



Service Manual

Reelmaster[®] 4000-D

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Reelmaster 4000-D.

REFER TO THE TRACTION UNIT AND CUTTING UNIT OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Replacement Operator's Manuals are available by sending complete Model and Serial Number to:

The Toro Company
8111 Lyndale Avenue South
Bloomington, MN 55420-1196

The Toro Company reserves the right to change product specifications or this publication without notice.



This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A NOTE will give general information about the correct operation, maintenance, service, testing, or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Safety

Product Records
and Maintenance

Kubota Diesel
Engine

Hydraulic
System

Electrical
System

Axles and
Brakes

Cutting Units



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General Safety Instructions

The Reelmaster 4000-D was tested and certified by TORO for compliance with the B71.4-1984 specifications of the American National Standards Institute for riding mowers when rear tires are filled with calcium chloride and two rear wheel weight kits. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death.


WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Read and understand the contents of the traction unit and cutting unit operator's manuals before operating the machine. To get replacement manuals, send complete model and serial number to:

The Toro Company
8111 Lyndale Avenue South
Minneapolis, MN 55420-1196

2. Never allow children to operate the machine or adults to operate it without proper instruction.
3. Become familiar with the controls and know how to stop the machine and engine quickly.
4. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective or damaged, repair or replace it before operating the machine.
5. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes, sneakers or when barefoot. Do not wear loose fitting clothing that could get caught in moving parts and possibly cause personal injury.

6. Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local ordinances and insurance regulations.
7. Make sure the work area is clear of objects which might be picked up and thrown by the reels.
8. Do not carry passengers on the machine. Keep everyone, especially children and pets, away from the areas of operation.
9. Since diesel fuel is highly flammable, handle it carefully:
 - A. Use an approved fuel container.
 - B. Do not remove fuel tank cap while engine is hot or running.
 - C. Do not smoke while handling fuel.
 - D. Fill fuel tank outdoors and only to within an inch (25 mm) from the top of the tank, not the filler neck. Do not overfill.
 - E. Wipe up any spilled fuel.

While Operating

10. Do not run engine in a confined area without adequate ventilation. Exhaust is hazardous and could be deadly.

11. Sit on the seat when starting and operating the machine.

12. Check interlock switches daily for proper operation. If a switch fails, replace it before operating the machine. The interlock system is for your protection, so do not bypass it. Replace all interlock switches every two years.

13. This product may exceed noise levels of 85 dB(A) at the operator position. Ear protectors are recommended for prolonged exposure to reduce the potential of permanent hearing damage.

14. Before starting the engine each day, test lamps, warning buzzer and signal lights to assure proper operation.

15. Pay attention when using the machine. To prevent loss of control:

A. Mow only in daylight or when there is good artificial light.

B. Watch for holes or other hidden hazards.

C. Be extremely careful when operating close to sand traps, ditches, creeks, steep hillsides or other hazards.

D. Reduce speed when making sharp turns. Avoid sudden stops and starts. Use ground speed limiter lever to set pedal travel so excessive ground speed will be avoided during mowing and transport.

E. Look to the rear to assure no one is behind the machine before backing up.

F. Watch for traffic when near or crossing roads. Always yield the right-of-way.

G. Reduce speed when driving downhill.

16. Keep hands, feet, and clothing away from moving parts and the reels.

17. Traverse slopes carefully. Do not start or stop suddenly when traveling uphill or downhill.

18. Operator must be skilled and trained in how to drive on hillsides. Failure to use caution on slopes or hills may cause loss of control and vehicle to tip or roll possibly resulting in personal injury or death.

19. When operating 4 wheel drive machine, always use the seat belt and ROPS together and have seat pivot retaining pin installed.

20. If engine stalls or loses headway and cannot make it to the top of a slope, do not turn machine around. Always back slowly straight down the slope.

21. Raise cutting units and latch them securely in transport position before driving from one work area to another.

22. Do not touch engine, muffler or exhaust pipe while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

23. If cutting unit strikes a solid object or vibrates abnormally, stop immediately, turn engine off, set parking brake and wait for all motion to stop. Inspect for damage. If reel or bedknife is damaged, repair or replace it before operating. Do not attempt to free blocked cutting unit by moving Mow/Backlap lever rapidly between FORWARD and BACKLAP. Damage to hydraulic system may result. Lever should easily return and hold in the STOP position.

24. Before getting off the seat:

A. Move traction pedal to neutral.

B. Set parking brake.

C. Disengage cutting units and wait for reels to stop.

D. Stop engine and remove key from switch.

E. Do not park on slopes unless wheels are chocked or blocked.

25. The optional TORO tow bar is for emergency towing only. Use only the special tow bar if it becomes necessary to tow machine. Use trailer for normal transport.

Maintenance and Service

26. Before servicing or making adjustments, stop engine and remove key from the switch.
27. Assure entire machine is properly maintained and in good operating condition. Frequently check all nuts, bolts and screws.
28. Frequently check all hydraulic line connectors and fittings. Assure all hydraulic hoses and lines are in good condition before applying pressure to the system.
29. Keep body and hands away from pin hole leaks or nozzles that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor or gangrene may occur.
30. Before any hydraulic system maintenance, stop engine and lower cutting units to the ground so all pressure is relieved.
31. For major repairs or other assistance, contact your local Toro Distributor.
32. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on back of engine frequently.
33. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing and other parts of the body away from cutting units and other moving parts. Keep everyone away.
34. Do not overspeed the engine by changing governor setting. Maximum engine speed is 2500 rpm + or – 100 rpm. To assure safety and accuracy, have an Authorized Toro Distributor check maximum engine speed.
35. Shut engine off before checking or adding oil to the crankcase.
36. Disconnect battery before servicing the machine. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery.
37. Toro recommends that two people be used to back-lap reels. Each person has specific duties and you must communicate with one another.
38. For optimum performance and safety, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers could be dangerous and may void the product warranty of The Toro Company.
39. When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Used jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Reelmaster 4000–D. If any decal becomes illegible or damaged, install a new decal. Part numbers for replacement decals are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.



Product Records and Maintenance

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Product Records

Insert Operator’s Manual and Parts Catalog for your Reelmaster 4000–D at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator’s Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for the Reelmaster 4000–D are covered in the Operator’s Manual. Refer to that publication when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm		
	1/64	0.015625	— 0.397	33/64	0.515625	— 13.097	
	1/32	0.03125	— 0.794	17/32	0.53125	— 13.494	
	3/64	0.046875	— 1.191	35/64	0.546875	— 13.891	
1/16	—	0.0625	— 1.588	9/16	—	0.5625	— 14.288
	5/64	0.078125	— 1.984	37/64	0.578125	— 14.684	
	3/32	0.09375	— 2.381	19/32	—	0.59375	— 15.081
	7/64	0.109275	— 2.778	39/64	0.609375	— 15.478	
1/8	—	0.1250	— 3.175	5/8	—	0.6250	— 15.875
	9/64	0.140625	— 3.572	41/64	0.640625	— 16.272	
	5/32	0.15625	— 3.969	21/32	—	0.65625	— 16.669
	11/64	0.171875	— 4.366	43/64	0.671875	— 17.066	
3/16	—	0.1875	— 4.762	11/16	—	0.6875	— 17.462
	13/64	0.203125	— 5.159	45/64	0.703125	— 17.859	
	7/32	0.21875	— 5.556	23/32	—	0.71875	— 18.256
	15/64	0.234375	— 5.953	47/64	0.734375	— 18.653	
1/4	—	0.2500	— 6.350	3/4	—	0.7500	— 19.050
	17/64	0.265625	— 6.747	49/64	0.765625	— 19.447	
	9/32	0.28125	— 7.144	25/32	—	0.78125	— 19.844
	19/64	0.296875	— 7.541	51/64	0.796875	— 20.241	
5/16	—	0.3125	— 7.938	13/16	—	0.8125	— 20.638
	21/64	0.328125	— 8.334	53/64	0.828125	— 21.034	
	11/32	0.34375	— 8.731	27/32	—	0.84375	— 21.431
	23/64	0.359375	— 9.128	55/64	0.859375	— 21.828	
3/8	—	0.3750	— 9.525	7/8	—	0.8750	— 22.225
	25/64	0.390625	— 9.922	57/64	0.890625	— 22.622	
	13/32	0.40625	— 10.319	29/32	—	0.90625	— 23.019
	27/64	0.421875	— 10.716	59/64	0.921875	— 23.416	
7/16	—	0.4375	— 11.112	15/16	—	0.9375	— 23.812
	29/64	0.453125	— 11.509	61/64	0.953125	— 24.209	
	15/32	0.46875	— 11.906	31/32	—	0.96875	— 24.606
	31/64	0.484375	— 12.303	63/64	0.984375	— 25.003	
1/2	—	0.5000	— 12.700	1	—	1.000	— 25.400
	1 mm = 0.03937 in.			0.001 in. = 0.0254 mm			

U.S. to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32°
			2. Multiply by 5/9

Torque Specifications

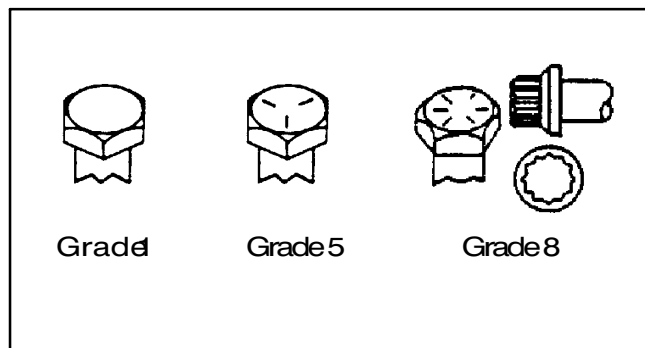
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head, or similar condition which affects the installation.

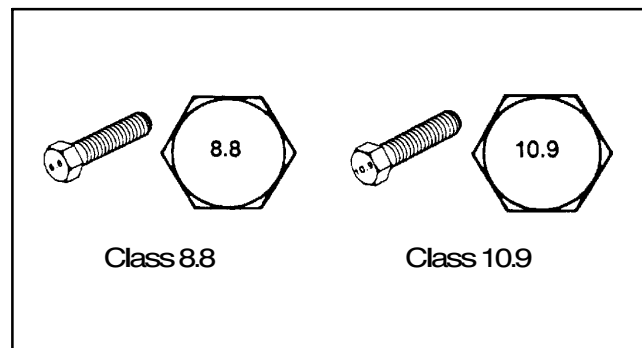
As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws



Metric Bolts and Screws

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	in-lb	N-cm	in-lb	N-cm	in-lb	N-cm
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Note: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

Note: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in-lb	640 ± 60 N-cm	78 ± 7 in-lb	885 ± 80 N-cm
M6 X 1.0	96 ± 9 in-lb	1018 ± 100 N-cm	133 ± 13 in-lb	1500 ± 150 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	27 ± 2 ft-lb	36 ± 3 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	53 ± 5 ft-lb	72 ± 7 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	92 ± 9 ft-lb	125 ± 12 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 20 N-m	229 ± 22 ft-lb	310 ± 30 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 37 ft-lb	610 ± 50 N-m

Product Records and Maintenance

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Note: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

Note: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in-lb	73 ± 12 in-lb
5/16 – 18 UNC	215 ± 35 in-lb	145 ± 20 in-lb
3/8 – 16 UNC	35 ± 10 ft-lb	18 ± 3 ft-lb
1/2 – 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft-lb	88 ± 14 N-m
1/2 – 20 UNF Grade 5	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.25 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.5 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23, or Type F	
Thread Size	Baseline Torque*
No. 6 – 32 UNC	20 ± 5 in-lb
No. 8 – 32 UNC	30 ± 5 in-lb
No. 10 – 24 UNC	38 ± 7 in-lb
1/4 – 20 UNC	85 ± 15 in-lb
5/16 – 18 UNC	110 ± 20 in-lb
3/8 – 16 UNC	200 ± 100 in-lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb
No. 8	15	18	30 ± 5 in-lb
No. 10	12	16	38 ± 7 in-lb
No. 12	11	14	85 ± 15 in-lb

* Hole size, material strength, material thickness & finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

$$\begin{aligned} \text{in-lb} \times 11.2985 &= \text{N-cm} \\ \text{ft-lb} \times 1.3558 &= \text{N-m} \end{aligned}$$

$$\begin{aligned} \text{N-cm} \times 0.08851 &= \text{in-lb} \\ \text{N-m} \times 0.7376 &= \text{ft-lb} \end{aligned}$$

Lubrication

GREASING BEARINGS AND BUSHINGS

The machine has grease fittings that must be lubricated after every 50 hours of operation with No. 2 General Purpose Lithium Base Grease. Lubricate fitting immediately after every washing regardless of interval listed. The lubrication points are: lift arms (Fig. 1), rear axle (Fig. 2), floating or fixed head kit pivots (Fig. 3), and cutting unit reel and roller bearings (Fig. 4). **Also, grease fitting on reel control valve (not shown), located under right hand console.**

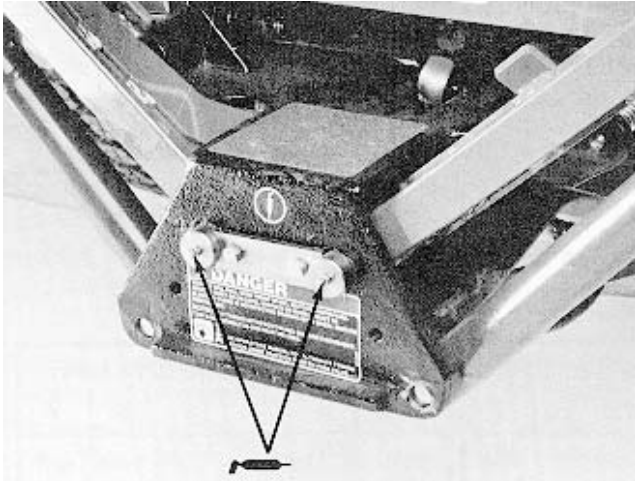


Figure 1
Lift arms (5 fittings total)

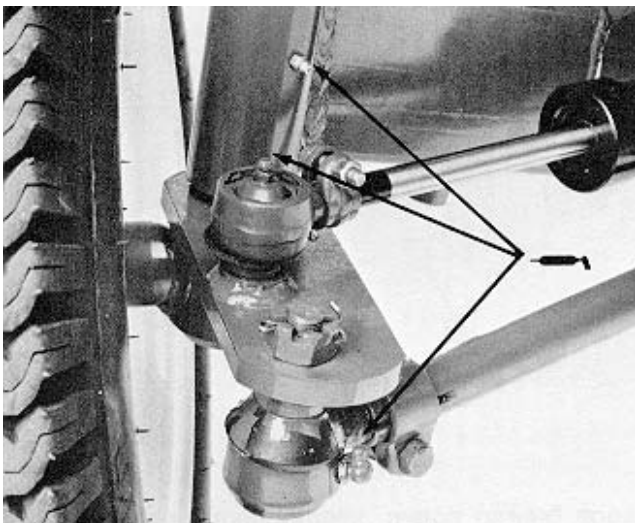


Figure 2
Rear Axle (3 Fittings per side)

Note: Remove plastic caps over the fittings on the floating or fixed head pivots and replace caps after greasing (Fig. 3).

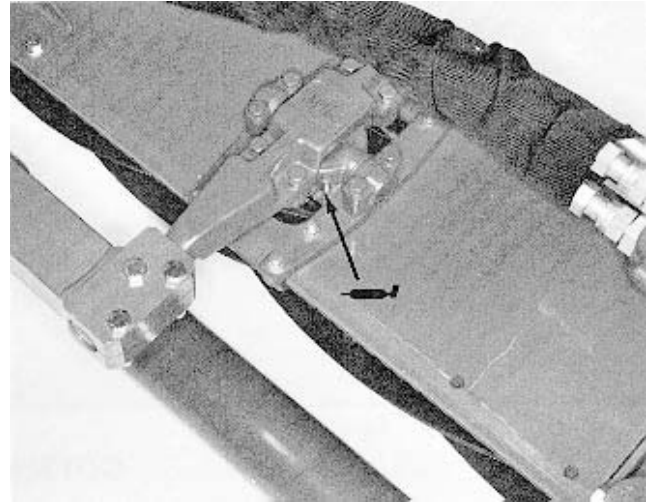


Figure 3
Floating of Fixed Kit Pivots (1 fitting per head)
(Floating Kit Shown)

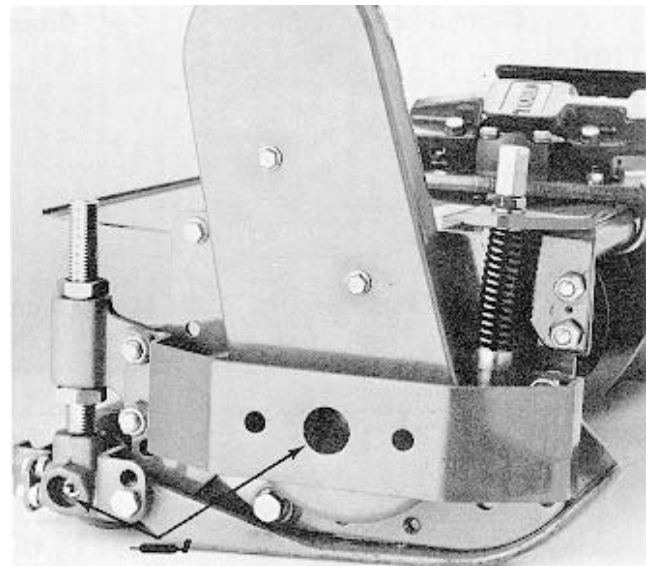


Figure 4
Reel and Roller Bearings
(2 fittings per reel & 2 fittings per roller)

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Wipe grease fitting clean so foreign matter cannot be forced into the bearing or bushing.
3. Pump grease into the bearing or bushing.
4. Wipe up excess grease.

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Kubota Diesel Engine

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Kubota Diesel Engine

Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the diesel engine used in the Reelmaster 4000–D.

Most repairs and adjustments require tools, which are commonly available in many service shops. Special tools are described in the **Kubota Workshop Manual, 03 Series, Diesel Engine**. The use of some specialized test equipment is explained. However, the cost of the

test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kubota diesel engines are supplied through your local Kubota dealer or distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

Specifications

Item	Description
Make / Designation	Kubota, V2203, 4-Cylinder, 4-Cycle, Water Cooled, In-line, Spherical Chamber, OHV, Diesel Engine
Horse Power	39.4 HP @ 2300 RPM
Torque	103 ft-lb @ 1600 RPM
Firing Order	1 - 3 - 4 - 2
Bore mm (in.)	87.0 (3.43)
Stroke mm (in.)	92.0 (3.64)
Total Displacement cc (cu. in.)	2197 (134.07)
Fuel	No. 2 Diesel Fuel per ASTM D975
Fuel Capacity liters (gallons)	56.8 (15.0)
Fuel Pump	Bosch Type Mini pump
Governor	Centrifugal flyweight Mechanical Type
Low Idle (no load)	1250 ± 50 RPM
High Idle (no load)	2500 ± 50 RPM
Compression Ratio	23.0 : 1
Rotation	Counterclockwise Facing Flywheel
Injection Nozzles	Bosch Throttle Type
Engine Oil	SAE 10W30 SF or CD
Oil Pump	Trochoid Type
Crankcase Oil Capacity liters (U.S. qt.)	7.6 (8.0) with filter
Starter	12 VDC 1.4 KW
Alternator/Regulator	12 VDC 40 AMP
Weight Kg (Lb.)	190 (418)
Engine Coolant Capacity liters (U.S. qt.)	14.0 (14.8)
Timing	BTDC 17 to 19 Degrees

General Information

Check Engine Oil

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Release engine cover latches. Open engine cover (Fig. 1).
3. Remove dipstick, wipe clean and reinstall dipstick into tube and pull it out again. Oil level should be up to the FULL mark (Fig. 2).
4. If oil is below FULL mark, remove fill cap and add SAE 10W-30 oil until level reaches the FULL mark. **Do not overfill.** Crankcase capacity is 8 qt. (7.6 L) with filter (Fig. 3).
5. Install oil fill cap and dipstick.
6. Close engine cover and secure with the latches.

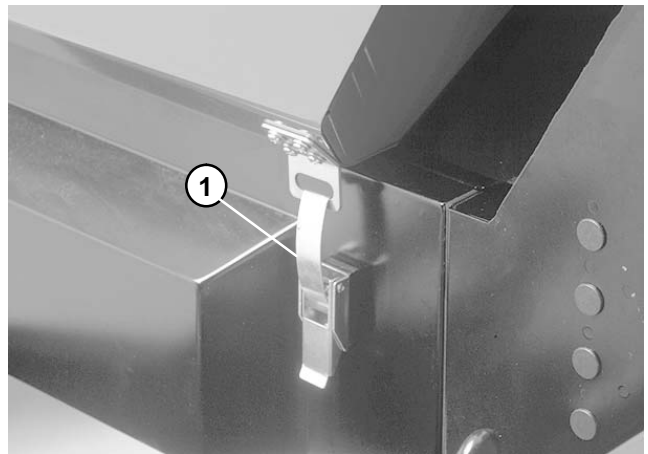


Figure 1
1. Engine cover latch

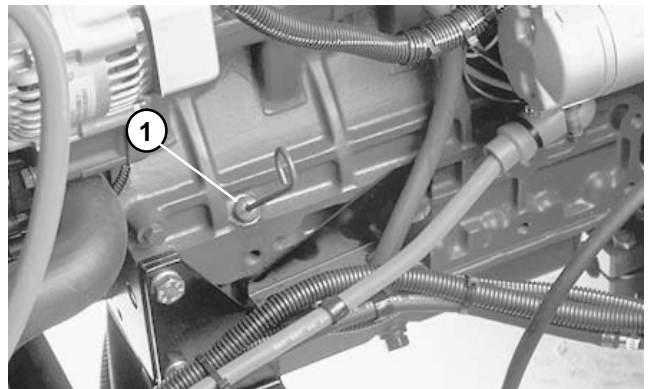


Figure 2
1. Dipstick

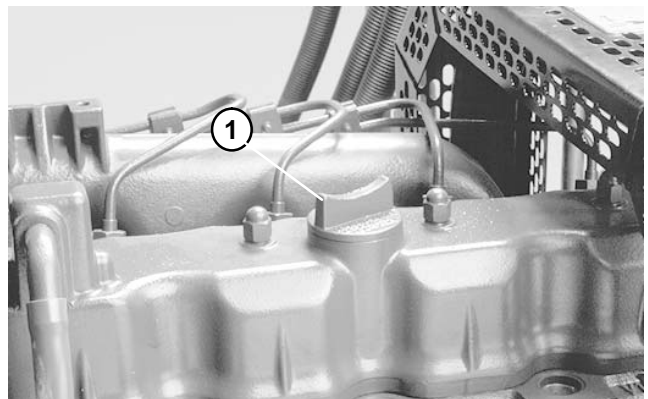


Figure 3
1. Oil fill cap

Check Cooling System

Check level of coolant at the beginning of each day. Capacity of system is 3.7 gal. (14 L).



CAUTION

If engine is hot, pressurized coolant can escape and cause burns when the radiator cap is removed. Remove radiator cap slowly and carefully if engine coolant is hot.

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Carefully remove radiator cap (Fig. 4) and expansion tank cap (Fig. 5).

3. Check level of coolant in radiator. Radiator should be filled to the top of the filler neck and the expansion tank filled to the marks on its side.

IMPORTANT: Do not use water only. Do not use alcohol / methanol base coolants.

4. If coolant is low, add a 50/50 mixture of water and ethylene glycol anti-freeze.
5. Install radiator cap and expansion tank cap.

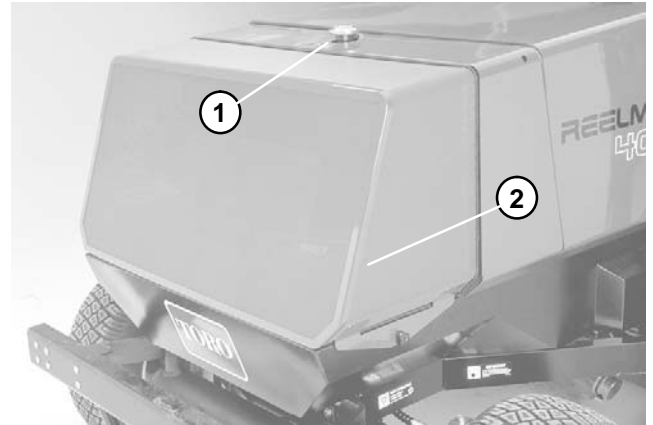


Figure 4

1. Radiator cap
2. Rear screen

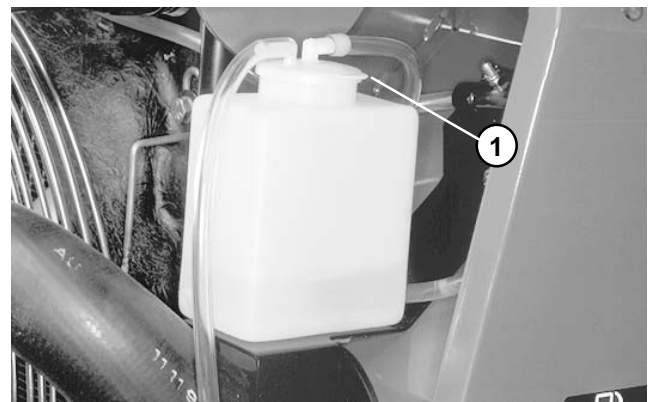


Figure 5

1. Expansion tank cap

Fill Fuel Tank

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Remove fuel tank cap (Fig. 6).
3. Fill tank to about one inch (25 mm) below bottom of filler neck with No. 2 diesel fuel. Then install cap.

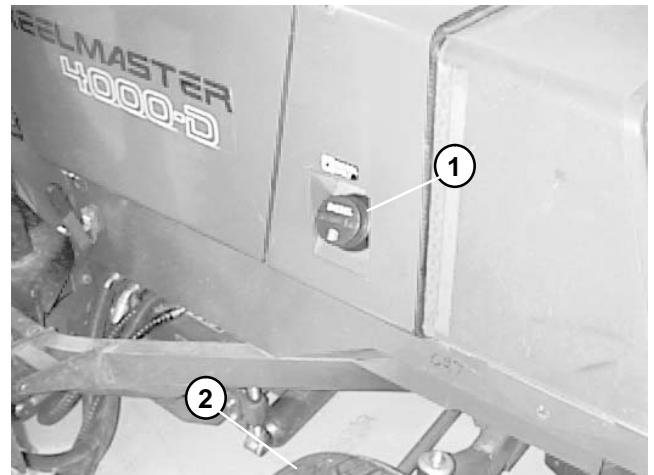


Figure 6

1. Fuel tank cap
2. Left rear tire

Prime Fuel System

IMPORTANT: The fuel system must be primed when a new engine is started for the first time, if it runs out of fuel, or if maintenance is performed on the fuel system.

Note: The fuel pump, located on left side of engine, under the fuel injection pump and behind the fuel stop solenoid. It can be manually primed to get fuel from fuel tank to fuel filter/water separator (Fig. 7).

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.

2. Raise engine cover.

3. Insert a 3/16-inch hose over the bleed screw, and run the other end of the hose into a container to catch the fuel (Fig. 8).

IMPORTANT: Priming fuel filter without opening bleed screw may damage priming plunger.

4. Loosen fuel filter/water separator bleed screw a few turns. Pump priming plunger until a steady stream of fuel comes out of hole in in bleed screw. When fuel stops foaming, tighten the bleed screw **during the down-stroke** of the priming plunger. Wipe up any spilled fuel (Fig. 8).

Note: It may be necessary to bleed the air out of the fuel line between the fuel filter / water separator and the injection pump. To do this, loosen the knob on the injection pump (Fig. 7) and repeat bleeding procedure.

5. Pump priming plunger until resistance is felt. Try to start engine. If engine does not start repeat step 4.

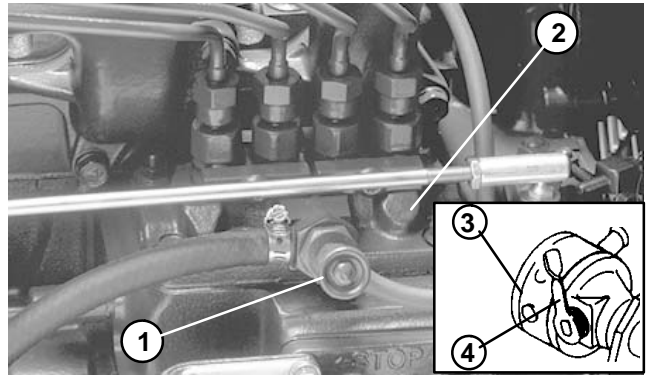


Figure 7

- 1. Bleed knob
- 2. Injection pump
- 3. Fuel pump
- 4. Priming lever

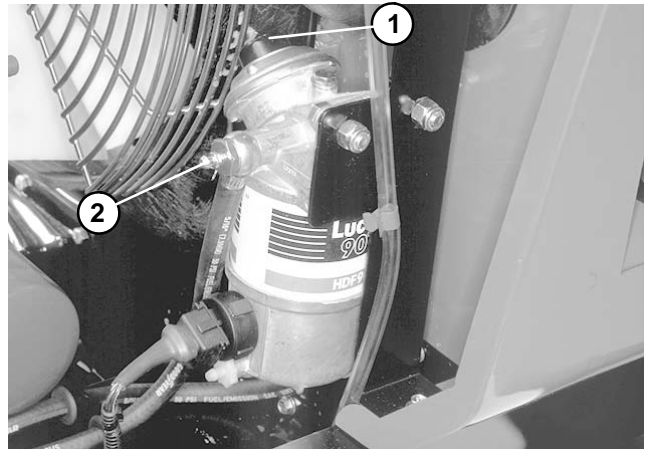


Figure 8

- 1. Primer plunger
- 2. Bleed screw

Adjustments

Adjust Alternator Belt

Check condition and tension of belt after every 100 operating hours (Fig. 9).

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Proper belt tension will allow 3/8 inch (10 mm) deflection when a force of 10 lbs (44.4 N) is applied on the belt midway between both pulleys.
3. If deflection is not 3/8 inch (10 mm), loosen alternator mounting bolt. Increase or decrease alternator belt tension and tighten bolt. Make sure tension is correct; check deflection of belt again.

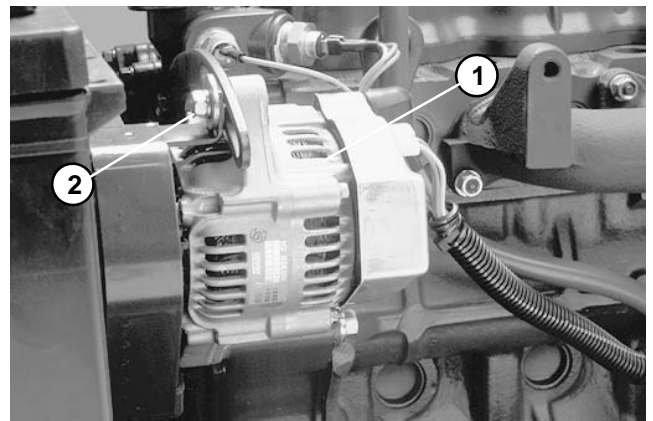


Figure 9

1. Alternator

2. Mounting bolt

Service and Repairs

Service Air Cleaner

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Remove knobs securing rear screen to frame . Remove rear screen (Fig. 10).
3. Check air cleaner body for damage which could possibly cause an air leak. Replace a damaged air cleaner body (Fig. 11).
4. Service the air cleaner filters when ever air cleaner indicator light illuminates and warning signal sounds or every 400 hours (more frequently in extreme dusty or dirty conditions). Do not over service air filter.
5. Be sure cover is sealing around air cleaner body (Fig. 11).
6. Release latches securing air cleaner cover to air cleaner body. Separate cover from body. Clean inside of air cleaner cover (Fig. 11).
7. Gently slide primary filter out of air cleaner body to reduce the amount of dust dislodged. Avoid knocking filter against air cleaner body. **Do not remove safety filter.**

IMPORTANT: Never attempt to clean a safety filter (Located inside primary filter). Replace the safety filter with a new one after every three primary filter services.

8. Inspect primary filter and discard if damaged. Do not wash or reuse a damaged filter.

Washing Method

- A. Prepare a solution of filter cleaner and water and soak filter element about 15 minutes. Refer to directions on filter cleaner carton for complete information.
- B. After soaking filter for 15 minutes, rinse it with clear water. Maximum water pressure must not exceed 40 psi to prevent damage to the filter element. Rinse filter from clean side to dirty to side.
- C. Dry filter element using warm, flowing air of not greater than 160°F (71°C), or allow element to air-dry. Do not use a light bulb to dry the filter element because damage could result.

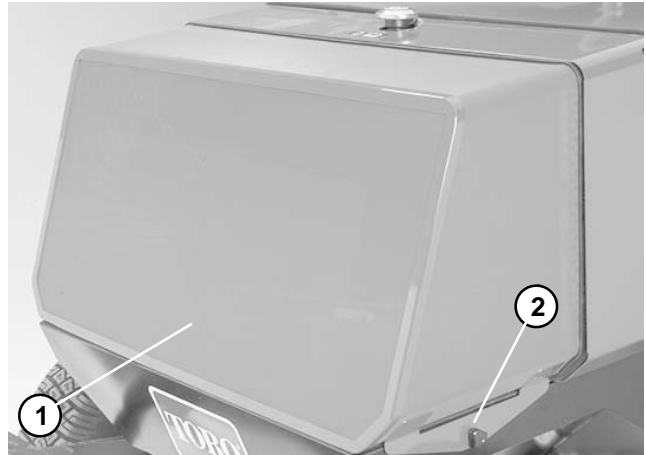


Figure 10

1. Rear screen
2. Knob

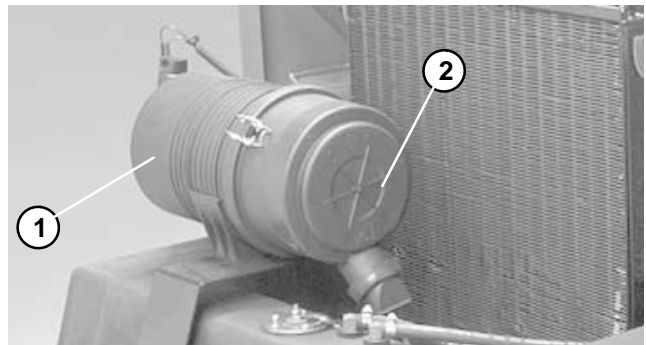


Figure 11

1. Air cleaner body
2. Air cleaner cover

Compressed Air Method

- A. Blow compressed air from inside to the outside of dry filter element. Do not exceed 100 psi (6.9 Bar) to prevent damage to the element.
 - B. Keep air hose nozzle at least 2 inches (5 cm) from filter and move nozzle up and down while rotating the filter element. Inspect for holes and tears by looking through the filter toward a bright light.
9. Inspect new filter for shipping damage. Check seal end of filter. Do not install a damaged filter.
 10. Insert new filter properly into air cleaner body. Make sure filter is sealed properly by applying pressure to outer rim of filter when installing. Do not press on flexible center of filter.
 11. Reinstall cover and secure latches. Make sure cover is positioned with top side up.

Change Engine Oil and Filter

Change oil and filter after the first 50 hours of operation and every 100 hours thereafter.

1. Remove drain plug and let oil flow into drain pan. When oil stops, install drain plug (Fig. 12).
2. Remove oil filter. Apply a light coat of clean oil to the new filter seal before screwing it on. **Do not overtighten filter** (Fig.13).
3. Add oil to crankcase (see Check Engine Oil).

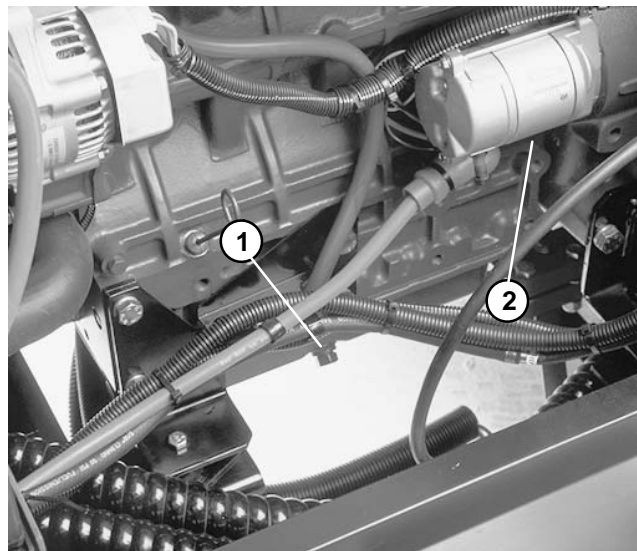


Figure 12

1. Drain plug

2. Starter

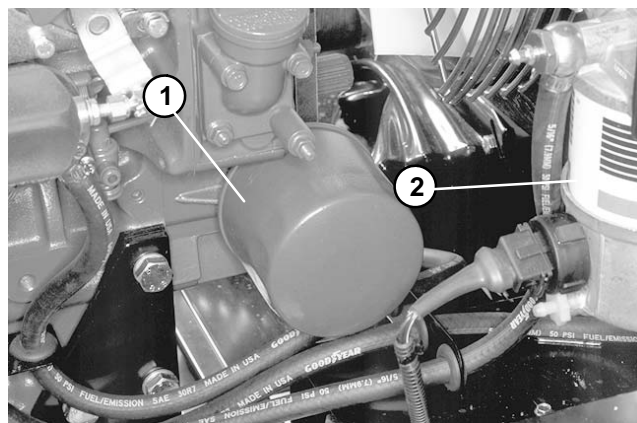


Figure 13

1. Oil filter

2. Fuel filter/water separator

Drain Fuel System



DANGER

Because diesel fuel is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when machine is in an enclosed area. Always fill fuel tank outside and wipe up any spilled diesel fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use diesel fuel for the engine only; not for any other purpose.

Fuel Tank

Drain and clean fuel tank every 800 hours of operation or yearly, whichever comes first. Also, drain and clean tank if fuel system becomes contaminated or if machine is to be stored for an extended period. Use clean fuel to flush out the tank.

Fuel Filter/Water Separator

Drain water or other contaminants from fuel filter/water separator daily.

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Place a clean container under the fuel filter.
3. Loosen drain thumb screw on the side of fuel filter. Press primer plunger until only fuel is evident draining into container.
4. Tighten drain screw.

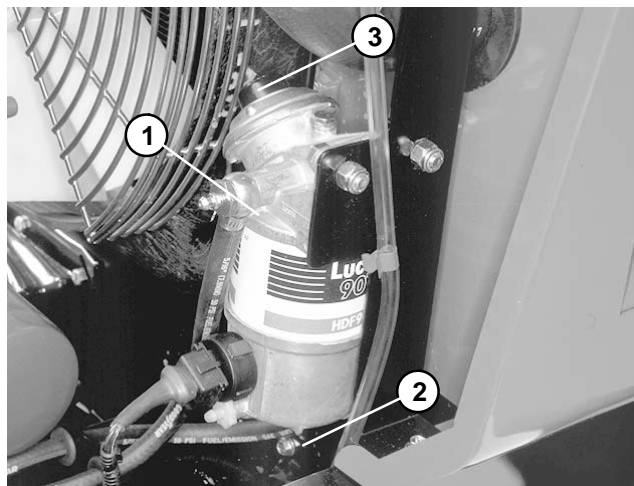


Figure 14

1. Fuel filter/water separator
2. Drain screw
3. Priming plunger

Check Fuel Lines and Connections

Check lines and connections every 400 hours or yearly, whichever comes first. Inspect for deterioration, damage, or loose connections.

Replace Fuel Filter



DANGER

Because diesel fuel is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when machine is in an enclosed area. Always fill fuel tank outside and wipe up any spilled diesel fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use diesel fuel for the engine only; not for any other purpose.

There are 2 fuel filters on the RM 4000-D. A small in-line filter is located on top of the fuel tank and behind the radiator (Fig. 15). The fuel filter/water separator is located near the left rear end of the engine (Fig. 16).

Replace fuel filters if fuel flow becomes restricted, after every 400 hours of operation or annually, whichever comes first.

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Unscrew bottom filter cap from filter assembly. Remove cap, gaskets, o-ring and filter from assembly. Note position of gaskets and o-ring when disassembling from filter.
3. Install new filter, gaskets, o-ring with filter assembly cap.
4. Prime fuel system, refer to Priming Fuel System.

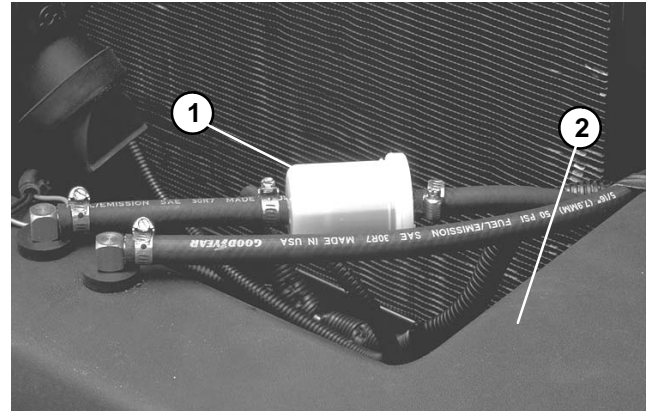


Figure 15

1. In-line fuel filter
2. Fuel tank

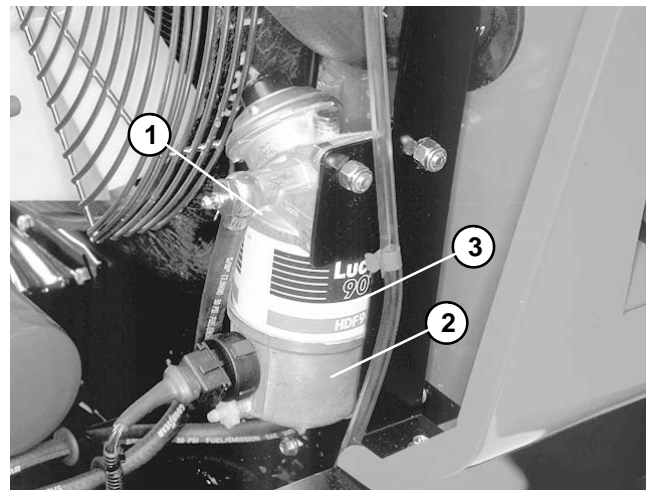


Figure 16

1. Fuel filter/water separator
2. Filter cap
3. Filter

Engine Cooling System

Debris Removal

Remove debris from oil cooler, radiator and rear screen daily, clean more frequently in dirty conditions.

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. Release front engine cover latches and raise engine cover. Clean engine area thoroughly of all debris.
3. Remove knobs securing rear screen to frame and remove screen (Fig. 17).
4. Lift up on oil cooler handles and pivot rearward in mounting slot. Clean both sides of oil cooler, radiator and rear engine area thoroughly with compressed air (Fig. 18).
5. Pivot oil cooler back into position and install rear screen.
6. Lower engine cover and secure latches.

Cooling System Maintenance

Capacity of the system is 3.7 gal. (14 L). Always protect cooling system with a 50/50 solution of water and ethylene glycol anti-freeze.

IMPORTANT: Do not use water only. Do not use alcohol / methanol base coolants.

1. Park machine on a level surface. Stop engine. Remove key from the ignition switch.
2. After every 100 operating hours, tighten hose connections. Replace any damaged or deteriorated hoses.
3. After every 800 operating hours, drain and flush the cooling system. Add anti-freeze (see Check Cooling System).

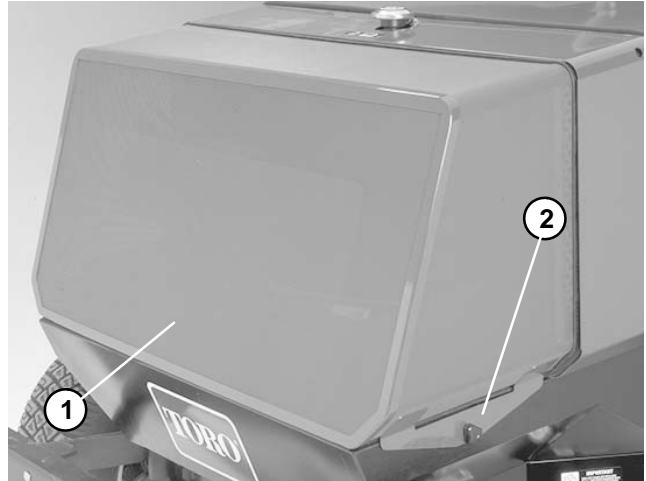


Figure 17

1. Rear screen

2. Knob

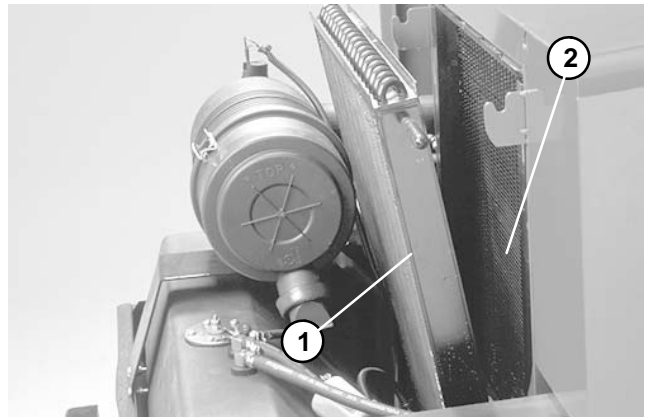


Figure 18

1. Oil cooler

2. Radiator

Engine

Engine Removal

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.
2. Pivot seat up. Lift front canopy and remove from the brackets (Fig. 19).

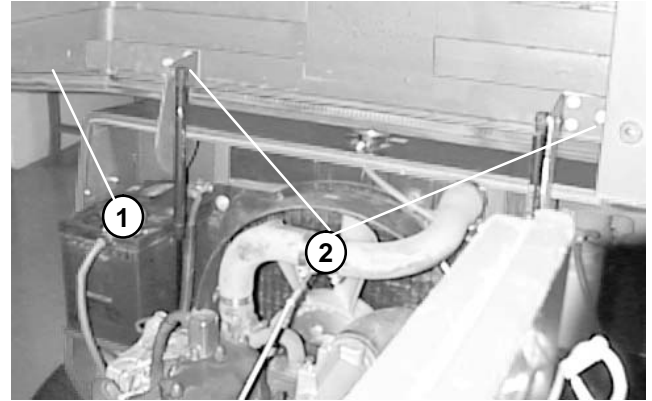



Figure 19

1. Canopy
2. Brackets

3. Disconnect and remove battery from the machine (see Battery Service in Chapter 5 – Electrical Systems).

**CAUTION**

If engine is hot, pressurized coolant can escape and cause burns when the radiator hoses are removed. The radiator and exhaust exhaust tube may be hot. Avoid possible burns; allow engine, radiator, and exhaust system to cool before removing radiator hoses or exhaust tube.

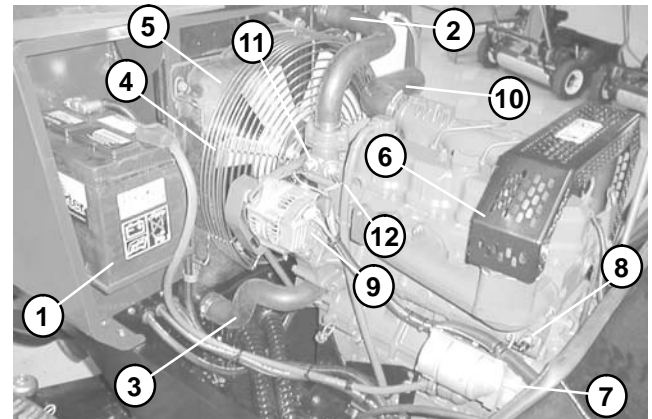


Figure 20

- | | |
|------------------------|-----------------------------|
| 1. Battery | 7. Starter |
| 2. Upper radiator hose | 8. Oil pressure switch |
| 3. Lower radiator hose | 9. Alternator |
| 4. Fan guard | 10. Air hose |
| 5. Fan shroud | 11. Hi temp. warning switch |
| 6. Exhaust shield | 12. Hi temp. cutout switch |

4. Drain radiator. Disconnect both hoses from the radiator (Fig. 20).
5. Remove air hose from air intake manifold (Fig. 20).
6. Remove exhaust shield from the engine (Fig. 20).
7. Remove fan guard and fan shroud from the radiator (Fig. 20).
8. Remove fan from the fan pulley. Remove fan shroud and fan from machine (Fig. 21). Remove fan shroud from the machine.

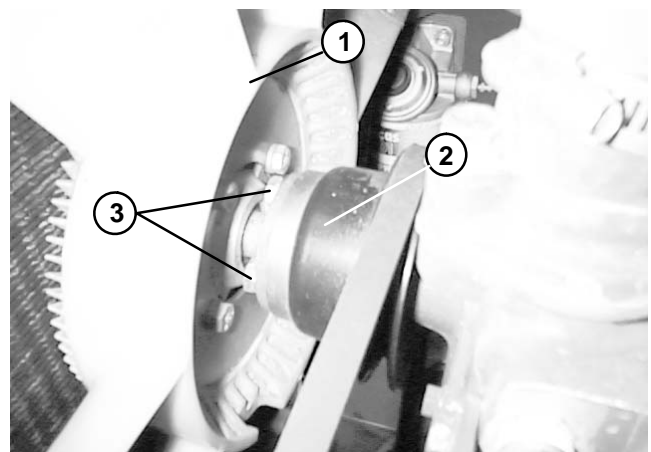


Figure 21

- | | |
|---------------|---------------|
| 1. Fan | 3. Cap screws |
| 2. Fan pulley | |

9. Clamp to prevent drainage, and disconnect the following fuel hoses:

- A. Suction hose at the injector pump from the fuel filter. Suction and discharge hoses at the fuel pump (Fig. 22).
- B. Return hose from the fuel injectors (Fig. 23).

