and is momentarily stopped before starting its outward movement. The L.H. cylinder is half way through its stroke and is capable of turning the circle (under load) by itself.

Note that the ports that we ensured were closed are, in fact, connected to the R.H. cylinder.

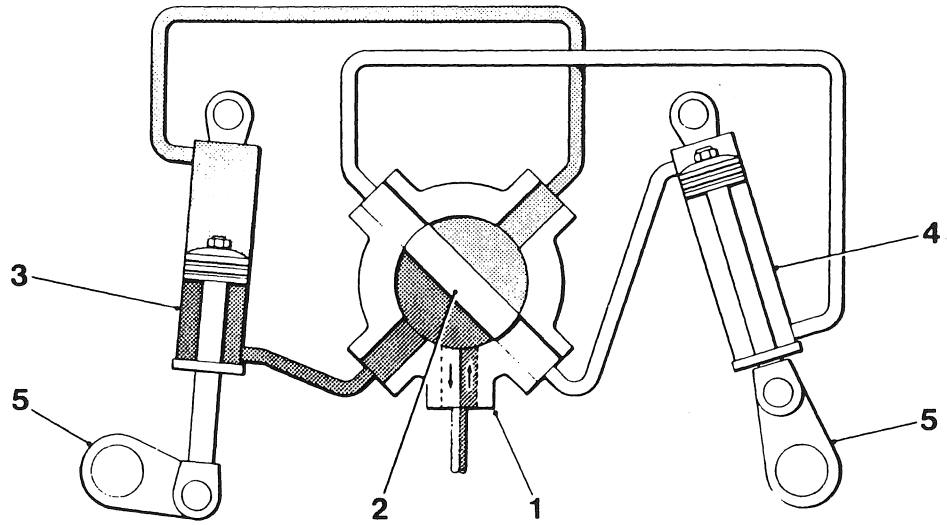
Since it is momentarily stopped, it requires no oil flow.

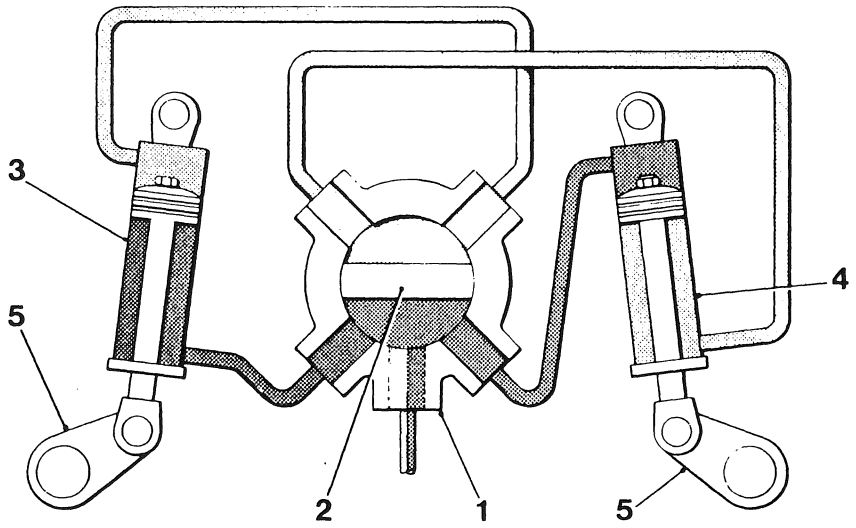
As the control lever is moved we will direct oil to the rod-end of the L.H. cylinder to make it retract. This will move the crank and pinion to turn the circle. As this happens, the R.H. pinion turns it will cause the crank to be offset and in a position to help the L.H. cylinder. The valve pinion also turns the timing valve spool and opens the ports to the R.H. cylinder giving us a situation as shown in the lower L.H. illustration.

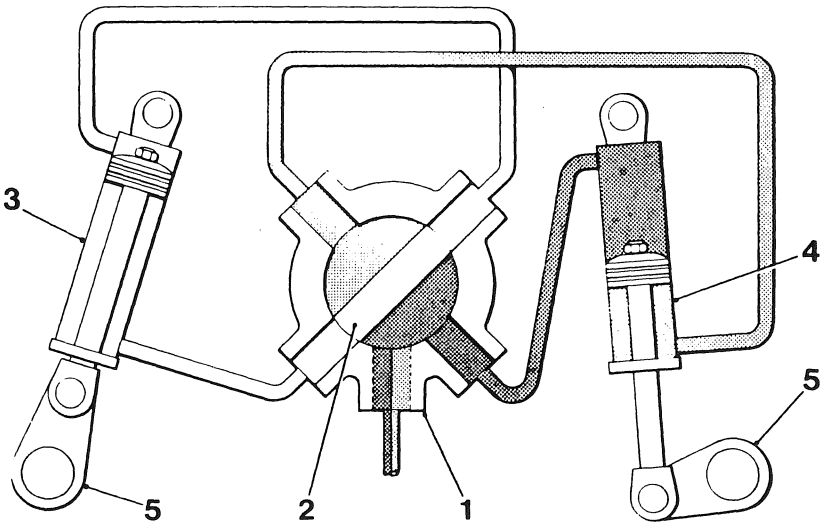
Now follow the sequence to arrive at the position shown in the third diagram.

CHAMPION

SUPPLY
RETURN
STATIONARY







8400 TRANSMISSION AND CLUTCH OIL SUPPLY CIRCUIT

1. 8400 Transmission
2. Transmission Pressure Regulating Valve
3. Breather
4. Transmission Oil Filter
5. Slave Cylinder
6. Clutch Cross Shaft
7. Clutch Housing
8. Pressure Line
9. Oil Cooler Bypass Valve
10. Oil Cooler
11. Transmission Supply Pump*
12. Return from Lock/Unlock**
13. Differential Lock/Unlock Control Valve**
14. Differential Lock/Unlock Cylinder**
15. Suction Line
16. Suction Strainer

Oil is supplied to the transmission and engine clutch by the transmission supply pump. This oil is completely separated from the hydraulic system oil. The oil is drawn through the suction strainer and suction line to the gear pump.

Supply oil is then pushed through the oil cooler. If the oil is too cold or the cooler is plugged the oil cooler bypass valve opens at a 65 PSI pressure differential and allows the oil to bypass the cooler.

The oil then flows to the transmission oil filter. This is a spin-on type disposable, 10-micron filter. A bypass valve is built into the filter head. This bypass allows cold, stiff oil to bypass the filter if a pressure differential of over 25 PSI develops. If the filter is plugged by contamination the bypass valve will also open and allow oil to bypass and continue to the transmission pressure regulating valve. **This makes servicing the filter vital to long transmission life.**

For graders with a lock/unlock differential, when the differential is being locked or unlocked a small amount of oil is taken from a tee, on the outlet of the filter. The oil flows through the lock/unlock control valve and to the lock/unlock shift cylinder. This moves the piston and shift fork to lock or unlock the differential. The control valve and shift cylinder have drains back to the transmission sump.

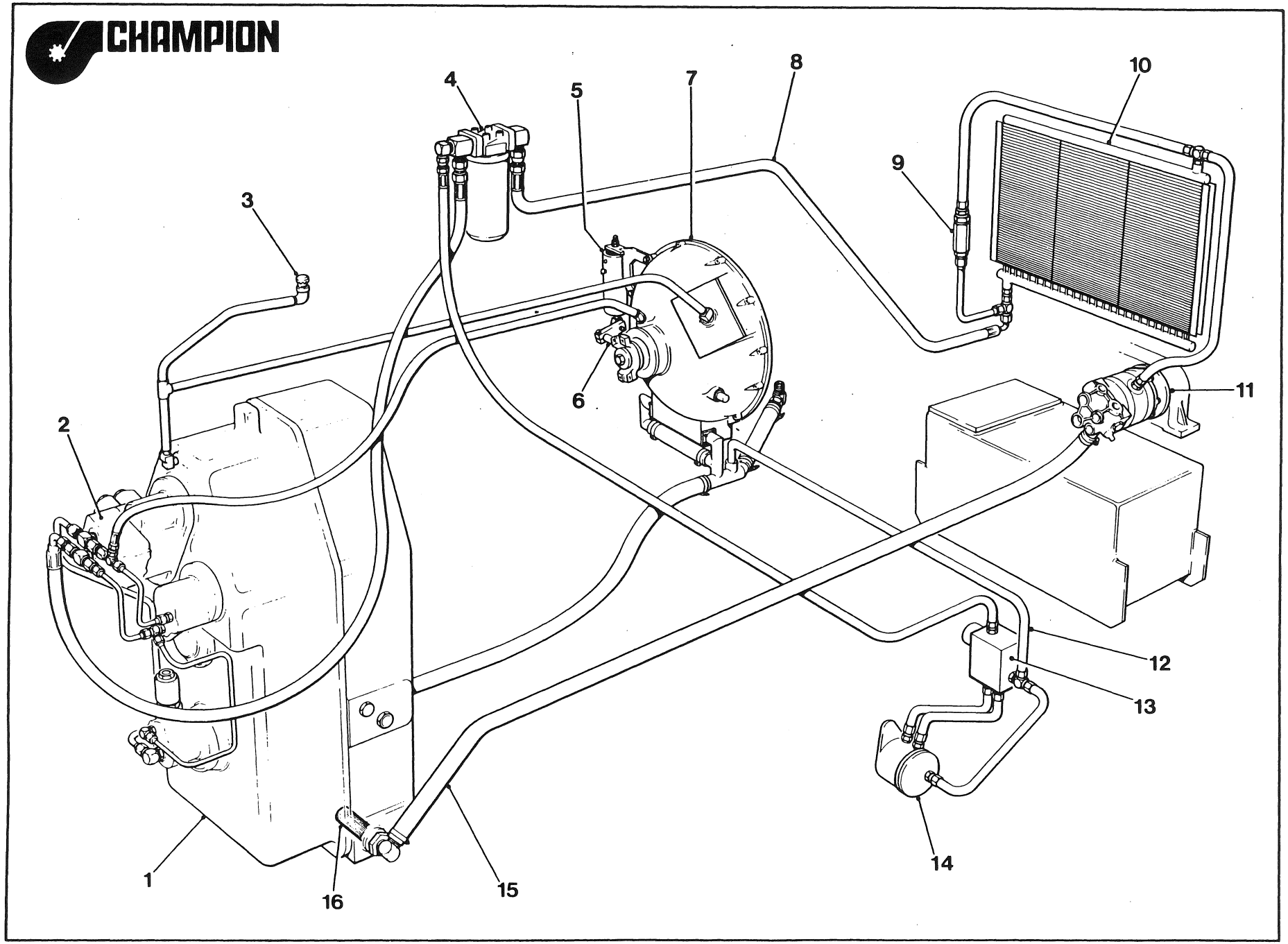
Mounted on the transmission is the transmission pressure regulating valve. This two-spool valve regulates both transmission clutch pressure and the lubrication circuit pressure. Lubrication oil is used to cool and lubricate both the transmission and the engine clutch. Lubrication oil then drains back into the transmission sump.

The engine clutch is operated by a master cylinder. This master cylinder is similar to the master cylinder used in the brake circuit. When the operator depresses the clutch pedal, hydraulic pressure "helps" move the master cylinder. The master cylinder then pushes brake fluid out to the slave cylinder which disengages the clutch.

The clutch adjustment must be checked on a regular basis.

*710 Transmission supply pumps are mounted on the engines.

** Differential Lock/Unlock Final Drive only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16 INCH CLUTCH ASSEMBLY

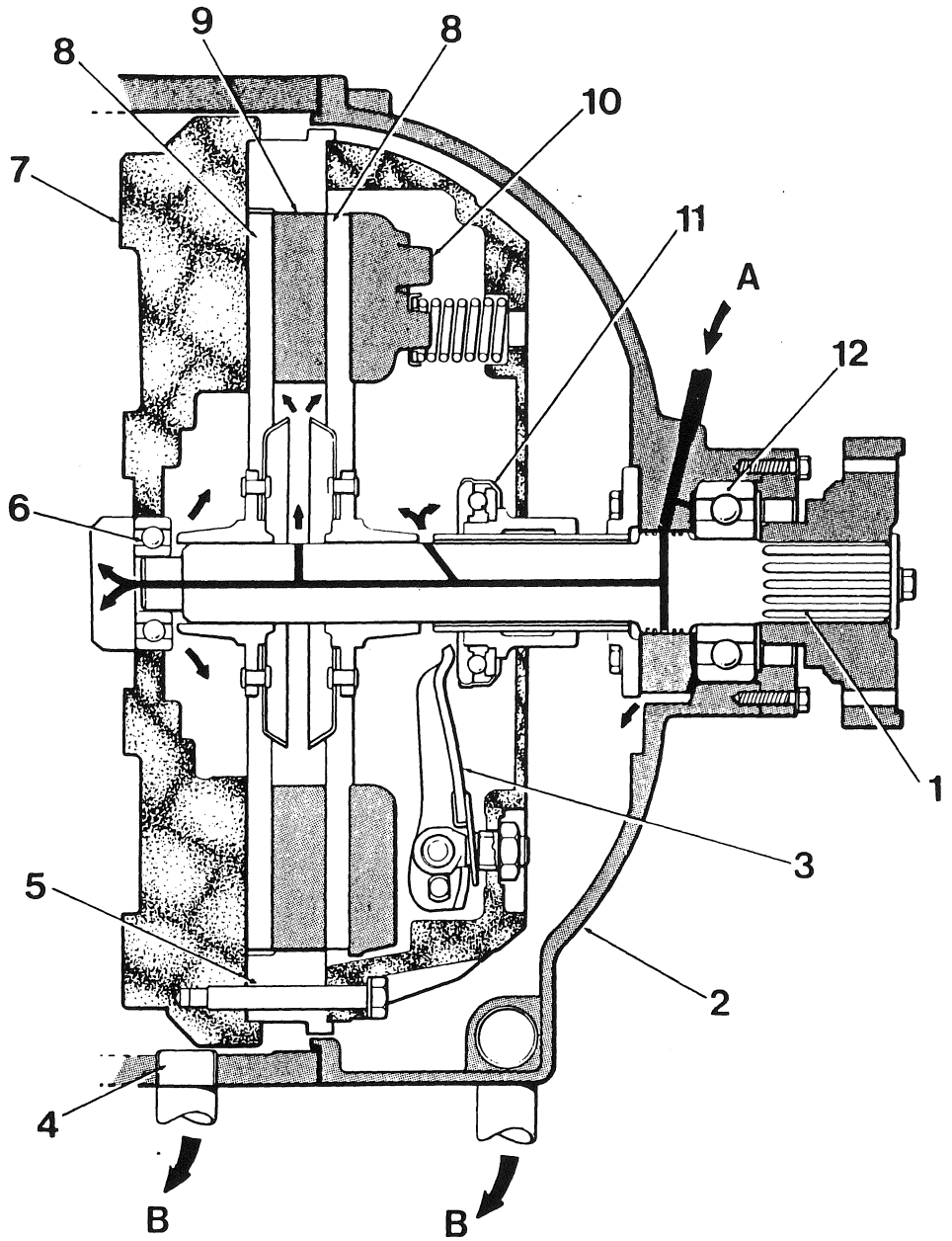
740-760

1. Clutch Output Shaft
2. Clutch Housing
3. Clutch Fingers
4. Oil Scoop
5. Spacer Ring Gear
6. Pilot Bearing
7. Engine Flywheel
8. Driven Member
9. Spacer
10. Pressure Plate
11. Throw-out Bearing
12. Clutch Shaft Bearing

The function of the clutch assembly is to disengage the drive line from the engine to facilitate smoother direction changes, starts, and stops. The illustration here shows the clutch in the engaged position.

The clutch pedal is connected to the assembly by the hydraulic circuit and slave cylinder previously described. When the pedal is depressed, brake fluid causes the piston in the slave cylinder to be extended causing the cross-shaft to turn. This pushes the clutch fork against the throw-out bearing. The throw-out bearing moves the clutch fingers, which pull the pressure plate back, thereby releasing the clutch driven members.

Oil enters the clutch housing at restricted orifice "A" and is divided to provide lubrication and cooling to the clutch components. Oil is bled off the main inlet flow to provide lubrication, through a 3/32" drilling, to the clutch shaft bearing. Four piston rings prevent the oil from passing between the shaft and the housing and direct it through cross drillings to the center of the shaft where rifle-drillings carry it to the distribution orifices as indicated by arrows. Oil flowing over the friction surfaces cools them and lubricates the bearings throughout the assembly. Oil leaves the assembly through two drains in the clutch housing "B" and is directed back to the transmission as previously discussed.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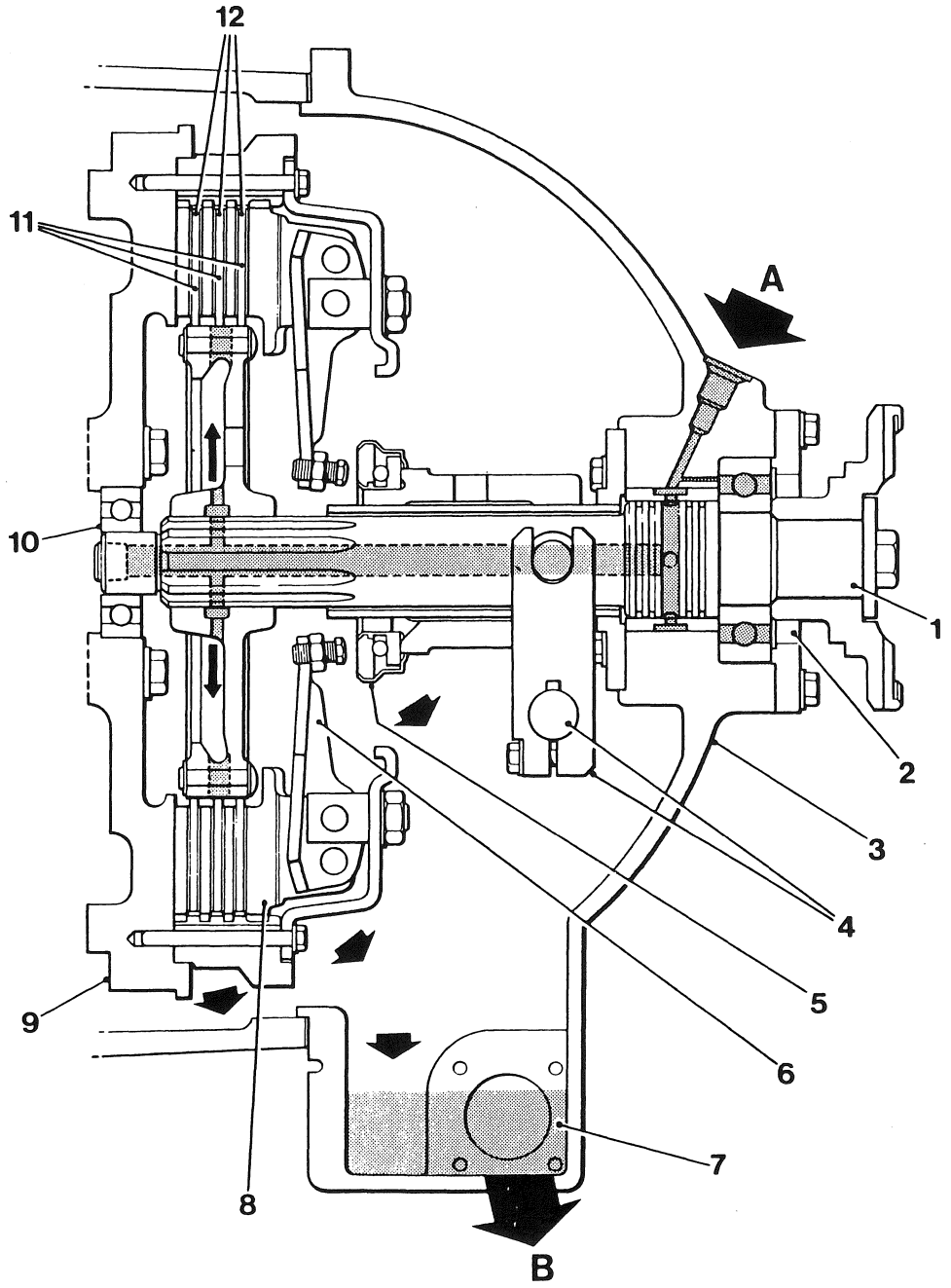
13 INCH TRIPLE PLATE CLUTCH

710-730

1. Clutch Shaft
2. Shaft Seal
3. Clutch Housing
4. Cross Shaft/Throwout Yoke
5. Throw-out Bearing
6. Clutch Fingers
7. Clutch Sump/Drain
8. Pressure Plate
9. Engine Flywheel
10. Pilot Bearing
11. Driven Member (Friction Plates)
12. Spacers

The 13 inch clutch functions like the 16 inch clutch but differs in design features. Instead of two friction plates and spacers three are used to increase driving torque. The spacer closest to the flywheel takes the wear normally put on the flywheel. This means the flywheel should never require turning.

Oil is used to cool the plates and lubricate the bearings. The lubrication oil from the transmission lube circuit enters at point A. Some oil flows through the 3/32 inch drilling to the clutch shaft bearing; the remainder goes down the 3/8″ rifle drilling in the clutch shaft to two cross bores and then out to cool the plates and driven members. The pilot bearing and throw-out bearing are splash lubricated. All oil drains back to the clutch sump and then to the transmission sump at point B.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8400 TRANSMISSION

OVERVIEW

The 8400 Transmission was developed to provide an 8-speed forward, 4-speed reverse, full powershift transmission for grader applications. It is simple in operation and construction which makes it simple to troubleshoot and repair. As a componentized transmission it is very easy to remove from the grader and no other major components have to be disturbed to remove the transmission.

The use of steel lines and hoses was minimized to keep the possibility of damage and leaks to a minimum. There are no linkages in the transmission controls to adjust or wear. The controls use an electronic controller and four simple solenoid valve cartridges to actuate the speed ranges.

The transmission was also designed with a wide ratio spread of 10.35:1 between first and eighth speed. The eight speeds were carefully selected to provide an even increase in speed in each forward speed. Seventh and eighth speeds provide an overdrive ratio since output shaft speed is greater than the input shaft speed.

CONSTRUCTION

All gears are helical cut except two which are for the low range gear set (1-4). Helical cut gears minimize noise.

The cast iron housing is vertically split to ease assembly and disassembly. This allows easy access to all seven clutch packs and idler shaft. R (reverse), A,B,C and D clutch packs are 5 1/4" in diameter. H (high) and L (low) clutch packs are 6 5/8" in diameter. The number of friction discs and separator plates varies according to the torque loading of the packs:

Clutch Pack	Diameter	# Separator Plates	# Friction Discs
R	5 1/4"	10	11
A	5 1/4"	10	11
B	5 1/4"	10	11
C	5 1/4"	10	11
D	5 1/4"	12	13
H	6 5/8"	6	7
L	6 5/8"	10	11

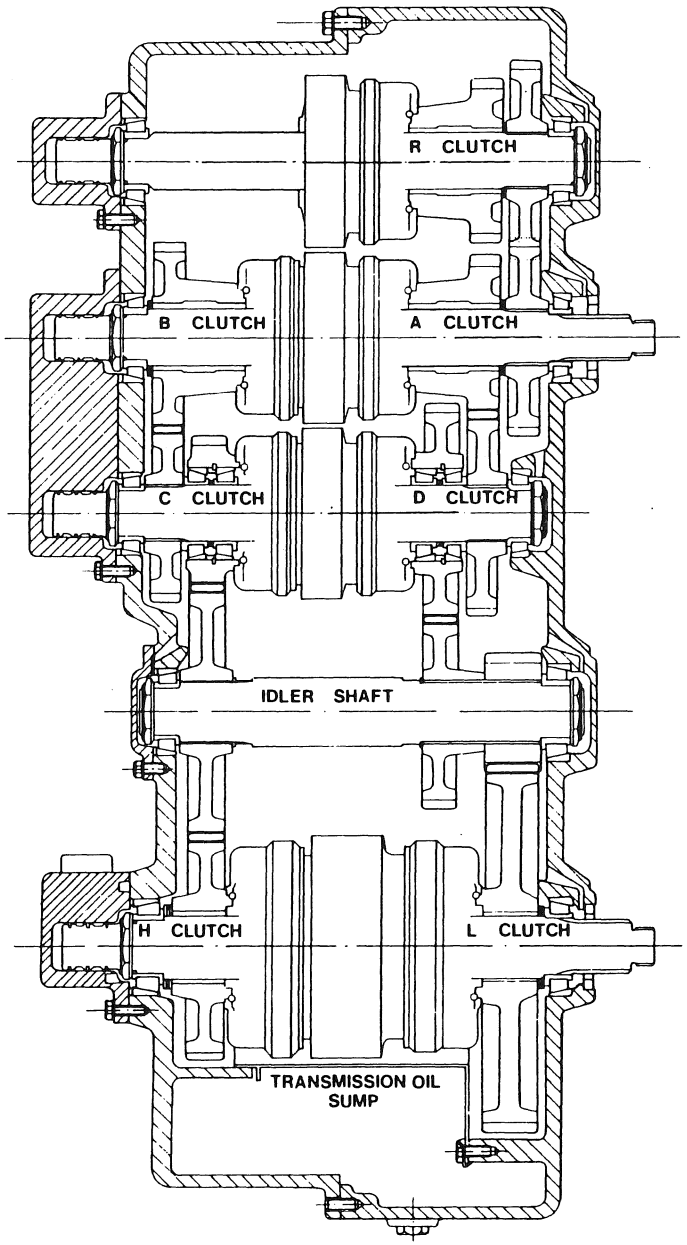
OPERATION

To provide motion, either forward or reverse, three of the seven clutch packs must be locked up (engaged). This will allow power flow through the transmission. A chart is provided on the next page which shows clutch pack engagement in each speed.

The operator uses a transmission controller to select the speed desired. The controller will be discussed separately.

Reverse speeds are the equivalent of the following forward speeds:

Reverse	Corresponding Forward Speed
– 1	1
– 2	3
– 3	5
– 4	7



GEAR	RATIO
F1	7.317 : 1
F2	5.236 : 1
F3	3.777 : 1
F4	2.703 : 1
F5	1.913 : 1
F6	1.369 : 1
F7	.987 : 1
F8	.707 : 1
R1	7.317 : 1
R2	3.777 : 1
R3	1.913 : 1
R4	.987 : 1

GEAR	CLUTCH PACKS ENGAGED
F1	ACL
F2	BCL
F3	ADL
F4	BDL
F5	ACH
F6	BCH
F7	ADH
F8	BDH
N	C
R1	RCL
R2	RDL
R3	RCH
R4	RDH

8400 TRANSMISSION OIL CIRCUIT
(FIRST FORWARD SHOWN)

1. Transmission Sump
2. Suction Strainer
3. Transmission Pump
4. Transmission Oil Cooler
5. Oil Cooler Bypass Valve
6. Transmission Oil Filter
7. Oil Filter Bypass Valve
8. Transmission Regulator Valve Body
9. Main Pressure Regulator Valve
10. Lubrication Pressure Regulator Valve
11. Reverse Solenoid Control Valve
12. A/B Clutch Solenoid Control Valve
13. D Clutch Solenoid Control Valve
14. H/L Clutch Solenoid Control Valve
15. Reverse Clutch/Shaft
16. A/B Clutch/Shaft
17. C/D Clutch/Shaft
18. H/L Clutch/Shaft
19. Main Engine Clutch

The 8400 Transmission was developed to be a simple, efficient, full power shift transmission with a simple hydraulic circuit. The following pages describe this circuit and show several shift engagements.

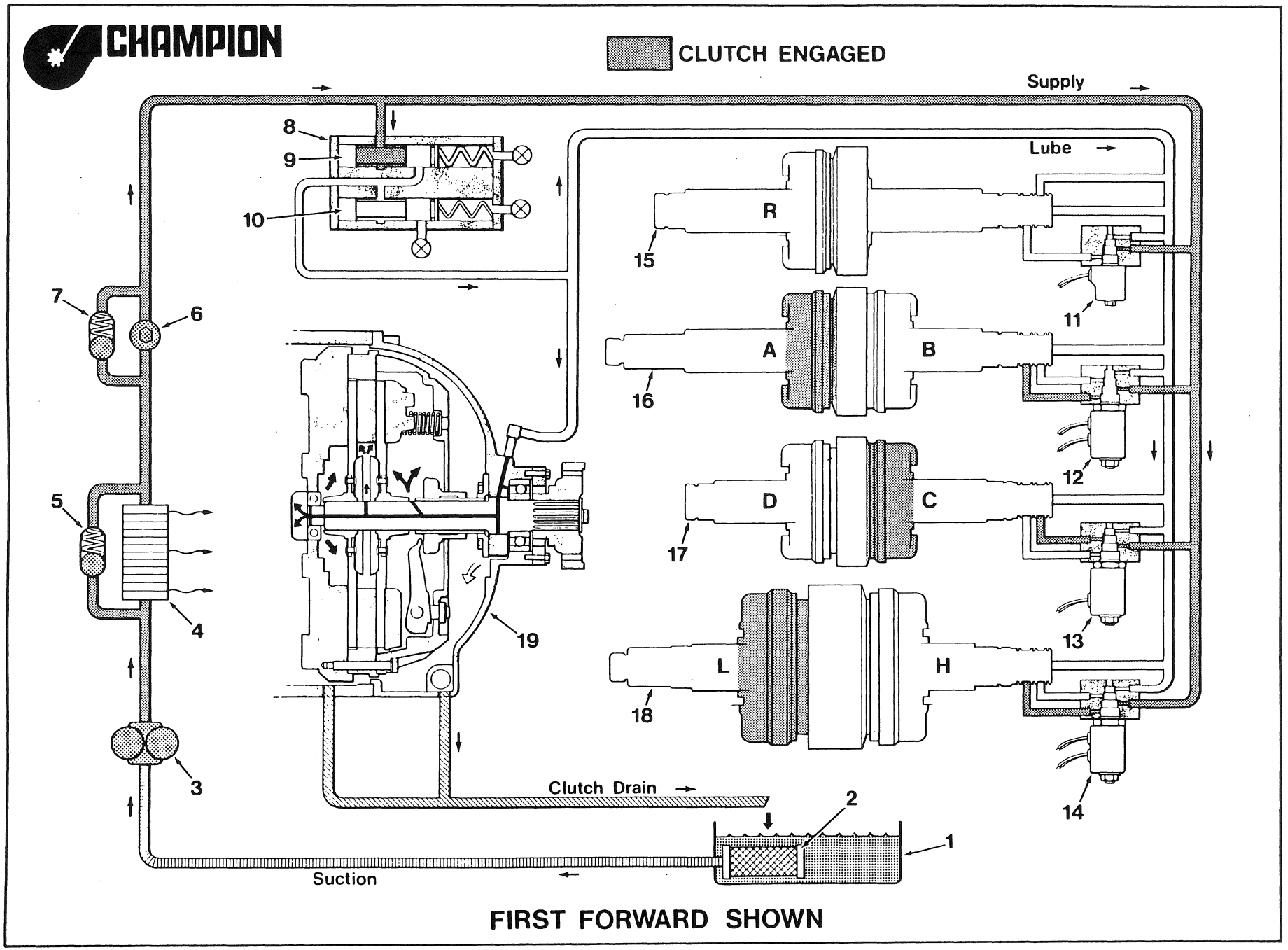
Transmission oil is drawn from the transmission sump through the suction strainer to the transmission pump. A transmission pump, mounted either to the pump drive gearbox or engine, then pushes oil through the transmission oil cooler and on to the filter. Both cooler and filter have bypass valves which open if there is a large pressure differential between inlet and outlet sides of the cooler or filter. This differential could be caused by either cold, stiff oil or a blockage of either component. The cooler bypass valve should open if inlet oil pressure is 65 PSI greater than the cooler outlet pressure, while the filter bypass opens at 25 PSI differential. A 10-micron disposable spin-on type filter is used. **Changing filters at recommended intervals is vital to long transmission life.**

Oil is then directed to the transmission regulator valve body. Inside this valve body are two regular spools. The first sets main transmission pressure. This spool has one spring and is shim adjustable to maintain transmission engagement pressure at 165-185 PSI. At the regulated pressure the spool moves back against its springs to open a passage to the lubrication circuit and lube pressure spool. Should a maximum lubrication pressure of 25 PSI be reached this valve spool moves back and opens a passage to sump. This valve has one spring and is also shim adjustable. If lube pressure drops below 2 PSI a warning light on the console will come on. The grader should be stopped and the problem diagnosed.

Lubrication oil goes through the center of each clutch shaft. From this central drilled passage oil lubricates and cools the clutch bearings and clutch plates and then drains back to sump. Lubrication oil also goes to lubricate and cool the engine clutch. This oil also drains back to sump.

Lock up pressure oil is directed to the four solenoid valves which are actuated by the transmission controller in the cab. With the exception of the D solenoid valve the solenoids block oil to the packs until energized. The C clutch pack is always engaged until the controller energizes the D solenoid and the D clutch pack locks up. The controller energizes the appropriate solenoids which then direct oil to the clutch packs to lock them up and provide the speed selected by the operator.

To obtain first forward the operator works the controller to indicate "1" on the display and with the mode lever in forward the controller energizes the A/B solenoid to direct oil to the A clutch pack and the H/L solenoid to direct oil to the L (low) clutch pack. This combination of clutches ACL, provides the lowest overall gear ratio available and results in first forward speed.



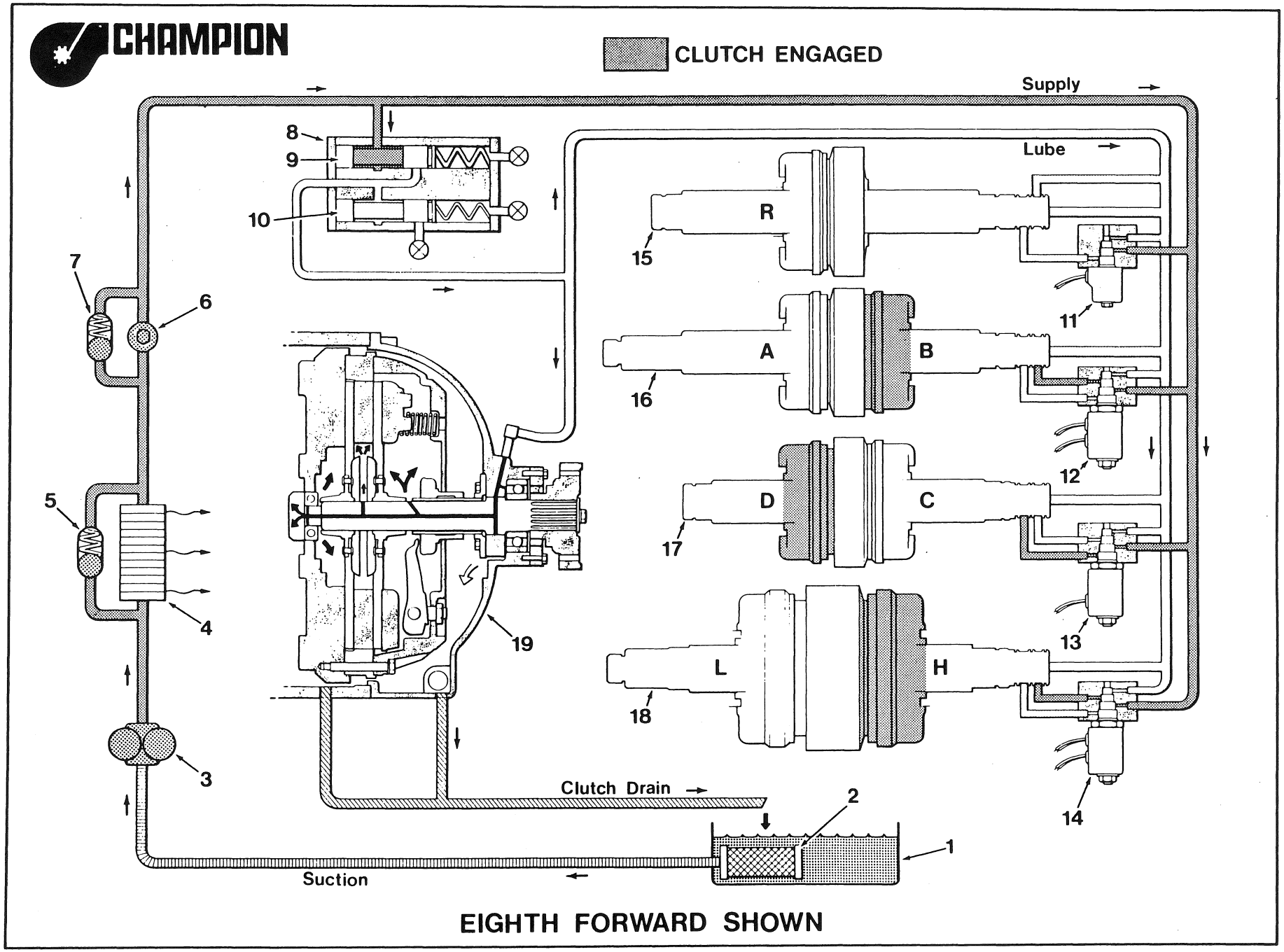
FIRST FORWARD SHOWN

8400 TRANSMISSION OIL CIRCUIT
(EIGHTH FORWARD SHOWN)

1. Transmission Sump
2. Suction Strainer
3. Transmission Pump
4. Transmission Oil Cooler
5. Oil Cooler Bypass Valve
6. Transmission Oil Filter
7. Oil Filter Bypass Valve
8. Transmission Regulator Valve Body
9. Main Pressure Regulator Valve
10. Lubrication Pressure Regulator Valve
11. Reverse Solenoid Control Valve
12. A/B Clutch Solenoid Control Valve
13. D Clutch Solenoid Control Valve
14. H/L Clutch Solenoid Control Valve
15. Reverse Clutch/Shaft
16. A/B Clutch/Shaft
17. C/D Clutch/Shaft
18. H/L Clutch/Shaft
19. Main Engine Clutch

When the operator wishes to operate in eighth gear he "pulses" or pushes the pulser lever forward to move up in speed. When the indicator shows "8" and the mode lever is in forward the controller energizes A/B solenoid, D solenoid, and H/L solenoid. This allows 165-185 PSI oil to flow to the B,D and H Clutch packs and engage them. With BDH packs engaged the transmission is in its highest gear ratio.

All speed changes may be made without use of the engine clutch. Each up shift or down shift may be made in as little as 1/2 second.



EIGHTH FORWARD SHOWN

8400 TRANSMISSION OIL CIRCUIT
(FIRST REVERSE SHOWN)

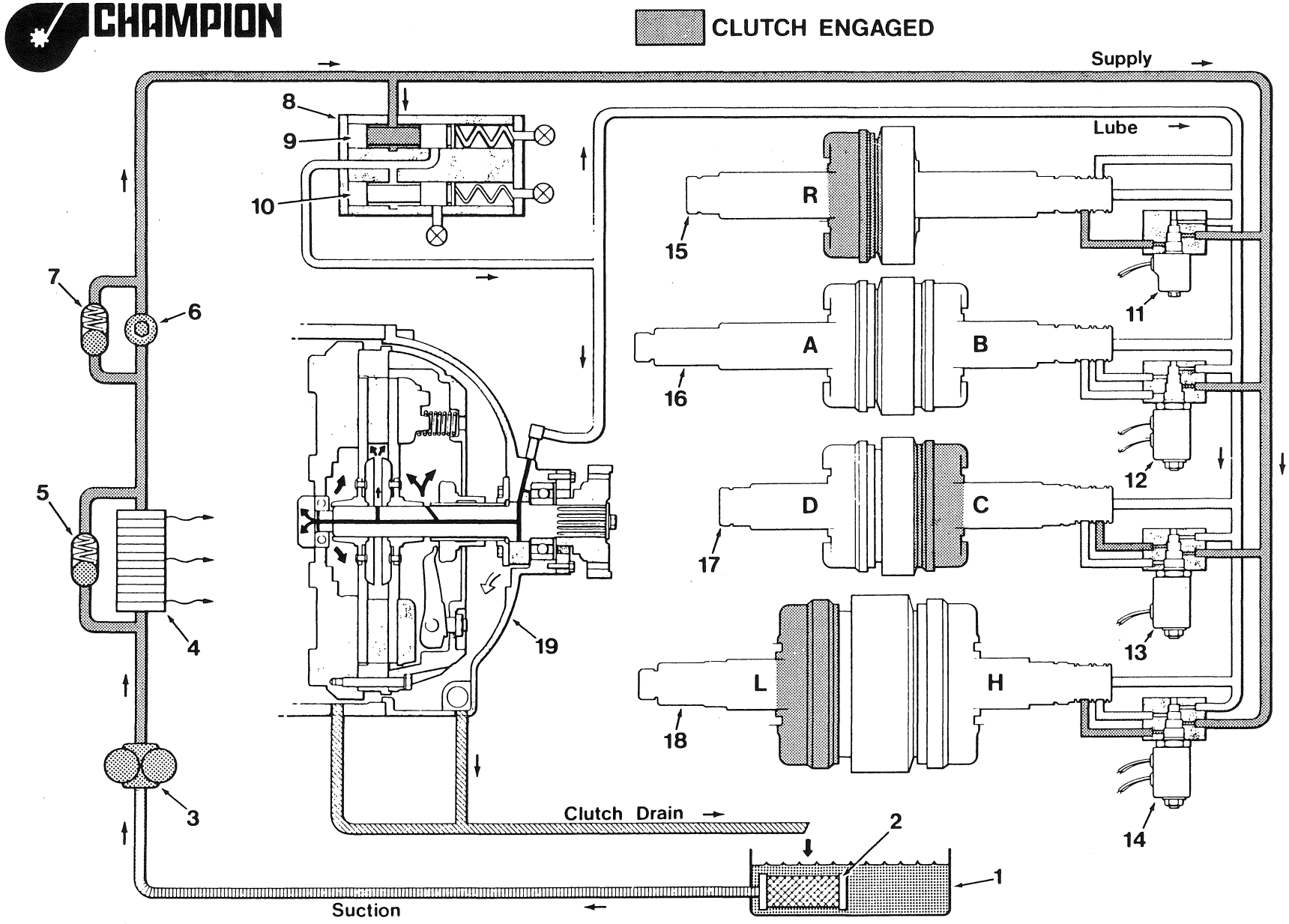
1. Transmission Sump
2. Suction Strainer
3. Transmission Pump
4. Transmission Oil Cooler
5. Oil Cooler Bypass Valve
6. Transmission Oil Filter
7. Oil Filter Bypass Valve
8. Transmission Regulator Valve Body
9. Main Pressure Regulator Valve
10. Lubrication Pressure Regulator Valve
11. Reverse Solenoid Control Valve
12. A/B Clutch Solenoid Control Valve
13. D Clutch Solenoid Control Valve
14. H/L Clutch Solenoid Control Valve
15. Reverse Clutch/Shaft
16. A/B Clutch/Shaft
17. C/D Clutch/Shaft
18. H/L Clutch/Shaft
19. Main Engine Clutch

When first reverse is selected by the operator the display will show "– 1". The controller will then energize the R solenoid to direct pressure oil to the reverse clutch pack. It will also energize the H/L solenoid which supplies oil to the low clutch pack. The C pack is also engaged and this provides the lowest possible reverse speed RCL.

When making a direction change the operator should disengage the engine clutch, stop the grader, move the mode lever to the opposite direction position and release the clutch. This assures smooth, safe direction changes. The controller will automatically select the closest corresponding speed in the opposite direction according to this chart:

Forward	Reverse
1 2	– 1
3 4	– 2
5 6	– 3
7 8	– 4

CHAMPION



FIRST REVERSE SHOWN

DOUBLE CLUTCH PACK

1. High Gear
2. Disc Valve
3. Separator Plate
4. Lock-up Piston
5. Low Gear
6. Low Clutch Oil Passage
7. Lubrication Oil Passage
8. High Clutch Oil Passage
9. Drive Disc
10. Steel Drive Plates
11. Accelerator Piston

A. High Gear Accelerator Piston Cavity
B. High Gear Lock-up Cavity
C. Low Gear Lock-up Cavity
D. Low Gear Accelerator Piston Cavity

The hydraulic clutch pack consists of one set of organic material discs splined to a rotating shaft and one set of steel plates retained in a drum and gear by means of external tags. The drum and gear are allowed to rotate independently of the shaft by mounting them on a bearing. The discs are positioned in the pack so that two of the same type are not located side by side. By locking these discs together, we can effectively connect the gear to the shaft. To perform this function, a hydraulic cylinder assembly is included. The operation of the assembly is detailed below.

NEUTRAL PHASE

Lube oil is fed to both sides of the clutch pack while the transmission is in neutral by a separate lube passage. At this time, the double clutch pack is in neutral phase. Oil, at lube pressure, flows down the passage and through cross-drillings to lubricate the bearings and to cool and partially lubricate the clutch discs in both packs.

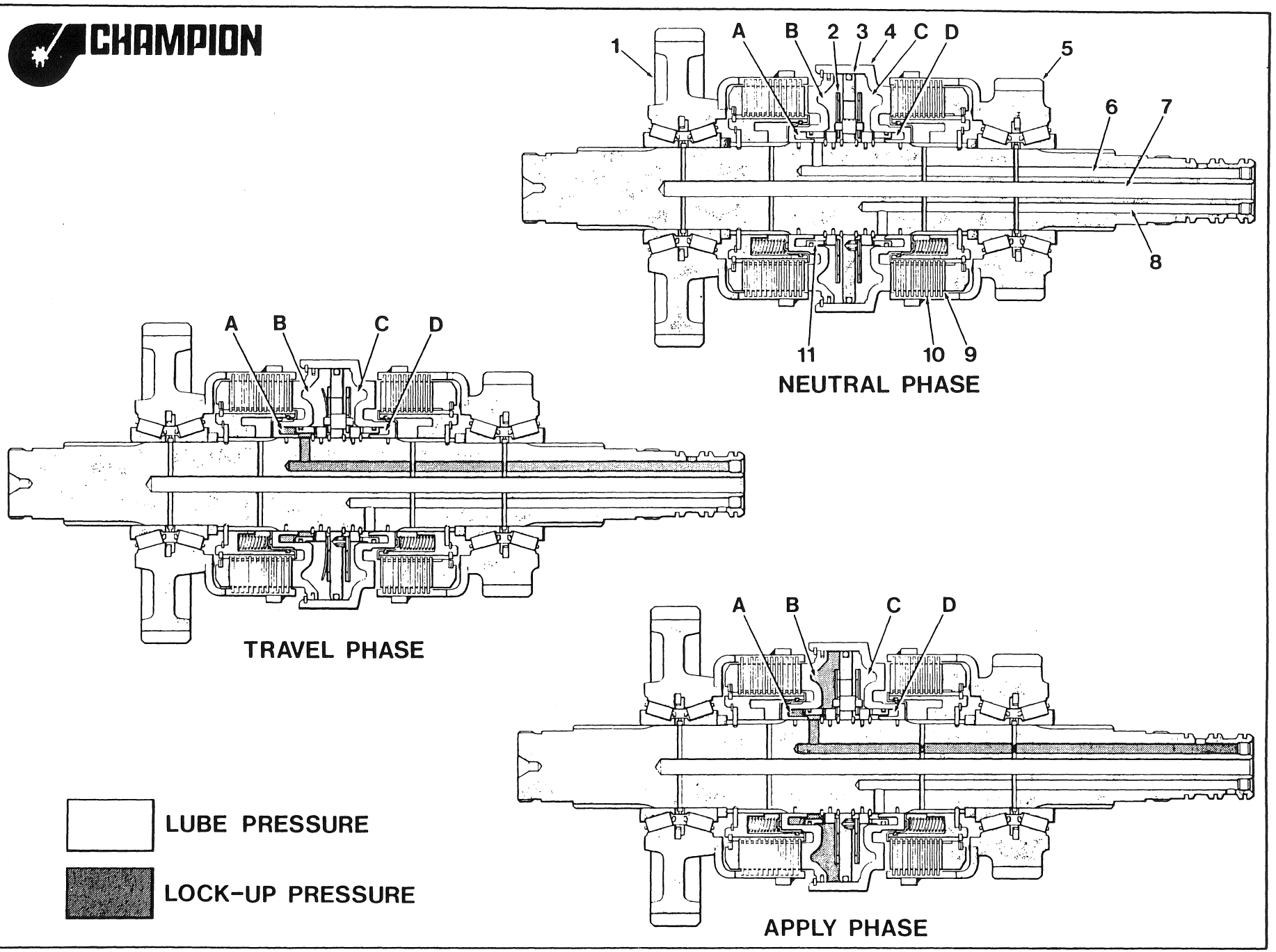
TRAVEL PHASE

The travel phase begins when the solenoid valve is energized to engage low or high clutch. This delivers system-pressure oil down one tube, while lube oil is fed down the central lube passage. The lock-up oil enters the area known as the accelerator piston cavity. As pressure builds within this cavity, the lock-up piston, which is the outer housing, begins to move. At the same time, the guide pin is pushed by the accelerator piston and holds the disc valve open on the opposite side allowing oil to pass through the separator plate into the lock-up cavity. This action causes the clutch discs to be forced together, effectively connecting the gear and drum to the shaft.

APPLY PHASE

At the end of the travel phase, the disc valve closes and pressure builds within the force piston cavity due to system-pressure oil entering via a drilling through the accelerator piston. The clutch pack will remain locked up as long as system-pressure oil is directed to it. Very little oil is required to maintain lock-up.

This process is the same for any of the three double clutch packs used in the 8400 Transmission.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NEUTRAL PHASE
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TRAVEL PHASE
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C
D
APPLY PHASE
LUBE PRESSURE
LOCK-UP PRESSURE

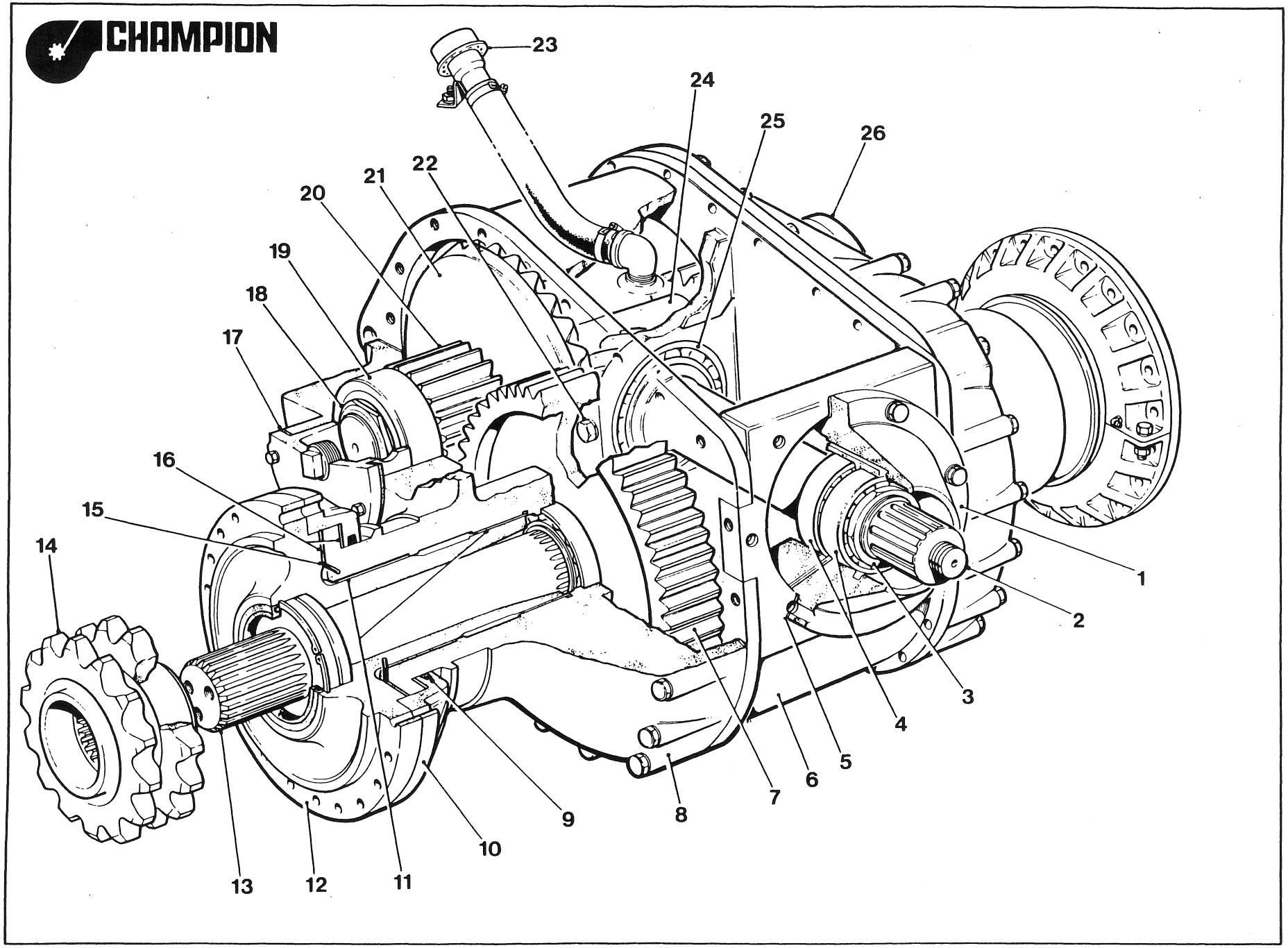
FINAL DRIVE

1. Pinion Bearing Cap
2. Pinion Shaft
3. Stake Nut
4. Taper Bearings
5. Shim Pack
6. Main Case
7. Bull Gear
8. Extension Housing
9. Uniring Seal
10. Half Ring
11. Sleeve Bushings
12. Flanged Sleeve
13. Drive Axle
14. Drive Sprocket
15. O Ring
16. Thrust Plate
17. Shim Pack
18. Nut
19. Bearing
20. Bull Pinion
21. Crown Gear
22. Bearing Retaining Screw
23. Vent
24. Cross Shaft
25. Pinion Support Bearing
26. Bearing Cap

The final drive is a positive drive gear box providing a gear reduction and a directional change of the power flow. The power enters on the pinion shaft and is transferred to the crown gear which is, in turn, splined to the cross-shaft. The cross-shaft is supported by taper roller bearings, and also carries two bull pinions. The bull pinions mesh with twin bull gears which are supported by roller bearings. Splined into the centre of the bull gear is a floating drive axle (so named because it carries no weight) supported at the outer end by a double-race, self-aligning roller bearing.

The weight of the machine is transferred from the final drive to the tandem by means of the flanged sleeve which oscillates in two Teflon coated, steel backed bronze bushings, pressed into the extension housing. They are held together by the split ring, which allows oscillation but prevents lateral movement of the flanged sleeve in the bushings.