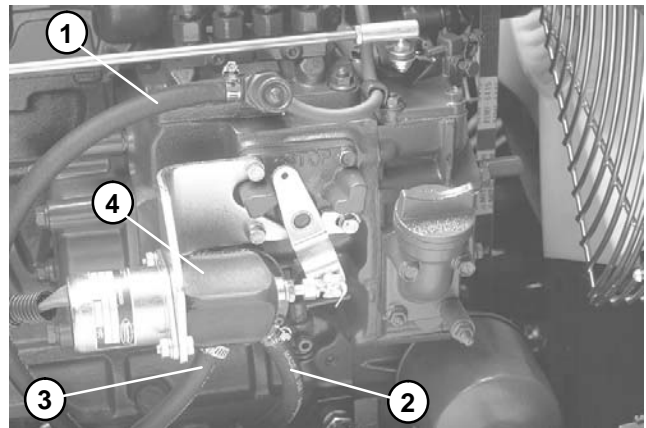


Figure 22

- | | |
|--------------------------|------------------------|
| 1. Injector pump suction | 3. Fuel pump discharge |
| 2. Fuel pump suction | 4. Fuel solenoid |

10. Disconnect wire harness and electrical wires from the engine as follows:

- A. Disconnect wire and connector from the alternator, red cable from starter, three wires from the starter, wire from the oil pressure switch, and wires from high temperature warning and shutdown switches (Fig. 20).
- B. Disconnect electrical connector from the fuel solenoid (Fig. 22).
- C. Disconnect red/black wire from the glow plug bus bar (Fig. 23).

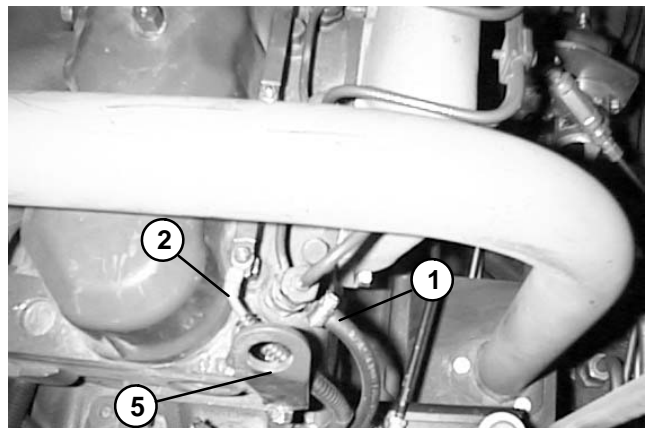


Figure 23

- | | |
|-------------------------|-------------|
| 1. Injector return hose | 4. Bracket |
| 2. Glow plug wire | 5. Lift tab |
| 3. Exhaust tube | |

11. Disconnect throttle control cable from the swivel lever and R-clamp from the engine plate (Fig. 24).

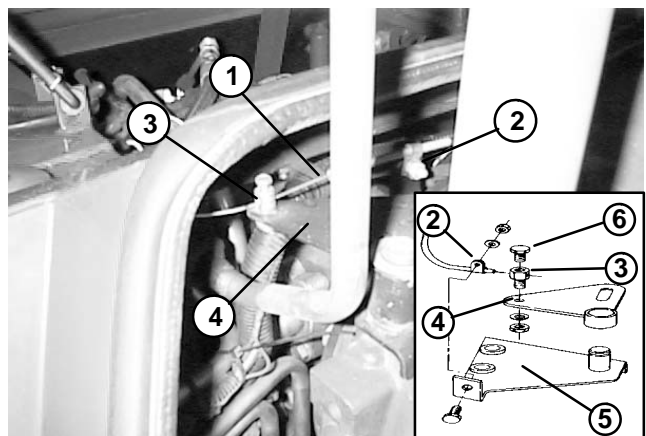


Figure 24

- | | |
|---------------------------|-----------------|
| 1. Throttle control cable | 4. Swivel lever |
| 2. R-clamp | 5. Engine plate |
| 3. Swivel | 6. Screw |

12. Separate hydraulic pump assembly from the engine (Fig. 25).

- A. Disconnect damper from the bracket.
- B. Remove four cap screws, lock washers, and flat washers securing the pump mounting flange to the pump adapter plate.
- C. Support pump, and pull pump shaft from the spring coupling.

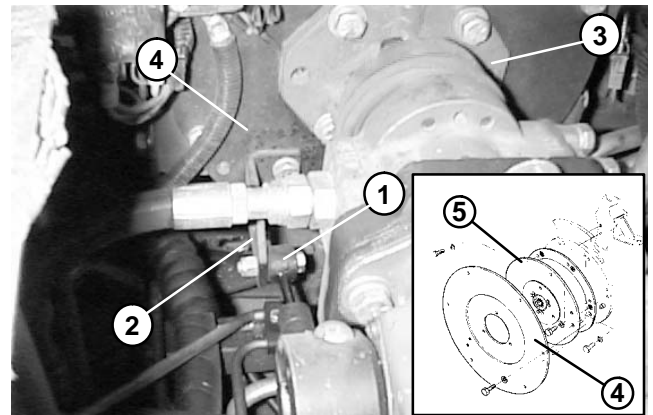



Figure 25

- | | |
|-------------------------|-----------------------|
| 1. Damper | 4. Pump adapter plate |
| 2. Bracket | 5. Spring coupling |
| 3. Pump mounting flange | |

13. Remove three lock nuts and cap screws securing the upper exhaust tube to the exhaust bracket (Fig. 26).

14. Remove hex nut, spring washer, cap screw, and flat washers securing both front brackets to the engine mounts (Fig. 26).

15. Connect hoist or lift to the engine.



CAUTION

Make sure lift or hoist can support the total weight of the engine before removing the cap screws from the rear bracket and engine.

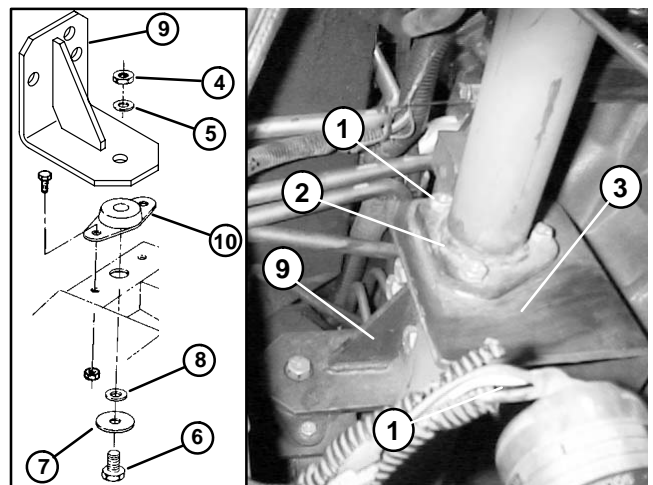



Figure 26

- | | |
|-----------------------|------------------|
| 1. Cap screw | 6. Cap screw |
| 2. Upper exhaust tube | 7. Flat washer |
| 3. Exhaust bracket | 8. Flat washer |
| 4. Hex nut | 9. Front bracket |
| 5. Spring washer | 10. Engine mount |

16. Remove three cap screws and lock washers securing the engine to the rear bracket and spacer (Fig. 27).



CAUTION

One person should operate lift or hoist while the other person guides the engine out of the machine.

IMPORTANT: Make sure not to damage the engine, fuel and hydraulic lines, electrical harness, or other parts while removing the engine.

17. Remove engine slowly from the machine. Save gasket for exhaust tube (Fig. 26).

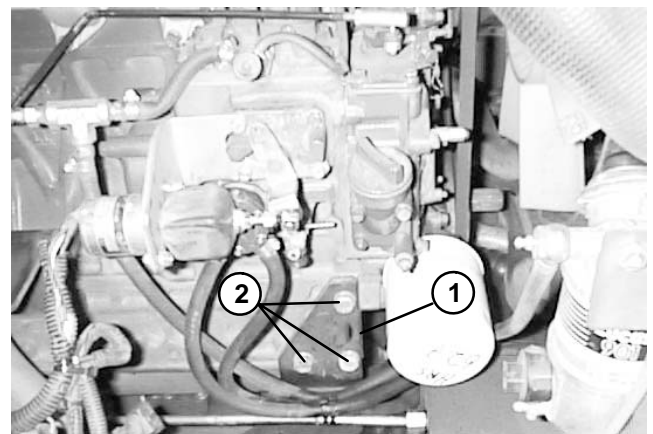


Figure 27

- | | |
|--------------------------|----------------------------|
| 1. Rear bracket & spacer | 2. Cap screw & lock washer |
|--------------------------|----------------------------|

Engine Installation



1. Install engine to the front engine mounts and rear brackets.

A. Attach a hoist or lift to the engine.

IMPORTANT: Make sure not to damage the engine, fuel and hydraulic lines, electrical harness, or other parts while installing the engine.

B. Place gasket onto exhaust bracket to receive exhaust tube (Fig. 26).

C. Lower engine slowly into the machine.

2. Secure both front brackets to the engine mounts with cap screw, flat washers, spring washer, and hex nut. Torque cap screw and hex nut from 59 to 73 ft-lb (8.2 to 10.1 kg-m) (Fig. 26).

3. Secure engine to the spacers and rear brackets with three cap screws and lock washers. Torque cap screws from 61 to 75 ft-lb (8.4 to 10.4 kg-m) (Fig. 27).

4. Secure exhaust tube and gasket to the exhaust bracket with three cap screws and lock nuts (Fig. 26).

5. Connect hydraulic pump assembly to the engine (Fig. 25).

A. Position the pump shaft into the spring coupling.

B. Secure pump mounting flange to the pump adapter plate with four cap screws, flat washers, and lock washers. Torque cap screws from 60 to 80 ft-lb (8.3 to 11.1 kg-m).

C. Connect damper to the bracket.

6. Connect throttle control cable to the swivel lever. Secure cable to engine plate with R-clamp (Fig. 24).

7. Connect wire harness and electrical wires to the engine as follows:

A. Connect wire and connector to the alternator, red cable to starter, three wires to the starter, wire to the oil pressure switch, and wires to high temperature warning and shutdown switches (Fig. 20).

B. Connect electrical connector to the fuel solenoid (Fig. 22).

C. Connect red/black wire to the glow plug bus bar (Fig. 23).

8. Connect the following fuel hoses:

A. Suction hose at the injector pump from the fuel filter. Suction and discharge hoses at the fuel pump (Fig. 22).

B. Return hose from the fuel injectors (Fig. 23).

C. Remove clamps used to prevent drainage.

9. Position fan shroud to the radiator. Install fan to the fan pulley (Fig. 21).

A. Apply Loctite (Blue) 242 or equivalent to the ends of the cap screws.

B. Torque cap screws from 80 to 110 in-lb (92 to 127 kg-cm).

10. Install fan shroud and guard to the radiator (Fig. 20).

11. Install exhaust shield to the engine (Fig. 20).

12. Install air hose to air intake manifold (Fig. 20).

13. Install battery the machine and connect cables (see Battery Service in Chapter 5 – Electrical Systems).

14. Connect both hoses to the radiator (Fig. 20).

15. Secure canopy to the brackets (Fig. 19).

16. Fill radiator with coolant (see Check Cooling System).

17. Adjust control cable throttle cable (Fig. 24).

A. Push throttle lever to the FAST position.

B. Loosen screw on swivel that secures the cable to the swivel lever.

C. Adjust position of swivel lever with cable so the injector pump lever is contacting the stop in the full throttle position.

D. Secure cable to swivel with screw.

18. Prime fuel system (see Prime Fuel System).

19. Check traction pedal adjustment for NEUTRAL.



Hydraulic System

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Hydraulic System

Specifications

Item	Description
Traction Pump Traction Relief Pressure Charge Pressure	Variable displacement axial piston pump 5000 – 5200 PSI 50 – 150 PSI (2WD) 75 – 150 PSI (4WD)
Steering Pump Steering Relief Pressure	Gear pump with flow divider 1200 – 1300 PSI
Traction Motor (front)	Fixed axial piston motor
Traction Motor (rear w/4WD)	Geroter type wheel motors
Reel Pump Cutting Circuit Relief Pressure	Gear pump 2650 – 2750 PSI
Reel Motor Cross-over Relief Pressure	Gear Motor 1500 PSI
Lift Control Valve Lift Relief Pressure Counterbalance Pressure (Max. RPM)	Spool type directional control valve 2650 – 2900 PSI Hot oil 500 – 550 PSI, cold oil 600 – 650 PSI
Hydraulic Filter (Fig. 1)	Spin-on cartridge type
Hydraulic Oil	Mobil DTE 26/Shell Tellus 68 or equivalent (see Add Hydraulic Fluid)
Reservoir (Fig. 2)	Reservoir capacity 15 gal. U.S. System capacity approximately 18.2 gal. U.S.

General Information

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as, pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions or mishandling during operation or maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint on the hose. Use two wrenches; one to hold the hose straight and one to tighten the hose swivel nut onto the fitting.



WARNING

Before disconnecting or performing any work on hydraulic system, all pressure in system must be relieved by stopping the engine and lowering or supporting the box and/or other attachment.

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and do serious damage. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.

Hydraulic Fitting Installation

O-Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Make sure the O-ring is installed and properly seated in the groove. It is recommended that the O-ring be replaced any time the connection is opened.
3. Lubricate the O-ring with a light coating of oil.
4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.
5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct flats from finger tight (F.F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	.75 ± .25
6 (3/8 in.)	.75 ± .25
8 (1/2 in.)	.75 ± .25
10 (5/8 in.)	1.00 ± .25
12 (3/4 in.)	.75 ± .25
16 (1 in.)	.75 ± .25

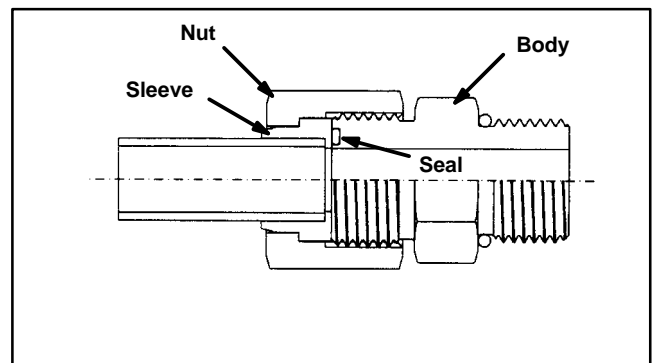


Figure 1

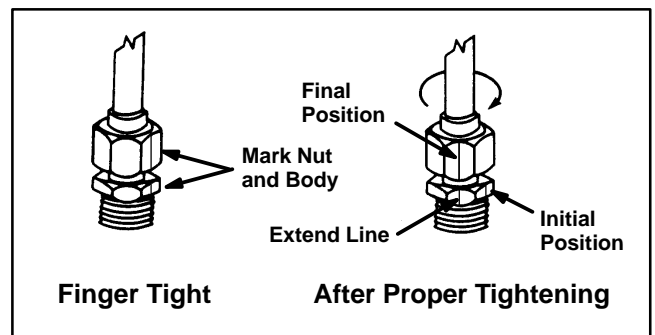


Figure 2

SAE Straight Thread O-Ring Port – Non-adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
3. Lubricate the O-ring with a light coating of oil.
4. Install the fitting into the port and tighten it down full length until finger tight.
5. Tighten the fitting to the correct flats from finger tight (F.F.F.T.).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± .25
6 (3/8 in.)	1.50 ± .25
8 (1/2 in.)	1.50 ± .25
10 (5/8 in.)	1.50 ± .25
12 (3/4 in.)	1.50 ± .25
16 (1 in.)	1.50 ± .25

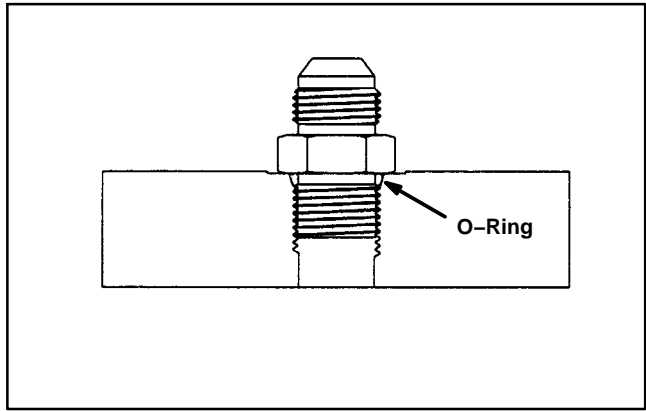


Figure 3

SAE Straight Thread O-Ring Port – Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
3. Lubricate the O-ring with a light coating of oil.
4. Turn back the jam nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1).
5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).
6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).
7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct flats from finger tight (F.F.F.T.) (Step 4).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± .25
6 (3/8 in.)	1.50 ± .25
8 (1/2 in.)	1.50 ± .25
10 (5/8 in.)	1.50 ± .25
12 (3/4 in.)	1.50 ± .25
16 (1 in.)	1.50 ± .25

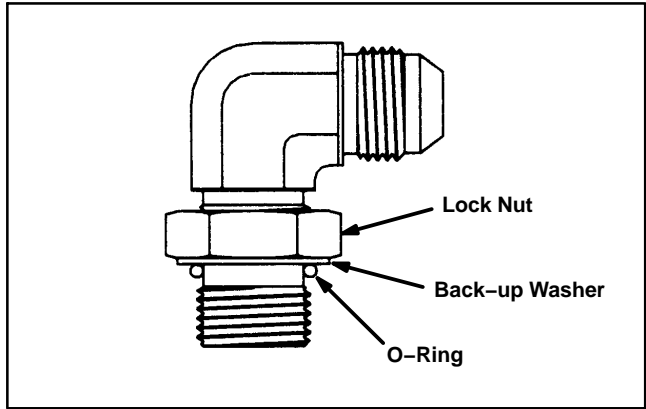


Figure 4

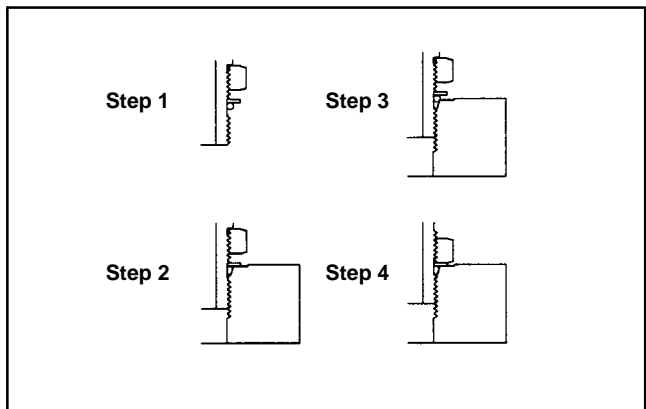


Figure 5

Pushing or Towing Traction Unit Using Traction Pump By-Pass Valve

In an emergency, the traction unit can be pushed or towed for a very short distance by using the traction pump by-pass valve.

IMPORTANT: Do not push or tow the traction unit faster than 2 to 3 MPH (3 to 5 Km/Hr) because the hydraulic system may be damaged. If traction unit must be moved a considerable distance, transport it on a truck or trailer.

1. Remove the retainer clip from seat lock rod.
2. Raise seat and support it in upright position with seat support rod (Fig. 6).

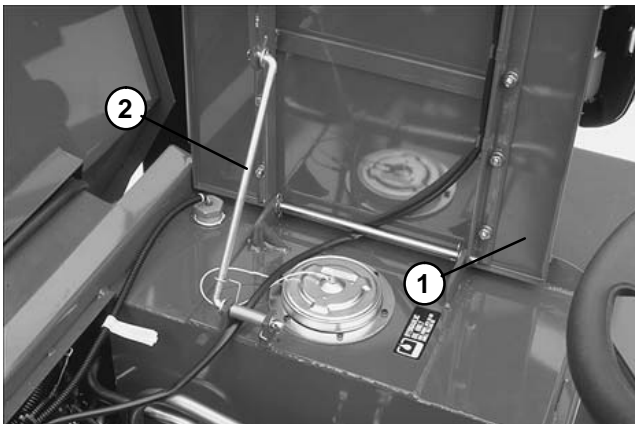


Figure 6

1. Seat
2. Support rod

3. Lift and remove front panel (Fig. 7).

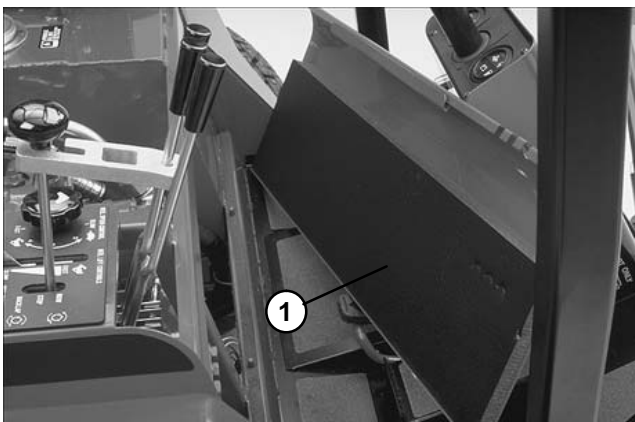


Figure 7

1. Front panel

4. Rotate by-pass valve 90 degrees. Opening the valve opens an internal passage in the traction pump, thereby by-passing hydraulic oil. Because oil is by-passed, traction unit can be moved without damaging the hydraulic system (Fig. 8).

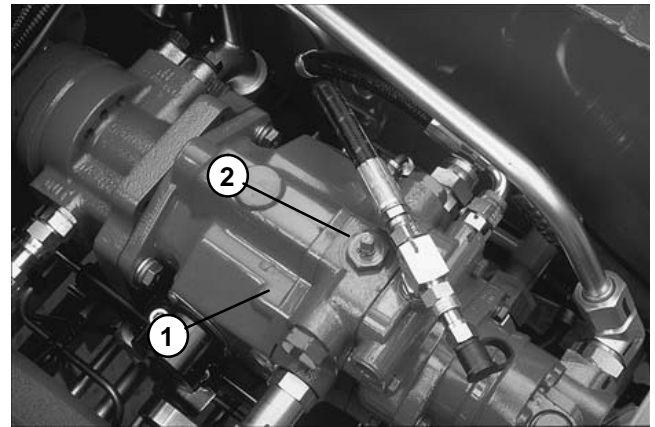


Figure 8

1. Traction pump
2. By-pass valve

IMPORTANT: Make sure that hand brake is engaged before opening the by-pass valve.

5. Before starting engine, close by-pass valve. Do not start engine when valve is open.

IMPORTANT: Running the machine with the by-pass valve open will cause the hydraulic system to overheat.



DANGER

Vehicle will roll with front wheel motors disengaged. Vehicle must be on level surface or wheels must be blocked. There is no effective braking with wheel motors disengaged.

If towing, with front wheel motors disengaged, Tow Bar Assembly, Toro part no. 58-7020, must be used.

Disengaging Planetary Wheel Drives

In an emergency, the Reelmaster 4500-D can be moved by unlocking the front wheel hubs and towing the machine.



DANGER

Vehicle will roll with front wheel motors disengaged. Vehicle must be on level surface or wheels must be blocked. There is no effective braking with wheel motors disengaged.

If towing with front wheel motors disengaged, Tow Bar Assembly, Toro part no. 58-7020, must be used.

NOTE: The machine can also be moved slowly a short distance by opening the by-pass valve on the variable displacement hydraulic pump and pushing or towing the machine (See Pushing or Towing in the General Information section of Chapter 4 – Hydraulic System).

1. Block the wheels or connect the machine to a towing vehicle with a rigid towing device.

2. Remove bolts securing disengage covers to both front wheel hubs (Fig. 9).



Figure 9

3. Install disengage covers so dimple on cover is facing in towards hub. Wheel hubs are now unlocked. (Fig. 10).



Figure 10

1. Disengage cover – engaged (dimple facing out)

4. Lock the wheel hubs immediately after towing is completed. Remove disengage covers and reinstall so dimple on cover is facing away from hub.



CAUTION

Do not remove wheel blocks or towing devices until wheel hubs are securely locked.

Check Hydraulic System Fluid

1. Look into sight glass (Fig. 11). Oil level should be even with arrows when checking warm oil. Oil will be 1/4 to 1/2 inch below arrows when cold.

2. If oil level is low, add hydraulic oil to the reservoir (see Add Hydraulic Fluid).

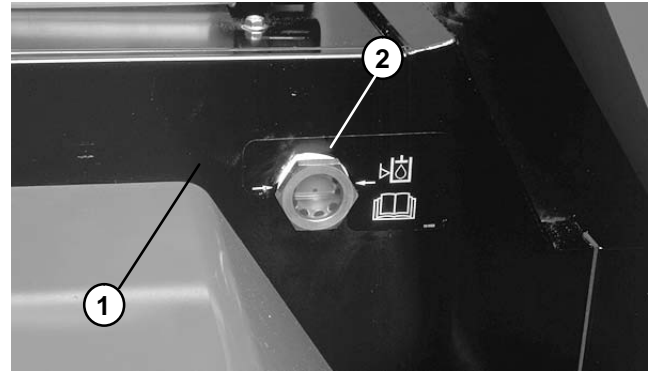
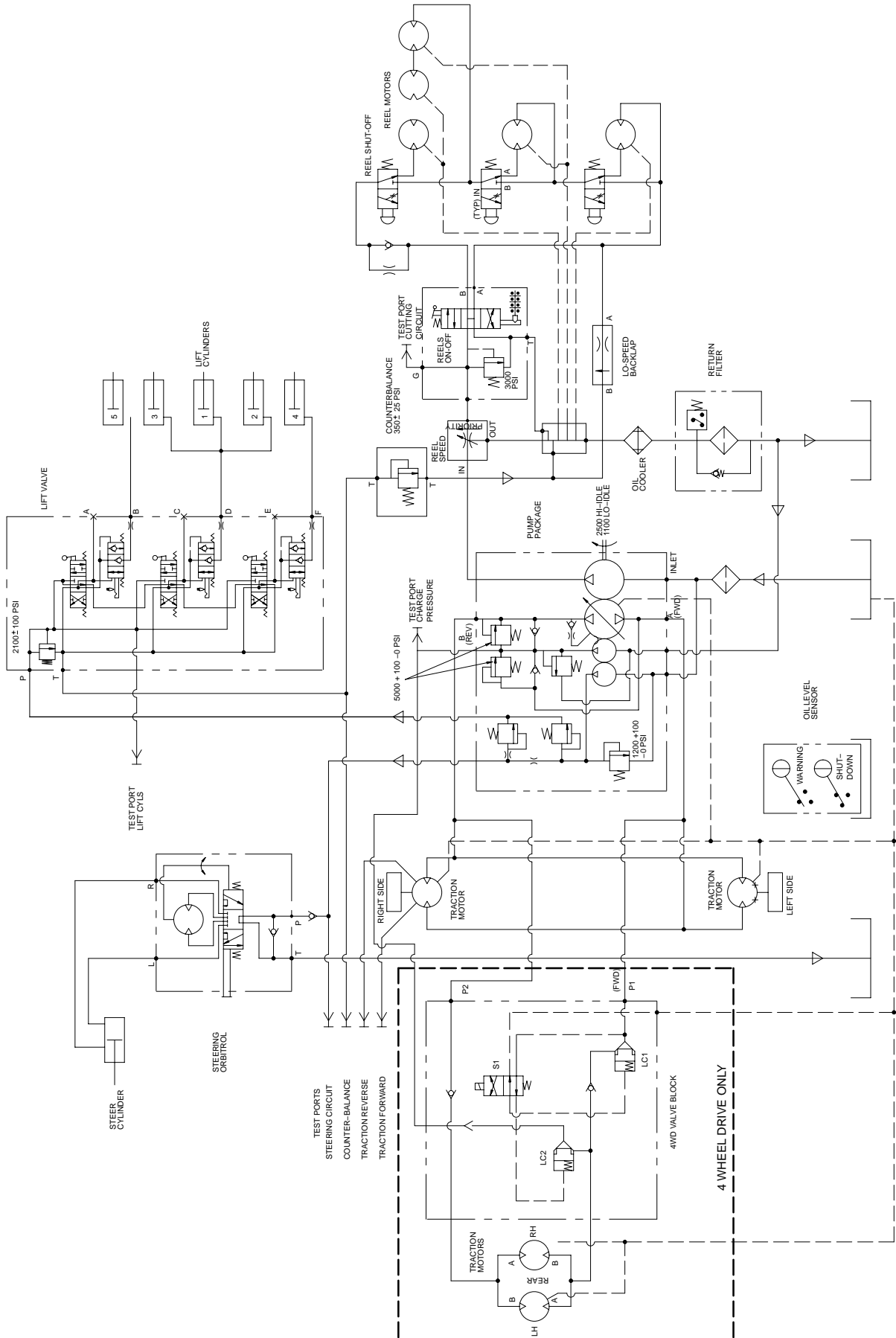


Figure 11

1. Hydraulic reservoir 2. Sight glass

Hydraulic Schematic



Hydraulic Flow Diagrams (2WD Machines Only)

General Pump Flow

Refer to “Engine Run – No Functions” Flow Diagram

The traction, reel, and auxiliary pumps are directly coupled to the engine. With all controls in neutral and the engine running, the steer–lift pump draws oil through the suction line from the reservoir. Priority output flow is directed to the steering function. Excess flow exits the secondary output of the pump and is directed to the lift valve.

The flow continues through the lift valve where it meets the counterbalance valve. The counterbalance valve “super–charges” the incoming oil before allowing the oil to continue on its return path back to the sump tank. The counterbalance pressure may be monitored at pressure tap port 3.

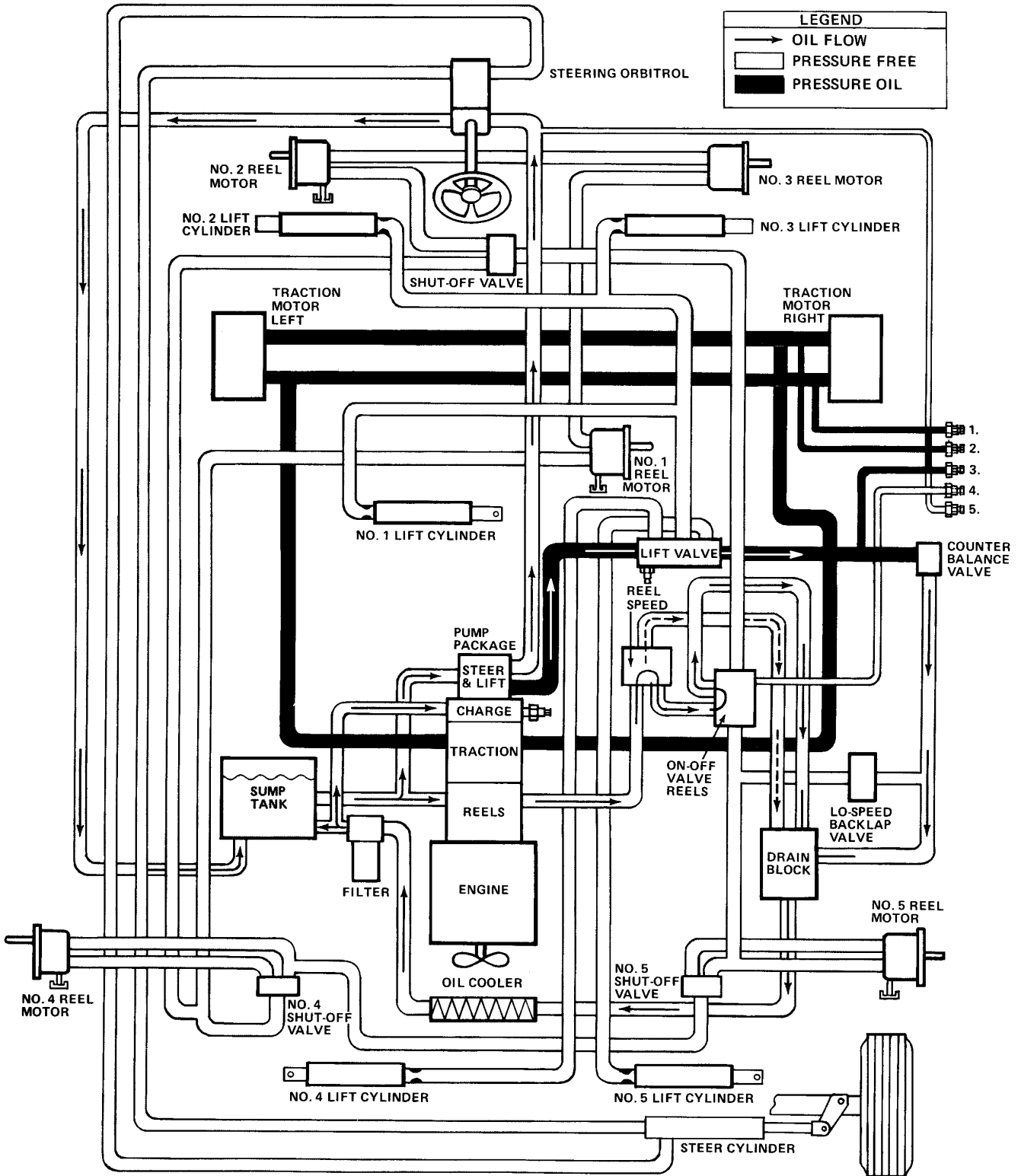
The oil pressure provided by the counterbalance valve will be used to reduce the cutting unit weight on the turf during the mowing function.

After joining with oil returning from other functions through the drain block, the oil flows through the oil cooler to dissipate heat from the hydraulic system and then through the filter to collect any particles in the hydraulic system.

Clean oil is collected at the filter by the charge pump. This oil is used to maintain a supply of oil to the closed–loop traction circuit to prevent cavitation. The charge pressure is regulated by a relief internal to the traction pump. The charge pressure may be monitored at the pressure tap port on top of the charge pump.

Oil collected by the reel pump is directed to the reel speed valve and split into two variable flows. Primary oil is directed to the reel “On–Off” control valve. With the valve in the “Off” position, the oil is returned directly to the drain block. The remaining oil will also return to the tank through the drain block.

Engine Run – No Functions



Traction Circuit

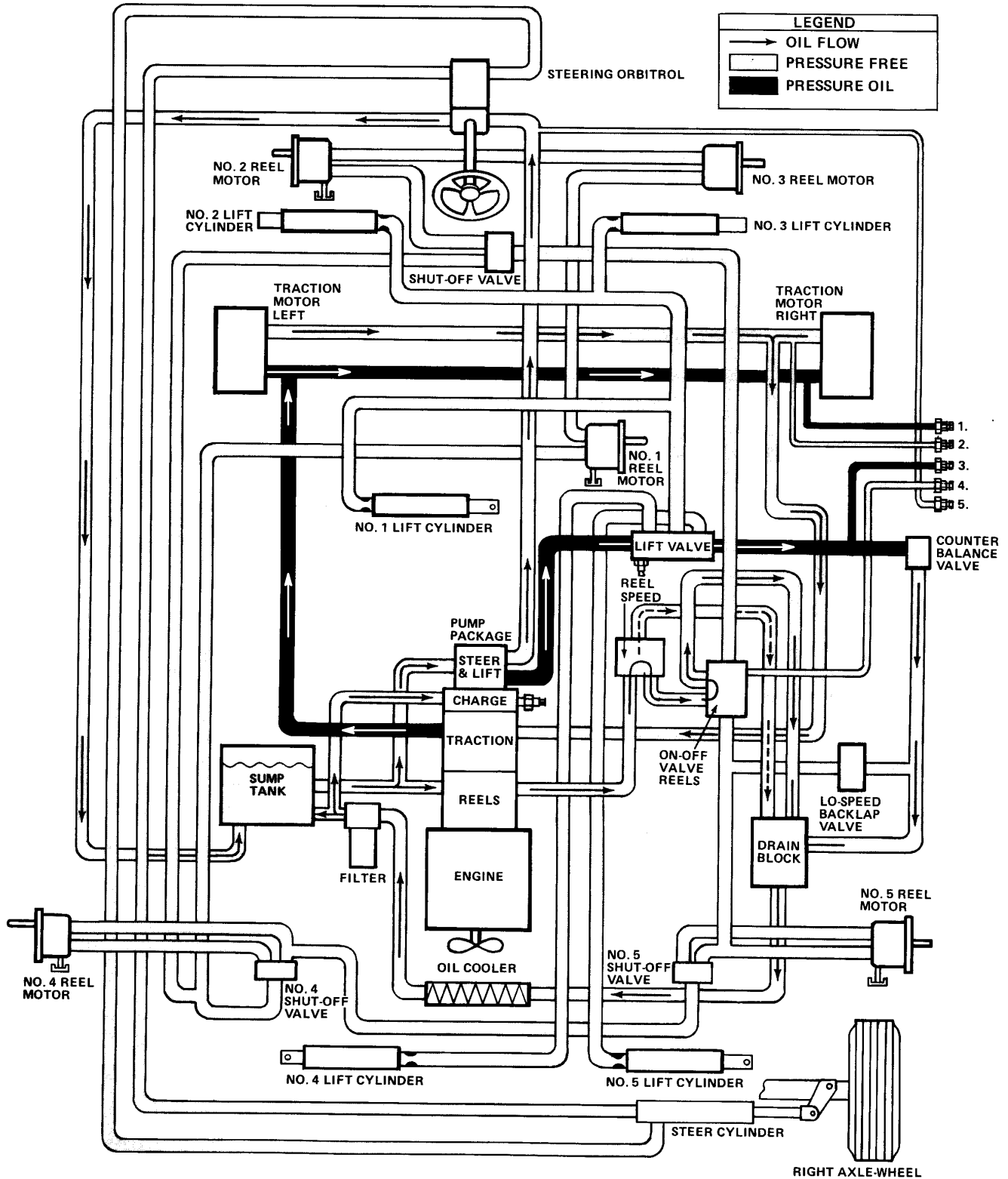
Refer to “Traction Circuit – Forward” Flow Diagram

A mechanical interlock between the traction pedal linkage and the parking brake prevents traction pedal movement unless the brake is released.

Depressing the top of the traction pedal will shift the traction pump swash plate to direct a flow of oil to the forward

inlet of the traction motors. The oil returns from the motor to the pump where it continues through the pump in a closed-loop circuit. System pressure may be monitored at pressure tap port 1.

Traction Circuit – Forward



Steering Circuit

Refer to “Steering Right” Flow Diagram

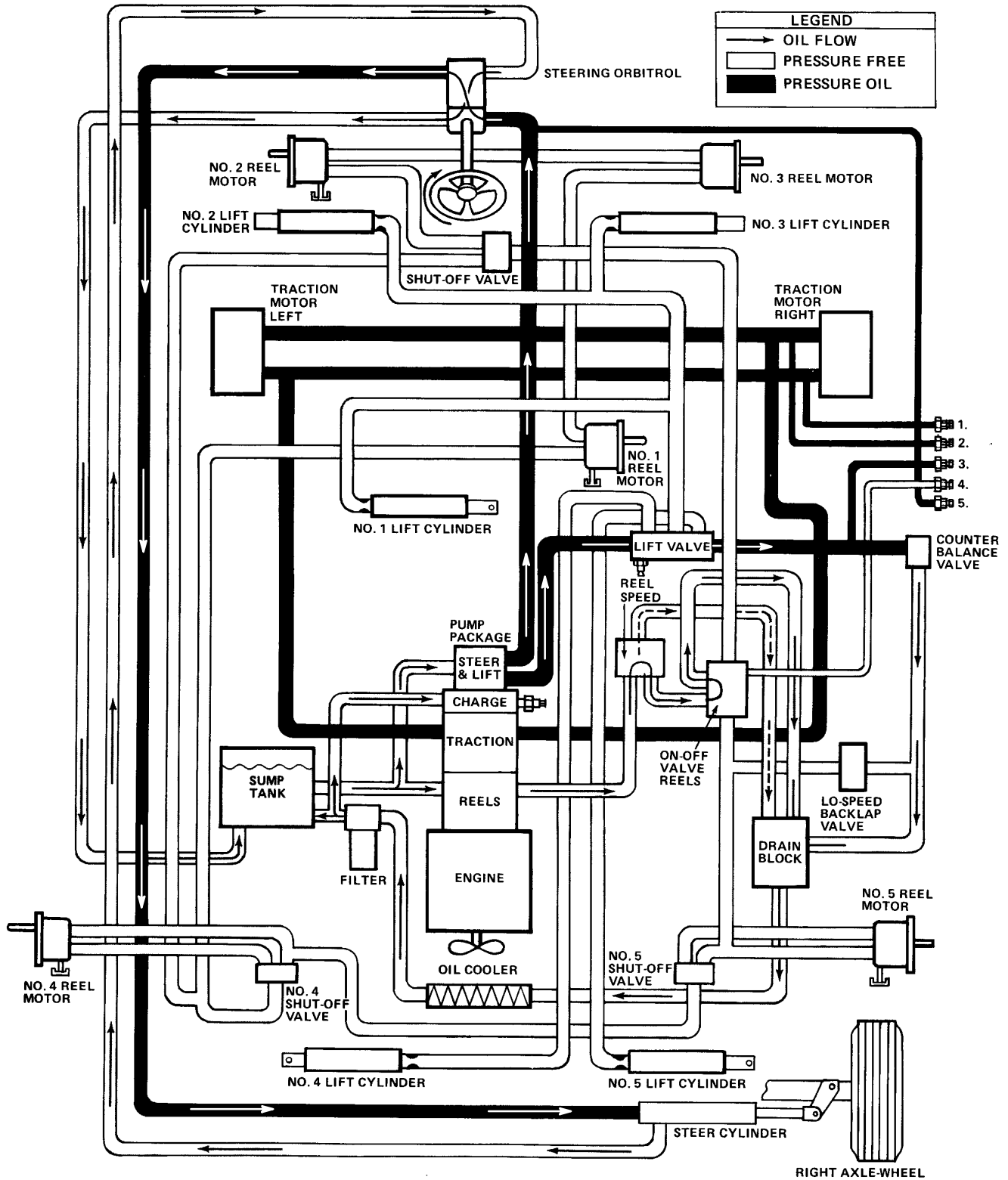
With the engine running, the priority flow of oil from the steer–lift pump is directed to the power steering unit at the base of the steering column and returns to the reservoir.

Turning the steering wheel to the right moves the control spool in the steering unit to direct the oil to the steering

cylinder for a right–hand turn. Turning the steering wheel to the left has the opposite effect. Cylinder movement returns oil from the low pressure side back through the power steering unit to the reservoir.

System pressure may be monitored at pressure tap port 5.

Steering Right



Lift/Lower Circuit

Refer to “Lift Circuit” Flow Diagrams

The lift cylinders are controlled by an open center valve with three spools. The number 4 and 5 cutting units are independently controlled. The center spool controls the number 1, 2, and 3 cutting units.

To lift the cutting units, the engine must be running above half throttle. The flow of oil from the steer and lift pump is used to accomplish the lift function. Holding a lever in the “LIFT” position will direct the flow of oil to the lift cylinder and raise the cutting unit. Oil pressure to the lift cylinder is monitored during LIFT by a relief at the valve inlet. System pressure may be monitored at the pressure tap port on the lift valve.

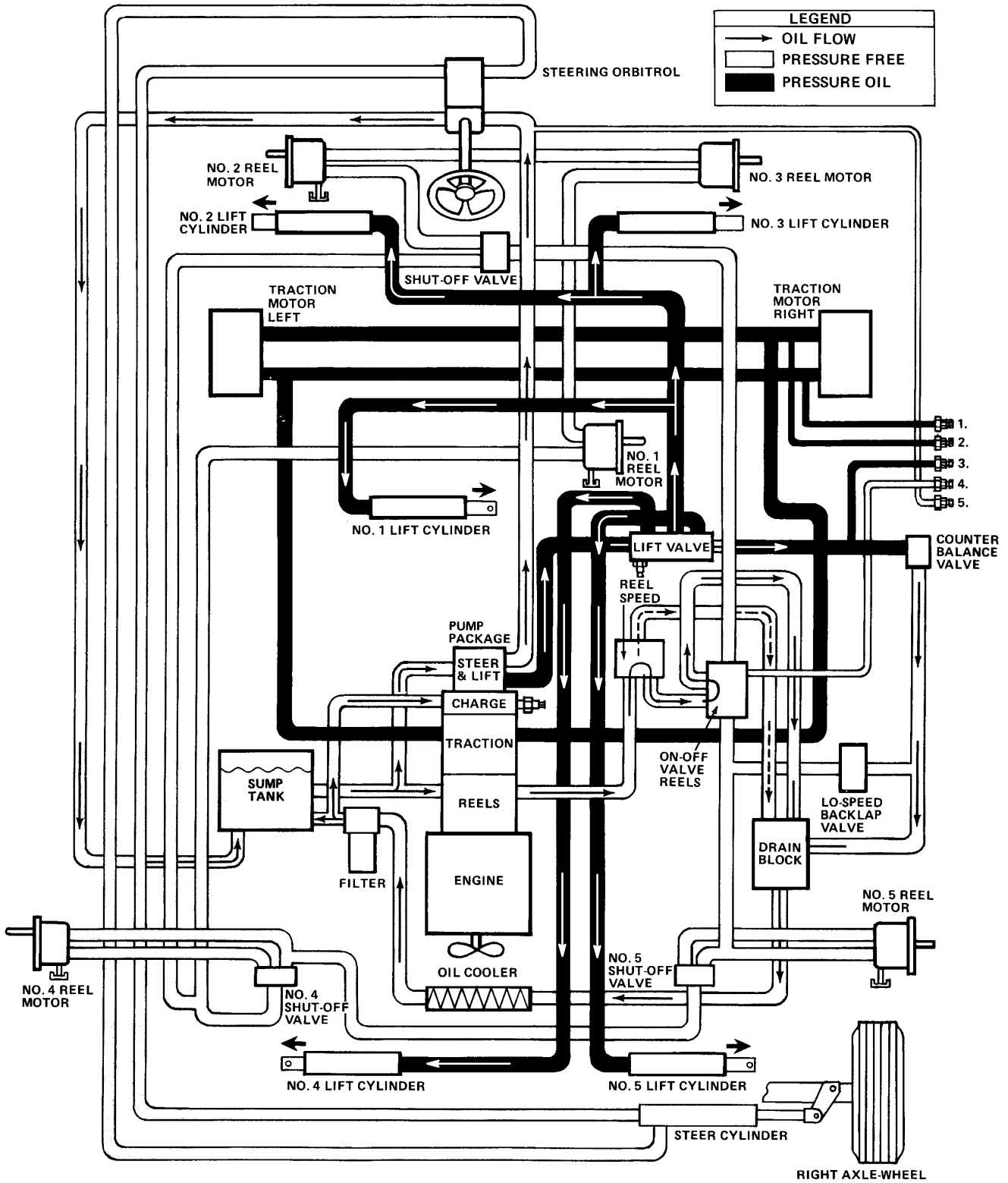
Moving the lever forward will open a path for oil to escape from the lift cylinder. The weight of the cutting unit will push oil from the cylinders through the valve allowing the cutting unit to lower. Moving the lever into “LIFT”

while the cutting unit is lowering will lock the cutting unit at any position by trapping oil between the valve and cylinder.

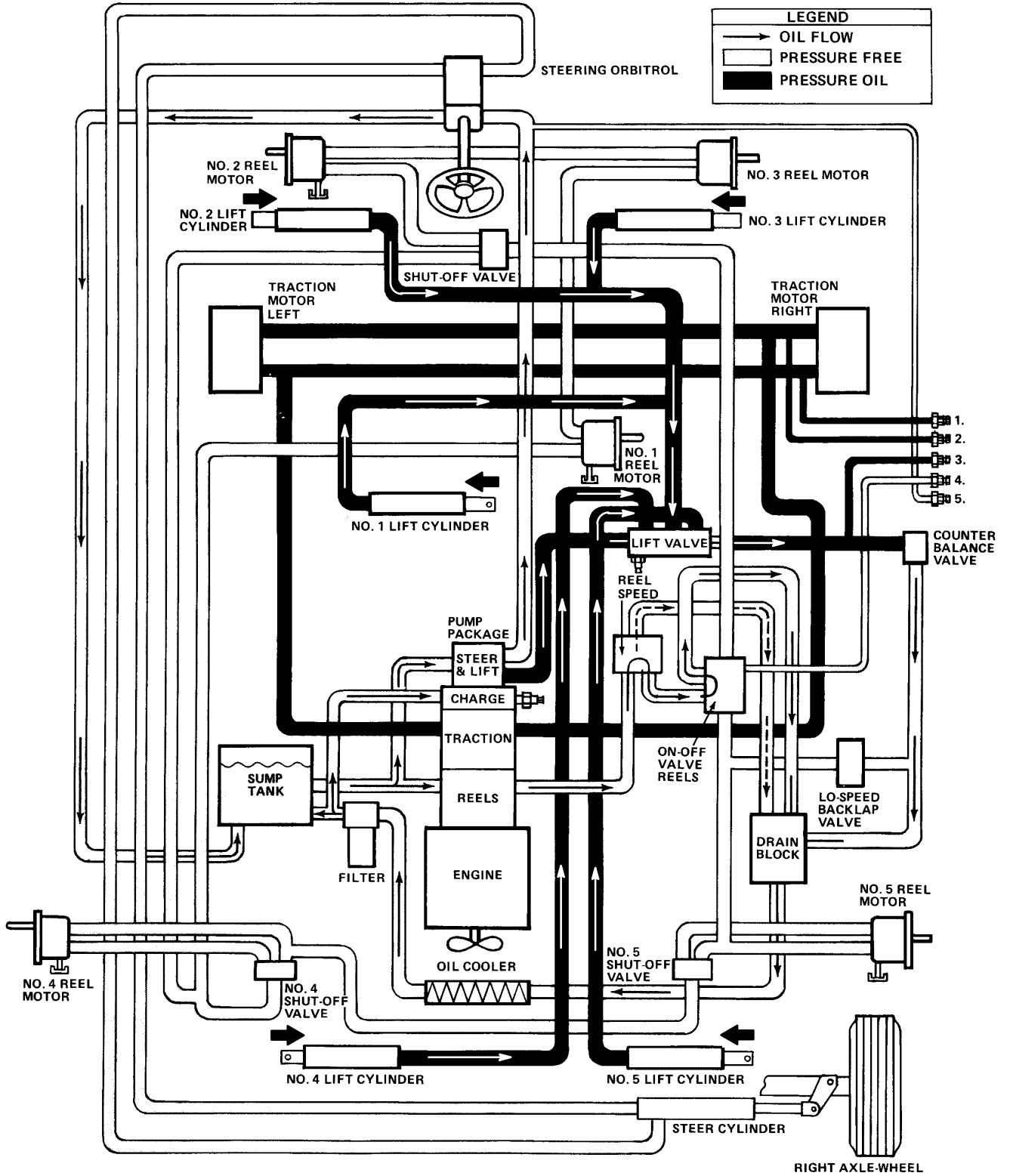
The cylinders work against counterbalance pressure during lowering. For this reason, the cutting units will drop faster at slow engine speeds or low counterbalance pressures compared to full engine speed or high counterbalance pressures. The counter balance pressure may be monitored at pressure tap port 3.

Since the lift levers are spring loaded from return to neutral, a detent plunger latches the spool in the valve to hold the spool in a “Free Float” position. The position enables the cutting units to follow ground contours by allowing a two-way flow between the lift valve and lift cylinders.

Lift Circuit – Lift All Units

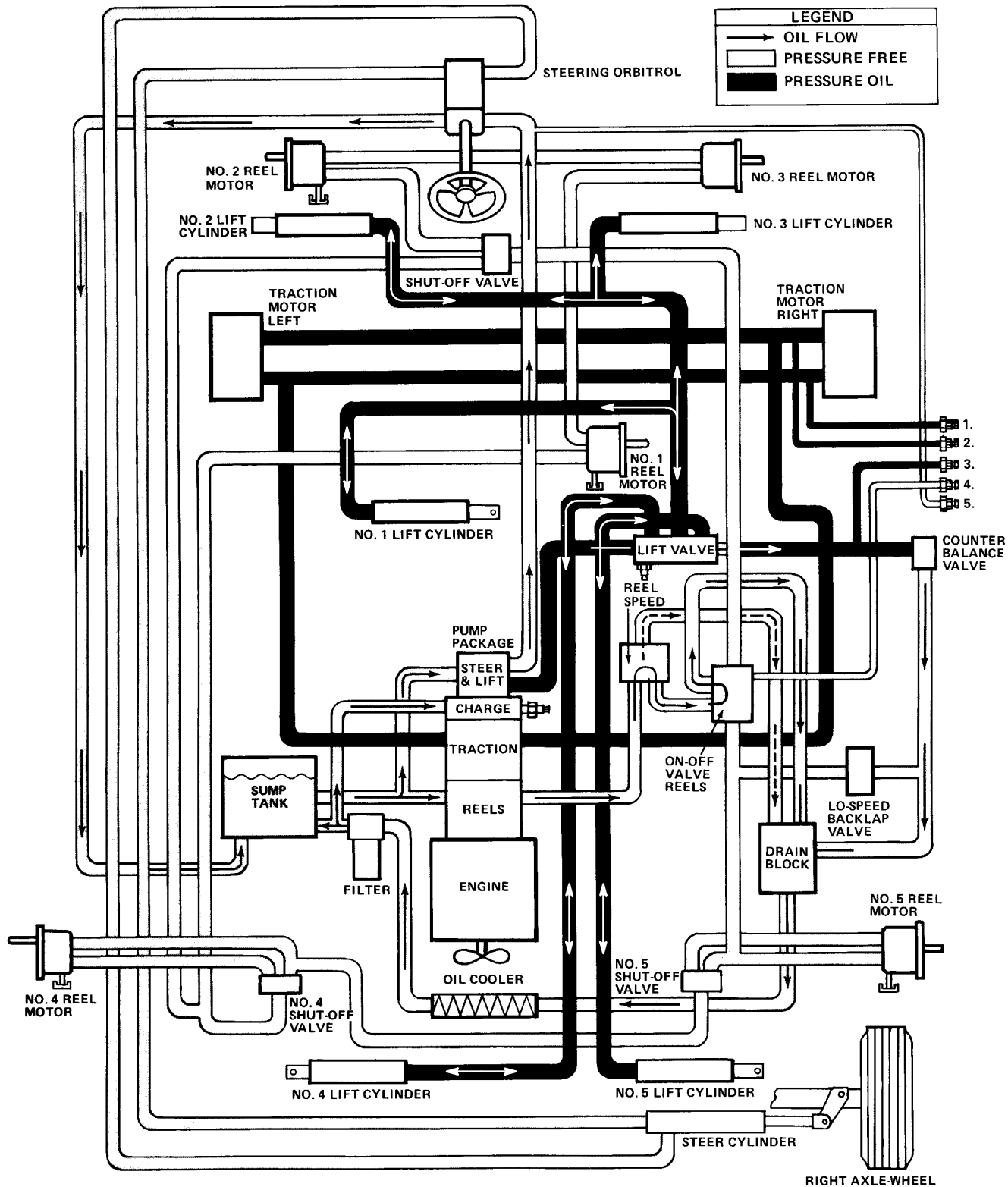


Lift Circuit – Lower All Units



Hydraulic System

Lift Circuit – Free Float (Detent)



Reel Circuit

Refer to “Reel Circuit” Flow Diagrams

The three reel shut-off valves in this circuit enable the cutting units to be operated in several configurations for easier control, better clearance, or closer trimming.

The reel pump supplies a constant flow of oil to the reel speed control valve. The reel speed is variable and adjustable by the operator to supply a flow of oil to the reel “On-Off” valve. Oil not needed to obtain the selected reel speed is directed back to the sump tank through the drain block, oil cooler, and filter.

When the reel “On-Off” valve lever is moved into “Mow” to engage the reels, a spool in the valve is shifted to direct oil to the shut-off valve at the front of the unit. With the Number 1, 2, and 3 cutting units in mowing position, the shut-off valve will allow oil to flow to the Number 2, 3, and 1 reel motors. The oil is also available for use at the Number 4 shut-off valve. If the Number 1, 2, and 3 cutting units are in the raised position, the oil will bypass these motors and be available directly to the Number 4 shut-off valve.

With the Number 4 cutting unit in the down and mowing position, the Number 4 shut-off valve will allow the oil through to drive the reel motor and then to the Number

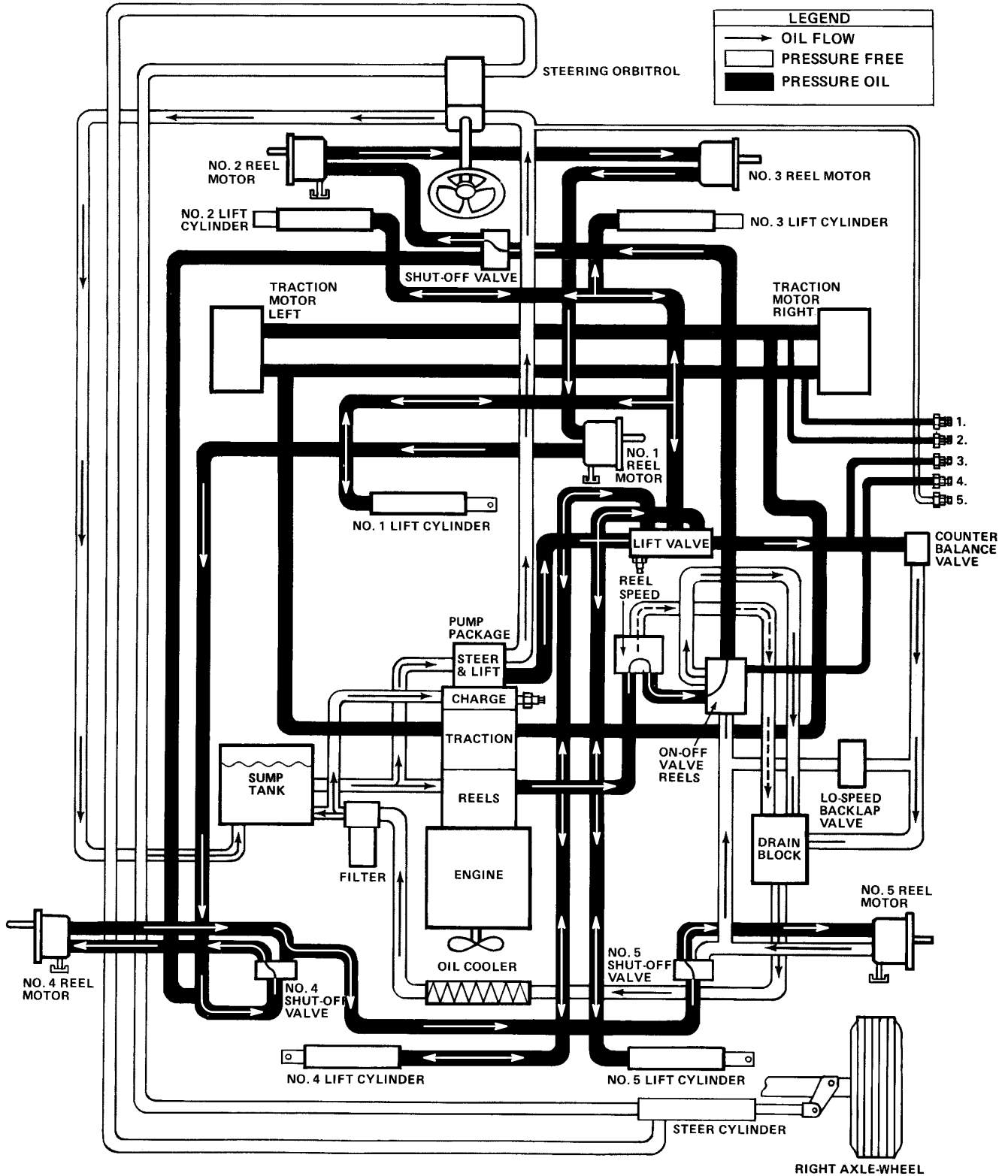
5 shut-off valve. If the Number 4 cutting unit is in the raised position, the oil will bypass the Number 4 reel motor and be available directly to the Number 5 shut-off valve.

With the Number 5 cutting unit in the down and mowing position, the Number 5 shut-off valve will allow the oil through to drive the reel motor. If the Number 5 cutting unit is in the raised position, the oil will bypass the Number 5 reel motor and return to the reel “On-Off” valve. From the reel “On-Off” valve, the oil returns to the sump tank through the drain block, oil cooler, and filter.

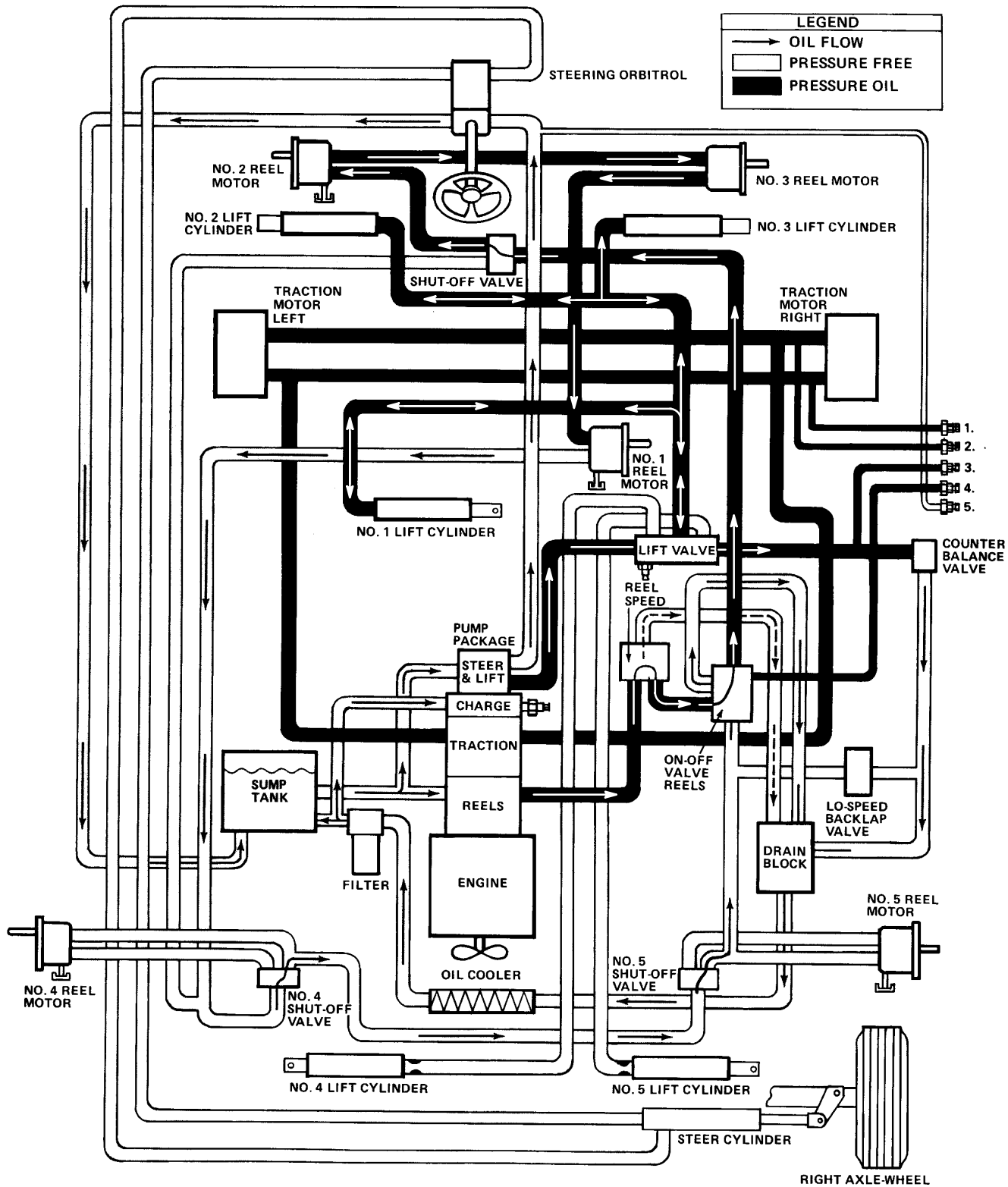
“Backlap” is provided by pulling the reel “On-Off” valve lever up and back. The backlap function requires that the lever be held in this position for safety. The direction of flow in “Backlap” is the opposite of “Mow”. Some units will include a low-speed backlap valve in the circuit to remove some oil flow from the circuit during the backlap function. The reduced oil flow results in a slower reel speed in “Backlap”, but does not affect performance during “Mow”.

System pressure may be monitored at pressure tap 4 for either “Mow” or “Backlap”.

Reel Circuit – All Units Mow (Free Float)

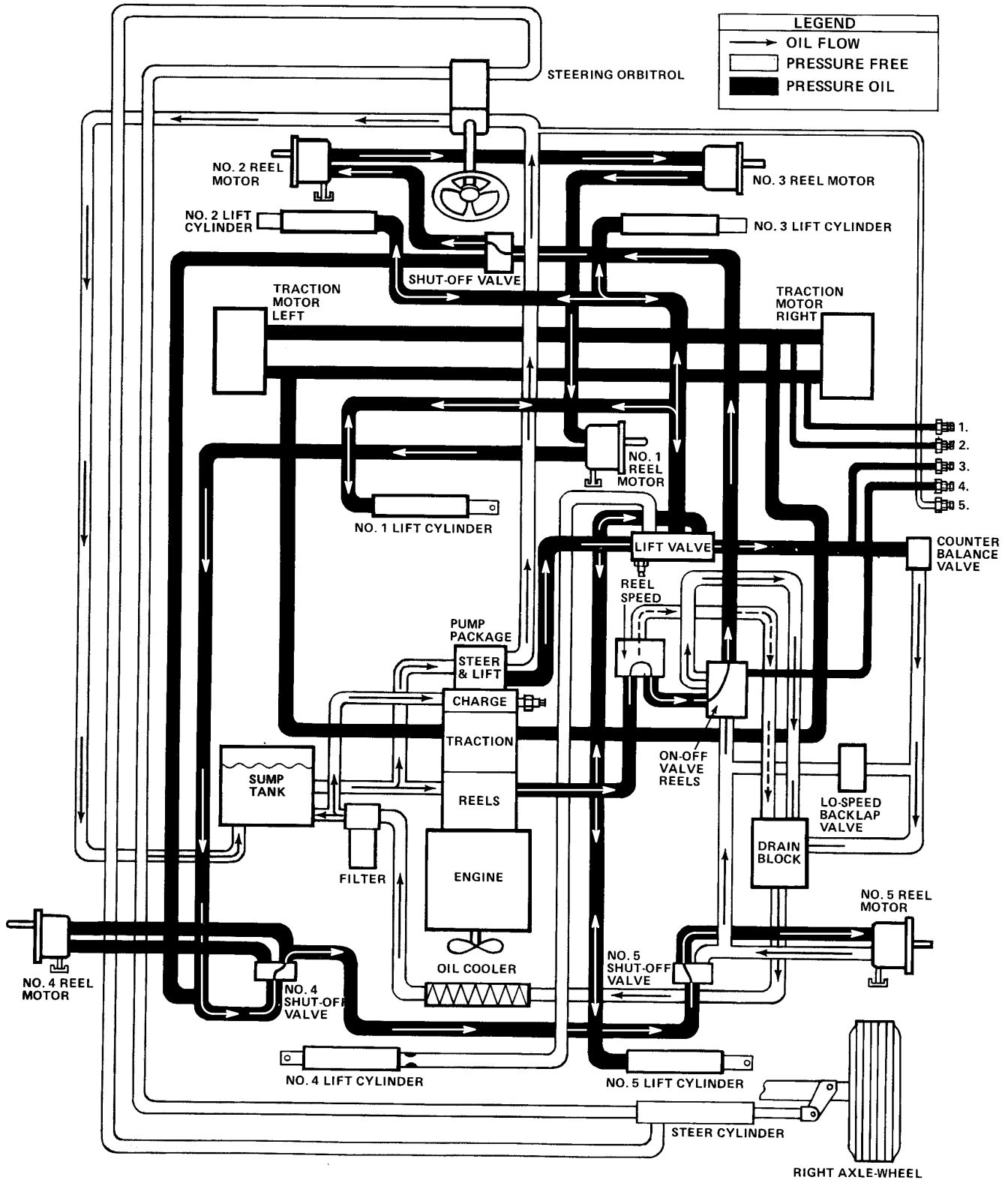


Reel Circuit – Units 1, 2 & 3 Mow (Free Float)

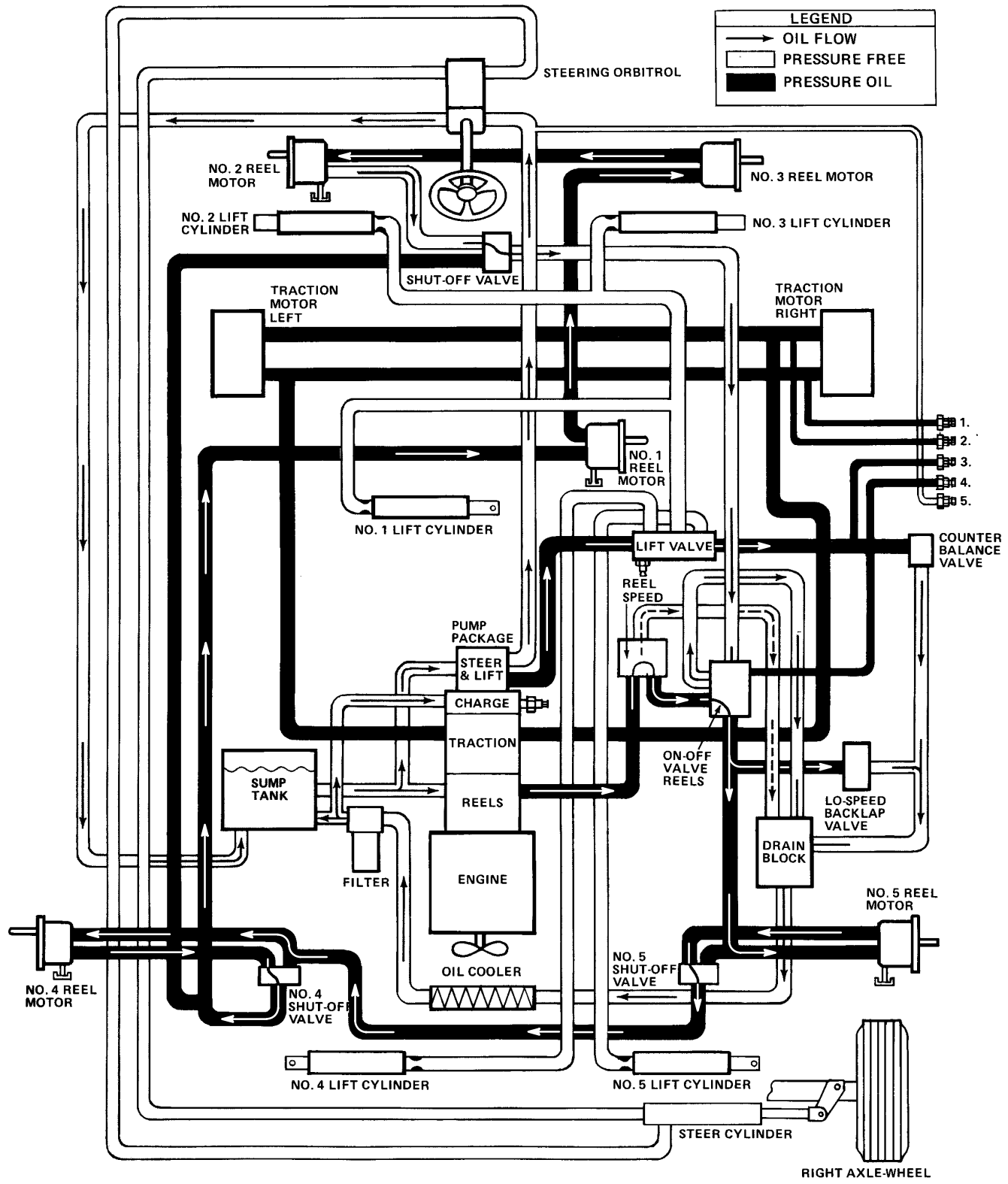


Hydraulic System

Reel Circuit – Units 1, 2, 3 & 5 Mow (Free Float)



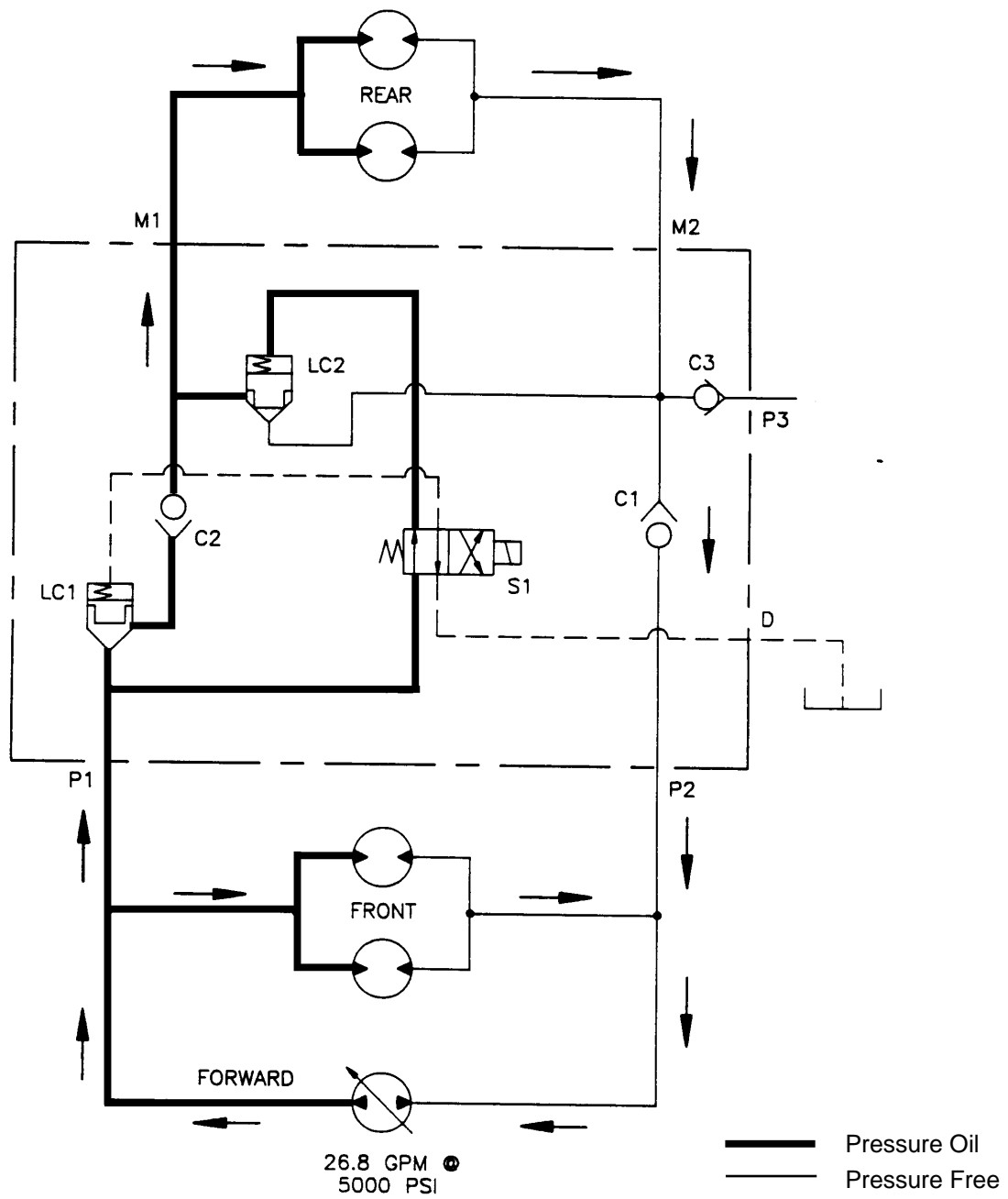
Reel Circuit – Any Unit Backup



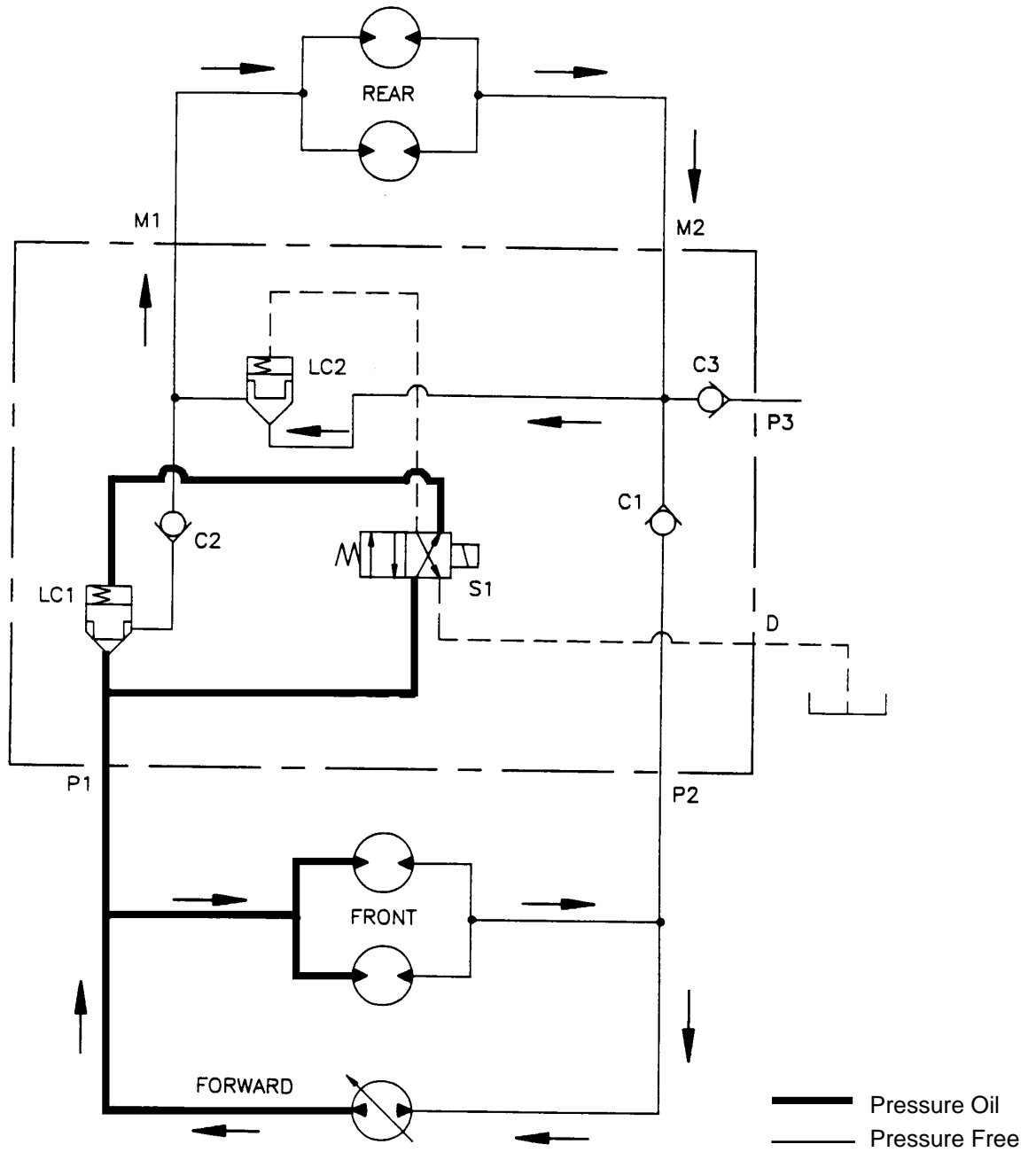
Hydraulic System

4WD Selector Valve Operation

4WD Forward ("S1" OFF)



2WD Forward ("S1" ON)



Hydraulic System

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Hydraulic Tester – With Pressure and Flow Capabilities – TOR214678

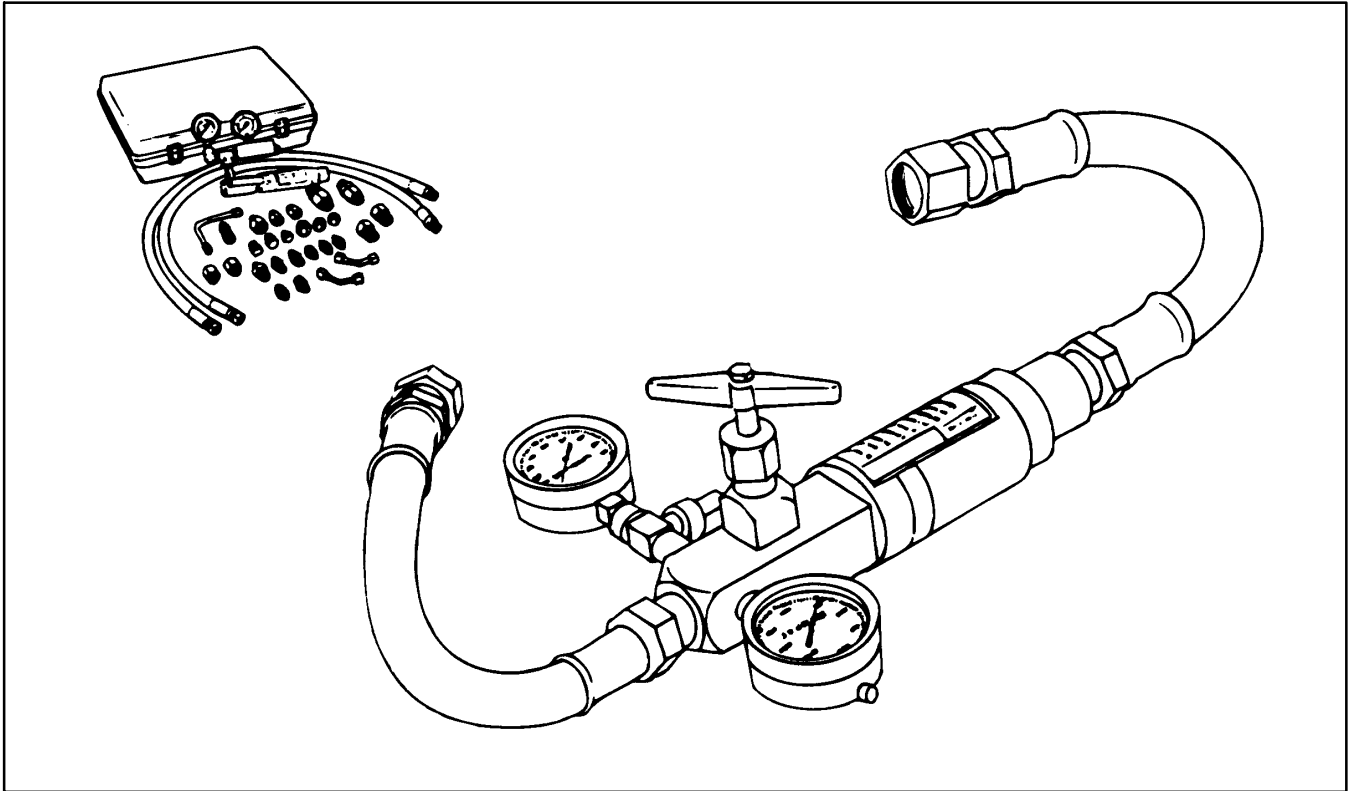


Figure 12

You must have o-ring face seal (ORFS) adapter fittings for this tester to use it on Toro equipment.

1. **INLET HOSE:** Hose connected from the system circuit to the inlet side of the hydraulic tester.
2. **LOAD VALVE:** If required, upon turning the valve to restrict flow, a simulated working load is created in the circuit.
3. **LOW PRESSURE GAUGE:** Low range gauge to provide accurate reading at low pressure, 0 – 1000 PSI.

This gauge has a protector valve which cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. **HIGH PRESSURE GAUGE:** High range gauge to accommodate pressure beyond the capacity of the low pressure gauge, 0 – 5,000 PSI.
5. **FLOW METER:** This meter measures actual oil flow in the operation circuit, with a gauge rated at 15 GPM.
6. **OUTLET HOSE:** Hose from the outlet side of the hydraulic tester to be connected to the hydraulic system circuit.

Hydraulic Pressure Test Kit – TOR47009

Use to take various pressure readings for diagnostic tests. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.



Figure 13

Hydraulic Test Fitting Kit – TOR4079

This kit includes a variety of O-ring Face seal fittings to enable you to connect test gauges into the system.

The kit includes: tee's, unions, reducers, plugs, caps, and male test fittings.

Toro Test Fitting Kit TOR4079			
Fitting	Tool Number		
	1/2" x 1/2" x 1/2" Tee 2 Each Toro Tool Number No. 4 No. 6 No. 8 No. 10		Union 1 Each Toro Tool Number No. 4 to No. 8 No. 10 to No. 8 No. 12 to No. 8
	Plug 2 Each Toro Tool Number No. 4 No. 6 No. 8 No. 10		Reducer 1 Each Toro Tool Number No. 10 to No. 8 No. 12 to No. 8
	Cap 2 Each Toro Tool Number No. 4 No. 6 No. 8 No. 10		Test Cap Fitting 2 Each Toro Tool Number No. 4 No. 6 No. 8 No. 10
			Test Fitting 2 Each Toro Tool Number 7/16"-20 1/8" Pipe thread

Figure 14

Hydraulic System

Troubleshooting

The cause of an improperly functioning hydraulic system is best diagnosed with the use of proper testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic system with an excessive increase in heat or noise is a potential failure. Should either of these conditions be noticed, immediately stop the machine, turn off the engine, locate the cause of the trouble, and correct it before allowing the machine to be used again.

Continued use of an improperly functioning hydraulic system could lead to extensive internal component damage.

The charts that follow contain information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific test procedures.

Problem	Possible Causes
Hydraulic oil leak(s).	Fitting(s), hose, or tube loose or damaged. Missing or damaged o-ring.
Slow or no traction in either direction.	Low engine RPM. Low hydraulic oil level. Open or damaged traction pump by-pass valve. Disengaged or damaged final drive. Loose or damaged traction linkage. Low charge pressure. (See Test No. 8.) Low traction pressure. (See Test No. 1.) Damaged or worn traction motors.
Reels slow or won't turn.	Low engine RPM. Low hydraulic oil level. Reel to bedknife adjustment too tight. Improper reel drive motor belt adjustment. Low reel shut-off valves. Low reel system pressure. (See Test No. 3.) Worn or damaged priority flow divider. Low flow to reel motors. (See Test No. 4.) Inefficient reel motor. (See Test No. 5.)

Problem	Possible Causes
Steering loss.	<p>Thermal shock after washing.</p> <p>NOTE: Normal functions will return after orbital temperatures stabilize (approximately 15 minutes). DO NOT ATTEMPT TO TURN STEERING WHEEL UNTIL TEMPERATURES STABILIZE WHEN THERMAL SHOCK IS NOTED.</p> <p>Improper cylinder action.</p> <p>Low steering relief pressure. (See Test No. 6.)</p> <p>Worn or damaged steering cylinder.</p> <p>Worn or damaged steering pump.</p> <p>Worn or damaged steering control unit.</p>
Cutting units lift slowly or won't lift.	<p>Low engine RPM.</p> <p>Low hydraulic oil level.</p> <p>Binding lift arm pivot points or bushings.</p> <p>Worn or damaged bushings.</p> <p>Worn or damaged cylinders.</p> <p>Improper counterbalance pressure. (See Test No. 2.)</p> <p>Worn or damaged counterbalance valve.</p> <p>Low lift relief pressure. (See Test No.7.)</p> <p>Plugged cylinder orifice.</p> <p>Worn or damaged lift valve.</p> <p>Worn or damaged steering/lift pump.</p>
Cutting units won't drop or follow ground contours.	<p>Low engine RPM.</p> <p>Low hydraulic oil level.</p> <p>Binding lift arm pivot points or bushings.</p> <p>Worn or damaged bushings.</p> <p>Worn or damaged cylinders.</p> <p>Improper counterbalance pressure. (See Test No. 2.)</p> <p>Worn or damaged counterbalance valve.</p> <p>Plugged cylinder orifice.</p> <p>Worn or damaged spool detent in lift valve.</p> <p>Worn or damaged lift valve.</p>


Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks. (See the Special Tools section in this Chapter.)

Before Performing Hydraulic Tests


IMPORTANT: All obvious areas such as oil supply, filter, binding linkages, loose fasteners, or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

Precautions for Hydraulic Testing

 CAUTION
<p>Failure to use gauges with recommended pressure (psi) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.</p> <p>All testing should be performed by two (2) people. One person should be in the seat to operate the machine, and the other should read and record test results.</p>

 CAUTION
<p>Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.</p>

 WARNING
<p>Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. Stop engine; lower or support attachments.</p>

 WARNING
<p>Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use hands to search for leaks; use paper or cardboard. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.</p>

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of components.
2. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.
3. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings.
4. The inlet and the outlet hoses must be properly connected and not reversed (tester with pressure and flow capabilities) to prevent damage to the hydraulic tester or components.
5. When using tester with pressure and flow capabilities, open load valve completely in the hydraulic tester to minimize the possibility of damaging components.
6. Install fittings finger tight and far enough to make sure that they are not cross-threaded before tightening them with a wrench.
7. Position tester hoses to prevent **rotating** machine parts from contacting and damaging the hoses or tester.
8. Check oil level in the hydraulic tank. After connecting test equipment, make sure tank is full.
9. Check control linkages for improper adjustment, binding, or broken parts.
10. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

TEST NO. 1: Check Traction Circuit Working and Relief Pressures

Procedure for Working Pressure Check:

1. Install a 10,000 psi gauge into the quick disconnect test port for the function to be checked.

NOTE: If the machine is equipped with 4WD, check working pressure in both 2WD and 4WD modes.

2. Operate the unit while monitoring gauge.

RANGE OF TESTER READINGS: 50 – 5200 PSI

NOTE: Typical working pressure during operation while going uphill, would be approximately 4000 PSI in 2WD and 2500 PSI in 4WD.

3. If working pressure is too low in 2WD, perform the traction circuit relief pressure check.

NOTE: If pressure is good in 2WD but too low in 4WD, check the cartridge valve seals in the 4WD valve block. If 4WD pressure is low after making repairs to the valve block the rear wheel motor(s) should be suspected of wear and inefficiency. Maximum allowable bypass for each rear wheel motor is 2 GPM.

Procedure for Relief Pressure Check:

1. Hydraulic oil must be at operating temperature.

2. Install a 10,000 psi gauge into the traction circuit quick disconnect for the function to be checked.

3. Set traction pedal stop for minimum ground speed (1 mph).

4. Start the engine and move throttle to full speed (2500 rpm) and release the parking brake.

5. Carefully drive the machine into position so it will push against a strong wall or other immovable obstacle. Continue an attempt to go forward with the machine against the obstacle and read the pressure gauge.

TESTER READING TO BE APPROXIMATELY
5000 – 5200 PSI

6. If traction pressure is too low, inspect the traction pump check valves and relief valves. Clean or replace relief valve(s) or check valves as necessary. If check valves and relief valves are in good condition, the traction pump and / or motors should be suspected of wear and inefficiency.

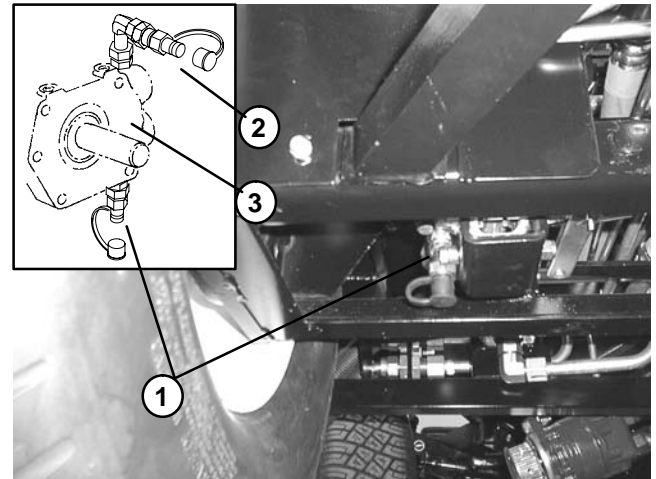


Figure 15

1. Reverse test port
2. Front wheel motor (RH)
3. Forward test port

TEST NO. 2: Check Counterbalance Oil Pressure

Procedure:

1. Install a 10,000 psi gauge into the center quick disconnect as shown.
2. Start the engine and move throttle to full speed (2500 rpm).
3. Tester reading should be within the range listed:

COLD OIL: 600 – 650 PSI

HOT OIL: 500 – 550 PSI

NOTE: Due to special conditions or customer preference, the counterbalance may require setting outside this recommended range. However, the range listed will be adequate for most conditions.

4. If necessary, adjust the relief valve screw until the desired pressure is attained. Turn the screw in to increase counterbalance pressure and turn the screw out to decrease counterbalance pressure. Adjust nearer the high end of the range for improved hill climbing or nearer the low end for improved quality-of-cut.

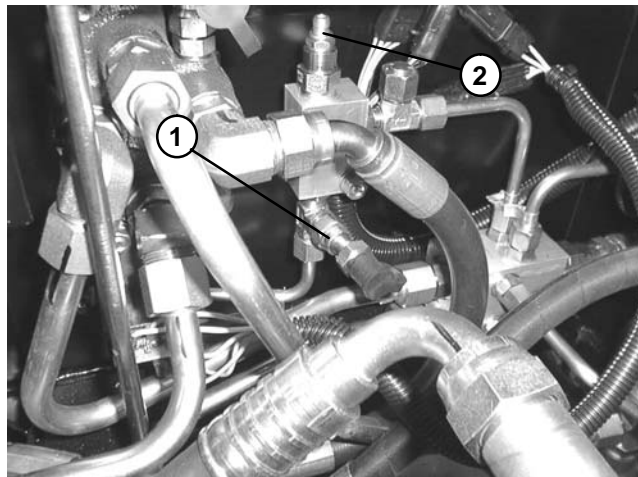


Figure 16

1. Counter balance test port
2. Relief valve adjustment screw

TEST NO. 3: Check Reel Circuit Working and Relief Pressures

Procedure For Working Pressure Check:

1. Install a 5,000 psi gauge into the cutting circuit quick disconnect.
2. Operate the unit while monitoring the gauge.


RANGE OF TESTER READINGS 0 – 2750 PSI

3. If working pressure is too high or too low, perform relief pressure check.

NOTE: Due to special conditions or customer preference, the counterbalance may require setting outside this recommended range. However, the range listed will be adequate for most conditions.

Procedure For Relief Pressure Check:

1. Hydraulic oil must be at operating temperature.
2. Install a 5,000 psi gauge into the cutting circuit quick disconnect.
3. Start the engine and lower the No. 2 (left front) and 3 (right front) cutting units to the ground.
4. Turn the engine OFF.
5. Block the reel of the No. 2 cutting unit to prevent rotation. The No. 2 cutting unit motor is the first in series flow from the pump. Use a substantial hardwood block inserted between the reel blades.

	CAUTION
Stand clear of the reels during the following procedures.	

6. Place reel speed control knob at minimum.
7. Start engine and position throttle at idle.
8. Ease the reel control lever into "MOW" while monitoring the gauge.

NOTE: It may be necessary to raise the throttle slightly to prevent the engine from stalling.

TESTER READING TO BE 2650 – 2750 PSI

9. If reel circuit relief pressure is above 2750 psi or below 2650 psi, clean or replace relief valve in reel control valve.

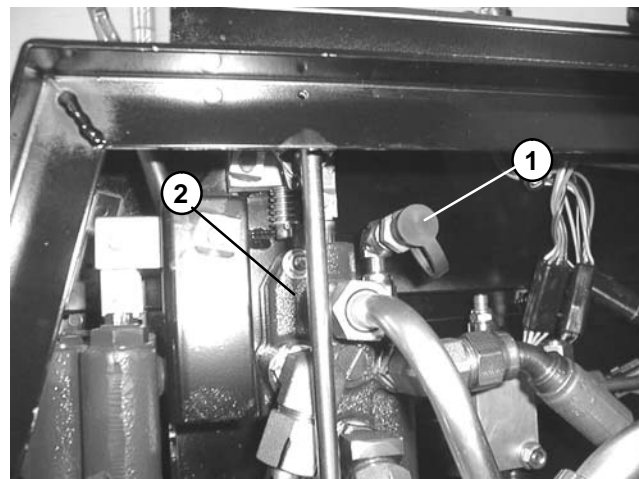


Figure 17

1. Cutting circuit test port
2. Reel control valve

TEST NO. 4: Check Reel Circuit Flow

Procedure:

1. Hydraulic oil must be at operating temperature.
2. Start the engine and lower the No. 2 and 3 cutting units to the ground.
3. Turn the engine OFF.
4. Disconnect inlet hose at No. 2 reel motor.
5. Install tester in series between disconnected hose and reel motor (flow direction is from hose to motor). Make sure gate valve of tester is OPEN.
6. Position reel speed control knob at middle range (90 degree position).
7. Start engine and move throttle to full speed (2500 rpm).
8. Engage the reel control lever into the "MOW" position.

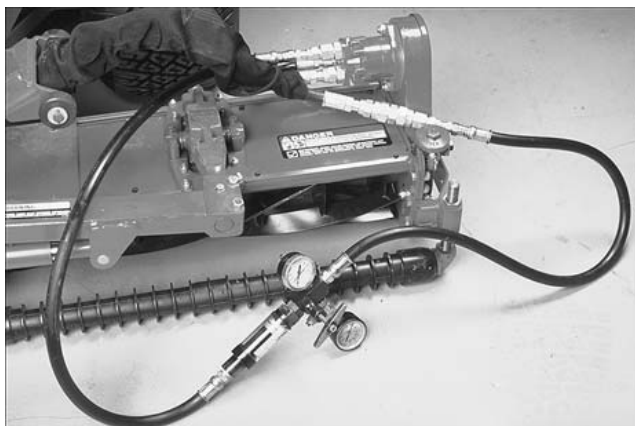


Figure 18



CAUTION

Reels will rotate when reel control lever is moved into the "MOW" position. Keep clear of rotating reels.

TESTER READING TO BE APPROXIMATELY
14 – 15 GPM.

9. If reel circuit oil flow is too low, check for restriction in pump intake line. If not restricted, remove pump and repair or replace as necessary.

TEST NO. 5: Check Reel Motor Cross-Over Relief Pressure

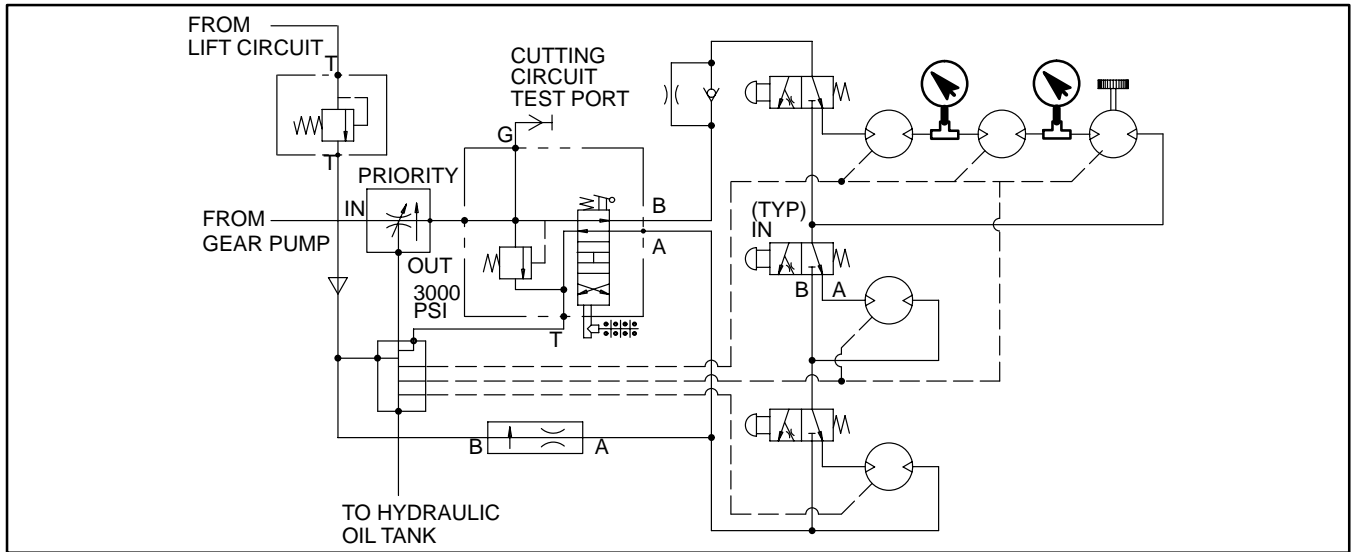


Figure 19

NOTE: Before testing a reel motor for possible failure, make sure to inspect the affected cutting unit for possible causes of malfunction. Eliminate such possible causes as: bad reel bearings, bent or damaged reel, jammed debris, etc. It is often helpful to remove the reel motor from the unit when inspecting.