Lubrication is provided by gear oil SAE 80W/90 which should be checked weekly and changed every 2000 hours.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LOCK/UNLOCK DIFFERENTIAL

720A-740A

1. Oil Pump
2. Nut
3. Taper Bearing
4. Ring Gear Retaining Bolt
5. Ring Gear
6. Differential Hub
7. Shift Clutch Gear
8. Shift Fork
9. Cross Shaft Bearing Cap
10. Bull/Spider Pinion
11. Shift Clutch
12. Spider Gear
13. Bearing
14. Shift Rail Seal
15. Cylinder Body
16. Hook Type Seal Ring
17. Switch
18. Drain Port
19. Spring Retainer
20. Spring
21. Vent
22. Half Ring
23. Shim Pack
24. Shift Cartridge
25. Shift Valve
26. Oil Supply Hose
27. Return to Sump
28. Shift Cylinder

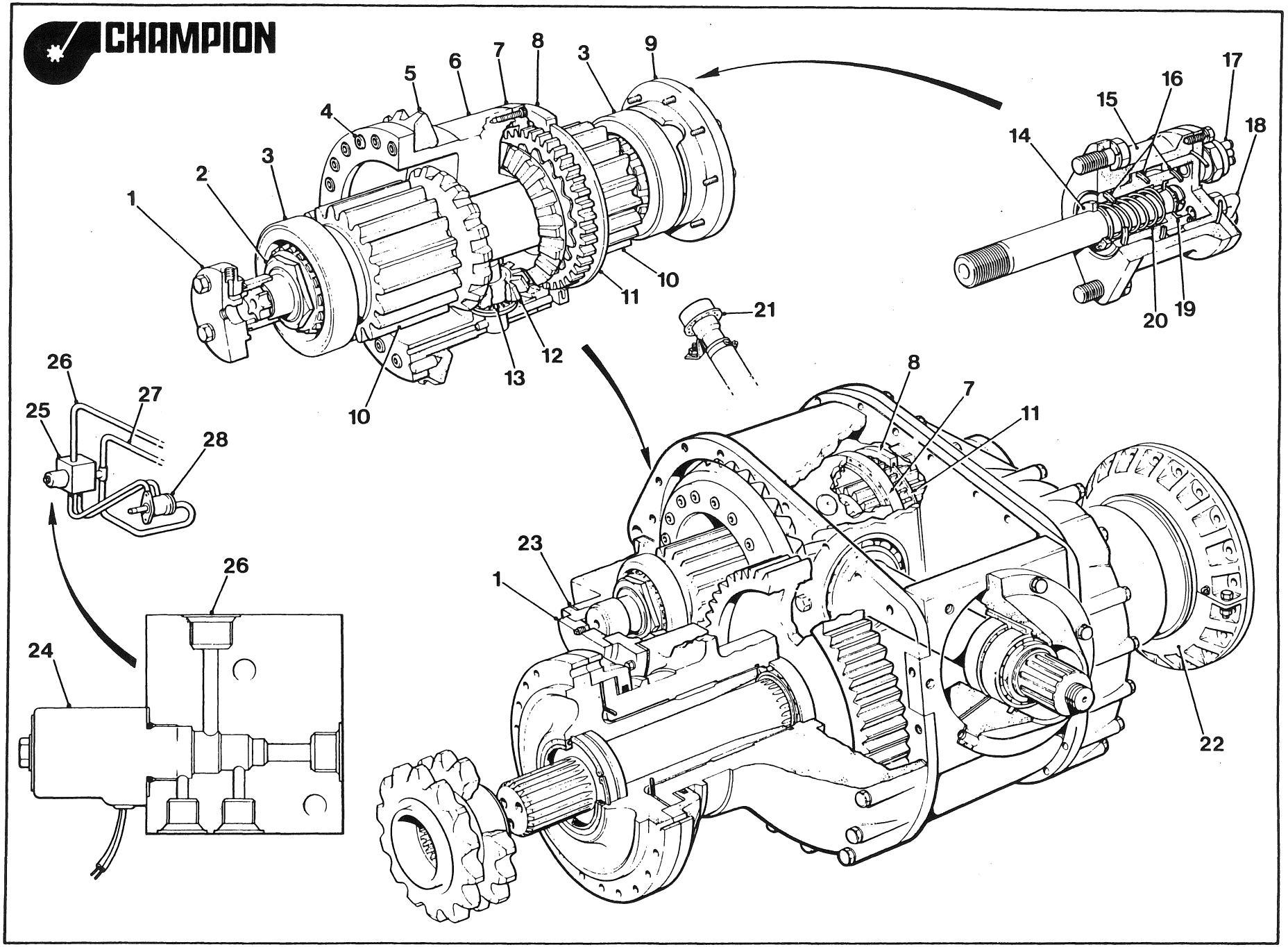
A standard final drive drives all four tandem wheels at the same speed. However, in sharp turns when articulated, it is an advantage to have a differential action available. A lock/unlock differential type final drive is standard on 720A, 730A and 740A motor graders and optional on 720R, 730R, 740R and 760R graders. This allows both maximum traction in the locked position and minimum turning radius in the unlocked position. **Normal operating position should be locked. An indicator light in the cab will come on when the differential is unlocked.**

To lock or unlock the differential an electrical switch on the right-hand cab post is moved. To unlock the differential the solenoid is energized allowing oil to flow to the cylinder body and pull the piston and shift fork to unlock the spider pinion from the differential hub, allowing differential action. At full travel the piston contacts a normally open switch, closing it and turning the indicator light on in the cab.

Pressure oil to supply this circuit is supplied from the filtered side of the transmission filter and all return and leakage oil returns to the transmission sump. The oil pressure is the same as transmission oil pressure — 165-185 PSI.

To lubricate the bull/spider pinion bearings and the spider gears a small bi-directional oil pump is mounted on the end of the right cross shaft. It sends pressure oil down the cross shaft and lubricates the bearings and gears through small cross drilled passages.

The recommended final drive oil is SAE 80W/90 and should be changed every 2000 hours or annually.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FINAL DRIVE

710/710A

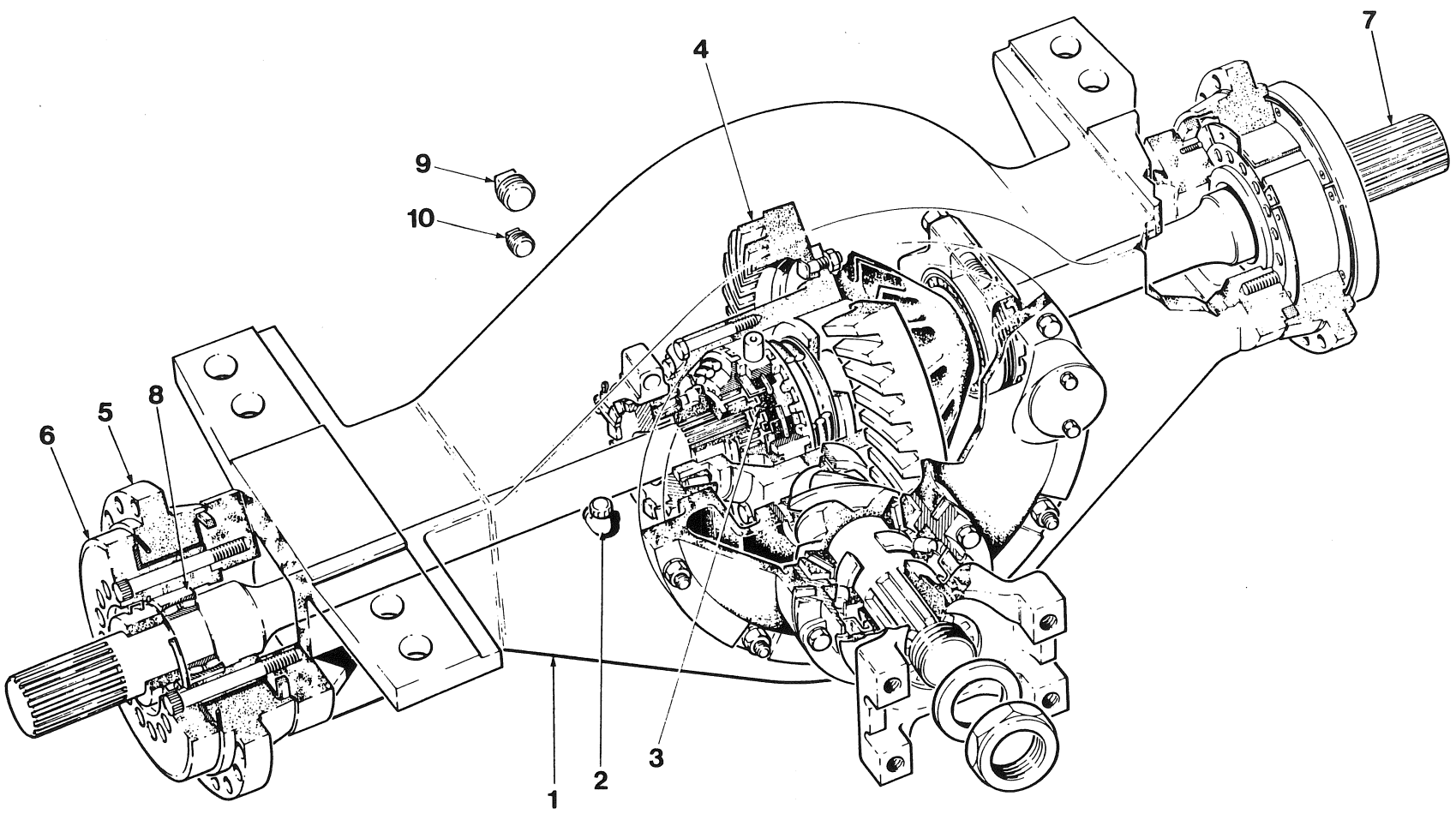
1. Cast Iron Housing
2. Breather
3. NoSpin Assembly
4. Ring Gear
5. Pivot Ring
6. Retainer
7. Axle Shaft
8. Barrel Type Bearing
9. Check/Fill Plug
10. Extra Plug

This single reduction final drive, equipped with NoSpin, is used on 710R and 710A graders. Since the only reduction is provided by the ring gear and pinion the tandems must provide a greater gear reduction than on other Champion graders.

NoSpin provides the advantage of a lock/unlock action. When operating in a normal forward or reverse operation both tandems are locked together. This provides the same speed and torque at either wheel regardless of traction. However, in a sharp turn the outside wheels may "unlock" and overspeed while the inside wheels turn at ring gear speed. This allows minimum tire scuffing in turns and tighter turns. This action is completely automatic in operation.

Housing construction is cast iron for maximum strength and rigidity. Also, to support the axles an outboard double barrel-type, self-aligning bearing is used. Two seals are used to keep oil in the final drive and dirt out.

The single reduction final drive uses SAE 80W/90 which should be checked weekly. To check, remove the upper check plug and oil should be at the plug on level ground. At 2000 hours or annually drain and refill with new oil.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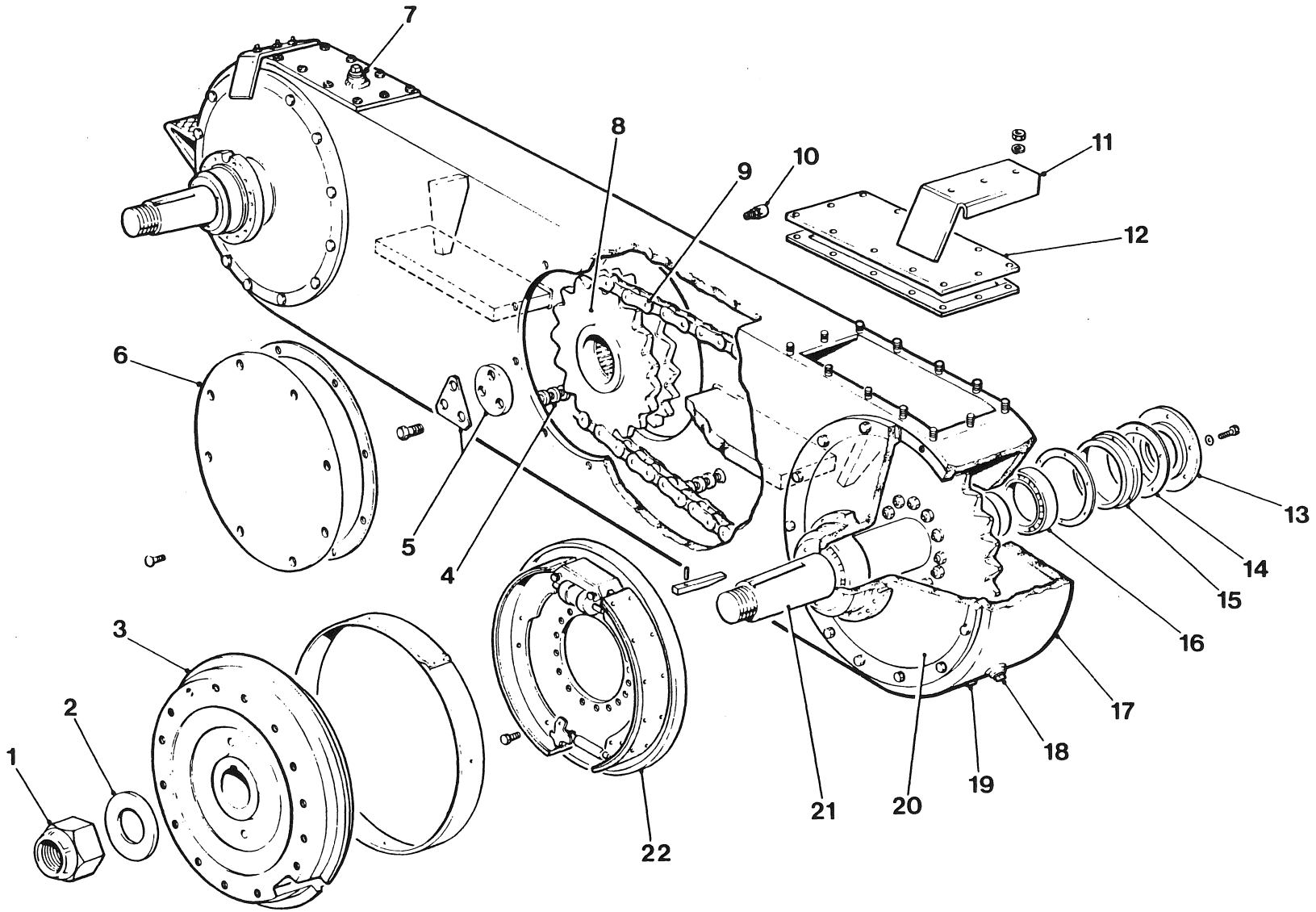
TANDEM ASSEMBLY

1. Wheel Nut
2. Washer
3. Wheel
4. Magnetic Plugs (2)
5. Retainer Washer & Lock Plate
6. Inspection Cover
7. Filler Plug
8. Double Drive Sprocket
9. Drive Chain
10. Breather
11. Brake Line Shield
12. Inspection Plate
13. Bearing Cap
14. Shim Pack
15. Bearing Flange
16. Inner Bearing
17. Tandem Case
18. Level Plug
19. Drain Plug
20. Stub Axle Bearing Housing
21. Stub Axle
22. Brake Assembly

The tandem assembly divides the power flow from a single floating drive axle (each side) to two tandem mounted axles and drive wheels. The tandem case is fabricated from steel plate, and is stress relieved before machining. Two plates are used to provide additional stiffness to the tandem assembly. This adds accuracy to the machining, which is done in a single jig, thus eliminating misalignment of the chains. The chains connect a double-drive sprocket on the final drive axle and the driven sprockets on the stub axle.

The shim pack under the inner bearing cap should be gauged so that a definite pre-load is felt when you turn the sprocket by hand. No provision is made for tightening the chains. A certain amount of slack is required and a slight rubbing of the chain on the bottom of the tandem case is normal and no cause for concern. However, a chain which has excessive slack and appears to require tightening may have a pitch of more than 2" (or 1.75" for the 710). If this is the case, it should be replaced as continued use will cause undue wear on the sprockets. For lubrication, gear oil SAE80W/90 should be used and changed once per year or every 2000 hours. At the same time, the two magnetic plugs in each tandem should be removed, cleaned and replaced.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STANDARD BRAKES

1. Adjusting Wheel
2. Adjusting Screw Spring
3. Auto Adjuster Lever
4. Cable
5. Shoe Return Spring
6. Rivet
7. Brake Shoe
8. Wheel Cylinder Assembly
9. Bleeder Screw
10. Parking Brake Cable
11. Parking Brake Disc
12. Brake Shoe & Lever Assembly
13. Release Spring
14. Auxiliary Reservoir
15. Parking Brake Lever
16. Brake Pedal
17. Master Cylinder
18. Brake Light Sender

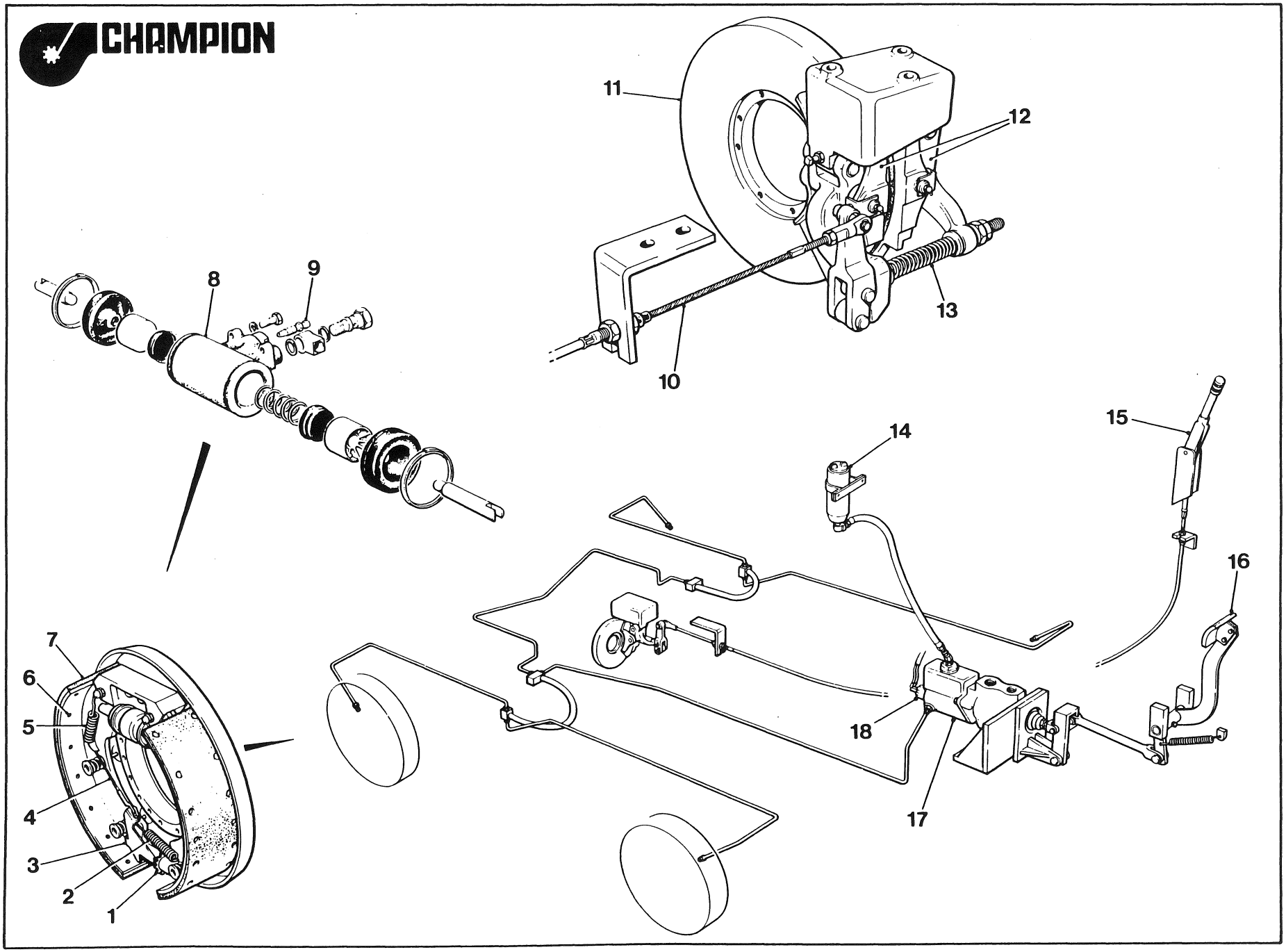
Four wheel booster brakes are standard equipment on all 700 Series except 710's where two wheel rear mounted booster brakes are standard equipment. Power for the booster cylinder is supplied by oil in the return line of the steering system.

When the brake is depressed, a valve in the booster cylinder is closed and oil pressure builds up to a maximum of 290 PSI (relief), and presses on the push rod of the master cylinder. This is a 1¼" (31.75 mm) cylinder. Brake fluid then is forced into all four 1½" (38.1 mm) wheel cylinders to expand the shoes against the brake drums.

The wheel brakes are self-adjusting drum type brakes. All four shoe sets are adjusted tight against the drums, then backed off 4 notches on the adjusting wheel. The linings should be replaced when worn to within 1/16" (1.59 mm) of the rivet heads retaining them to the shoes.

½"-1" (12.70 mm.-25.40 mm) free travel on the pedal is required to ensure that the booster assembly is fully neutralized when the pedal is released.

The emergency brake is a caliper type assembly mounted over the final drive input disc. Small adjustments are made by turning the knob on the hand lever inside the cab while major adjustments are made at the emergency brake assembly ensuring .015" clearance between the brake lining and disc on both sides.


CHAMPION
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OIL DISC BRAKE

1. Tandem
2. Disc Brake Assembly
3. Supply Line
4. Pressure Sender
5. Accumulator
6. Return Oil Line
7. Brake Light Switch
8. Brake Pedal
9. Apply Shaft
10. Hydraulic Brake Valve
11. Walking Beam
12. Main Hydraulic Relief Valves

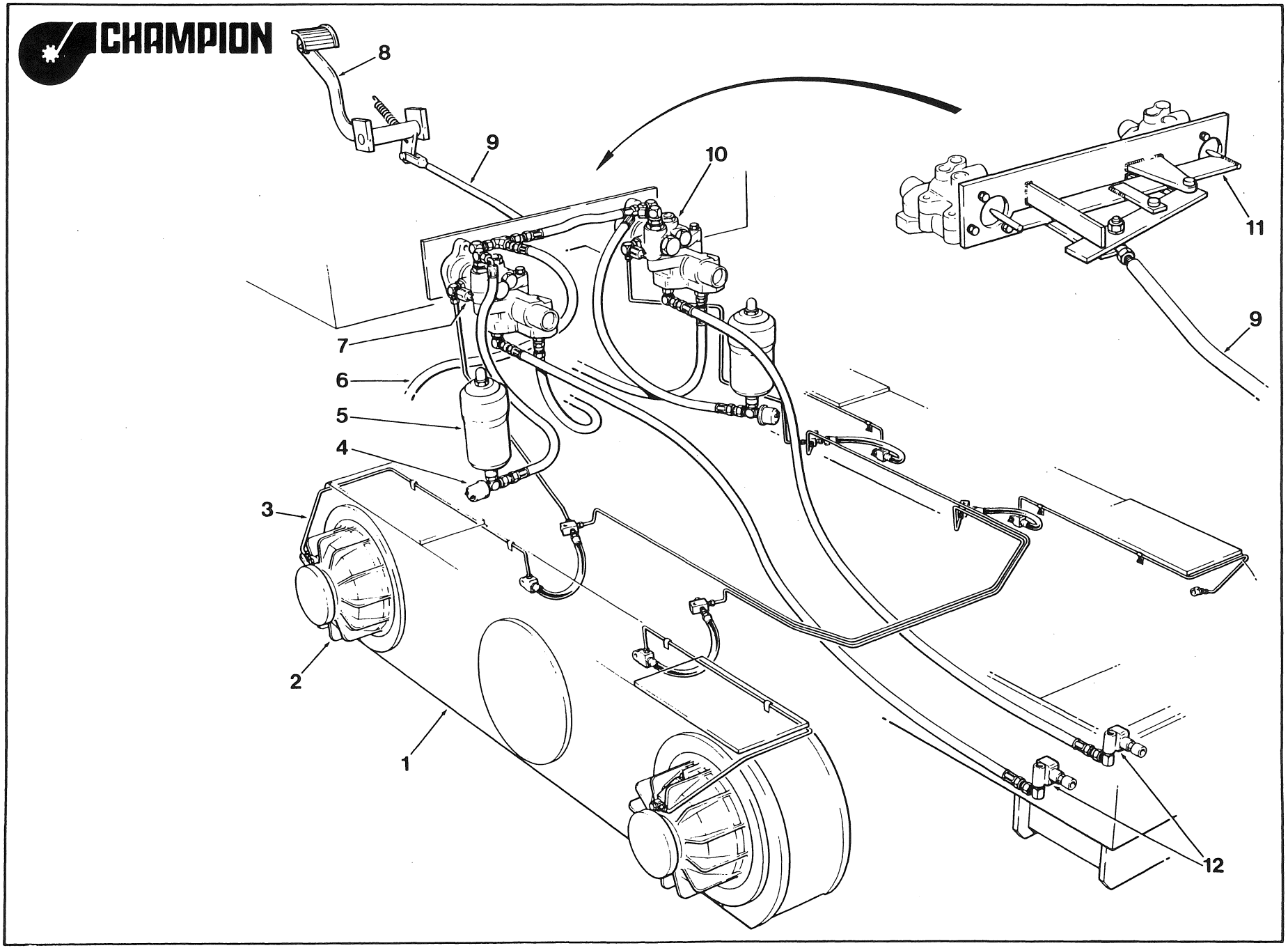
Champion offers oil disc brakes as optional equipment for specific applications.

The brake pedal is connected, through a shaft, to a walking beam which applies pressure to the activating plunger of two hydraulic valves mounted either on or under the rear of the cab, depending on the model.

The brake valves are multi-purpose valves which direct oil from the accumulator to the brake units. They control the apply pressure of the brakes according to pedal pressure. They direct oil, from the brake circuit, back to the main hydraulic tank when the brakes are released. They also take small amounts of oil from the hydraulic system to replace what is used in braking and use it to recharge the accumulator.

Oil in the main hydraulic supply lines flows into the bottom of the valve and, if the accumulator is properly charged, it flows uninterrupted through the valve and on to the main manifold. If accumulator pressure is low, oil is taken from the hydraulic supply to recharge it at a rate of 2 gpm. Capacity of the accumulator is 1 US quart and maximum charge is 1500 PSI. Recharge takes place at 1200 PSI. As the brake pedal is depressed, oil is routed from the accumulator to the oil disc brake assemblies. When applying the brakes, oil pressure increases with increased brake pedal force up to a maximum of 900 PSI.

If the accumulator recharge circuit fails, for example, due to a stalled engine, hydraulic system failure, etc., a sending unit on the outlet of the accumulator will operate a buzz-lite in the instrument panel when accumulator pressure drops to 1050 PSI and this will advise the operator that there is one application left.


CHAMPION
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ALL WHEEL DRIVE SYSTEM

1. Flow Divider
2. Motor Control Valve
3. Control Box
4. A.W.D. Reservoir
5. Pump Control Valve
6. Main Hydraulic and Steering Pump
7. A.W.D. Cooler
8. Transmission Pump
9. A.W.D. System Hydraulic Pump
10. A.W.D. Charge Pump
11. A.W.D. Filter
12. Wheel Motor
13. Planetary Hub
14. Front Axle

All Wheel Drive (A.W.D. or 4 + 2) is used to increase tractive effort and steering control in slippery conditions. The front wheels are driven by a variable displacement, piston-type hydrostatic pump and a variable displacement motor in each wheel driving through planetary hubs. Hydraulics for the A.W.D. system are completely separate from all other systems. A.W.D. operates in all forward speeds except eighth and all reverse speeds.

Oil is drawn from the A.W.D. reservoir by the charge pump. It then goes through the A.W.D. cooler and 6-micron, cartridge type filter. Both have bypass valves to permit cold, stiff oil to bypass. If either component is plugged, oil will bypass.

Cooled filtered oil then flows to the primary hydraulic pump. If the control lever is in its rearward, "Zero," position a small amount of oil is directed, at low pressure, to provide cooling and lubrication for the wheel motors. As the control lever is moved forward the pressure increases to increase at the front end.

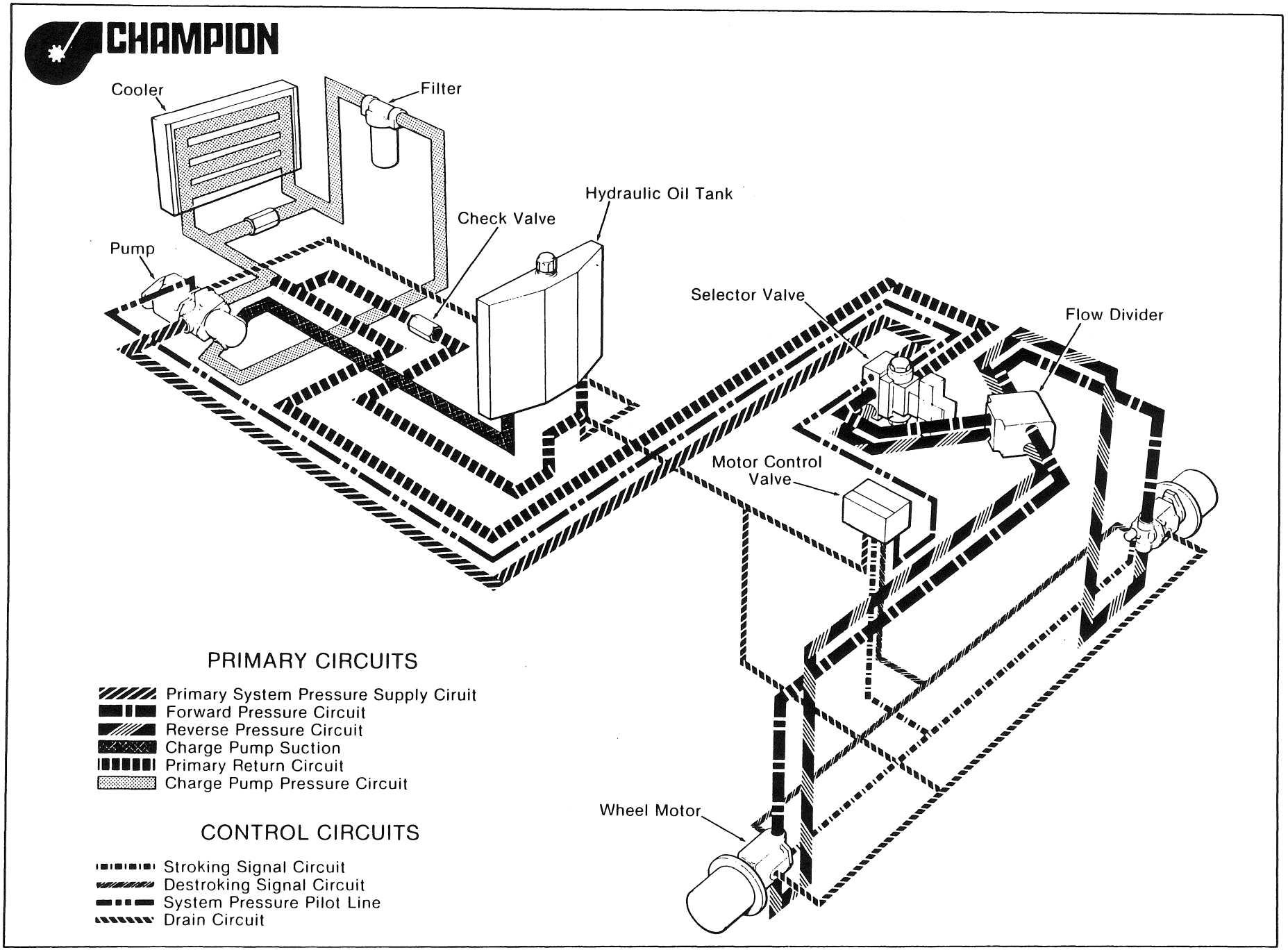
Oil from the motors is returned to the primary hydraulic pump to be "reused." This creates a "closed-loop" circuit. The charge pump makes up for leakage and when increased volume is required because of changing conditions.

The planetaries reduce motor speed and increase torque at the wheel. **They run in SAE 80W/90 gear oil which should be changed after the first 50 hours of operation** and then every 1000 hours or annually (whichever comes first). The planetaries may be disengaged for extended roading or if service is required.

The A.W.D. System uses Dexron II fluid which should be replaced annually or every 2000 hours. The filter change is every 1000 hours, with special care taken to replace it with comparable 6-micron element.

The control box has several indicator lights in addition to the control lever. The lights indicate: forward, reverse, excessive oil temperature and low charge pressure.

Further information on specific components may be found in the A.W.D. section of the Service Manual and in the A.W.D. service video tapes.


CHAMPION
Cooler
Filter
Hydraulic Oil Tank
Check Valve
Pump
Selector Valve
Flow Divider
Motor Control Valve
Wheel Motor
PRIMARY CIRCUITS
Primary System Pressure Supply Ciruit
Forward Pressure Circuit
Reverse Pressure Circuit
Charge Pump Suction
Primary Return Circuit
Charge Pump Pressure Circuit
CONTROL CIRCUITS
Stroking Signal Circuit
Destroking Signal Circuit
System Pressure Pilot Line
Drain Circuit

700 SERIES GRADER

Series III

Service Training Manual

PRINTED ON RECYCLED PAPER

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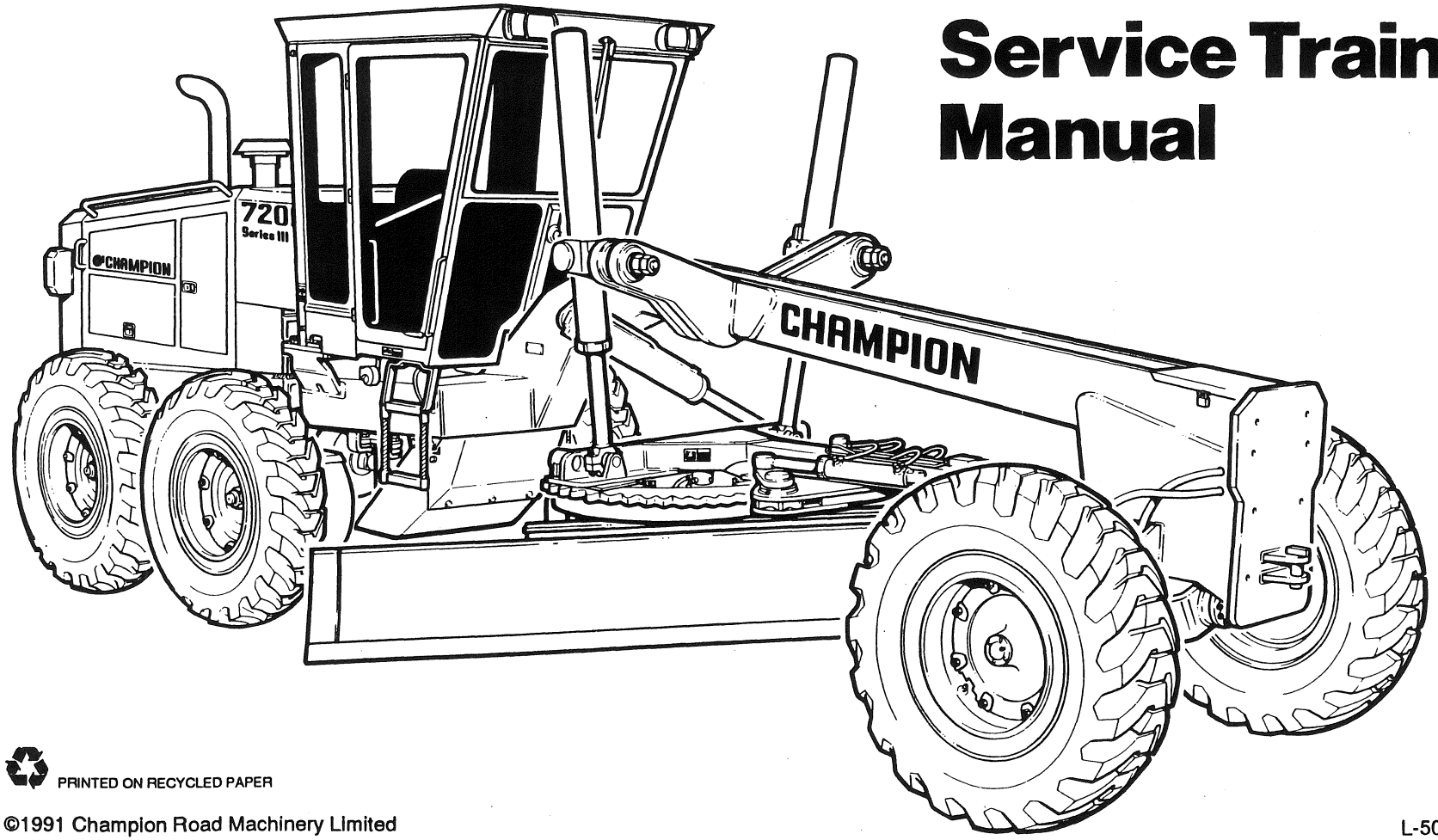
700 SERIES GRADER

Series III

Service Training Manual



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L-5003-01 (10/91)

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The following abreviations are used in this manual:

R.H. - Right-hand
L.H. - Left-hand
rpm - Revolutions per minute
psi - Pounds per square inch
gpm - Gallons per minute
MPLS - Moveable Point Blade Lift System

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700 SERIES GRADER

SERIES III

Service Training Manual

This Service Training Manual has been prepared only to assist you in understanding the basic theory and relationship of the systems on the Champion Series III motor grader.

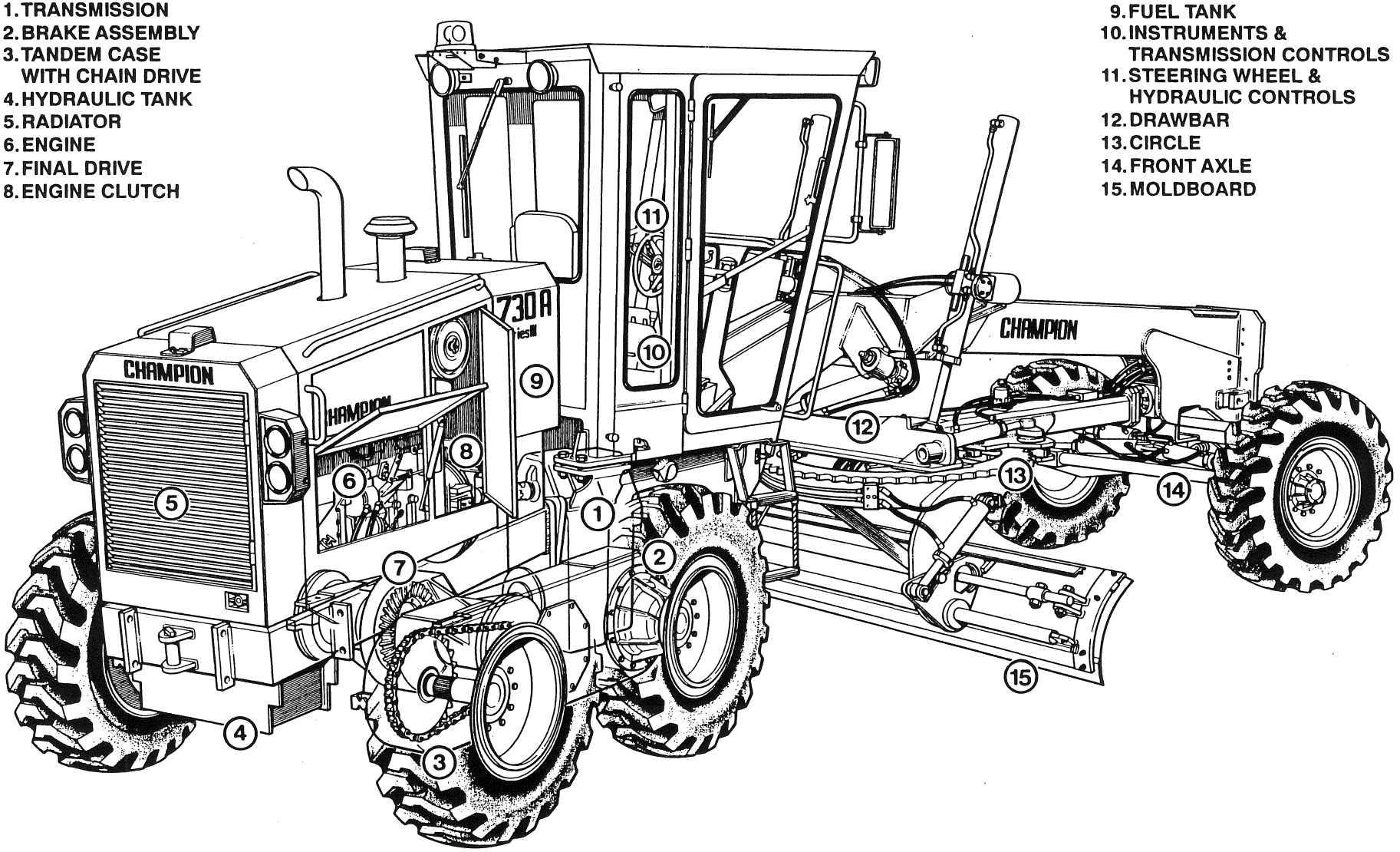
REFER TO THE SHOP MANUAL FOR SAFETY WARNINGS, SPECIFICATIONS, SPECIAL TOOLS AND CORRECT SERVICE PROCEDURES. ALWAYS READ AND UNDERSTAND THE SAFETY WARNINGS AND OPERATING PRECAUTIONS FOUND IN THE GRADER OPERATOR'S MANUAL BEFORE ATTEMPTING TO OPERATE ANY MOTOR GRADER.

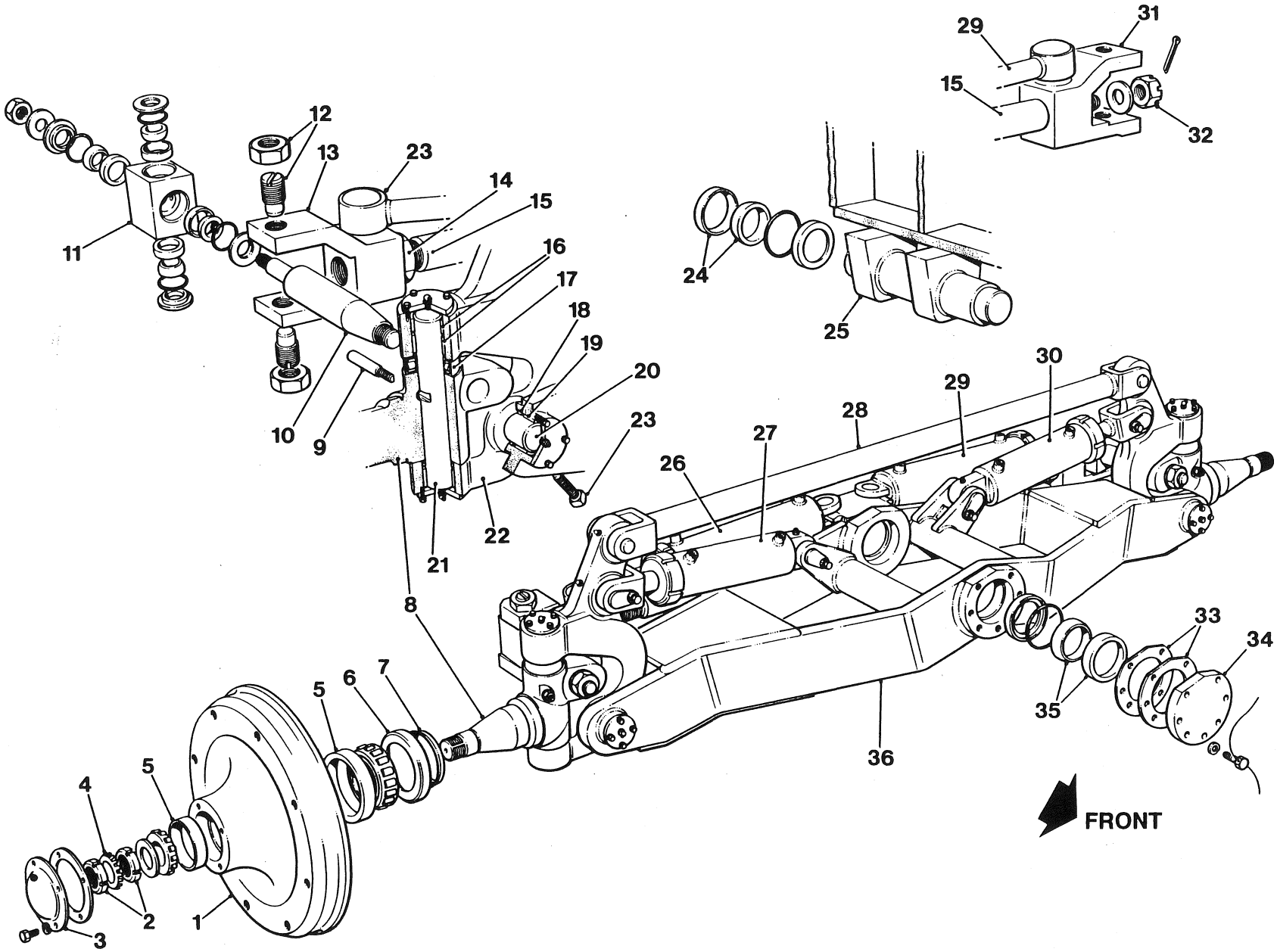
This manual generally applies to **Series III** motor graders **S/N 20605 and up**. However, most principles presented apply to earlier machines also.

The information in this manual is correct at time of publication. Your grader may be equipped with options not illustrated. Champion reserves the right to make product improvements without notice.

MAJOR COMPONENTS IDENTIFICATION ILLUSTRATION

1. TRANSMISSION
2. BRAKE ASSEMBLY
3. TANDEM CASE WITH CHAIN DRIVE
4. HYDRAULIC TANK
5. RADIATOR
6. ENGINE
7. FINAL DRIVE
8. ENGINE CLUTCH
9. FUEL TANK
10. INSTRUMENTS & TRANSMISSION CONTROLS
11. STEERING WHEEL & HYDRAULIC CONTROLS
12. DRAWBAR
13. CIRCLE
14. FRONT AXLE
15. MOLDBOARD

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FRONT

LEGEND

1. Front Wheel
2. Spindle Nuts
3. Hub Cap
4. Tab Washer
5. Wheel Bearings
6. Back-up Ring
7. V-Ring Seal
8. Spindle
9. Key Pin
10. Radius Arm
11. Pivot Block Assembly
12. Adjustment Pin
13. R.H. Steering Yoke
14. Lock Nut
15. Steering Drag Link
16. King Pin Needle Bearings
17. Thrust Bearing
18. Dust Seal
19. Knuckle Pivot Pin Bearing
20. Knuckle Pivot Pin
21. King Pin
22. R.H. Knuckle
23. Knuckle Pin Lock
24. Rear Pivot Pin Bushing
25. Axle Pivot Pin (Frame)
26. R.H. Steering Cylinder Assembly
27. R.H. Leaning Wheel Cylinder Assembly *
28. Leaning Wheel Tie-Bar
29. L.H. Steering Cylinder Assembly
30. L.H. Leaning Wheel Cylinder Assembly
31. L.H. Steering Yoke
32. Castellated Retaining Nut
33. Pivot Adjustment Shims
34. Front Bushing Cap
35. Front Pivot Pin Bushing
36. Axle Frame

** Optional on some models.*

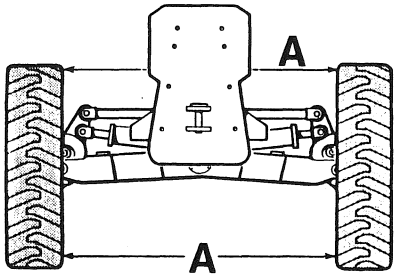
The front axle of a motor grader must perform several functions: **steering**, **oscillation** and **front wheel lean**. It must also have the ability to carry heavy front mounted attachments. The Champion front axle is designed to provide long life with minimum maintenance.

The front wheel is supported by two tapered roller bearings. Front wheel preload is determined by the tightness of the spindle nuts. After adjustment, the tab washer prevents them from turning. A self-relieving V-Ring grease seal prevents over greasing of the bearing cavity.

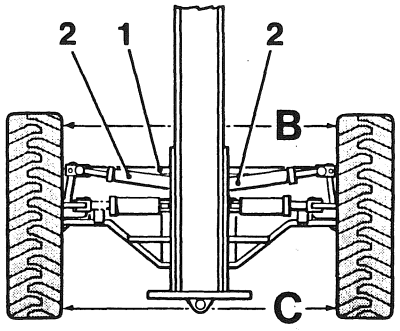
Steering is accomplished by the spindle pivoting on the king pin, through the action of the two hydraulic steering cylinders. The drag link makes both sides turn together. The toe-in is adjusted by loosening the lock nut on the right-hand yoke and turning the drag link. See page 9 for details. Front wheel lean is accomplished by pivoting the knuckle/spindle assembly on the knuckle pivot pin. The tie bar makes both wheels lean together. The king pin and the knuckle pivot pin are uniform in diameter. Both are supported by needle bearings. Thrust loads, including weight of attachments are transmitted between the knuckle and spindle by a sealed thrust roller bearing. The pivot block assembly acts like a universal joint, in that it allows movement in two directions at the same time: wheel lean and steering. The design of the pivot block permits easy adjustment without removal or replacement of parts.

The axle pivot uses angular contact bushings placed under a slight preload which is shim adjustable. This design permits axle oscillation over uneven ground or ditch cutting applications. Axle pivot preload is increased by removing shims.

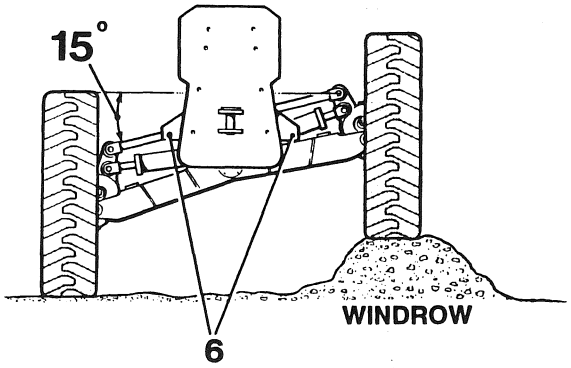
Under most applications, the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals if operating in extremely dusty or wet applications; or if the joints are dry.



CAMBER



TOE-IN



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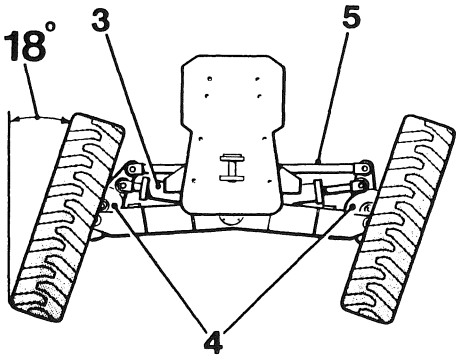
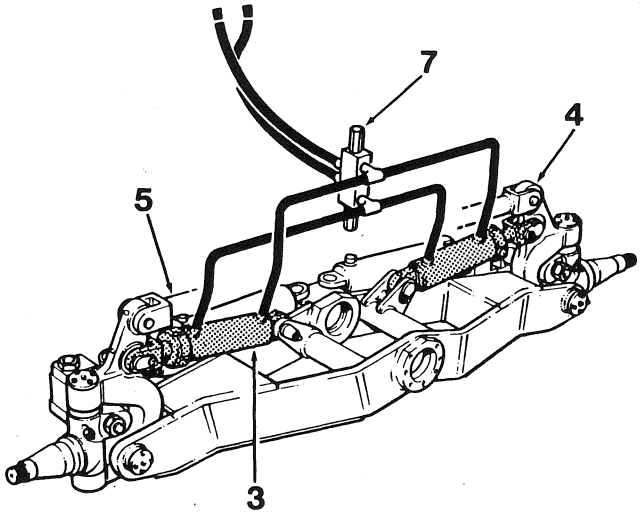


WHEEL LEAN



LEGEND

1. Drag Link
2. Steering Cylinders
3. Leaning Wheel Cylinders
4. Knuckles
5. Tie-bar
6. Axle Pivot Stops
7. Lock Valve

The front axle is designed around three basic functions:

1. Oscillation of the front axle assembly under the grader main frame allows the wheels to travel over uneven ground with little movement of the main frame. It also allows one wheel to ride a windrow as shown. The blade will move or spread the windrow while the grader stays level because the driving wheels are on the graded surface. Axle stops limit oscillation to 15° each side of centre.

2. The Leaning Wheel function allows the wheels to lean 18° right or left of centre to brace against side draft imposed by the moldboard. It gives better stability while grading on slopes by allowing the operator to keep the wheels vertical. It also gives better cornering ability by reducing the turning radius. Depending on the model, one or two hydraulic cylinders lean the wheels. A lock valve eliminates hydraulic cylinder drift to maintain wheel position. Too much wheel lean will stress the tires' side wall. A tie-bar keeps both wheels parallel.

3. The third function is Steering. It is directly affected by the other two. Steering is accomplished through two steering cylinders and a drag link that turns the two wheels together.

Caster and 1° positive camber are built into the front axle assembly. They cannot be adjusted as indicated by dimension **A**.

Toe-in means the toe or front of the wheels are closer together than the rear. On Champion graders, (except All Wheel Drive models where **0** toe-in is specified) dimension **B** is 1/2" - 5/8" larger than dimension **C**. A tires' natural tendency is to pivot on the king pin or toe-out as it rolls forward. By having the front of the wheels closer together, toe-out is counteracted, allowing the wheels to run true. But more importantly the toe-in puts a small compression load on the steering linkage. This reduces the pounding of the pivot points as the grader works and also increases component life.

To set toe-in:

1. With the wheels straight, move the grader ahead on smooth ground two complete tire revolutions. This removes any side wall flex.

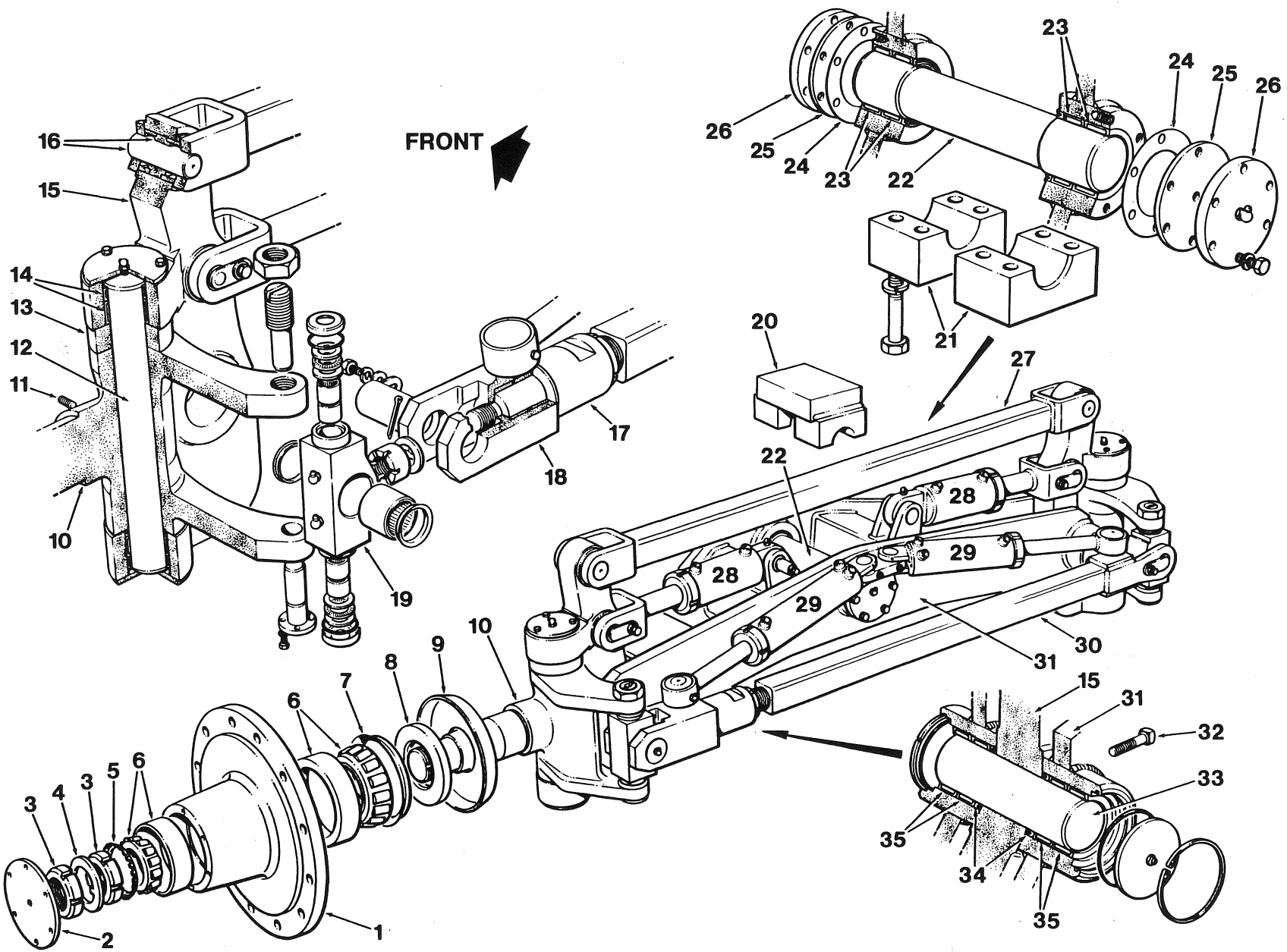
2. Place the grader in the service position. Mark an **X** on each tires' inside side wall parallel with the spindle at the tires' front. Measure the distance **C**, between the two tires at the **X** marks.

3. Move the grader ahead half a tire revolution, until the **X** marks are parallel with the spindle at the rear of the tire. Measure this distance, **B**.

4. Subtract the **C** measurement from the **B** measurement. If the result is not within specification, adjust the toe-in by:
   A) Increase the length of the drag link to increase toe-in.
   B) Decrease the length of the drag link to decrease toe-in.

After making an adjustment, secure the drag link lock nut and repeat the first three steps.

Tires - Generally front tires on a motor grader are mounted with the tread facing the opposite of the rear drive tires. This allows the front tires to clean themselves, providing better traction to any side thrust. All Wheel Drive model graders are the exception. The front tires are also drive tires and must have the tire tread facing the same direction as the rear tires.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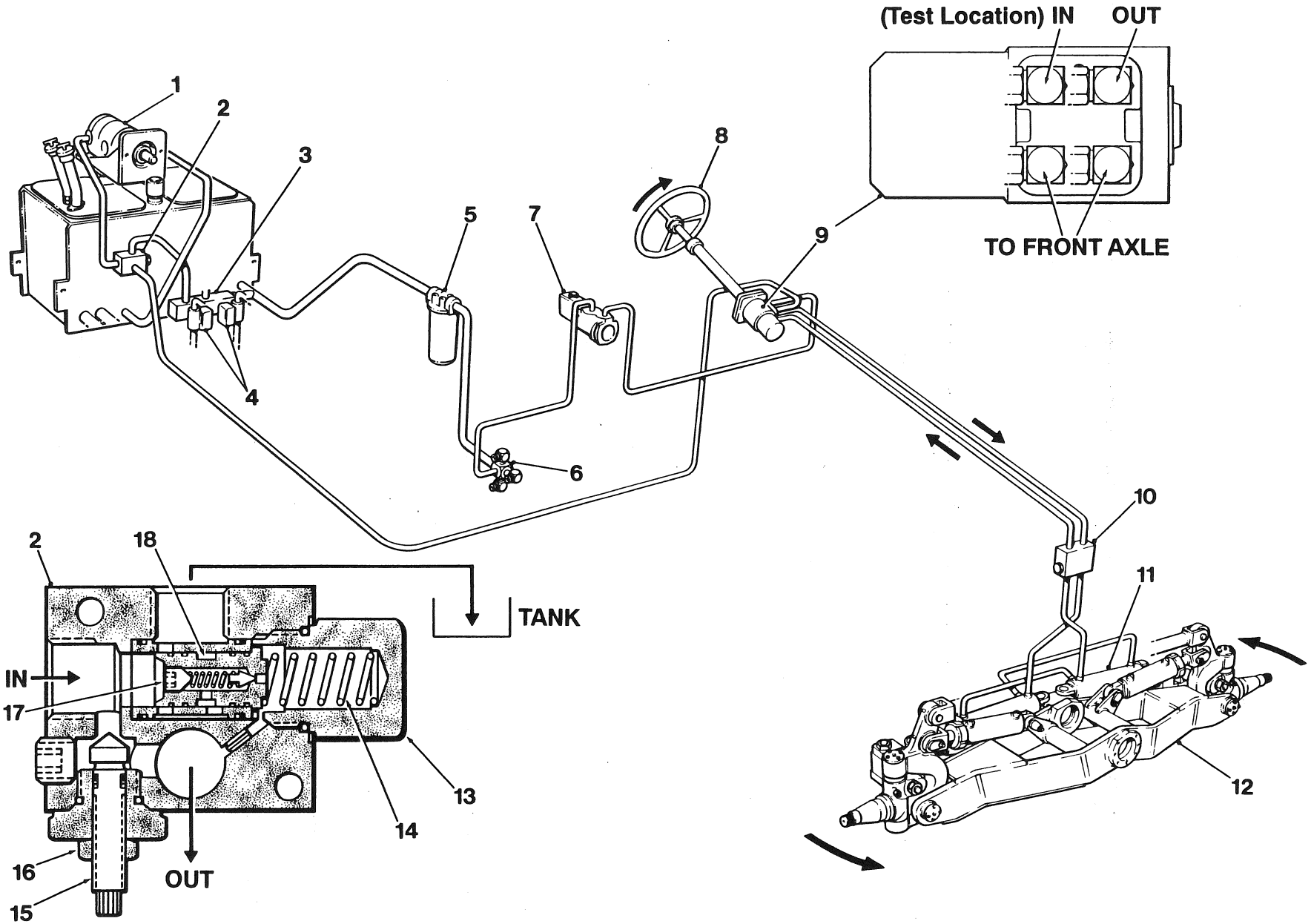
LEGEND

1. Wheel
2. Hub Cap
3. Spindle Nuts
4. Tab Washer
5. Lock Washer
6. Wheel Bearings
7. V Ring Seal
8. Spacer
9. Dust Shield
10. Spindle
11. Lock Screw
12. King Pin
13. Thrust Bearing
14. King Pin Bearing
15. R.H. Knuckle
16. Pin and Bearing
17. Adjustment Collar - Toe-in
18. R.H. Steering Yoke
19. Pivot Block Assembly
20. Mounting Block - Frame
21. Mounting Block - Matched Halves
22. Pivot Pin
23. Axle Pivot Needle Bearings
24. Shims
25. Thrust Washer
26. End Cap
27. Leaning Wheel Tie-bar
28. Leaning Wheel Cylinders
29. Steering Cylinders
30. Drag Link
31. Axle Frame
32. Lock Screw
33. Knuckle Pivot Pin
34. Dust Seals
35. Knuckle Pivot Bearings

Models 780/780A front axle performs all of the same functions as the standard front axle. The fundamental difference between models 780/780A front axle and other 700 Series grader axles is size. This axle is larger and more heavily constructed to withstand the higher stress exerted in the 780/780A applications. This axle has wider spacing (or track width) between the front tires to allow full axle mobility with 20.5 x 25 tires. The axle pivot, king and knuckle pins are all supported by double row needle roller bearings. End thrust on the axle pivot pin is measured on the thrust washer. It is limited to .003" - .005" and shim adjustable.

Under most applications the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals in extremely dusty or wet conditions, or if the joints are dry.

Refer to the Shop Manual for specifications.


(Test Location) IN
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IN
OUT
TANK

LEGEND

1. Transmission/Steering Pump
2. Priority Flow/Relief Valve Assembly
3. Manifold Return Block (Reference only)
4. Main System Relief Valves (Reference only)
5. Return Line Filter
6. 5 Way Connector
7. Clutch Master Cylinder Booster Assembly
8. Steering Wheel
9. Steering Valve - Open Centre
10. Cushion Valve
11. L.H. Steering Cylinder
12. Axle
13. Spring Cap
14. Balance Spring
15. Flow Adjustor
16. Lock Nut
17. Pressure Regulation Adjustment Set Screw
18. Pressure Regulation Spool Assembly

The transmission steering pump is a two section gear pump driven from the engine crankshaft. Each section is sealed from the other. The steering pump draws oil directly from the hydraulic tank. It has an output displacement of approximately 22 U.S. gpm @ 2100 rpm. Since displacement of a gear pump is directly proportional to its speed, Champion uses a priority flow valve to maintain consistant steering response throughout the entire engine operating range. With engine speed between low idle and approximately 1300 rpm, 100% of the flow is directed to the steering valve. At engine speeds above this, the first 12 U.S. gpm is directed to the steering valve, the remainder returns to the tank.

If the operator is not turning the steering wheel, hydraulic oil circulates through the valve and enters the clutch booster, to provide clutch pedal hydraulic assistance. After flowing through the booster, the steering oil joins the main hydraulic oil at the 5 way connector, continues through the filter and returns to the tank.

When the operator turns the steering wheel to the left for example, oil is directed to the front axle as shown. The right hand steering cylinder extends and the left hand cylinder retracts, causing the grader to steer to the left. Return oil flow from the cylinders passes back through the steering valve and supplies the clutch booster, finally returning to tank. If the steering wheel is turned to the right the process is reversed.

The cushion valve performs two important functions:

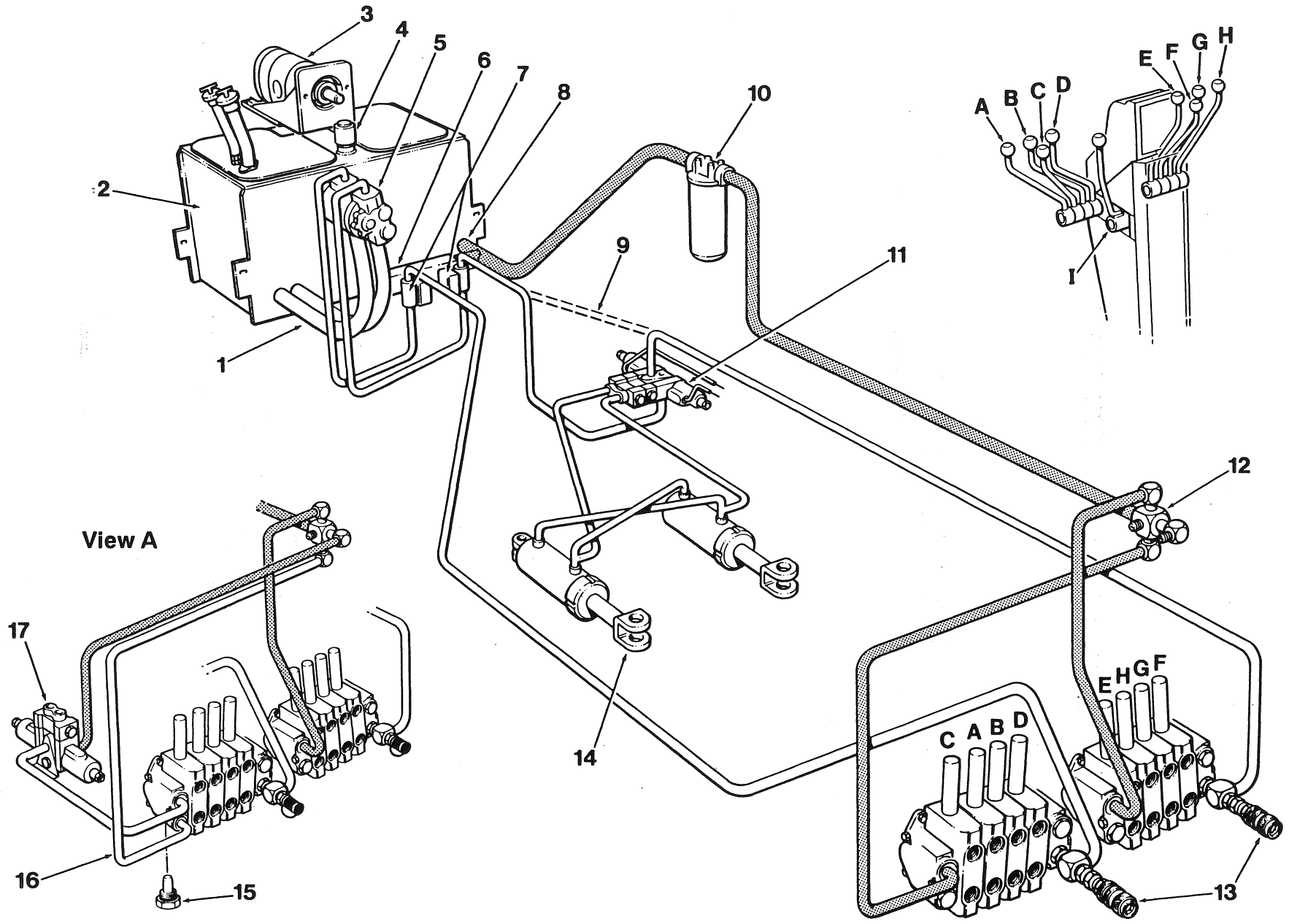
1. It prevents shock forces to the steering valve if for instance a front wheel drops into a hole.
2. It also becomes a bypass valve allowing oil to return to the steering valve, if the operator continues to turn the steering wheel after the wheels reach lock. The cushion valve is actually two valves in one housing. See page 17.

NOTE: Do not continue to turn the steering wheel after the wheels reach turning lock. This prevents unnecessary stress to the steering components.

The system is protected by a relief valve (set at 2300 $\pm$100 psi @ 2100 rpm) incorporated into the priority flow valve. Under normal operating conditions the relief valve does not open.

The relief valve setting, as well as the left-hand and right-hand cushion valve settings can be checked by installing a pressure gauge on the quick coupler located on the inlet hose.

Refer to the Shop Manual for detailed Instructions and Specifications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View A

LEGEND

1. Dual Suction Lines
2. Hydraulic Tank
3. Transmission/Steering Pump (Reference only)
4. Breather
5. Main Hydraulic Pump
6. Relief Valve Manifold Block
7. Relief Valve
8. Tank Return
9. Rigid Frame Bypass
10. Return Line Filter
11. Articulation Valve
12. 5 Way Connector
13. Quick Coupler Test Ports
14. Articulation Cylinders

VIEW 'A'

Front Mounted Attachment Circuit

15. Power Beyond Plug
16. Drain Line
17. Attachment Valve

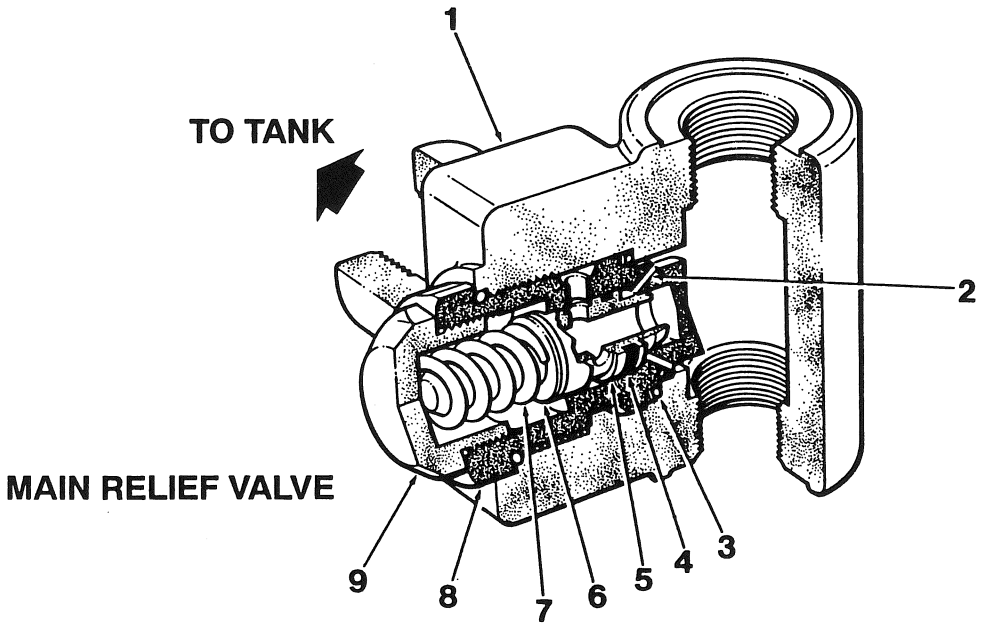
Champion motor graders use two main hydraulic systems. This twin flow hydraulic system uses separate gear pumps, relief valves and open centre manifold control valves for each side. Both main hydraulic pumps are contained in a single housing mounted to the engine's accessory drive. Each section has its own suction line and is protected by a separate relief valve set at 2100 $\pm$100 psi @ 2100 rpm. Oil enters each separate manifold on the left side and exits from the right where it joins the return from the steering system at the 5 way connector, continues through the filter, and returns back to the tank.

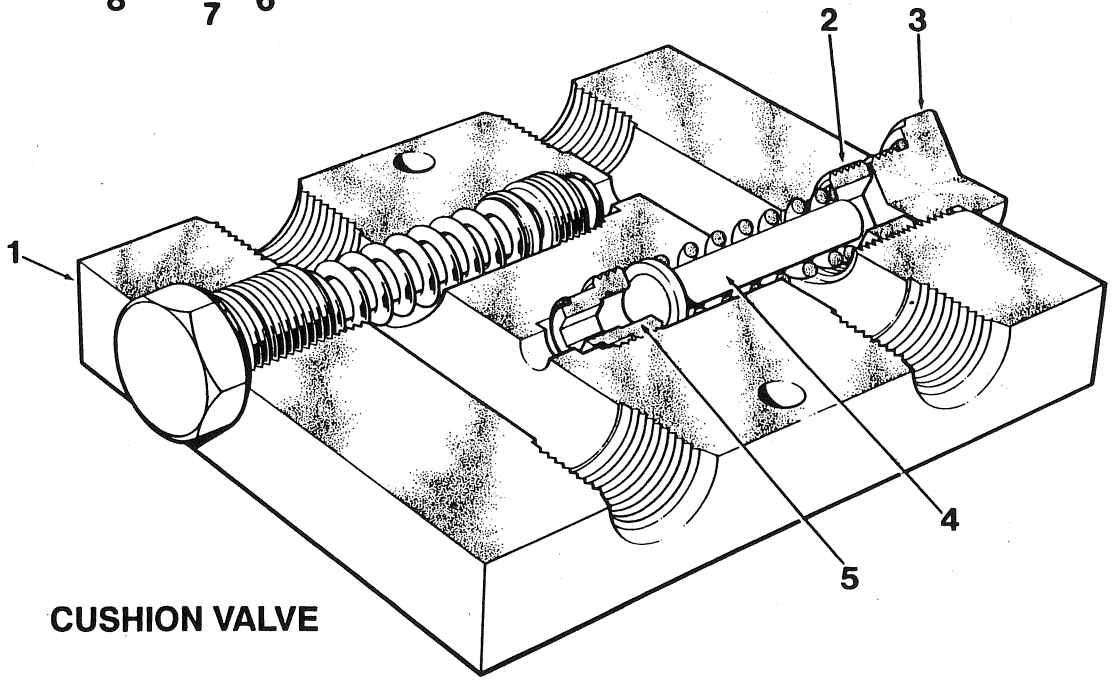
Levers to the **left** of the steering wheel, control the **left-hand** manifold valve and levers to the **right** of the steering wheel control the **right-hand** manifold. Each manifold is equipped with a quick coupler test port on the inlet. By bottoming out a cylinder, relief valve pressure setting can be obtained. Champion recommends taking pressure readings only at these specified test points.

Articulated graders use a double acting solenoid valve located in the **left-hand** hydraulic system to control frame articulation. All articulated graders use two cylinders diagonally powered, providing even articulation speed left or right of centre.

Special consideration must be given when connecting additional solenoid valves to the manifolds, whether they are for snow wings or dozer blades. A power beyond plug must be installed as shown. An additional drain line is used to vent controlled internal spool leakage back to the tank to prevent internal pressure build up in the manifold control valve.

Refer to the Shop Manual for specifications.





CUSHION VALVE

LEGEND

Main Relief Valve

1. Valve Body
2. Valve Seat
3. O-Ring and Back-up Washer
4. Poppet Seal
5. Poppet
6. Shims
7. Spring
8. Valve Cartridge
9. End Cap

Relief valves limit the pressure in a hydraulic system to protect system components from damage. The two main hydraulic relief valves are identical and are mounted to the return manifold block on the front of the hydraulic tank. Oil leaving the pump flows straight through the valve under most operating conditions. When pressure exceeds the relief valve setting of 2100 $\pm$100 psi (e.g. when a cylinder is bottomed out), the valve poppet moves off its seat, opening a passage directly into the hydraulic tank.

To check relief valve operation:

A) Install a 0-3000 psi gauge into one of the test port quick couplers located on the inlet to the manifold valve.

B) When it is safe to do so start the engine and fully retract the blade lift cylinder on the same side as the gauge installation. Hold the blade lift lever in the retracted position. Read the gauge with the engine at 2100 rpm.

C) Add shims to raise, or remove shims to lower the relief valve setting. The shims are between the spring and poppet. Never add shims between the spring and end cap as the poppet travel could be restricted resulting in a reduced flow rating of the valve and higher system pressures.

D) Always retest the relief valve setting.

Repeat Steps **A)** through **D)** for the other side of the twin flow hydraulic system and its relief valve.

LEGEND

Cushion Valve

1. Body
2. Adjustment Screw
3. O-Ring Cap
4. Poppet
5. Poppet Seat

Cushion valves are used in the steering and circle turn systems.

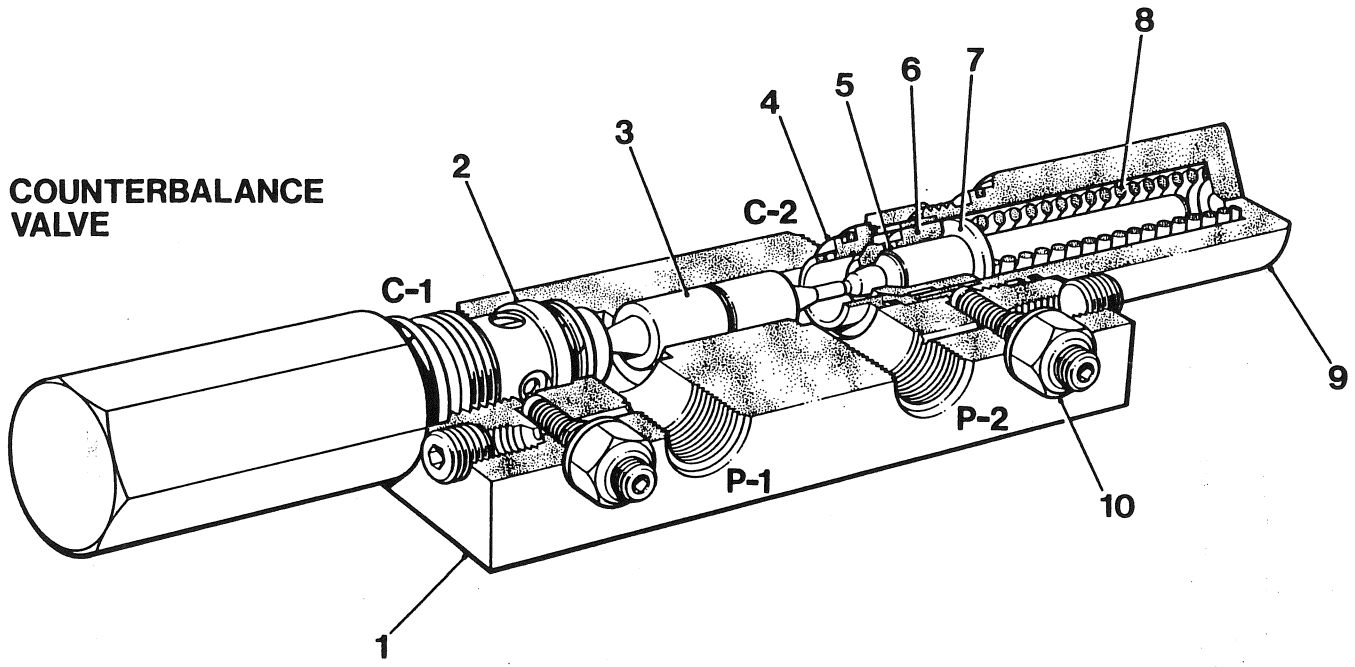
The cushion valve is actually two resetable relief valves in one body, protecting both sides of the same circuit from high pressure spikes created by shock loads. Under these conditions, a small amount of oil is vented across the valve to the opposite side of the same circuit, hence the common name of cross-over relief valves. During normal operation, oil flows straight through the valve and the poppets remain closed.

Whenever the moldboard first strikes an immovable object the pressure spike created is vented to the opposite low pressure side. The internal valve porting prevents the circle from suddenly turning.

The circle cushion valve setting is 2200 $\pm$100 psi cracking. Because this is higher than the main relief, the valve cannot be checked by using the grader's hydraulic system. It must be removed and checked with a hand pump. For more information on the steering cushion valve see page 13.

NOTE: The adjustment is on the opposite side to the side being tested.

Refer to the Shop Manual for specifications.


COUNTERBALANCE VALVE
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3
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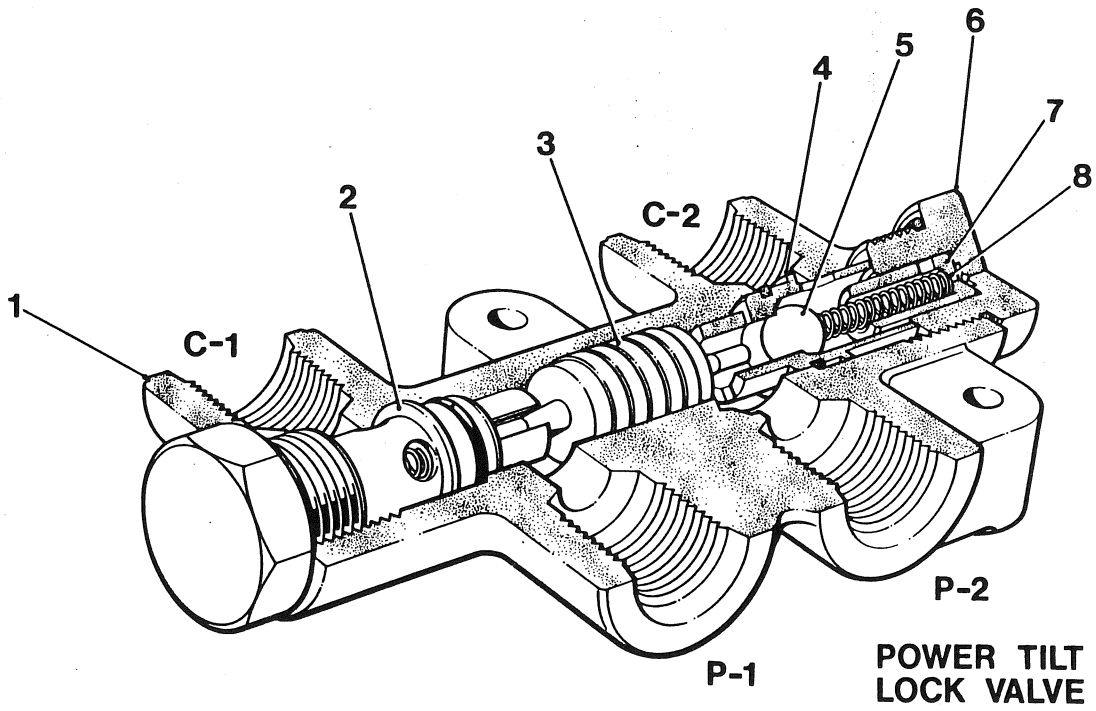
9
10
C-1
C-2
P-1
P-2


1
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6
7
8
C-1
C-2
P-1
P-2
POWER TILT LOCK VALVE

LEGEND

Counterbalance Valve

1. Valve Body
2. L.H. Check Valve Assembly
3. Pilot Piston
4. R.H. Check Valve Seat
5. R.H. Poppet
6. R.H. Check Poppet
7. R.H. Spring Seat
8. R.H. Spring
9. R.H. End Cap
10. R.H. Thermal Relief Assembly

NOTE: L.H. and R.H. are for purposes of explanation only. L.H. Components are identical to the R.H.

The **counterbalance valve** is a pilot operated check valve found in the hydraulic blade lift, leaning wheel, and the moveable point blade lift system lock circuit. It is used to lock oil into the cylinder and prevent drift. It also prevents blade lift cylinder cavitation when lowering the drawbar from the carry position.

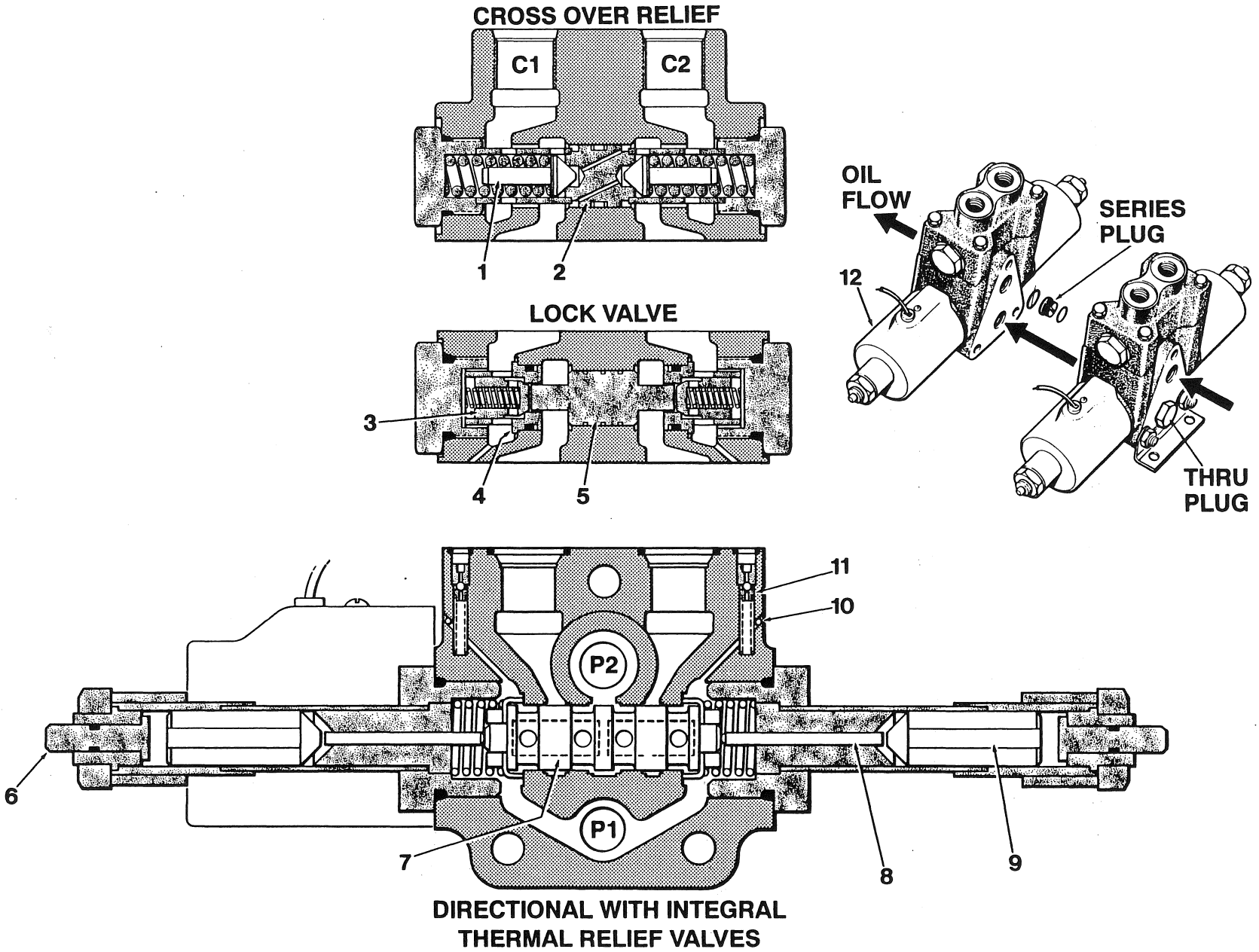
Oil pressure directed to **P-2** pushes the R.H. check poppet against the spring and oil is free to flow into the cylinder. Oil exiting the opposite end of the cylinder enters at **C-1**, but is trapped by the L.H. check poppet. This creates back pressure between **C-2** and **P-2**. The pilot piston is then pushed across to the L.H. poppet which is moved off its seat and oil is free to flow out **P-1**. If the cylinder is to move in the opposite direction, the process is reversed. The poppet assembly is tapered to allow smooth, accurate hydraulic control of these circuits. Two thermal reliefs in the valve allow for thermal expansion inside the cylinders. If this expansion causes cylinder pressures to exceed 3000 psi, a small amount of oil is bypassed around the check poppets and vented to the manifold port **P-1** or **P-2**. Champion does not recommend removal or adjustment of the thermal relief valve assemblies.

LEGEND

Power Tilt Lock Valve

1. Valve Body
2. L.H. Check Valve
3. Pilot Piston
4. R.H. Check Valve Seat
5. R.H. Check Ball
6. R.H. O-Ring Cap
7. R.H. Spring Seat
8. R.H. Spring

The **power tilt lock valve** is a pilot operated check valve, used on all twin hydraulic cylinder moldboard tilt installations. It is used to prevent moldboard drift under load. Oil entering the valve at **P-2** unseats the R.H. check ball and flows to the cylinder. At the same time the pilot piston moves to the left unseating the L.H. check ball and allows oil leaving the cylinder to exit at **P-1**. When the manifold control valve is in neutral, both check valves are closed, locking the oil in both ends of the cylinder.



DIRECTIONAL WITH INTEGRAL THERMAL RELIEF VALVES

LEGEND

1. Poppet
2. Crossover poppet seat
3. Check Poppet
4. Lock Valve Cage
5. Pilot Piston
6. Manual override Plunger
7. Spool
8. Pin
9. Plunger
10. Plug
11. Thermal Relief Assembly
12. Solenoid Coil

Solenoid operated valves are used to control articulation and most attachments. Depending on the use, the valve configuration can vary.

When the valve is in neutral, the spool is centered, (both solenoids de-energized) oil enters **P-1** and splits left and right, flowing through the hollow portions of the spool and exits through **P-2. (NOTE:** Oil could enter at **P-2** and exit at **P-1** but cylinder operation is reversed). Since these valves are also used in series, the through port must be plugged by an O-Ring plug.

If the left-hand solenoid is energized, the spool is moved to the left, directing oil from **P-1** up the right-hand passage to the lock valve. This lock valve operates similar to the power tilt lock valve in that pressure opens the right-hand check poppet and moves the pilot piston to the left which unseats the left-hand check poppet. Oil then continues up the right side flowing through the crossover relief valve and out **C-2.** Oil exiting the cylinder enters at **C-1**, flows through the crossover relief valve and the now open lock valve. Oil enters the left-hand section of the hollow spool and exits the valve assembly at **P-2.**

CROSSOVER RELIEF SECTION

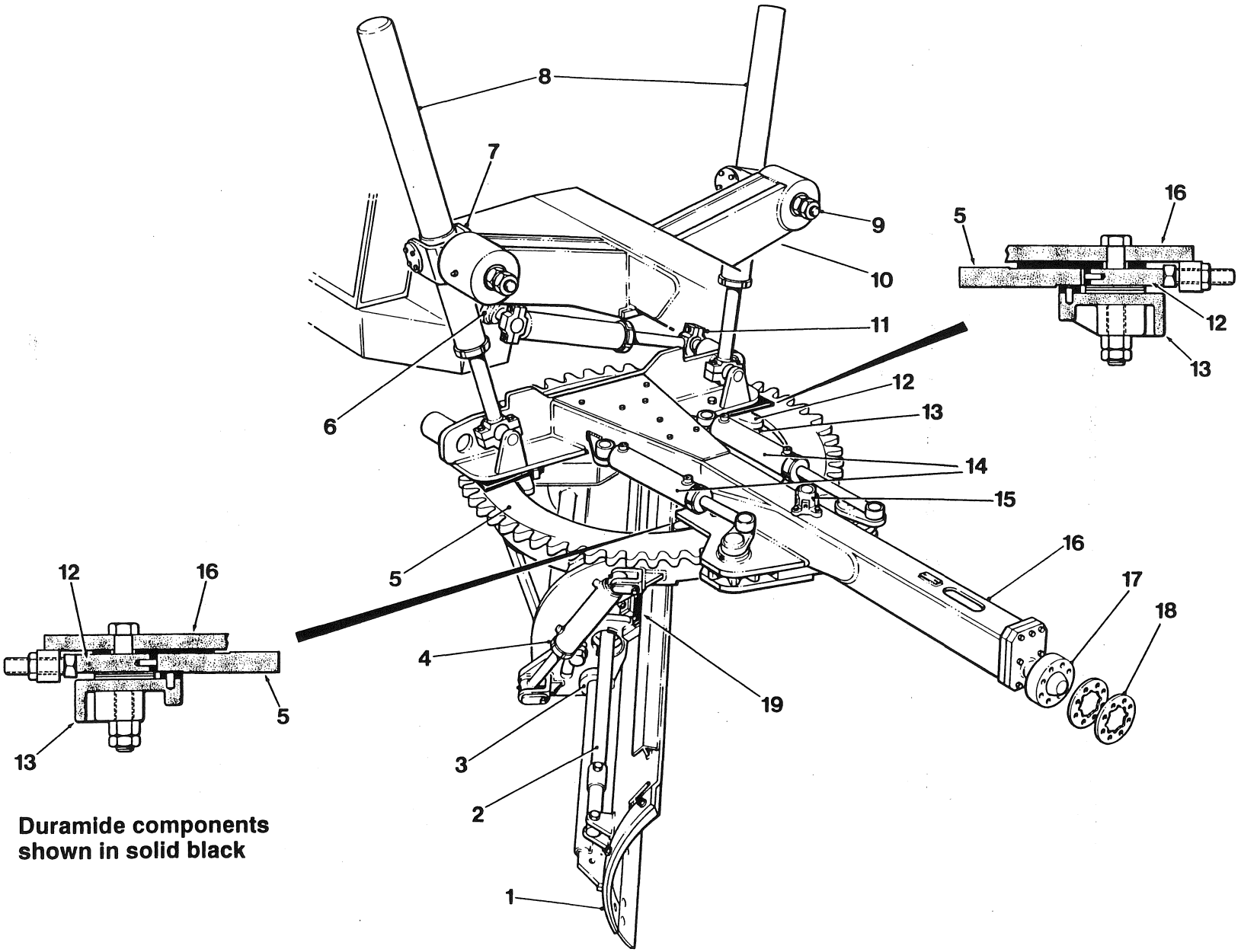
If a shock load occurs, the high pressure oil is transferred to the low pressure side, reducing the stress on other components. The relief setting of 3100 psi is shim adjustable. This valve section is similar in operation to the cushion valve discussed on Page 17.

LOCK VALVE SECTION

When the directional control section is in neutral, the lock valve traps oil in the cylinder. This prevents articulation 'wandering' or a ripper slowly being forced up. Two different peg sizes are available on the pilot piston. Generally the larger peg size is used in articulation valve assemblies. Although this slows the speed of articulation slightly at high rpm, it prevents valve chatter (rapidly opening and closing lock valves) at low rpm by slightly increasing back pressure.

DIRECTIONAL CONTROL SECTION

Non-adjustable thermal relief valves are incorporated into the body. Whenever trapped oil pressure exceeds 3500 psi due to thermal expansion, oil is vented into the main hydraulic system. On graders prior to **S/N 20719** the thermal relief valves were external and vented to the atmosphere. Casting differences do not allow component inter-changability.



Duramide components shown in solid black

LEGEND

1. Moldboard
2. Slide Shift Cylinder
3. Lower Slide Casting
4. Power Tilt Cylinder *
5. Circle
6. R.H. Shift Cylinder Anchor
7. Stirrup
8. Blade Lift Cylinders
9. Stirrup Nut/Lock Nut
10. Fixed Point Hi-Lift Arm
11. Circle Shift Cylinder
12. Guide Plate - with Duramide
13. Clamp Plate - with Duramide
14. Circle Turn Cylinders
15. Timing Valve
16. Drawbar
17. Drawbar Ball Stud
18. Ball Stud Shims
19. Upper Slide Bearing with Duramide

** Models 710/710A feature one centre mounted tilt cylinder.*

The standard duty Fixed Point Hi-Lift as equipped on models 710 thru 740A is illustrated. Models 750 thru 780A use the heavy duty circle moldboard blade lift assembly. Its' heavier construction is required for the mining and forest industry applications. In addition, five sets of guide and clamp plates are used; however, the set-up principle is the same.

The circle, drawbar, moldboard assembly is the working area of the grader. Long life and good performance depend on proper adjustment, lubrication and maintenance of this assembly. Carefully follow the lubrication chart and Operator's Manual to perform these tasks.

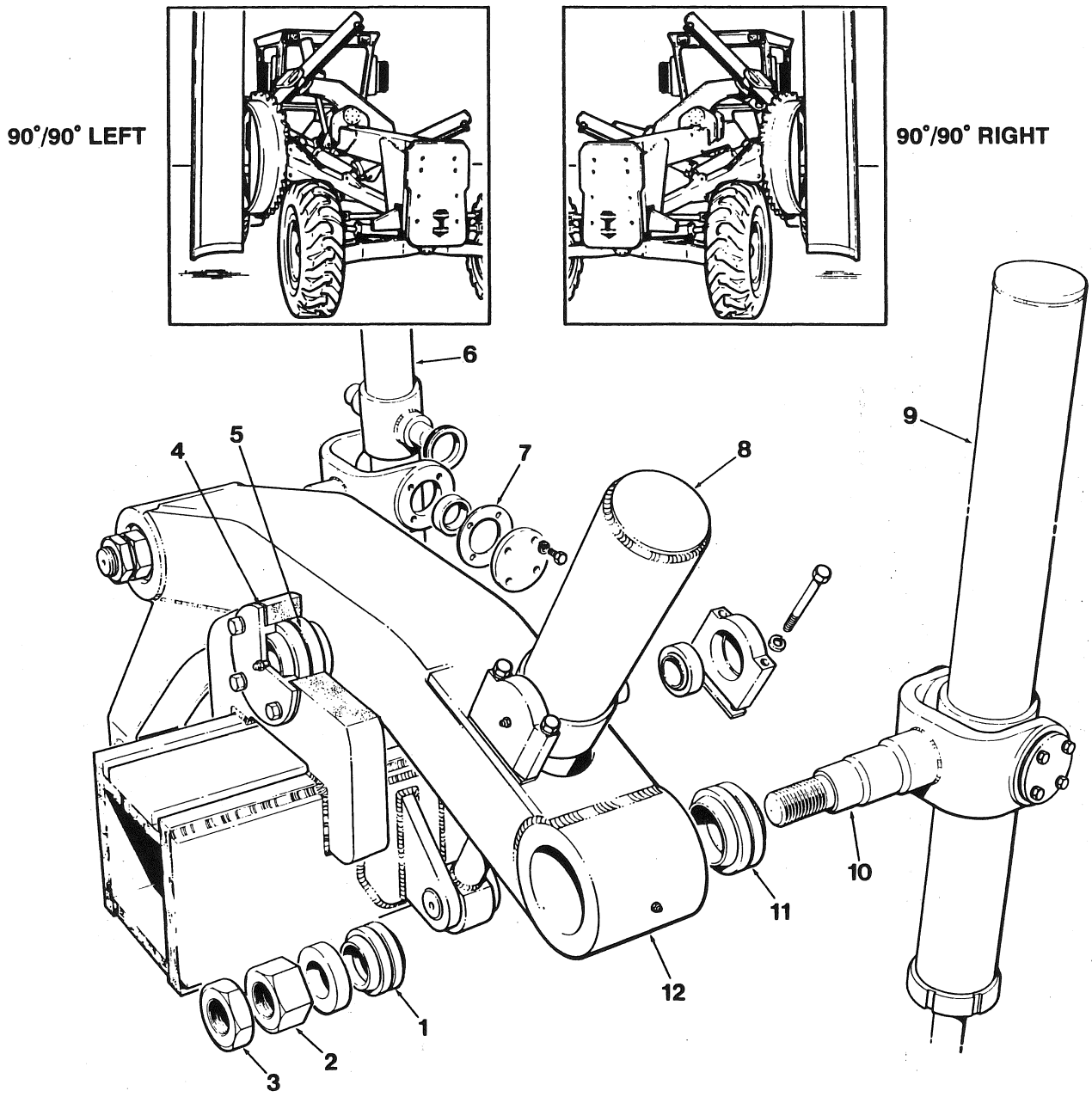
Duramide circle support bearings are standard on all models except models 710 thru 720A, where they are available optionally. Duramide's non-metalic composition provides reduced maintenance, long life, and an easier turning circle. Duramide assemblies can be easily interchanged with metalic components with the benefit of retaining the same set up procedures.

A properly adjusted circle has the front guide plate(s) tight against the circle. The two rear guide plates must have .040" - .080" clearance to the circle.

To keep the blade properly adjusted, all excessive 'free play' must be taken out of the assembly. This may be done by removal of shims from between the guide and clamp plates, drawbar ball stud, and cylinder ball caps. **NOTE:** Ball caps are a matched set and cannot be interchanged or reversed. Excessive 'free play' of the moldboard affects blading tolerance. It may be removed from the slide rails by replacing slide castings and/or shimming upper slide rail bearings. Always slide the moldboard end to end to check for binding after any adjustments. Any visible movement of the stirrup shank or trunion bushings indicate adjustment is required. After seating the stirrup shank bearing, back off the nut and tighten to 50 ft.lbs. Tighten the locknut to 400 ft.lbs. while holding the first nut. The trunion bushings have a preload sufficient to require 15-25 lbs. on the top of the cylinder to move the cylinder in the stirrup. Adjust this preload by adding or removing shims. Always inspect the V-Ring seal on the trunion for damage and replace as necessary.

Lubrication is required on the circle top surface, inner surface and underside where the clamp plates support the circle, regardless of whether the circle is supported by Duramide or metalic guide and clamp plate assemblies. Recommended lubrication is a coating of spray graphite dampened with diesel fuel. Grease or molycoat may be used in some operating conditions. Fresh lubricant should be applied only after cleaning the surface. Do not allow a build up of dry lubricants.

Refer to the Shop Manual for specifications.


90°/90° LEFT
90°/90° RIGHT
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8
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10
11
12

LEGEND

1. Bushing
2. Adjusting Nut
3. Lock Nut
4. Shims
5. Bushing
6. L.H. Blade Lift Cylinder
7. Shims
8. Lock Cylinder
9. R.H. Blade Lift Cylinder
10. Stirrup Yoke
11. Bushing
12. Over Frame Arm

The Moveable Point Blade Lift System is optional on models 710 thru 740A. The Fixed Point Hi-Lift System is standard on all models and is the only system available on models 750 thru 780A. The Moveable Point Blade Lift System is available for applications where extreme reaches are required.

COMPONENTRY

Champion's Moveable Point Blade Lift System consists of three major components.

The Over Frame Arm rotates on a pin and bearing assembly welded directly to the top of the frame. Controlled from the cab, the arm is hydraulically rotated over an infinite range of positions through 70°.

The Arm Lock Cylinder is mounted to the frame and extends through the over frame arm. By activating the control lever in the cab, the arm lock cylinder repositions the arm through its 70° arc. The cylinder locks the arm in position when the desired angle is attained. A counterbalance valve prevents cylinder movement.

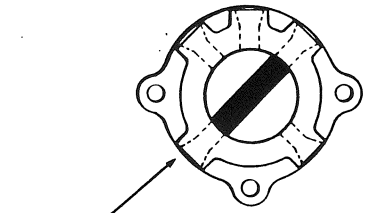
The Circle Side Shift Cylinder is mounted directly between the circle drawbar and the over frame arm. Functioning similarly to other fixed or moveable point blade lift systems, the circle side shift provides lateral movement of the circle. However, the circle side shift on Champion's Moveable Point Blade Lift System permits movement either left or right without a mechanical change to the circle side shift cylinder or the use of a latch/detach mechanism.

ADJUSTMENTS

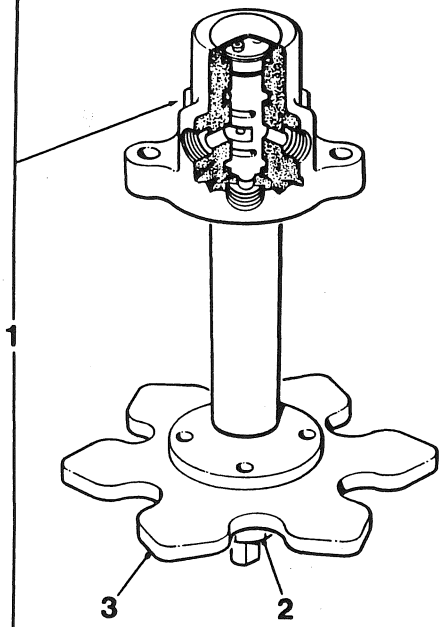
The stirrup bearing adjustment procedure is similar to the fixed point system, as is the blade lift cylinder trunion bushing adjustment.

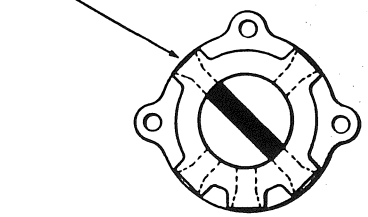
The over frame arm pivot bearings are shim adjustable. The clearance specification is .002" - .007" on both sides.

Refer to the Shop Manual for specifications.

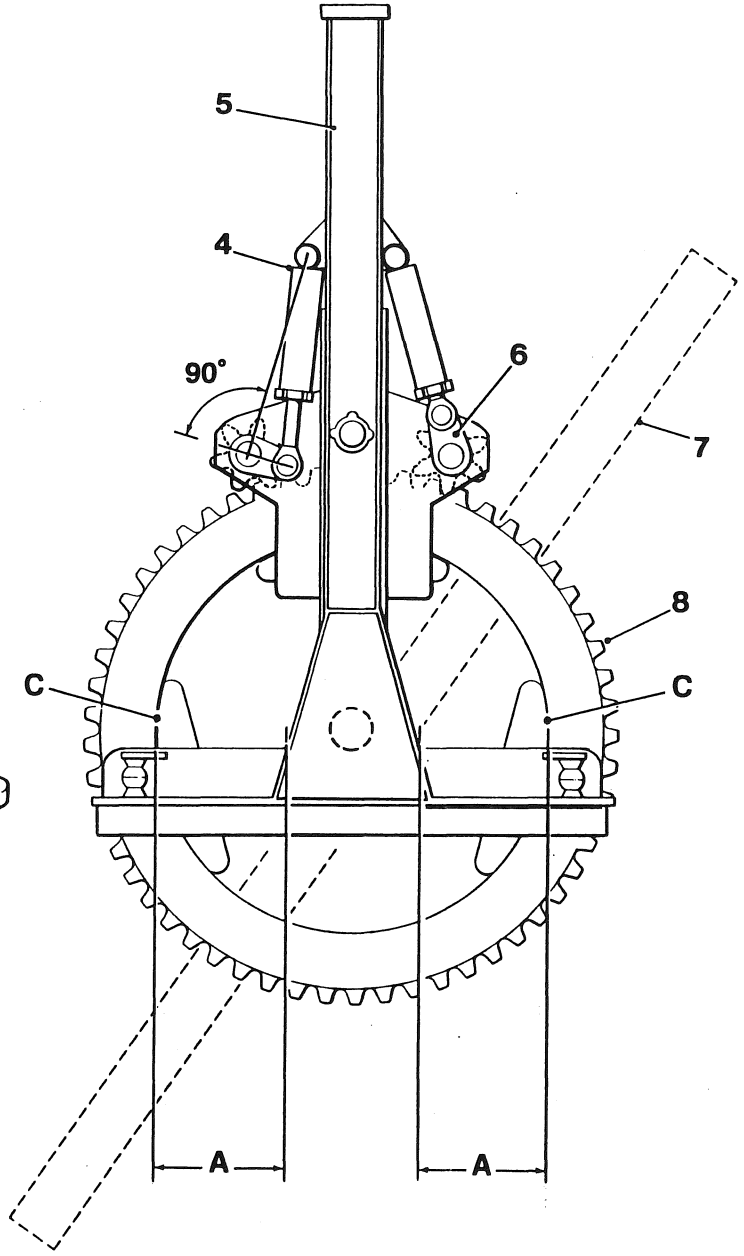


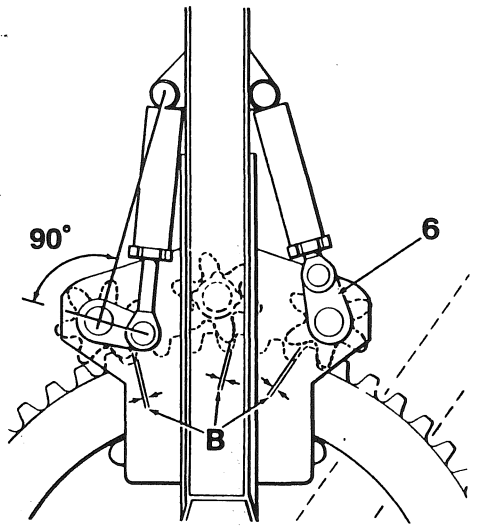
DETAIL 'EE'



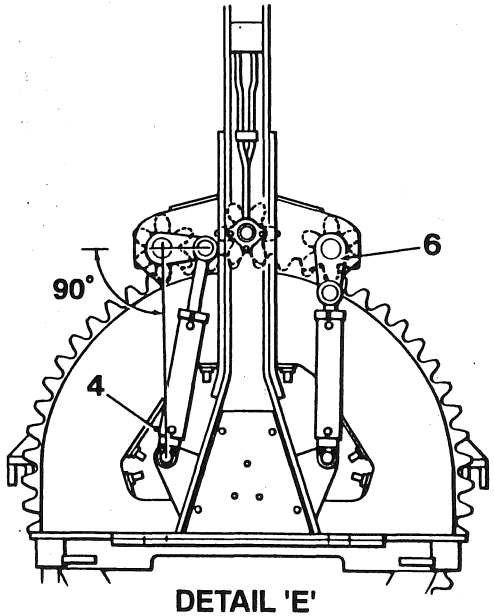


DETAIL 'DD'





DETAIL 'D'



DETAIL 'E'

LEGEND

1. Circle Timing Valve
2. Timing Shaft Lock Nut
3. Timing Valve Pinion
4. L.H. Circle Turn Cylinder
5. Drawbar
6. R.H. Circle Turn Crank
7. Moldboard
8. Circle

A Centering Dimension
B Tooth Clearance
C Horizontal Clearance
D Forward Mounted Circle Turn Cylinders
DD Cross Section of Valve Showing Blocked Forward Left Port
E Rear Mounted Circle Turn Cylinders
EE Cross Section of Valve Showing Blocked Forward Right Port

The Champion grader uses two hydraulic cylinders to turn the circle. In conjunction with the timing valve this system is the strongest in the industry, for turning and holding power. The circle must be kept properly adjusted through regular maintenance for smooth operation and long life. If the circle fails to turn smoothly, one of the corrective measures is re-timing.

To time the circle there is a three step procedure. Follow this procedure whenever the timing is checked or whenever the circle is adjusted.

STEP 1

CENTRE THE CIRCLE TO THE DRAWBAR

Measure the distance from the inside lip of the circle to the side of the drawbar on both sides. These measurements should be approximately equal as indicated by dimension **A**. Note that this is only a starting point.

Setting drive pinion to circle clearance:

A) **Graders with flat tips on the circle teeth:** adjust the guide plates until .040" - .080" back lash clearance is between the drive pinion and circle teeth, as indicated by dimension **B**.

B) **Older graders with round tips on the circle teeth:** adjust the guide plates until .060" - .120" root to tip clearance is between the drive pinion and circle teeth.

In either version, the timing valve pinion should have the same clearance as the circle to drive pinions. If not, check for wear on the drive pinion teeth. Adjust the rear guide plates to obtain the specified clearance at the circle. See detail **C**.

STEP 2

POSITION THE CYLINDER AND CRANKS

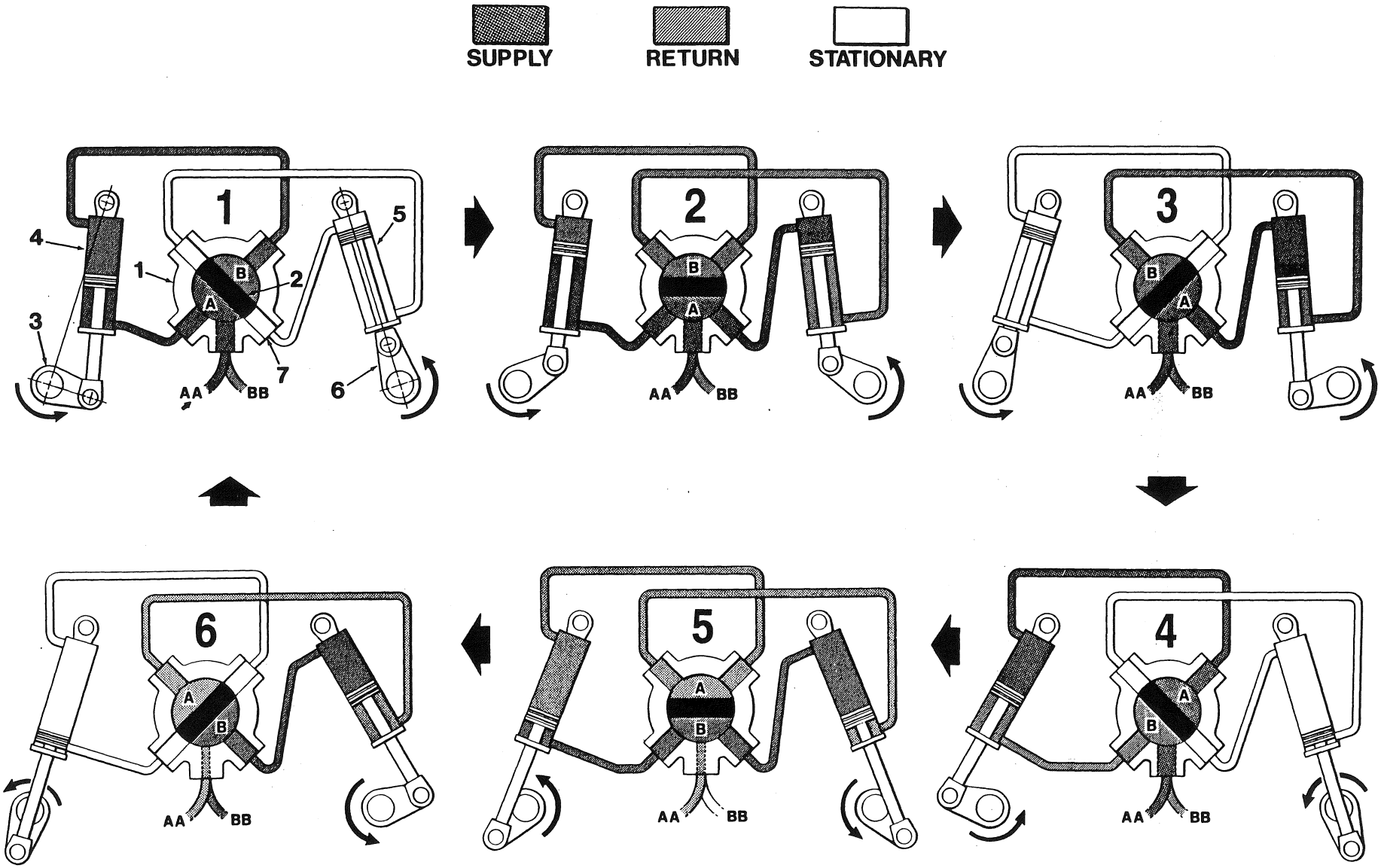
Fully retract the right hand cylinder so that a straight line intersects all three pivot points. Ensure the left-hand cylinder and crank is towards the drawbar. Position the cylinder so that a straight line, drawn between the centre of the cylinder anchor and the centre of the crank shaft will form a 90° angle with a line drawn through the centres of both the crank shaft and pivot. This set-up is very important and applies to both orientations of circle turn cylinders. See details **D** and **E**.