Check Relief Pressure

NOTE: The reel motor has an internal relief valve that relieves when the pressure across the motor exceeds 1500 ± 100 PSID.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.
2. Make sure machine is parked on a level surface. Lower cutting unit to be tested. Make sure engine is OFF, and the parking brake is engaged.
3. Read Precautions for Hydraulic Testing.
4. Block reel being tested to prevent rotation. Use a substantial hardwood block inserted between the reel blades.
5. Disconnect **supply** hose from the motor. Install test gauge with T-connector in series with the motor and disconnected **supply** hose.
6. Disconnect **return** hose from the motor. Install test gauge with T-connector in series with the motor and disconnected **return** hose.



CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

7. Position reel speed control knob to **minimum** speed. Start engine and move throttle to low idle speed of **1200 RPM**.

IMPORTANT: Each reel motor has two cross-over reliefs. Test relief in the backlap direction only if a problem is expected.

8. Gently ease reel control lever to **MOW**. If testing the reel motor in the backlap direction, gently ease reel control lever to **BACKLAP**. Slowly raise engine speed to high idle speed of **2400 RPM** while monitoring pressure. The pressure **difference** between the two gauges should be from **1400 to 1600 PSI**.

A. If pressure is **greater than** the specified range, **stop** the engine and repair or replace the reel motor.

B. If pressure is **less than** the specified range, check reel pump output pressure (TEST NO. 3: Check Reel Circuit Working and Relief Pressures). If reel circuit pressure is correct, check reel motor cross-over relief valve for damage.

9. Disengage cutting units by positioning reel control lever to STOP position. Stop the engine.

10. Disconnect tester from motor and hose. Reconnect hose to the pump. Remove hardwood block from reel.

TEST NO. 7: Check Steering Circuit Working and Relief Pressure

Procedure For Working Pressure Check:

1. Install a 5,000 psi gauge into the steering quick disconnect.
2. Operate the unit while monitoring the gauge.

RANGE OF TESTER READINGS 0 – 1300 PSI

3. If working pressure is too high or too low, perform relief pressure check.

Procedure For Relief Pressure Check:

1. Hydraulic oil must be at operating temperature.
2. Install a 5,000 psi gauge into the steering quick disconnect.
3. Start the engine and move the throttle to full speed (2500 rpm).
4. Turn the steering wheel until heavy resistance is felt indicating that the cylinder has reached maximum stroke.
5. Momentarily hold the steering wheel against the resistance and read gauge.

TESTER READING TO BE APPROXIMATELY
1200 – 1300 PSI

6. If pressure is too high, clean and adjust relief valve in steering pump by removing the required shims. If pressure is too low, check for restriction in pump intake line. Check the steering cylinder for internal leakage. If cylinder is not leaking, adjust the relief valve by adding the required shims. If pressure is still too low, repair or replace steering pump.

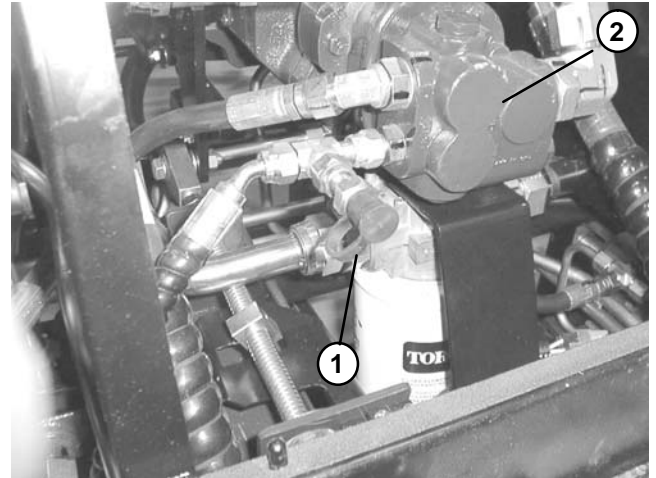


Figure 21

1. Steering circuit test port
2. Steering pump

TEST NO. 8: Check Lift Circuit Working and Relief Pressure

Procedure For Working Pressure Check:

1. Install a 5,000 psi gauge onto the quick disconnect of the lift valve.
2. Operate the unit while monitoring the gauge. Gauge should read from **500 to 2900 PSI**.
3. If working pressure is too high or too low, perform relief pressure check.

Procedure For Relief Pressure Check:

1. Hydraulic oil must be at operating temperature.
2. Install a 5,000 psi gauge onto the quick disconnect of the lift valve.
3. Start the engine and move the throttle to full speed (2500 rpm).
4. Engage the control lever into the "LIFT" position. Momentarily hold the lever in the engaged position after full cylinder extension and read gauge. Tester reading should be from **2650 to 2900 PSI**.

NOTE: Always set counterbalance pressure to desired amount before attempting to adjust lift pressure.

5. If pressure is too high, clean and adjust relief valve in lift valve by removing the required shims. If pressure is too low, check for restriction in pump intake line. Check the lift cylinder for internal leakage. If cylinder is not leaking, adjust the relief valve by adding the required shims. If pressure is still too low, repair or replace steering/lift pump.

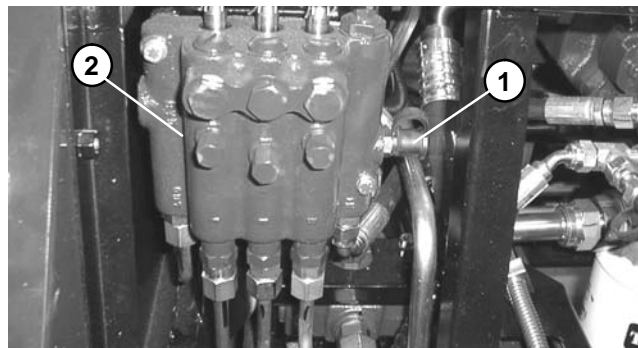


Figure 22

1. Lift control test port
2. Lift control valve

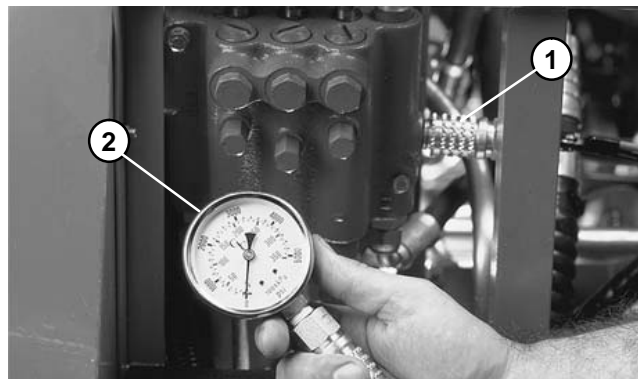


Figure 23

1. Lift control test port
2. Test gauge

TEST NO. 9: Check Charge Pressure

1. Hydraulic oil must be at operating temperature.
2. Install a 1000 psi gauge onto the quick disconnect at the top of the pump package.
3. Start the engine and position throttle at idle (1200 rpm). Tester reading should be from **75 to 150 PSI**.
4. If there is no pressure or pressure is too low, check for restriction in pump intake line. Inspect charge relief valve and valve seat. Check for sheared charge pump key. Disassemble charge pump and check for internal damage or worn parts. If the charge pump is in good condition (no scoring, scratches, or excessive wear), the general condition of the piston pump might be suspected of wear and inefficiency.

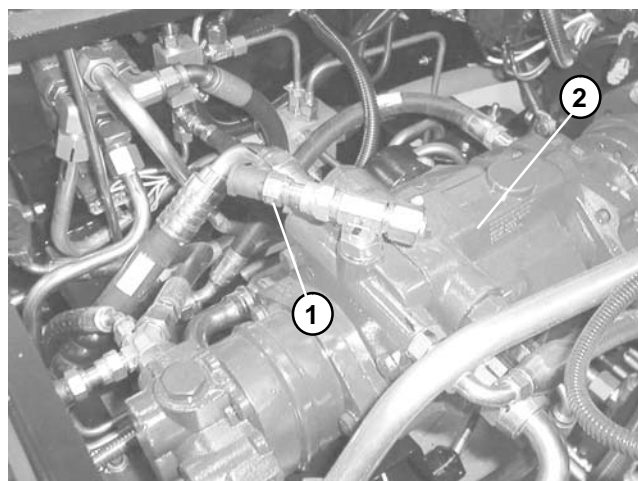


Figure 24

1. Charge press. test port
2. Traction pump

Service and Repairs

Removing Hydraulic System Components

1. Thoroughly clean the machine before disconnecting, removing or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment.
2. Put caps or plugs on any hydraulic lines or fittings left open or exposed.
3. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.
2. After repairs, check control linkage for proper adjustment, binding or broken parts.
3. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system.
4. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

After Repair or Replacement of Components

1. Check oil level in hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated.

Steering Control Unit

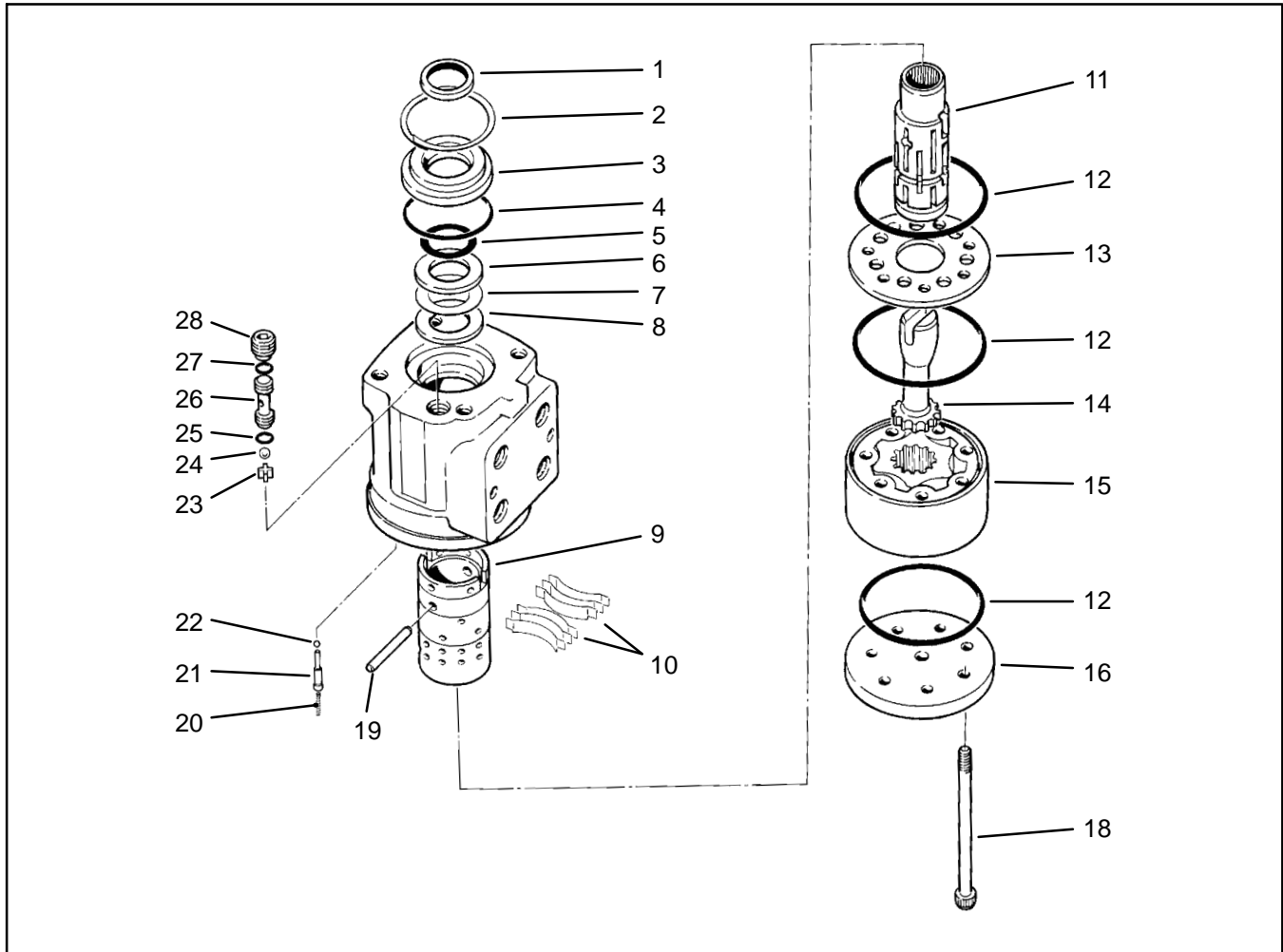


Figure 25

- | | |
|-------------------------------|--------------------------|
| 1. Seal 1" I.D. | 15. Gerotor |
| 2. Retaining Ring | 16. End Cap |
| 3. Seal Gland Bushing | 18. Cap Screw |
| 4. Seal 1.875 I.D. | 19. Pin Kit, Centering |
| 5. Quad Ring Seal, 1.062 I.D. | 20. Spring |
| 6. Bearing Race | 21. Retainer Plug |
| 7. Thrust Bearing, Needle | 22. Check Ball |
| 8. Housing | 23. Check Ball, Retainer |
| 9. Control Sleeve | 24. Check Ball |
| 10. Centering Spring Kit | 25. Seal |
| 11. Control Spool | 26. Check Ball Seat |
| 12. Seal | 27. Seal |
| 13. Spacer Plate | 28. Set Screw |
| 14. Drive | |

Disassembly

Cleanliness is extremely important when repairing a steering control unit. Work in a clean area. Before disconnecting lines, clean port area of unit thoroughly. Use a wire brush to remove foreign material and debris from around exterior joints of the unit.

NOTE: Troubleshooting information defines terms and problems, possible causes for problems, and recommends procedures for correcting problems.

Although not all drawings show the unit in a vise, we recommend that you keep the unit in the vise during disassembly. Follow the clamping procedure explained throughout the manual.

Meter (Gerotor) End Disassembly

1. Clamp unit in vise, meter end up. Clamp lightly on edges of mounting area, see Fig. 26. Use protective material on vise jaws. Housing distortion could result if jaws are over-tightened.

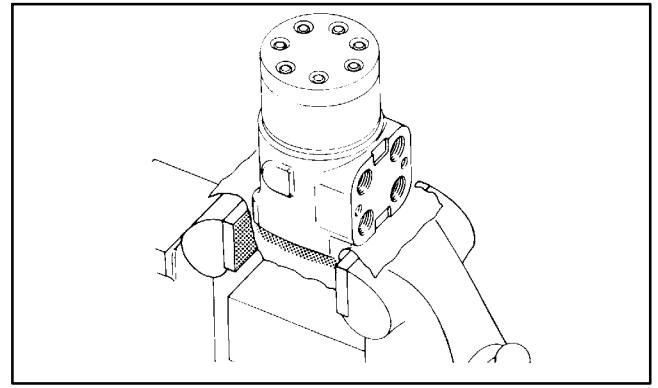


Figure 26

2. Remove 5/16" cap screws.
3. Remove end cap.
4. Remove seal from end cap.

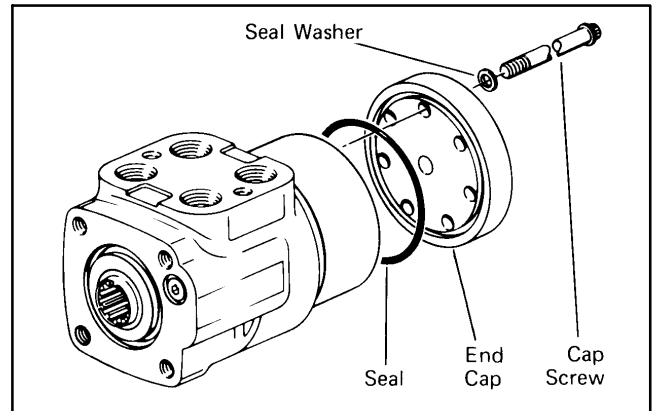


Figure 27

5. Remove meter. Be careful not to drop star.
6. Remove seal from meter.

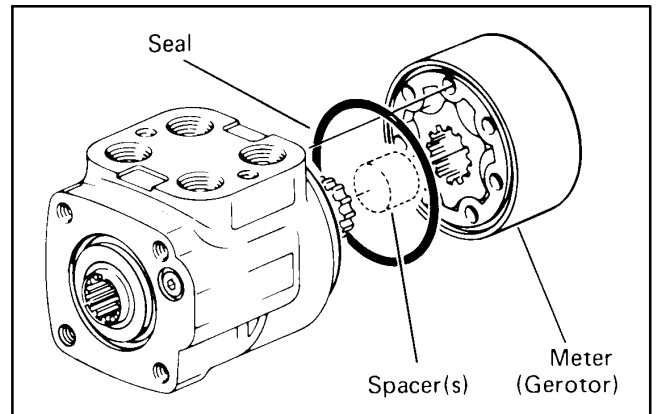


Figure 28

7. Remove drive spacer(s) (not used on 4.5 cu. in. displacement units).
8. Remove drive.
9. Remove spacer plate.
10. Remove seal from housing.

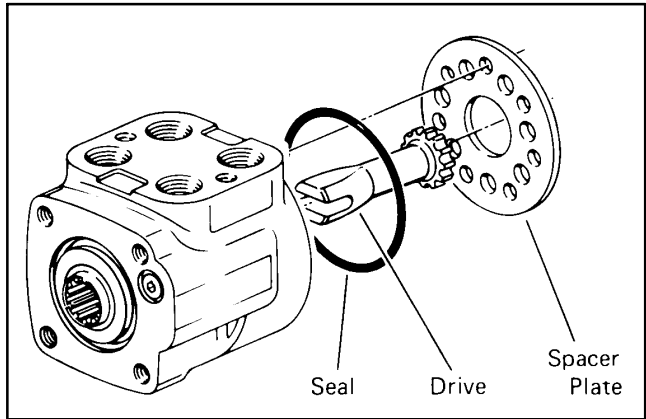


Figure 29

Control End Disassembly

11. Remove housing from vise. Place housing on a clean soft cloth to protect surface finish. Use a thin-blade screwdriver to pry retaining ring from housing, as shown in Fig. 30.

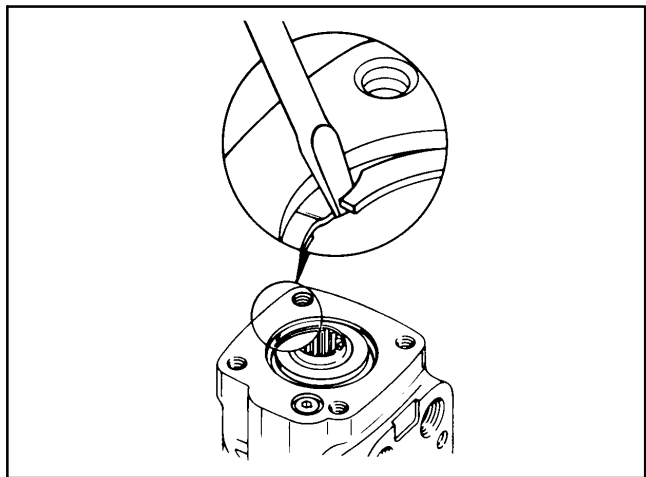


Figure 30

12. Rotate spool and sleeve until pin is horizontal. Push spool and sleeve assembly forward with your thumbs just far enough to free gland bushing from housing, see Fig. 31. Remove bushing.

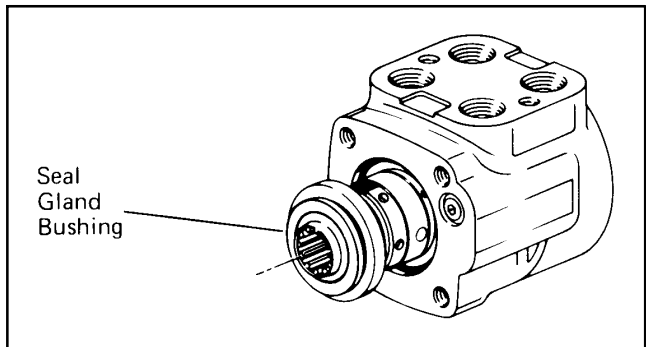


Figure 31

13. Remove quad ring seal from seal gland bushing.

14. Use a thin-blade screwdriver to pry dust seal from seal gland bushing. Do not damage bushing.

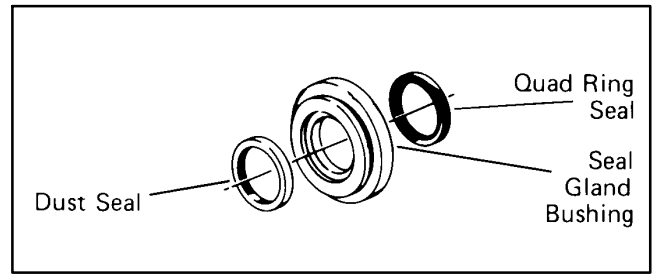


Figure 32

15. Remove 2 bearing races and the needle thrust bearing from spool and sleeve assembly.

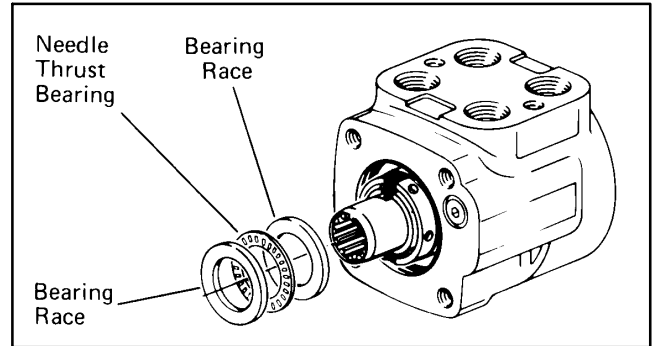


Figure 33

16. Remove spool and sleeve assembly from 14-hole end of housing, see Fig. 34.

IMPORTANT: Do not bind spool and sleeve in housing. Rotate spool and sleeve assembly slowly when removing from housing.

17. Push pin from spool and sleeve assembly.

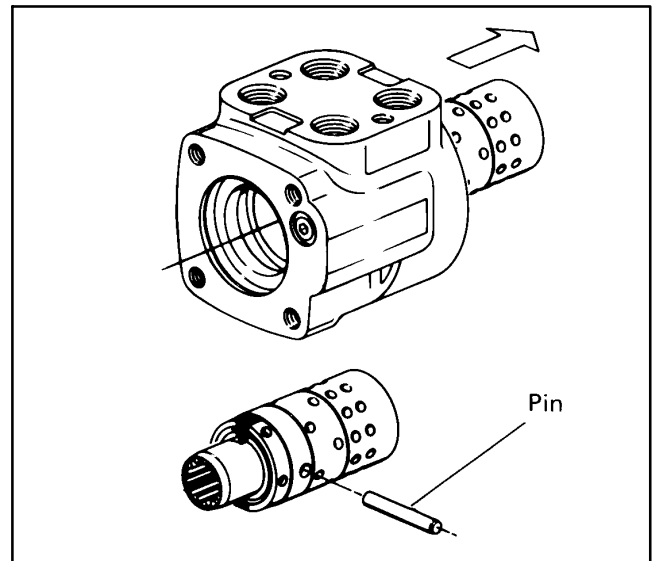


Figure 34

18. Push spool partially from control end of sleeve, then remove 6 centering springs from spool carefully by hand, see Fig. 35.

19. Push spool back through and out of sleeve, see Fig. 35. Rotate spool slowly when removing from sleeve.

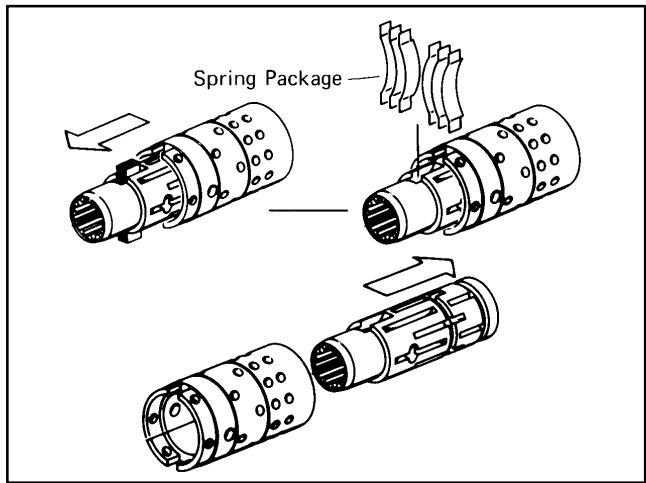


Figure 35

20. Remove seal from housing, see Fig. 36.

21. Screw a #10–24 machine screw into end of check ball seat. Then, by pulling on screw with a pliers, lift seat out of housing, see Fig. 36.

22. Remove 2 seals from check valve seat.

23. Tip housing to remove check ball and check ball retainer.

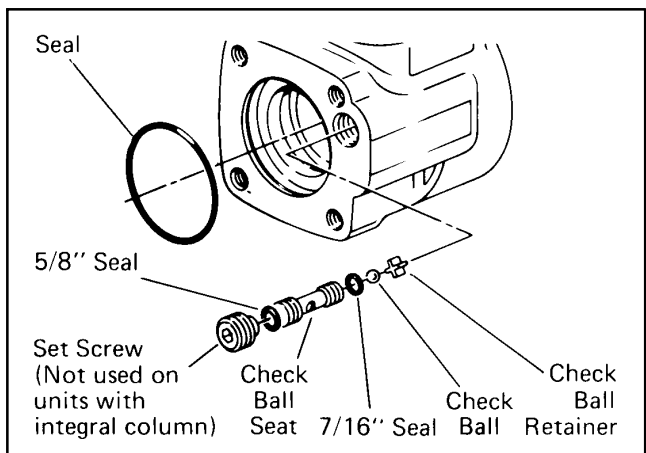


Figure 36

Reassembly

Check all mating surfaces. Replace any parts that have scratches or burrs that could cause leakage. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because of lint or other matter can get into the hydraulic system and cause damage. Do not use a coarse grit, try to file or grind these parts.

NOTE: Lubricate all seals with clean petroleum jelly such as Vaseline.

Do not use excessive lubricant on seals for meter section.

Refer to parts listing covering your steering control unit when ordering replacement parts. A good service policy is to replace all old seals with new seals.

Control End Reassembly

1. Use a needle-nose pliers to lower check ball retainer into check valve hole of housing. Make sure retainer is straight (not tilted on edge) in housing, see Fig. 37.

2. Install check ball in housing.

3. Lubricate 5/8" diameter seal and 7/16" diameter seal. Install seals on check ball seat as shown in Fig. 37.

4. Lubricate check ball seat and seals thoroughly before installing seat in housing. When installing seat, do not twist or damage seals. Install check ball seat in housing, insert open end of seat first, see Fig. 37. Push check ball seat to shoulder of hole.

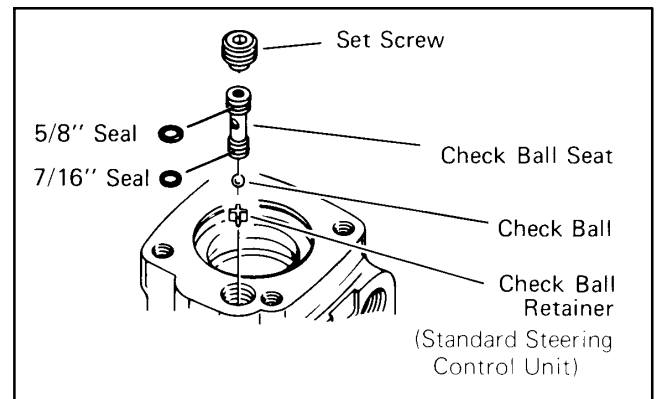


Figure 37

5. Assemble spool and sleeve carefully so that the spring slots line up at the same end. Rotate spool while sliding parts together. Some spool and sleeve sets have identification marks, align these marks as shown in Fig. 38. Test for free rotation. Spool should rotate smoothly in sleeve with finger tip force applied at splined end.

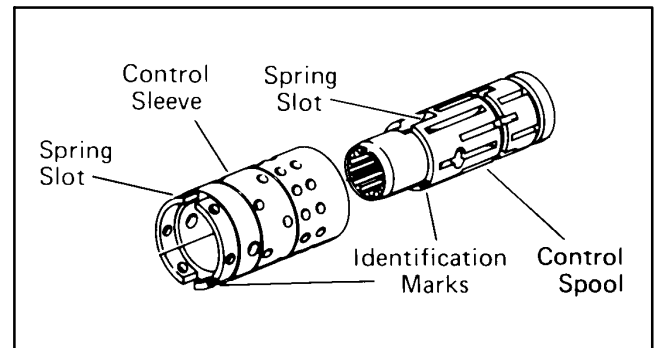


Figure 38

6. Bring spring slots of both parts in line and stand parts on end of bench. Insert spring installation tool through spring slots of both parts. Tool is available from an Eaton hydraulics supplier as Eaton part no. 600057. Position 3 pairs of centering springs (or 2 sets of 3 each) on bench so that extended edge is down and arched center section is together. In this position, insert one end of entire spring set into spring installation tool, as shown in Fig. 39, with spring notches facing sleeve.

7. Compress extended end of centering spring set and push into spool sleeve assembly withdrawing installation tool at the same time.

8. Center the spring set in the parts so that they push down evenly and flush with the upper surface of the spool and sleeve.

9. Install pin through spool and sleeve assembly until pin become flush at both sides of sleeve.

10. Position the spool and sleeve assembly so that the splined end of the spool enters the 14-hole end of housing first, see Fig. 40.

IMPORTANT: Be extremely careful that the parts do not tilt out of position while inserting. Push parts gently into place with slight rotating action, keep pin nearly horizontal. Bring the spool assembly entirely within the housing bore until the parts are flush at the meter end or 14-hole end of housing. Do not pull the spool assembly beyond this point to prevent the cross pin from dropping into the discharge groove of the housing. With the spool assembly in this flush position, check for free rotation within the housing by turning with light finger tip force at the splined end.

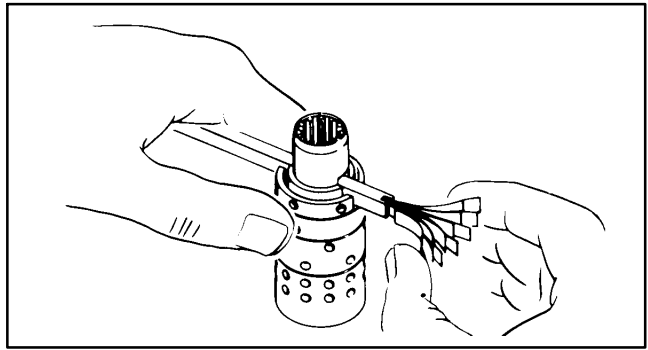


Figure 39

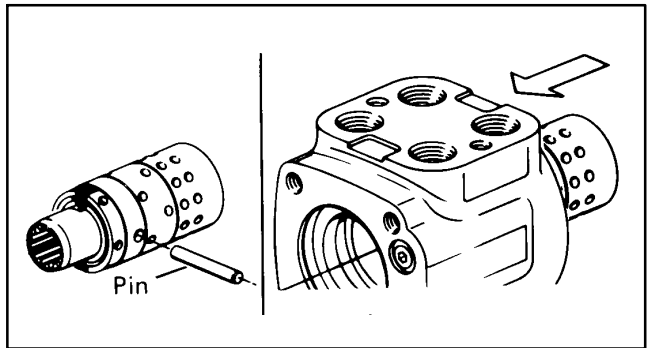


Figure 40

11. Place housing on clean, lint free cloth. Install 2-1/8" diameter seal in housing, see Fig. 41.

12. Install 2 bearing races and the needle thrust bearing in the order shown.

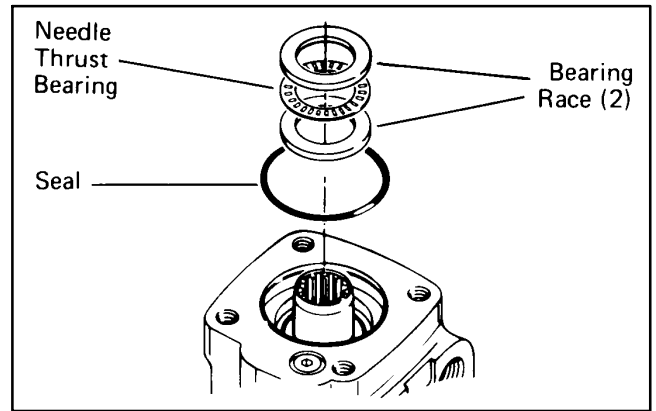


Figure 41

13. Install 1-1/4" diameter dust seal in seal gland bushing, flat or smooth side of dust seal must face down towards bushing, see Fig. 43.

14. Install the quad ring seal in seal gland bushing. Smooth seal in place with your finger. Do not use any seal that falls freely into pocket of bushing, see Fig. 43.

15. Install seal gland bushing over the spool end with a twisting motion. Tap the bushing in place with a rubber hammer. Make sure the bushing is flush against the bearing race.

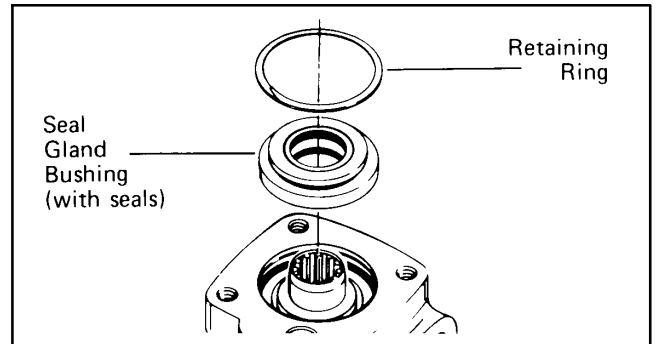


Figure 42

16. Install retaining ring (see Fig. 42 and 43) in housing. After installing ring, tap on ring end or pry with screwdriver around entire circumference of ring to properly seat ring in groove.

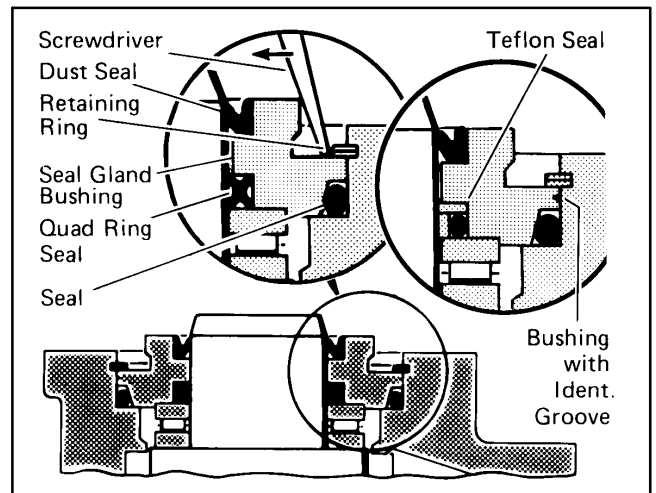


Figure 43

17. Clamp housing in vise, as shown in Fig. 44. Clamp lightly on edges of mounting area. Do not over-tighten jaws.

NOTE: Check to insure that the spool and sleeve are flush or slightly below the 14-hole surface of the housing.

IMPORTANT: Clean the upper surface of the housing by wiping with the palm of clean hand. Clean each of the flat surfaces of the meter section part in a similar way when ready for reassembly. Do not use cloth or paper to clean surfaces.

18. Install 3" diameter seal in housing, see Fig. 45.

19. Install spacer plate. Align bolt holes in spacer plate with tapped holes in housing.

20. Rotate spool and sleeve assembly until pin is parallel with port face, see Fig. 46. (Install drive, make sure you engage drive with pin. To assure proper alignment, mark drive as shown in Fig. 48 (ref. B). Record the relationship between slotted end of drive to splined end of drive when marking.

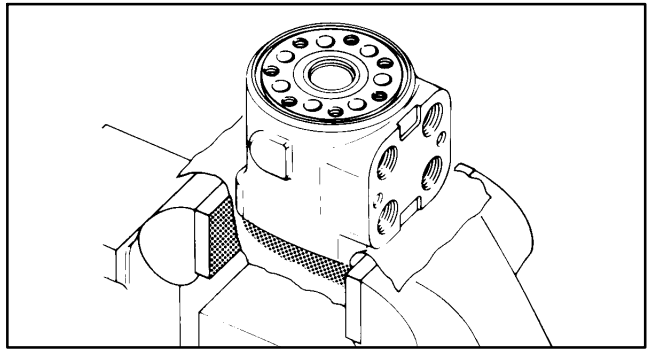


Figure 44

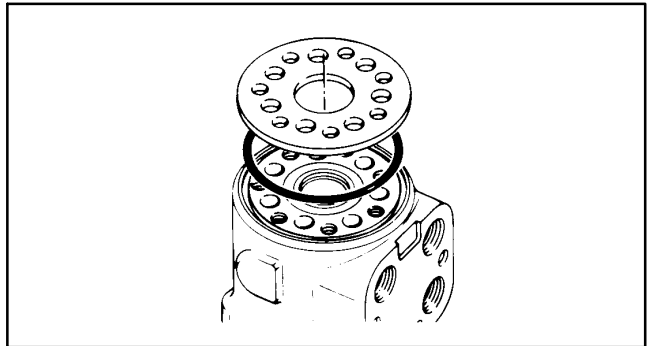


Figure 45

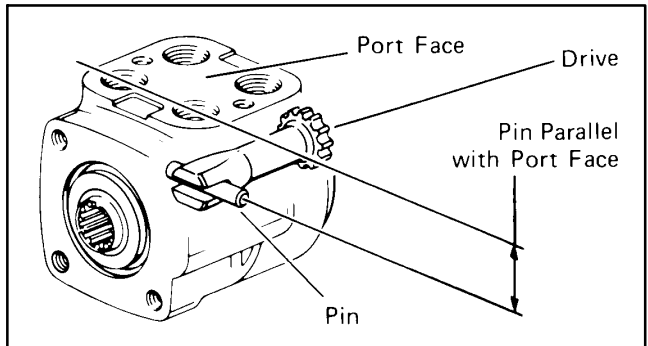


Figure 46

21. Install 3" diameter seal in meter.

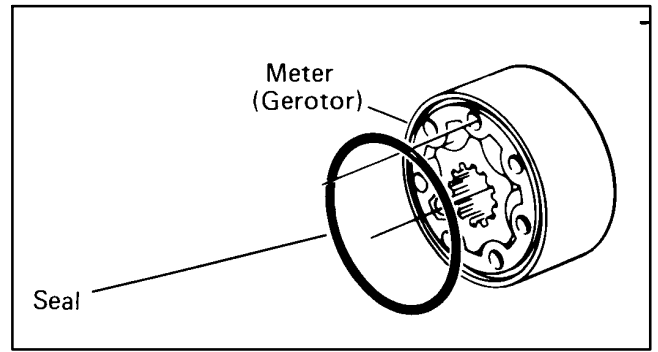


Figure 47

22. With seal side of meter toward spacer plate, align star valleys (ref. A) on drive (ref. B). Record the parallel relationship of reference lines A, B, C, and D in Fig. 48. Align bolt holes without disengaging meter from drive.

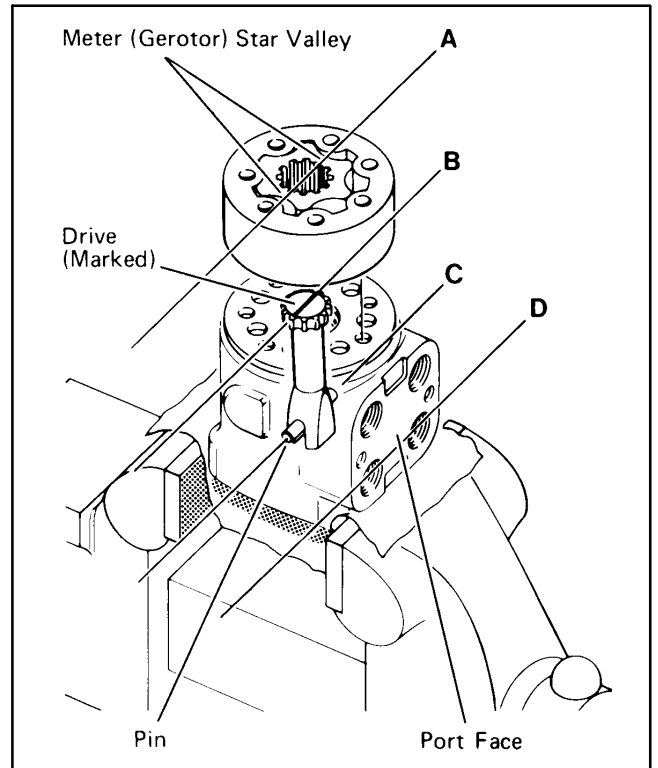


Figure 48

Hydraulic System

23. Install drive spacer(s), when used, in meter, see Fig. 49.

24. Install 3" diameter seal in end cap.

25. Install end cap on gerotor, align holes.

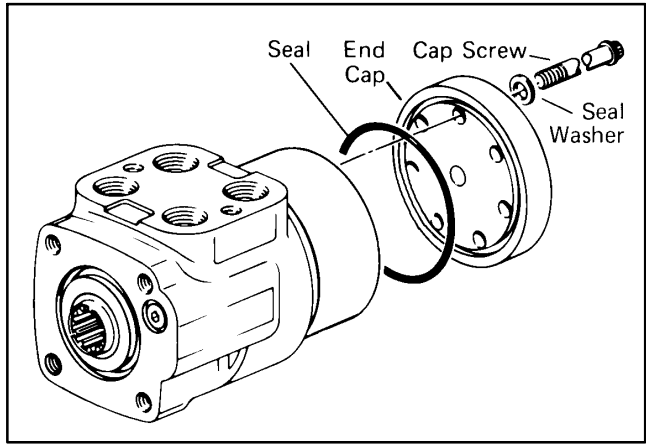


Figure 49

26. Install 7 dry cap screws with new seal washers in end cap. Pre-tighten screws to 150 inch pounds, then torque screws to 275 inch pounds in sequence shown in Fig. 50.

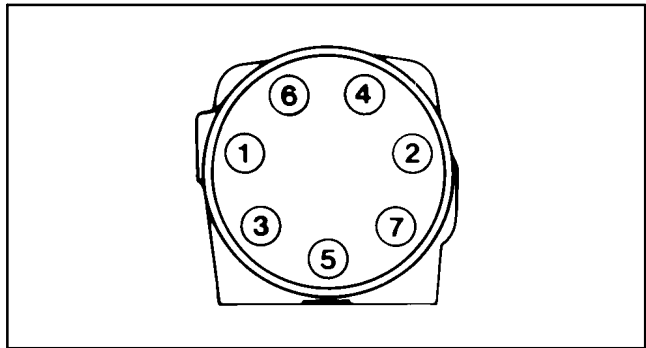


Figure 50

Add Hydraulic Fluid

Capacity of the hydraulic reservoir is approximately 9.3 gal. (35.2 L). With machine on a level surface, hydraulic oil level should be 1/4 to 1/2 inch below arrows on sight glass, when oil is cold. Warm oil should be even with arrows on sight glass. If level is low, add hydraulic oil. Refer to Hydraulic Oil Specifications (Fig. 51).

1. Remove seat lock pin, raise seat and hold open with support rod.
2. Clean around reservoir filler cap (Fig. 52). Remove cover and add hydraulic oil until it is even with arrows on sight glass (Fig.51).

IMPORTANT: To prevent contamination, clean top of hydraulic oil containers before puncturing. Assure pour spout and funnel are clean.

3. Install reservoir cover, lower seat and secure with lock pin.

Hydraulic Oils Specifications (Interchangeable):
Mobil DTE 26/Shell Tellus 68 Equivalent*

*Equivalent Hydraulic Oils (Interchangeable)

Mobil	DTE 15 M
Amoco	Rykon Oil #68
Conoco	Super Hydraulic Oil 68
Exxon	Nuto H 68
Kendall	Kenoil R & O AW 68
Pennzoil	Penreco 68
Phillips	Magnus A 68
Standard	Energol HLP 68
Sun	Sunvis 831 WR
Union	Unax AW 68

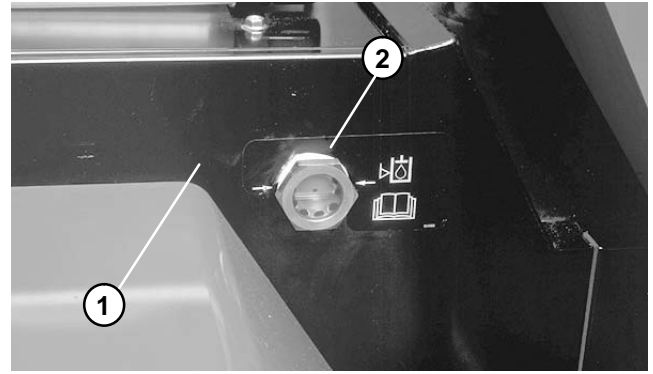


Figure 51

1. Hydraulic reservoir
2. Sight glass

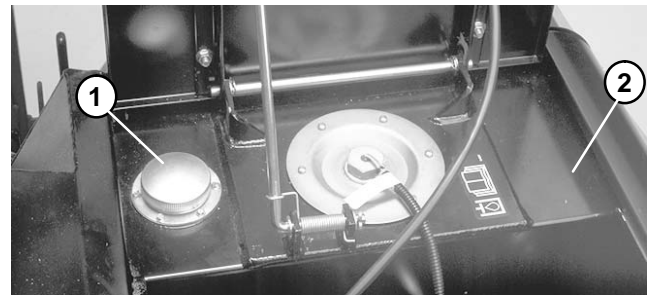


Figure 52

1. Filler cap
2. Hydraulic reservoir

Drain Water from Hydraulic Reservoir

After every 100 operating hours, drain water from hydraulic reservoir.

1. Open drain plug one-half turn and allow fluid to flow into drain pan until water is not noticed in hydraulic oil (Fig. 53).
2. Tighten drain plug and add hydraulic oil (see Add Hydraulic Oil).

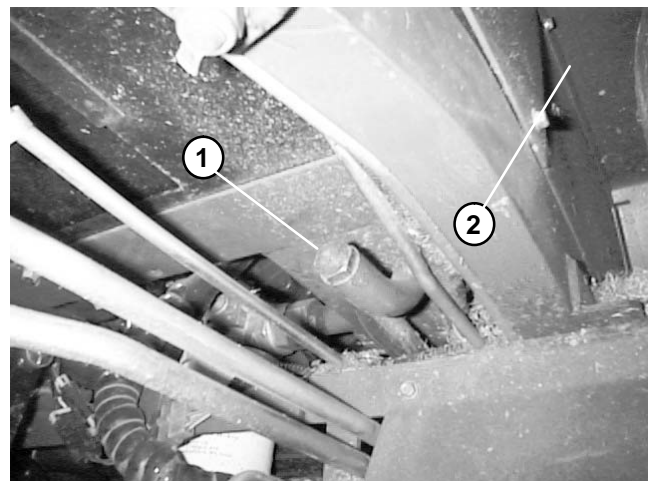


Figure 53

1. Drain plug
2. Right front fender

Reel Motor

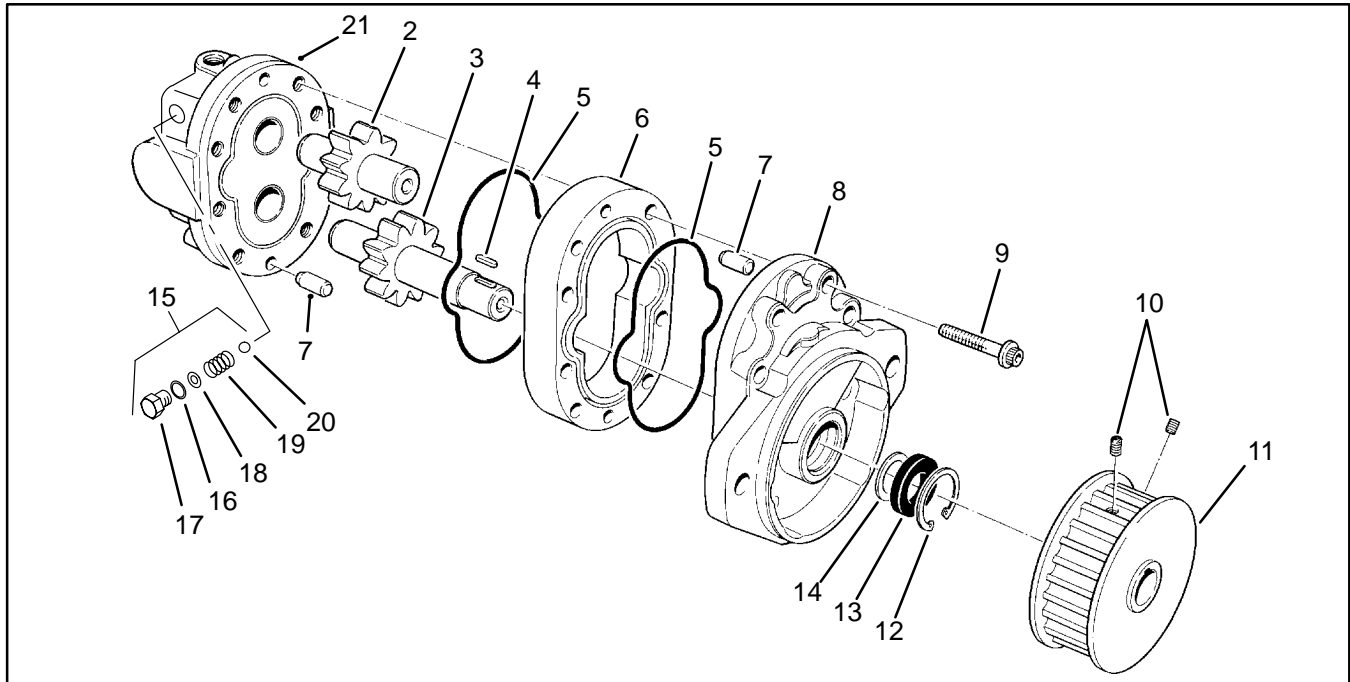


Figure 54

- | | | |
|---------------|-----------------------------|--------------------------------|
| 1. Not used | 8. Plate & Bushing Assembly | 15. Relief Valve Kit |
| 2. Idler Gear | 9. Socket Head Cap Screw | 16. O-Ring |
| 3. Drive Gear | 10. Set Screw | 17. Plug |
| 4. Key | 11. Drive Pulley | 18. Shim |
| 5. O-Ring | 12. Retaining Ring | 19. Spring |
| 6. Body | 13. Shaft Seal | 20. Ball |
| 7. Dowel Pin | 14. Backup Washer | 21. Back Plate/Relief Assembly |

Disassembly of Reel Motor

1. Remove set screws (10) from drive pulley (11).
2. Remove drive pulley (11) from drive shaft.
3. Remove key (4) from drive shaft.
4. Clean outside of motor thoroughly. Scribe a line along front plate assembly (8), body (6), and back plate assembly (21) to assure proper reassembly.
5. Clamp motor in vise, shaft up.
6. Remove eight cap screws (9).
7. Remove motor from vise, hold motor in hands and bump shaft against wooden block to separate the front plate assembly (8) from the back plate assembly (21). The body (6) will remain with either the front or back plate.
8. Separate body (6) from either the front or back plate.
9. Remove drive gear (3) and idler gear (2).
10. Remove retaining ring (12), shaft seal (13), and back-up washer (14) from front plate assembly (8).