STEP 3

SET THE TIMING VALVE

After relieving all hydraulic pressure, locate and remove the hose and fitting from the forward left-hand port on the timing valve on forward mounted circle turn cylinders. See detail **DD**. On rear mounted circle turn cylinders use the forward right port. See detail **EE**. Looking inside, the spool must completely block the timing port as shown. If adjustment is required, loosen the timing pinion shaft lock nut and rotate the shaft until the spool completely blocks the port. Secure the lock nut and ensure the spool did not move. Replace the fitting and hose.

Refer to the Shop Manual for specifications.


SUPPLY
RETURN
STATIONARY
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A
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AA
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7

LEGEND

1. Timing Valve Body
2. Centre Land of Timing Spool
3. L.H. Crank
4. L.H. Circle Turn Cylinder
5. R.H. Circle Turn Cylinder
6. R.H. Crank
7. Timing Port

To enable us to understand the theory of Champion's circle turn system it is important to know the following:
The L.H. cylinder and crank is always 90° out of phase to the right and due to the internal porting of the circle turn valve:

- Port **AA** is always connected to cavity **A**
- Port **BB** is always connected to cavity **B**

Regardless of which circle turn cylinder orientation is on your grader, the principle of operation remains the same. The following series of illustrations will show what happens when the circle turn lever is pulled back, turning the circle clockwise from the timing position, e.g. oil enters port **AA**.

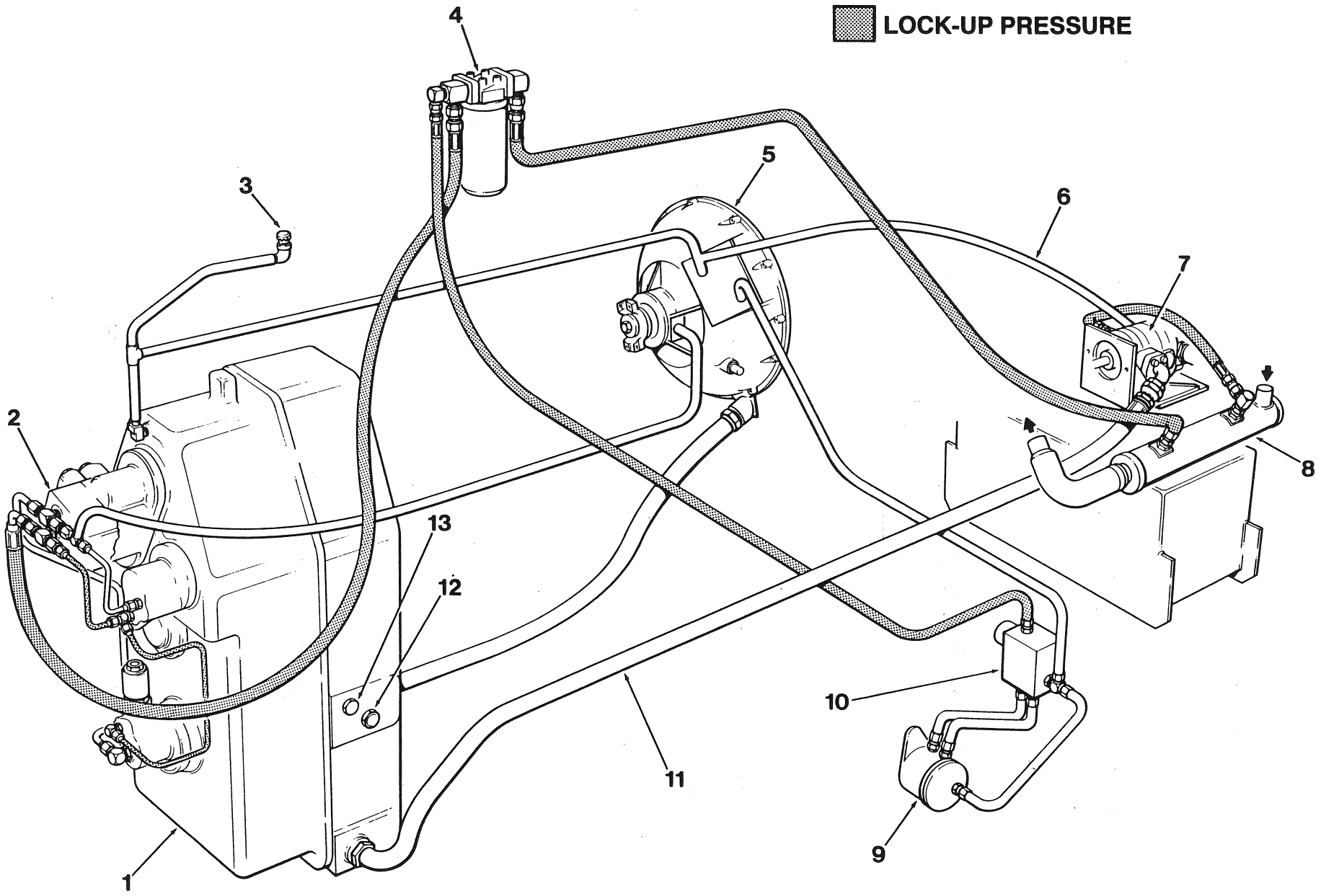
In diagram **1**, the cylinders and timing valve are in the circle timing position. The R.H. cylinder is fully retracted and momentarily cannot provide any useful force. The L.H. cylinder is half way through its stroke, in fact at the maximum torque angle, and is capable of turning the circle (under load) by itself. The timing valve spool is positioned so that 100% of the oil flow entering at **AA** is directed by cavity **A** to the rod end of the L.H. cylinder. The L.H. cylinder retracts, driving the circle clockwise which also turns the timing valve spool and R.H. cylinder to position **2**.

In diagram **2** the rotated spool permits oil to flow to the base end of the R.H. cylinder which extends and assists the left hand cylinder to turn the circle. Oil exiting the cylinder enters cavity **B** of the timing valve and exits through Port **BB**.

As long as the circle turn lever is pulled back, the assembly rotates to diagram **3** which is 90° from diagram **1**. The R.H. cylinder is now turning the circle by itself as the L.H. cylinder is straight and momentarily at rest. The timing valve spool has blocked the ports leading to the L.H. cylinder.

In Diagram **4**, the cylinders and timing valve are positioned 180° from diagram **1**. Oil still enters at Port **AA** and flows through the internal porting of the valve to the base end of the L.H. cylinder which extends, driving the circle clockwise.

Follow the oil flow in diagrams **5** and **6** to understand the sequence.


LOCK-UP PRESSURE
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LEGEND

1. Model 8400 Transmission
2. Transmission Pressure Regulating Valve - 2 stage
3. Transmission/Clutch Breather
4. Transmission Oil Filter
5. Clutch Housing
6. Transmission/Steering Pump Vent
7. Transmission/Steering Pump
8. Transmission Oil to Water Cooler
9. Lock/Unlock Final Drive Shift Cylinder
10. Lock/Unlock Final Drive Control Valve
11. Suction Line
12. Fluid Level Sight Glass
13. Transmission Filler Plug

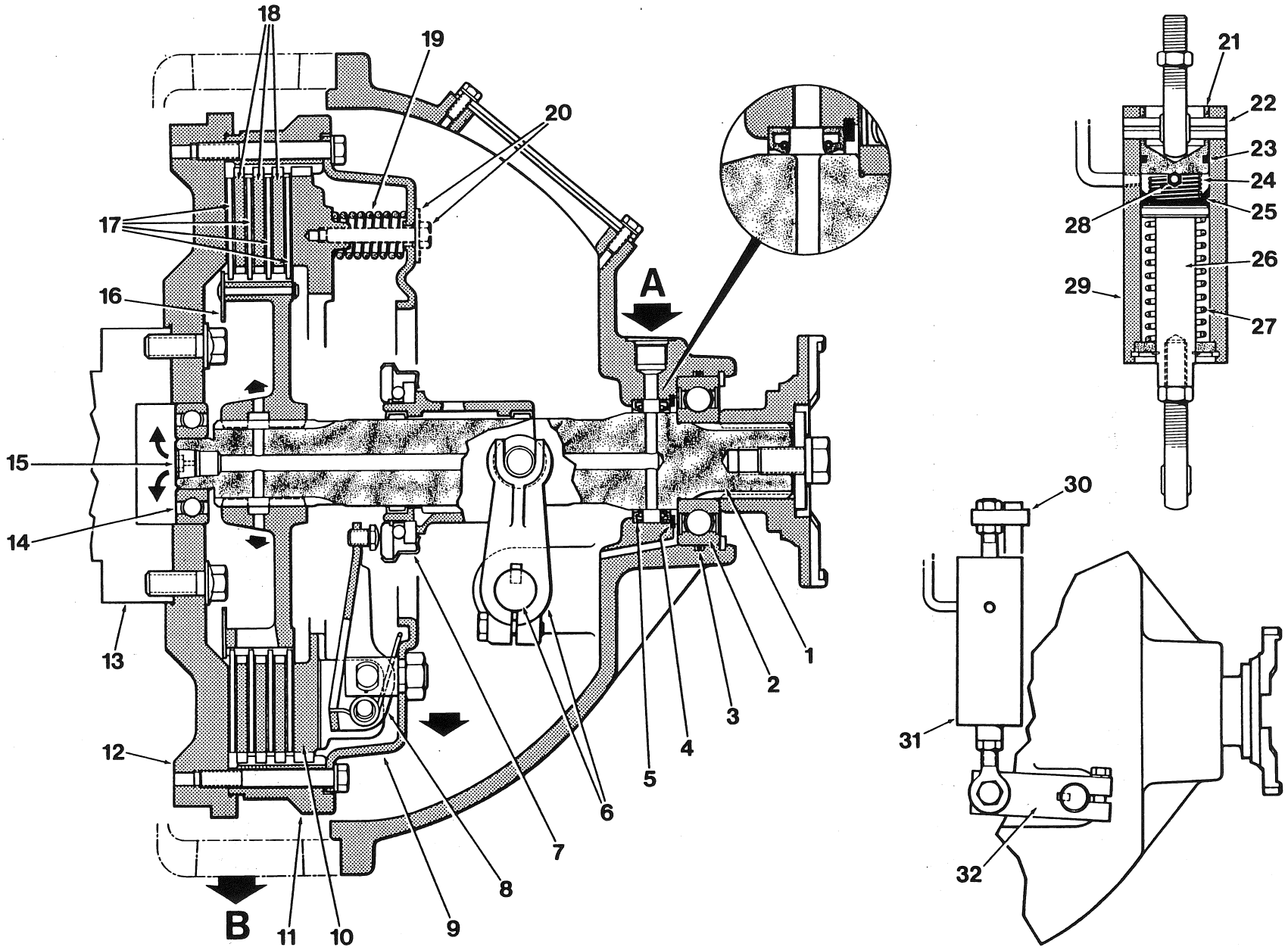
Oil is supplied to the transmission and engine clutch by the transmission supply pump. The pump is driven from the engine's crankshaft and is located below the radiator. This oil is completely separate from the hydraulic system oil. The oil is drawn from the transmission to the pump directly, without passing through a strainer. Oil leaving the pump enters an oil-to-engine coolant, bundle-type cooler. This type of heat exchanger not only provides cooling to the transmission, but also provides a more consistant temperature, regardless of ambient temperatures. Cold coolant exiting the radiator passes through the cooler and enters the engine's water pump.

The oil then flows to the transmission oil filter. This is a special large capacity, spin-on, 7 micron, disposable filter. A bypass valve is built into the filter head. This bypass allows cold, stiff oil to bypass the filter if a pressure differential of over 25 psi develops between the inlet and outlet. If the filter is plugged by contamination the bypass valve will also open and allow oil to bypass and continue to the transmission pressure regulating valve. **Filter replacement at the recommended intervals is critical to transmission operation.**

The pressure regulating valve is mounted on the front of the transmission. It is a two stage design. Oil first enters the lock-up section where oil pressure is controlled for use in the transmission clutch lock-up circuit. The remainder and majority of the oil enters the lube section where oil pressure in the lube circuit is controlled.

Lubrication oil is used to cool and lubricate both the transmission and the engine clutch. Lubrication oil then drains back into the transmission sump.

Lock/Unlock final drives are standard equipment on all Champion motor graders. This feature is operator selected through a solenoid controlled valve. Transmission lock-up pressure affects the shift.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LEGEND

Clutch Assembly

1. Clutch Shaft
2. Clutch Shaft Bearing
3. O-Ring
4. Snap Ring
5. Spring Lip Seals (Qty.2)
6. Cross Shaft and Yoke
7. Throw-out Bearing
8. Clutch Finger (Qty.3)
9. Backing Plate
10. Pressure Plate
11. Adaptor-Drive Ring
12. Flywheel
13. Crank Shaft
14. Pilot Bearing
15. Orifice Plug
16. Oil Deflector and Clutch Hub
17. Fricton Plates (Qty.4)
18. Steel Spacers (Qty.4)
19. Clutch Spring
20. Caging Cap Screw and Washer (for clutch assembly servicing only)

Slave Cylinder Assembly

21. Cylinder Head
22. Roll Pin
23. O-Ring
24. Spring
25. Piston Cup
26. Piston
27. Return Spring
28. Bleeder Screw
29. Barrel
30. Bracket
31. Shift Cylinder Assembly
32. Cross Shaft Arm

The function of the clutch assembly is to disengage the drive line from the engine to facilitate smoother direction changes, starts and stops. The illustration here shows the clutch in the engaged position.

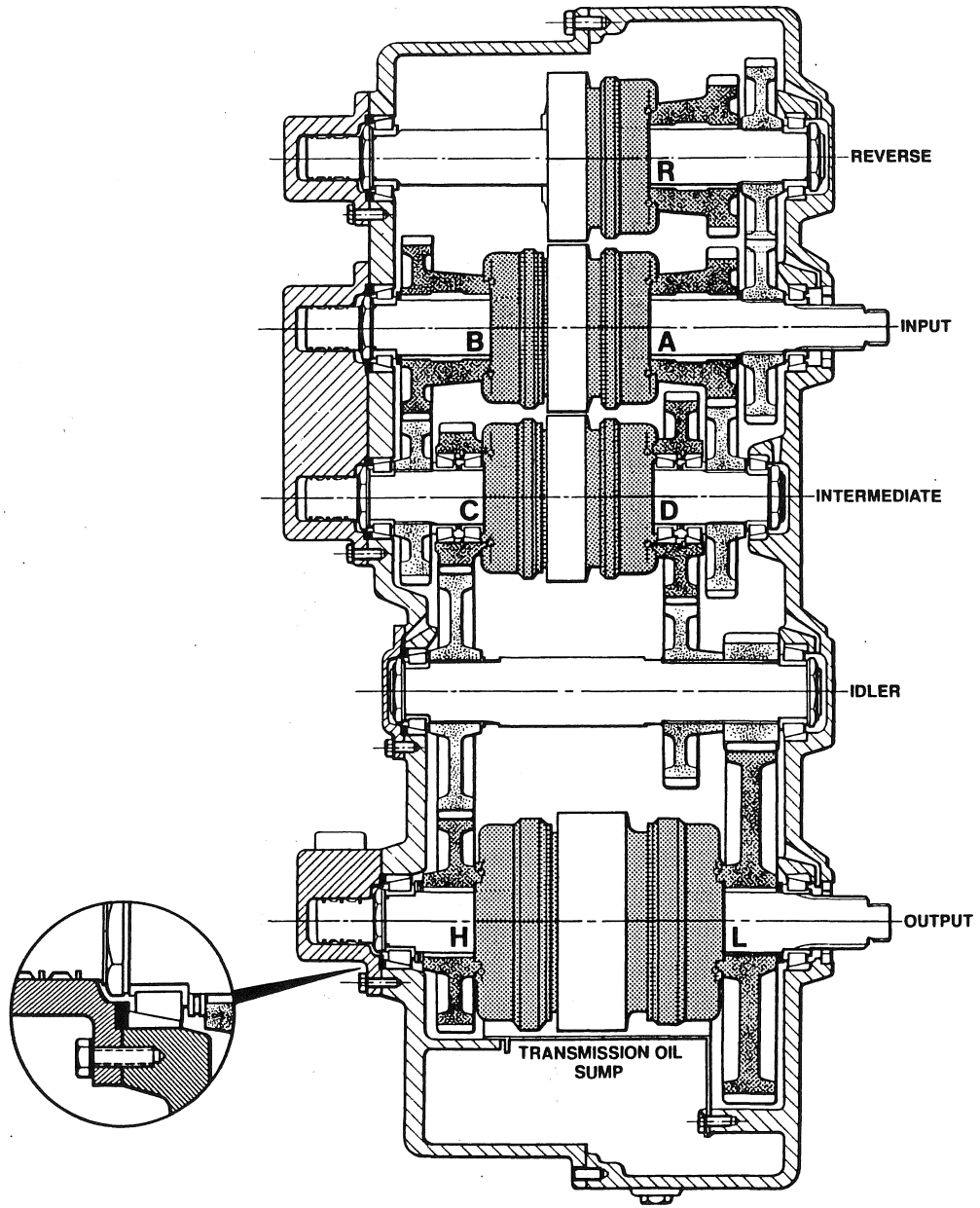
The engine clutch is hydraulically operated by a master cylinder/slave cylinder circuit. When the operator depresses the clutch pedal, hydraulic pressure from the steering circuit assists the master cylinder piston to move. The displaced brake fluid from the master cylinder causes the slave cylinder to extend, and the cross shaft to turn, pushing the yoke against the throw-out bearing. The throw-out bearing moves towards the direction of the flywheel and the clutch fingers. This action pulls the pressure plate away from the flywheel, thereby releasing the clutch driven members.

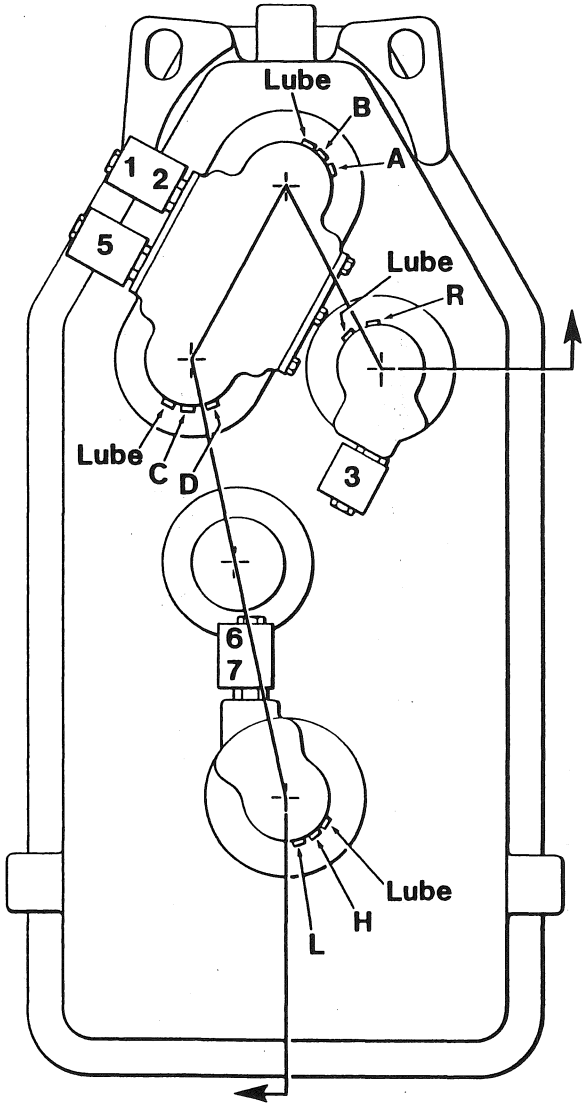
Oil is used to cool the friction and steel plates and lubricate the bearings. The oil from the transmission lube circuit enters at Point **A** (shown on top for illustrating purposes only). The oil is directed into the clutch shaft by the two spring lip seals. The clutch shaft bearing is sealed and requires no lubrication. Some oil flows through the 3/32" orifice plug to lubricate the pilot bearing. The majority of the oil collects in the clutch hub where under centrifugal force, it flows through the clutch pack members, providing a cooling effect. The throw-out bearing is splash lubricated. All oil drains back to the clutch sump and then to the transmission at point **B**.

ADJUSTMENTS

Check the clutch slave cylinder adjustment once a week. Since the cross shaft arm and yoke have the same effective length, the distance the slave cylinder can be extended until a resistance is felt, is the same as the clearance between the throw-out bearing and the adjustment screws on the clutch fingers. The specified clearance is .150". As the clutch plates wear through normal use, this clearance gets smaller. Adjustments can be made at either end of the slave cylinder. Since the slave cylinder is hydraulic, a bleeder screw is provided. Always remember to check clutch pedal linkage free play as well.

Refer to the Shop Manual for specifications.


REVERSE
R
INPUT
B
A
INTERMEDIATE
C
D
IDLER
OUTPUT
H
L
TRANSMISSION OIL SUMP


Lube
B
A
1
2
5
Lube
R
Lube
C
D
3
6
7
Lube
H
L

OVERVIEW

The 8400 transmission was introduced in 1984. It was developed to provide an 8-speed forward, 4-speed reverse, full powershift transmission for grader applications. It is simple in operation and construction making it easy to troubleshoot and repair. As part of the modular powertrain, the transmission is easy to remove from the grader as no other powertrain components have to be disturbed.

There are no linkages in the transmission control system to adjust or wear. Shifting is accomplished by an electronic controller and four solenoid valve cartridges.

The transmission was also designed with a wide ratio spread of 10.35:1 between first and eighth speeds. The eight speeds were carefully selected to match the engine's power curve, providing an even increase in road speed with each upshift. Seventh and eighth speeds provide an overdrive ratio since output shaft speed is greater than the input shaft speed.

CONSTRUCTION

The cast iron housing is vertically split to ease assembly and disassembly. This allows for complete access to all seven clutch packs and the idler shaft. **R** (reverse) **A**, **B**, **C**, and **D** clutch packs are 5 1/4" in diameter. **H** (high) and **L** (low) clutch packs are 6 5/8" in diameter. Each of the five shafts is supported by tapered roller bearings that control end thrust created by the helical gearing. Each shaft has between .002" and .007" end float adjustable by shims and piloted in counter-bores in the collector caps.

OPERATION

To provide power flow through the transmission, either forward or reverse, three of the seven clutch packs must be locked up (engaged). The following chart shows clutch packs lock-up vs. speed. Understanding the sequence of clutch pack engagement will help to troubleshoot hydraulic and mechanical problems.

GEAR	FORWARD CLUTCH PACKS	REVERSE CLUTCH PACKS	GEAR RATIO
1	A C L	1 R C L	7.317:1
2	B C L		5.236:1
3	A D L	2 R D L	3.777:1
4	B D L		2.703:1
5	A C H	3 R C H	1.913:1
6	B C H		1.369:1
7	A D H	4 R D H	.987:1
8	B D H		.707:1
N	C	N C	

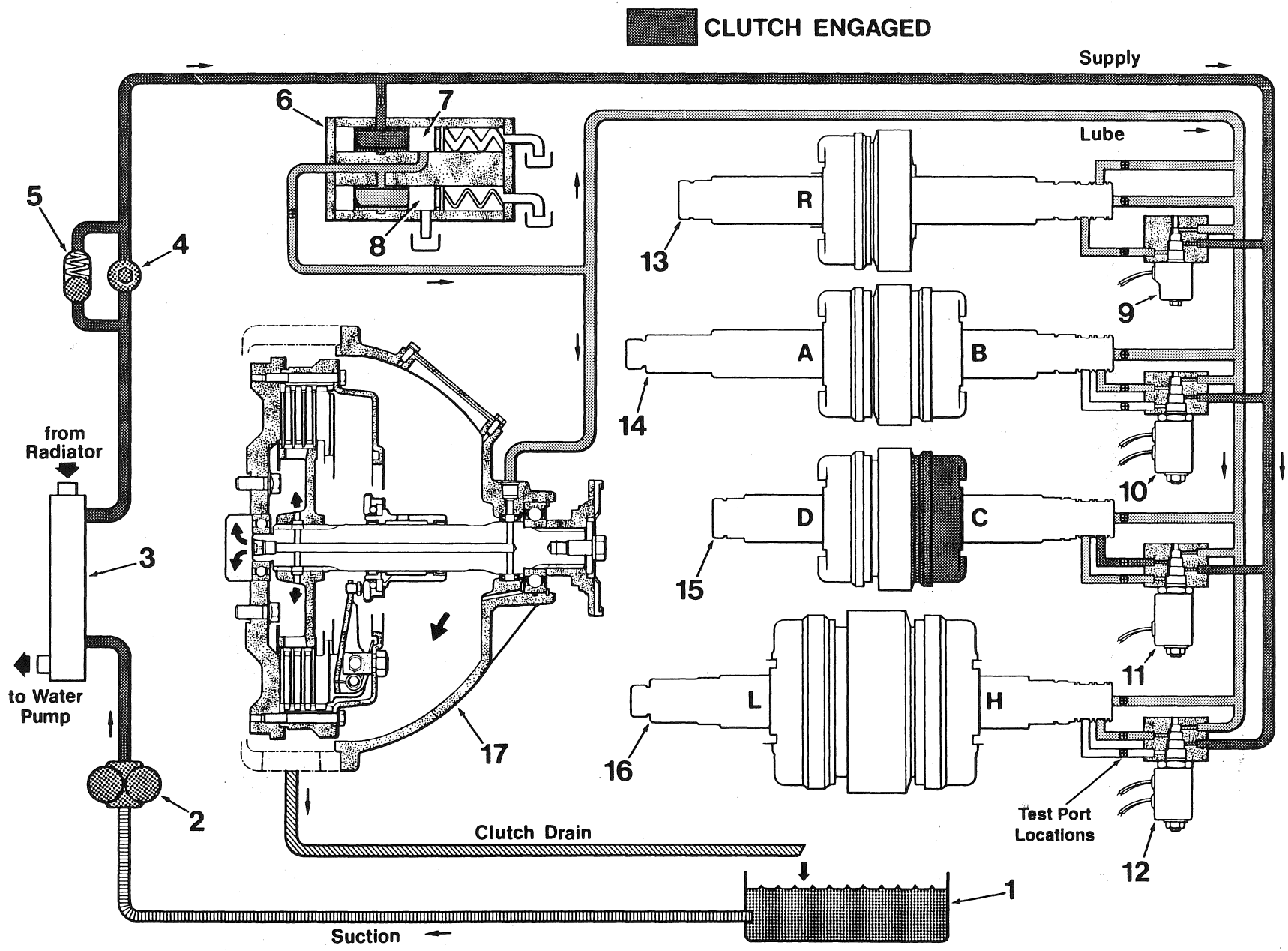
NOTE:

1. **C** Clutch pack is engaged in neutral

2. This transmission has two forward clutch packs; **A** and **B**. It is also a High/Low range design - but as this is automatically shifted, it is not considered as such.

3. Gear ratios holds true for all models except 780/780A which has slightly faster reverse speeds due to different tandem sprocket ratios.

The cutaway illustration shows the reverse shaft above the input shaft, when in fact it is not. This has been done for illustrative purposes only. The righ-hand illustration shows the location of the cutting plane, pressure test ports and the four solenoid cartridge valves.


CLUTCH ENGAGED
Supply
Lube
from Radiator
to Water Pump
Clutch Drain
Suction
Test Port Locations
R
A
B
D
C
L
H
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

LEGEND

1. Transmission Case
2. Transmission/Steering Pump
3. Oil/Water Cooler
4. Filter Assembly
5. Internal Bypass Valve
6. Transmission Pressure Regulator Valve Body
7. Lock-up Pressure Regulator Spool
8. Lube Pressure Lock-up Spool
9. R (reverse) Solenoid Cartridge Valve
10. A/B Solenoid Cartridge Valve
11. C/D Solenoid Cartridge Valve
12. L/H Solenoid Cartridge Valve
13. Reverse Shaft
14. Input Shaft
15. Intermediate Shaft
16. Output Shaft
17. Engine Clutch

The 8400 transmission was developed to be a simple, efficient, full powershift transmission with a simple hydraulic circuit. The following pages describe this circuit and show several shift engagements.

As explained earlier, transmission oil is drawn from the transmission sump by the pump and passes through the cooler and filter assemblies.

Oil is then directed to the transmission pressure regulator valve body. Inside this valve body are two spools. The first sets main transmission pressure. This spool has two springs and is shim adjustable to maintain transmission lock-up pressure to 215-235 psi *. At the regulated pressure the spool moves back against its' springs to open a passage to the lubrication circuit and lube pressure spool. Should a maximum lubrication pressure of 25 psi be reached, this spool valve will uncover a passage to sump. This valve has one spring and also is shim adjustable. Minimum lube pressure is 5 psi.

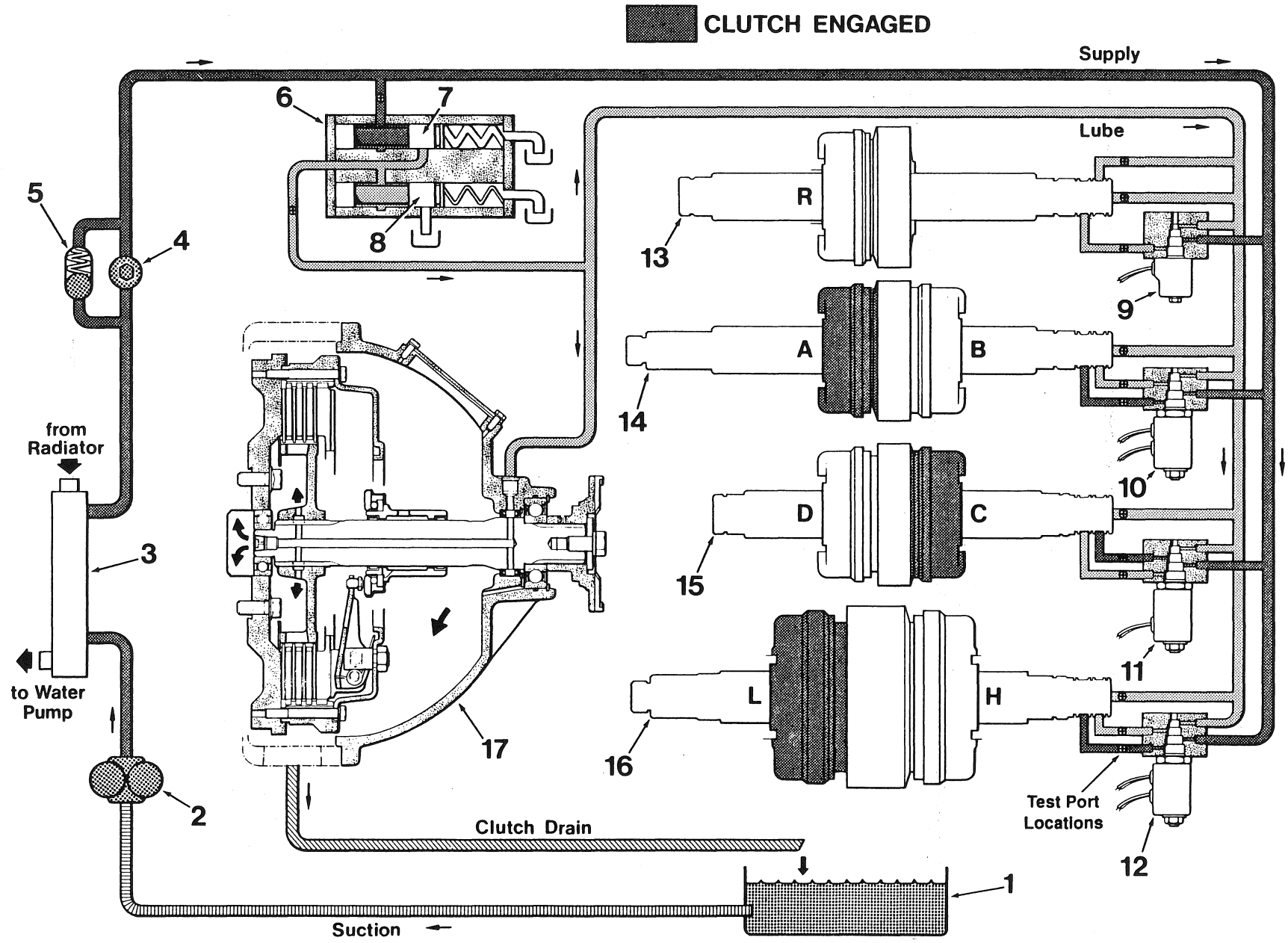
NOTE: for ease of discussion the regulator valve assembly has been illustrated upside down.

Whenever the engine is running, lubrication oil goes through the centre of each clutch shaft. From this central drilled passage, oil lubricates and cools the clutch bearings and clutch plates, and then drains back to sump. Lubrication oil also goes to lubricate and cool the engine clutch. This oil drains back to the sump. Whenever the transmission is in neutral or if a clutch pack is not applied, the solenoid valves direct lubrication oil pressure to fill each clutch pack. This ensures rapid clutch pack lock-up.

Lock-up pressure oil is directed to the four solenoid valves, which are actuated by the transmission controller in the cab. With the exception of the **C** Clutch, the solenoids block the oil pressure to the packs until energized. The **C** clutch pack is always engaged, even in neutral, until the controller energizes the **D** solenoid, and the **D** clutch locks up. When the operator moves the shift lever out of neutral, the electronic controller completes the circuit to ground, energizing the appropriate solenoids, depending upon the gear the operator selects, directing lock up oil pressure to the correct clutch packs.

** Starting at grader **S/N 20265** and up, the transmission is assembled using sintered, bronzed-faced friction discs having lock-up pressure between 215-235 psi. On graders with the model 8400 transmission prior to **S/N 20265** fiber composite friction plates with lock-up pressure of 165-185 psi were installed.*

Refer to the Shop Manual for specifications.

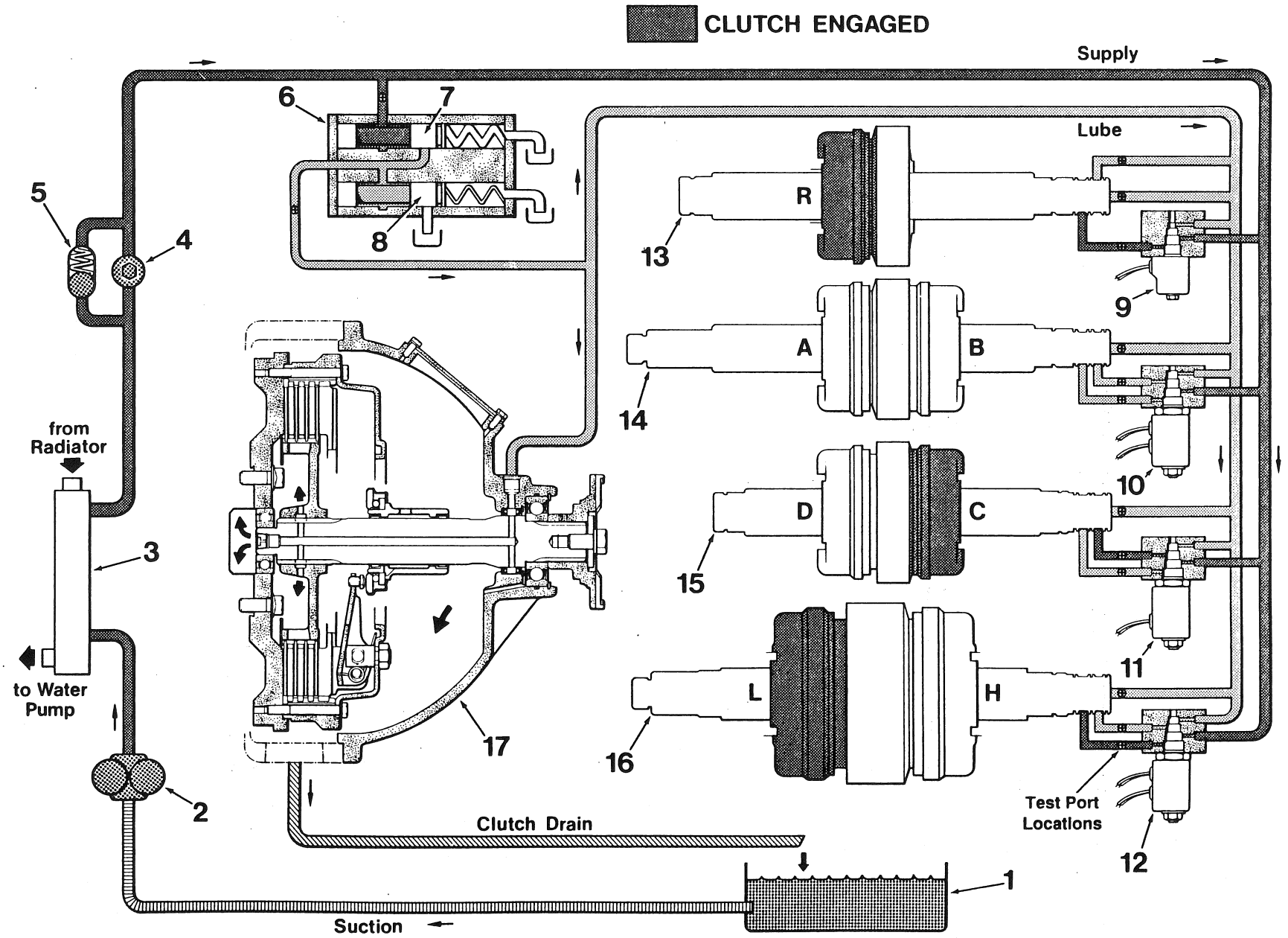

CLUTCH ENGAGED
Supply
Lube
6
7
8
5
4
R
13
9
A
B
14
10
from Radiator
D
C
15
3
11
to Water Pump
L
H
16
17
Test Port Locations
12
2
Clutch Drain
1
Suction

LEGEND

1. Transmission Case
2. Transmission/Steering Pump
3. Oil/Water Cooler
4. Filter Assembly
5. Internal Bypass Valve
6. Transmission Pressure Regulator Valve Body
7. Lock-up Pressure Regulator Spool
8. Lube Pressure Lock-up Spool
9. R (reverse) Solenoid Cartridge Valve
10. A/B Solenoid Cartridge Valve
11. C/D Solenoid Cartridge Valve
12. L/H Solenoid Cartridge Valve
13. Reverse Shaft
14. Input Shaft
15. Intermediate Shaft
16. Output Shaft
17. Engine Clutch

To obtain first forward, the operator moves the controller lever to indicate **1** on the display. With the mode lever in forward the controller energizes the **A** coil of the **A/B** solenoid to direct oil to the **A** clutch pack, and at the same time the **L** coil of the **L/H** solenoid to direct oil to the **L** (low) clutch pack. This combination of clutches **A C L**, provides the lowest overall gear ratio available and results in first forward speed. Remember **C** clutch is always engaged unless **D** clutch is required.

When the operator wishes to operate in eighth gear, he pulses or pushes the pulser lever forward to move up in speed, realizing he can only increase one gear at a time or sequentially shift. For example, the controller automatically selects the correct solenoids for the particular gear selected. When the indicator shows **8** and the mode lever is in forward, the controller energizes the **B** coil of the **A/B** solenoid, **D** solenoid, and the **H** coil of the **L/H** solenoid. This allows lock-up pressure to the **B D H** clutch packs and engages them. With **B D H** clutches locked, the transmission is in its highest gear ratio.


CLUTCH ENGAGED
Supply
Lube
6
7
8
5
4
R
13
9
A
B
14
10
from Radiator
D
C
15
3
11
L
H
16
17
to Water Pump
2
Clutch Drain
Test Port Locations
12
1
Suction

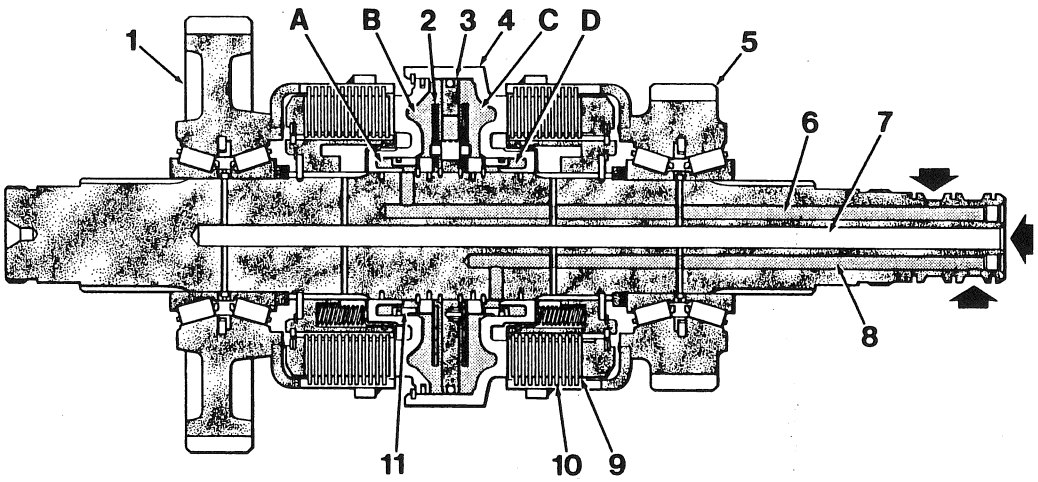
LEGEND

1. Transmission Case
2. Transmission/Steering Pump
3. Oil/Water Cooler
4. Filter Assembly
5. Internal Bypass Valve
6. Transmission Pressure Regulator Valve Body
7. Lock-up Pressure Regulator Spool
8. Lube Pressure Lock-up Spool
9. R (reverse) Solenoid Cartridge Valve
10. A/B Solenoid Cartridge Valve
11. C/D Solenoid Cartridge Valve
12. L/H Solenoid Cartridge Valve
13. Reverse Shaft
14. Input Shaft
15. Intermediate Shaft
16. Output Shaft
17. Engine Clutch

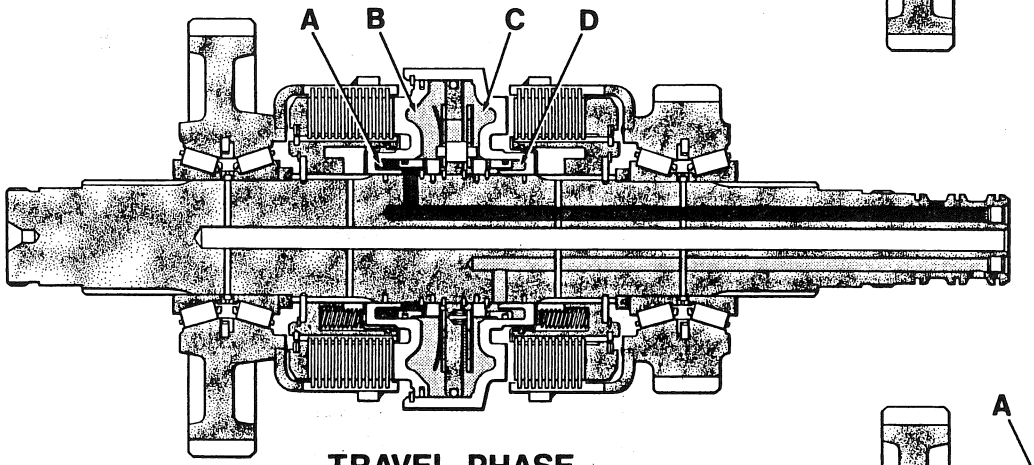
Whenever the transmission is in reverse the digital display will show a "–" in front of the digit. For example, when first reverse is selected by the operator the display will show **–1**. The controller selects the **R** solenoid to direct lock-up pressure to the reverse clutch pack. It also selects the **L** coil of the **L/H** solenoid which supplies oil to the low clutch pack. The **C** clutch is also engaged and this provides the lowest possible reverse speed of **R C L**. Power flow must travel through one extra shaft (5 in total) when in reverse compared to forward (only 4). This provides the directional change required.

When making a direction change the operator should disengage the engine clutch, bring the grader to a complete stop, then move the mode lever to the opposite direction position, and when it is safe, slowly release the clutch. This ensures smooth, safe directional changes. The controller will automatically select the closest corresponding speed in the opposite direction according to the chart:

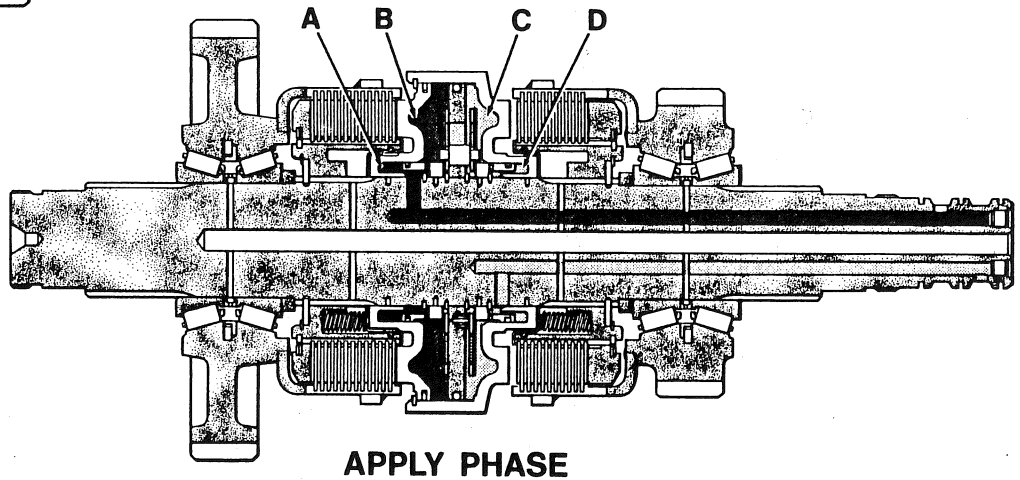
Forward	Reverse
1	-1
2	
3	-2
4	
5	-3
6	
7	-4
8	



NEUTRAL PHASE



TRAVEL PHASE



APPLY PHASE

LUBE PRESSURE

LOCK-UP PRESSURE

LEGEND

1. High Gear
2. Disc Valve (2 Parts)
3. Separator Plate
4. Lock-up Piston
5. Low Gear
6. Low Gear Oil Passage
7. Lubrication Oil Passage
8. High Clutch Oil Passage
9. Friction Disc
10. Steel Drive Plates
11. Accelerator Piston

A. High Gear Accelerator Piston Cavity
B. High Gear Lock-up Cavity
C. Low Gear Lock-up Cavity
D. Low Gear Accelerator Piston Cavity

The hydraulic clutch pack consists of one set of sintered, bronzed-faced friction discs, splined to a rotating shaft and one set of steel plates retained in a drum and gear assembly by means of external tangs. The drum and gear are allowed to rotate independently of the shaft by mounting them on a bearing. The discs are positioned in the pack so that two of the same type are not located side by side. By squeezing these discs together, we can effectively connect or lock the gear to the shaft. To perform this function, a hydraulic cylinder assembly is used. The operation of the assembly is detailed below.

NEUTRAL PHASE

Lube oil is fed by separate lube passages to both sides of the clutch pack while the transmission is in neutral. At this time, the double clutch pack is in neutral phase. Oil at lube pressure, flows down the centre passage through cross drillings to lubricate the bearings and to cool the clutch discs in both packs.

TRAVEL PHASE

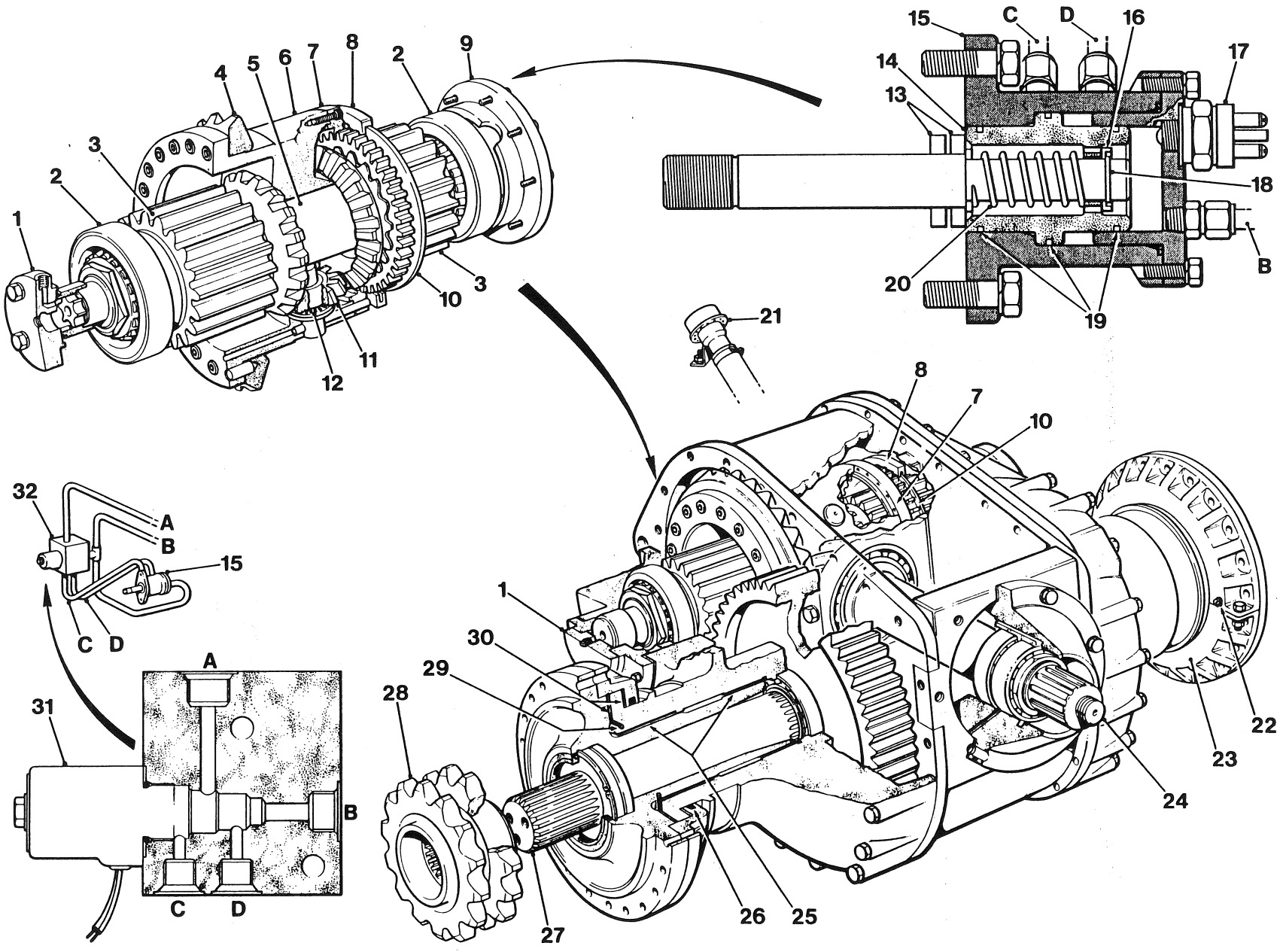
The travel phase begins when the solenoid valve is energized to engage high clutch. This delivers lock-up pressure oil down the top passage. Lube oil is fed down the centre and bottom passages. Lock-up oil enters the area known as the accelerator piston cavity. As pressure builds within this cavity, the lock-up piston, which is the outer housing, begins to move to the left. At the same time, the guide pin is pushed by the accelerator piston and holds the disc valve open on the right side of the separator plate allowing oil to transfer through into the lock-up cavity. This transfer of oil ensures the high gear lock-up piston cavity is quickly filled with oil.

APPLY PHASE

At the end of the travel phase, the disc valve closes and pressure builds within the lock-up piston cavity due to lock-up oil pressure entering via a small drilling in the accelerator piston. The clutch pack will remain applied as long as lock-up oil pessure is directed to it. Very little oil is required to maintain lock-up.

To engage low clutch, low solenoid valve is energized, directing lock-up pressure down the bottom passage, and lube oil down the top and centre passages.

The principle oil transfer between cavities is used to quicken lock-up and eliminate pressure drops while the clutch cavity fills. During the apply phase lock-up oil pressure in **B** is opposed by lubrication oil pressure in **C**. Both pressures must be maintained within specifications as the apply force is dependant upon the difference. Conversely, too high of an apply force can lead to friction disc damage.


1
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22
23
24
25
26
27
28
29
30
31
32
A
B
C
D

LEGEND

1. Oil Pump
2. Taper Roller Bearing
3. Bull Spider Pinion
4. Ring Gear
5. Cross Shaft
6. Differential Hub
7. Shift Clutch Gear
8. Shift Fork
9. Cross Shaft Bearing Cap
10. Shift Clutch
11. Spider Gear
12. Bearing
13. Shift Rail Seals
14. Shift Piston
15. Shift Cylinder Body
16. Spring Retainer
17. Switch
18. Snap Ring
19. Hook Type Seal Rings
20. Spring
21. Vent
22. Grease Fitting
23. Half Ring
24. Pinion Shaft
25. Sleeve Bushings
26. Uniring Seal
27. Drive Axle
28. Drive Sprocket
29. O-Ring
30. Thurst Plates
31. Shift Solenoid
32. Shift Valve

A - Pressure
B - Drain
C - Unlock Port
D - Lock Port

The double reduction final drive is Bsed on models 740 thru 780A graders, and incorporates a lock/unlock differential as standard equipment. The double reduction final drive is a positive drive gear box providing a gear reduction and a directional change of the power flow. The power enters on the pinion shaft and is transferred to the crown gear which is in turn, splined to the cross shaft. The cross shaft is supported by taper roller bearings, and also carries two bull pinions. The bull pinions mesh with twin bull gears which are supported by roller bearings.

Splined to the bull gear is a semi-floating drive axle (so named because it carries no weight). It is supported at the outer end by a double race, self-aligning roller bearing. The weight of the grader is transferred from the final drive to the tandem by means of the flanged sleeve which oscillates in two teflon-coated, steel-backed bronze bushings, pressed into the extension housing. This assembly is held together by the split ring, which allows oscillation, but prevents lateral movement of the flanged sleeve in the bushings. Differential lock/unlock allows both maximum traction in the locked position and minimum turning radius in the unlocked position. Normal operating position should be locked. An indicator light in the cab energizes when the differential is unlocked.

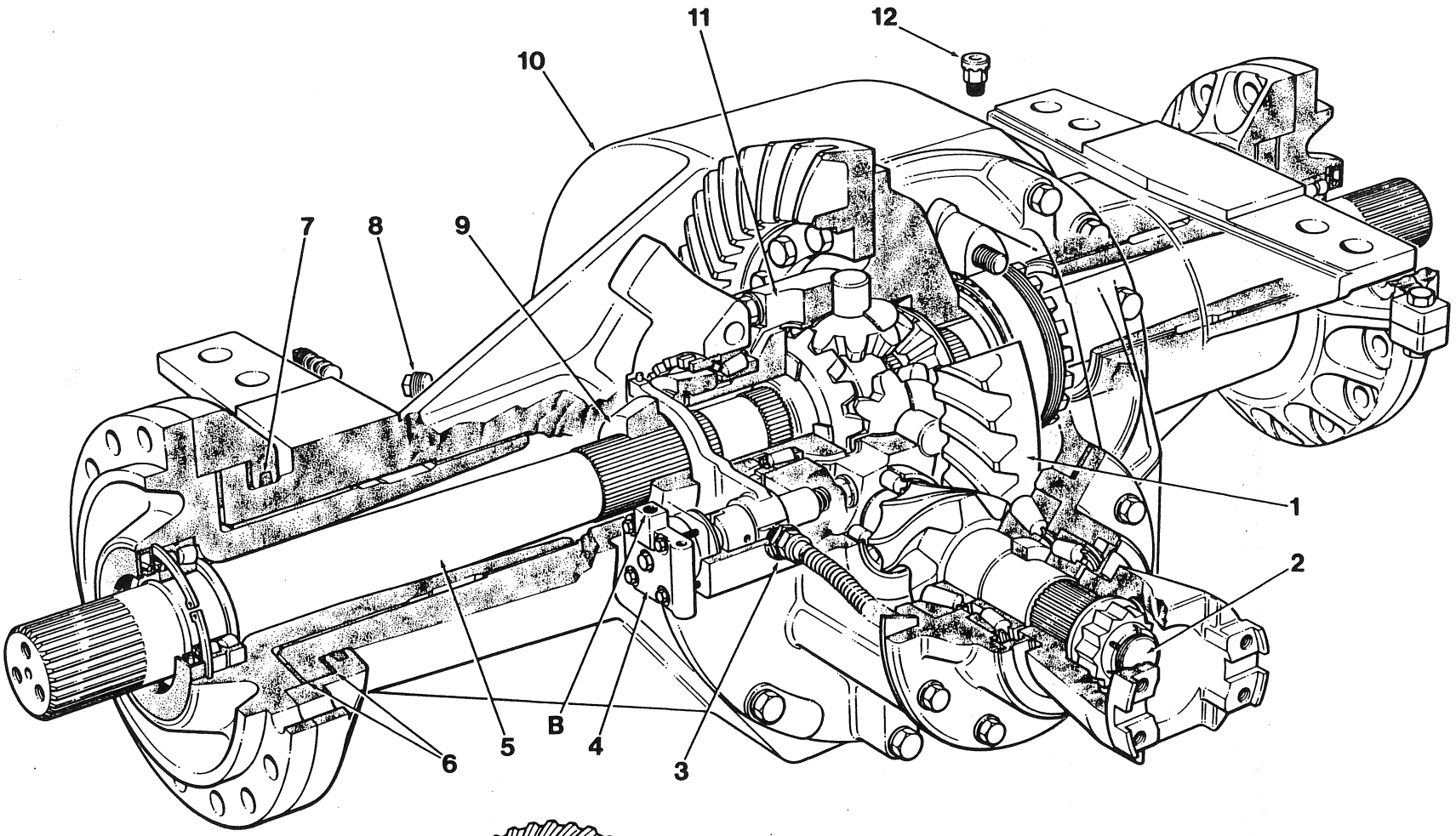
To lock or unlock the differential an electric solenoid is controlled by a switch on the right-hand cab door post. Energizing the solenoid directs transmission lock-up oil pressure to port **C** on the cylinder body. This pulls the shift fork to unlock the spider pinions, disengaging the shift clutch from between the left-hand axle shaft and the differential hub, allowing differential action. At full travel the shift piston contacts a normally open switch, closing it to energize the indicator light in the cab.

To lock the differential, the solenoid is de-energized. This directs oil to flow to the shift cylinder body at port **D**. Oil pressure against the shift piston engages the shift clutch, locking the left-hand axle to the differential hub.

All return oil exits at port **B** and returns to the clutch housing cover, eventually draining back to the transmission sump. See page 30.

To lubricate the bull gear pinion bearings and the spider gears, a small bi-directional oil pump is mounted on the end of the right cross shaft. It sends oil flow down the cross shaft and lubricates the bearings and gears through small cross drilled passages. The recommended final drive lubricant is a hypoid gear oil. Do not use a mineral base lubricant. First lubricant change at 100 hours, thereafter every 2000 hours or 12 months, whichever comes first. The lubricant level check interval is weekly, or every 50 hours, whichever comes first.

Refer to the Shop Manual for specifications.


11
12
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5
4
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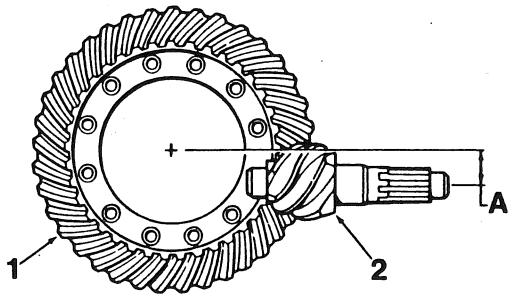

A
1
2

LEGEND

1. Ring Gear
2. Pinion Shaft/Gear
3. Lock/Unlock Indicator Switch
4. Shift Cylinder
5. R.H. Axle Shaft
6. Thrust Plates
7. Seal
8. Level Check Plug
9. Shift Collar
10. Final Drive Housing
11. Differential Housing
12. Breather

A. Hypoid Gear Offset
B. Shift Cylinder Pressure Port

The Single Reduction SR30 Final Drive is used on models 710 thru 720A graders and the Single Reduction SR40 Final Drive is used on models 730/730A graders. Refer to the Parts Manual for the effective grader serial numbers.

Both SR final drives use a hypoid gear set. Hypoid gear sets position the drive pinion shaft below the center line of the ring gear - dimension **A**. Hypoid gear design provides the drive pinion to ring gear one and one half additional tooth contact over conventional spiral bevel ring gear drive design, resulting in 30% more tooth strength against shock loads. They use a similar design of semi-floating axle and flanged sleeve as the double reduction final drive. This permits the weight of the grader to be transferred directly to the tandems through the final drive housing.

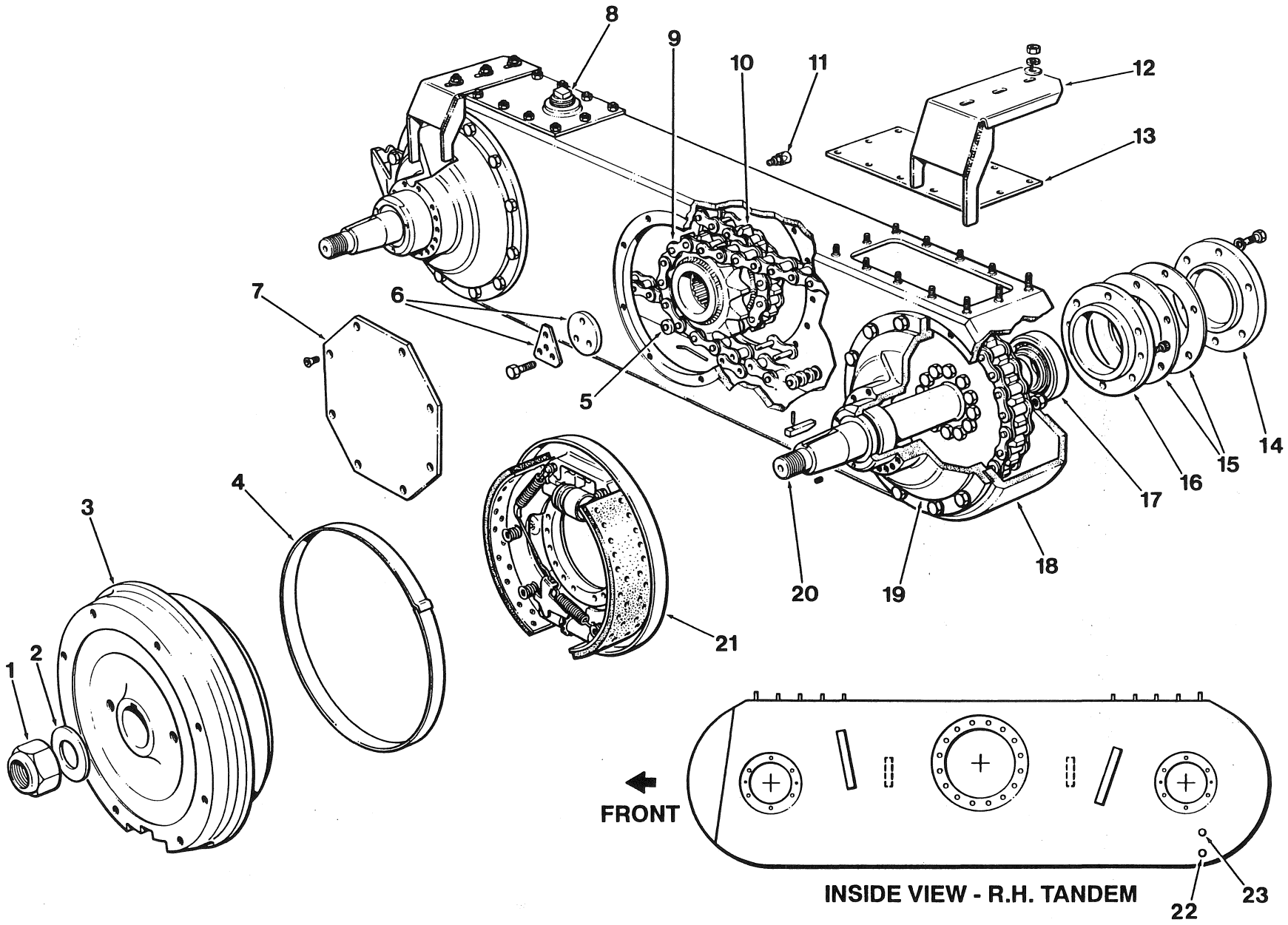
Both SR final drives feature differential lock/unlock as standard equipment. The differential lock is operated by a hydraulic actuated shift cylinder assembly that is mounted on the differential housing assembly. An electric switch on the right-hand cab post is activated to lock or unlock the differential. With the switch in the down position, the solenoid valve is energized and directs continuous oil pressure, supplied from the filtered side of the transmission filter to port **B** on the shift cylinder. The piston moves the shift fork against a spring until the collar engages the splines on the differential case. The right-hand axle shaft is now locked to the differential assembly. No differential action occurs between the tandems.

For differential action, the operator moves the switch to the **UP** position, opening the circuit and de-energizing the solenoid valve. The spring moves the shift fork and collar away from the differential case, providing differential action.

The red indicator light is mechanically switched by the shift fork. Therefore, the light is independent of the switch and reflects the true position of the differential lock.

The recommended final drive lubricant is a hypoid gear lube. Check lubricant level weekly or after 50 hours of operation. First lubricant change at 100 hours use, then every 1000 hours thereafter.

Refer to the Shop Manual for specifications.


8
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13
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14
15
16
17
18
19
20
4
3
21
1
2
FRONT
INSIDE VIEW - R.H. TANDEM
22
23

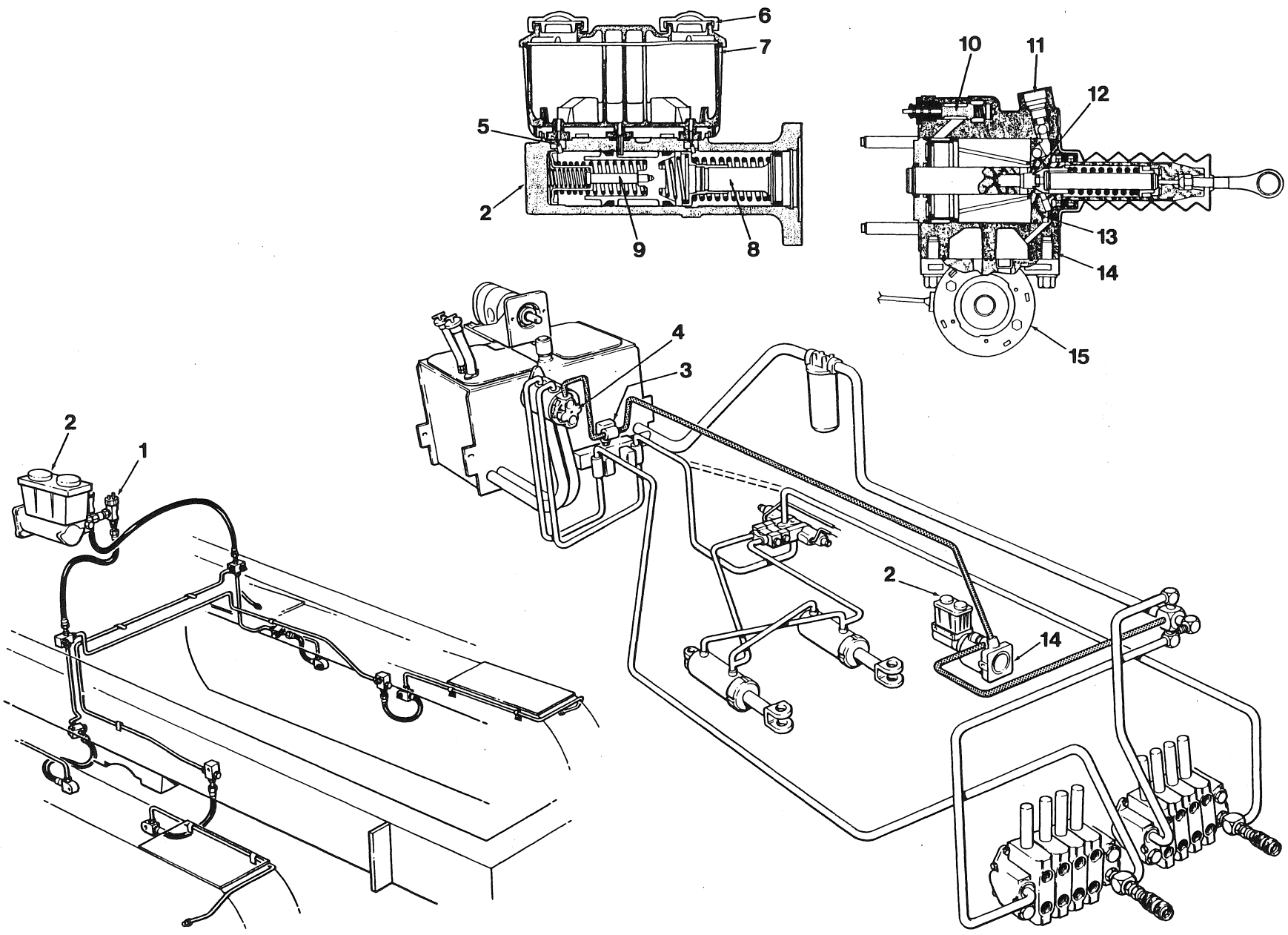
LEGEND

1. Wheel Nut
2. Washer
3. Wheel
4. Brake Band Seal
5. Magnetic Plug
6. Retainer Washer and Lock Plate
7. Inspection Cover
8. Filler Plug
9. Chain
10. Drive Sprocket
11. Breather
12. Brake Line Guard
13. Inspection Plate
14. Bearing Cap
15. Shims
16. Bearing Flange
17. Inner Bearing
18. Tandem Case
19. Bearing Housing
20. Stub Axle and Key
21. Drum Brake Assembly
22. Drain Plug
23. Oil Level Plug - Drum Brakes

Each tandem assembly divides the power flow from a single floating drive axle to two tandem mounted axles and drive wheels. The tandem case is fabricated from steel plate and is robotically welded. The inner tandem wall is 1" thick and together with two internal plates provide exceptional strength and rigidity. This allows accurate machining in a single jig, eliminating misalignment of the stub axles, chains and tires.

The shim pack under the stub axle inner bearing cap should be gauged so that a definite preload is felt when you turn the sprocket by hand. No provision is made for tightening the chains. A certain amount of slack is required and a slight rubbing of the chain on the bottom of the tandem case is normal and no cause for concern. However, a chain which has excessive slack and appears to require tightening may have a pitch of more than 2" (1.75" for models 710/710A). If this is the case, it should be replaced, as continued use will cause undue wear on the sprockets. Consult the Operator's Manual for the correct lubricant type and level on drum brake equipped graders. The lubricant change interval is every 2000 hours or 12 months which ever comes first. The tandem oil level should be checked weekly or every 50 hours whichever comes first. When checking the level ensure the grader is on level ground.

Refer to the Shop Manual for specifications.


6
7
5
2
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8
10
11
12
13
14
15
4
3
2
1
2
14

LEGEND

1. Brake Light Switches
2. Master Cylinder
3. Relief Valve
4. Hydraulic Pump - Third Section
5. Compensator Valve
6. Cap
7. Reservoir
8. Secondary Piston
9. Primary Piston
10. Flow Switch
11. Inlet
12. Orifice
13. Power Piston
14. Booster
15. Motor/Pump Assembly

The booster is a self-contained reservoir and pump assembly. It effectively provides the operator with hydraulic pedal assistance when the brake pedal is applied.

The master cylinder features two separate chambers providing two independent brake circuits. Refer to the Champion Operator's Manual Lubrication Specifications for important fluid information.

A third section on the main hydraulic pump provides hydraulic power for the brake booster. It is independent of any other hydraulic functions e.g. steering. The brake hydraulic circuit also has its own relief valve, identical to the main hydraulic system relief valves, set to relieve at 2100 psi.

Reserve Power Assist

In the event of an engine stall or any situation where oil flow is interrupted to the service brake booster, an electric motor/pump will supply hydraulic power assist automatically. In this instance, the operator is alerted that the grader is functioning on the reserve system by a brake warning light and alarm. This supplementary system provides power assisted brake capability at a reduced level until main hydraulic flow is restored. The system automatically shuts off when hydraulic flow is restored.

NOTE: All reserve or supplementary braking systems are designed to bring the machine to a safe stop, or hold the machine on a slope until the **PARK/EMERGENCY** brake is applied. These systems are not intended for continuous use.

Dual Braking System

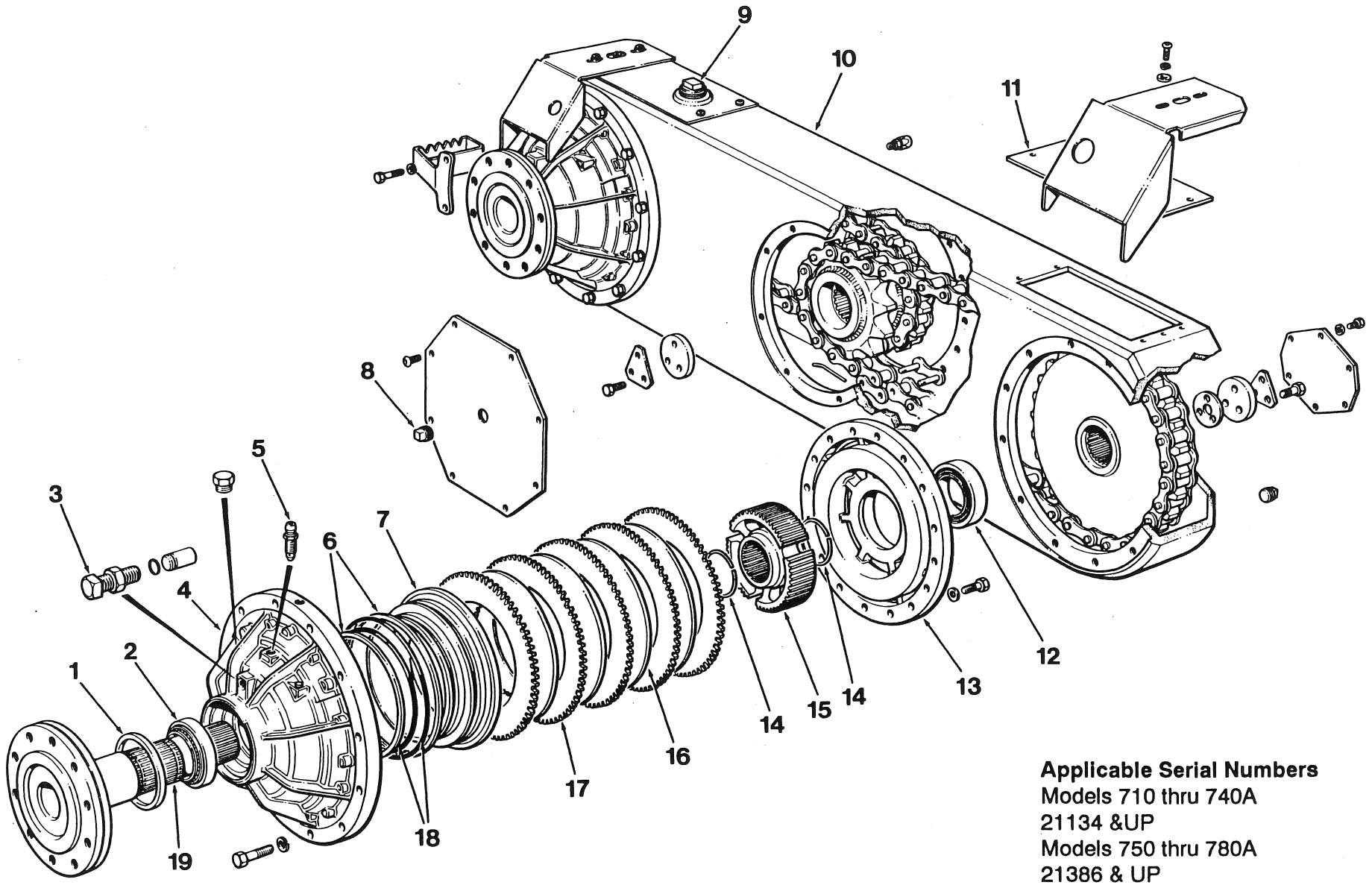
All models are equipped with four wheel dual brake system as standard equipment.

The dual braking system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.

Each of the two circuits function on one front, and opposite rear driven wheels. Should one circuit fail, there is braking on both sides of the machine and it remains effective on all four drive wheels through the tandem chains.

If the system is functioning on only one of the two circuits, the operator is alerted by a brake warning light and alarm, energized when the brake pedal is depressed.

Refer to Shop Manual for specifications.



Applicable Serial Numbers
Models 710 thru 740A
21134 &UP
Models 750 thru 780A
21386 & UP

LEGEND

1. Oil Seal
2. Bearing
3. Piston Travel Limiting Screw
4. Outer Housing
5. Bleeder Screw
6. Back-up Rings
7. Piston
8. Level Check Plug
9. Filler Plug
10. Tandem
11. Inspection Cover
12. Bearing
13. Inner Housing
14. Snap Ring
15. Hub
16. Friction Disc
17. Reaction Plate
18. O-Rings
19. Axle

The Champion Oil Disc Brake System consists of four brake units, a hydraulic brake booster with an integrated back-up electrick pump, a master cylinder with reservoir and flexible hydraulic brake lines.

The hydraulic brake booster multiplies the braking effort of the pressed brake pedal and transfers it to the master cylinder. Refer to "Service Brakes Hydraulic Circuit" page 50 for information about the master cylinder and booster assembly.

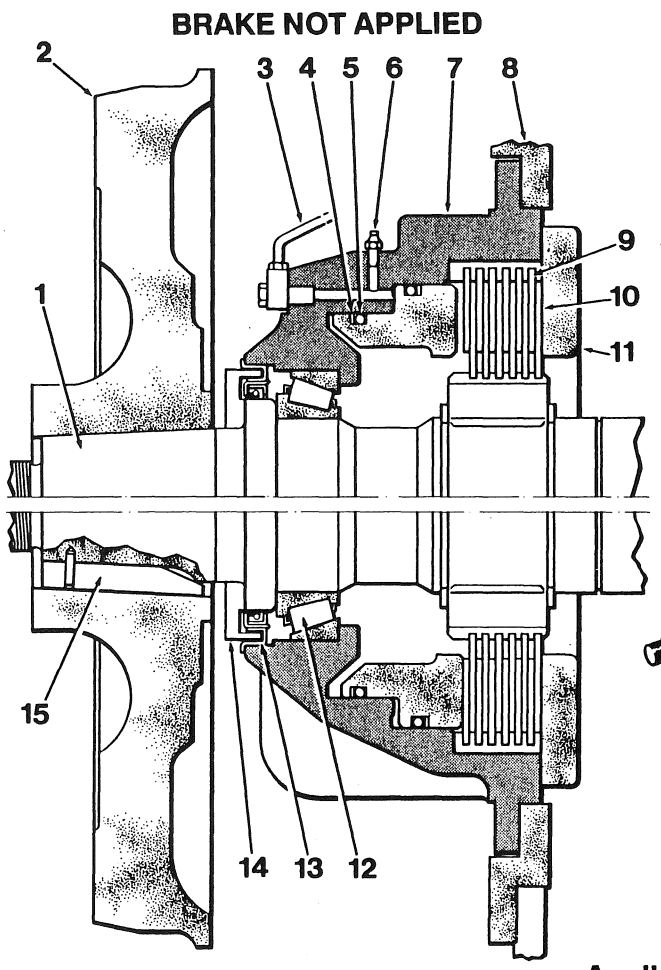
The Oil Disc Brake units are supplied with apply fluid from the dual circuit master cylinder. Each of the two outlet ports on the master cylinder use a "T" fitting, connected to flexible brake hoses that divide the apply fluid in a diagonal pattern to the four brake units.

The apply fluid enters the brake unit at the top of the brake housing. In the piston chamber, the fluid moves the piston away from the "piston travel limiting screw" toward the friction disc and reaction plate assembly. As the piston compresses the plates and discs together, the tandem oil is forced out of the friction disc grooves. Braking action results as the friction discs contact the reaction plates.

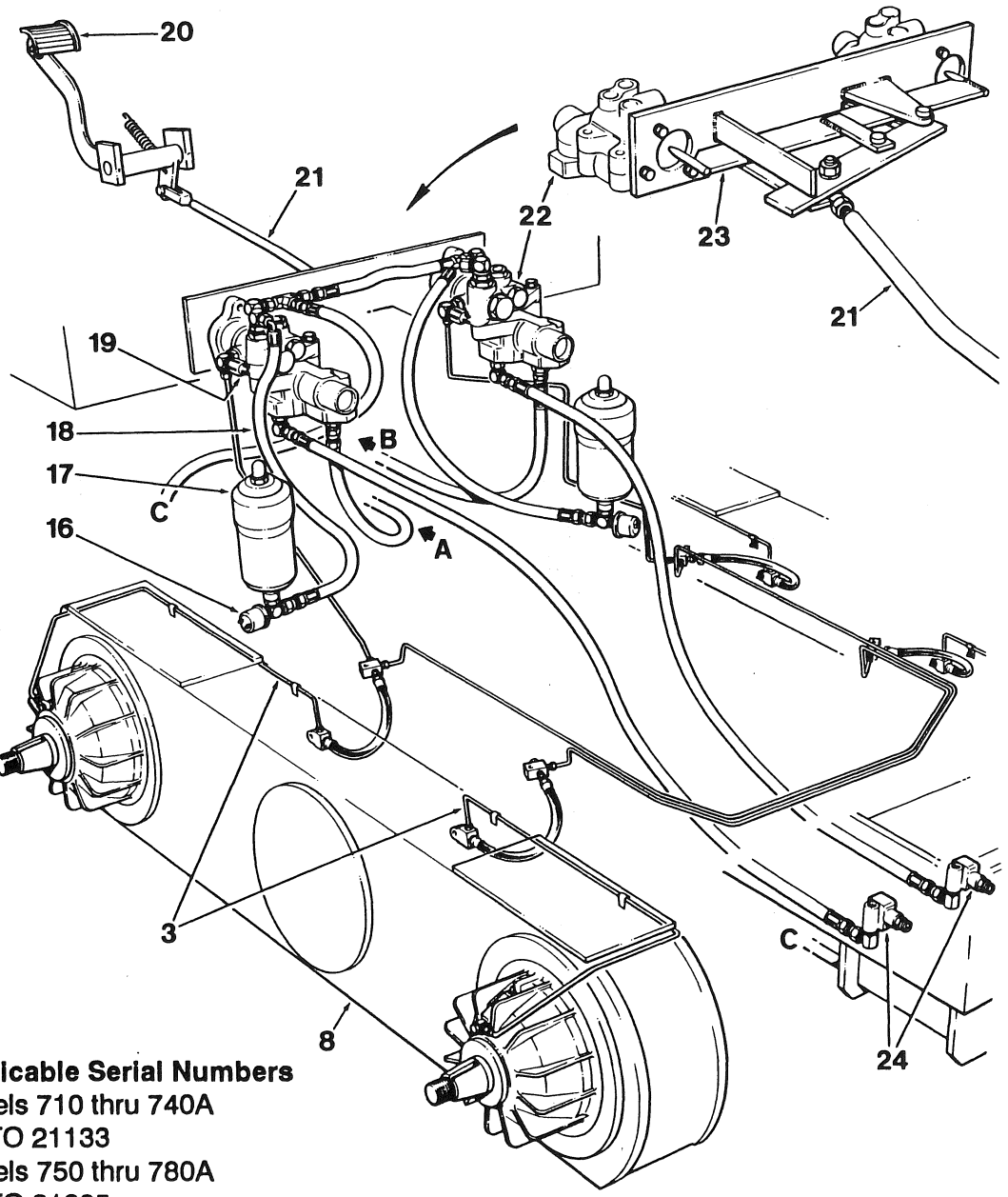
The friction discs are splined to a hub that is splined to the axle shaft. The wheel and tire assembly is bolted to the axle shaft. The wheel and tire assembly is bolted to the axle shaft. In a emergency stop situation, with the brake pedal pressed at full forc e, the friction disc and reaction plate assembly will lock up.

To release the brakes, lift the foot off the brake pedal. The apply fluid pressure will vent to the master cylinder reserv oir. The grooves in the rotating friction discs allow the tandem oil to pass between the stationary reaction plates and friction discs. This allows the plates and discs to separate slightly moving the piston toward the "piston travel limiting screw". Once the piston releases its clamping force, the discs, hub, axle, wheel and tire rotate freely.

Refer to the Operator's Manual for more information.
Refer to the Shop Manual for specifications.



BRAKE APPLIED



Applicable Serial Numbers
Models 710 thru 740A
UP TO 21133
Models 750 thru 780A
UP TO 21385

LEGEND

1. Stub Axle
2. Wheel
3. Hydraulic Brake Line
4. Back-Up Ring
5. O-Ring
6. Bleeder Screw
7. Brake Housing
8. Adaptor Ring/Tandem
9. Reaction Plate
10. Friction Disc
11. End Plate
12. Axle Bearing
13. Seal
14. Guard
15. Key
16. Pressure Sender-Warning
17. Accumulator
18. Hose
19. Pressure Sender-Brake Light
20. Brake Pedal
21. Linkage Rod
22. Brake Valve
23. Walking Beam
24. Main Hydraulic System Relief Valves (Reference only)

A Supply to L.H. Manifold Valve
B Supply to R.H. Manifold Valve
C Return to Tank

Champion's oil disc brake system is comprised of two separate braking systems. Through this design, cross-over braking is accomplished by connecting the **Left Front** tandem wheel and the **Right Rear** tandem wheel to the same brake circuit. This provides effective braking on all 4 wheels if in the unlikely event that one system is inoperative. A warning light and alarm energizes when a malfunction occurs.

The brake pedal is connected by a linkage rod to a walking beam. The walking beam pushes the activating plunger of two hydraulic brake valves mounted to the rear of the cab.

Each brake system works indentically, we will describe the operation of only the **left-hand** brake valve and circuit.

The brake valve consists of two parts:
1) The charging section on the bottom, and
2) The activation section on the top.

The charging section maintains 1200-1500 psi hydraulic pressure in the accumulator at all times. As the brake valve is in series with the main hydraulic system, a small amount of oil is directed to the accumulator. When the pressure reaches 1500 psi, charging stops and all oil flows to the main hydraulic manifold. As the brake pedal is depressed, oil is routed from the accumulator to the oil disc brake assemblies. When applying the brakes, oil pressure to the brake assemblies increases proportionately to brake pedal pressure. The higher the pedal force, the higher the apply pressure (up to a maximum of 900 psi brake line pressure), resulting in higher braking forces. When the brake pedal is released the actuation section directs oil from the brake circuit to the hydraulic tank.

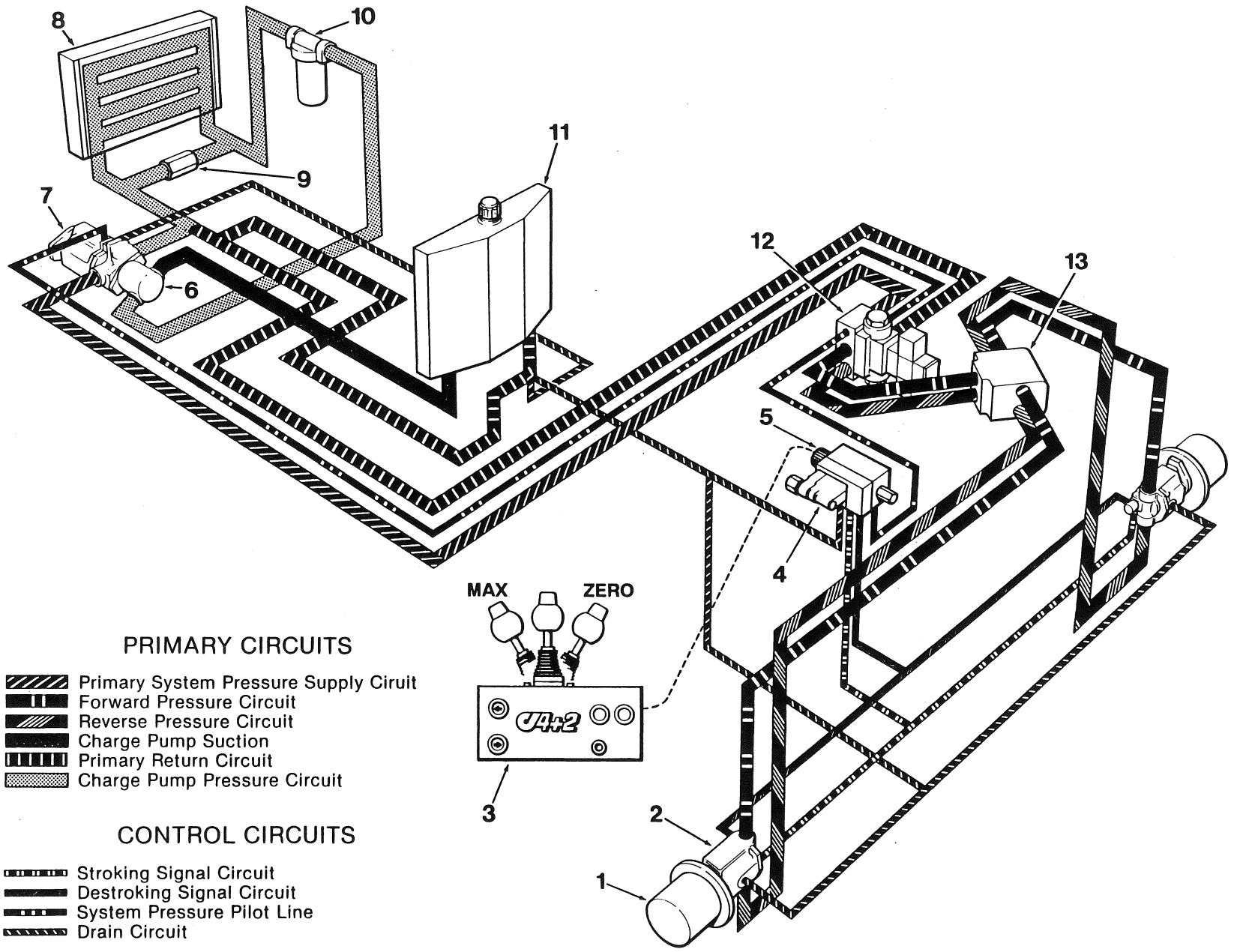
Subsequent brake applications are supplied with oil pressure from the accumulators. Each brake application reduces accumulator pressure. When 1200 psi is reached, the charging section directs main hydraulic system oil flow to the accumulators until 1500 psi is reached. As long as the engine is running, this cycle of charging takes place as required by brake applications.

If the accumulator recharge circuit fails, for example, due to a stalled engine or hydraulic system failure etc., a sending unit on the outlet of the accumulator causes a warning light and alarm to energize when pressure drops below 1050 psi. Remember, maximum brake line pressure is 900 psi, once apply pressures fall below this, braking ability is reduced.

In order for the brake system to function correctly, the accumulators contain a pre-charge of dry nitrogen of 500 psi.

The oil disc brake assembly is half submerged in tandem oil for cooling purposes. As this is a 'wet type' braking system, tandem oil type and level is critical to braking performance.

Refer to the Operator's Manual for more information.
Refer to the Shop Manual for specifications.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MAX
ZERO
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PRIMARY CIRCUITS
Primary System Pressure Supply Ciruit
Forward Pressure Circuit
Reverse Pressure Circuit
Charge Pump Suction
Primary Return Circuit
Charge Pump Pressure Circuit
CONTROL CIRCUITS
Stroking Signal Circuit
Destroking Signal Circuit
System Pressure Pilot Line
Drain Circuit

LEGEND

1. Planetary Reduction Wheel Hub
2. Wheel Motor
3. Hand Controller (Located in Cab)
4. Motor Control Valve Assembly
5. Force Motor
6. Charge Pump
7. Main System Pump
8. Oil Cooler
9. Check Valve
10. Filter
11. A.W.D. Reservoir
12. Selector Valve
13. Flow Divider

All Wheel Drive (A.W.D. or 4+2) is used to increase tractive effort and steering control in slippery conditions. The front wheels are driven by a variable displacement, piston-type, hydrostatic pump and a variable displacement motor in each wheel, driving through planetary hubs. Hydraulics for the A.W.D. system are completely separate from all other systems. A.W.D. operates in all forward speeds except eighth and all reverse speeds.

Oil is drawn from the A.W.D. reservoir by the charge pump. It then goes through the A.W.D. cooler and 6-micron, cartridge type filter. Both have bypass valves to permit cold, stiff oil to bypass.

Cooled, filtered oil then flows to the primary hydraulic pump. If the control lever is in its rearward **ZERO** position, a small amount of oil is directed, at low pressure to provide cooling and lubrication for the wheel motors. As the control lever is moved forward, the stroke pressure increases to control the power output of the wheel motors.

Stroke pressure is regulated by the force motor which is basically a variable drain orifice. As the hand controller is moved toward the **MAX** position, applied voltage to the force motor increases, decreasing the orifice size, thus raising stroke pressure.

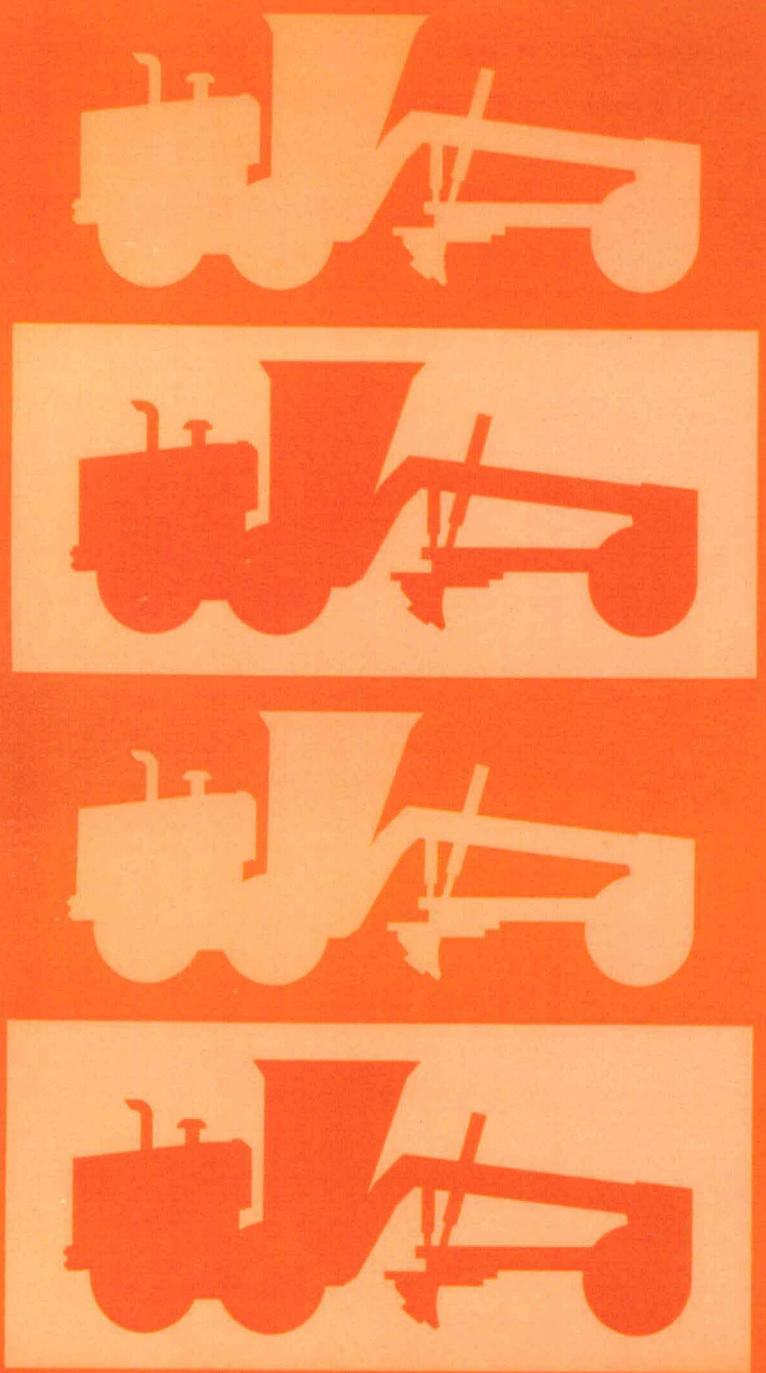
Oil from the motors is returned to the primary hydraulic pump to be 'reused'. This creates a 'closed-loop' circuit. The charge pump makes up for controlled leakage used for lubrication, and when increased volume is required because of changing conditions.

The planetaries reduce motor speed and increase torque at the wheel. They run in SAE 80W/90 gear oil which should be changed after the first 100 hours of operation and then every 1000 hours or annually (whichever comes first). The planetaries may be manually disengaged for extended roading or if service is required.

The A.W.D. system uses separate hydraulic fluid which should be replaced annually or every 2000 hours. The filter change is every 1000 hours.

The hand controller has several indicator lights in addition to the control lever. The lights indicate; forward, reverse, excessive oil temperature, and low charge pressure.

Further information on specific components may be found in the A.W.D. section of the Shop Manual and in the All Wheel Drive Service Video Tapes.



CHAMPION
MOTOR GRADERS

700 SERIES GRADER

Series III

Service Training Manual

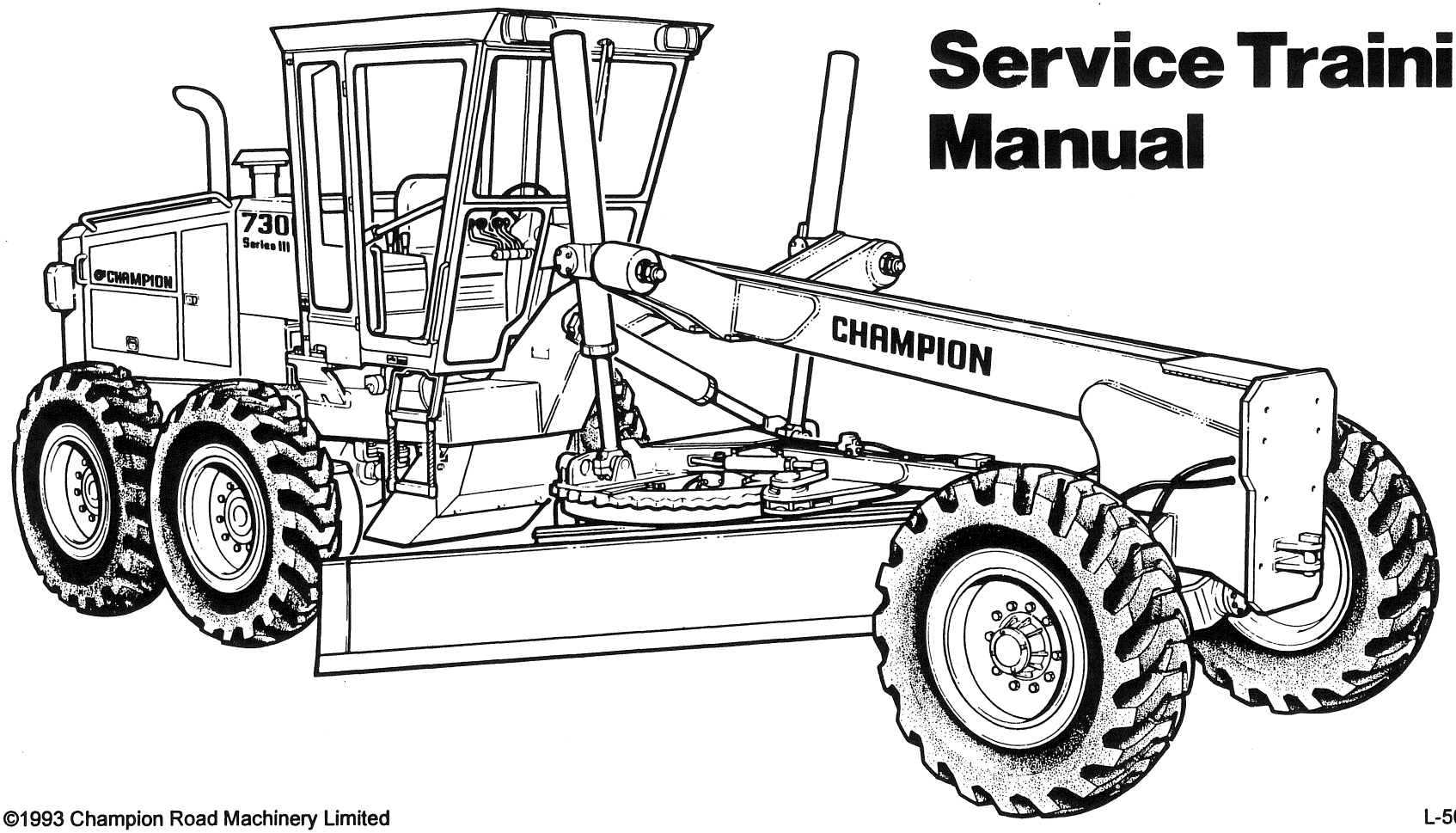
Serial Number 21911 to 24735

L-5005

700 SERIES GRADER

Series III

Service Training Manual



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L-5005 (12/93)

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The following abbreviations are used in this manual:

R.H. - Right-hand
L.H. - Left-hand
rpm - Revolutions per minute
psi - Pounds per square inch
gpm - Gallons per minute
MPLS - Moveable Point Blade Lift System

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700 SERIES GRADER

SERIES III

Service Training Manual

This Service Training Manual has been prepared only to assist you in understanding the basic theory and relationship of the systems on the Champion Series III motor grader.

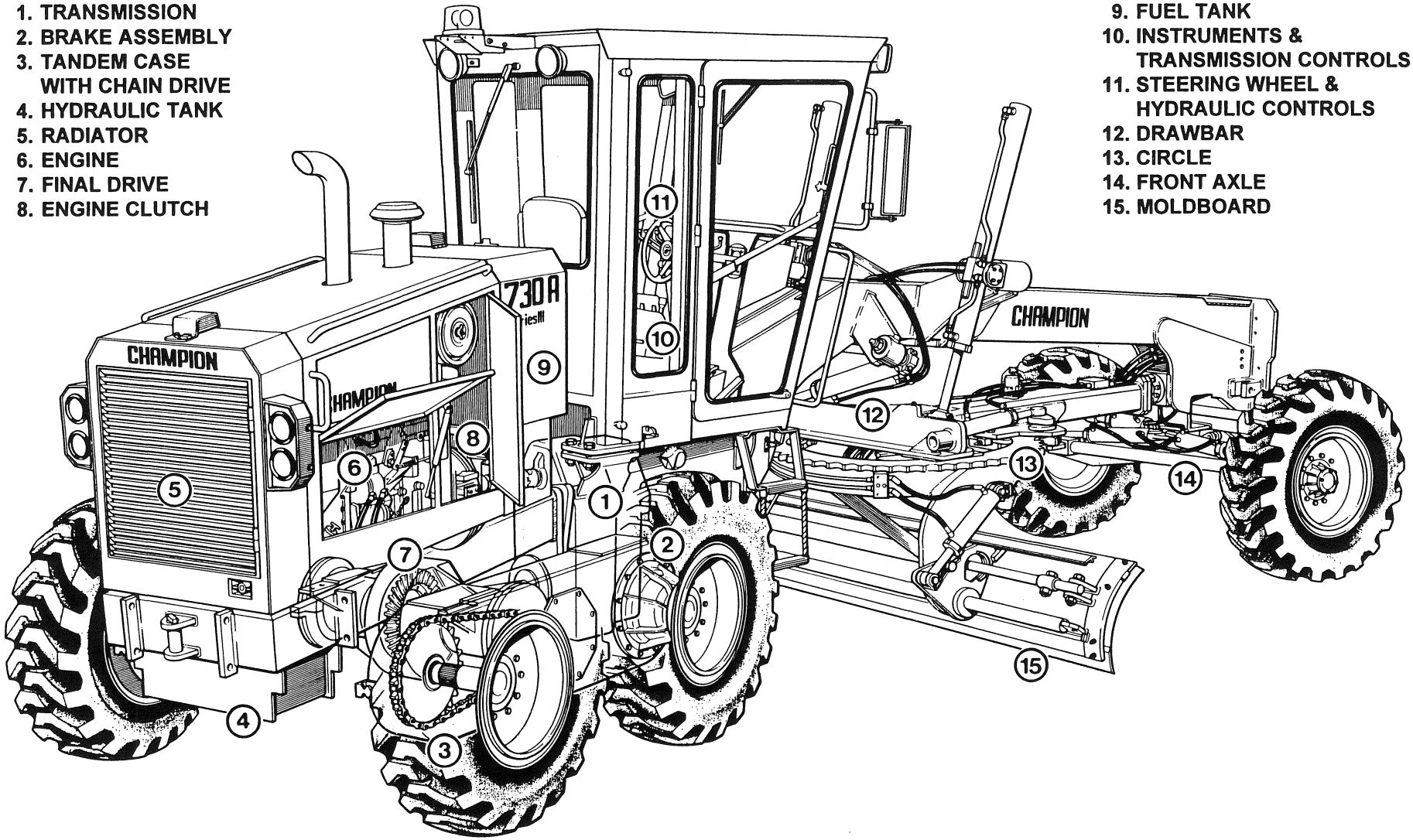
Refer to the Shop Manual for safety warnings, specifications, special tools and service procedures. Always read and understand the safety warnings and operating precautions found in the grader Operator's Manual before attempting to operate any motor grader.

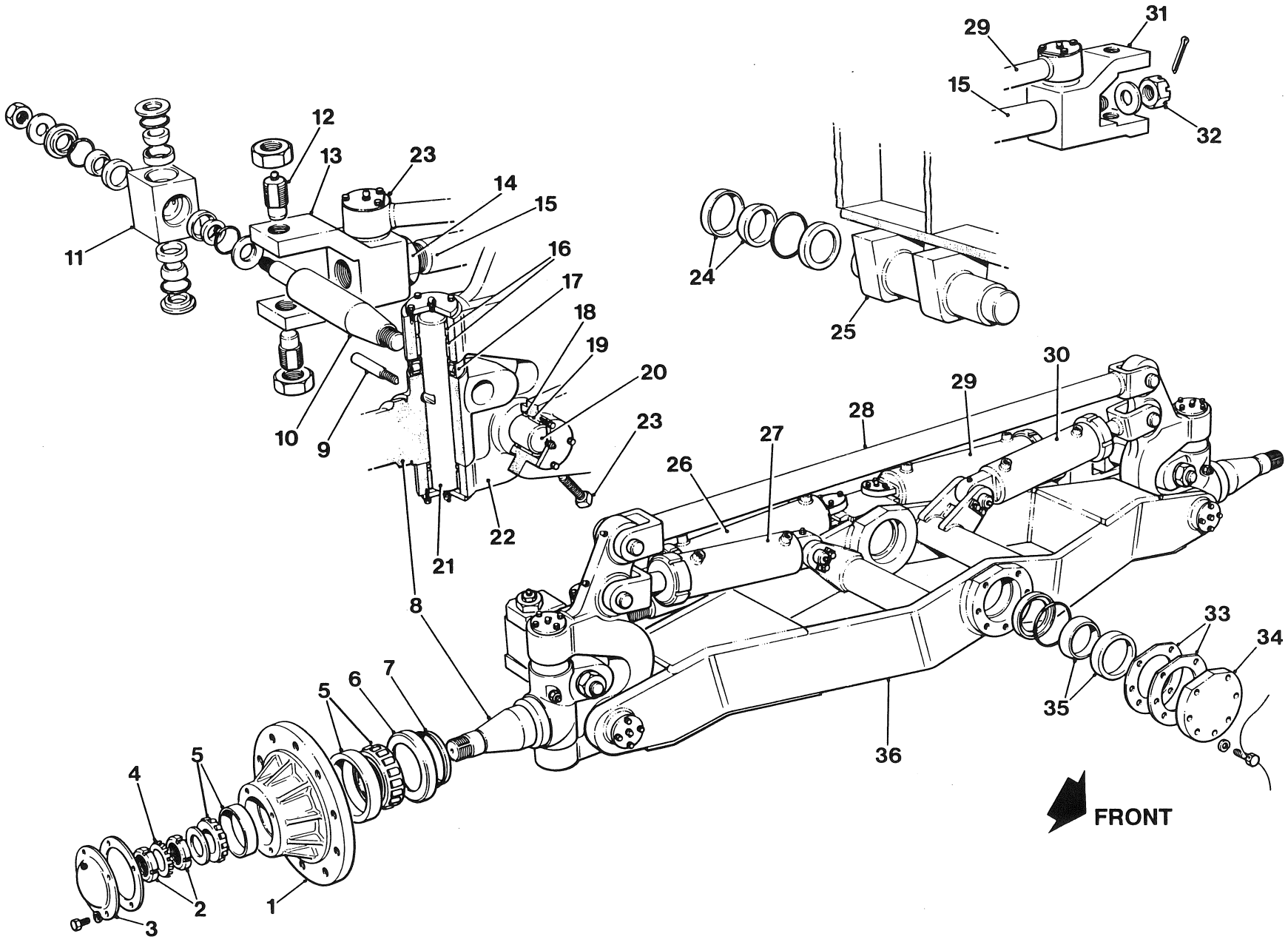
This manual generally applies to **Series III** motor graders **S/N 21911 and up**. However, most principles presented apply to earlier machines also.

The information in this manual is correct at time of publication. Your grader may be equipped with options not illustrated. Champion reserves the right to make product improvements without notice.

MAJOR COMPONENTS IDENTIFICATION ILLUSTRATION

1. TRANSMISSION
2. BRAKE ASSEMBLY
3. TANDEM CASE WITH CHAIN DRIVE
4. HYDRAULIC TANK
5. RADIATOR
6. ENGINE
7. FINAL DRIVE
8. ENGINE CLUTCH
9. FUEL TANK
10. INSTRUMENTS & TRANSMISSION CONTROLS
11. STEERING WHEEL & HYDRAULIC CONTROLS
12. DRAWBAR
13. CIRCLE
14. FRONT AXLE
15. MOLDBOARD

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FRONT

LEGEND

1. Wheel Hub
2. Spindle Nuts
3. Hub Cap
4. Tab Washer
5. Wheel Bearings
6. Back-up Ring
7. V-Ring Seal
8. Spindle
9. Key Pin
10. Radius Arm
11. Pivot Block Assembly
12. Adjustment Pin
13. R.H. Steering Yoke
14. Lock Nut
15. Steering Drag Link
16. King Pin Needle Bearings
17. Thrust Bearing
18. Dust Seal
19. Knuckle Pivot Pin Bearing
20. Knuckle Pivot Pin
21. King Pin
22. R.H. Knuckle
23. Knuckle Pin Lock
24. Rear Pivot Pin Bushing
25. Axle Pivot Pin (Frame)
26. R.H. Steering Cylinder Assembly
27. R.H. Leaning Wheel Cylinder Assembly *
28. Leaning Wheel Tie-Bar
29. L.H. Steering Cylinder Assembly
30. L.H. Leaning Wheel Cylinder Assembly
31. L.H. Steering Yoke
32. Castellated Retaining Nut
33. Pivot Adjustment Shims
34. Front Bushing Cap
35. Front Pivot Pin Bushing
36. Axle Frame

** Optional on some models.*

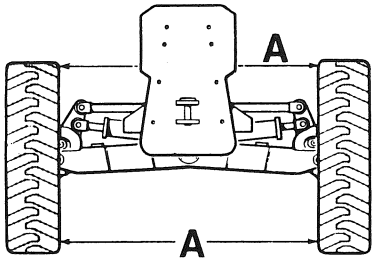
The front axle of a motor grader must perform several functions: **steering**, **oscillation** and **front wheel lean**. It must also have the ability to carry heavy front mounted attachments. The Champion front axle is designed to provide long life with minimum maintenance.