11. Remove the two O-rings (5) and two dowel pins (7) between front plate assembly (8) and body (6), and between body (6) and back plate assembly (21).

IMPORTANT: Remove relief valve kit only if testing indicates the relief valve is faulty.

12. Remove plug (17) and O-ring (16) from the back plate (21). Remove shim (18), spring (19), and ball (20) from the back plate.

Inspection of Reel Motor

GENERAL

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

GEAR ASSEMBLY

1. Inspect drive gear assembly (3) for broken or cracked keyway.
2. Inspect both the drive gear (3) and idler gear (2) shafts at bearing point for rough surfaces and excessive wear.
3. If shaft measures less than .686 in bearing area, the gear assembly should be replaced. (One gear assembly may be replaced separately. Shafts and gears are available as assemblies only.)
4. If gear width is below 1.327, gear assembly should be replaced.
5. Inspect gear face for scoring and excessive wear.
6. Retaining ring (12) on shaft assemblies should be in groove.
7. If edge of gear teeth are sharp, break edge with emery cloth.

FRONT PLATE, BODY, BACK PLATE, AND RELIEF VALVE

1. Inspect I.D. of bushings in front plate (8), body (6), and back plate (21). If I.D. exceeds .693, front plate, body, or back plate should be replaced. (Bushings are not available as separate items.)
2. Back plate assembly (21) should be replaced if I.D. of gear pocket exceeds 1.719.
3. Check for scoring on face of front plate (8), body (6), and back plate (21). If wear exceeds .0015, front plate, body, or back plate should be replaced.
4. If the relief valve kit (15) was removed, inspect valve bore in the back plate (21) for dirt, debris, and damage. Clean bore of dirt and debris. Replace back plate if bore or valve seating surfaces are damaged.

IMPORTANT: The plug (17), shim (18), spring (19), and ball (20) must be replaced as a complete unit.

5. If the relief valve kit was removed, inspect plug (17), shim (18), spring (19), and ball (20) for wear and damage. Replace parts as necessary.

Reassembly of Reel Motor

1. If the relief valve kit was removed, install ball (20), spring (19), shim (18), **new** O-ring (16), and plug (17) into the back plate (21). Torque plug from 10 to 12 ft-lb (1.4 to 1.7 kg-m).
2. Retaining ring (12), shaft seal (13), back-up washer (14), and O-rings (5) should be replaced as new parts.
3. Install O-rings (5) in grooves of front plate (8) and body (6).
4. Install body (6) in front plate assembly (8) noting position of scribe line.
5. Install dowel pins (7) in body (6) and front plate assembly (8).
6. Dip gear assemblies (2 & 3) into oil and slip into body and front plate bushing.
7. Install back plate assembly (21) noting position of scribe line. Install cap screws (9), draw up bolts evenly and torque to 22-25 ft. lbs.
8. Install new back-up washer (14) on drive shaft.
Oil shaft seal (13) liberally. Work shaft seal (13) over drive shaft taking care not to cut rubber sealing lip.
9. Seat shaft seal (13) by tapping with plastic hammer. Install new retaining ring (12).
10. Replace key (4) in drive shaft (3).
11. Install drive pulley (11) on drive shaft.
12. Tighten set screws (10) in drive pulley (11).

Steering Pump

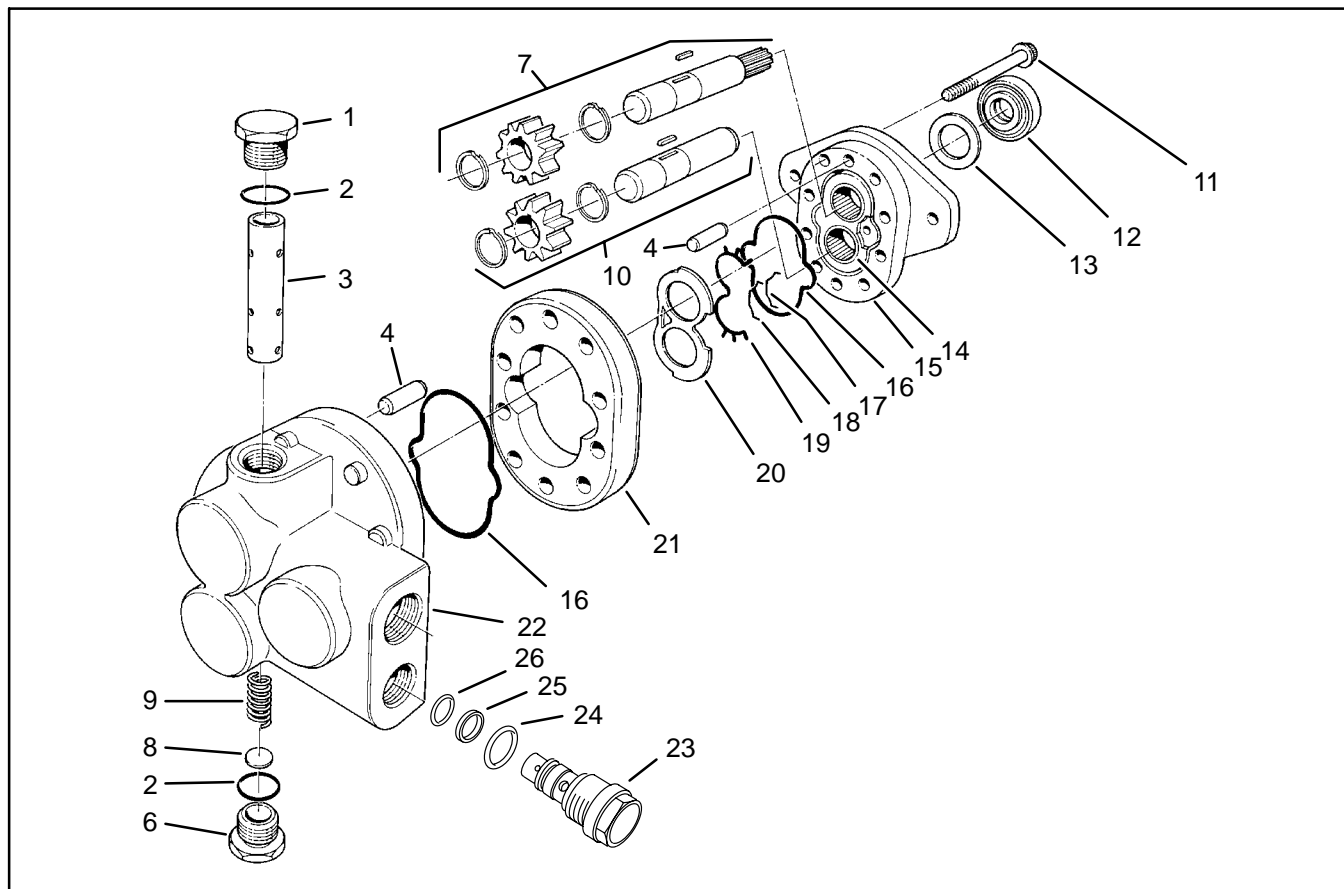


Figure 55

- | | |
|-------------------------|---------------------------|
| 1. Plug (includes #2) | 15. Front Plate Assembly |
| 2. O-Ring | 16. O-Ring |
| 3. Spool | 17. Molded O-Ring |
| 4. Dowel Pin | 18. Bearing Seal |
| 6. Plug (includes #2) | 19. Backup Gasket |
| 7. Drive Gear Assembly | 20. Wear Plate |
| 8. Disc | 21. Body Assembly |
| 9. Spring | 22. Back Plate Assembly |
| 10. Idler Gear Assembly | 23. Relief Valve Assembly |
| 11. Hex Head Cap Screw | 24. O-Ring |
| 12. Shaft Seal | 25. Back Up Washer |
| 13. Washer | 26. O-Ring |
| 14. Bushing | |

Disassembly of Steering Pump

1. Thoroughly clean outside of pump.
2. Use a sharp tool or marker to mark across front plate (15), body (21) and back plate (22). This will assure proper reassembly.
3. Clamp pump in a vise, with the shaft up.
4. Remove capscrews (11).
5. Remove pump from vise, hold pump in hands and bump shaft against a wood block to separate front plate (15) from back plate (22). Body (21) will remain with either front plate or back plate.
6. If front plate (15) was removed first, remove wear plate (20) from body gear pockets.
7. Remove drive gear assembly (7) and idler gear assembly (10) from body (21).
8. To separate body (21) from plate it remains with, put drive gear assembly (7) in a bushing and tap protruding end with a plastic hammer or soft mallet.
9. Remove O-ring (16) from front plate (15) and back plate (22).
10. Remove backup-up gasket (19) from front plate (15).
11. Remove bearing seal (18) from front plate (15) by prying with a sharp tool.
12. Remove molded O-ring (17) from front plate (15) by prying with a screwdriver.
13. Remove shaft seal (12) from front plate (15) by prying with a screwdriver.

Disassembly of Back Plate Assembly (Flow Divider / Flow Control / Relief Valve)

1. Remove relief valve (23) from back plate (22).

NOTE: Do not disassemble relief valve cartridge assembly – it must be replaced as an assembly.

2. Remove hex plugs (1, 6) flow divider spool (3), spring (9) and disk (8).

Inspect Steering Pump Parts

GENERAL

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

GEAR ASSEMBLY

1. Check drive shaft spline for twisted or broken teeth.
2. Inspect both drive gear (7) and idler gear (10) shafts at bushing points and seal area for rough surfaces and excessive wear.
3. If shaft measures less than 0.748" in bushing area, the gear assembly should be replaced (one gear assembly may be replaced separately; shafts and gears are available as assemblies only).
4. Inspect gear face for scoring and excessive wear.
5. If gear width is less than 0.636", the gear assembly should be replaced.
6. Be sure snap rings are in grooves on either side of drive and idler gears.
7. If edge of gear teeth are sharp, break edge with emery cloth.

FRONT PLATE AND BACK PLATE

1. Oil groove in bushings in both front plate and back plate should be in line with dowel pin holes and 1805 apart.
2. If I.D. of bushings in front plate (15) or back plate (22) exceed 0.755", front or back plate should be placed (bushings are not available separately).
3. Bushings in front plate should be flush with face of front plate.
4. Check for scoring on face of back plate. If wear exceeds 0.0015", back plate should be replaced.

BODY

1. Check inside gear pockets for excessive scoring or wear.
2. Body (21) should be replaced if I.D. of gear pocket exceeds 1.713".

FLOW DIVIDER / FLOW CONTROL / RELIEF VALVE

1. Check disk (8) for wear.
2. Check spring (9) for weakness or breakage.
3. Wash back plate (22) in clean solvent, then direct compressed air into relief valve and flow divider cavities in back plate to remove any contamination.

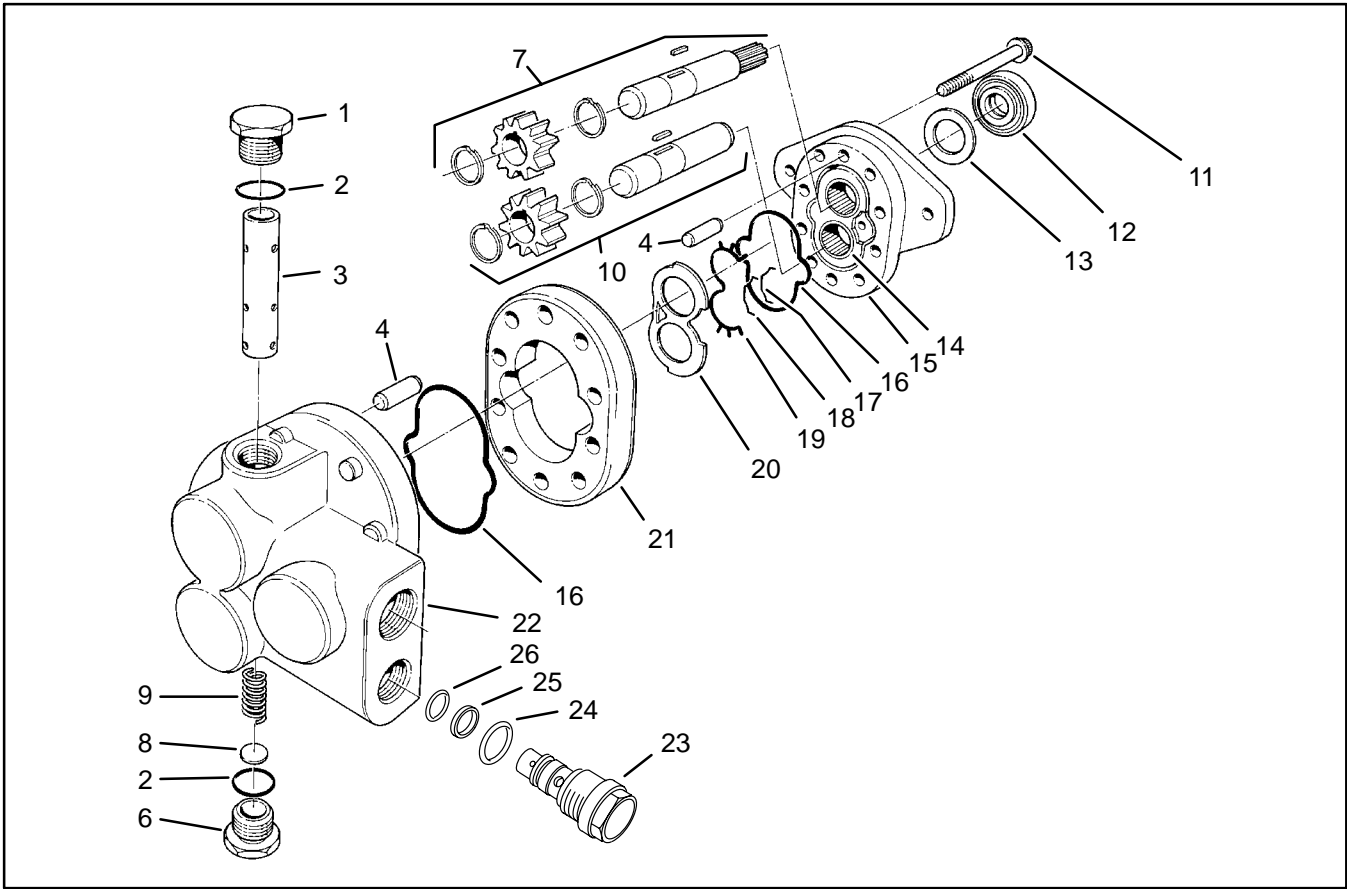


Figure 56

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. Plug (includes #2) 2. O-Ring 3. Spool 4. Dowel Pin 6. Plug (includes #2) 7. Drive Gear Assembly 8. Disc 9. Spring 10. Idler Gear Assembly 11. Hex Head Cap Screw 12. Shaft Seal 13. Washer 14. Bushing | <ul style="list-style-type: none"> 15. Front Plate Assembly 16. O-Ring 17. Molded O-Ring 18. Bearing Seal 19. Backup Gasket 20. Wear Plate 21. Body Assembly 22. Back Plate Assembly 23. Relief Valve Assembly 24. O-Ring 25. Back Up Washer 26. O-Ring |
|---|---|

Assembly of Steering Pump

It is important that the relationship of the back plate (22), body (21), wear plate (20) and front plate (15) is correct. You will note two half moon cavities in the body which must face away from the front plate.

NOTE: The smaller half moon port cavity must be on the pressure side of the pump. Side of wear plate with mid section cut out must be on suction side of pump. Suction side of back plate is always side with larger port boss.

1. Install relief valve (23) with new O-ring (24), back-up washer (25), and O-ring (26).
2. Install flow divider spool (3), plug (1) with new O-ring (2), and other plug (6) with new O-ring (2).
3. The wear plate (20), bearing seal (18), molded O-ring (17), back-up gasket (19), shaft seal (12), and O-rings (9) should be replaced as new parts.
4. Install O-ring (16) in groove of front plate (15).
5. Tuck back-up gasket (19) into groove in front plate with open part of "V" section down.
6. Put molded O-ring (17) in groove in front plate. Put bearing seal (18) over molded O-ring – groove side down.

7. Apply a thin coat of heavy grease to both milled faces of body (21). Slip body onto plate – half moon port cavities in body must face away from front plate.

NOTE: The small half moon port cavity must be on the pressure side of the pump.

8. Put wear plate (20) on top of back-up gasket (19) with bronze face up. The side with the mid section cut away must be on suction side of pump.

Dip gear assemblies (10, 7) into oil and slip into front plate bushings.

9. Install O-ring (16) in groove in back plate (22).

10. Slide back plate (22) over gear shafts until dowel pins (4) are engaged.

Install bolts (11) and washers (13). Tighten evenly to a torque of 25 – 28 ft.-lb.

11. Install washer (13). Liberally oil shaft seal (12) and carefully work over drive shaft, being careful not to cut rubber sealing lip.

12. Put a 1-5/16" O.D. sleeve over the shaft and press in shaft seal until flush with front surface of front plate.

Lift Control Valve

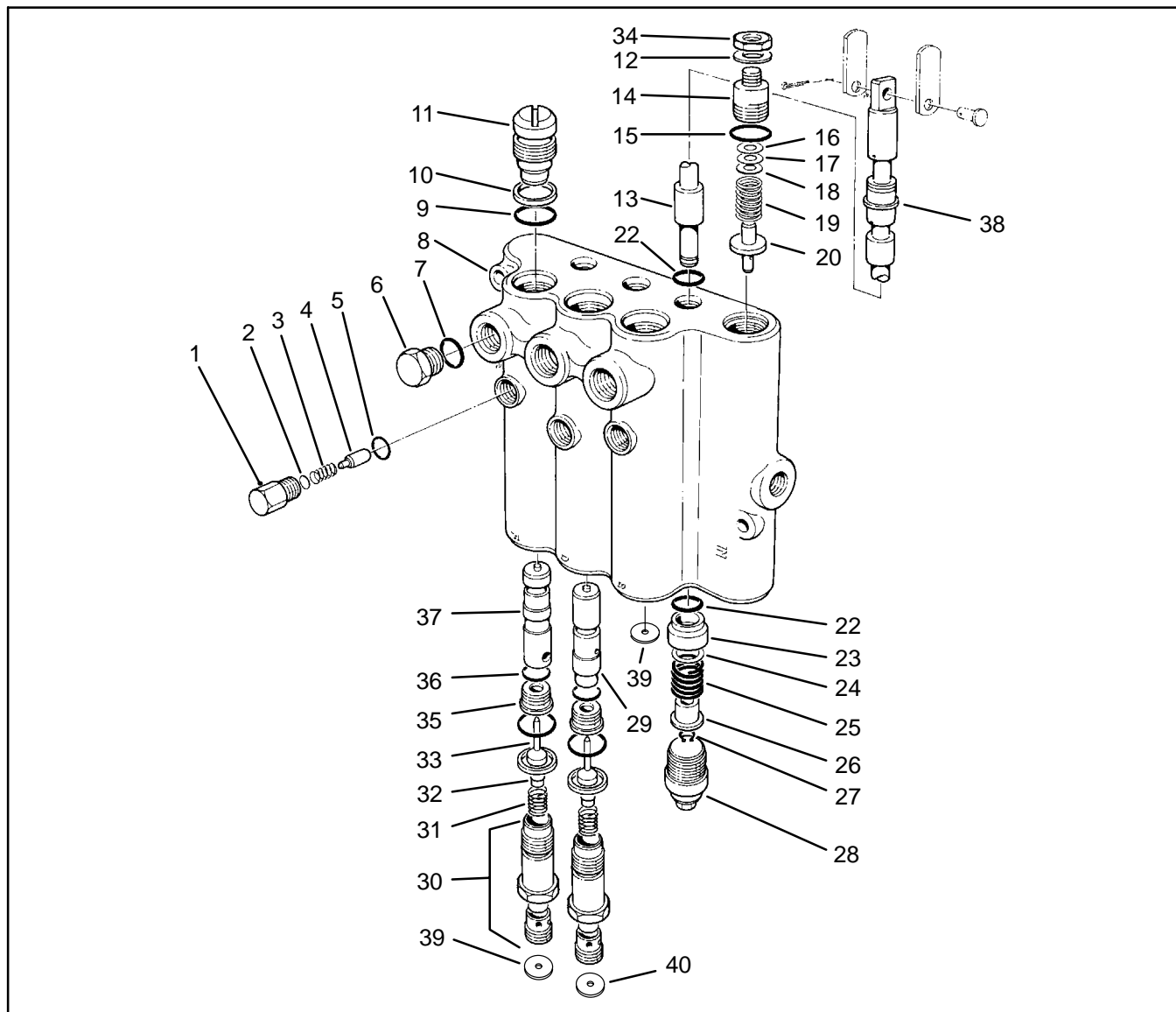


Figure 57

- | | |
|-------------------|-----------------------|
| 1. Plug Assembly | 22. O-Ring |
| 2. Disc | 23. Bushing |
| 3. Spring | 24. Washer |
| 4. Detent Plunger | 25. Spring |
| 5. O-Ring | 26. Spacer |
| 6. Plug Assembly | 27. Retaining Ring |
| 7. O-Ring | 28. Cap Assembly |
| 8. Body | 29. Plunger |
| 9. O-Ring | 30. Plug Assembly |
| 10. Backup Washer | 31. Spring |
| 11. Plug Assembly | 32. Eyelet |
| 12. Washer | 33. Poppet Assembly |
| 13. Spool | 34. Locknut |
| 14. Plug Assembly | 35. Seat Assembly |
| 15. O-Ring | 36. O-Ring |
| 16. Washer | 37. Plunger |
| 17. Washer | 38. Seal Wiper |
| 18. Washer | 39. .047 Dia. Orifice |
| 19. Spring | 40. .052 Dia. Orifice |
| 20. Poppet | |

Disassembly of Lift Control Valve

1. Plug all ports and clean outside of valve thoroughly.
2. Remove cap assemblies (28). Do not remove retaining rings (26) from spools unless spring (25) is broken.
3. Remove spools (13) from body (8).

NOTE: Spools and spool bores are matched sets. Be sure each spool is identified with the correct body spool bore.

4. Remove bushings (23) and O-rings (22) from spools.
5. Remove plugs (11).
6. Remove plugs (30), springs (31), poppets (33), seats (35) and plungers (37, 29).

IMPORTANT: Check location and positioning of plungers when removing from body to assure proper assembly.

7. Remove plugs (6).
8. Remove plugs (1), discs (2), springs (3) and detent plungers (4).
9. Remove locknut (34), washer (12), plug (14), washers (16, 17, 18), spring (19) and poppet (20).
10. Remove all O-rings and back-up rings from all plugs and seats.

Inspection of Lift Control Valve

1. Remove all nicks and burns from parts and inspect for excessive wear.
2. Inspect all plungers and poppet seats for burrs or roughness.
3. Inspect spool springs (25), relief valve spring (19), lockout springs (31), and detent springs (3) for breakage.
4. If spools (13) have excessive wear, the valve becomes non-serviceable as the spools and spool bores are matched and damaged spools cannot be replaced.
5. Inspect relief valve poppet (20) for breakage or wear.

Assembly of Lift Control Valve

1. Thoroughly clean and dry all parts. Apply a light coating of clean hydraulic oil to parts prior to assembly.

NOTE: All O-rings, back-up washers, wiper seals and nylon poppets should be replaced as new items.

2. Install new O-rings (22) in proper grooves in spool bores.
3. Install relief valve components (20, 19, 18, 17, 16) with new O-ring (15) on plug (14).
4. Install plugs (11) with new back-up washers (10) and O-rings (9).
5. Install plungers (37, 29).

IMPORTANT: Check location and positioning of plungers during installation.

6. Install new O-rings (36) on seats (35). Install new back-up washers (10) and O-rings (9) on plugs (30).
7. Install seats (35), new poppets (33), and plugs (30).
8. Install plugs (6) with new O-rings (7).
9. Install detent plungers (4), springs (3), discs (2), and plugs (1) with new O-rings (5).
10. If retaining ring (27) has been removed to replace spool spring (25), install washer (24), spring (25), spacer (26), and secure with retaining ring (27).
11. Slide bushings (23) over spools. Slide new O-rings (22) over spools and position next to bushings. Dip spools in clean hydraulic oil and install spool assemblies in proper location.
12. Install spool caps (28) and tighten to a torque of 20 – 25 ft-lb.
13. Install new wiper seals (38).

Priority Flow Divider

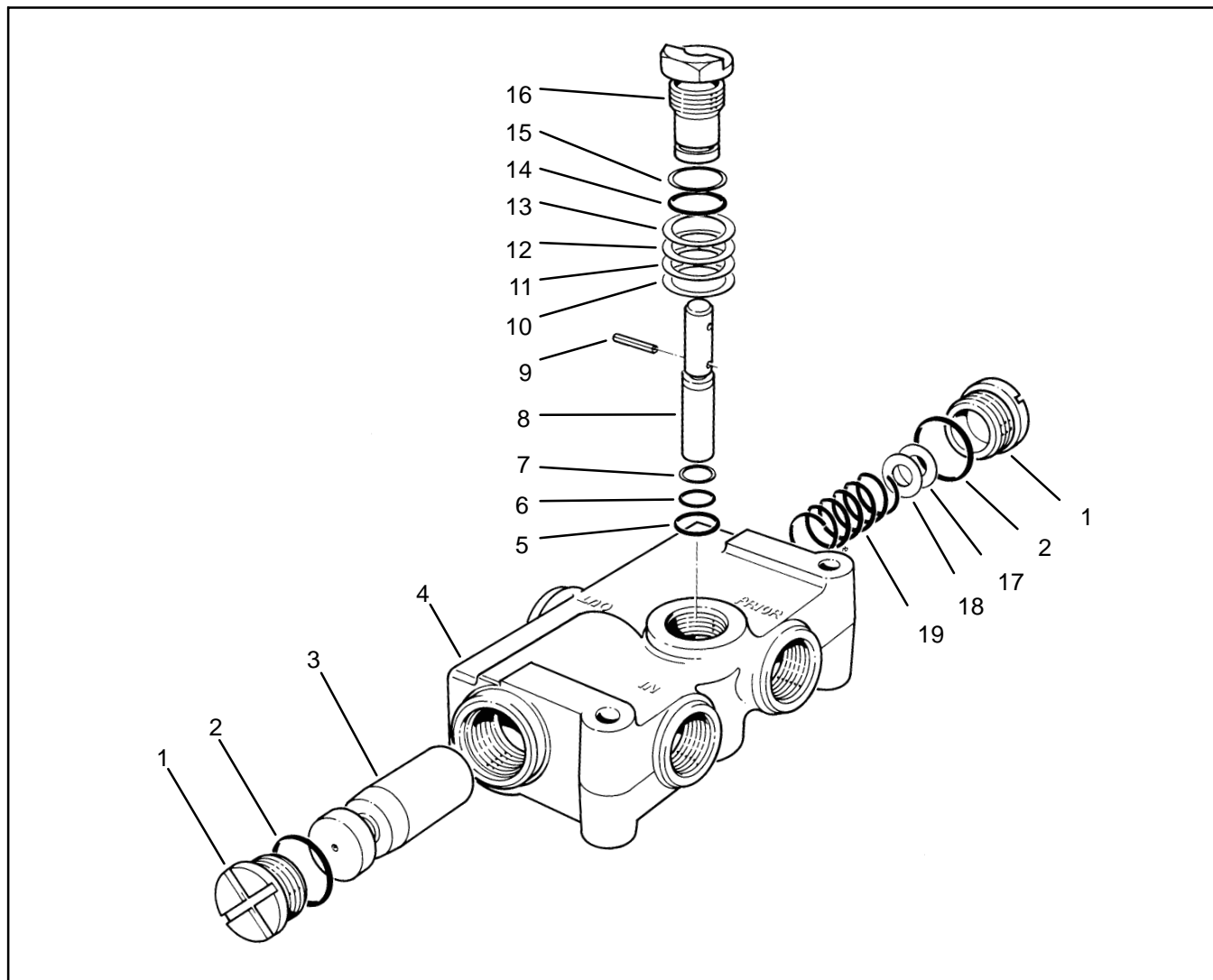


Figure 58

- | | |
|------------------|-------------------|
| 1. Plug Assembly | 11. Shim |
| 2. O-Ring | 12. Shim |
| 3. Spool | 13. Shim |
| 4. Body | 14. O-Ring |
| 5. O-Ring | 15. Backup Washer |
| 6. O-Ring | 16. Metering Plug |
| 7. Backup Washer | 17. Shim |
| 8. Metering Stem | 18. Shim |
| 9. Groove Pin | 19. Spring |
| 10. Shim | |

Disassembly of Priority Flow Divider

1. Plug all ports and thoroughly clean outside of valve.
2. Remove plug (1), shims (17 & 18), spring (19), and flow control spool (3) from body (4).

NOTE: Notice the position of the spool in relation to valve body when removing spool (3).

3. Remove metering plug (16).
4. Remove shims (10, 11, 12, & 13) from metering plug (16).
5. Remove O-rings (5 & 14) and back-up washer (15) from metering plug (16).
6. Remove groove pin (9) and remove metering stem (8) from metering plug (16).
7. Remove O-ring (6) and back-up washer (7) from inside metering screw (16).

Inspection of Priority Flow Divider

1. Thoroughly clean and dry all parts.
2. Remove all nicks and burrs with emery cloth.
3. Inspect the spool bore inside the body, the surface should be smooth and free of deep score marks.
4. Inspect O.D. of spool, it should be smooth and free of nicks and burrs. Spool should slide freely inside the body bore.
5. Inspect surface of metering stem (8) for deep scratches and burrs.

Reassembly of Priority Flow Divider

1. Install new back-up washer (7) inside metering plug (16).
2. Install new O-ring (6) inside metering plug (16).
3. Oil metering stem (8) and install in metering plug (16). Secure with groove pin (9).
4. Install new back-up washer (15) and new O-rings (5 & 14) on metering plug (16).
5. Install shims (10, 11, 12, & 13) on metering plug (16).

NOTE: Install the same number of shims that were removed.

6. Install metering plug assembly and tighten.
7. Install new O-ring (2) on plug (1) and install plug.
8. Install flow control spool (3), spring (19) shims (18 & 17).

NOTE: Install same number of shims as were removed.

9. Install new O-ring (2) and plug (1) and install plug.

Lift Cylinder

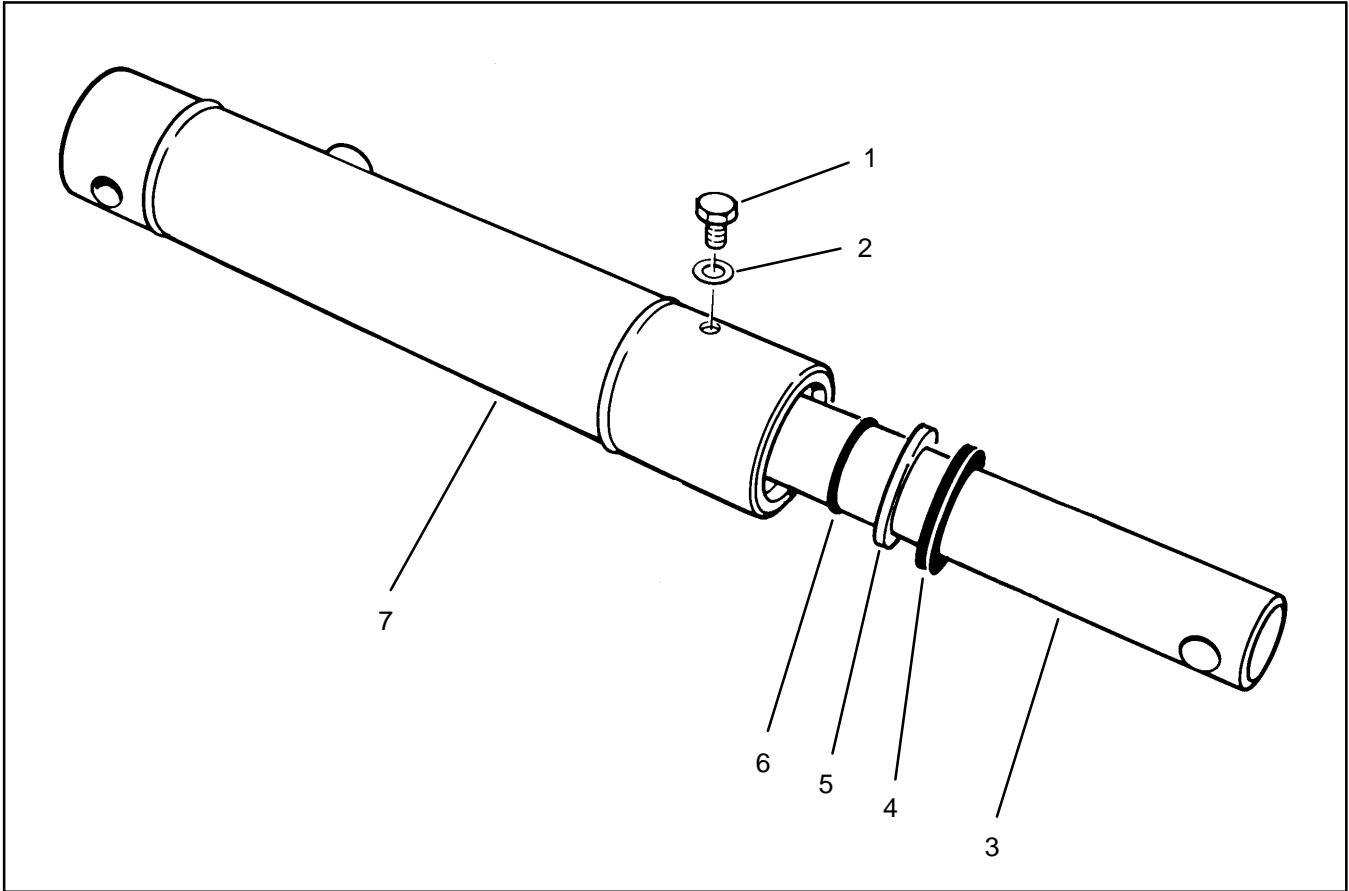


Figure 59

- 1. Bleed Screw
- 2. Washer
- 3. Rod
- 4. Wiper

- 5. Seal
- 6. Snap Ring
- 7. Seal Kit

Disassembly of Lift Cylinder

1. Thoroughly clean outside of cylinder assembly.
2. Pull rod (3) out until end of rod and snap ring (6) can be seen through inlet port.
3. Insert screw driver in inlet port and slide snap ring (6) into deep groove in the rod assembly.
4. Remove rod assembly (3) from barrel assembly (7).
5. Remove wiper seal (4) and seal (5) from I.D. of barrel assembly.

Inspection of Lift Cylinder

1. It is not necessary to inspect wiper (4), seal (5), or snap ring (6). These parts should be replaced as new items and are included in the seal repair kit available for this cylinder.
2. Thoroughly clean all parts and remove all nicks and burrs with emery cloth.
3. Inspect I.D. of barrel assembly (7) for excessive wear or scoring.

4. Inspect O.D. of rod (3) for nicks, scratches or scoring.

Reassembly of Lift Cylinder

1. All parts should be cleaned and dried thoroughly. Metal parts should be lightly oiled prior to reassembly.
2. Install new seal (5) in barrel. Install new wiper (4) in barrel with lips facing outward.
3. Install new snap ring (6) in deep groove of rod end (3).
4. Oil outside of piston rod (3) and carefully insert rod in barrel assembly (7).
5. Push rod into barrel assembly until snap ring area of rod can be seen through port.
6. By using screwdriver through port, pop snap ring (6) into lock position.
7. Extend rod (3) to full out position to make sure snap ring (6) is locked.
8. Cycle cylinder and check for leaks.

Reel Control Valve

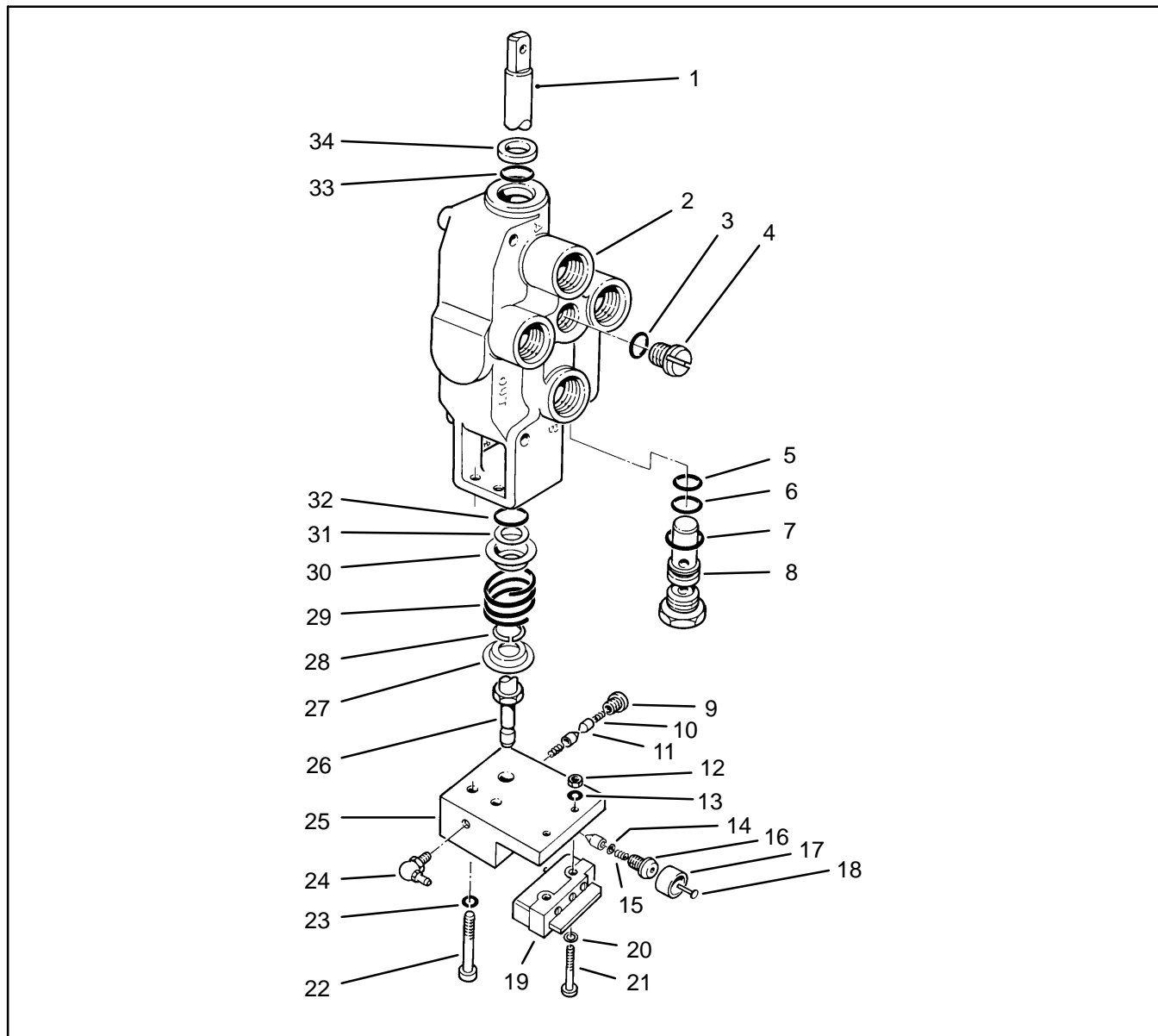


Figure 60

- | | |
|-------------------|--------------------|
| 1. Spool | 18. Plunger |
| 2. Body | 19. Micro Switch |
| 3. O-Ring | 20. Flat Washer |
| 4. Plug | 21. Machine Screw |
| 5. O-Ring | 22. Cap Head Screw |
| 6. Backup Washer | 23. Lock Washer |
| 7. O-Ring | 24. Grease Fitting |
| 8. Relief Valve | 25. Block Detent |
| 9. Detent Plug | 26. Screw Spool |
| 10. Detent Spring | 27. Shallow Washer |
| 11. Detent Pawl | 28. Wire Washer |
| 12. Locknut | 29. Spring |
| 13. Lock Washer | 30. Deep Washer |
| 14. Circlip | 31. Washer |
| 15. Spring | 32. O-Ring |
| 16. Plug | 33. O-Ring |
| 17. Sleeve | 34. Wiper |

Disassembly of Reel Control Valve Assembly

1. Plug all outlets and thoroughly clean outside of valve.
2. Remove plug (4) and O-ring (3).
3. Remove relief valve components (8, 7, 6, & 5).
4. Remove screws (22) and lock washers (23).
5. Remove detent block (25).
6. Remove detent plug (9), spring (10), and pawls (11) from detent block (25).
7. Remove screw spool (26).
8. Remove shallow washer (27), wire washer (28), spring (29), deep washer (30), washer (31), and O-ring (32).
9. Remove spool (1).
10. Remove all O-rings and back-up washers from all plugs, relief valves, and body bore.
11. Thoroughly clean all parts.

Inspection of Reel Control Valve Assembly

1. Remove nicks and burrs from all parts.
2. Inspect spool and body bore for excessive wear.

NOTE: If internal leakage with the spools in spring-centered position has been experienced, wear is indicated between the spool and body bore. This can be corrected by replacing the spool and body as an assembly. Spools or bodies cannot be serviced separately.

3. Inspect relief valve.

NOTE: The pilot-operated cartridge-type relief valve is not adjustable and is pre-set at the factory. However, to ensure cleanliness in the system; snap ring, washer, and screens may be removed, cleaned with air, and replaced.

4. Inspection of O-rings and back-up washers is not necessary. It is recommended that these be replaced as new parts.

5. Inspect seats in body for wear.

Reassembly of Reel Control Valve Assembly

1. Thoroughly clean and dry all parts. Metal parts should be lightly oiled prior to assembly.

NOTE: All O-rings and back-up washers should be replaced as new parts.

2. Position O-rings (5, 32, & 33) in body bore.
3. Install O-rings and back-up washers on relief valve and plugs.
4. Install plug (4).
5. Install O-ring (32), washer (31), deep washer (30), spring (29), wire washer (28), and shallow washer (27) into proper position in body casting.
6. Insert spool (1) into body bore and screw spool screw (26) into spool.
7. Install spring (10), pawls (11), spring (10) and detent plug (9) into detent block (25).
8. Slip detent block (25) over spool screw (26) and secure to valve body (2) with lock washers (23) and cap screws (22).
9. Install relief valve (8).
10. Run operational check.

Reel Shut Off Valve

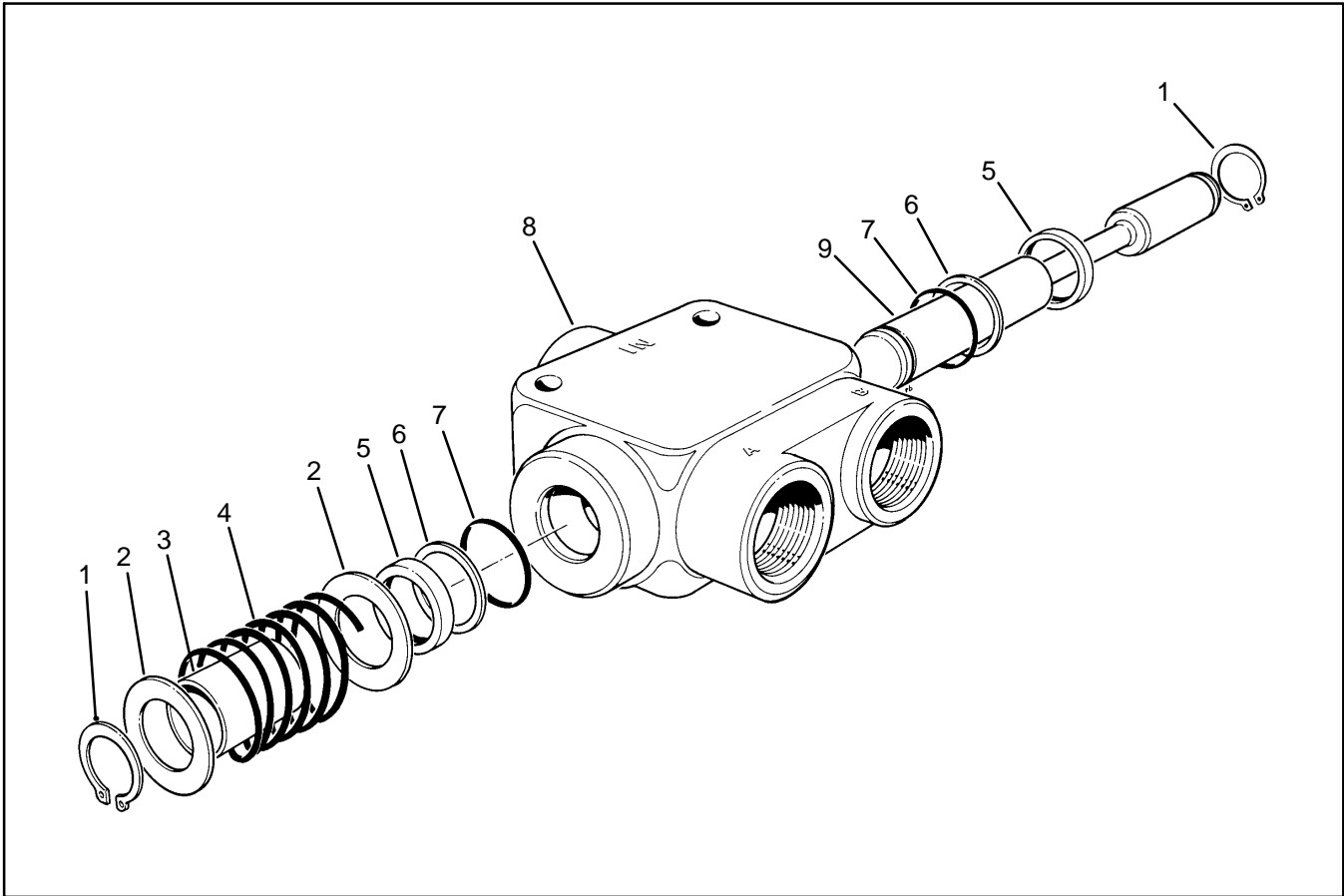


Figure 61

- 1. Circlip
- 2. Washer
- 3. Spacer
- 4. Spring
- 5. Wiper

- 6. Backup Washer
- 7. O-Ring
- 8. Body
- 9. Spool

Disassembly of Reel Shut-Off Valve Assembly

1. Thoroughly clean outside of valve.
2. Remove retaining ring (1) from end of spool (9).
3. Remove spool (9) from valve body (8).
4. Remove washers (2), spring (4), and spacer (3) from spool (9).
5. Remove wipers (5), back-up washers (6), and O-rings (7) from spool bore.

Inspection of Reel Shut-Off Valve Assembly

1. Thoroughly clean and dry all parts.
2. Inspect the spool bore inside the body. The surface should be smooth and free of deep scratches.

3. Inspect O.D. of spool (9). It should be smooth and free of nicks and burrs.

4. Inspect spring (4) for breakage.

Reassembly of Reel Shut-Off Valve Assembly

1. Install new O-rings (7) and back-up washers (6) in spool bore, with O-rings to the inside of the back-up washers.
2. Install new wipers (5) in spool bore.
3. Install washer (2), spacer (3), spring (4), and washer (2) on spool (9).
4. Dip spool (9) in oil and slide in body bore, taking care not to cut O-rings (7). Be sure spool is installed in the proper position.
5. Install retaining ring (1) on end of spool (9).

Traction Rod Assembly

The traction rod assembly allows adjustment to prevent the machine from creeping when the traction pedal is in neutral. Additionally, the rod block on the traction rod prevents traction pedal movement unless the brake is released.

If the traction rod is disassembled, use the following steps during assembly.

1. Position neutral lock bracket so that socket head screws are in the center of mounting slots.

2. Assemble traction rod to machine using Figure 62 as a guide. Make sure that rod block is positioned downward to engage traction lock lever. Overall traction rod length (center to center) should be 26.060" (66.2 cm). The distance between pump lever clevis center and rod block should be from 8.250" to 8.310" (20.96 to 21.11 cm) (Fig. 63).

3. Attach traction rod to traction pedal and pump lever. Do not fully tighten fasteners.

4. Make sure that ground speed control lever on machine is in the fully forward position.

5. Depress traction pedal fully to engage ground speed control lever and make sure that pump lever has reached the full rearward stroke. If pump lever does not reach full stroke or if traction pedal does not engage ground speed control lever, adjust traction control rod ends as needed. Make sure that rod block stays in alignment with traction lock lever during any control rod adjustment.

6. Tighten all traction control rod fasteners.

7. Start engine and make sure that machine does not creep when traction pedal is in the neutral position.

8. If machine creeps when in neutral, loosen two (2) socket head screws that secure neutral lock bracket to machine (Fig. 62). Slide neutral lock bracket until machine does not move when in neutral. Tighten socket head screws.

9. Verify that hand brake functions correctly after traction rod assembly and adjustments are completed (see Hand Brake and Traction Switches in the Adjustments section of Chapter 6 – Axles and Brakes).

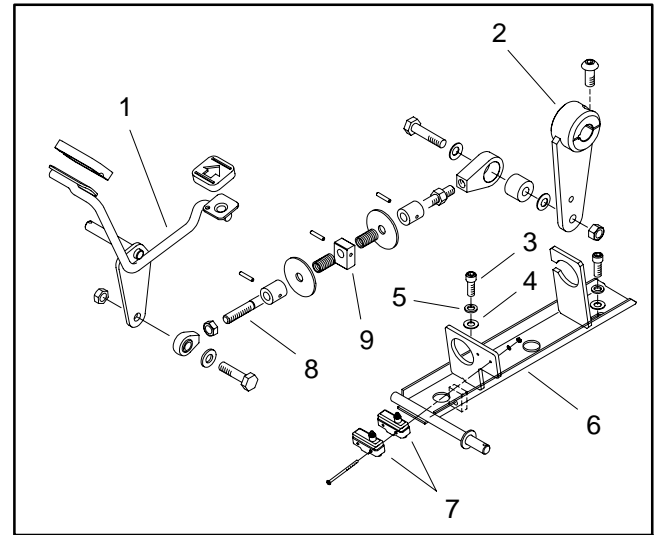


Figure 62

- | | |
|-----------------------------|-------------------------|
| 1. Traction pedal | 6. Neutral lock bracket |
| 2. Pump lever | 7. Switch |
| 3. Socket hd screw (2 used) | 8. Traction rod |
| 4. Flat washer (2 used) | 9. Rod block |
| 5. Lock washer (2 used) | |

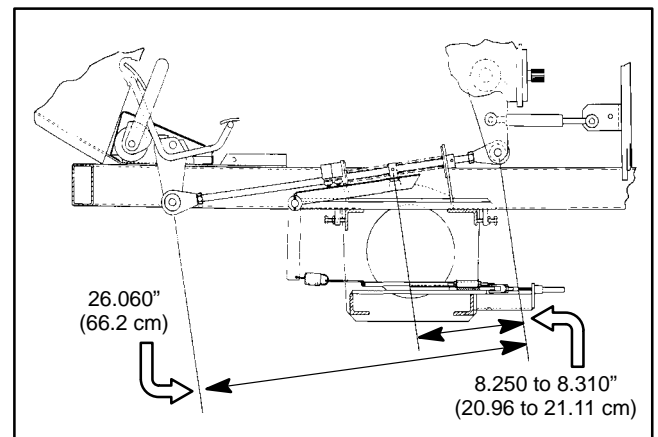


Figure 63

Traction Pump

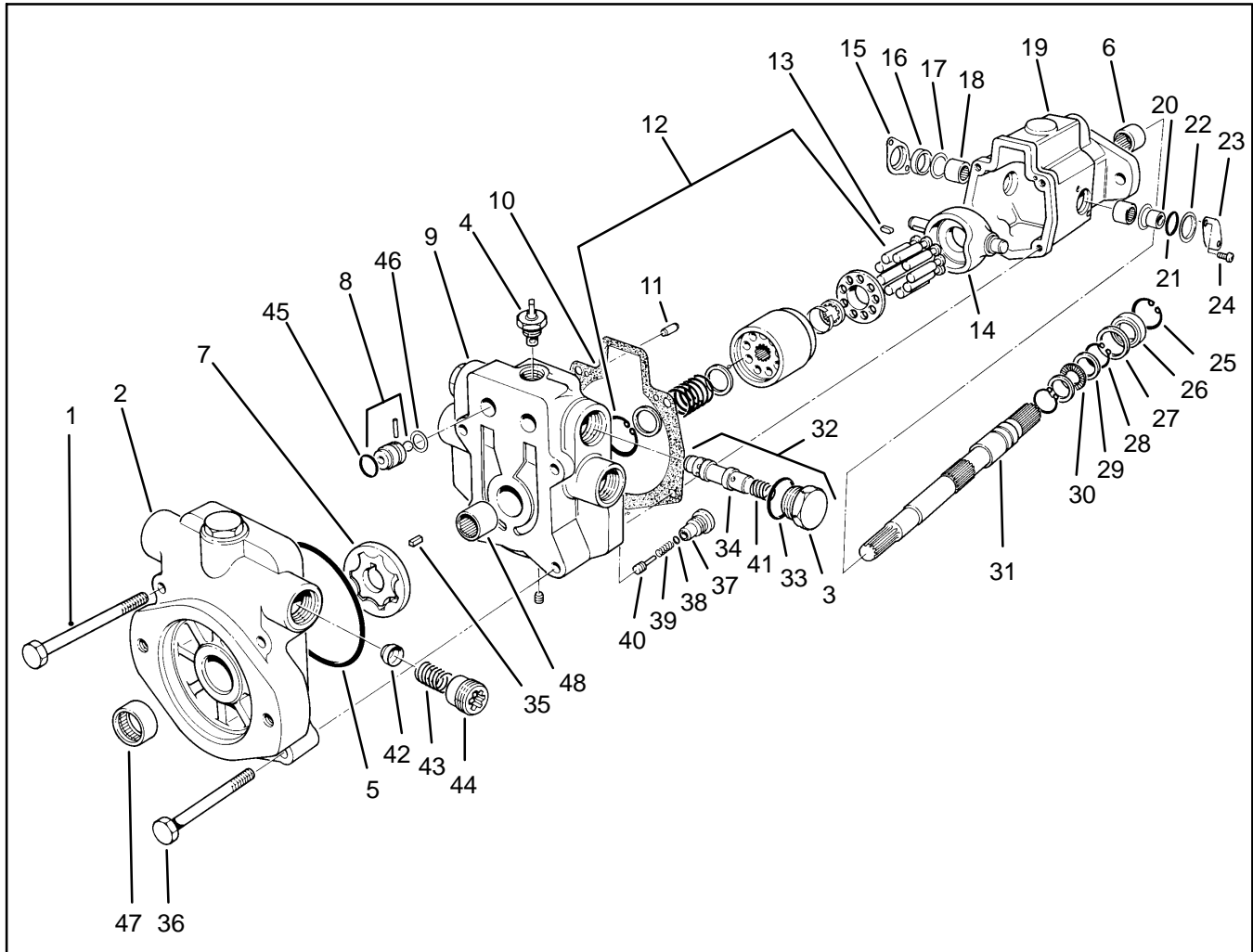


Figure 64

- | | |
|---------------------------------|----------------------------|
| 1. Hex Head Cap Screw | 25. Retaining Ring |
| 2. Charge Pump Adapter Assembly | 26. Shaft Seal |
| 3. Plug Assembly | 27. Washer |
| 4. Tow Valve Assembly | 28. Retaining Ring |
| 5. O-Ring | 29. Thrust Ring |
| 6. Needle Bearing | 30. Needle Bearing, Thrust |
| 7. Gerotor Gear Assembly | 31. Drive Shaft |
| 8. Check Valve Assembly | 32. Relief Valve Kit |
| 9. Back Plate Assembly | 33. O-Ring |
| 10. Housing Gasket | 34. Relief Valve Assembly |
| 11. Dowel Pin | 35. Key |
| 12. Rotating Kit Assembly | 36. Hex Head Cap Screw |
| 13. Key | 37. Cartridge |
| 14. Camplate | 38. O-Ring |
| 15. Seal Cover | 39. Spring |
| 16. Shaft Seal | 40. Poppet |
| 17. Washer | 41. Spring |
| 18. Needle Bearing | 42. Poppet |
| 19. Housing Assembly | 43. Spring |
| 20. Inner Race | 44. Spring Retainer |
| 21. O-Ring | 45. O-Ring |
| 22. O-Ring Cover | 46. Back-up Washer |
| 23. Trunnion Cover | 47. Bearing |
| 24. Screw | 48. Bearing |

Disassembly of Traction Pump

1. Disconnect all control linkage, hydraulic lines and remove pump assembly from vehicle.
 2. Plug all ports and thoroughly clean outside of pump.
 3. Clamp the end of the drive shaft in a protected jaw vise with the body of the pump up and remove the four cap screws (1 & 36) from the adapter plate of the pump.
 4. Use a plastic mallet and tap the charge pump adapter (2) to loosen it, then pull the adaptor straight up until it is free.
 5. Remove spring retainer (44) and remove spring (43) and poppet (42) from adaptor assembly (2).
 6. Remove the gerotor gear (7) and key (35) from the pump shaft.
 7. Remove the two check valve assemblies (8) from back plate (9). Pin is loose fitting. Caution should be taken when removing check valve assembly so that pin and ball are not lost.
 8. Use screwdriver slots in housing and pry up on back plate (9) or tap with plastic mallet to loosen, then pull the back plate straight up to remove. Remove housing gasket (10).
 9. Remove the tow valve (4) from back plate (9). To disassemble tow valve, remove retaining ring from spreader, and pull spreader from spreader plug.
 10. Remove plug assembly (3), spring (41) and relief valve assembly (34) from back plate.
 11. Remove pump from vise and remove rotating kit assembly (12) from housing (19).
 12. If pistons did not come out with piston block, you may remove them, spider, and spider pivot.
- IMPORTANT: Do not attempt to disassemble the piston block and spring. The parts are not serviceable separately. The rotating kit (12) must be replaced as an assembly.**
13. Remove retaining ring (25) from housing. Press drive shaft (31) from housing (19) and remove shaft seal (26) and washer (27).
 14. Remove retaining ring (28) from shaft and remove thrust race (29) and thrust bearing (30).
 15. To remove the camplate (14) from housing, remove screws (24) from the sides of the housing. Remove trunnion cover (23), seal cover (15), O-ring cover (22), O-ring (21), washer (17), inner race (20), and needle bearing (18). Remove shaft seal (16), washer (17), and needle bearing (18).

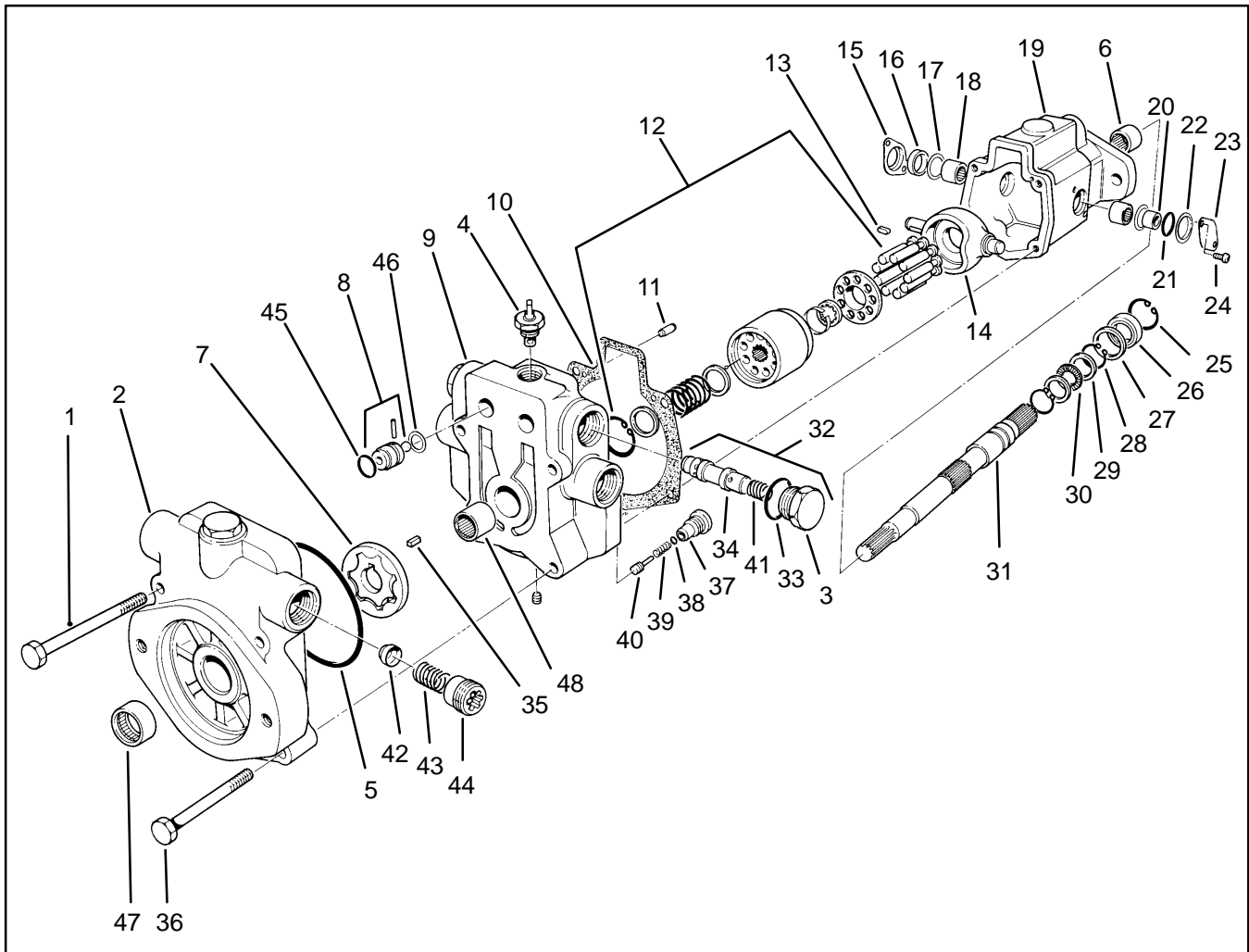


Figure 65

- | | |
|---------------------------------|----------------------------|
| 1. Hex Head Cap Screw | 25. Retaining Ring |
| 2. Charge Pump Adapter Assembly | 26. Shaft Seal |
| 3. Plug Assembly | 27. Washer |
| 4. Tow Valve Assembly | 28. Retaining Ring |
| 5. O-Ring | 29. Thrust Ring |
| 6. Needle Bearing | 30. Needle Bearing, Thrust |
| 7. Gerotor Gear Assembly | 31. Drive Shaft |
| 8. Check Valve Assembly | 32. Relief Valve Kit |
| 9. Back Plate Assembly | 33. O-Ring |
| 10. Housing Gasket | 34. Relief Valve Assembly |
| 11. Dowel Pin | 35. Key |
| 12. Rotating Kit Assembly | 36. Hex Head Cap Screw |
| 13. Key | 37. Cartridge |
| 14. Camplate | 38. O-Ring |
| 15. Seal Cover | 39. Spring |
| 16. Shaft Seal | 40. Poppet |
| 17. Washer | 41. Spring |
| 18. Needle Bearing | 42. Poppet |
| 19. Housing Assembly | 43. Spring |
| 20. Inner Race | 44. Spring Retainer |
| 21. O-Ring | 45. O-Ring |
| 22. O-Ring Cover | 46. Back-up Washer |
| 23. Trunnion Cover | 47. Bearing |
| 24. Screw | 48. Bearing |

Inspection of Traction Pump

1. Inspect the charge pump relief valve seat inside the charge pump adaptor. It should be smooth and free of burrs or other defects.
2. Inspect the charge pump relief valve poppet (42) and spring (43).
3. Inspect the gerotor pocket inside the charge pump adaptor assembly (2). It should not be scored excessively.
4. Inspect the bearing (47) inside the charge pump adaptor assembly, if the needles are free of excessive play and remain in the bearing cage there is no need to replace the bearing.
5. Inspect the check valve assembly (8), make sure the ball seat is in good condition and the ball is free to move.
6. Inspect the flat surfaces of the back plate (9), the finish on the gerotor side should show on galled surface. The finish on the piston block side should be smooth and free of grooves. The back plate should be replaced if it shows any of the wear characteristics outlined above. The cam stop should be tight in the back plate.
7. Inspect the piston block. The surface that contacts the back plate should be smooth and free of grooves.
8. The pistons should move freely in the piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.
9. Examine the O.D. of the pistons for finish condition, they should not show wear or deep scratches. The shoes should be snug fit on the ball end of the pistons. The flat surfaces of the shoes should be flat and smooth. **DO NOT LAP THE PISTON SHOES.**
10. Examine the spider. It should be flat, no cracks and no signs of wear in the pivot area.
11. Examine the pivot. It should be smooth and show no signs of wear.
12. The camplate (14) should be inspected for the condition of the finish of the polished shoe surface. It should show no signs of scoring.
13. Inspect the drive shaft (31) for fretting in the bearing and spline areas.
14. Inspect thrust bearing (30) and thrust race (29) for wear.
15. Inspect the needle bearing (6) in the housing assembly. If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the bearing.

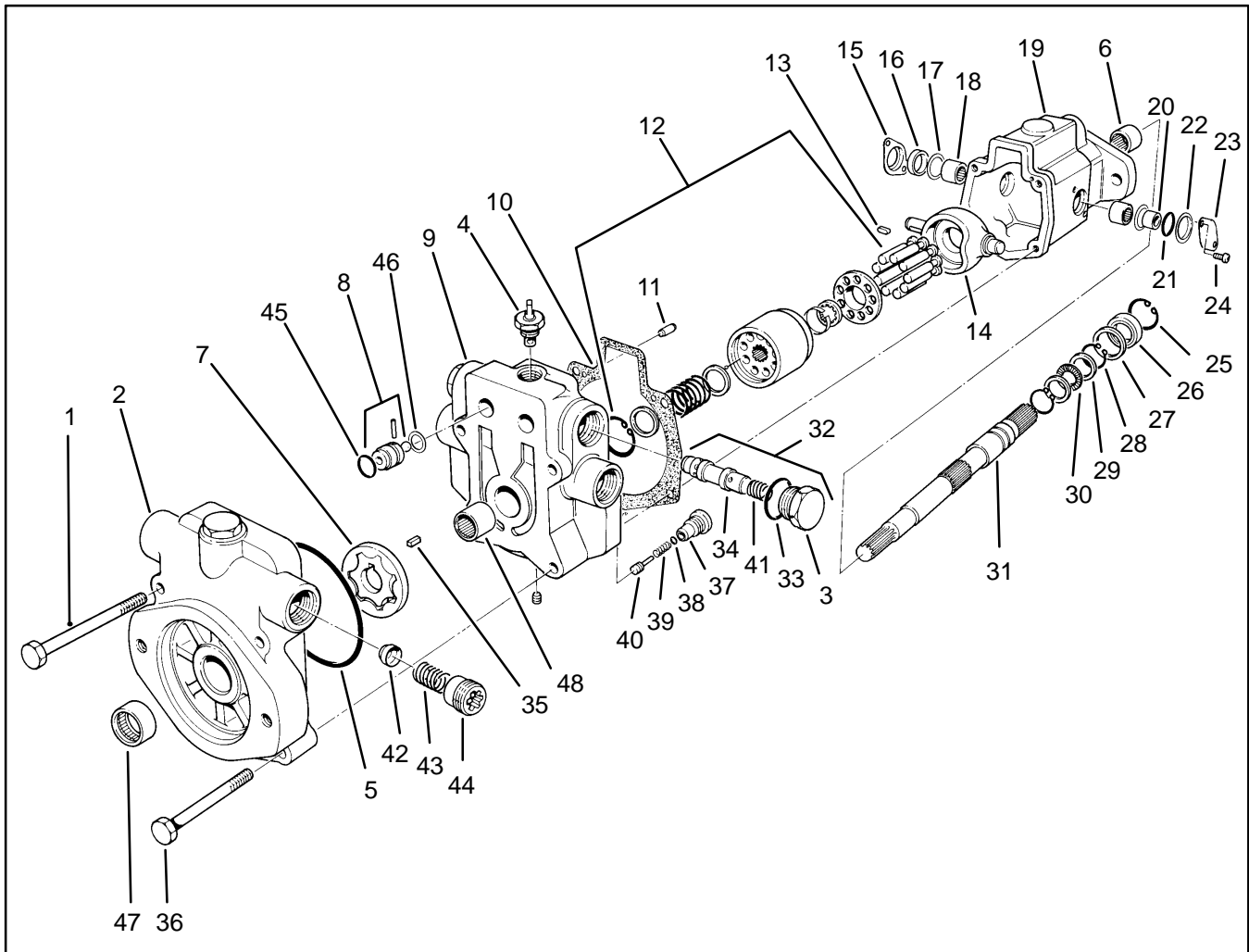


Figure 66

- | | |
|---------------------------------|----------------------------|
| 1. Hex Head Cap Screw | 25. Retaining Ring |
| 2. Charge Pump Adapter Assembly | 26. Shaft Seal |
| 3. Plug Assembly | 27. Washer |
| 4. Tow Valve Assembly | 28. Retaining Ring |
| 5. O-Ring | 29. Thrust Ring |
| 6. Needle Bearing | 30. Needle Bearing, Thrust |
| 7. Gerotor Gear Assembly | 31. Drive Shaft |
| 8. Check Valve Assembly | 32. Relief Valve Kit |
| 9. Back Plate Assembly | 33. O-Ring |
| 10. Housing Gasket | 34. Relief Valve Assembly |
| 11. Dowel Pin | 35. Key |
| 12. Rotating Kit Assembly | 36. Hex Head Cap Screw |
| 13. Key | 37. Cartridge |
| 14. Camplate | 38. O-Ring |
| 15. Seal Cover | 39. Spring |
| 16. Shaft Seal | 40. Poppet |
| 17. Washer | 41. Spring |
| 18. Needle Bearing | 42. Poppet |
| 19. Housing Assembly | 43. Spring |
| 20. Inner Race | 44. Spring Retainer |
| 21. O-Ring | 45. O-Ring |
| 22. O-Ring Cover | 46. Back-up Washer |
| 23. Trunnion Cover | 47. Bearing |
| 24. Screw | 48. Bearing |

Reassembly of Traction Pump

1. Clean all parts in suitable solvent, lubricate all critical moving parts before reassembly. If necessary, install new needle bearings in the housing. The camplate pivot bearings are slip fit; the needle bearing (6) is press fit, install with numbered end of the bearing outward.
2. Insert camplate into housing. Insert the needle bearings (18) over the arm and slide into the housing.
3. Install washers (17) and shaft seal (16) over cam pivot bearing. Install seal cover (15) and secure with screws (24).
4. On the opposite side of housing install needle bearing (18), inner race (20) with chambered I.D. inward, washer (17), O-ring (21), and O-ring cover (22), and secure with trunnion cover (23) and screws (24).
5. Install retaining ring (28) on drive shaft (31). Install thrust race (29), thrust bearing (30), and second thrust race (29), secure with second retaining ring (28).
6. Install shaft in housing and install washer (27), shaft seal (26), and retain with retaining ring (25).
7. Install the pivot, spider and the piston assemblies in the piston block. Install rotating assembly in the housing assembly, the piston shoes must be in contact with the camplate.
8. Clamp pump assembly in a protected jaw vise with the open end of the housing up.
9. Install new housing gasket (10).
10. Install back plate (9).
11. Install ball and pin into check valve housing if removed. Install new O-ring (45) and back-up washer (46) on check valve assembly (8). Install O-ring nearest pin. Install in back plate (9) with pin in back plate.
12. Install key (35) on shaft and install gerotor gear (7) over shaft.
13. Install new O-ring (5) in groove in charge pump adaptor (2), hold in place with clean clear grease. Assemble adaptor on pump back plate. Retain with four cap screws (36 & 1) and torque to 27/31 ft. lbs.
14. Reassemble tow valve assembly (4) by installing new O-rings, inserting spreader into separators plug, and securing with retaining ring.
15. Install tow valve assembly (4) in back plate (9) and torque 27 to 30 ft. lbs.
16. Install relief valve assemblies (34) in back plate.
17. Install new O-ring (33) and spring (41) on plug (3). Install plugs (3) in back plate and torque 55/60 ft. lbs.
18. Remove pump from vise and install poppet (42), spring (43), and spring retainer (44).

Front Traction Motor

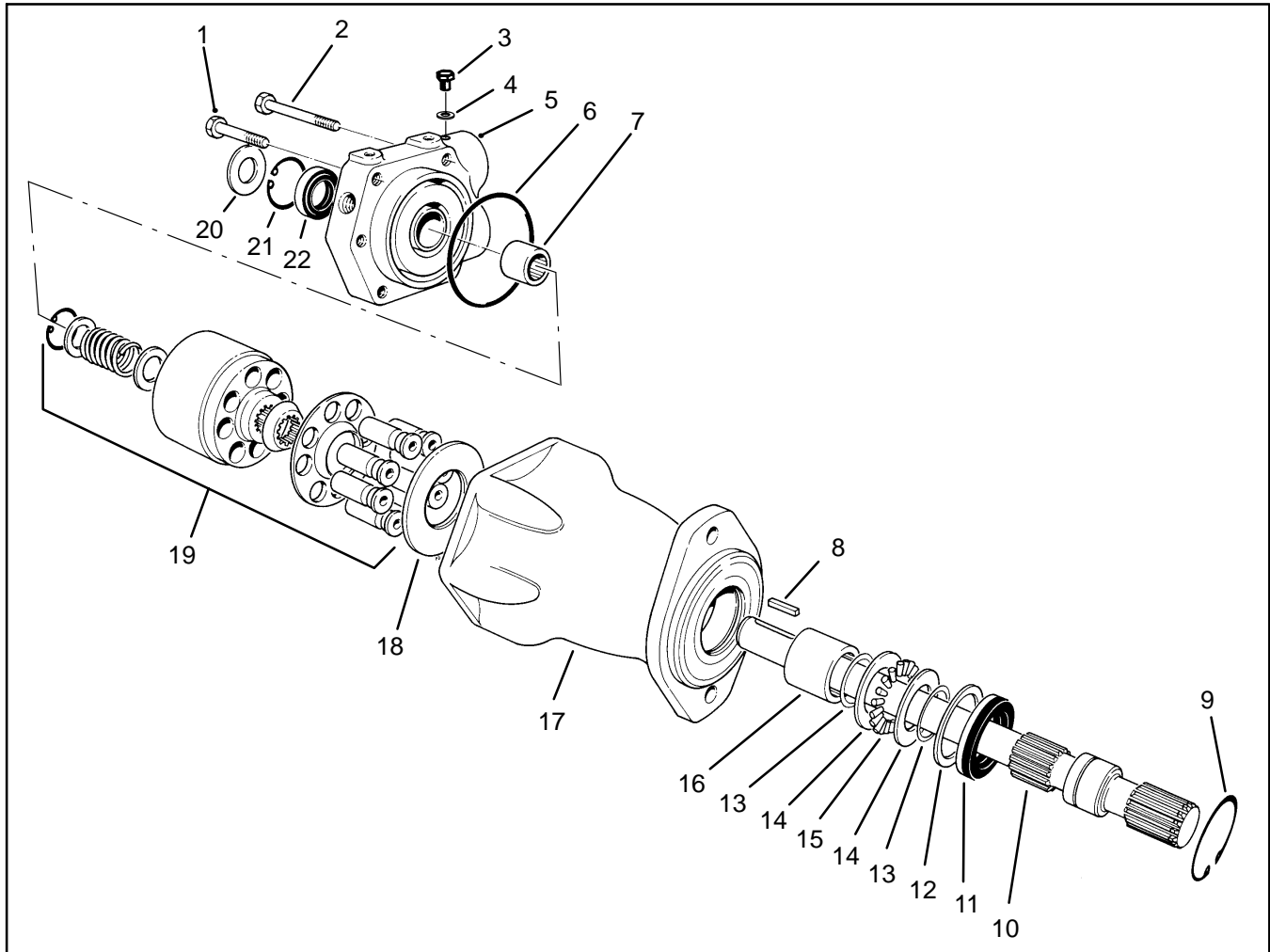


Figure 67

- | | |
|------------------------|-----------------------|
| 1. Hex Head Cap Screw | 12. Washer |
| 2. Hex Head Cap Screw | 13. Retaining Ring |
| 3. Plug | 14. Thrust Ring |
| 4. O-Ring Seal | 15. Thrust Bearing |
| 5. Back Plate Assembly | 16. Bearing |
| 6. O-Ring | 17. Housing Assembly |
| 7. Bearing | 18. Camplate Assembly |
| 8. Key | 19. Rotating Assembly |
| 9. Retaining Ring | 20. Grass Shield |
| 10. Drive Shaft | 21. Retaining Ring |
| 11. Shaft Seal | 22. Shaft Seal |

Disassembly of Traction Motor

1. Clean outside of unit thoroughly.
2. Remove retaining ring (9) from housing assembly (17).
3. Clamp shaft in a protected jaw vise with backplate end up.
4. Remove retaining ring (21) and shaft seal (22) from backplate (5).

5. Remove capscrews (1 & 2) from backplate (5).
6. Use a plastic mallet and tap the backplate (5) to loosen it; then pull the backplate straight out.
7. Remove O-ring (6) from backplate.
8. Remove the complete rotating assembly (19) from the housing assembly (17).
9. Remove piston assemblies, spider, and pivot from the rotating assembly (19).

IMPORTANT: Do not attempt to disassemble the piston block and spring. The parts are not serviceable separately. The rotating assembly (19) must be replaced as an assembly.

10. Remove camplate assembly (18) from housing.
11. Remove shaft seal (11) from housing.
12. Remove washer (12) and drive shaft (10) from housing.
13. Remove the two retaining rings (13), thrust races (14), and thrust bearing (15) from drive shaft (10).

Inspection of Traction Motor

1. Wash all parts thoroughly in a suitable solvent.
2. Examine bearings (16) and (7) in housing (17) and backplate (5). If the needles are free of excessive play and remain in the bearing cage, there is not need to replace the bearing.
3. Inspect thrust races (14) and thrust bearing (15). All surfaces should be free of any signs of wear or fretting.
4. Inspect spider and pivot; conical surfaces should be free of wear and score marks.
5. Inspect the pistons; the O.D. surface should be smooth and free of scoring. The shoes should be snug fit to the piston. The face of the shoes should be flat and free of scoring and flaking. Do not lap piston shoes.
6. Inspect the piston block; the bores should be free of scoring. The surface that contacts the backplate should be smooth and free of grooves or metal build-up.
7. Inspect the camplate assembly (18); the surface opposite the chamfered side should show no signs of scoring.

8. Inspect the flat surface on the backplate (5); it should be free of excessive scoring or metal build-up.

9. Inspect the drive shaft (10) for fretting in the bearing areas. Check spline area for twisted or broken teeth. If keyed shaft, check for cracked or chipped keyway.

Reassembly of Traction Motor

1. Lubricate all critical moving parts before assembly.
2. Install one retaining ring (13) in rear groove on drive shaft (10). Install one thrust race (14), thrust bearing (15), and second thrust race (14) on drive shaft (10). Install second retaining ring (13) in front groove on drive shaft.
3. Replace needle bearing (16) in housing (17) if necessary. Install shaft in housing assembly (17). Install washer (12), shaft seal (11) and retain with retaining ring (9).
4. Install the pivot, spider, and the piston assemblies in the piston block assembly.
5. Lubricate camplate assembly (18) and install in housing assembly with chamfered edge of race against housing surface.
6. Install piston block assembly in housing assembly. The piston shoes must contact the camplate assembly (18). Be sure all parts are in their proper position.
7. Install new bearing (7) in backplate (5) if necessary.
8. Install new O-ring (6) on backplate.
9. Install backplate (5) on housing.
10. Install capscrew (1 & 2) and torque 15–18 ft. lbs.

Reel Pump

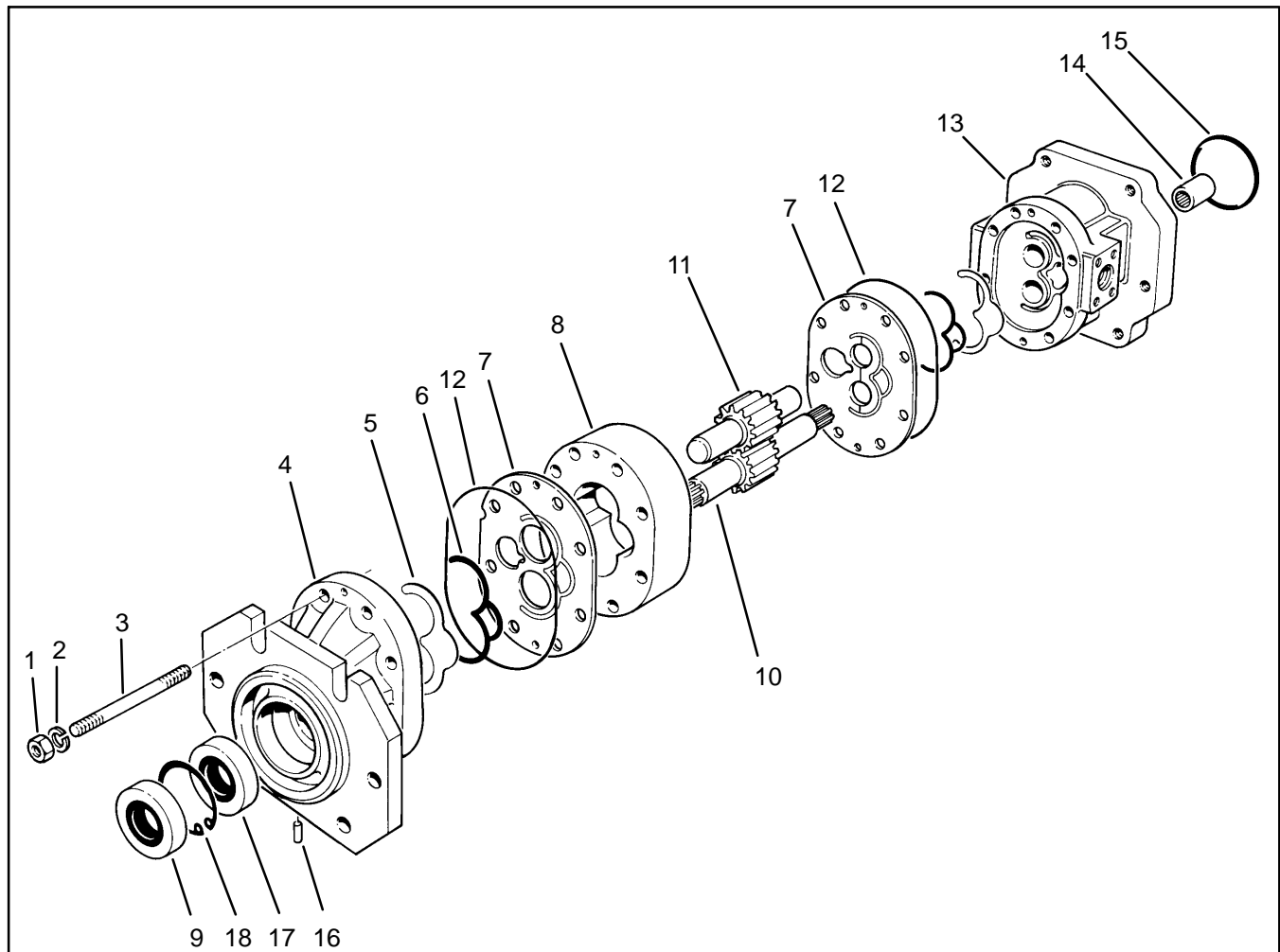


Figure 68

- | | |
|-----------------------|-----------------------|
| 1. Nut | 10. Spline Drive Gear |
| 2. Lock Washer | 11. Driven Gear |
| 3. Stud | 12. O-Ring Seal |
| 4. Stud | 13. Rear Port Section |
| 5. Front Cover | 14. Coupling |
| 6. Gland Seal | 15. O-Ring |
| 7. Wear Plate | 16. Plug |
| 8. Center S/A Section | 17. Shaft Seal |
| 9. Shaft Seal | 18. Retaining Ring |

Disassembly of Reel Pump

During disassembly, pay particular attention to identification of the parts for correct assembly.

1. Clamp the port section (13) in a vise with protective jaws to avoid damage to the port section's machined surfaces.
2. Remove gear coupling (14) from port section (13).
3. Remove eight nuts (1) and eight washers (2).
4. Remove front cover (4) from wear plate (7).
5. Remove seal retainer (6) and gland seal (5) from front cover (4) and discard.
6. Remove wear plate (7) from center section (8).
7. Remove spline drive gear (10) and driven gear (11) from center section (8).
8. Removal of the center section (8) may require the use of a plastic hammer.
9. Remove wear plate (7) from port section (13).
10. Remove seal retainer (6) and gland seal (5) from port section (13) and discard.

Inspection of Reel Pump

All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Paint found on the edges of all parts must be removed. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water and contamination.

New seal kits (5 & 6) are required for assembly. Wash the metal parts, blow dry them with air, and place on a clean surface (Kraft paper) for inspection.

1. Place front cover S/A (4) in a vise (mounting flange up). Using a screwdriver, pop out the outer shaft seal (9), being careful not to raise a burr on the shaft seal bore.

2. Remove the retaining ring (18) with internal retaining ring pliers.

3. Remove front cover S/A (4) from vise and place on work bench with mounting flange down. Using a bronze drift and hammer, drive inner shaft seal (17) out through mounting flange, being careful not to damage bearing.

4. Inspect the drive and driven gear bushings of front cover (4) for pickup, scoring, discoloration, or excessive wear. Any of the preceding conditions shall warrant replacement of the front cover S/A (4). Inspect mounting flange for nicks and burrs. Remove with India stone.

5. Inspect wear plates (7) for erosion, pitting, scratching, and/or scoring. Replace if necessary.

6. Inspect the center S/A section (8) for porosity, cracks, and scratches (.010 or deeper). Replace if necessary. DO NOT deburr the figure eight section of the center section.

7. Inspect splines on the drive gear (10) and driven gear (11) for nicks or excessive wear. Inspect gear journals for scratches and discoloration. *Any discoloration warrants replacement.* Inspect gear teeth for spalling, scratches, and/or excessive wear. Replace if necessary. Stoning teeth to remove burrs is permissible. The face of the gear teeth should also be inspected for scratches.

8. Inspect the drive and driven gear bushings on the port section (13) for pickup, scoring, discoloration, and/or wear. *Any of the preceding conditions shall warrant replacement of the port section.* Inspect inlet flange for nicks and burrs. Stone to remove. Inspect studs (3) for cross threads, cracks, and burrs. If studs are defective, remove as follows: Install a nut (1) on the stud as far as possible. Then install another nut over the first one and tighten to lock in place. Apply torque to the first nut and remove the stud. Refer to the parts drawing for stud part numbers and installation instructions.

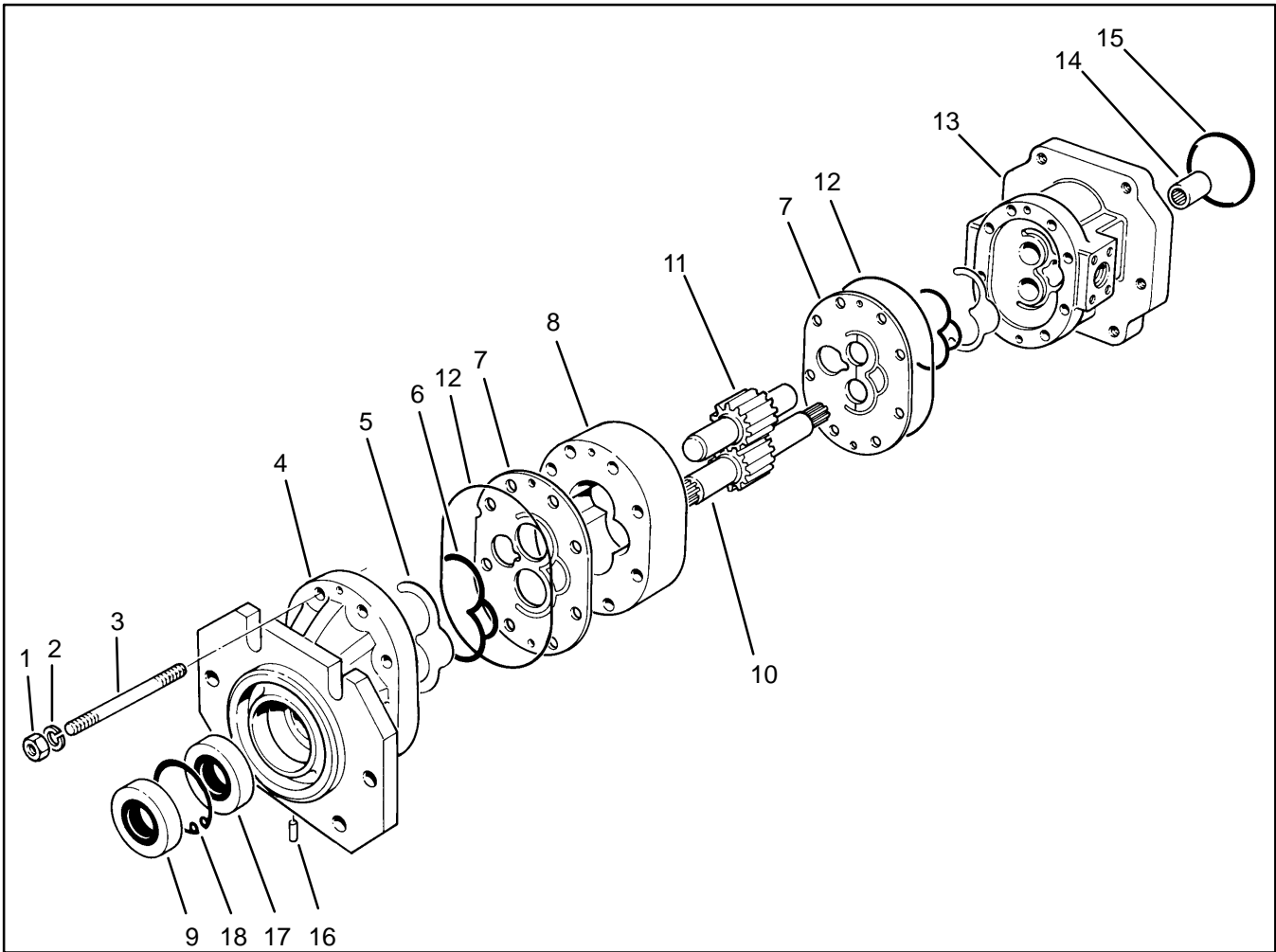


Figure 69

- | | |
|-----------------------|-----------------------|
| 1. Nut | 10. Spline Drive Gear |
| 2. Lock Washer | 11. Driven Gear |
| 3. Stud | 12. O-Ring Seal |
| 4. Stud | 13. Rear Port Section |
| 5. Front Cover | 14. Coupling |
| 6. Gland Seal | 15. O-Ring |
| 7. Wear Plate | 16. Plug |
| 8. Center S/A Section | 17. Shaft Seal |
| 9. Shaft Seal | 18. Retaining Ring |

Reassembly of Reel Pump

NOTE: Coat all parts with clean hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amount of petroleum jelly to hold seal glands (5) and retainers (6) in place during assembly.

1. Assemble seal packs by inserting the seal glands (5) into the seal retainers (6). Install a seal pack into the cavity located on the face of the port section (13) with the seal retainer pointing up.

2. Place port section (13) in vise with studs (3) facing up.

NOTE: The next five steps pertain to installation of front cover shaft seals (9 & 17). Lubricate the shaft seals with Marfak grease to provide initial lubrication.

3. Install inner shaft seal (17) into front cover (4). Make sure the spring loaded member of shaft seal faces the inside of pump. Place the shaft seal (17) on shaft seal driver and press in place.

4. Install retaining ring (18) into front cover on top of shaft seal (17).

5. Place a guide over the pilot diameter of front cover (4).

6. Install a new outer shaft seal (9) on the driver. Make sure the spring loaded member of shaft seal faces the inside of pump.

7. Insert the driver and shaft seal through the guide and press in place.

8. Place wear plate (7) on port section (13) with bronze face up and notch facing inlet port.

9. Lubricate bronze face of wear plate (7). Install center section (8) on top of wear plate (7) and into locating holes of port section (13) with major diameter facing port

section and notch facing inlet port. Make sure wear plate and center section set flush against port section.

10. Tape the spline area (long spline) of drive gear (10) to prevent cutting shaft seal(s) during assembly.

11. Lubricate drive gear (10) and driven gear (11). Install drive gear (10) into port section (13) with short spline towards port section. Install driven gear (11).

12. Lubricate bronze face of wear plate (7). Install wear plate (7) over locating pins of center section (8) with bronze face towards center section and notch facing inlet port.

13. Install seal pack (5 & 6) into cavity located on face of front cover (4). Apply petroleum jelly around seal pack area on face of front cover.

14. Carefully position front cover (4) over studs (3), gears (10 & 11), and center section guide pins. Gently slide front cover over the gears until it is flush against wear plate (7).

15. Lubricate stud (3) threads with hydraulic fluid. Install washer (2) and nuts (1) on ends of studs. Cross torque nuts to 60 to 70 ft–lb.

16. Clamp port section (13) into vise with studs facing down. Make sure port section is clamped securely.

17. Install O–ring (15) into groove located on face of port section (13).

18. Install lubricated coupling (14) on spline of drive gear (10).

19. Turn the drive gear (10) one revolution with a suitable socket wrench. Not binding shall be evident during this operation. The breakaway torque necessary to turn the drive gear must not exceed 140 in–lb.

Rear Wheel Drive Motor

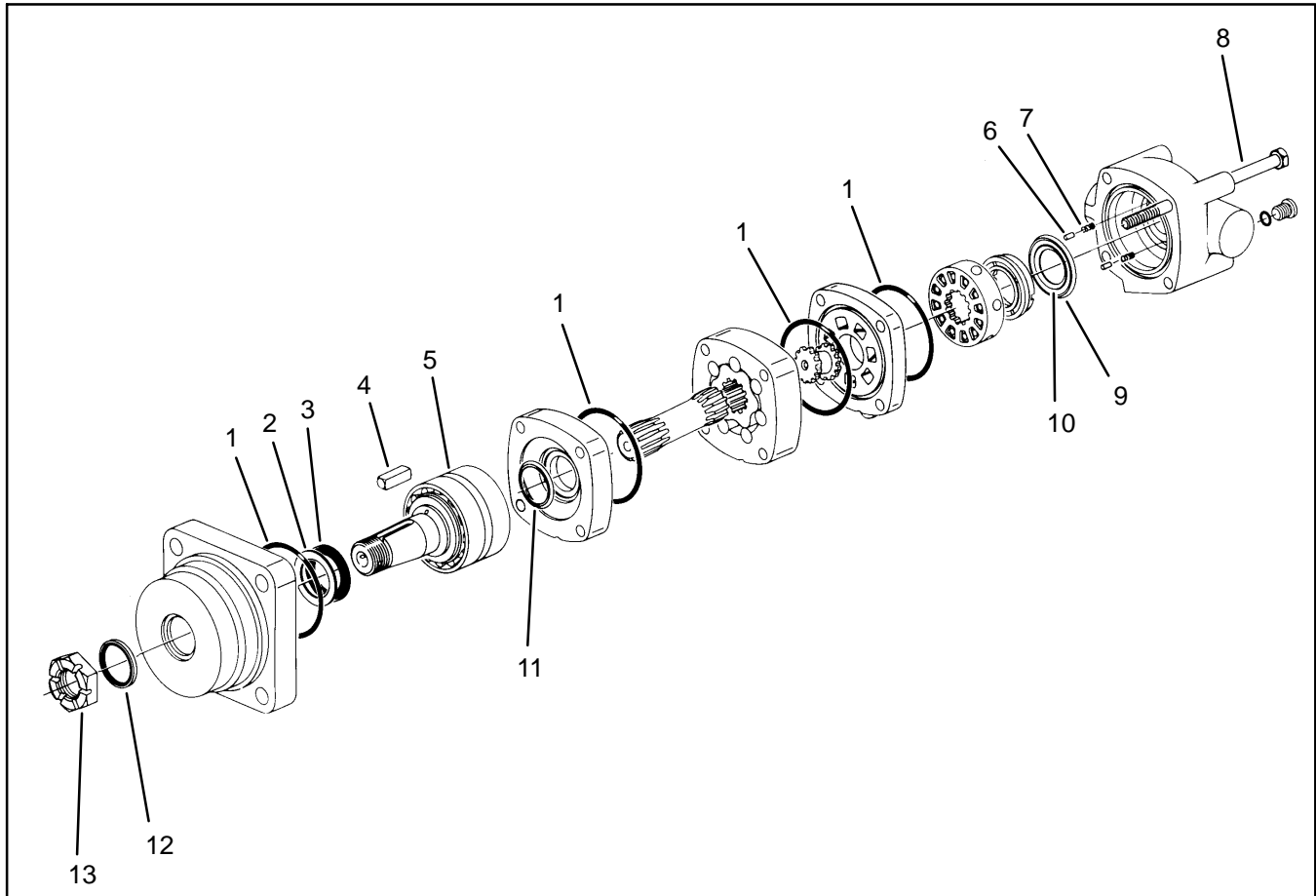


Figure 70

- | | |
|-----------------------|-----------------|
| 1. O-Ring Seal | 8. Bolt |
| 2. Backup Washer | 9. Outer Seal |
| 3. Shaft Seal | 10. Inner Seal |
| 4. Key | 11. Shaft Seal |
| 5. Sub Shaft Assembly | 12. Dust Seal |
| 6. Pin | 13. Slotted Nut |
| 7. Spring | |

Disassembly of the Rear Wheel Drive Motor

Cleanliness is extremely important when repairing a hydraulic motor. Work in a clean area. Before disconnecting the lines, clean the port area of the motor thoroughly. Use a wire brush to remove foreign material and debris from around the exterior joints of the motor. Check the shaft and keyslot, remove all nicks, burrs or sharp edges that might damage the bearing housing seals when installing the shaft and bearing assembly. Before starting the disassembly procedures, drain the oil from inside the motor.

1. Place the motor in a vise with the output shaft down. Clamp across the mounting flange of the motor not the housing. Excessive clamping pressure will cause distortion. When clamping, use some protective device on the vise, such as special soft jaws, pieces of hard rubber or board.

Although not all drawings show the motor in a vise, we recommend that you keep the motor in the vise during disassembly and reassembly. Follow the clamping procedures explained throughout the manual.