The front wheel is supported by two tapered roller bearings. The tightness of the spindle nuts determines front wheel preload. After adjustment, tab washers prevent the spindle nuts from turning. A self-relieving V-Ring grease seal prevents over greasing of the bearing cavity.

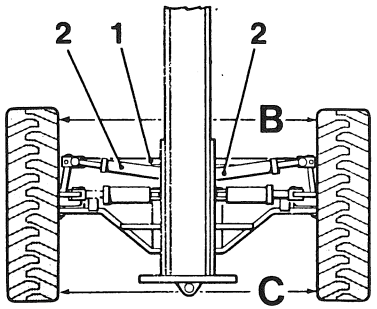
Two hydraulic cylinders pivot the spindles on their king pins to accomplish steering. The drag link makes both sides turn together. Toe-in is adjusted by loosening the lock nut on the right-hand yoke and turning the drag link. See page 9 for details. Front wheel lean is accomplished by pivoting the knuckle/spindle assemblies on the knuckle pivot pins. The tie bar makes both wheels lean together. The king pin and the knuckle pivot pin are uniform in diameter. Both are supported by needle bearings. Thrust loads, including weight of attachments are transmitted between the knuckle and spindle by a sealed thrust roller bearing. The pivot block assembly acts like a universal joint, allowing movement in two directions at the same time; wheel lean and steering. The design of the pivot block permits easy adjustment without removal or replacement of parts.

The axle pivot uses angular contact bushings placed under a slight preload which is shim adjustable. This design permits axle oscillation over uneven ground or in ditch cutting applications. Axle pivot preload is increased by removing shims.

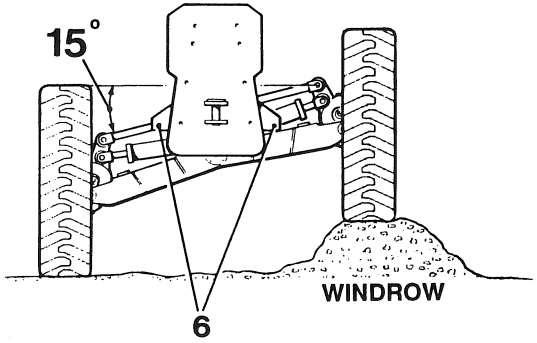
Under most applications, the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals if operating in extremely dusty or wet applications or if the joints are dry.



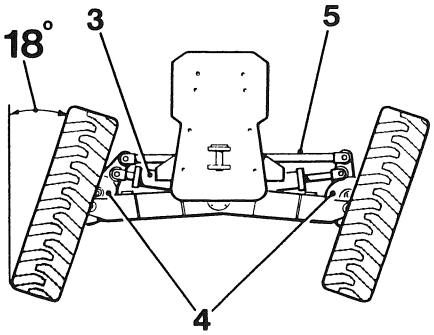
CAMBER



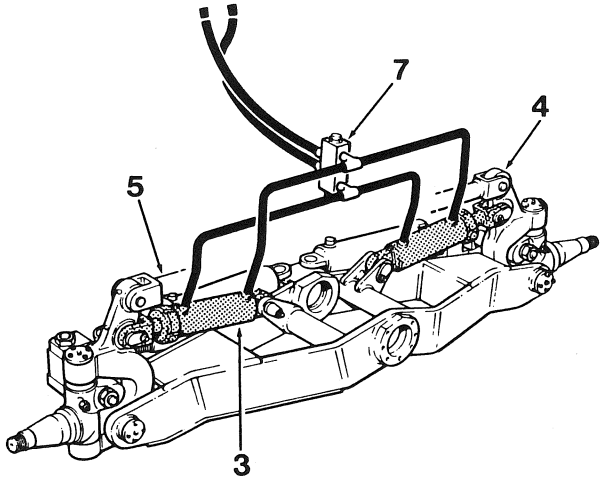
TOE-IN



OSCILLATION



WHEEL LEAN



LEGEND

1. Drag Link
2. Steering Cylinders
3. Leaning Wheel Cylinders
4. Knuckles
5. Tie-bar
6. Axle Pivot Stops
7. Lock Valve

The front axle is designed around three basic functions:

1. Oscillation of the front axle assembly under the grader main frame allows the wheels to travel over uneven ground with little movement of the main frame. It also allows one wheel to ride a windrow as shown. The blade will move or spread the windrow while the grader stays level because the driving wheels are on the graded surface. Axle stops limit oscillation to 15° each side of centre.

2. The Leaning Wheel function allows the wheels to lean 18° right or left of centre to brace against side draft imposed by the moldboard. It gives better stability while grading on slopes by allowing the operator to keep the wheels vertical. It also gives better cornering ability by reducing the turning radius. Depending on the model, one or two hydraulic cylinders lean the wheels. A lock valve eliminates hydraulic cylinder drift to maintain wheel position. Too much wheel lean will stress the tires' side wall. A tie-bar keeps both wheels parallel.

3. The third function is Steering. It is directly affected by the other two. Steering is accomplished through two steering cylinders and a drag link that turns the two wheels together.

Caster and 1° positive camber are built into the front axle assembly. They cannot be adjusted as indicated by dimension **A**.

Toe-in means the toe or front of the wheels are closer together than the rear. On Champion graders, dimension **B** is 1/2" - 5/8" larger than dimension **C,** (except on All Wheel Drive models where **0** toe-in is specified). A tires' natural tendency is to pivot on the king pin or toe-out as it rolls forward. By having the front of the wheels closer together, toe-out is counteracted, allowing the wheels to run true.

To set toe-in:

1. With the wheels straight, move the grader ahead on smooth ground two complete tire revolutions. This removes any side wall flex.

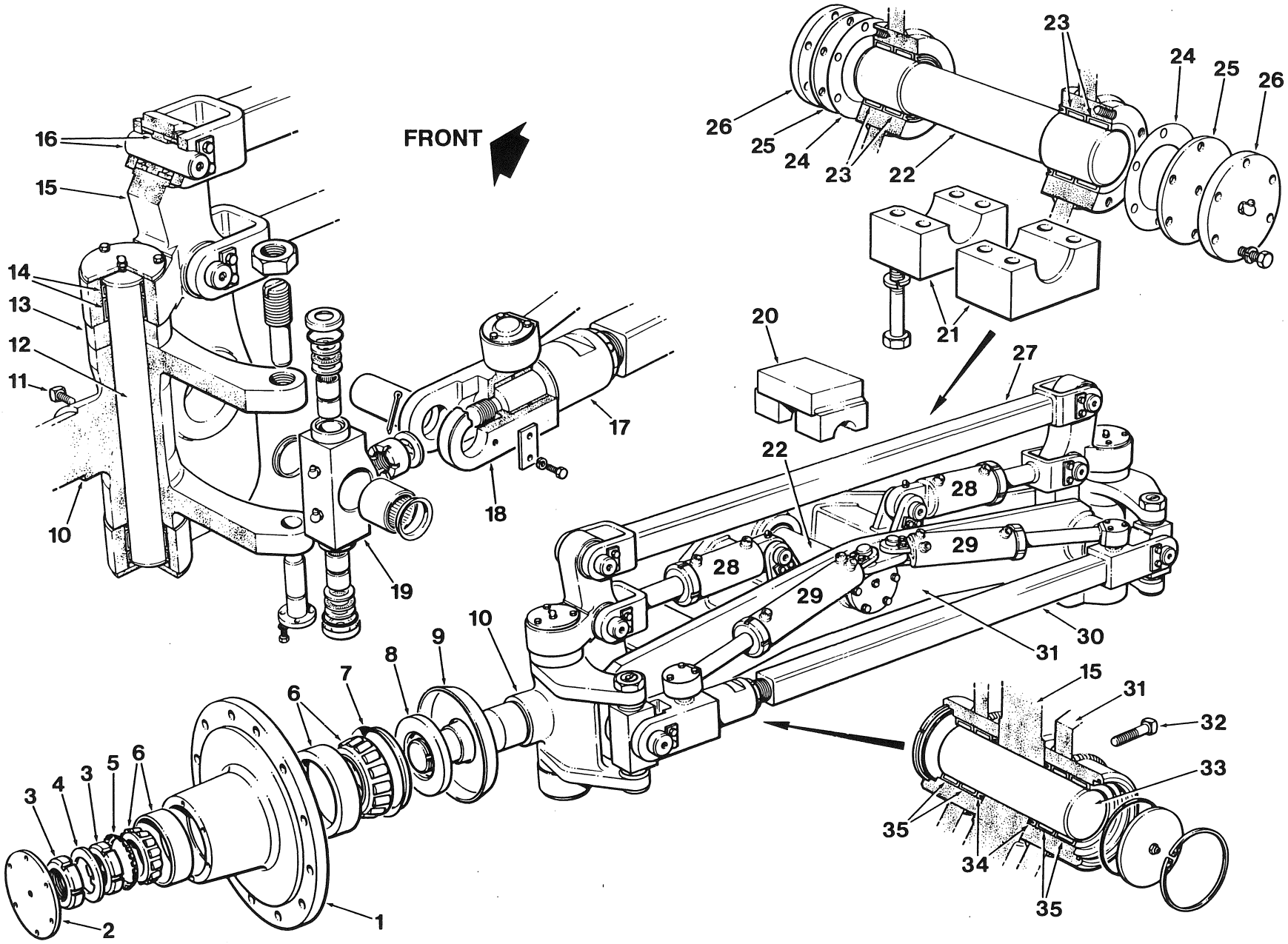
2. Place the grader in the service position. Mark an **X** on each tires' inside side wall parallel with the spindle at the tires' front. Measure the distance **C**, between the two tires at the **X** marks.

3. Move the grader ahead half a tire revolution, until the **X** marks are parallel with the spindle at the rear of the tire. Measure this distance, **B**.

4. Subtract the **C** measurement from the **B** measurement. If the result is not within specification, adjust the toe-in by:
   A) Increase the length of the drag link to increase toe-in.
   B) Decrease the length of the drag link to decrease toe-in.

After making an adjustment, secure the drag link lock nut and repeat the first three steps.

Tires - Generally front tires on a motor grader are mounted with the tread facing the opposite of the rear drive tires. This allows the front tires to clean themselves, providing better traction to any side thrust. All Wheel Drive model graders are the exception. The front tires are also drive tires and must have the tire tread facing the same direction as the rear tires.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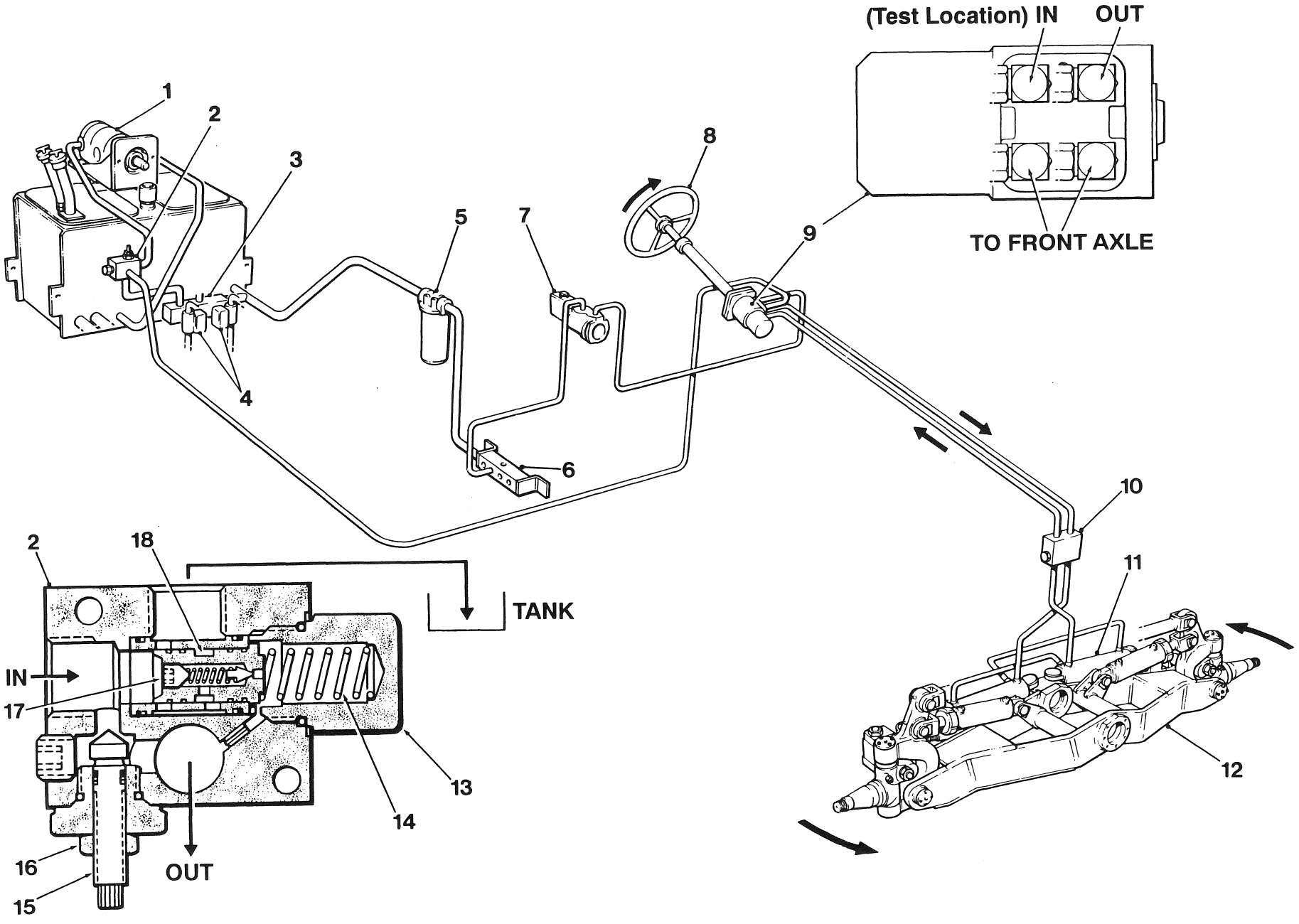
LEGEND

1. Wheel Hub
2. Hub Cap
3. Spindle Nuts
4. Tab Washer
5. Lock Washer
6. Wheel Bearings
7. V Ring Seal
8. Spacer
9. Dust Shield
10. Spindle
11. Lock Screw
12. King Pin
13. Thrust Bearing
14. King Pin Bearing
15. R.H. Knuckle
16. Pin and Bearing
17. Adjustment Collar - Toe-in
18. R.H. Steering Yoke
19. Pivot Block Assembly
20. Mounting Block - Frame
21. Mounting Block - Matched Halves
22. Pivot Pin
23. Axle Pivot Needle Bearings
24. Shims
25. Thrust Washer
26. End Cap
27. Leaning Wheel Tie-bar
28. Leaning Wheel Cylinders
29. Steering Cylinders
30. Drag Link
31. Axle Frame
32. Lock Screw
33. Knuckle Pivot Pin
34. Dust Seals
35. Knuckle Pivot Bearings

Models 780/780A front axle performs all the functions that the standard front axle does. The fundamental difference between models 780/780A front axle and other 700 Series grader axles is size. This axle is larger and more heavily constructed to withstand the higher stress exerted in 780/780A applications. This axle has a wider stance (or track width) between the front tires to allow full axle mobility with 20.5 x 25 tires. The axle pivot, king and knuckle pins are all supported by double row needle roller bearings. End thrust on the axle pivot pin is measured on the thrust washer. It is limited to .003" - .005" and shim adjustable.

Under most applications the front axle requires greasing only once a week. Champion recommends the front wheels be lifted off the ground at every fourth greasing. Place a suitable safety stand under the nose plate before greasing. Always increase the greasing intervals in extremely dusty or wet conditions or if the joints are dry.

Refer to the Shop Manual for specifications.


(Test Location) IN
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TANK
IN
OUT

LEGEND

1. Transmission/Steering Pump
2. Priority Flow/Relief Valve Assembly
3. Manifold Return Block (Reference only)
4. Main System Relief Valves (Reference only)
5. Return Line Filter
6. Return Collector Manifold
7. Clutch Master Cylinder Booster Assembly
8. Steering Wheel
9. Steering Valve - Open Centre
10. Cushion Valve
11. L.H. Steering Cylinder
12. Axle
13. Spring Cap
14. Balance Spring
15. Flow Adjustor
16. Lock Nut
17. Pressure Regulation Adjustment Set Screw
18. Pressure Regulation Spool Assembly

The transmission/steering pump is a two section gear pump driven from the engine crankshaft. Each section is sealed from the other. The steering pump draws oil directly from the hydraulic tank. It has an output displacement of approximately 22 U.S. gpm @2100 rpm. Since displacement of a gear pump is directly proportional to its speed, Champion uses a priority flow valve to maintain consistent steering response throughout the entire engine operating range. With engine speed between low idle and approximately 1300 rpm, 100% of the flow is directed to the steering valve. At engine speeds above this, the first 12 U.S. gpm is directed to the steering valve, the remainder returns to the tank.

If the operator is not turning the steering wheel, hydraulic oil circulates through the valve and enters the clutch booster to provide clutch pedal hydraulic assistance. After flowing through the booster, the steering oil joins the main hydraulic oil at the return collector manifold, continues through the filter and returns to the tank.

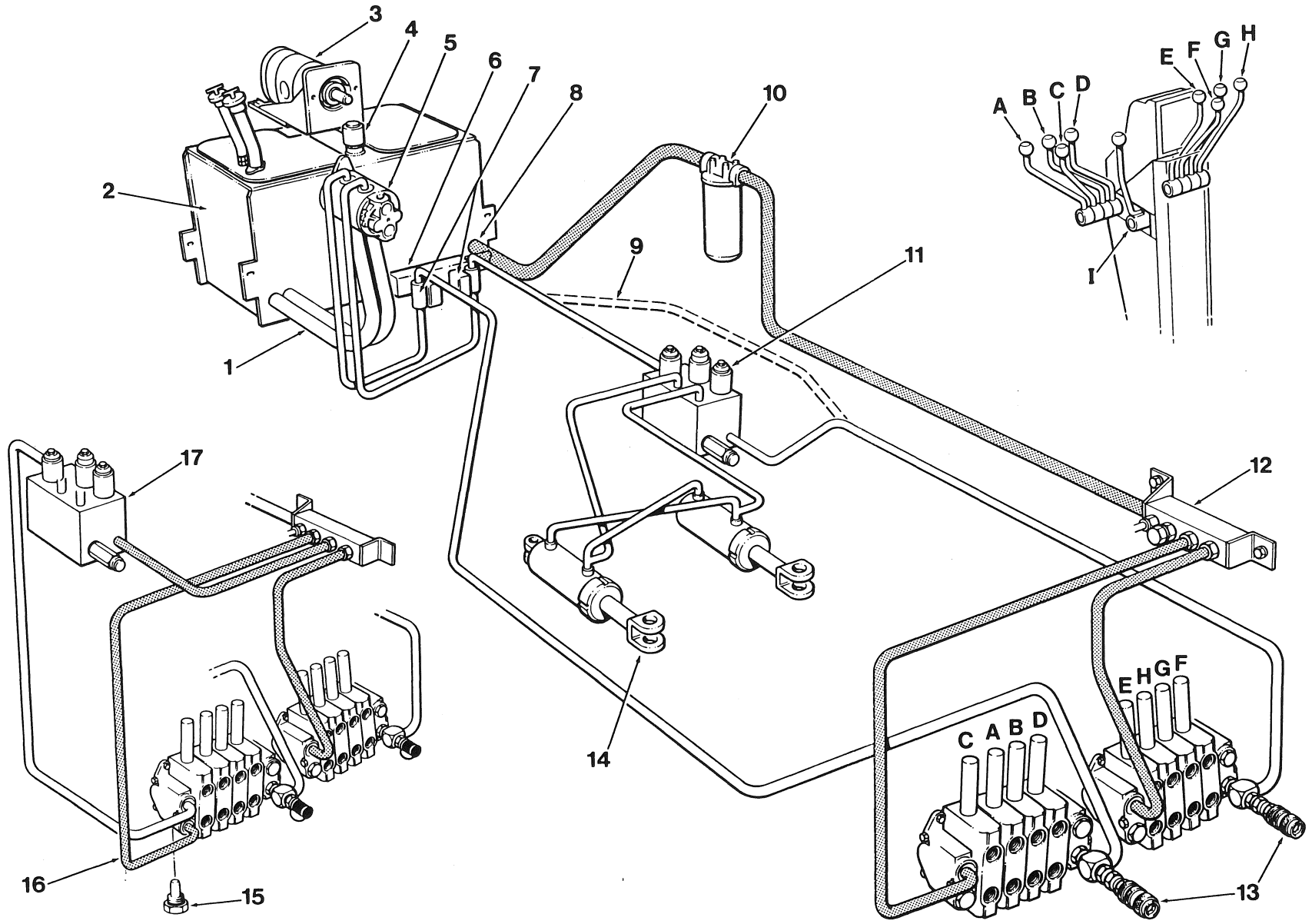
When the operator turns the steering wheel to the left for example, oil is directed to the front axle as shown. The right hand steering cylinder extends and the left hand cylinder retracts, causing the grader to steer to the left. Return oil flow from the cylinders passes back through the steering valve and supplies the clutch booster, finally returning to tank. If the steering wheel is turned to the right the process is reversed.

The cushion valve has two important functions in the steering system: See page 19 for more details.

The system is protected by a relief valve (set at 2200 $\pm$100 psi @2100 rpm) incorporated into the priority flow valve. Under normal operating conditions the relief valve does not open.

The relief valve setting, as well as the left-hand and right-hand cushion valve settings can be checked by installing a pressure gauge on the quick coupler located on the inlet hose.

Refer to the Shop Manual for detailed instructions and Specifications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LEGEND

1. Dual Suction Lines
2. Hydraulic Tank
3. Transmission/Steering Pump (Reference only)
4. Breather
5. Main Hydraulic Pump
6. Relief Valve Manifold Block
7. Relief Valve
8. Tank Return
9. Rigid Frame Bypass
10. Return Line Filter
11. Articulation Valve
12. Return Collector Manifold
13. Quick Coupler Test Ports
14. Articulation Cylinders

VIEW 'A'

Front Mounted Attachment Circuit

15. Power Beyond Plug
16. Drain Line
17. Attachment Valve

Champion motor graders use two main hydraulic systems. This twin flow hydraulic system uses separate gear pumps, relief valves and open centre manifold control valves for each side. Both main hydraulic pumps are contained in a single housing mounted to the engine's accessory drive. Each section has its own suction line and is protected by a separate relief valve set at 2100 ±100 psi @ 2100 rpm. Oil enters each separate manifold on the left side and exits from the right where it joins the return from the steering system at the return collector manifold, continues through the filter and returns back to the tank.

Levers to the **left** of the steering wheel, control the **left-hand** manifold valve and levers to the **right** of the steering wheel control the **right-hand** manifold.

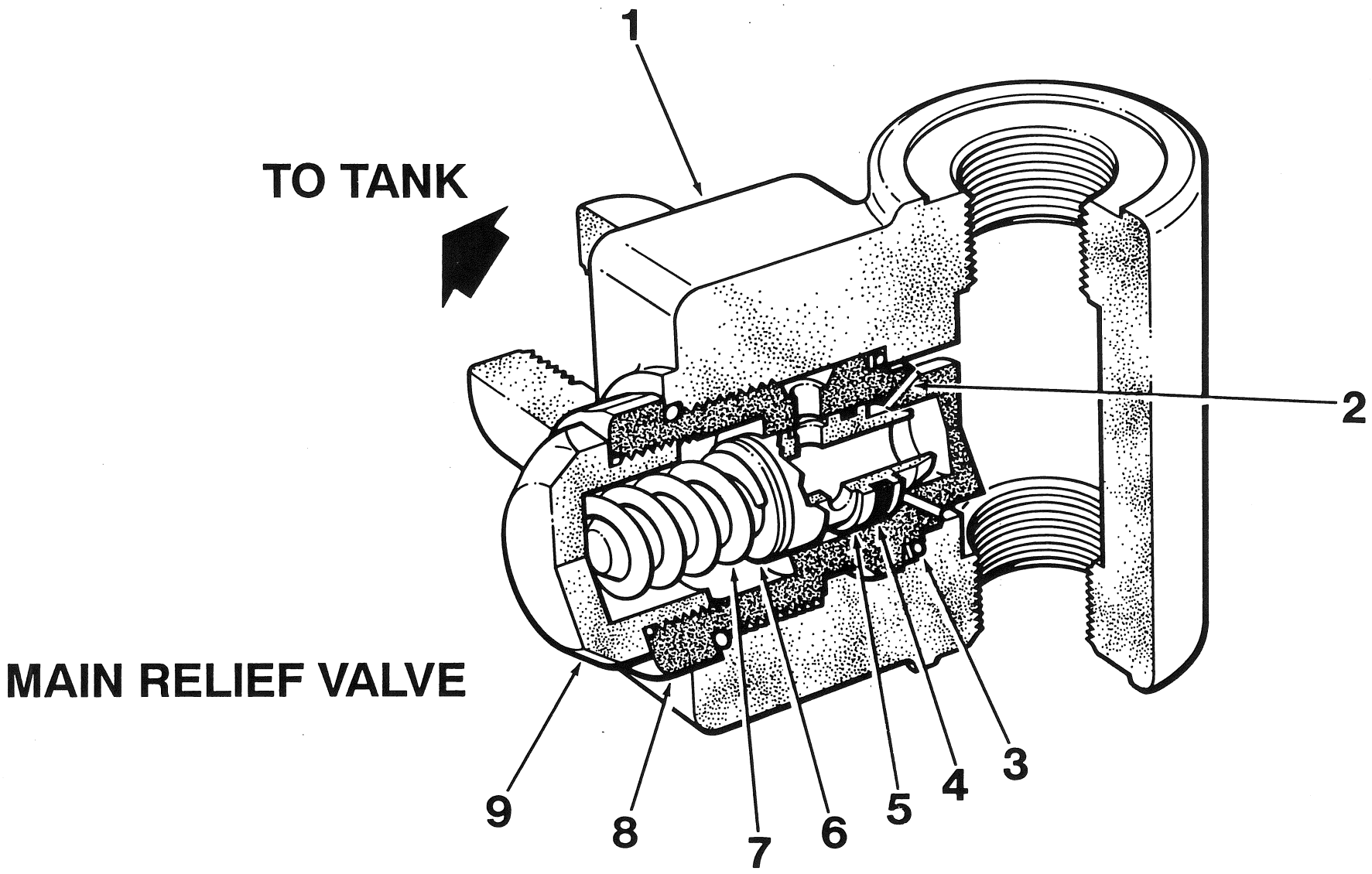
A - R.H. Blade Lift
B - Front Wheel Lean
C - Scarifier, Front Mounted Plow
D - Circle Shift
I - MPLS Lock Cylinder
E - Circle Turn
F - Moldboard Tilt
G - Moldboard Slide Shift
H - L.H. Blade Lift Lever

Each manifold is equipped with a quick coupler test port on the inlet. By bottoming out a cylinder, relief valve pressure setting can be obtained. Champion recommends taking pressure readings only at these specified test points.

Articulated graders use a double acting solenoid valve located in the **left-hand** hydraulic system to control frame articulation. All articulated graders use two diagonally powered cylinders, providing even articulation speed left or right of centre.

Special consideration must be given when connecting additional solenoid valves to the manifolds for snow wings or dozer blades. A power beyond plug must be installed as shown. An additional drain line is used to vent controlled internal spool leakage back to the tank to prevent internal pressure build up in the manifold control valve.

Refer to the Shop Manual for specifications.



MAIN RELIEF VALVE

LEGEND

Main Relief Valve

1. Valve Body
2. Valve Seat
3. O-Ring and Back-up Washer
4. Poppet Seal
5. Poppet
6. Shims
7. Spring
8. Valve Cartridge
9. End Cap

Relief valves limit the pressure in a hydraulic system to protect system components from damage. The two main hydraulic relief valves are identical and are mounted to the return manifold block on the front of the hydraulic tank. Oil leaving the pump flows straight through the valve under most operating conditions. When pressure exceeds the relief valve setting of 2100 ±100 psi (e.g. when a cylinder is bottomed out), the valve poppet moves off its seat, and opens a passage directly into the hydraulic tank.

To check relief valve operation:

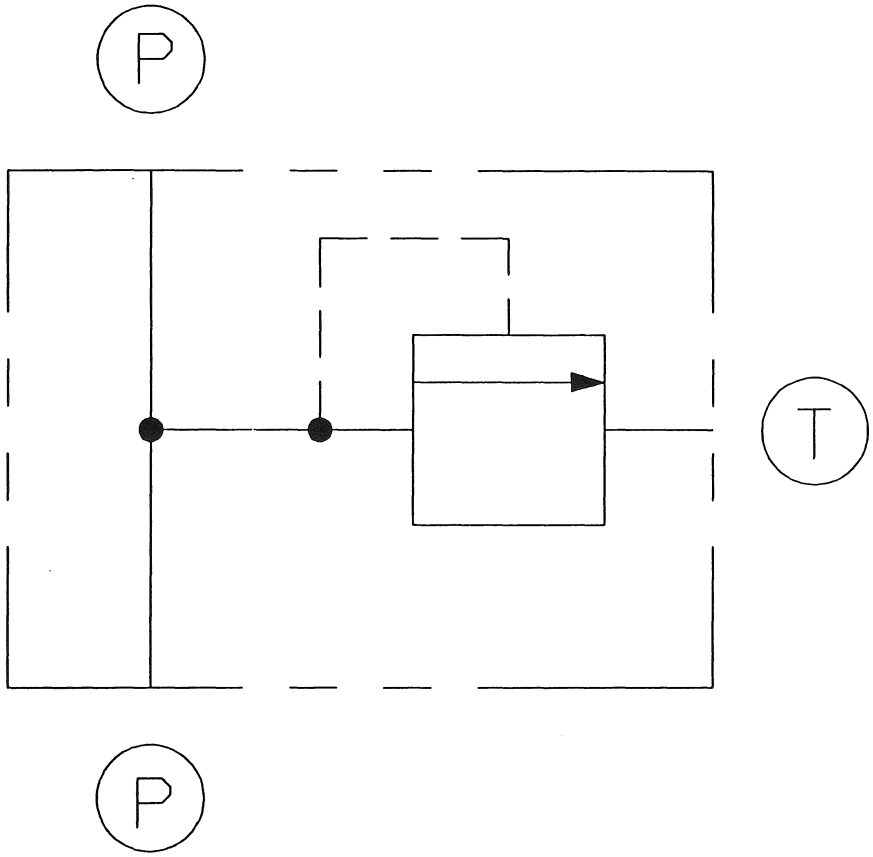
A) Install a 0-3000 psi gauge into one of the quick coupler test ports located on the inlets to the manifold valves.

B) When it is safe to do so start the engine and fully retract the blade lift cylinder on the same side as the gauge installation. Hold the blade lift lever in the retracted position. Read the gauge with the engine at 2100 rpm.

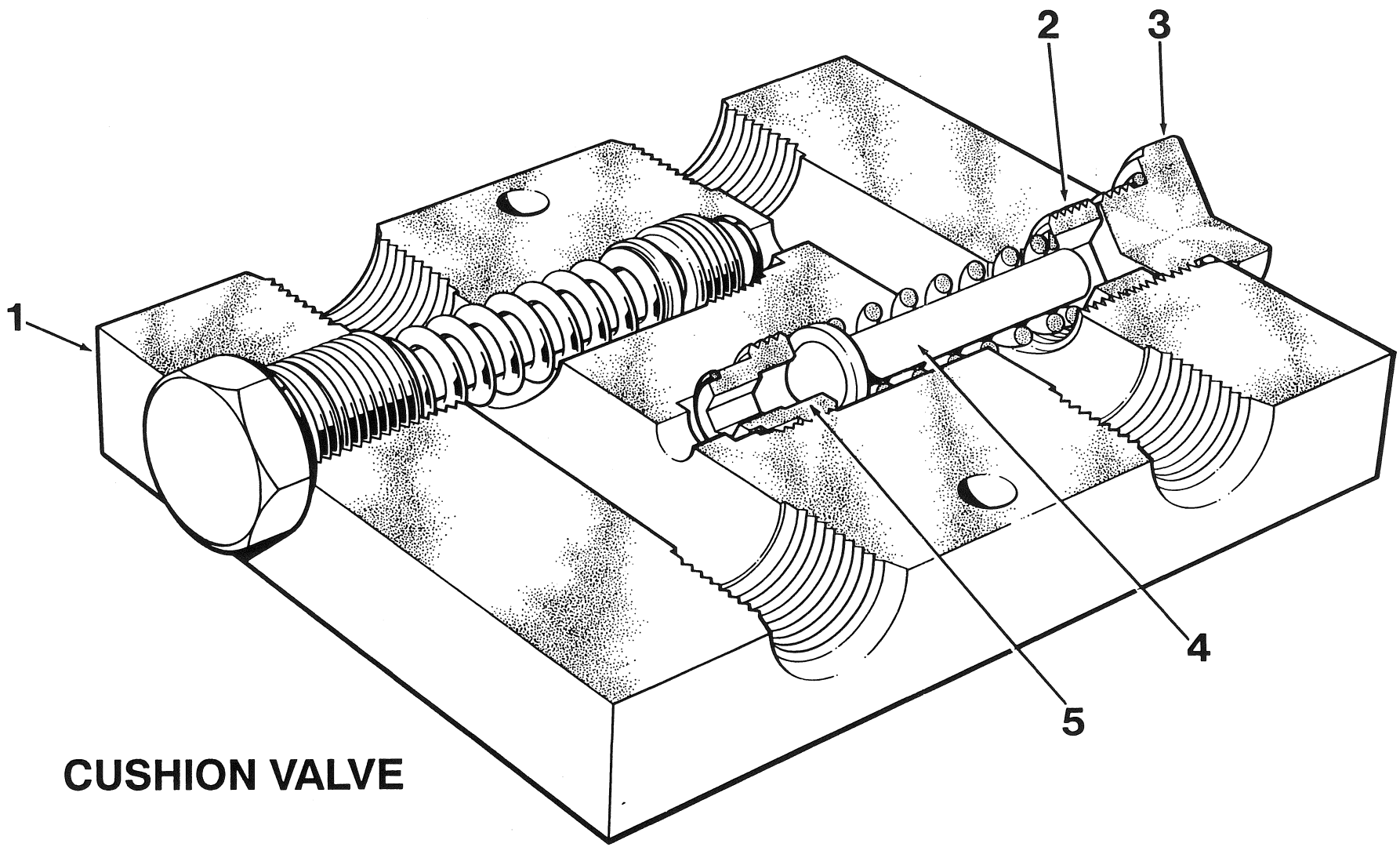
C) Add shims to raise, or remove shims to lower the relief valve setting. The shims are between the spring and poppet. Never add shims between the spring and end cap as the poppet travel could be restricted resulting in a reduced flow rating of the valve and higher system pressures.

D) Always retest the relief valve setting.

Repeat Steps **A)** through **D)** for the other side of the twin flow hydraulic system and its relief valve.



ISO Schematic - Relief Valve



CUSHION VALVE

LEGEND

Cushion Valve

1. Body
2. Adjustment Screw
3. O-Ring Cap
4. Poppet
5. Poppet Seat

Cushion Valves are found in the steering and circle turn circuits. This valve, commonly known as a crossover relief valve, is actually two relief valves in one body. It protects both sides of a circuit from high pressure spikes created by shock loads. Under these conditions, a small amount of oil vents across the valve to the opposite low pressure side. During normal operation, oil flows straight through the valve and the poppets remain seated.

STEERING CIRCUIT

The cushion valve in the steering circuit performs two important functions:

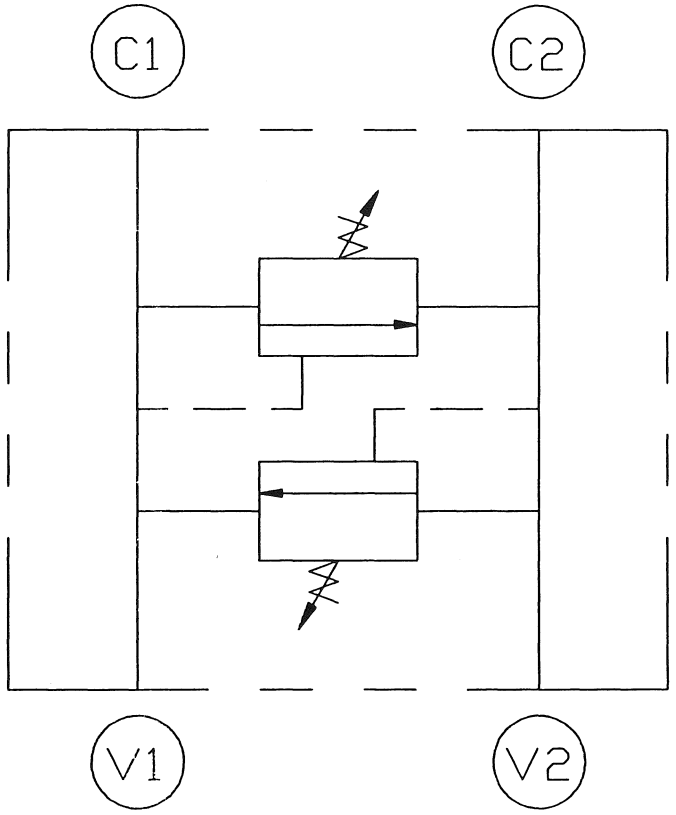
1. It prevents shock forces from being transferred to the steering wheel.
2. It becomes a bypass valve allowing oil to return to the steering valve if the operator continues to turn the steering wheel after the wheels reach lock.

NOTE: Turning the steering wheel after the wheels have reached lock places unnecessary stress on the steering components.

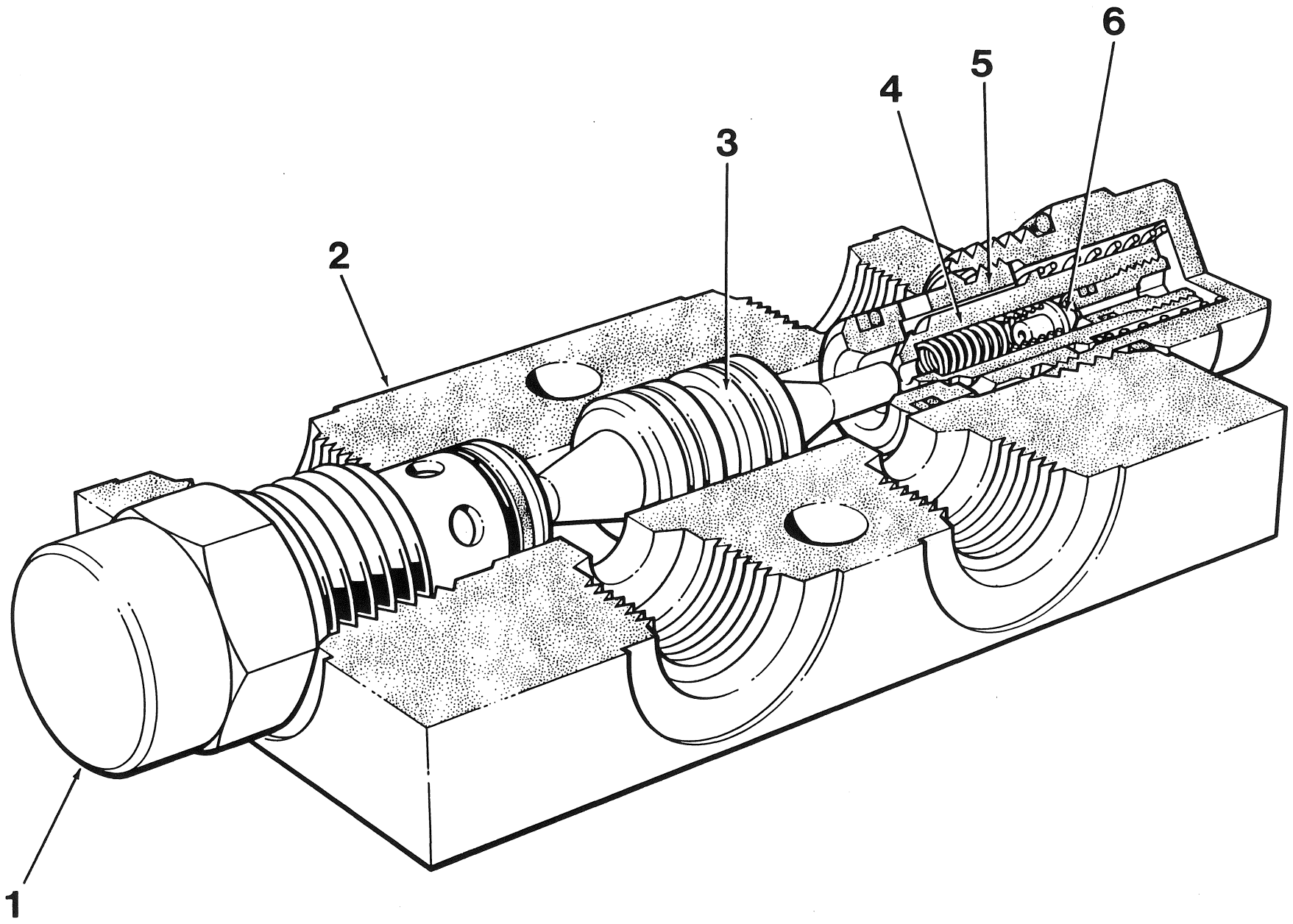
To test the cushion valve settings, start by installing a pressure gauge on the quick coupler located on the inlet hose to the steering motor. Run the engine at 2100 rpm and turn the steering wheel to the left until the wheels reach lock. Continue to turn the steering wheel 1 revolution every 2 seconds. The gauge should read 1150 (± 100) psi. If the valve needs adjustment, use the right hand side screw. Repeat these procedures steering the wheels to the right. If the valve needs adjustment, use the left hand side screw.

CIRCLE TURN CIRCUIT

Whenever the moldboard strikes an immovable object, the cushion valve allows for the pressure spike to vent to the low pressure side. The cushion valve is internally orificed so that the amount of oil that crosses over does not allow the circle to turn suddenly. The valve setting for this application is 2200 (± 100) psi. Because this is higher than the main relief setting, it can only be checked with a hand pump.



ISO Schematic - Cushion Valve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6

LEGEND

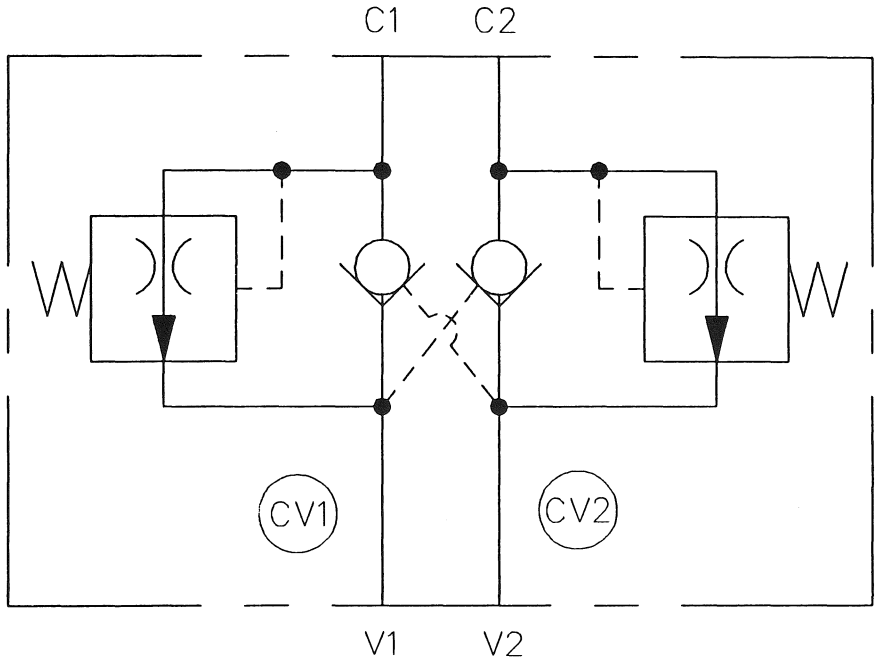
1. Check Valve Cartridge
2. Valve Body
3. Pilot Piston
4. Check Valve Poppet
5. Check Valve Sleeve
6. Thermal Relief Poppet

The **lock valve** is a pilot operated check valve used on scarifier lift, A-frame, leaning wheel and dual moldboard tilt circuits. It is used to prevent cylinder drift under load and moldboard warpage due to cylinder leakage.

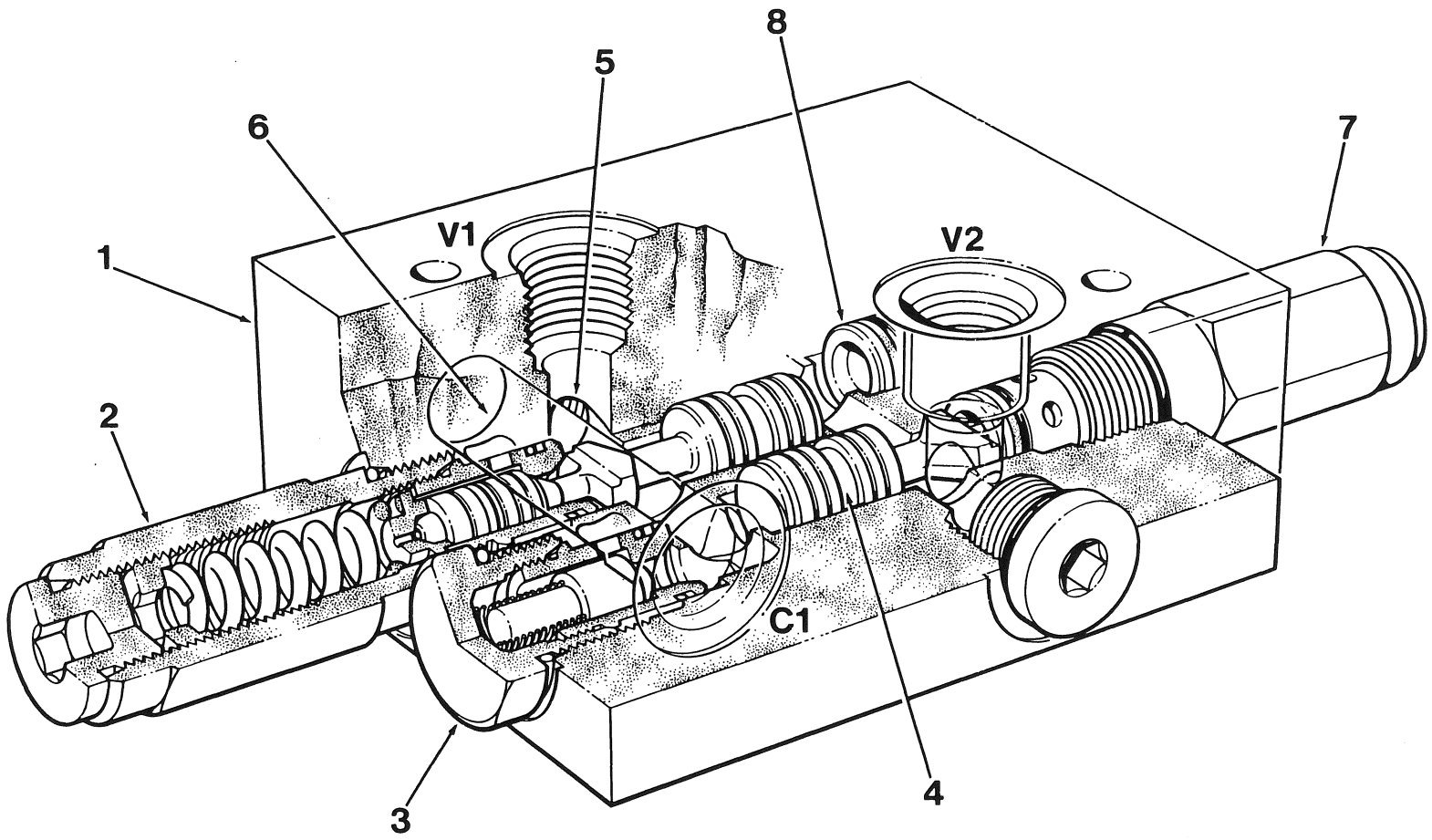
Oil pressure directed to V1 unseats the R.H. check poppet and flows to the cylinder. At the same time the pilot piston moves to the left unseating the L.H. poppet and allows oil leaving the cylinder to exit at V2.

Thermal relief is accomplished through a secondary internal poppet valve. When the manifold valve is in neutral, both check valves are closed and oil is locked in both ends of the cylinder. Oil is also present in the end caps of the cartridges due to clearance between the check poppet an it's mating sleeve. Should pressure exceed 3000 psi the thermal relief poppet unseats and allows oil to exit to port V1 or V2. Because this is higher than the main relief valve setting, the valve cannot be checked by using the main hydraulic system.

NOTE: R.H. and L.H. are for the purpose of explanation only. R.H. components are identical to L.H.



ISO Schematic - Lock Valve


8
5
6
7
V1
V2
1
2
C1
3
4

LEGEND

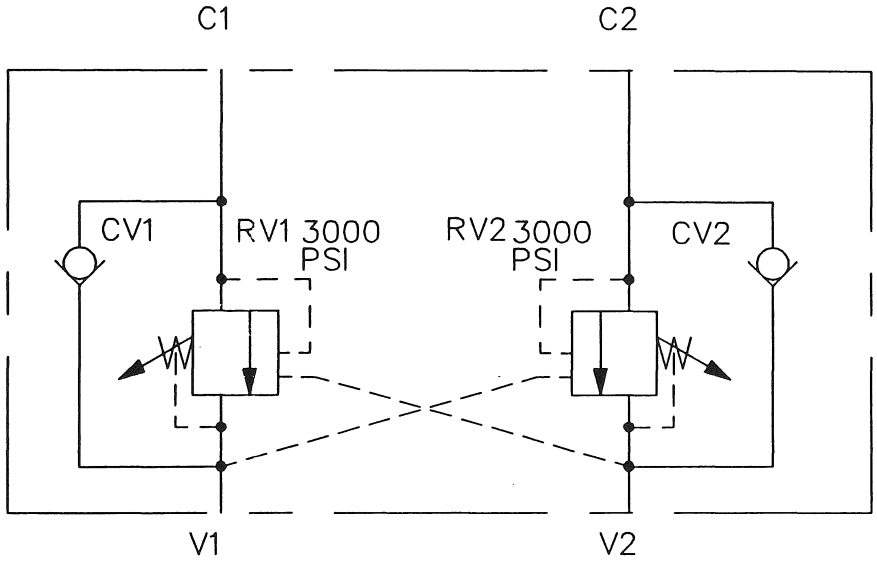
1. Valve Body
2. L.H. Relief Valve Cartridge
3. L.H. Check Valve Cartridge
4. Pilot Piston
5. Pilot Passage
6. Cylinder Passage
7. R.H. Relief Valve Cartridge
8. R.H. Check Valve Cartridge

The **counterbalance valve** is a combination valve utilizing check valve and relief valve cartridges. It is found in the hydraulic blade lift and moveable point lock cylinder circuits. It's purpose is to prevent cylinder drift and cavitation when lowering a cylinder.

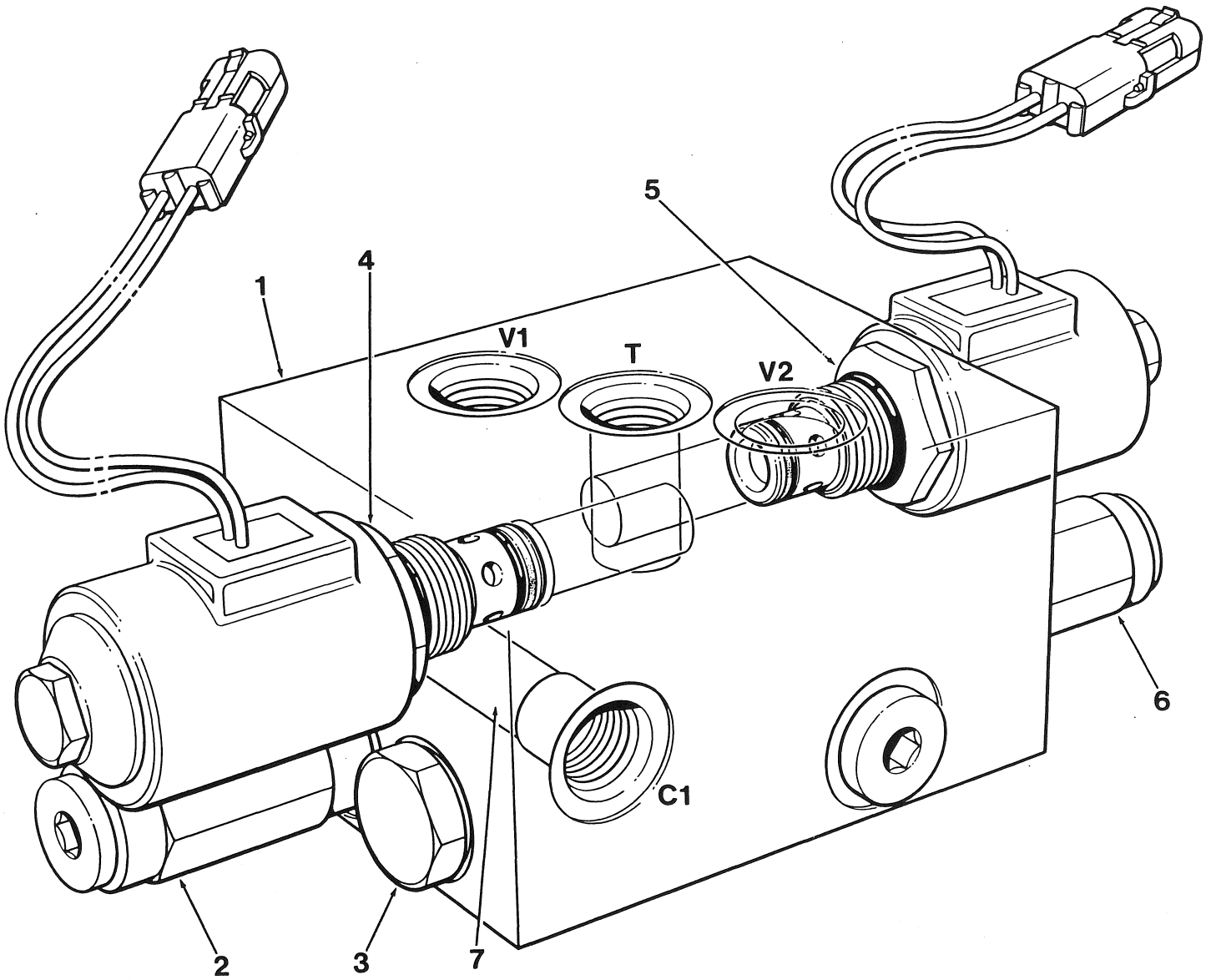
Oil pressure directed to V1 flows into the L.H. pilot passage, unseats the L.H. check valve, flows into the L.H. cylinder passage and out to the cylinder through C1. Oil exiting the opposite end of the cylinder enters the R.H. cylinder passage at C2 but is trapped by the R.H. check valve and relief valve. As pressure builds in the L.H. pilot passage, the R.H. pilot piston pushes the R.H. relief valve off its seat and allows oil to flow out V2.

When the cylinder is at rest, oil is present in both the R.H. and L.H. cylinder passages. The check valves prevent cylinder drift while the relief valves allow for shock loads and thermal expansion of oil. Should pressures exceed 3000 psi, the relief valves open and oil is allowed to exit to port V1 or V2. Because this is higher than the main relief valve setting, the valve cannot be checked by using the main hydraulic system.

NOTE: R.H. and L.H. are for purpose of explanation only. R.H. components are identical to L.H.