2. Remove 4 bolts from motor.

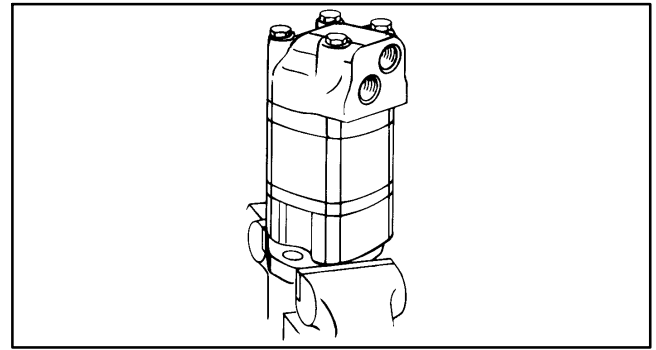


Figure 71

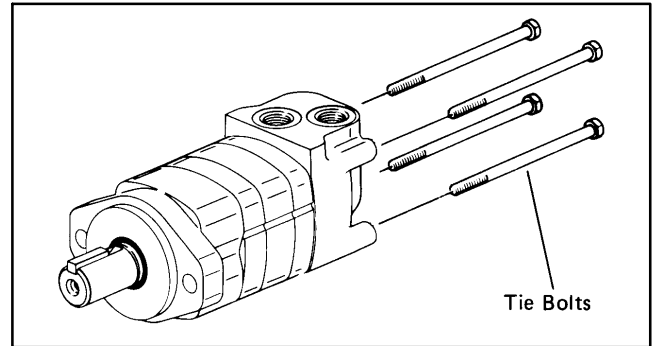


Figure 72

3. Lift valve housing straight up. If done carefully the pins, springs, balance ring assembly, and valve will remain on the valve plate.

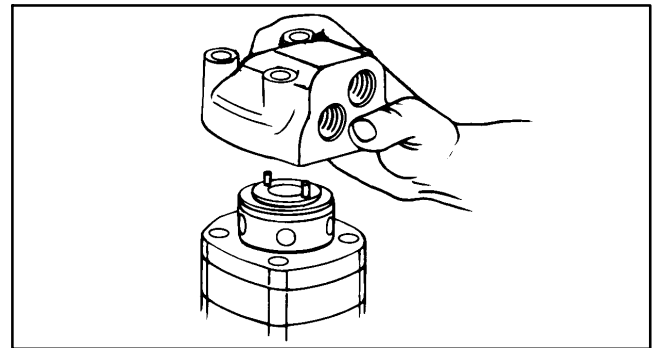


Figure 73

4. Carefully remove 3[76] diameter seal from valve housing.

5. Remove case drain plug—with seal, from front valve housing.

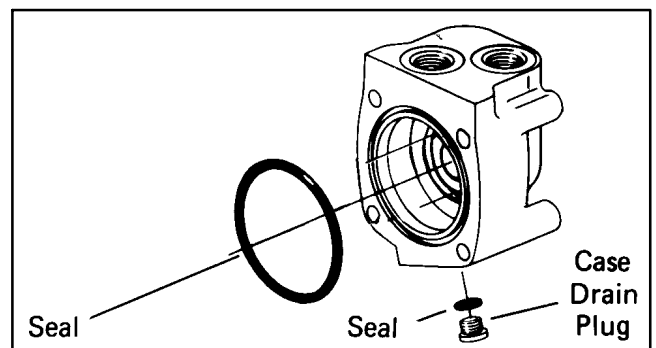


Figure 74

6. Remove 2 pins and 2 springs from balance ring assembly, see Fig. 75.
7. Remove balance ring assembly.
8. Remove inner and outer face seals from balance ring.
9. Remove the valve.

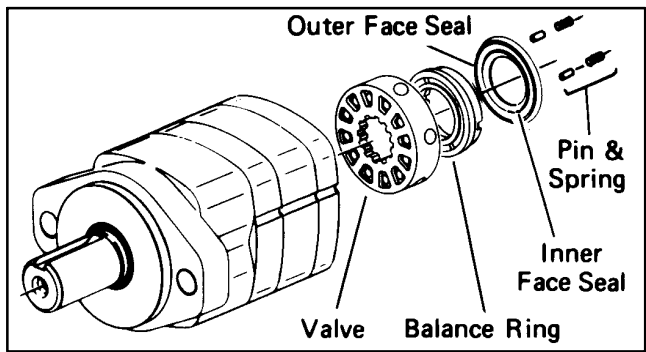


Figure 75

10. Remove the valve plate.
11. Remove the 3[76] diameter seal from valve plate.
12. Remove the valve drive.

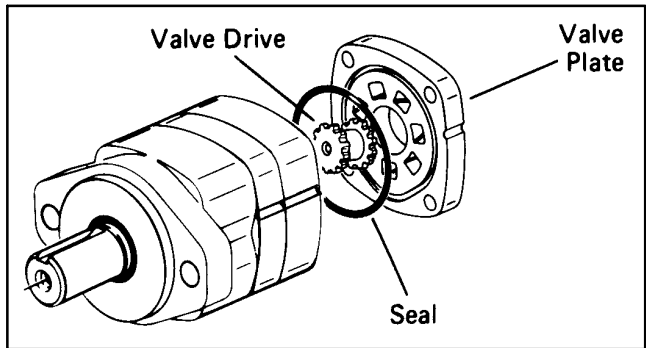


Figure 76

13. Remove the Geroter. Be sure to retain the rollers in the outer ring if they are loose.
14. Remove the drive.
15. Remove the 3[76] diameter seal from wear plate, see Fig. 77.

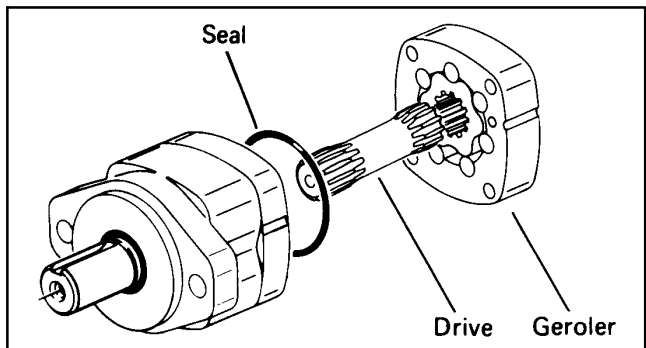


Figure 77

16. Remove the wear plate.
17. Remove the shaft face seal from the wear plate.
18. Remove the 3[76] diameter seal from bearing housing.

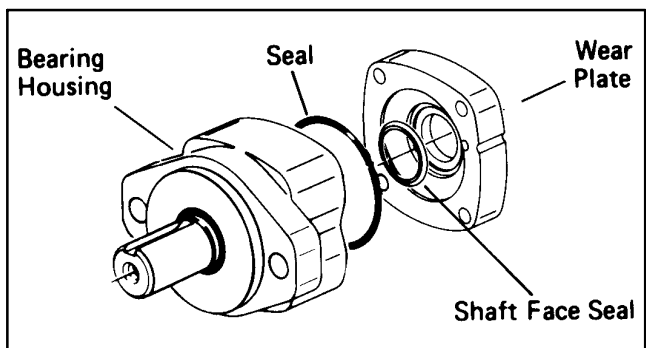


Figure 78

19. You may need a press to remove shaft and bearing assembly from bearing housing. (Key must be removed before removing shaft.)

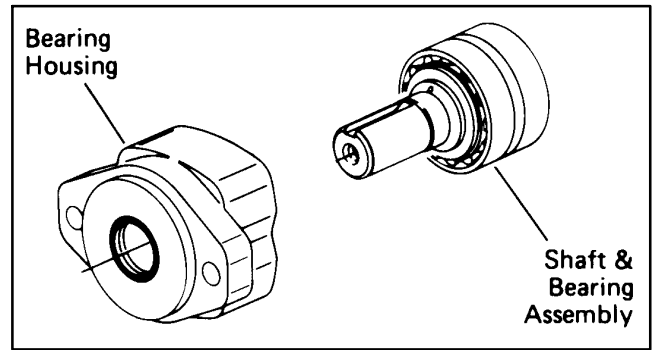


Figure 79

20. Use a small screwdriver to remove shaft seal, back-up washer and exclusion seal from bearing housing, see Fig. 80. Do not damage bore of housing.

NOTE: Individual parts of shaft and bearing assembly are not sold separately. Replace as a unit.

Check all mating surfaces. Replace any parts that have scratches or burns that could cause leakage. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because lint or other matter can get in the hydraulic system and cause damage. Do not use a coarse grit or try to file or grind these parts. Check around the keyway and chamfered area of the shaft for burrs, nicks or sharp edges that can damage the seals when reassembling the bearing housing.

NOTE: Lubricate all seals (prior to installation) with petroleum jelly such as Vaseline. Use new seals when reassembling this motor.

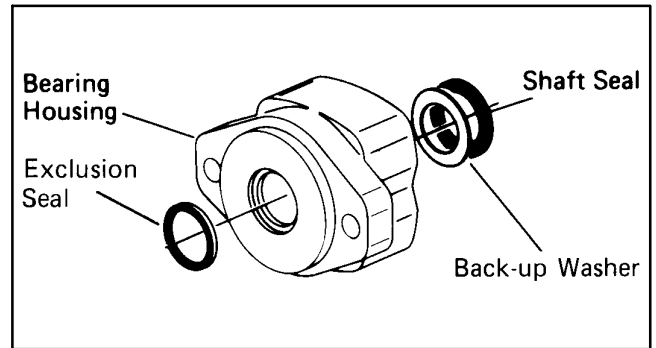


Figure 80

21. Use a press to install exclusion seal in outer bore of bearing housing. Lip of seal must face outward. See Fig. 81. If a press is not available use a plastic or rubber hammer, being careful not to damage or cock seal in the bore.

22. Place back-up washer into seal bore. Place shaft seal onto installation tool and press seal into seal bore of the housing.

23. Clamp housing in vise, see Fig. 71.

24. Place protective bullet over shaft. Apply petroleum jelly to inside diameter of dust and shaft seal. You may need a press to install shaft and bearing assembly. Do not distort shaft seal. Damage to this seal will cause leakage.

NOTE: Use tape over other shafts to prevent cutting the seats.

25. Apply petroleum jelly to the 3[76] diameter seal. Install seal into the bearing housing.

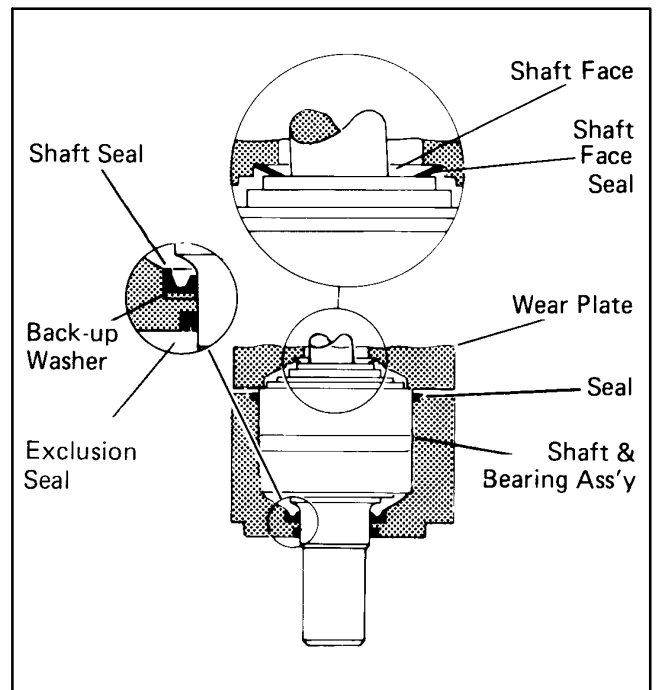


Figure 81

26. Alignment studs can be very helpful in reassembly of the motor. If you use studs, install 2 studs diagonally opposed in the bearing housing.

27. Install the shaft face seal in the wear plate as shown in Fig. 81. Do not distort seal.

28. Install the wear plate, see Fig. 81.

29. Apply a light film of petroleum jelly to the 3[76] diameter seal and install seal in the wear plate.

30. Install the drive into the output shaft.

31. Align the notch on the outside of the Geroter with the notch on the wear plate. Install the Geroter against the wear plate. Be sure to retain the rollers in the outer ring if they are loose.

32. Install the valve drive in the Geroter.

NOTE: Installation at this time involves 3 steps in the timing of the motor. Timing determines the direction of rotation of the output shaft. Timing parts include:

1. Geroter
2. Valve Drive
3. Valve Plate
4. Valve

Timing Step #1—Locate the largest open pocket in the Geroter and mark it on the outside edge of the Geroter.

33. Apply a light film of petroleum jelly to the 3[76] diameter seal. Install seal in groove of valve plate.

34. Align the notch on the outside of the valve plate with the notch on the Geroter as shown in Fig. 82.

Timing Step #2—Locate the slot opening in the valve plate which is in line with the largest open pocket of the Geroter.

Timing Step #3—Locate any one of the side openings of the valve and align this opening with the open slot of the valve plate that is in line with the largest open pocket of the Geroter. Install the valve by rotating it clockwise until the spline teeth engage (1/2 spline tooth max). This will provide the proper rotation when pressurized as shown in Fig. 83.

35. Install 2 springs and 2 pins in the holes located in the bore of the valve housing, as shown in Fig. 81.

36. Apply a light film of petroleum jelly to the 3[76] diameter seal. Install seal in the valve housing.

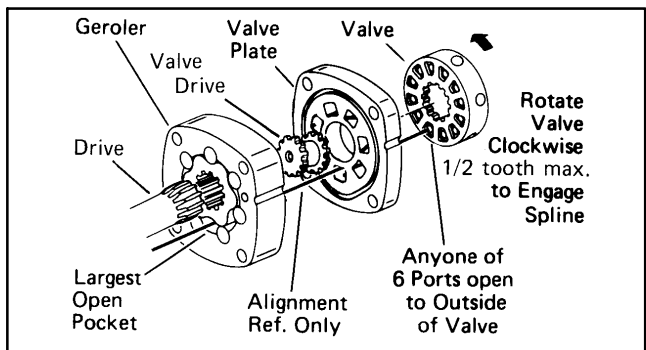


Figure 82

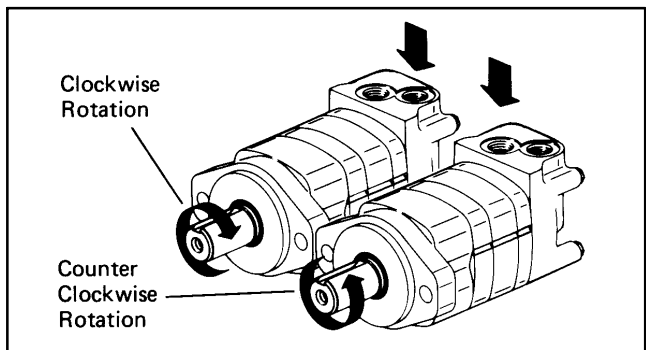


Figure 83

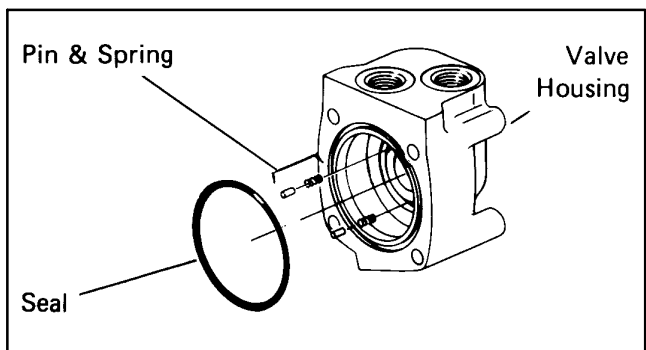


Figure 84

37. Apply petroleum jelly to inner and outer face seals. Install seals on balance ring as shown in Fig. 85.

IMPORTANT: Install face seals in the positions shown in Fig. 85. or the motor will not operate properly. Do not force or bend the face seals. Any damage to these seals will affect the operation of the motor.

38. Align pin notches in balance ring with pins in bore of valve housing. Install balance ring assembly in valve housing.

39. Insert your finger through port of valve housing. Apply pressure to side of balance ring as shown in Fig. 86. Hold ring in position until valve housing is in place against valve plate. See Fig. 87.

NOTE: Install face seals in the positions shown in Fig. 85. or the motor will not operate properly. Do not force or bend the face seals. Any damage to these seals will affect the operation of the motor.

40. Install the tie bolts. If you use alignment studs, install 2 bolts opposite the studs. Finger tighten the bolts. Remove the alignment studs and replace with the 2 remaining bolts. Torque all 4 bolts alternately to 450 lb-in[50Nm].

41. Install seal on case drain plug then install in valve housing. Torque to 50 lb-in[6Nm].

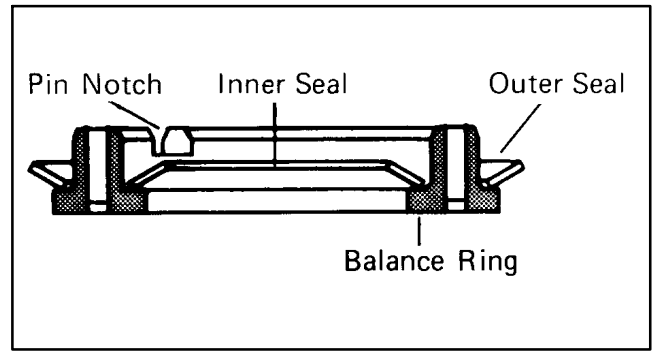


Figure 85

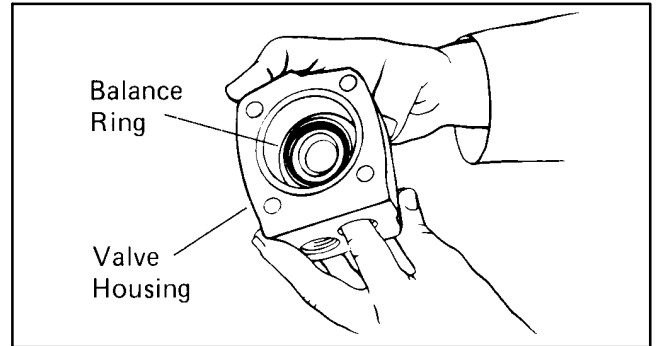


Figure 86

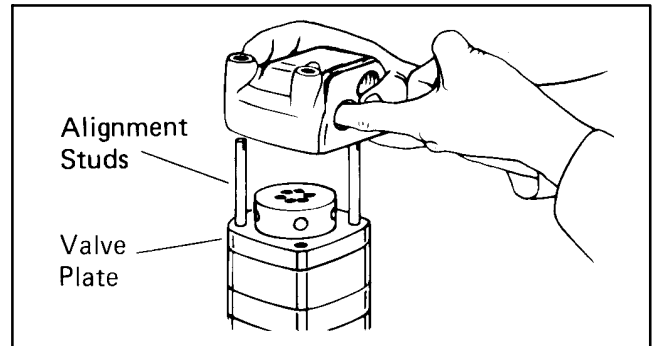


Figure 87

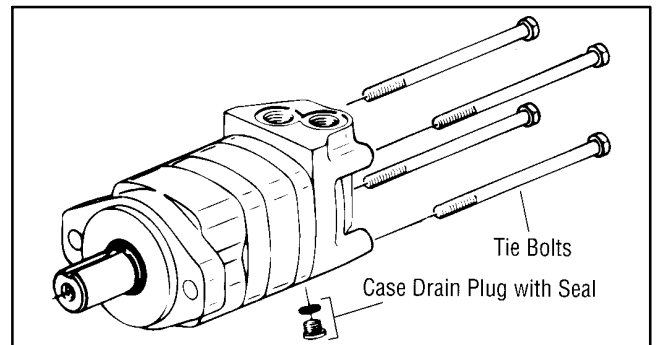


Figure 88

Wheel Motor

On wheel motors, a different bearing housing is used, see Fig. 89. Other than this the parts are the same as the standard motor and the same disassembly and reassembly procedures apply.

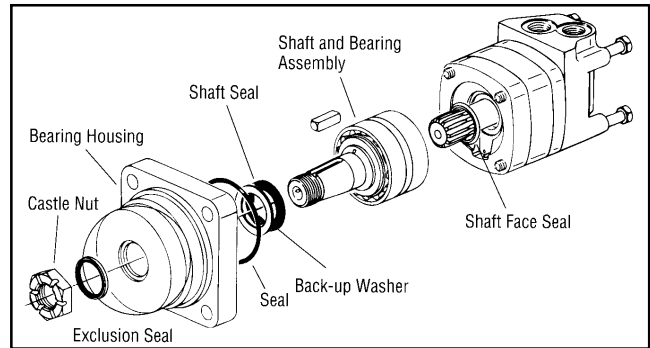


Figure 89

Rear Wheel Drive Valve Block

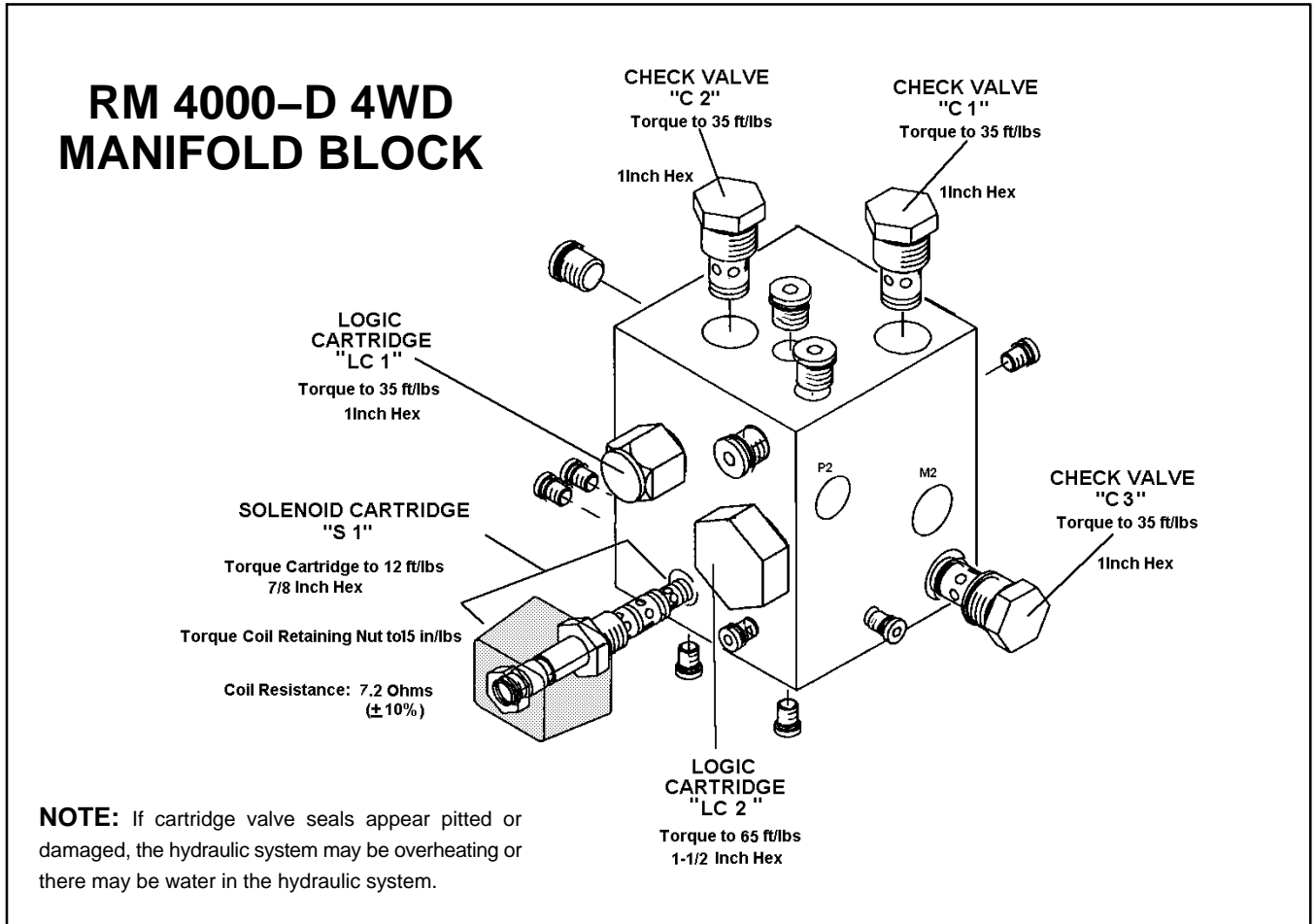


Figure 90

Cleaning Solenoid Actuated Cartridge Valve

Use a deep socket to remove the valve cartridge. Use mineral spirits to clean solenoid actuated cartridge valves. Submerge the valve in clean mineral spirits and use a probe to push the internal spool in and out 20 to 30 times to flush out contamination. Mineral spirits does not affect the O-ring material. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves.

NOTE: Apply clean hydraulic oil to the O-rings before installing the valve. Use a deep socket to install the valve into the manifold block. Tighten to a torque of 35 ft-lb (48 Nm). Install the solenoid coil. Make sure there is an O-ring at each end of the coil. After putting the solenoid onto the valve stem apply Loctite 242 or equivalent to the threads on the stem before installing the nut. Tighten the nut to a maximum torque of 15 in-lb (1.7 Nm) to secure the solenoid; do not over-tighten.

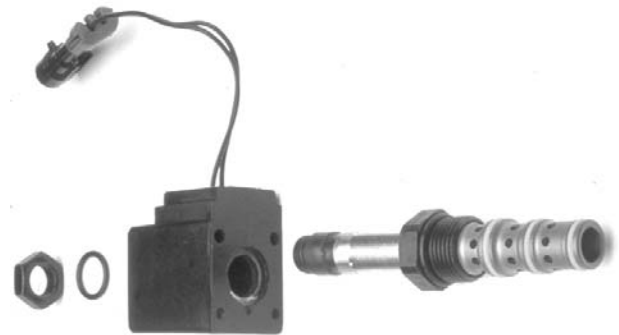


Figure 91

Steering Cylinder

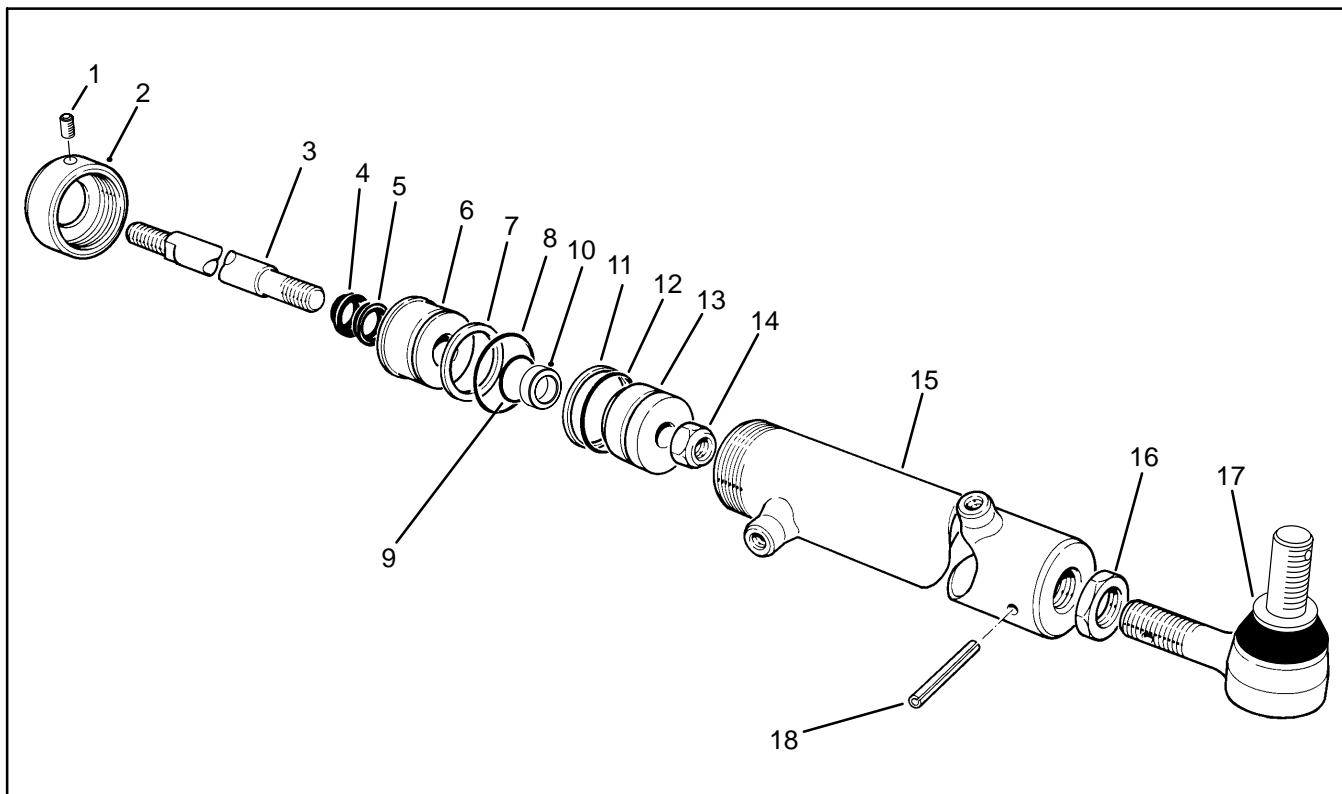


Figure 92

- | | |
|------------------|---------------------|
| 1. Set Screw | 10. Spacer |
| 2. Threaded Cap | 11. Servon |
| 3. Rod | 12. O-Ring |
| 4. Rod Wiper | 13. Piston |
| 5. U-Cup | 14. Locknut |
| 6. Cap Head | 15. Barrel Assembly |
| 7. Backup Washer | 16. Jam Nut |
| 8. O-Ring | 17. Rod Tie, End |
| 9. O-Ring | 18. Roll Pin |

Steering Cylinder Repair

IMPORTANT: To prevent damage when clamping cylinder barrel or rod in a vise, clamp only on pivotal ends.

1. After removing cylinder, pump oil out of cylinder in to a drain pan by SLOWLY moving rod and piston in and out of cylinder bore.
2. Plug ports and clean outside of cylinder.
3. Mount cylinder in a vise so piston rod end of cylinder is tilted up slightly. Do not close vise so firmly that cylinder tube could become distorted.
4. Loosen set screw and remove threaded cap.
5. Grasp clevis end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod, and head from cylinder barrel.
6. Securely mount piston, piston rod, and head into vise and remove nut.
7. Remove piston. Slide head off of piston rod.
8. Remove all seals and O-rings.
9. Wash part in a safe solvent. Dry parts with compressed air. DO NOT wipe them dry with a cloth or paper as lint and dirt may remain.
10. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect head, piston rod, and piston for evidence of excessive scoring, pitting, or wear. Replace any damaged parts.

11. Use a complete repair kit when rebuilding the cylinder. Put a coating of oil on all new seals, and O-rings. Install the new seal and O-rings.

12. Install head onto piston rod.

13. Install piston onto piston rod with O-ring seal (9) and tighten hex nut.

14. Put a coating of oil on all cylinder parts to ease assembly.

15. Slide piston rod assembly into cylinder tube.

16. Install head into tube. Install threaded cap and tighten set screw.

Change Hydraulic Oil

Normally, change hydraulic oil after every 2 years or 1500 operating hours. If oil becomes contaminated, contact your local TORO distributor because the system must be flushed. Contaminated oil looks milky or black when compared to clean oil.

1. Remove drain plug from reservoir and let hydraulic oil flow into drain pan. Tighten plug when hydraulic oil stops draining (Fig. 93).
2. Fill reservoir with approximately 9.3 gallons of hydraulic oil. Refer to Hydraulic Oil Specifications.

IMPORTANT: Use only hydraulic oils specified. Other fluids could cause system damage.

3. Install reservoir cover, lower seat and secure with lock pin. Start engine and use all hydraulic controls to distribute hydraulic oil throughout the system. Also check for leaks. Then stop the engine.

4. With cutting units up and oil warm, look into sight glass. If hydraulic oil is not even with arrows, add enough to raise to proper level. Do not fill full if oil is cold (Fig. 94).

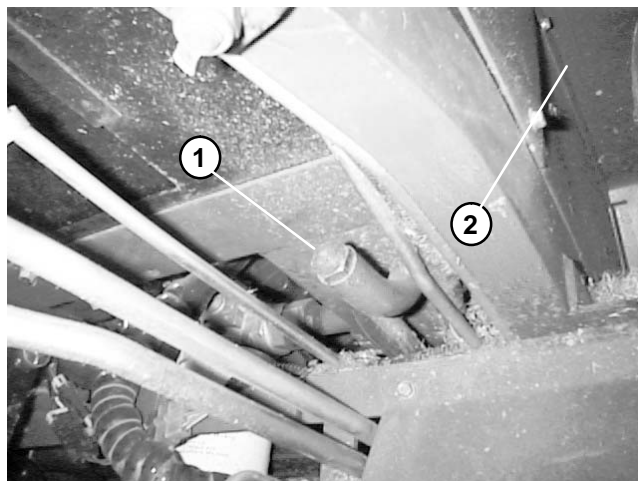


Figure 93

1. Drain plug
2. Right front fender

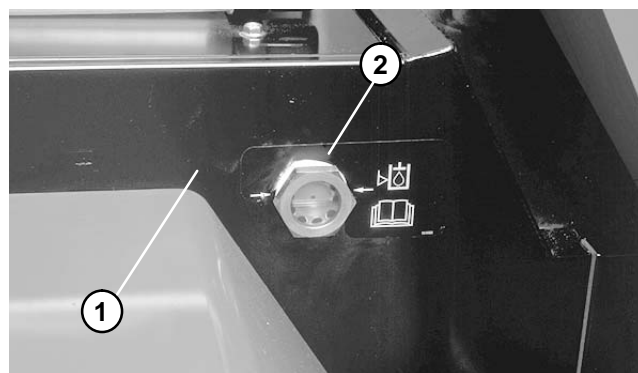


Figure 94

1. Hydraulic reservoir
2. Sight glass

Replace Hydraulic Oil Filter

Initially, change filter after the first 50 operating hours, thereafter, every 800 operating hours, annually, or on indication. Use Toro replacement filter (Part No. 86-6110).

IMPORTANT: Use of any other filter may void the warranty on some components.

1. Remove seat lock pin, raise seat and hold open with support rod. Also remove front panel (secured with magnets) ahead of the seat.
2. Clean area around filter mounting area (Fig. 95). Place drain pan under filter and remove filter.
3. Lubricate new filter gasket and fill the filter with hydraulic oil.
4. Assure filter mounting area is clean. Screw filter on until gasket contacts mounting plate. Then tighten filter one-half turn.
5. Start engine and let run for about two minutes to purge air from the system. Stop the engine and check for leaks.
6. Check hydraulic oil level (see Check Hydraulic System Fluid).

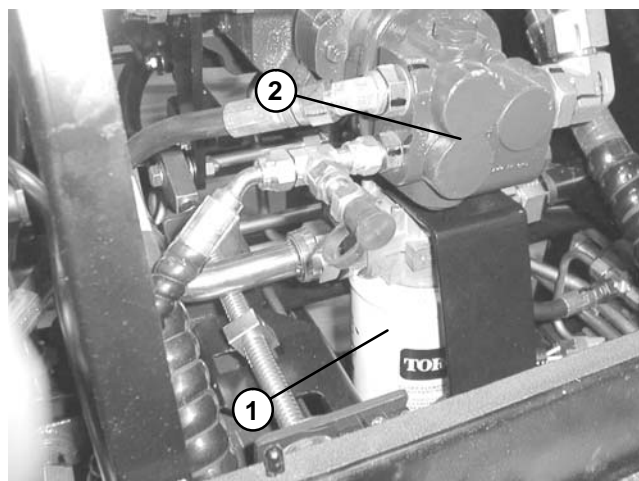


Figure 95

1. Hydraulic oil filter
2. Steering pump

NOTE: Under certain conditions, a bypass valve in the filter mounting plate allows oil to bypass the filter. Before the filter starts to bypass a warning light on the steering console will illuminate. The warning light may come on momentarily when the oil is cold. If the light does not go out after the oil is warm, the filter is clogged or an electrical problem exists. Correct problem before commencing operation.

Replace Hydraulic System Breather

Change hydraulic system breather after every 800 operating hours, or annually, whichever comes first. More often in extremely dusty or dirty conditions.

1. Release latches and open engine cover.
2. Clean around the breather and unscrew it with a wrench. Install new breather (Fig. 96).
3. Close engine cover and latch securely.

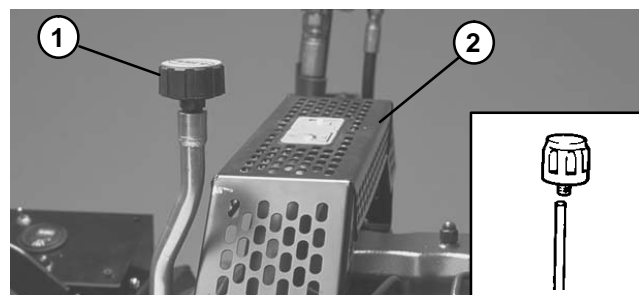


Figure 96

1. Breather
2. Exhaust shield

Replace Hydraulic Lines and Hoses

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings,

weather deterioration and chemical deterioration. Make all necessary repairs before operating.

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Electrical System

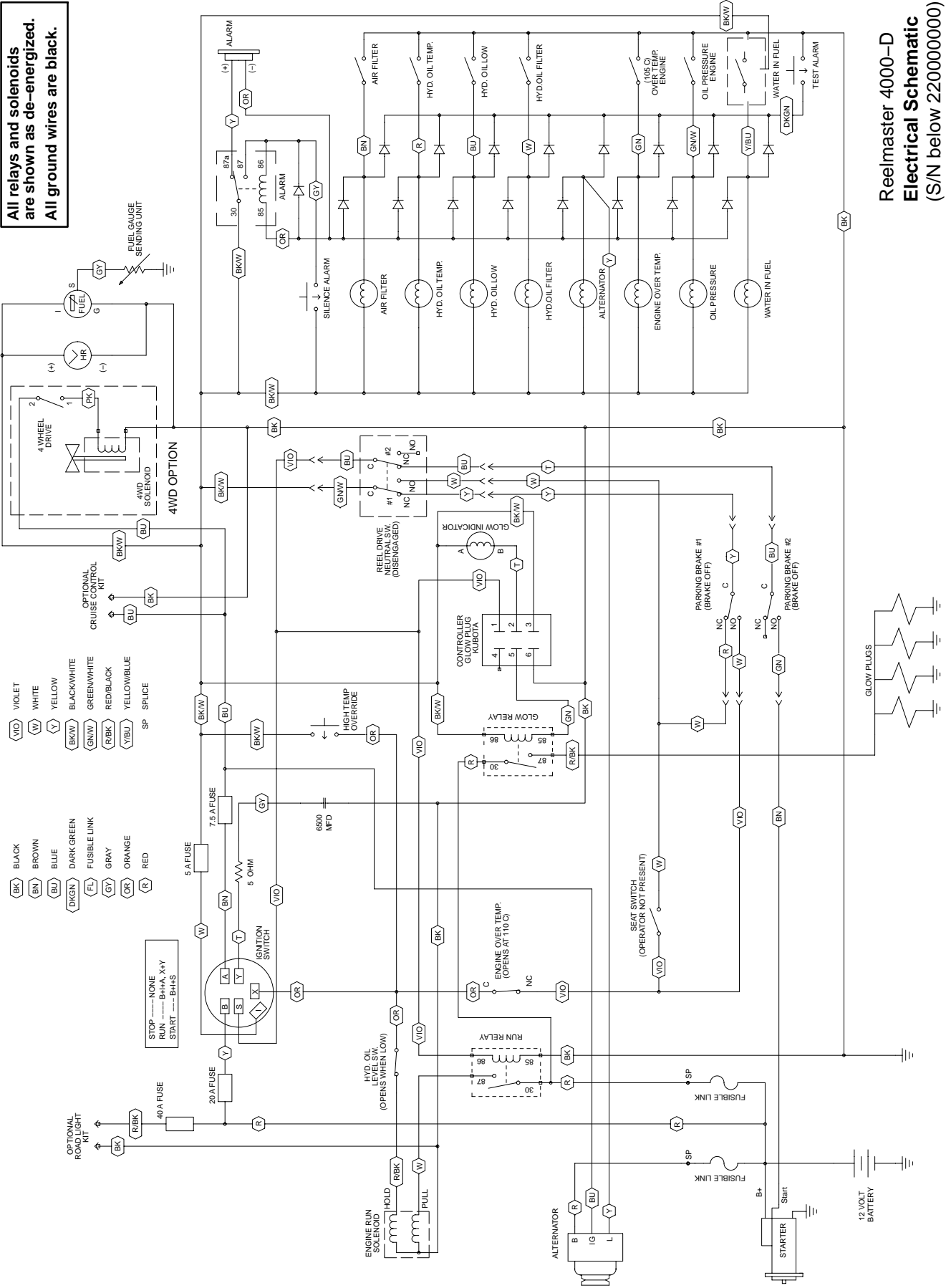
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Electrical System

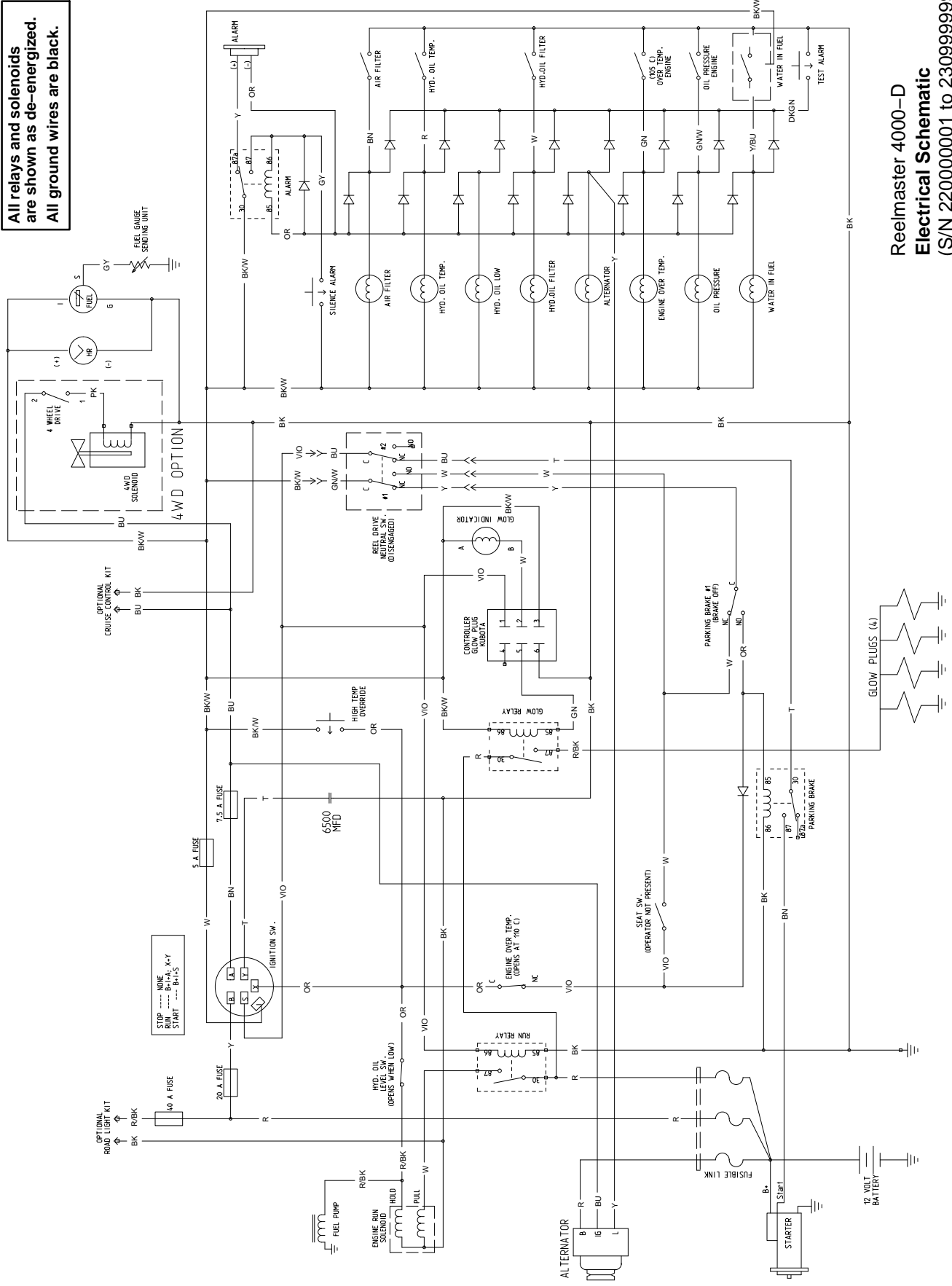
Electrical Schematics and Diagrams

All relays and solenoids are shown as de-energized.
All ground wires are black.



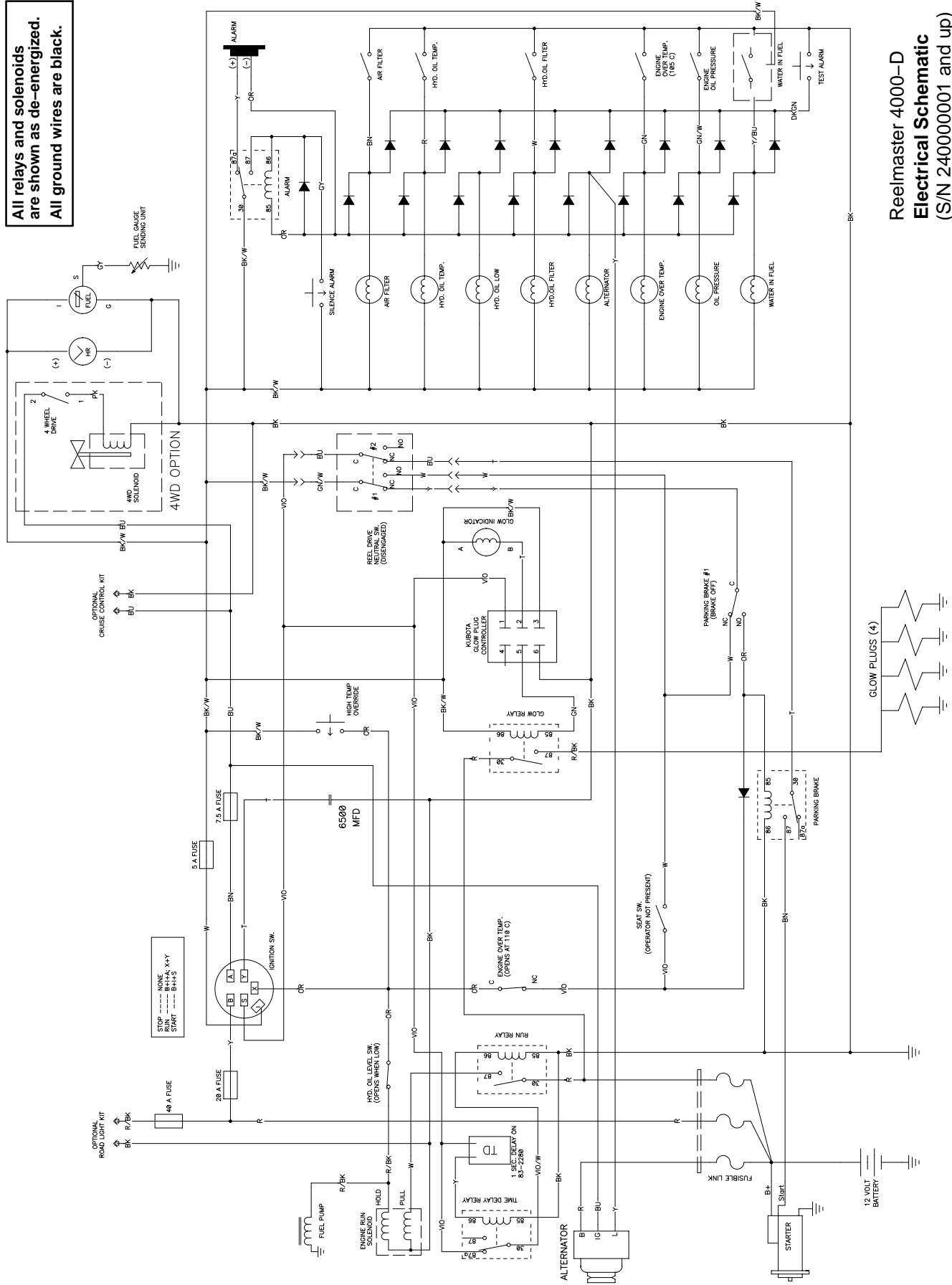
Reelmaster 4000-D
Electrical Schematic
(S/N below 220000000)

All relays and solenoids are shown as de-energized.
All ground wires are black.