ISO Schematic - Counterbalance Valve


1
4
5
V1
T
V2
6
C1
2
3
7

LEGEND

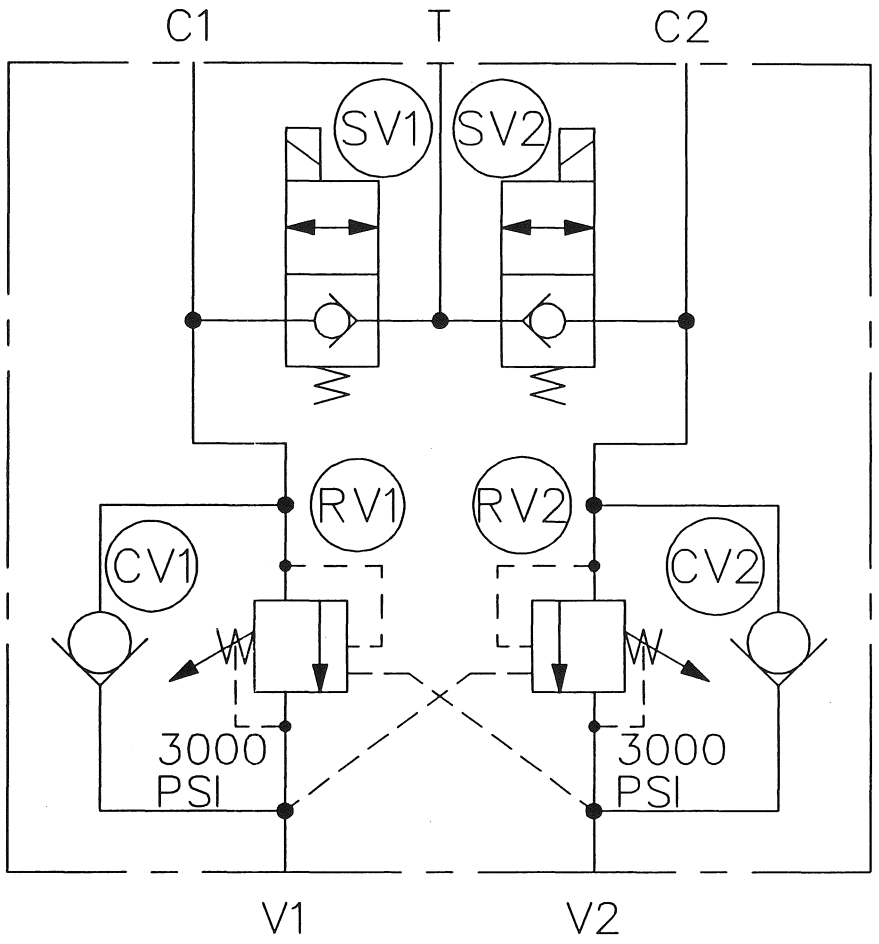
1. Valve Body
2. L.H. Relief Valve Cartridge
3. L.H. Check Valve Cartridge
4. L.H. Solenoid Valve Cartridge
5. R.H. Solenoid Valve Cartridge
6. R.H. Relief Valve Cartridge
7. Cylinder Passage

The **electric float valve** is a combination valve utilizing check valve, relief valve and solenoid valve cartridges. It is an option available in the hydraulic blade lift circuit. Like the counterbalance valve, it prevents cylinder drift and cavitation when extending the cylinder. It also allows a cylinder to float up and down for snow plowing and ditch cleaning applications.

See page 23 for an explanation of the counterbalance valve.

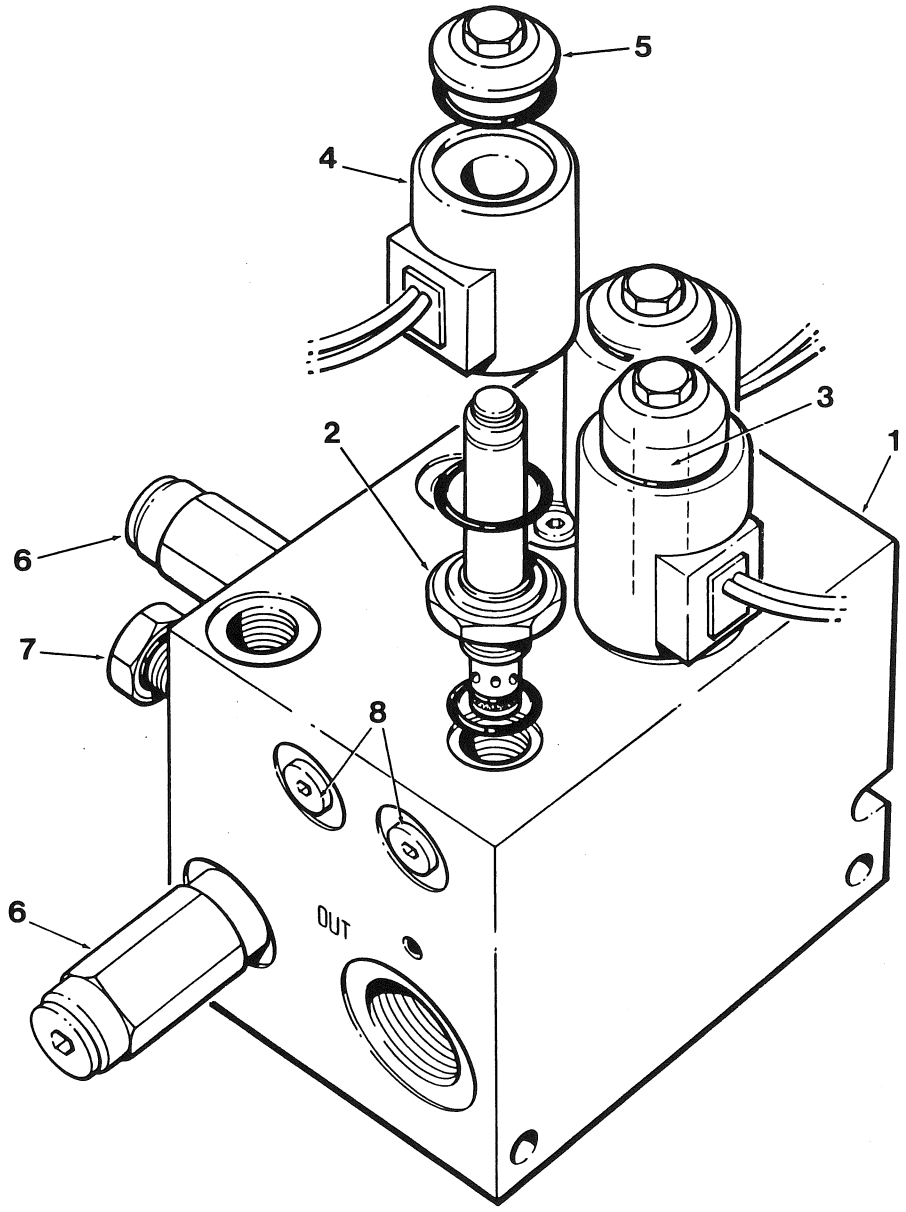
The electric float valve incorporates 2 normally closed solenoid operated valves which are present in the R.H. and L.H. cylinder passages along with the check valve and relief valve cartridges. To initiate the float function, both solenoids are energized. Once energized, they join the top and bottom of the cylinder together with a line to the hydraulic tank. This line is necessary to compensate for the differential area of the cylinder piston. When the cylinder retracts, oil from the top of the cylinder is displaced to the bottom and excess oil is sent to tank. When the cylinder extends, oil from the bottom of the cylinder is displaced to the top and additional oil is drawn from the tank.

NOTE: R.H. and L.H. are for purpose of explanation only. R.H components are identical to L.H.



ISO Schematic - Electric Float Valve

Attachments:
S/N 22688 & up
Articulation:
S/N 22132 & up



LEGEND

1. Valve Body
2. Directional Cartridges (Qty 2)
3. Unloader Cartridge
4. Solenoid Coils (Qty 3)
5. Coil Fastening Nuts (Qty 3)
6. Relief Valve Cartridges (Qty 2)
7. Check Valve Cartridges (Qty 3)
8. Plugs (Qty 7)

Solenoid operated valves are combination valves utilizing check valve, relief valve and solenoid valve cartridges. They are used to control articulation and most attachments. Both single and dual valves are used depending on the application.

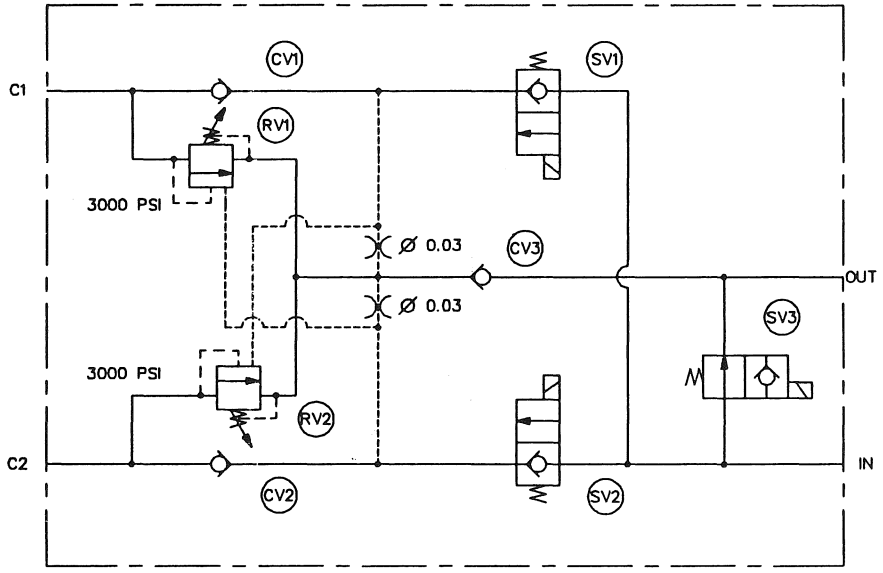
Like the counterbalance valve, they prevent cylinder drift and cavitation when operating cylinders. These valves are self contained units as they are able to provide directional control along with relief and lock functions. In comparison, the manually operated sections of the main hydraulic manifolds provide only directional control and require accessory valves (ie. counterbalance, lock) to accomplish these additional functions.

A large capacity, normally open, unloading cartridge allows these solenoid operated valves to function "open center" like the main hydraulic manifolds. This permits hydraulic oil to pass straight through them when not required for cylinder operation. To obtain directional flow, this unloader cartridge along with one directional cartridge must energize. This blocks the straight IN to OUT passage of oil and directs oil towards one of the cylinder ports.[1] From this point on, these valves are similar in function to the counterbalance valve. See page 23 for a complete explanation of the counterbalance valve.

[1] - *In the articulation application, SV1 articulates right and SV2 articulates left.*

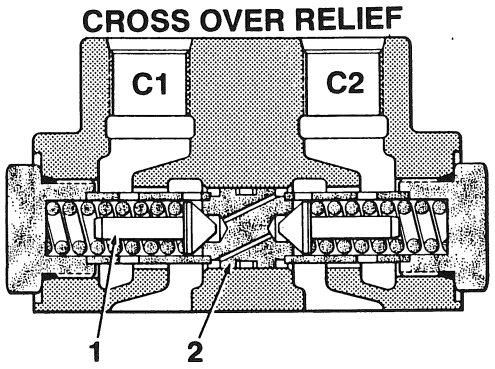
Proper torquing of the valve cartridges and coils will prevent internal distortion of the cartridge and ensure correct operation. When reinstalling a cartridge after service, dip it in clean oil and screw in **BY HAND** until the top o-ring contacts the valve body. **Torque to the following values:**

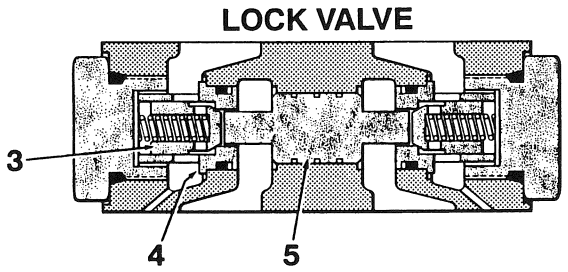
	Cartridge	Coil
Unloader Cartridge	35 ft.lbs 48 N.m 484 kgf.cm	5 ft.lbs 7 N.m 69 kgf.cm
Directional Cartridge	25 ft.lbs 34 N.m 345 kgf.cm	5 ft.lbs 7 N.m 69 kgf.cm

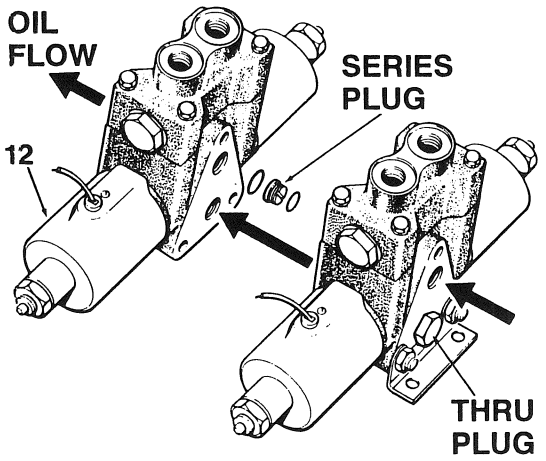


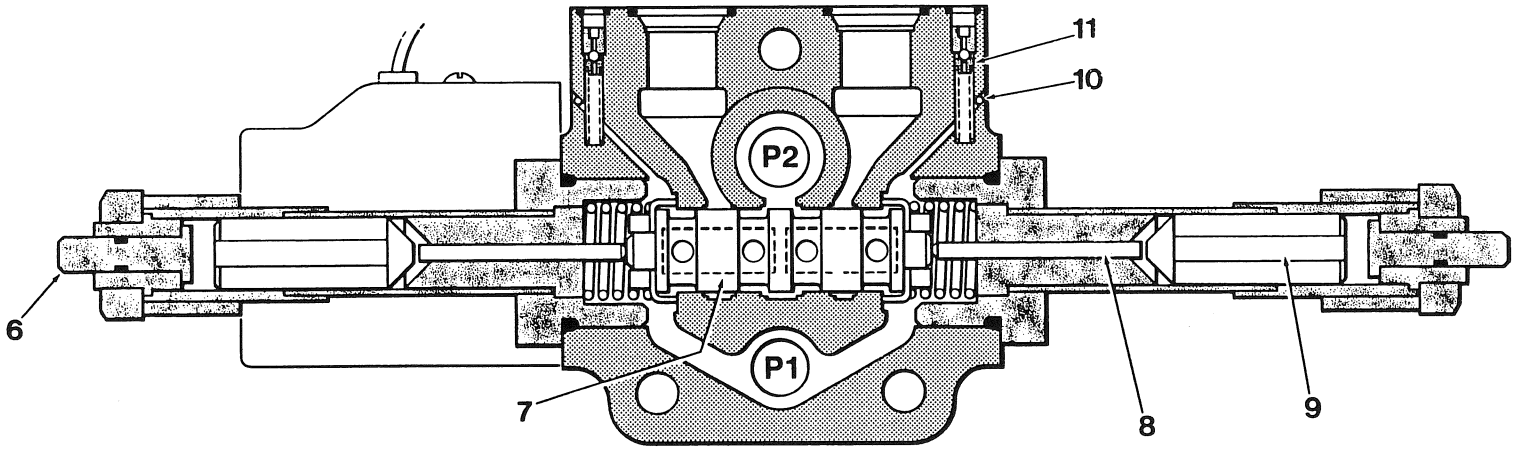
ISO Schematic - Solenoid Valve

Attachments:
Up to S/N 22687
Articulation:
Up to S/N 22131









DIRECTIONAL WITH INTEGRAL
THERMAL RELIEF VALVES

LEGEND

1. Poppet
2. Crossover poppet seat
3. Check Poppet
4. Lock Valve Cage
5. Pilot Piston
6. Manual override Plunger
7. Spool
8. Pin
9. Plunger
10. Plug
11. Thermal Relief Assembly
12. Solenoid Coil

Solenoid operated valves are used to control articulation and most attachments. Depending on the use, the valve configuration can vary.

When the valve is in neutral with both solenoids de-energized, the spool is centered. Oil enters **P-1** and splits left and right, flowing through the hollow portions of the spool and exits through **P-2. (NOTE:** Oil could enter at **P-2** and exit at **P-1** but cylinder operation would be reversed). Since these valves are used in series, the through port must be plugged by an O-ring plug.

If the left-hand solenoid is energized, the spool is moved to the left, directing oil from **P-1** up the right-hand passage to the lock valve. Pressure opens the right-hand check poppet and moves the pilot piston to the left which unseats the left-hand check poppet. Oil then continues up the right side flowing through the crossover relief valve and out **C-2**. Oil exiting the cylinder enters at **C-1**, flows through the crossover relief valve and the now open lock valve. Oil enters the left-hand section of the hollow spool and exits the valve assembly at **P-2**.

CROSSOVER RELIEF SECTION

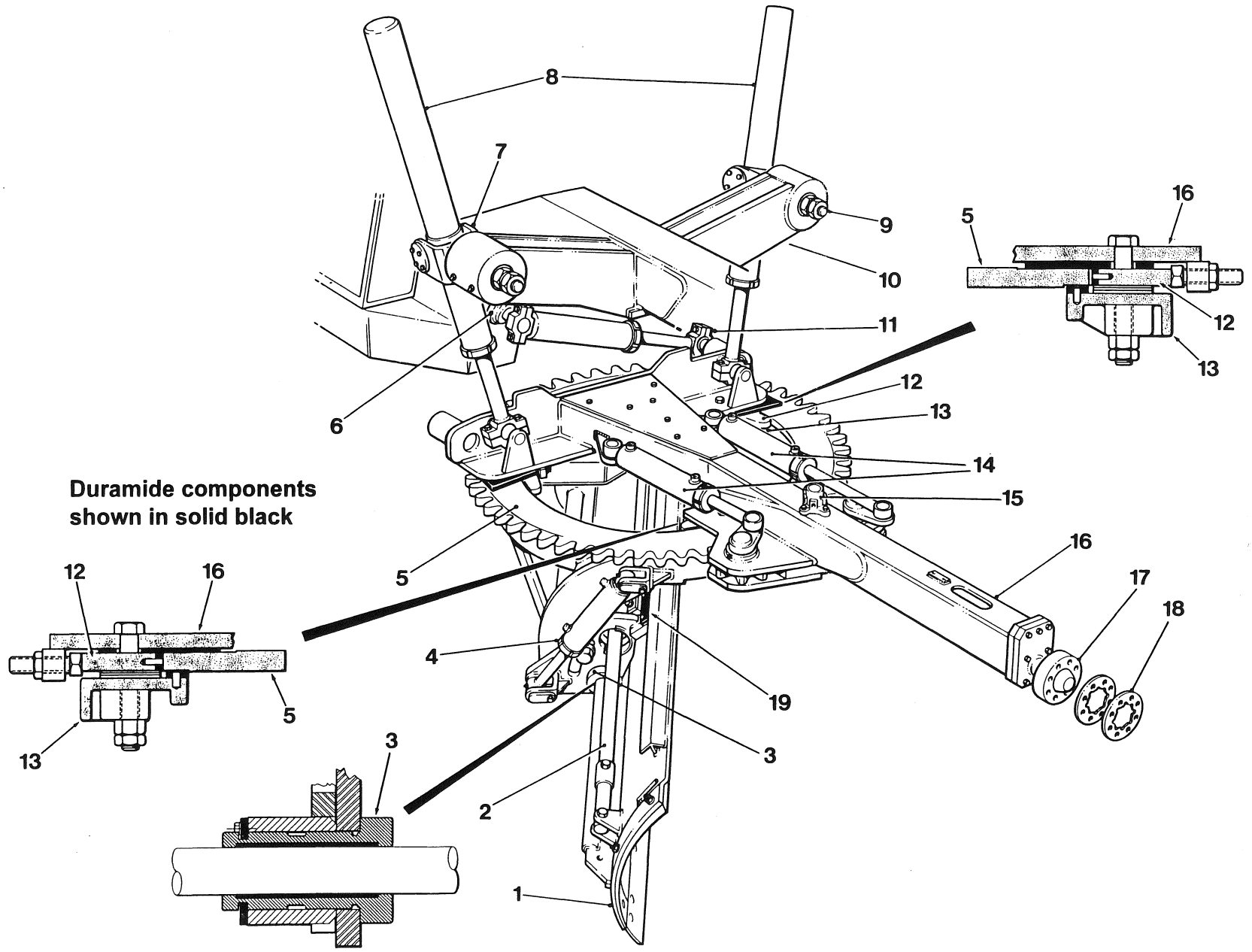
If a shock load occurs, the high pressure oil is transferred to the low pressure side, reducing the stress on other components. The relief setting of 3100 psi is shim adjustable. This valve section is similar in operation to the cushion valve discussed on Page 19.

LOCK VALVE SECTION

When the directional control section is in neutral, the lock valve traps oil in the cylinder. This prevents articulation 'wandering' or a ripper slowly being forced up. Two different peg sizes are available on the pilot piston. Generally the larger peg size is used in articulation valve assemblies. Although this slows the speed of articulation slightly at high rpm, it prevents valve chatter (rapidly opening and closing lock valves) at low rpm by slightly increasing back pressure.

DIRECTIONAL CONTROL SECTION

Non-adjustable thermal relief valves are incorporated into the body. Whenever trapped oil pressure exceeds 3500 psi due to thermal expansion, oil is vented into the main hydraulic system. On graders prior to **S/N 20719** the thermal relief valves were external and vented to the atmosphere. Casting differences do not allow component interchangeability.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Duramide components
shown in solid black

LEGEND

1. Moldboard
2. Slide Shift Cylinder
3. Slide Tube - with Duramide
4. Power Tilt Cylinder *
5. Circle
6. R.H. Shift Cylinder Anchor
7. Stirrup
8. Blade Lift Cylinders
9. Stirrup Nut/Lock Nut
10. Fixed Point Hi-Lift Arm
11. Circle Shift Cylinder
12. Guide Plate - with Duramide
13. Clamp Plate - with Duramide
14. Circle Turn Cylinders
15. Timing Valve
16. Drawbar
17. Drawbar Ball Stud
18. Ball Stud Shims
19. Slide Bearing -with Duramide

** Models 710/710A feature one centre mounted tilt cylinder.*

The standard duty Fixed Point Hi-Lift as equipped on models 710 thru 740A is illustrated. Models 750A & 780A use the heavy duty circle moldboard blade lift assembly. Its' heavier construction is required for mining and forest industry applications. Five sets of guide and clamp plates are used however, the set-up principle is the same.

The circle, drawbar, moldboard assembly is the working area of the grader. Long life and good performance depend on proper adjustment, lubrication and maintenance. Carefully follow the lubrication chart and Operator's Manual to perform these tasks.

Duramide circle support bearings are standard on all models. Duramide's nonmetallic composition provides reduced maintenance, extended life, and an easier turning circle. Duramide assemblies can be easily interchanged with metallic components with the benefit of retaining the same set up procedures.

A properly adjusted circle has the front guide plate(s) tight against the circle. The two rear guide plates must have .040" - .080" clearance between the circle.

To keep the blade properly adjusted, all excessive "free play" must be taken out of the assembly. This may be done by removal of shims from between the guide and clamp plates, drawbar ball stud, and cylinder ball caps.

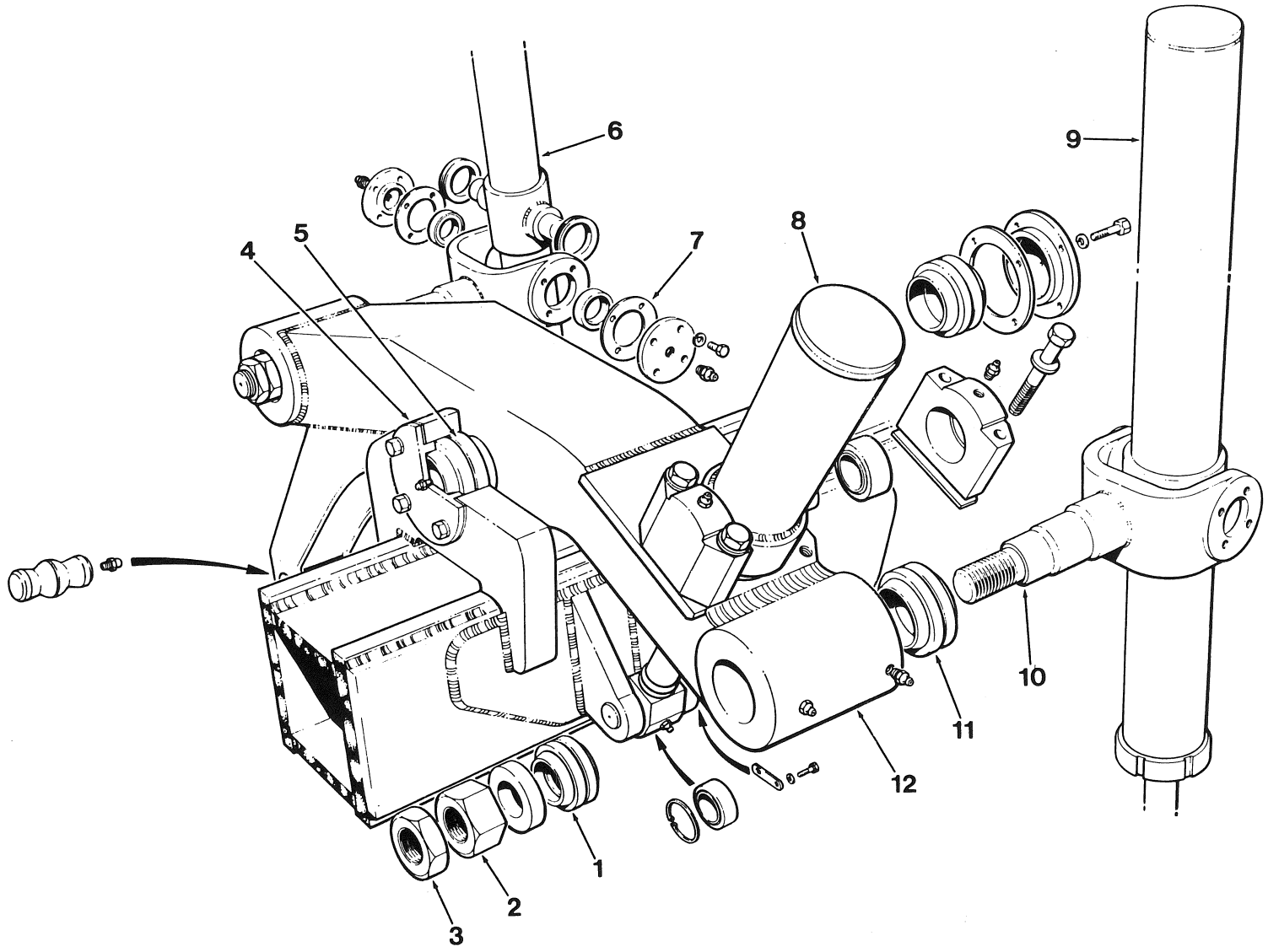
NOTE: Ball caps are a matched set and cannot be interchanged or reversed.

Excessive 'free play' of the moldboard affects blading tolerance. It may be removed from the slide rails by replacing slide castings and/or shimming upper slide rail bearings. Always slide the moldboard end-to-end to check for binding after any adjustments.

Any visible movement of the stirrup shank or trunion bushings indicate adjustment is required. Seat the stirrup shank bearing by torquing the stirrup nut to 250 ft.lbs, then back-off the nut and re-tighten to 50 ft.lbs. Tighten the locknut to 400 ft.lbs. while holding the stirrup nut. The trunion bushings have a preload sufficient to require 15-25 lbs. on the top of the cylinder to move the cylinder in the stirrup. Adjust this preload by adding or removing shims. Always inspect the V-Ring seal on the trunion for damage and replace as necessary.

Lubrication is required on the circle top surface, inner surface and underside where the clamp plates support the circle, regardless of whether the circle is supported by Duramide or metallic guide and clamp plate assemblies. Recommended lubrication is a coating of spray graphite dampened with diesel fuel. Grease or molycoat may be used in some operating conditions. Fresh lubricant should be applied only after cleaning the surface. Do not allow a build up of dry lubricants.

Refer to the Shop Manual for specifications.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3

LEGEND

1. Bushing
2. Adjusting Nut
3. Lock Nut
4. Shims
5. Bushing
6. L.H. Blade Lift Cylinder
7. Shims
8. Lock Cylinder
9. R.H. Blade Lift Cylinder
10. Stirrup Yoke
11. Bushing
12. Over Frame Arm

The Moveable Point Blade Lift System is optional on models 710 thru 740A. The Fixed Point Hi-Lift System is standard on all models and is the only system available on models 750A & 780A. The Moveable Point Blade Lift System is available for applications where extreme reaches are required.

COMPONENTRY

Champion's Moveable Point Blade Lift System consists of three major components.

The Over Frame Arm rotates on a pin and bearing assembly welded directly to the top of the frame. Controlled from the cab, the arm is hydraulically rotated over an infinite range of positions through 70°.

The Arm Lock Cylinder is mounted to the frame and extends through the over frame arm. By activating the control lever in the cab, the arm lock cylinder repositions the arm through its 70° arc. The cylinder locks the arm in position when the desired angle is attained. A counterbalance valve prevents cylinder drift and cavitation when extending the cylinder.

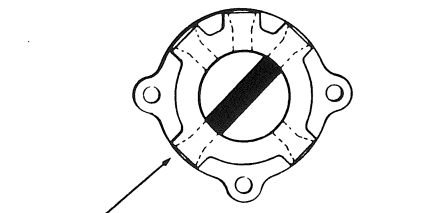
The Circle Side Shift Cylinder is mounted directly between the circle drawbar and the over frame arm. Functioning similarly to other fixed or moveable point blade lift systems, the circle side shift provides lateral movement of the circle. However, the circle side shift on Champion's Moveable Point Blade Lift System permits movement either left or right without a mechanical change to the circle side shift cylinder or the use of a latch/detach mechanism.

ADJUSTMENTS

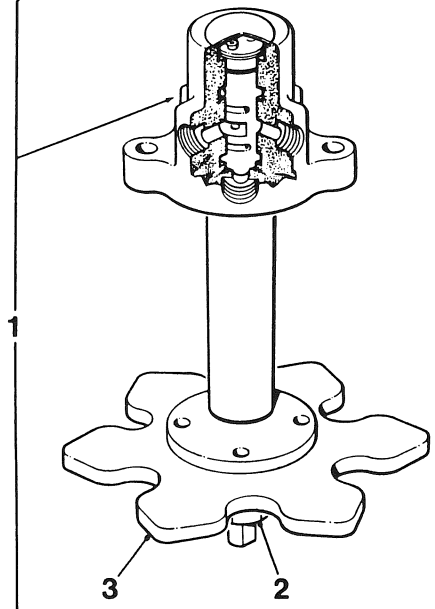
The stirrup bearing adjustment procedure is similar to the fixed point system, as is the blade lift cylinder trunion bushing adjustment.

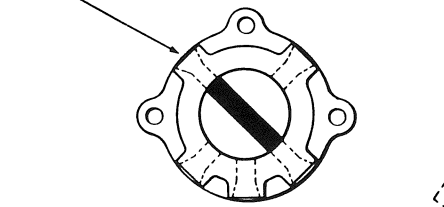
The over frame arm pivot bearings are shim adjustable. The clearance specification is .002" - .007" on both sides.

Refer to the Shop Manual for specifications.

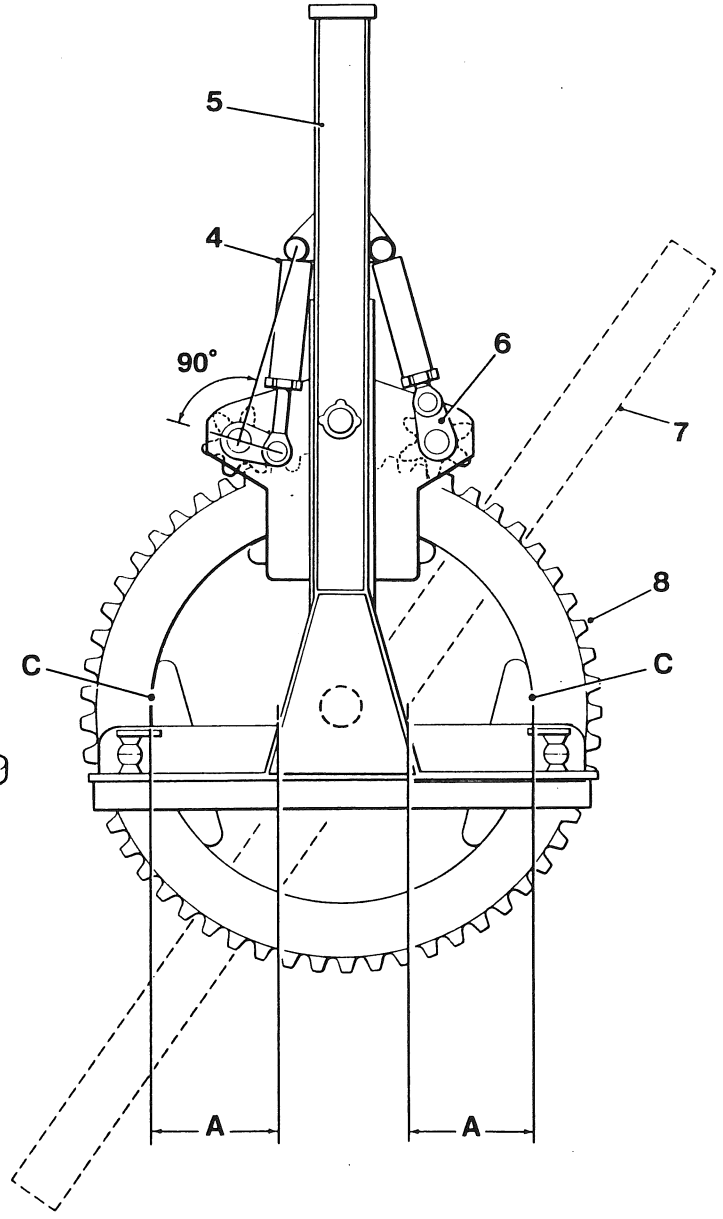


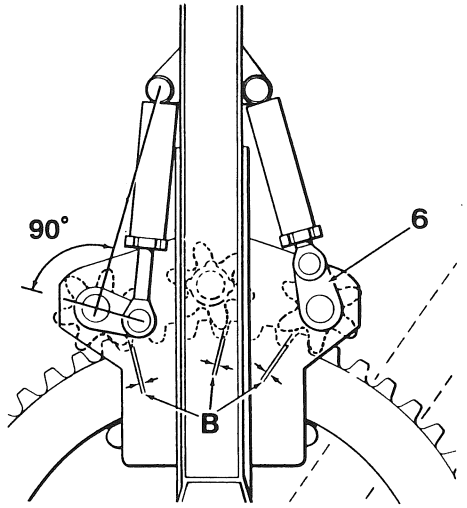
DETAIL 'EE'



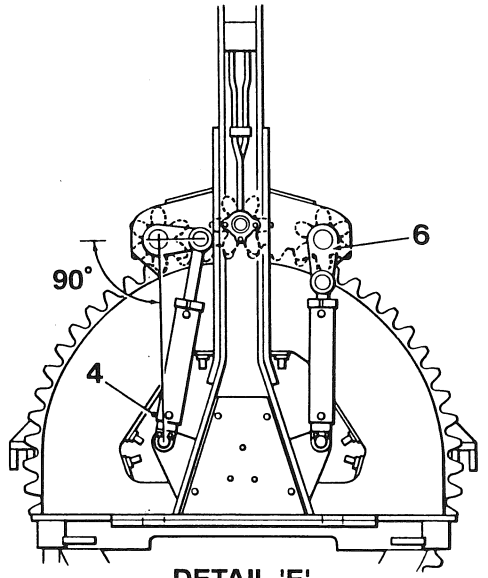


DETAIL 'DD'





DETAIL 'D'



DETAIL 'E'

LEGEND

1. Circle Timing Valve
2. Timing Shaft Lock Nut
3. Timing Valve Pinion
4. L.H. Circle Turn Cylinder
5. Drawbar
6. R.H. Circle Turn Crank
7. Moldboard
8. Circle

A. Centering Dimension
B. Tooth Clearance
C. Horizontal Clearance
D. Forward Mounted Circle Turn Cylinders
DD. Cross Section of Valve Showing Blocked Forward Left Port
E. Rear Mounted Circle Turn Cylinders
EE. Cross Section of Valve Showing Blocked Forward Right Port

The Champion grader uses two hydraulic cylinders in conjunction with a timing valve to turn the circle. This system is the strongest in the industry for turning and holding power. The circle must be kept properly adjusted through regular maintenance for smooth operation and long life. If the circle fails to turn smoothly, one of the corrective measures is re-timing.

To time the circle there is a three step procedure. Follow this procedure whenever the timing is checked or whenever the circle is adjusted.

STEP 1

CENTRE THE CIRCLE TO THE DRAWBAR

Measure the distance from the inside lip of the circle to the side of the drawbar on both sides. These measurements should be approximately equal as indicated by dimension **A**. Note that this is only a starting point.

Setting drive pinion to circle clearance:

A) **Graders with flat tips on the circle teeth:** adjust the guide plates until .040" - .080" back lash clearance is between the drive pinion and circle teeth, as indicated by dimension **B.**

B) **Graders with round tips on the circle teeth:** adjust the guide plates until .060" - .120" root to tip clearance is between the drive pinion and circle teeth.

In either version, the timing valve pinion should have the same clearance as the circle to drive pinions. If not, check for wear on the drive pinion teeth. Adjust the rear guide plates to obtain the specified clearance at the circle. See detail **C**.

STEP 2

POSITION THE CYLINDER AND CRANKS

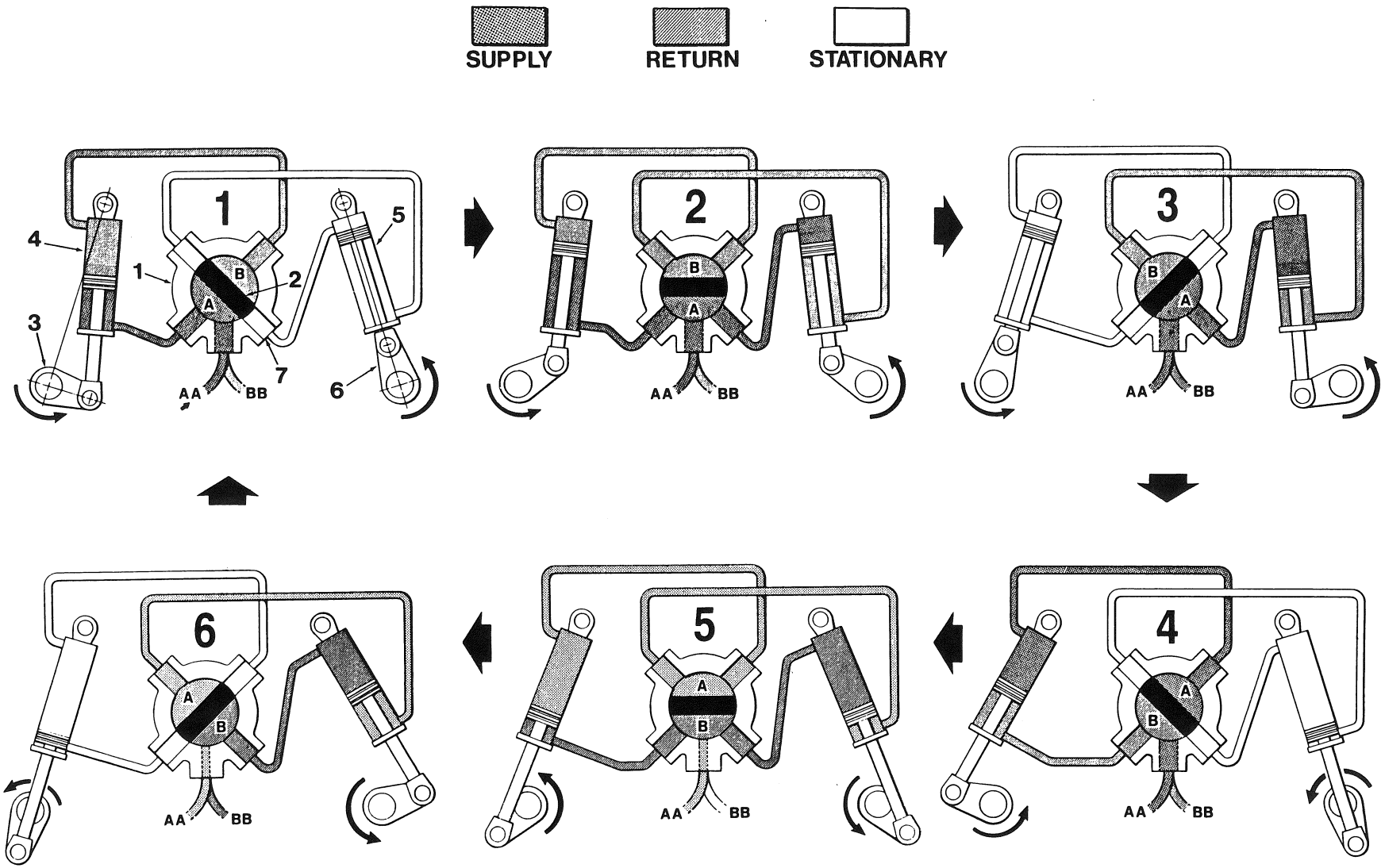
Fully retract the right hand cylinder so that a straight line intersects all three pivot points. Ensure the left-hand cylinder and crank is towards the drawbar. Position the cylinder so that a straight line, drawn between the centre of the cylinder anchor and the centre of the crank shaft will form a 90° angle with a line drawn through the centres of both the crank shaft and pivot. This set-up is very important and applies to both orientations of circle turn cylinders. See details **D** and **E**.

STEP 3

SET THE TIMING VALVE

After relieving all hydraulic pressure, locate and remove the hose and fitting from the port on the timing valve as shown in details "DD" or "EE". Looking inside, the spool must completely block the timing port as shown. If adjustment is required, loosen the timing pinion shaft lock nut and rotate the shaft until the spool completely blocks the port. Secure the lock nut and ensure the spool did not move. Replace the fitting and hose.

Refer to the Shop Manual for specifications.


SUPPLY
RETURN
STATIONARY
1
2
3
4
5
6
A
B
AA
BB
1
2
3
4
5
6
7

LEGEND

1. Timing Valve Body
2. Centre Land of Timing Spool
3. L.H. Crank
4. L.H. Circle Turn Cylinder
5. R.H. Circle Turn Cylinder
6. R.H. Crank
7. Timing Port

To understand the theory of Champion's circle turn system it is important to know the following:
The L.H. cylinder and crank is always 90° out of phase to the right and due to the internal porting of the circle turn valve:

- Port **AA** is always connected to cavity **A**
- Port **BB** is always connected to cavity **B**

Regardless of which circle turn cylinder orientation is on your grader, the principle of operation remains the same. The following series of illustrations will show what happens when the circle turn lever is pulled back, turning the circle clockwise from the timing position, e.g. oil enters port **AA**.

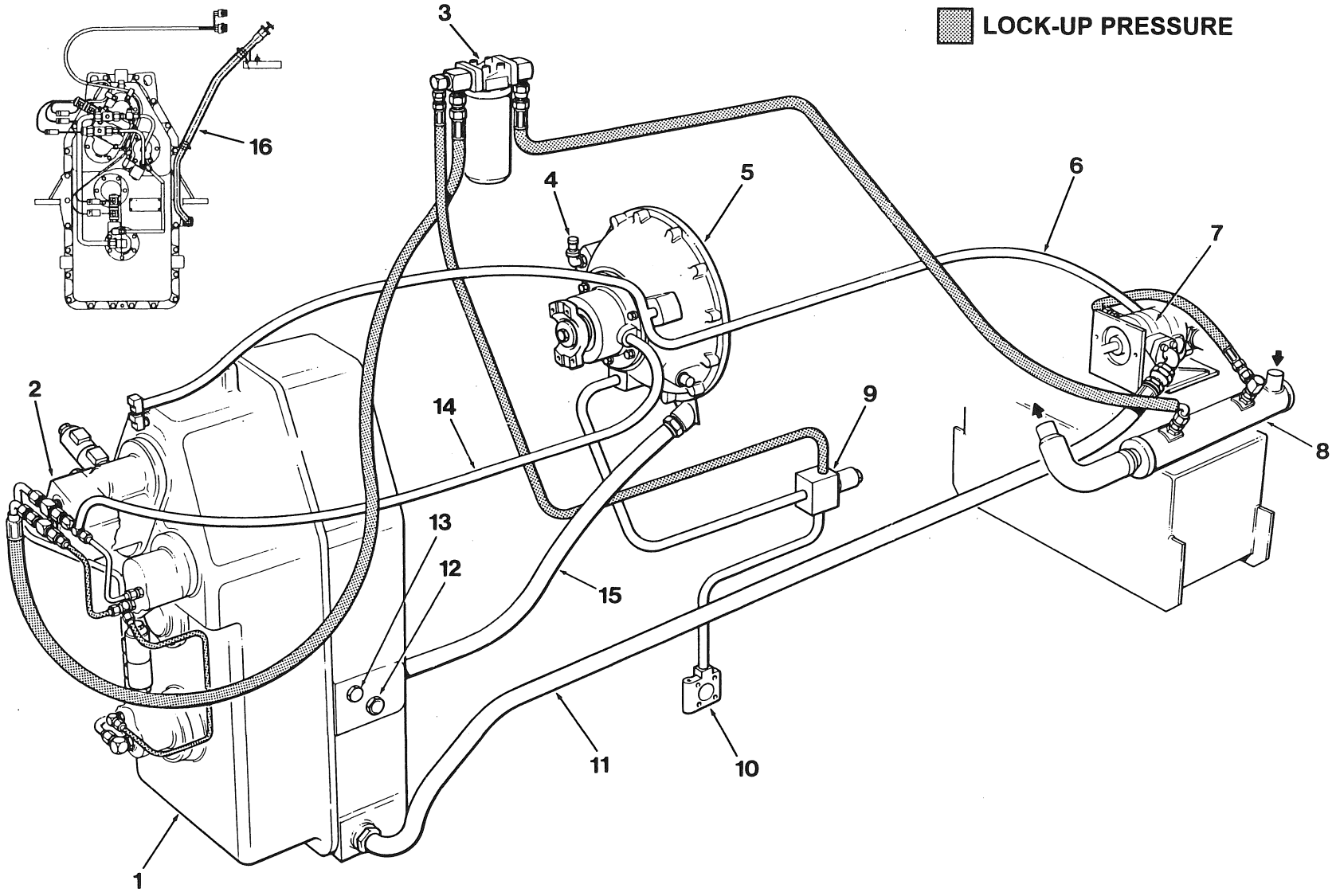
In diagram **1**, the cylinders and timing valve are in the circle timing position. The R.H. cylinder is fully retracted and cannot provide any useful force. The L.H. cylinder is half way through its stroke, and at the maximum torque angle. It is capable of turning the circle (under load) by itself. The timing valve spool is positioned so that 100% of the oil flow entering at **AA** is directed by cavity **A** to the rod end of the L.H. cylinder. The L.H. cylinder retracts, driving the circle clockwise which also turns the timing valve spool and R.H. cylinder to position **2**.

In diagram **2** the rotated spool permits oil to flow to the base end of the R.H. cylinder which extends and assists the left hand cylinder to turn the circle. Oil exiting the cylinder enters cavity **B** of the timing valve and exits through Port **BB**.

As long as the circle turn lever is pulled back, the assembly rotates to diagram **3** which is 90° from diagram **1**. The R.H. cylinder is now turning the circle by itself as the L.H. cylinder is straight and momentarily at rest. The timing valve spool has blocked the ports leading to the L.H. cylinder.

In Diagram **4**, the cylinders and timing valve are positioned 180° from diagram **1**. Oil still enters at Port **AA** and flows through the internal porting of the valve to the base end of the L.H. cylinder which extends, driving the circle clockwise.

Follow the oil flow in diagrams **5** and **6** to understand the sequence.


LOCK-UP PRESSURE
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15
16

LEGEND

1. Model 8400 Transmission
2. Pressure Regulating Valve
3. Oil Filter
4. Transmission Clutch Breather
5. Clutch Housing
6. Pump Vent Line
7. Transmission/steering Pump
8. Transmission Cooler
9. Shift Cylinder Control Valve
10. Final Drive Lock/Unlock Shift Cylinder
11. Pump Suction Line
12. Fluid Level Sight Glass
13. Transmission Filler Plug
14. Clutch Lubrication line
15. Clutch Drain Line
16. Transmission Filler Tube

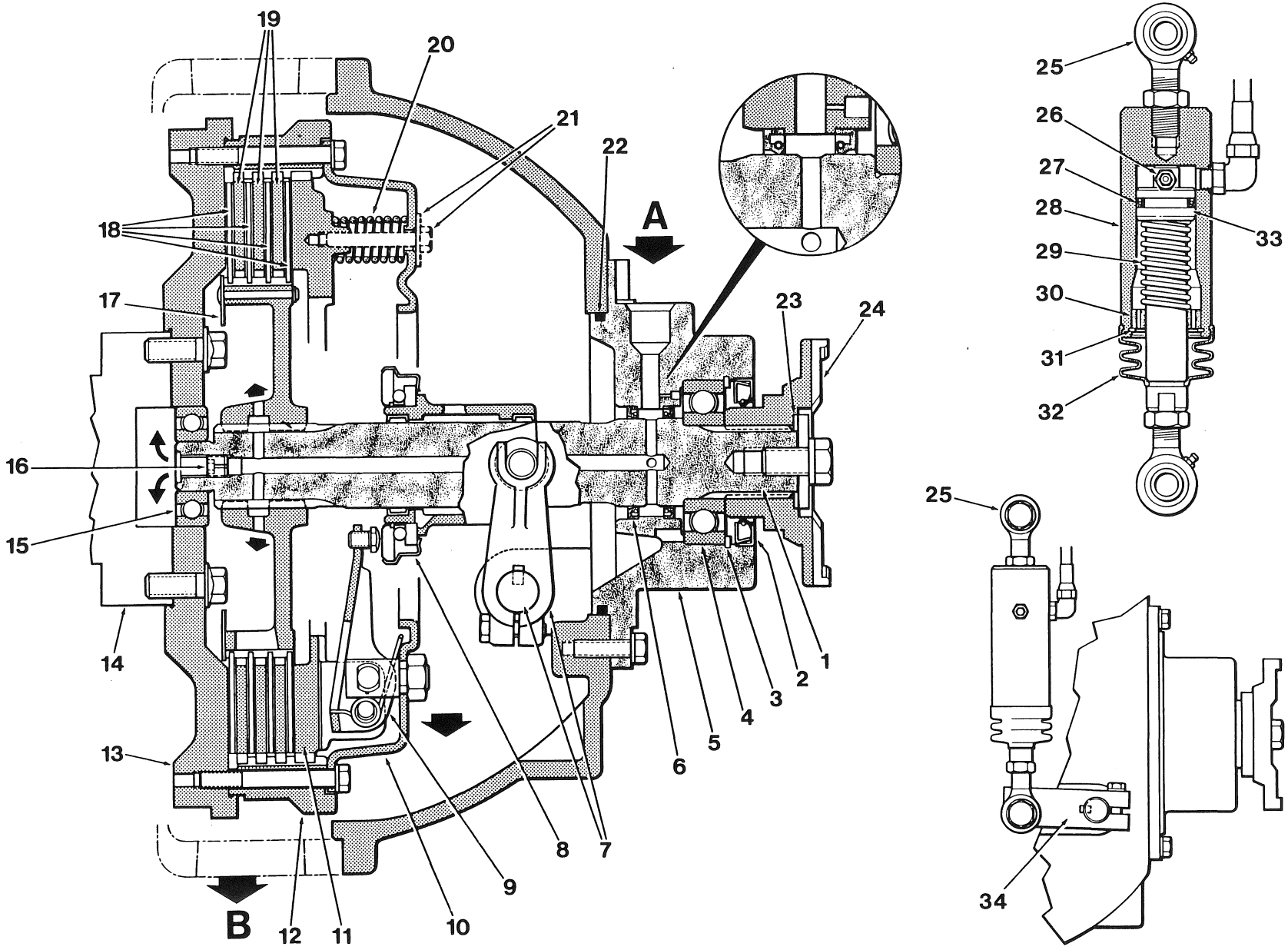
Oil is supplied to the transmission, engine clutch and differential lock/unlock circuit by one section of the transmission/steering pump. The pump is located below the radiator and is driven by the engine's crankshaft unless the grader is an All Wheel Drive model, then the pump is driven from the right side of the pump drive gearbox. The oil in this circuit is completely separate from the oil of the hydraulic system.

Oil is drawn from the transmission sump directly into the pump. Oil leaving the pump enters an oil to engine coolant bundle type cooler. Coolant exiting the radiator passes through this cooler before entering the engine's water pump. This type of heat exchanger maintains a consistent temperature regardless of ambient temperature.

Oil then flows to the transmission oil filter. This is a special large capacity, spin-on type disposable filter with a 7 micron rating. A bypass valve is built into the filter head to allow cold oil to bypass the filter element if the pressure differential between the inlet and outlet exceeds 25 psi. If the filter is plugged by contamination the bypass valve will also open and allow unfiltered oil to continue to the transmission regulating valve. **Filter replacement at the recommended intervals is critical to transmission operation.**

Mounted on the front of the transmission is the transmission pressure regulating valve. This two stage valve regulates both lock-up and lubrication pressures. Oil first enters the lock-up section where pressure is controlled for use in the clutch pack lock-up circuits. Lock-up pressure affects the shift characteristics of the transmission. The remainder and majority of the oil enters the lubrication section where pressure for the lubrication circuit is controlled. Lubrication oil is used to cool and lubricate both the transmission and engine clutch. Lubrication oil then drains back into the transmission sump.

A small amount of oil is taken from a tee on the outlet of the filter head to operate the differential lock/unlock circuit. Oil flows through the control valve to the lock/unlock shift cylinder. Models 710 thru 740A use a single acting spring return lock cylinder while models 750A & 780A use a double acting cylinder with spring assist.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34

LEGEND

Clutch Assembly

1. Clutch Shaft
2. Output Yoke Seal
3. Snap Ring
4. Clutch Shaft Bearing
5. Bearing Support Housing
6. Clutch Shaft Seals (Qty 2)
7. Cross Shaft and Yoke
8. Release Bearing
9. Clutch Fingers
10. Backing Plate
11. Pressure Plate
12. Adapter Drive Ring
13. Flywheel
14. Crankshaft
15. Pilot Bearing
16. Orifice Plug
17. Oil Deflector & Clutch Hub
18. Friction Plates (Qty 4)
19. Steel Spacers (Qty 3)
20. Clutch Springs*
21. Caging Capscrew & Washer (for clutch assembly servicing only)
22. O-Ring
23. Gasket
24. Output Yoke

Slave Cylinder Assembly

25. Rod End
26. Bleeder Screw
27. Piston Cup
28. Barrel
29. Spring
30. Gland
31. Snap Ring
32. Rubber Boot
33. Piston & Rod
34. Cross Arm Shaft

** 6BT5.9, 6CT8.3 and 6CT8.3 VHP - 12 springs • L10 - 15 springs*

OVERVIEW

The function of the clutch assembly is to disengage the driveline from the engine to facilitate smooth starts, stops and direction changes. The illustration here shows the clutch in the engaged position.

The engine clutch is spring applied and disengaged by a master cylinder/slave cylinder hydraulic circuit. Hydraulic oil returning from the steering circuit enters the clutch booster. When the operator depresses the clutch pedal, the booster utilizes this return oil to assist in pushing the master cylinder piston. The displaced fluid from the master cylinder causes the slave cylinder to extend and rotate the cross shaft. This causes the release bearing to move towards the flywheel and contact the clutch fingers which, through a lever action, pull the pressure plate away from the clutch plates. This disengages the clutch drive mechanism.

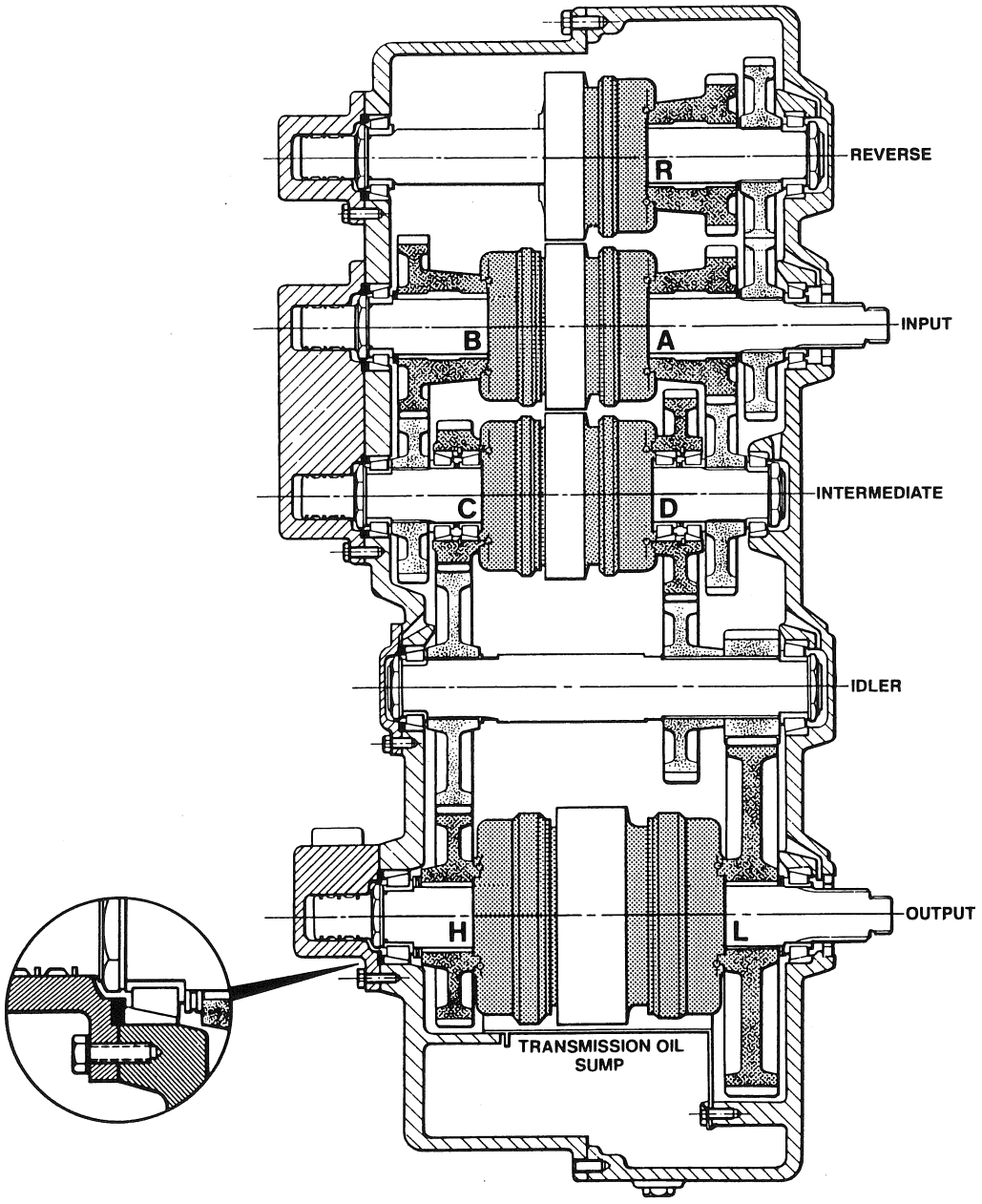
Oil is used to lubricate the bearings and to cool the clutch plates. Oil from the transmission lube circuit enters at point **A** (shown on top for illustrating purposes only). The oil is directed into the clutch shaft by two lip seals and into the clutch shaft bearing through a drilled passage. Some oil flows through the orifice plug to lubricate the pilot bearing. The majority of oil collects in the clutch hub where under centrifugal force, it flows outward through the clutch plates providing a cooling effect. The release bearing receives splash lubrication. All oil drains down into the sump and then returns to the transmission at point **B**.

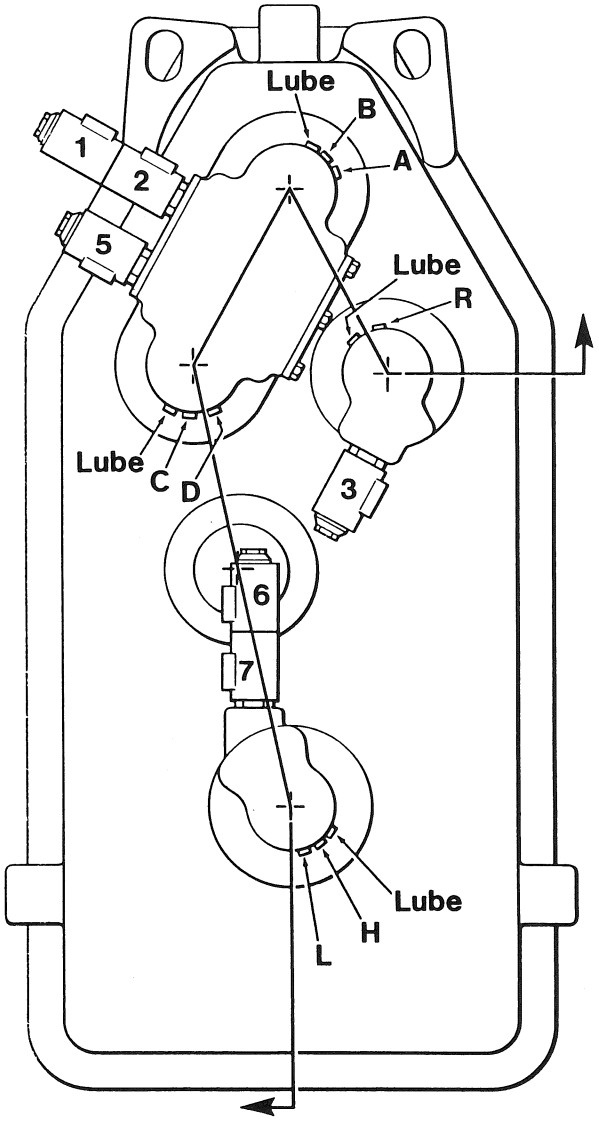
ADJUSTMENTS

Since the cross shaft arm and yoke have the same effective length, the distance the slave cylinder extends until a resistance is felt represents the clearance between the release bearing and the adjustment screws on the clutch fingers. Check the clutch slave cylinder adjustment weekly. The specified clearance is:

3.20mm to 3.80mm
0.125" to 0.150"
1/8" to 5/32"

As the clutch plates wear through normal use, this clearance will become smaller. Adjustments can be made at either end of the slave cylinder. Shorten the slave cylinder assembly to increase clearance; lengthen to decrease clearance. Since the slave cylinder is hydraulic, a bleeder screw is provided. Always remember to check the clutch pedal linkage free play as well.


REVERSE
R
INPUT
B
A
INTERMEDIATE
C
D
IDLER
OUTPUT
H
L
TRANSMISSION OIL
SUMP


Lube
B
A
1
2
5
Lube
R
Lube
C
D
3
6
7
Lube
H
L

OVERVIEW

The 8400 transmission was developed to provide an 8 speed forward, 4 speed reverse full powershift transmission for grader applications. It was designed with a wide ratio spread of 10.35:1 between first and eighth speeds. The eight speeds were carefully selected to match the engine's power curve, providing an even increase in road speed with each upshift. Seventh and eighth speeds provide an overdrive ratio since output shaft speed is greater than input speed. It's simple operation and construction make it easy to troubleshoot and repair. As part of the modular powertrain, the transmission is easy to remove from the grader as no other powertrain components need to be disturbed.

Shifting is accomplished by an electronic controller which completes the ground circuit to combinations of the four solenoid valve cartridges. A digital display informs the operator of which gear they are in as well as monitoring the electrical system to provide diagnostic information for troubleshooting.

CONSTRUCTION

The cast iron housing is vertically split to ease assembly and disassembly and allow complete access to all seven clutch packs and the idler shaft. Each of the five shafts are supported by tapered roller bearings to handle the end thrust created by helical gearing. The A/B,C/D and R shafts have .002"-.007" shim adjustable end float while the idler and L/H shafts have .000"-.005". Shims are piloted in the counterbores of the collector caps. The size of the clutch packs along with the number of friction discs and separator plates varies according to the torque loading of the packs. See **Chart 1**.

OPERATION

To provide power flow through the transmission, three of the seven clutch packs must be locked up (engaged). Power flow must travel through 5 shafts when in reverse compared to 4 when in forward. This accomplishes the directional change of power. **Chart 2** shows clutch packs locked up vs. speed as well as which reverse gears correspond to which forward gears.

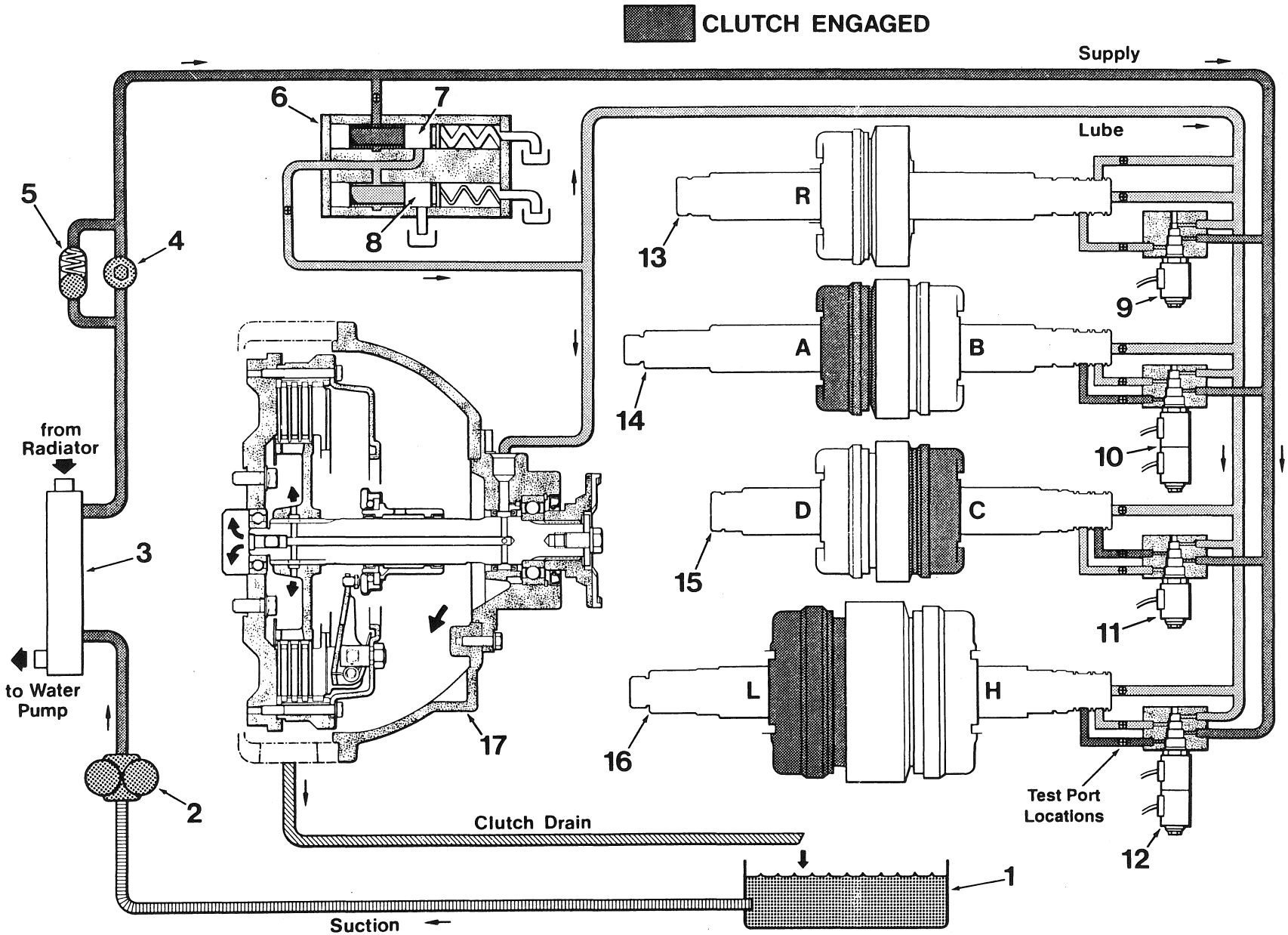
Chart 1

CLUTCH PACK	DIAMETER	PLATES	DISCS
R	5 1/4"	10	11
A	5 1/4"	10	11
B	5 1/4"	10	11
C	5 1/4"	12	13
D	5 1/4"	12	13
L	6 5/8"	10	11
H	6 5/8"	8	9

Chart 2

GEAR	FORWARD	REVERSE	RATIO
F1/R1	ACL	RCL	7.317:1
F2	BCL		5.236:1
F3/R2	ADL	RDL	3.777:1
F4	BDL		2.703:1
F5/R3	ACH	RCH	1.916:1
F6	BCH		1.369:1
F7/R4	ADH	RDH	.987:1
F8	BDH		.707:1
N	C	C	

NOTE: The cutaway illustration shows the reverse shaft above the input shaft, when in fact it is not. This has been done for illustrative purposes only. The right hand illustration shows the location of the cutting plane, pressure test ports and four solenoid cartridge valves.



FIRST FORWARD SHOWN

LEGEND

1. Transmission Case
2. Transmission/Steering Pump
3. Oil/Water Cooler
4. Filter Assembly
5. Filter Bypass Valve
6. Pressure Regulator Valve
7. Lock-up Pressure Spool
8. Lube Pressure Spool
9. R Cartridge Valve
10. A/B Cartridge Valve
11. C/D Cartridge Valve
12. L/H Cartridge Valve
13. Reverse Shaft
14. Input Shaft
15. Intermediate Shaft
16. Output Shaft
17. Engine Clutch

Transmission oil is drawn from the transmission's sump by the pump and passes through the cooler and filter assembly. Oil is then directed to the 2 stage transmission regulator valve. The first stage sets clutch pack lock-up pressure to 215-235 psi. Once this pressure is reached, the lock-up pressure spool uncovers a passage to the second stage which controls lubrication pressure to a maximum of 25 psi. Should this pressure be exceeded, the lubrication pressure spool uncovers a passage to the transmission sump. Accepted minimum pressure for lubrication is 5 psi. The lock-up pressure section contains 2 springs while the lubrication section has one. Both are shim adjustable.

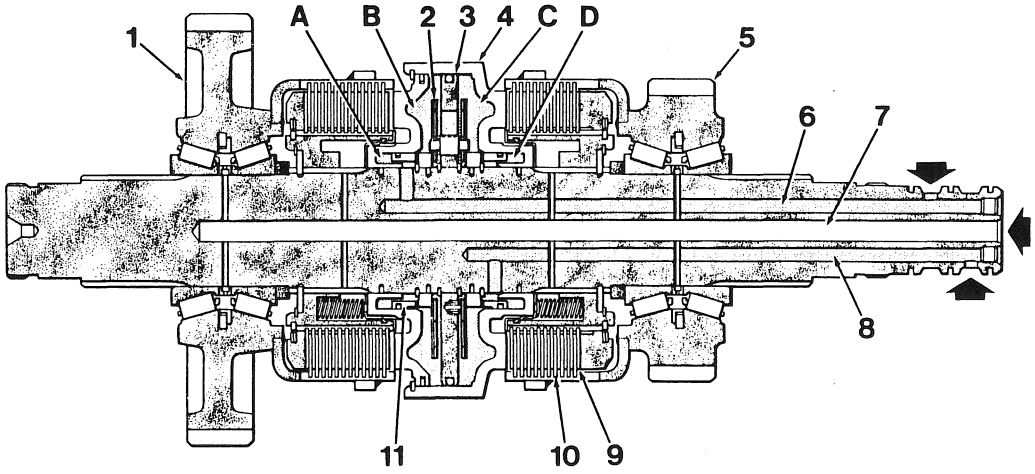
Whenever the engine is running, lubrication oil goes through the centre passage of each transmission shaft as well as to the engine clutch. This supplies oil to lubricate and cool all bearings and friction plates. Having done this, the oil drains back into the transmission sump. Lubrication pressure is also supplied to the four solenoid valve cartridges. Whenever a clutch pack is not applied, the valve directs oil at lubrication pressure to the lock-up cavity. This keeps the cavity full of oil to ensure rapid clutch pack lock-up.

Along with lubrication pressure, lock-up pressure is supplied to the solenoid valve cartridges. With the exception of the C clutch pack, the solenoids block lock-up pressure to the packs until energized. The C clutch pack is always engaged, even in neutral, until the controller energizes the D solenoid.

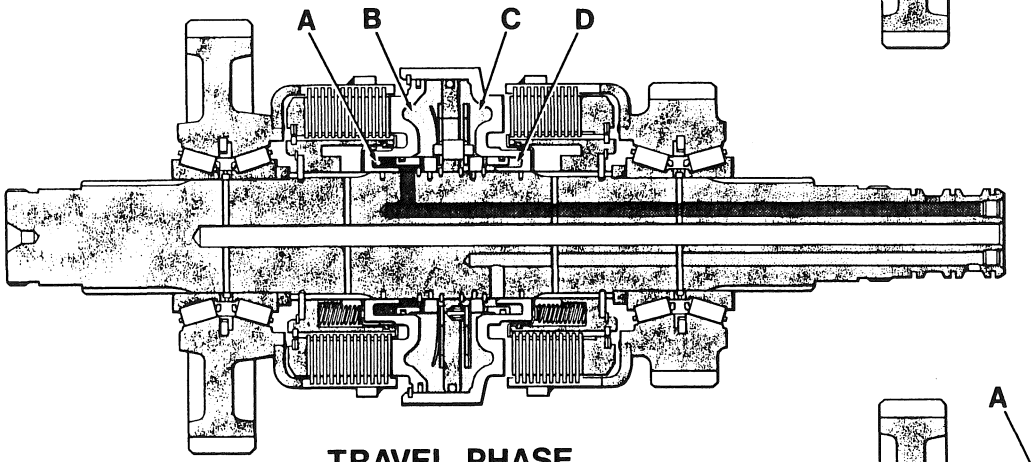
When the operator moves the mode lever out of neutral, the electronic controller energizes the appropriate solenoids by completing their ground circuits. To obtain first gear forward, the operator moves the pulser lever to indicate 1 on the display. With the mode lever in forward, the controller energizes the A and L coils. This combination of clutches, A-C-L, provides the lowest gear ratio available and results in first gear forward.

When the operator wishes to increase speed, he pushes the pulser lever forward to upshift the transmission. Each movement increments the speed by one gear. The controller automatically selects the correct solenoids for the particular gear selected.

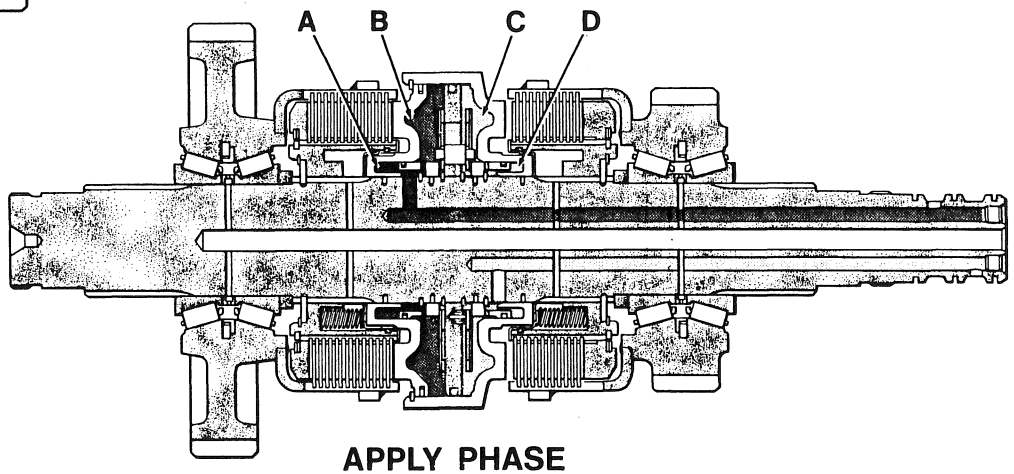
Whenever the mode lever is in reverse the digital display will show a "-" in front of the gear. For example, when first reverse is selected by the operator, the display will show -1. The controller energizes the R and L coils. This combination of clutches, R-C-L, provides the lowest reverse gear ratio available and results in first gear reverse.



NEUTRAL PHASE



TRAVEL PHASE



APPLY PHASE

LUBE PRESSURE

LOCK-UP PRESSURE

LEGEND

1. High Gear
2. Disc Valve (2 Parts)
3. Separator Plate
4. Lock-up Piston
5. Low Gear
6. High Clutch Oil Passage
7. Lubrication Oil Passage
8. Low Clutch Oil Passage
9. Friction Disc
10. Steel Drive Plates
11. Accelerator Piston

A. High Gear Accelerator Piston Cavity
B. High Gear Lock-up Cavity
C. Low Gear Lock-up Cavity
D. Low Gear Accelerator Piston Cavity

Hydraulic clutch packs consist of one set of bronze-faced friction discs, splined to a rotating shaft and one set of steel plates retained in a drum and gear assembly by means of external tangs. The drum and gear are allowed to rotate independently of the shaft by mounting them on a bearing. The discs and plates are alternated in the pack so that two of the same type are not located side by side. By squeezing these discs and plates together, we can effectively connect or lock the gear to the shaft. To perform this function an assembly similar to a hydraulic cylinder is used. The operation of the assembly is detailed below.

NEUTRAL PHASE

Lube oil is fed to both sides of the clutch pack by the high and low[1] oil passages. At all times oil at lube pressure flows down the centre lubrication passage and through cross drillings to lubricate the bearings and cool the clutch discs in both packs.

TRAVEL PHASE

Travel phase begins when the solenoid valve is energized to engage high clutch. This delivers oil at lock-up pressure down the high clutch oil passage into the high gear accelerator piston cavity. Lube oil is fed down the low clutch and lubrication oil passages. As pressure builds within the accelerator piston cavity, the lock-up piston begins to move to the left. At the same time the accelerator piston pushes the guide pins and holds the low clutch disc valve open on the right side of the separator plate allowing oil to transfer through into the high gear lock-up cavity. This transfer of oil ensures the high gear lock-up cavity is quickly filled with oil.

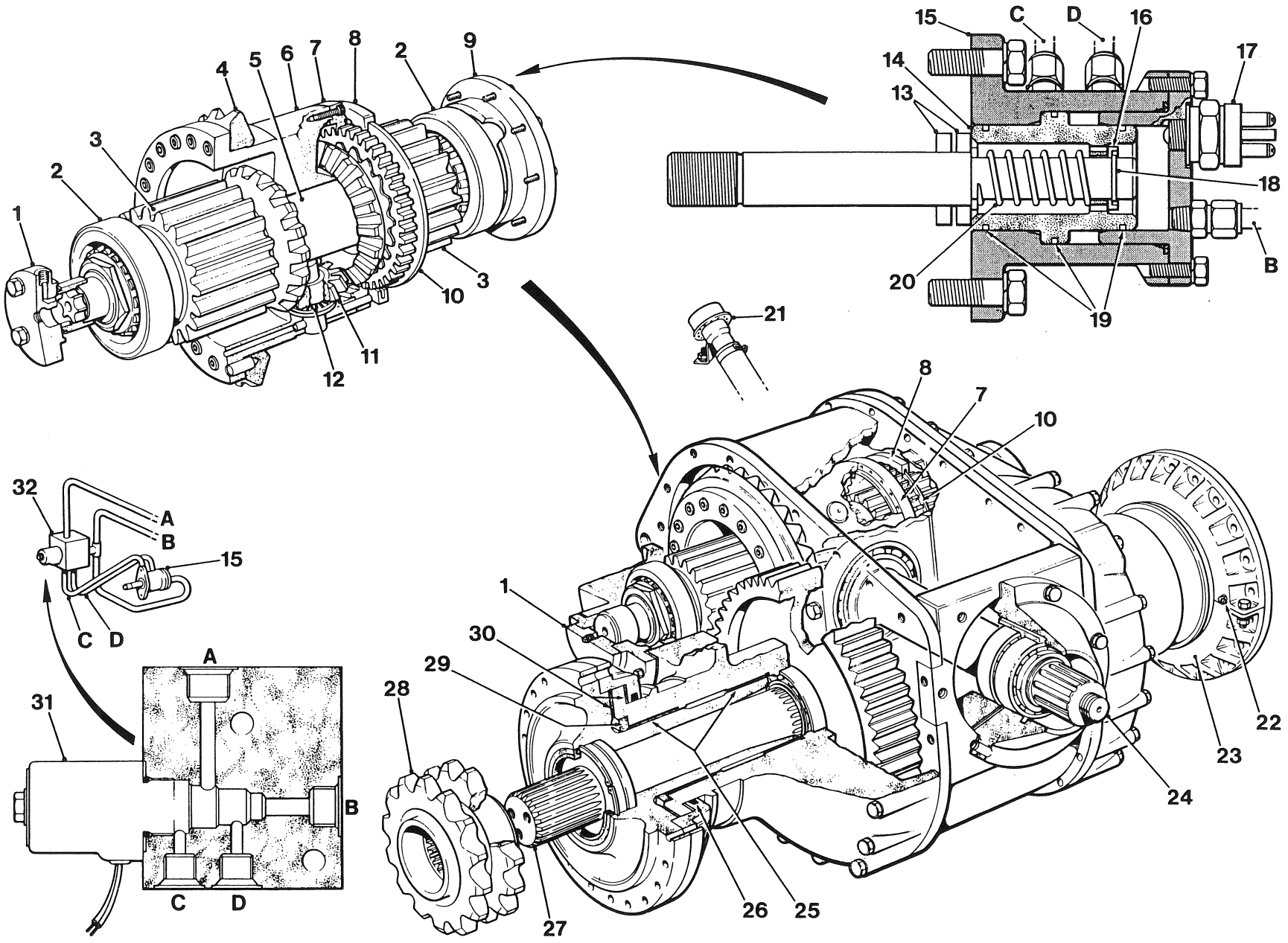
APPLY PHASE

At the end of the travel phase, pressure builds within the lock-up cavity due to oil entering via a small drilling in the accelerator piston. The disc valve closes and full lock-up pressure is achieved. The clutch pack will remain applied as long as lock-up oil pressure is directed to it. Very little oil is required to maintain lock-up.

To engage low clutch, low solenoid valve is energized directing lock-up pressure down the bottom passage, and lube oil down the top and centre passages.

The oil transfer between cavities is used to quicken lock-up and eliminate pressure drops while the clutch cavity fills. During the apply phase lock-up oil pressure in **B** is opposed by lubrication oil pressure in **C**. Both pressures must be maintained within specifications as the apply force is dependent upon the difference. Conversely, too high of an apply force can lead to friction disc damage.

[1] - *High and Low are used for the purpose of clarification only. The diagram is not representative of the actual High/Low shaft found in the 8400 transmission.*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26
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30
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32
A
B
C
D

LEGEND

1. Oil Pump
2. Taper Roller Bearing
3. Bull Spider Pinion
4. Ring Gear
5. Cross Shaft
6. Differential Hub
7. Shift Clutch Gear
8. Shift Fork
9. Cross Shaft Bearing Cap
10. Shift Clutch
11. Spider Gear
12. Bearing
13. Shift Rail Seals
14. Shift Piston
15. Shift Cylinder Body
16. Spring Retainer
17. Switch
18. Snap Ring
19. Hook Type Seal Rings
20. Spring
21. Vent
22. Grease Fitting
23. Half Ring
24. Pinion Shaft
25. Sleeve Bushings
26. Uniring Seal
27. Drive Axle
28. Drive Sprocket
29. Lip Seal
30. Thrust Plates
31. Shift Solenoid
32. Shift Valve

A - Pressure
B - Drain
C - Unlock Port
D - Lock Port

The double reduction final drive is used on models 750A and 780A graders, and incorporates a lock/unlock differential as standard equipment. The double reduction final drive is a positive drive gear box providing a gear reduction and a directional change of the power flow. The power enters on the pinion shaft and is transferred to the crown gear which is in turn, splined to the cross shaft. The cross shaft is supported by taper roller bearings, and also carries two bull pinions. The bull pinions mesh with twin bull gears which are supported by roller bearings.

Splined to the bull gear is a semi-floating drive axle (so named because it carries no weight). It is supported at the outer end by a double race, self-aligning roller bearing. The weight of the grader is transferred from the final drive to the tandem by means of the flanged sleeve which oscillates in two teflon-coated, steel-backed bronze bushings, pressed into the extension housing. This assembly is held together by the split ring, which allows oscillation, but prevents lateral movement of the flanged sleeve in the bushings. Differential lock/unlock allows both maximum traction in the locked position and minimum turning radius in the unlocked position. Normal operating position should be locked. An indicator light in the cab energizes when the differential is unlocked.

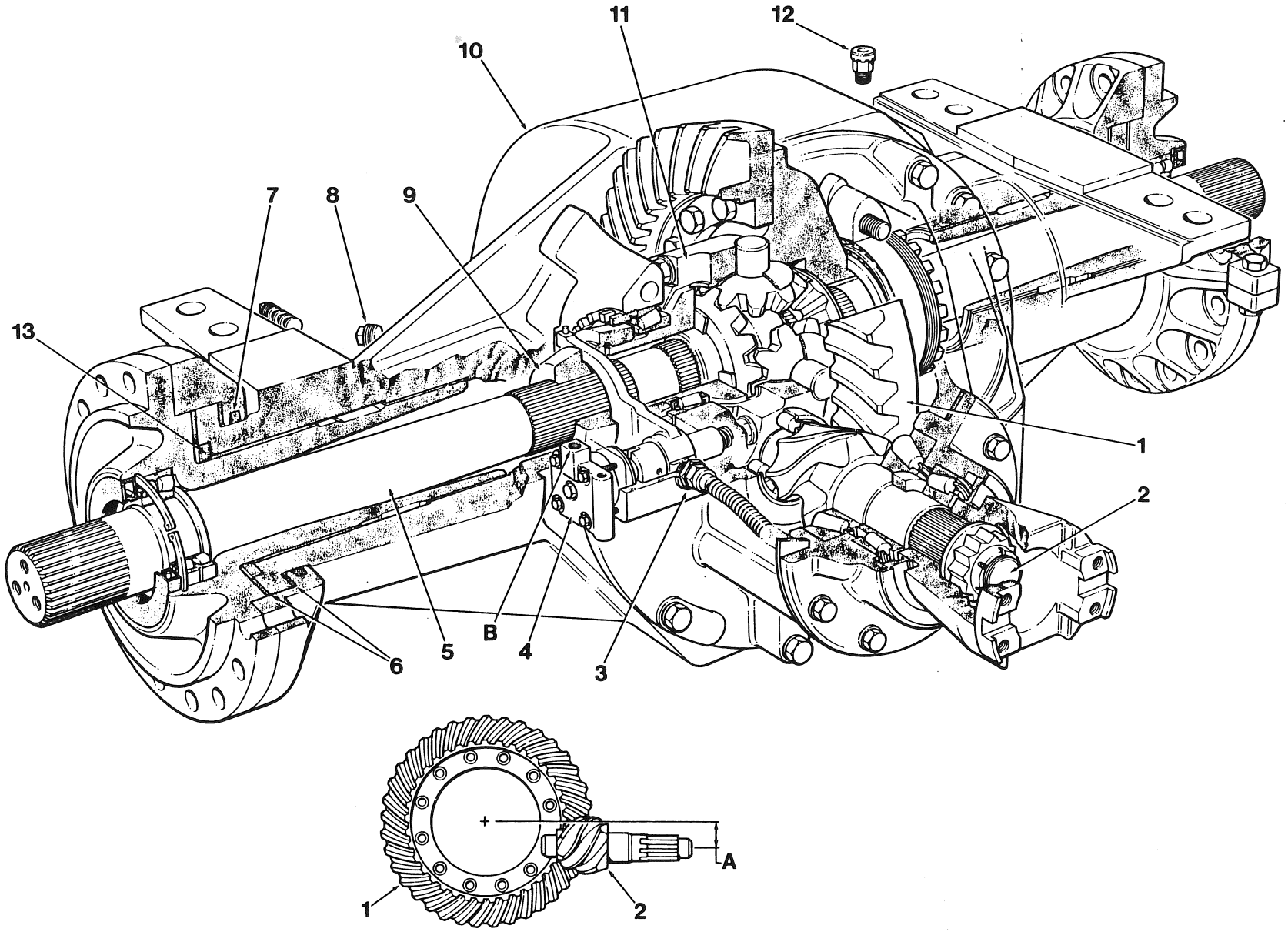
To lock or unlock the differential an electric solenoid valve is controlled by a switch on the right-hand cab door post. Energizing the solenoid directs transmission lock-up oil pressure to port **C** on the cylinder body. This pulls the shift fork to unlock the spider pinions, disengaging the shift clutch from between the left-hand axle shaft and the differential hub, allowing differential action. At full travel the shift piston contacts a normally open switch, closing it to energize the indicator light in the cab.

To lock the differential, the solenoid is de-energized. This directs oil to flow to the shift cylinder body at port **D**. Oil pressure against the shift piston engages the shift clutch, locking the left-hand axle to the differential hub.

All return oil exits at port **B** and returns to the clutch housing cover, eventually draining back to the transmission sump. See page 38.

To lubricate the bull gear pinion bearings and the spider gears, a small bi-directional oil pump is mounted on the end of the right cross shaft. It sends oil flow down the cross shaft and lubricates the bearings and gears through small cross drilled passages. The recommended final drive lubricant is a hypoid gear oil. Do not use a mineral base lubricant. First lubricant change at 100 hours, thereafter every 2000 hours or 12 months, whichever comes first. The lubricant level check interval is weekly, or every 50 hours, whichever comes first.

Refer to the Shop Manual for specifications.


11
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B
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3
A
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2

LEGEND

1. Ring Gear
2. Pinion Shaft/Gear
3. Lock/Unlock Indicator Switch
4. Shift Cylinder
5. R.H. Axle Shaft
6. Thrust Plates
7. Seal
8. Level Check Plug
9. Shift Collar
10. Final Drive Housing
11. Differential Housing
12. Breather
13. Lip Seal

A. Hypoid Gear Offset
B. Shift Cylinder Pressure Port

The Single Reduction SR30 Final Drive is used on models 710 thru 726A VHP graders and the Single Reduction SR40 Final Drive is used on models 730 thru 740A graders. Refer to the Parts Manual for the effective grader serial numbers.

Both SR final drives use a hypoid gear set. Hypoid gear sets position the drive pinion shaft below the center line of the ring gear - dimension **A**. Hypoid gear design provides the drive pinion to ring gear one and one half additional tooth contact over conventional spiral bevel ring gear drive design, resulting in 30% more tooth strength against shock loads. They use a similar design of semi-floating axle and flanged sleeve as the double reduction final drive. This permits the weight of the grader to be transferred directly to the tandems through the final drive housing.

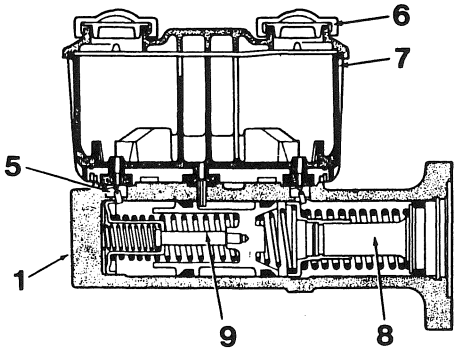
Both SR final drives feature differential lock/unlock as standard equipment. The differential lock is operated by a hydraulic actuated shift cylinder assembly that is mounted on the differential housing assembly. An electric switch on the right-hand cab post is activated to lock or unlock the differential. With the switch in the down position, the solenoid valve is energized and directs continuous oil pressure, supplied from the filtered side of the transmission filter to port **B** on the shift cylinder. The piston moves the shift fork against a spring until the collar engages the splines on the differential case. The right-hand axle shaft is now locked to the differential assembly. No differential action occurs between the tandems.

For differential action, the operator moves the switch to the **UP** position, opening the circuit and de-energizing the solenoid valve. The spring moves the shift fork and collar away from the differential case, providing differential action.

The red indicator light is mechanically switched by the shift fork. Therefore, the light is independent of the switch and reflects the true position of the differential lock.

The recommended final drive lubricant is a hypoid gear lube. The lubricant level check interval is weekly, or every 50 hours, whichever comes first. First lubricant change at 100 hours, thereafter every 1000 hours or 6 months, whichever comes first.

Refer to the Shop Manual for specifications.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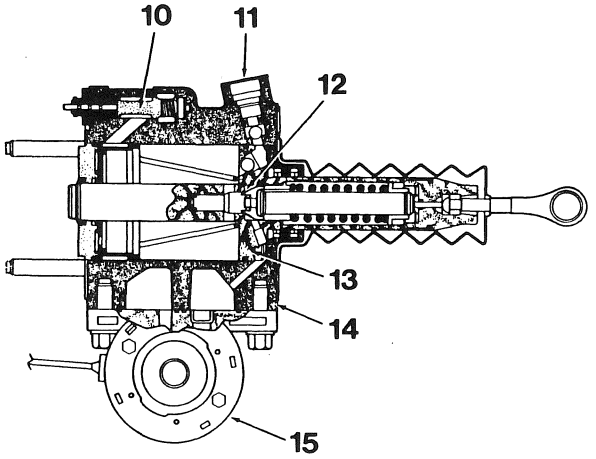
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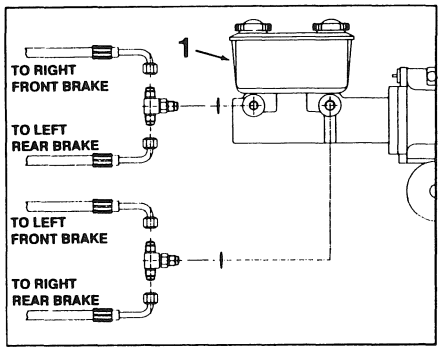
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TO RIGHT FRONT BRAKE
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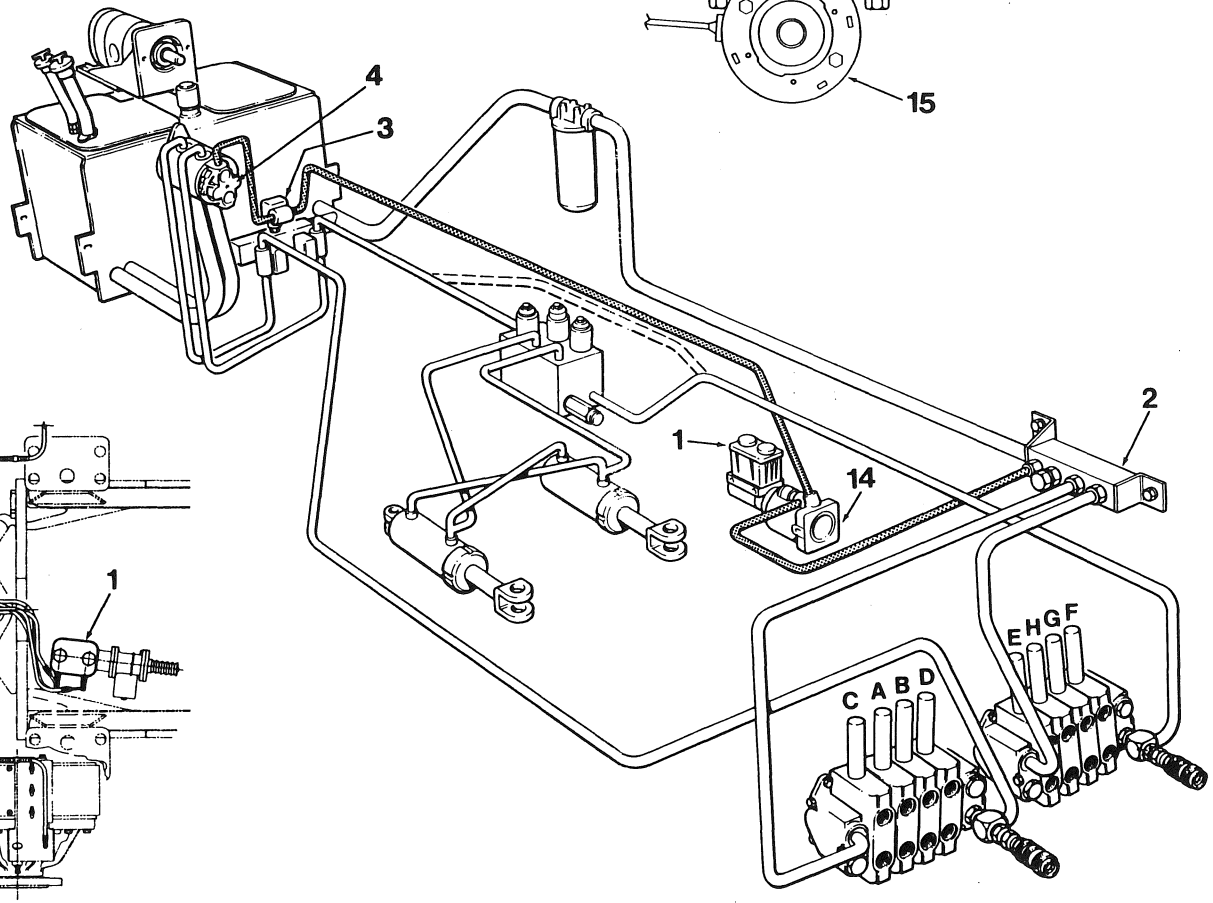
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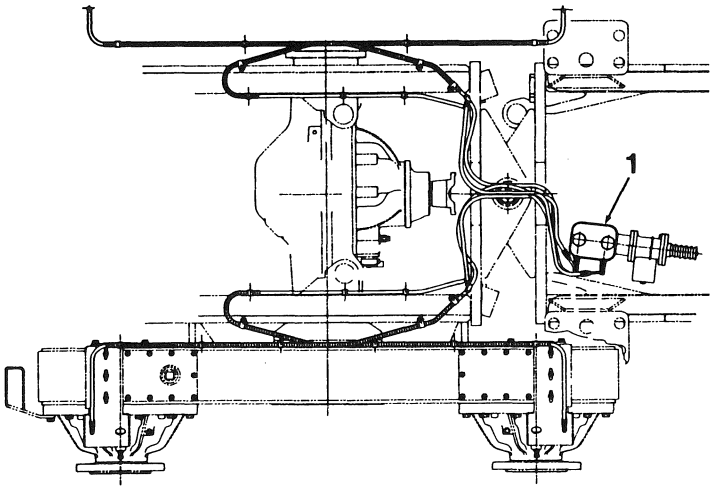
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LEGEND

1. Brake Master Cylinder
2. Return Collector Manifold
3. Relief Valve
4. Hydraulic Pump - Third Section
5. Compensator Valve
6. Cap
7. Reservoir
8. Secondary Piston
9. Primary Piston
10. Flow Switch
11. Inlet
12. Orifice
13. Power Piston
14. Booster
15. Motor/Pump Assembly

The booster is a self-contained reservoir and pump assembly. It effectively provides the operator with hydraulic pedal assistance when the brake pedal is applied.

The master cylinder features two separate chambers providing two independent brake circuits. Refer to the Champion Operator's Manual Lubrication Specifications for important fluid information.

A third section on the main hydraulic pump provides hydraulic power for the brake booster. It is independent of any other hydraulic functions. The brake hydraulic circuit also has its own relief valve, identical to the main hydraulic system relief valves, set at 2100 psi.

Reserve Power Assist

In the event of an engine stall or any situation where oil flow is interrupted to the service brake booster, an electric motor/pump will supply hydraulic power assist automatically. In this instance, the operator is alerted that the grader is functioning on the reserve system by a brake warning light and alarm. This supplementary system provides power assisted brake capability at a reduced level until main hydraulic flow is restored. The system automatically shuts off when hydraulic flow is restored.

NOTE: All reserve or supplementary braking systems are designed to bring the machine to a safe stop, or hold the machine on a slope until the **PARK/EMERGENCY** brake is applied. These systems are not intended for continuous use.

Dual Braking System

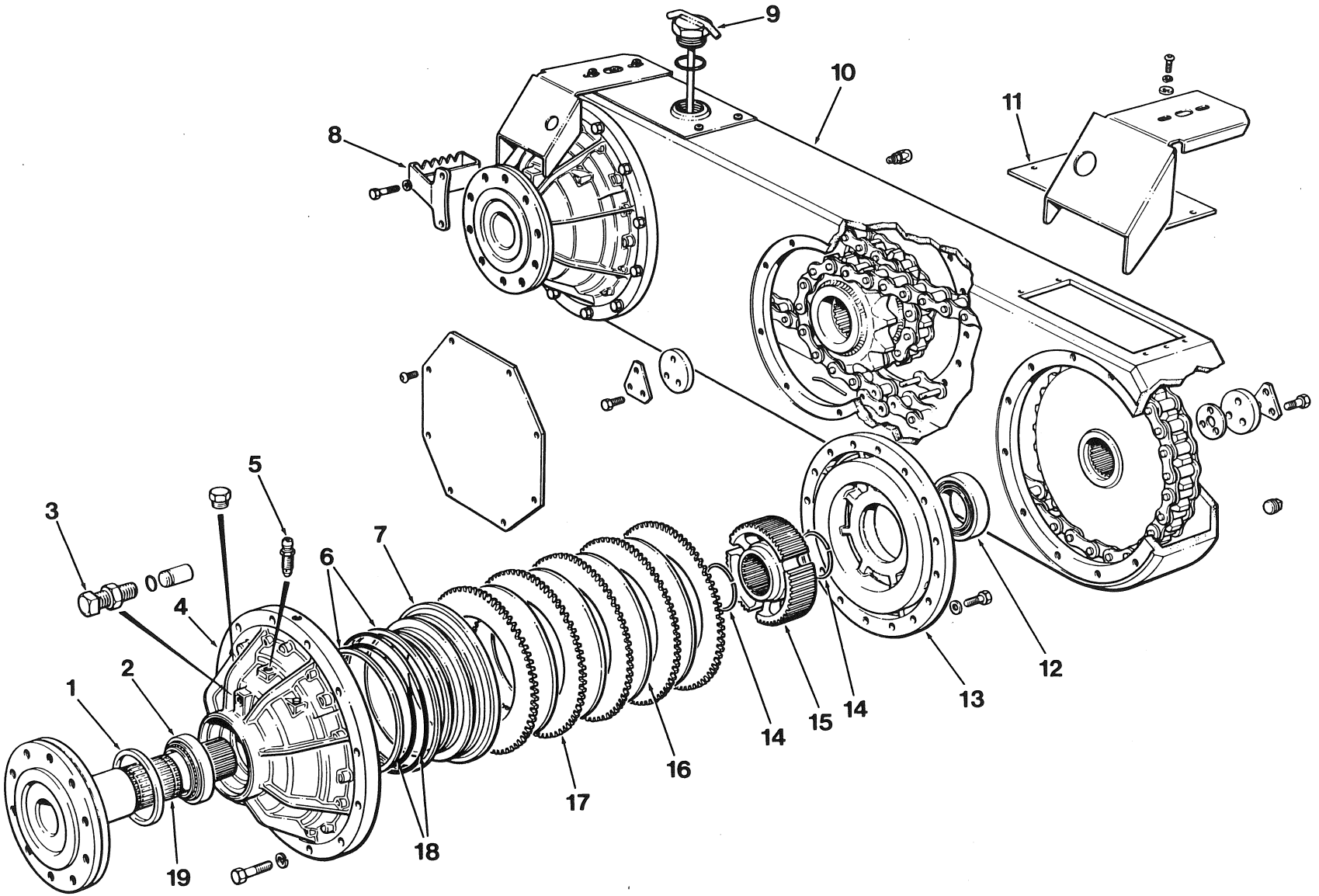
All models are equipped with four wheel dual brake system as standard equipment.

The dual braking system provides reduced braking capability in the event of a brake line rupture or other failure in one circuit.

Each of the two circuits function on one front, and opposite rear driven wheels. Should one circuit fail, there is braking on both sides of the machine and it remains effective on all four drive wheels through the tandem chains.

If the system is functioning on only one of the two circuits, the operator is alerted by a brake warning light and alarm, energized when the brake pedal is depressed.

Refer to Shop Manual for specifications.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LEGEND

1. Oil Seal
2. Bearing
3. Piston Travel Limiting Screw
4. Outer Housing
5. Bleeder Screw
6. Back-up Rings
7. Piston
8. Level Check Plug
9. Filler Plug
10. Tandem
11. Inspection Cover
12. Bearing
13. Inner Housing
14. Snap Ring
15. Hub
16. Friction Disc
17. Reaction Plate
18. O-Rings
19. Axle

The Champion Oil Disc Brake System consists of four brake units, a hydraulic brake booster with an integrated electric back-up pump, a master cylinder with reservoir and flexible hydraulic brake lines.

The hydraulic brake booster multiplies the braking effort of the pressed brake pedal and transfers it to the master cylinder. Refer to "Service Brakes Hydraulic Circuit" page 53 for information about the master cylinder and booster assembly.

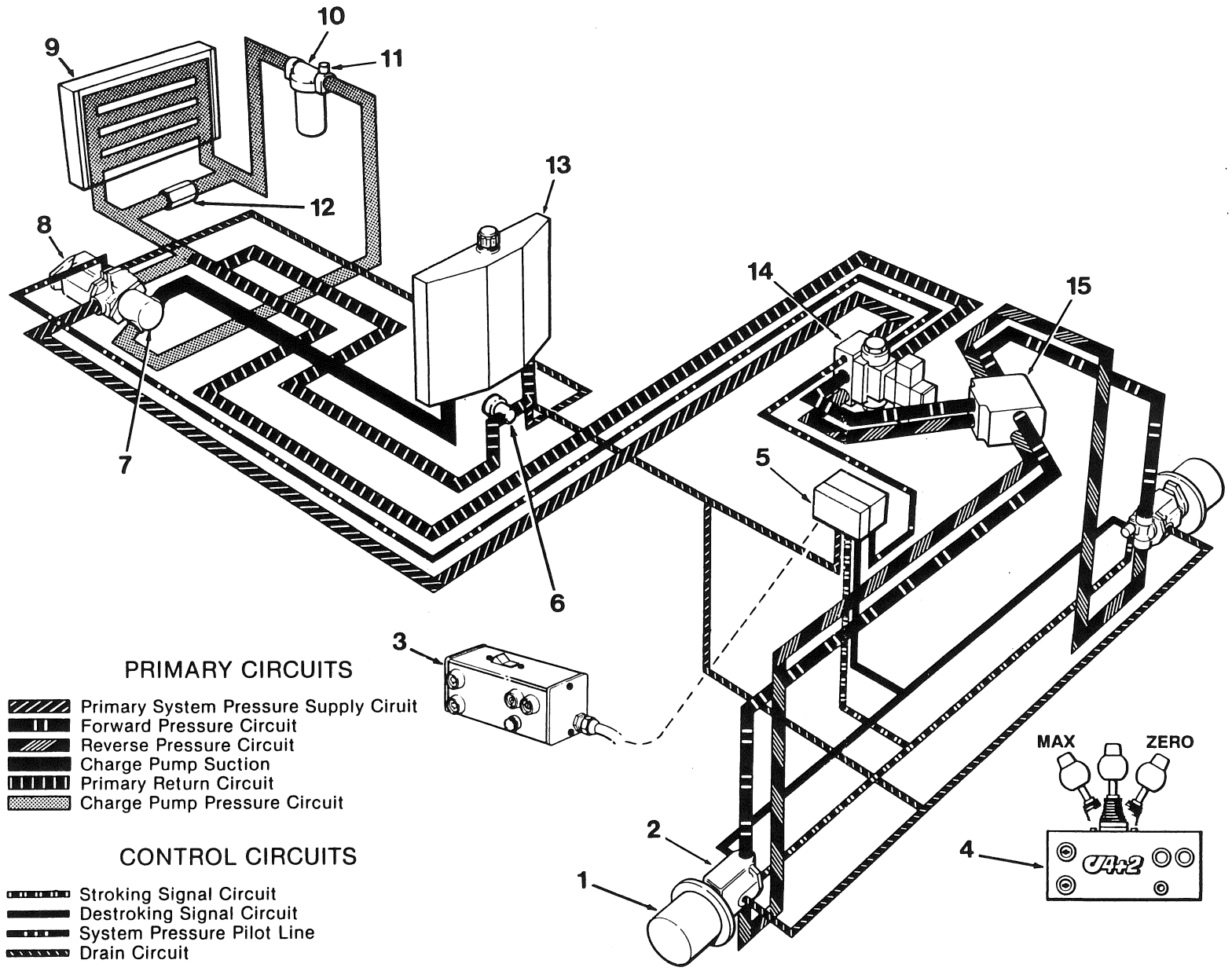
The Oil Disc Brake units are supplied with application fluid from the dual circuit master cylinder. Each of the two outlet ports on the master cylinder use a "T" fitting, connected to flexible brake hoses that divide the apply fluid in a diagonal pattern to the four brake units.

The application fluid enters the brake unit at the top of the brake housing. In the piston chamber, the fluid moves the piston away from the "piston travel limiting screw" toward the friction disc and reaction plate assembly. As the piston compresses the plates and discs together, the tandem oil is forced out of the friction disc grooves. Braking action results as the friction discs contact the reaction plates.

The friction discs are splined to a hub that is splined to the axle shaft. The wheel and tire assembly is bolted to the axle shaft. In an emergency stop situation, with the brake pedal pressed at full force, the friction disc and reaction plate assembly will lock up.

To release the brakes, lift the foot off the brake pedal. The apply fluid pressure will vent to the master cylinder reservoir. The grooves in the rotating friction discs allow the tandem oil to pass between the stationary reaction plates and friction discs. This allows the plates and discs to separate slightly moving the piston toward the "piston travel limiting screw". Once the piston releases its clamping force, the discs, hub, axle, wheel and tire rotate freely.

Refer to the Operator's Manual for more information.
Refer to the Shop Manual for specifications.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PRIMARY CIRCUITS
Primary System Pressure Supply Ciruit
Forward Pressure Circuit
Reverse Pressure Circuit
Charge Pump Suction
Primary Return Circuit
Charge Pump Pressure Circuit
CONTROL CIRCUITS
Stroking Signal Circuit
Destroking Signal Circuit
System Pressure Pilot Line
Drain Circuit
2
1
MAX
ZERO
4
4x2

LEGEND

1. Planetary Reduction Wheel Hub
2. Wheel Motor
3. Control Box - Simplified Controls
4. Control Box - Phase II
5. Motor Control Valve
6. Oil Temperature Sending Unit
7. Charge Pump
8. Main System Pump
9. Oil Cooler
10. Filter
11. Charge Pressure Sending Unit
12. Check Valve
13. AWD Reservoir
14. Selector Valve
15. Flow Divider

OVERVIEW

All Wheel Drive (AWD) is a hydrostatic assist system used in the front wheels to increase tractive effort and steering control in slippery conditions. The front wheels are driven by variable displacement motors driving through double reduction planetary hubs. A variable displacement, piston pump supplies power to the motors. The AWD hydraulic system contains its own reservoir, oil cooler, filter, pumps and motors. It is completely separate from all other hydraulic systems on the grader. AWD is available in all forward speeds except 8th and all reverse speeds. The control box turns the AWD system on and off and has several lights that indicate forward or reverse activation, excessive oil temperature and low charge pressure.

CIRCUIT

The charge pump supplies cool, filtered oil to the system and keeps the closed loop charged under low pressure to prevent cavitation. It draws its fluid from the system reservoir. The charge pump also makes up for a controlled amount of leakage in the hydraulic components which is necessary for lubrication as well as oil used in the control circuit. The main pump provides high pressure for the AWD system. Exiting from the main pump, the oil flows to the selector valve (for directional control), to the flow divider valve (for limited slip differential control) and on to the wheel motors. Oil from the motors is returns through the flow divider and selector valves to the inlet of the main hydraulic pump. The motor control valve regulates stroke and destroke pressures which control the power output of the wheel motors. If the control is in the off position, a small amount of oil is directed at low pressure to provide cooling and lubrication for the wheel motors.

CONTROLS

PHASE II

When the control lever is in its rearward ZERO position it is off. As the control lever is moved forward, stroke pressure increases. Stroke pressure is regulated by a force motor on the motor control valve. The force motor controls the opening of a variable drain orifice. As the hand controller is moved toward the MAX. position, applied voltage to the force motor increases. This decreases the orifice size and raises stroke pressure. Pressure switches on the transmission inform the control box which direction and gear have been selected.

SIMPLIFIED CONTROLS

Effective at S/N 21572, the AWD control system was redesigned to utilize the transmission controller and to simplify the system. The stroke pressure is controlled by a simple on/off switch on the control box. This activates a solenoid valve and a pressure reducing valve on the motor control valve. The transmission controller was modified to provide an additional wire that is used to turn AWD on in gears 1 through 7 forward. The back-up alarm circuit is used for controlling reverse. This eliminates all pressure switches on the transmission.

HIGH TORQUE

Effective at S/N 22101, the AWD system was modified to increase tractive effort to the front wheels.

- main pump flow increased to 30 gpm from 25
- maximum system pressure increased to 3500 psi from 3200
- planetary reduction ratio was increased to 30:1 from 26:1