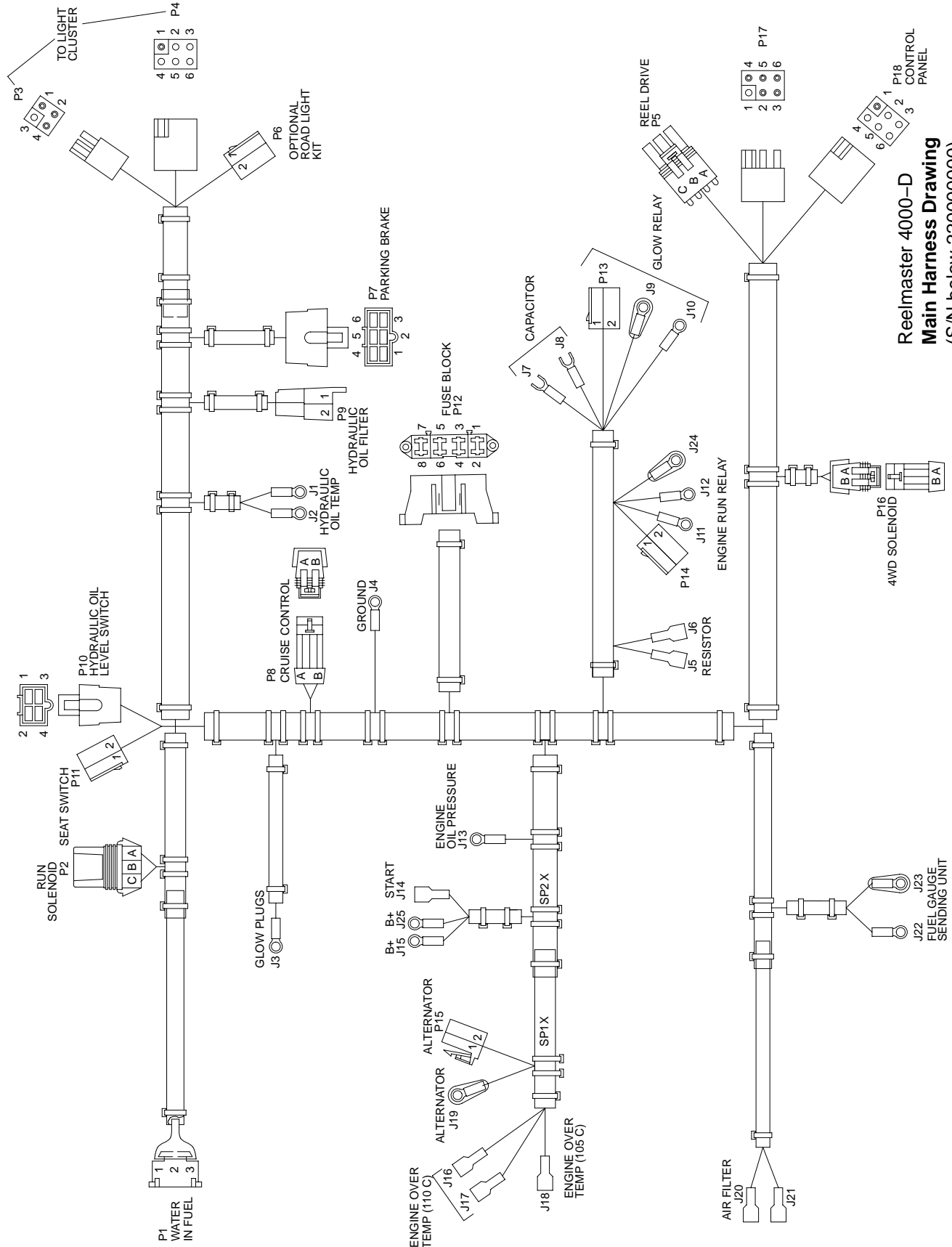


Reelmaster 4000-D
Electrical Schematic
(S/N 22000001 to 230999999)

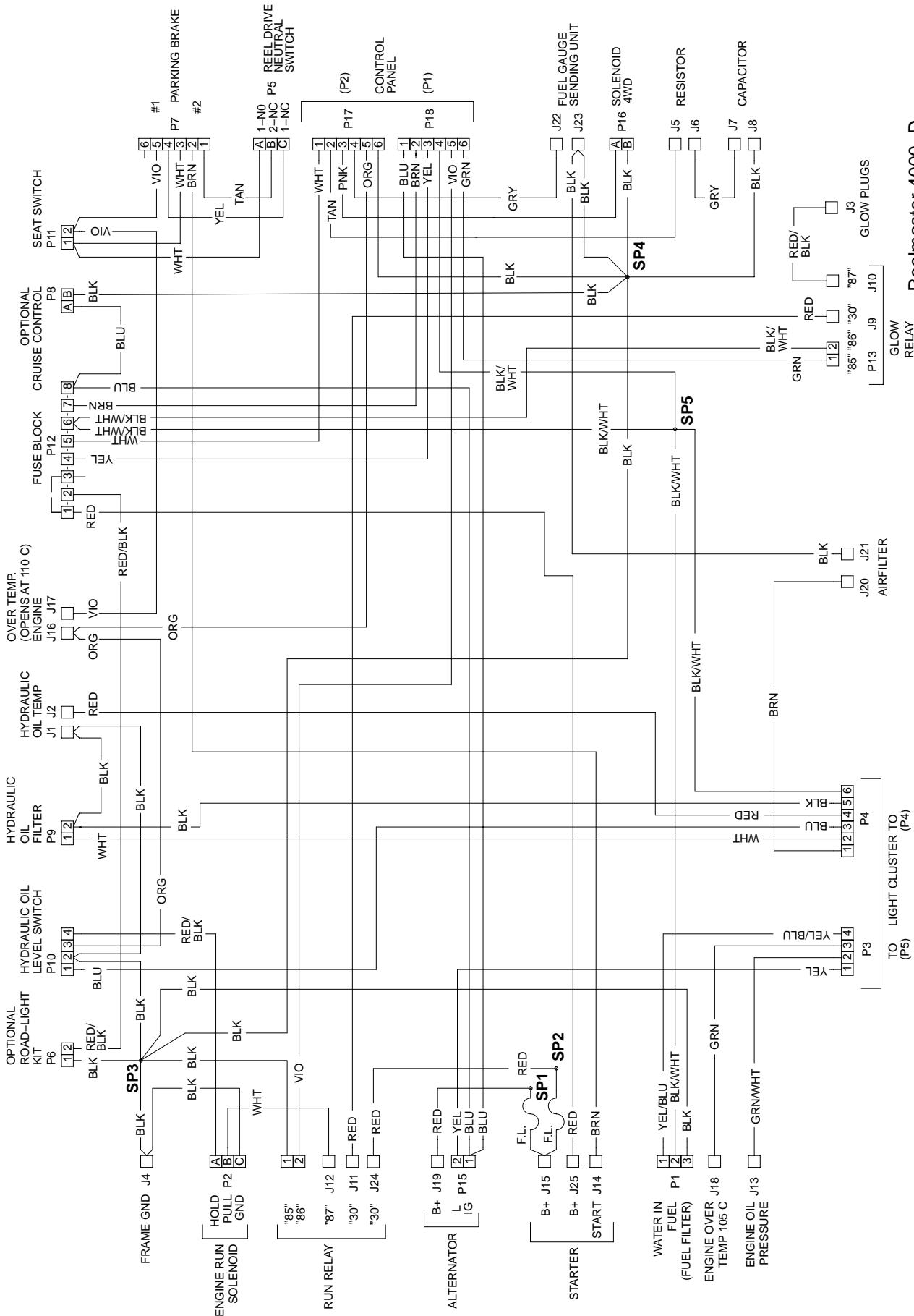
All relays and solenoids are shown as de-energized.
All ground wires are black.



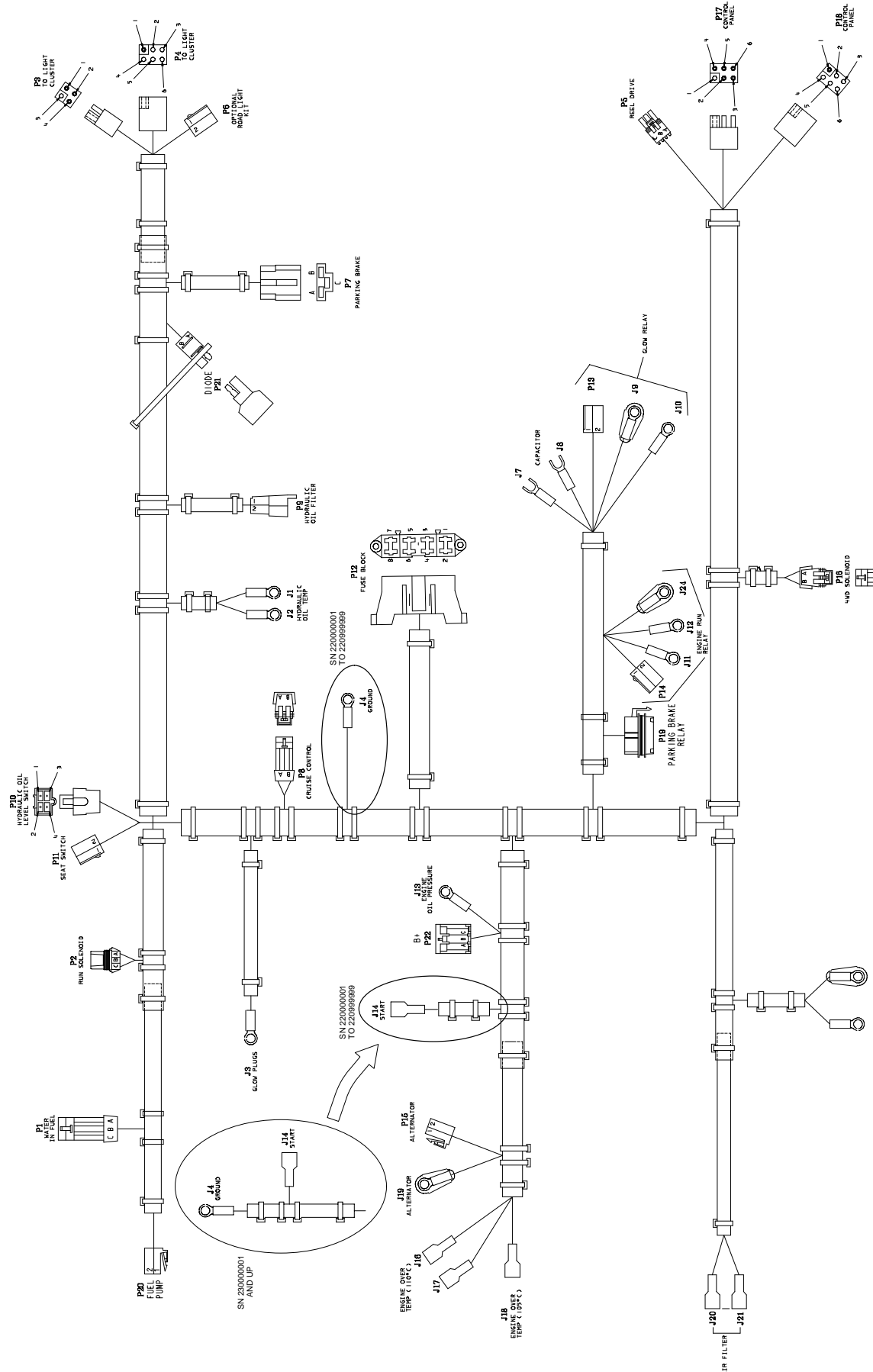
Reelmaster 4000-D
Electrical Schematic
(S/N 24000001 and up)



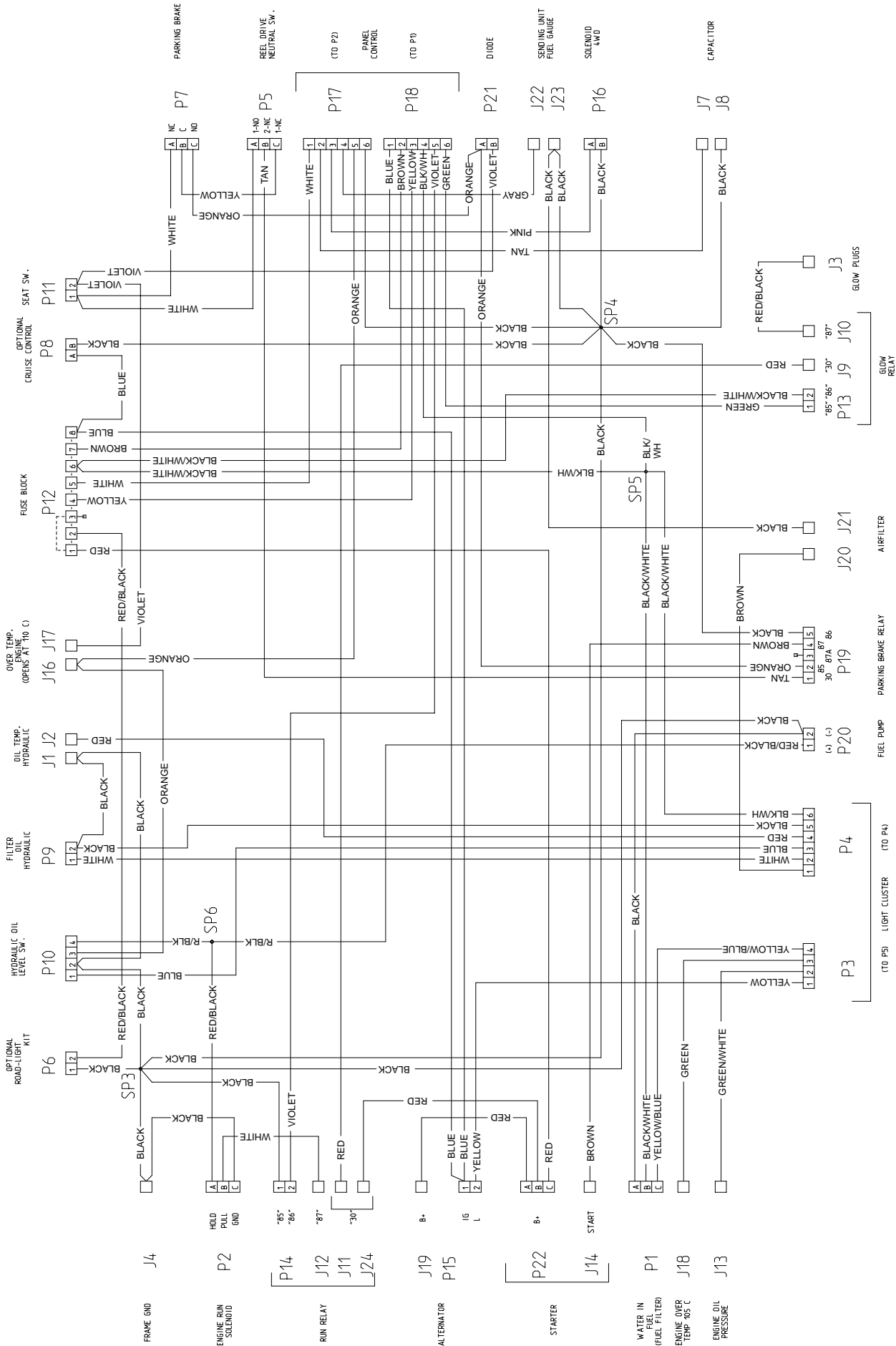
Reelmaster 4000-D
Main Harness Drawing
 (S/N below 220000000)



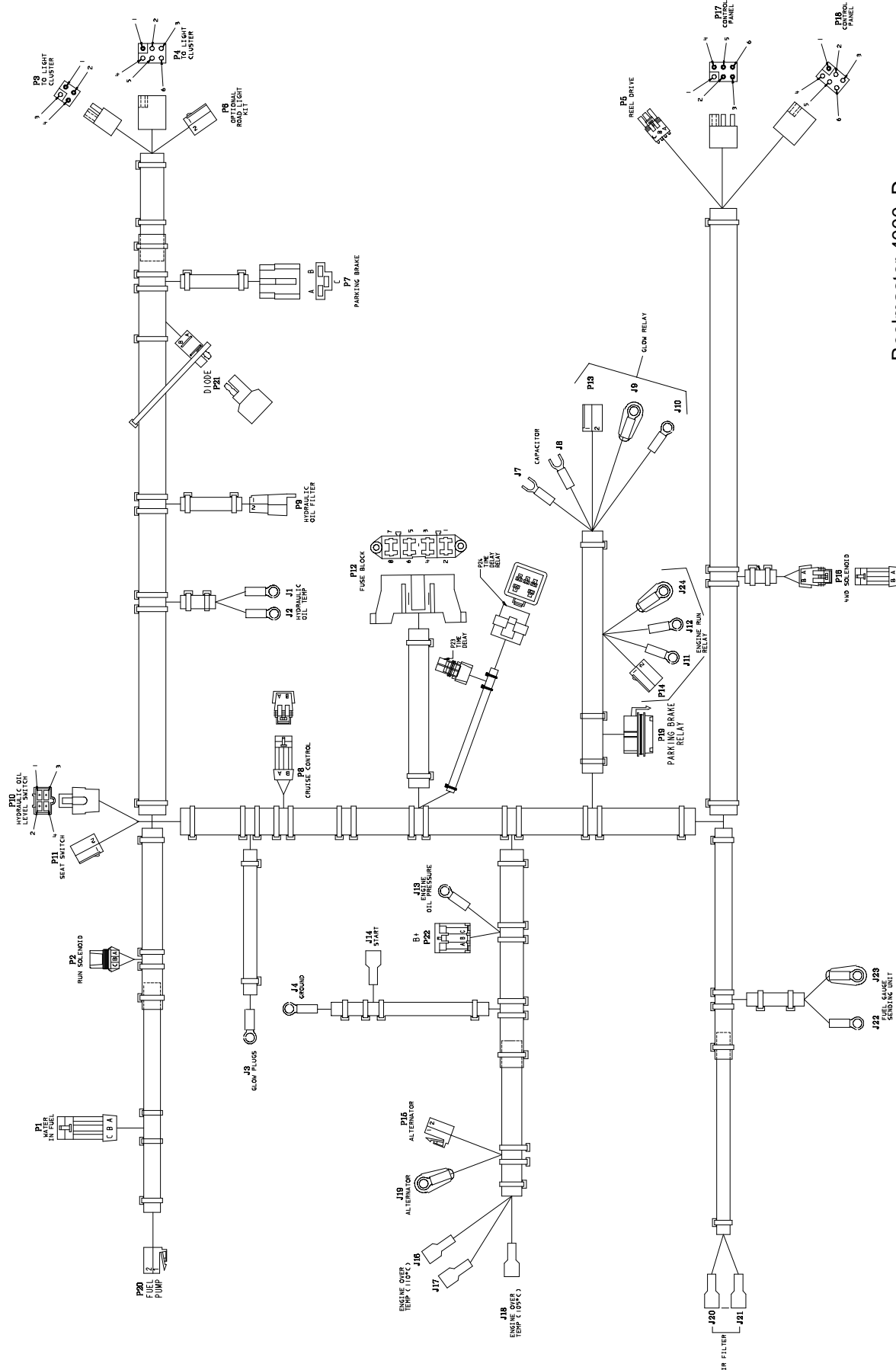
Reelmaster 4000-D
Main Harness Wiring Diagram
(S/N below 220000000)



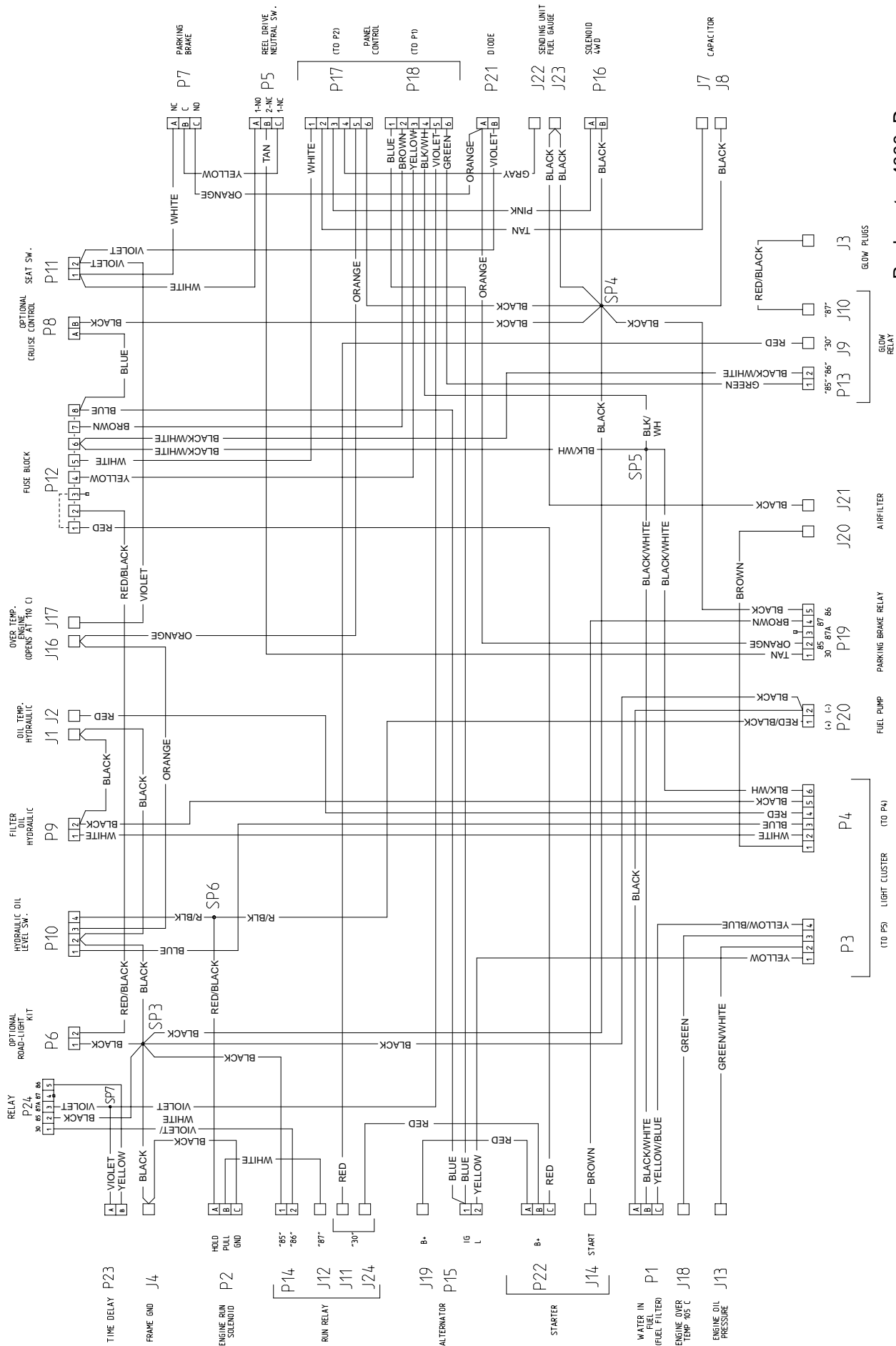
Reelmaster 4000-D
 Main Harness Drawing
 (S/N 220000001 to 230999999)



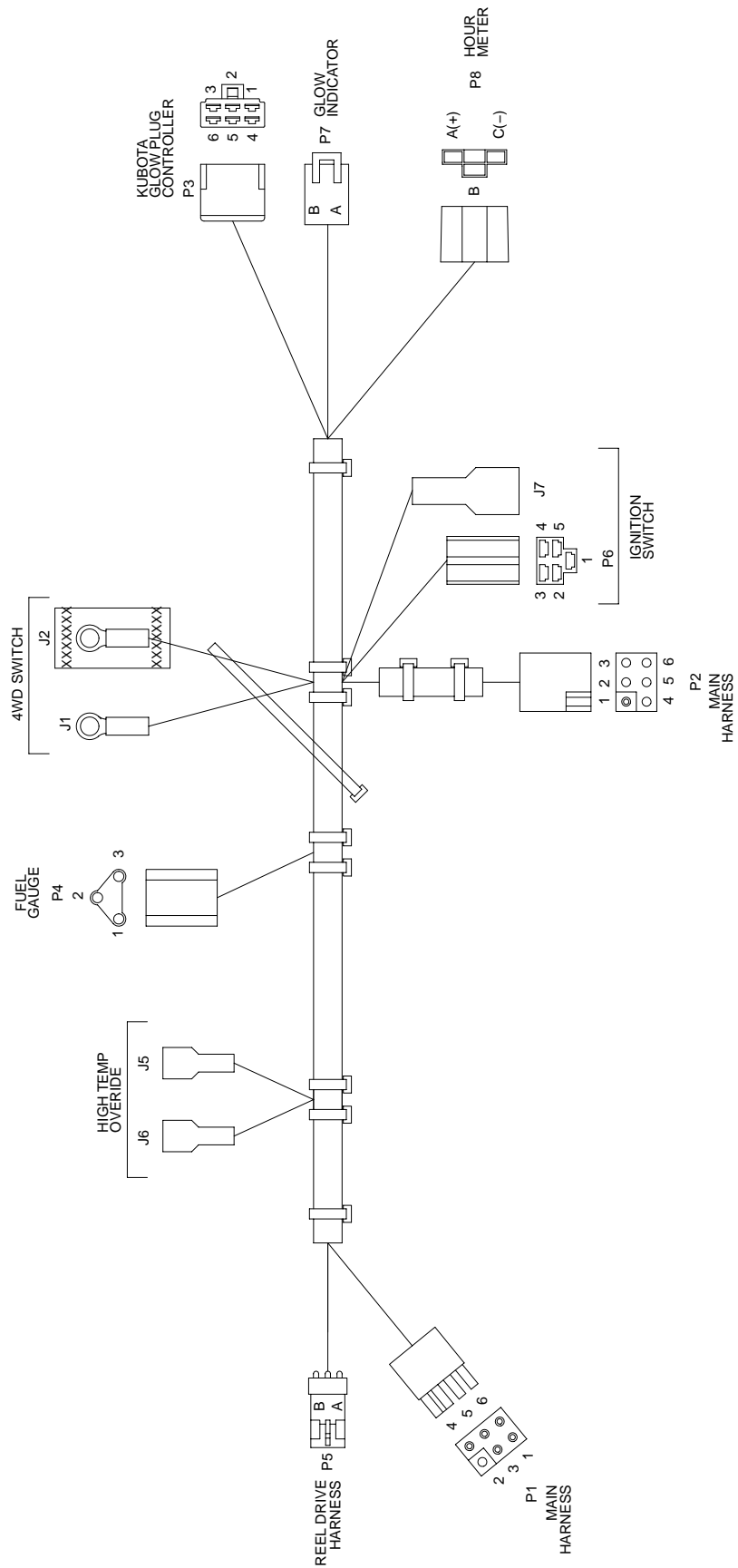
Reelmaster 4000-D
Main Harness Wiring Diagram
(S/N 22000001 to 23099999)



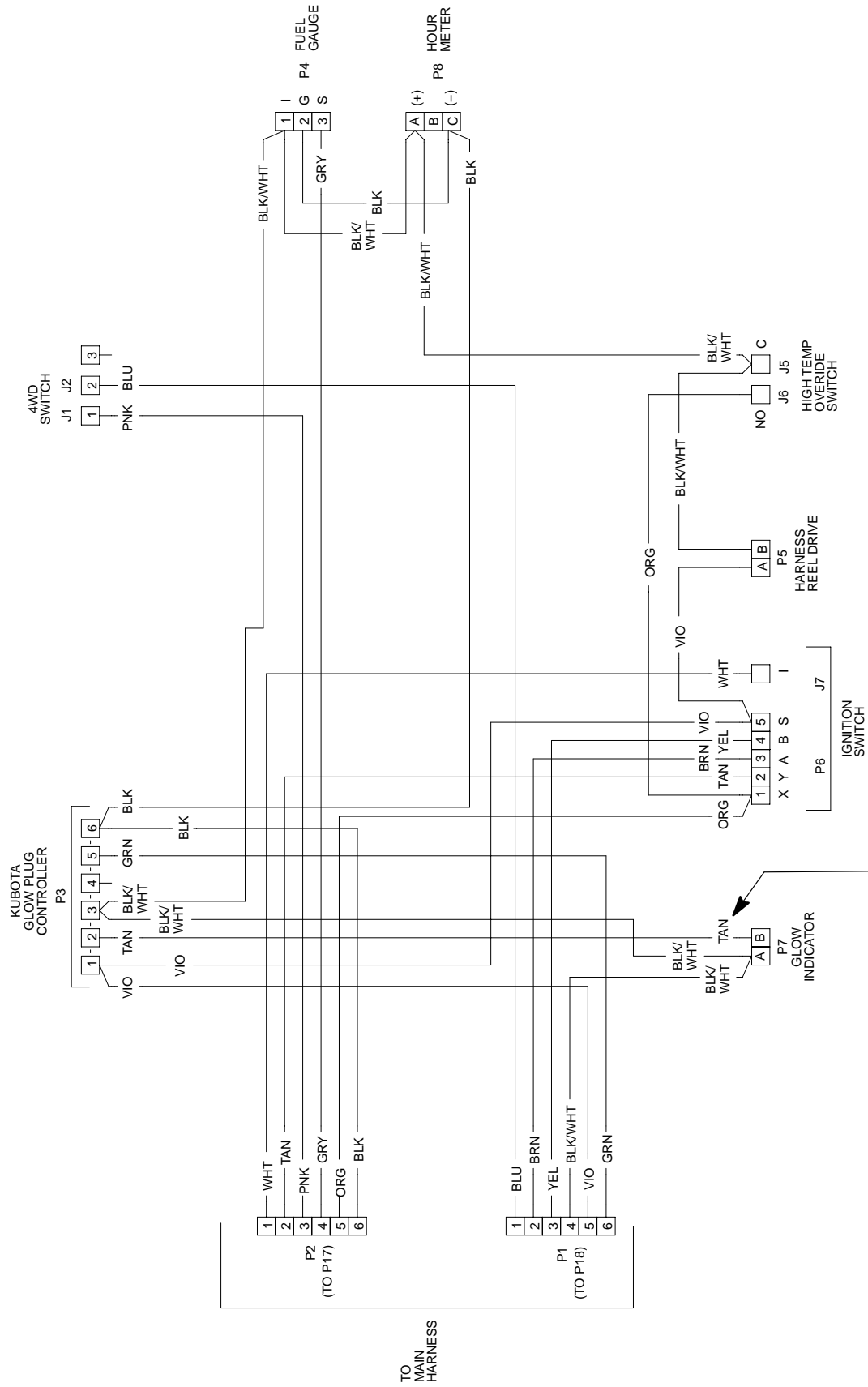
Reelmaster 4000-D
 Main Harness Drawing
 (S/N 240000001 and up)



Reelmaster 4000-D
Main Harness Wiring Diagram
(S/N 24000001 and up)

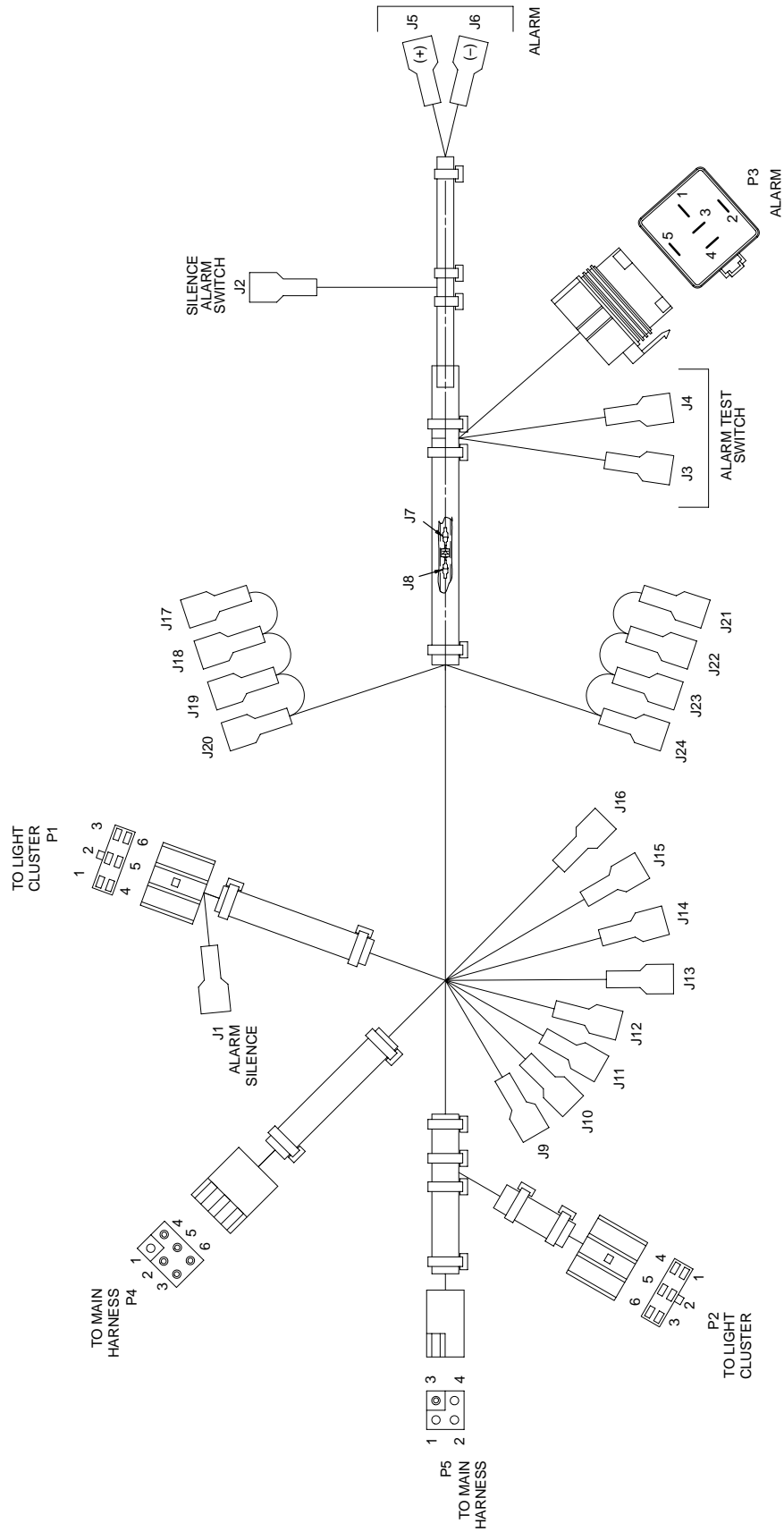


Reelmaster 4000-D
Control Panel Harness Drawing

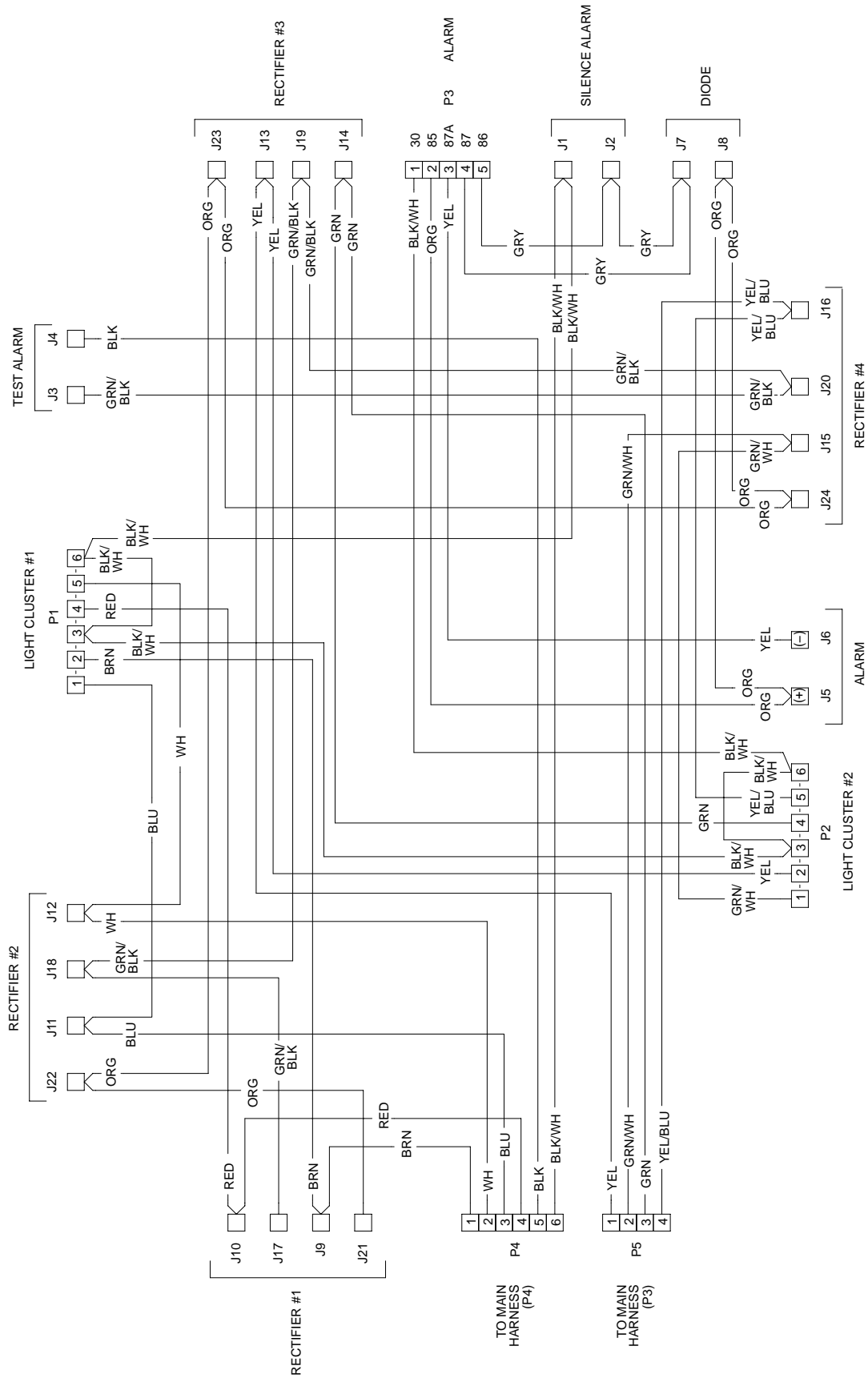


NOTE: THIS WIRE IS GREEN ON SN 220000001 AND UP

Reelmaster 4000-D
Control Panel Wiring Diagram



Reelmaster 4000-D
Light Cluster Harness Drawing



Reelmaster 4000-D
Light Cluster Wiring Diagram

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

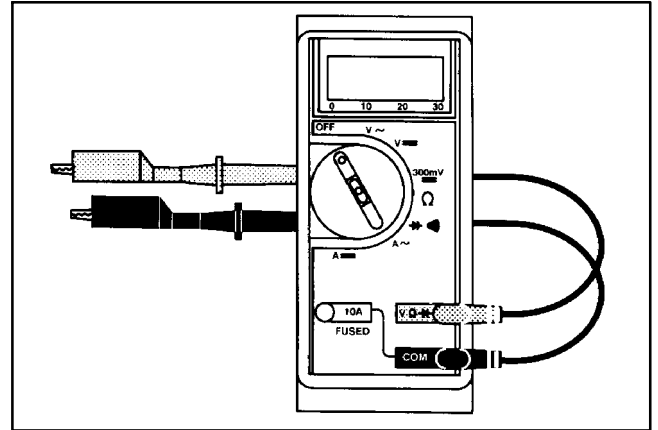


Figure 1

Skin-Over Grease

Special non-conductive grease (Toro Part No. 505-165) which forms a light protective skin which helps waterproof electrical switches and contacts.



Figure 2

Troubleshooting



CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics and Diagrams section of this chapter).

If the machine has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Low battery charge. Loose or corroded battery cables. Loose or corroded ground. Faulty wiring at starter. Faulty starter solenoid.
Nothing happens when start attempt is made.	Battery is dead. Loose or corroded battery cables. Loose or corroded ground. Parking brake is off. Mow – backlap lever is engaged. Circuit breaker open. Traction (brake) switch (#2) out of adjustment or faulty. Traction (brake) switch (#2) wiring loose, corroded or damaged. Reel drive neutral switch faulty. Reel drive neutral switch wiring loose, corroded or damaged. Key switch faulty. Key switch wiring loose, corroded or damaged. Starter solenoid wiring loose, corroded or damaged. Starter solenoid faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	<p>Engine run solenoid wiring loose or corroded.</p> <p>Engine run solenoid faulty.</p> <p>Low hydraulic oil level.</p> <p>Hydraulic oil low level switch is faulty.</p> <p>Hydraulic oil low level switch wiring loose, corroded or damaged.</p> <p>Engine is overheated.</p> <p>Engine overheat shutdown switch faulty.</p> <p>Engine overheat shutdown switch wiring loose, corroded or damaged.</p> <p>Traction (brake) switch (#1) out of adjustment or faulty.</p> <p>Traction (brake) switch (#1) wiring loose, corroded or damaged.</p> <p>Engine or fuel system problem.</p>
Engine cranks (but should not) with parking brake off.	<p>Traction (brake) switch (#2) is faulty.</p> <p>Short circuit in Traction (brake) switch circuit.</p>
Engine cranks (but should not) with mow-backlap lever in mow or backlap.	<p>Reel drive neutral switch faulty.</p> <p>Short circuit in Reel drive neutral switch circuit.</p>

General Run and Transport Problems

<p>Engine continues to run (but should not) when parking brake is released or mow-backlap lever is in mow or backlap with no operator on seat.</p>	<p>Seat switch plunger depressed with no operator on seat.</p> <p>Seat switch faulty or out of adjustment.</p> <p>Short circuit or by-pass in seat switch circuit.</p>
<p>Engine kills when parking brake is released or mow-backlap lever is moved to mow or backlap.</p>	<p>Operator sitting too far forward on seat (seat switch not depressed).</p> <p>Seat hinge, support pin or spring binding, preventing seat switch from closing.</p> <p>Seat switch is faulty or out of adjustment.</p> <p>Seat switch wiring loose, corroded or damaged.</p>
<p>Engine kills during operation (operator sitting on seat).</p>	<p>Operator moved too far forward on seat (seat switch not depressed).</p> <p>Low hydraulic oil level.</p> <p>Engine overheated.</p> <p>Wire broke or became disconnected.</p>
<p>4WD does not engage.</p>	<p>4WD selector switch faulty.</p> <p>4WD selector switch wiring loose, corroded or damaged.</p> <p>4WD solenoid valve faulty.</p> <p>4WD solenoid wiring loose, corroded or damaged.</p> <p>Problem is not electrical.</p>
<p>Battery does not charge.</p>	<p>Loose or broken wire(s).</p> <p>Faulty alternator.</p> <p>Dead battery.</p> <p>Alternator warning lamp is faulty or burned out.</p> <p>Alternator warning lamp wiring loose, corroded or damaged.</p>

Electrical System Quick Check

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60 to 100°F (16 to 38°C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (-) meter lead to the negative battery post.


NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: For more component testing information, see the Kubota Workshop Manual for 03 Series Diesel Engine.



CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN, and START). The terminals are marked as shown. The circuitry of the ignition switch is shown in the chart. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	NONE	NONE
RUN	B + A + I	X + Y
START	B + S + I	NONE

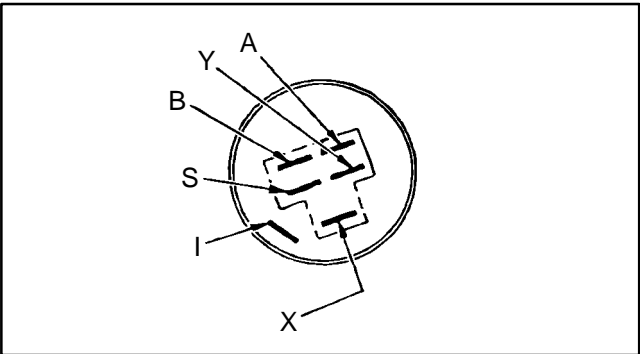


Figure 3

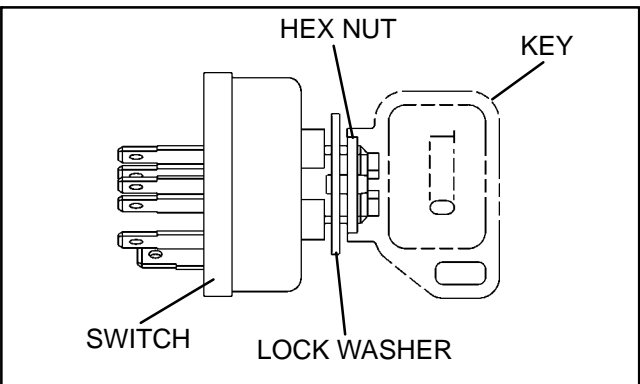


Figure 4

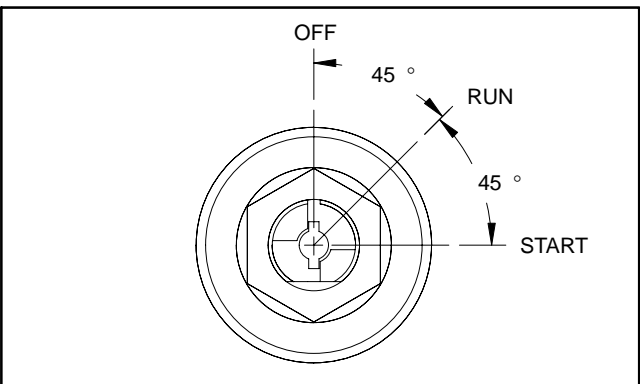


Figure 5

Hour Meter

IMPORTANT: Make sure to observe polarity on the meter label when testing. Damage to the meter may result from an improper connection.

1. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.
2. Connect the negative (-) terminal of the voltage source to the negative terminal of the hour meter.
3. The meter should move 1/10 hour in 6 minutes.
4. Disconnect the voltage source from the hour meter.

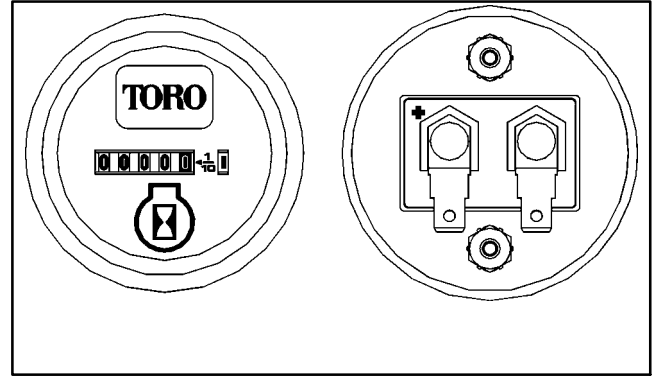


Figure 6

Glow Plug and Start Relays

These relays are located in the rear of the center console and below the seat. Access can be gained through the front access panel to the center console.

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 41 to 51 ohms.
2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85.
3. Disconnect voltage and leads from the terminals.

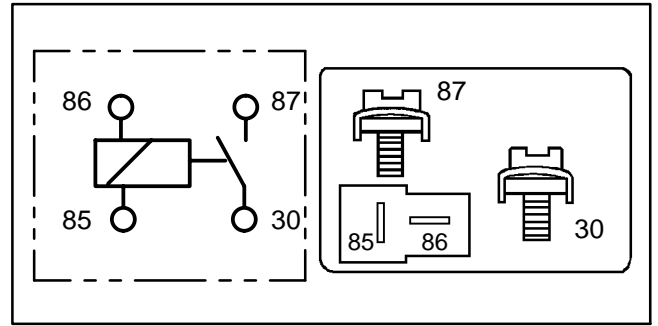


Figure 7

Audio Alarm

1. Isolate alarm from the circuit. Connect 12VDC source to terminals. Make sure to observe polarity.
2. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit.

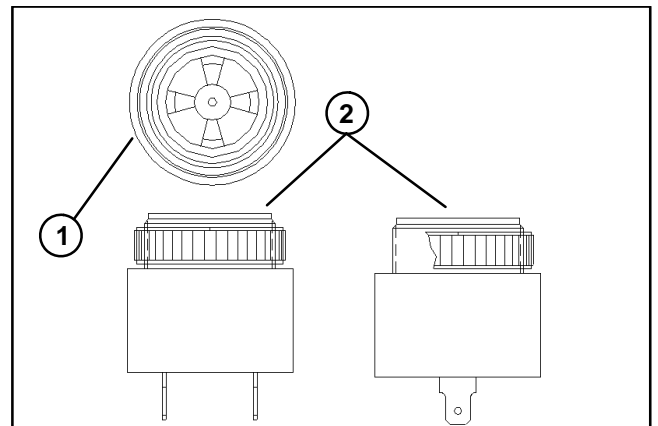


Figure 8

1. Top view

2. Side view

Alarm Relay

The alarm relay is located inside the steering tower.

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 80 to 90 ohms. There should be continuity between terminals 87A and 30.
2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85.
3. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
4. Connect multimeter (ohms setting) lead to relay terminal 30 and 87A. Apply +12 VDC to terminal 85. The relay should break and make continuity between terminals 30 and 87A as 12 VDC is applied and removed from terminal 85.
5. Disconnect voltage and multimeter leads from the relay terminals.

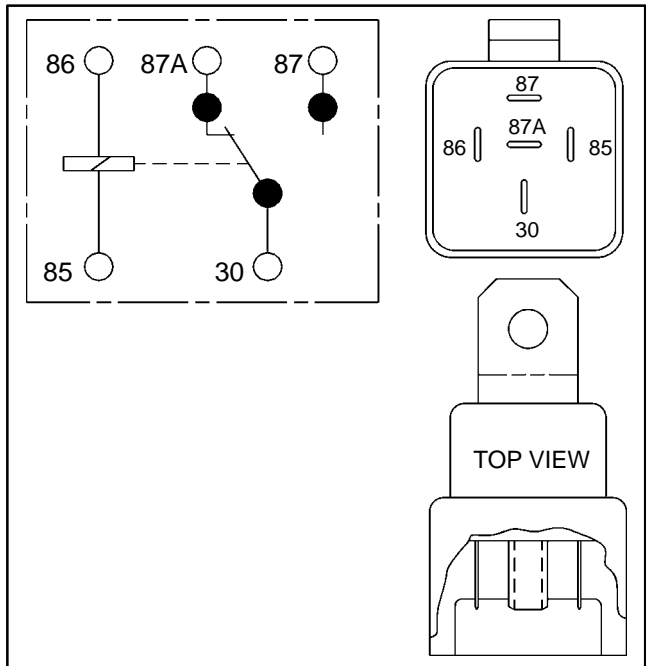


Figure 9

Hydraulic Oil Temperature Switch

The high temperature switch is located on the the bottom of the hydraulic reservoir with two black wires and one red wire connected to it (Fig. 10).

 **CAUTION**

Make sure engine is cool before removing the temperature switch.

1. Drain hydraulic fluid from the hydraulic reservoir, and remove high temperature switch.
2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 11).

 **CAUTION**

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check continuity of the switch with a multimeter (ohms setting). The switch is normally open and should close between 186 to 194°F (86 to 90°C).
4. Allow the oil to cool. The switch should open below 186°F (86°C).

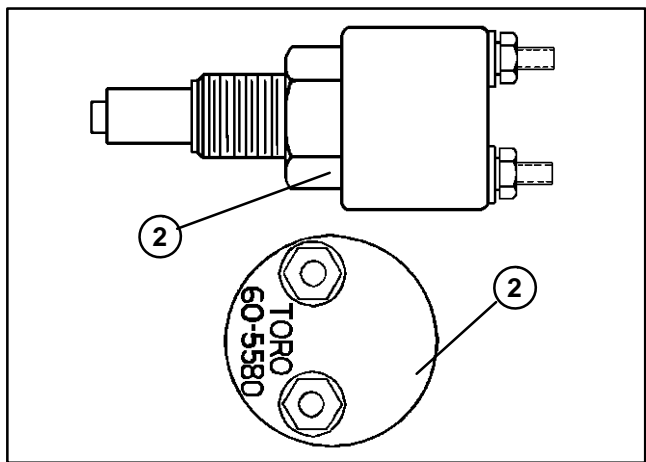


Figure 10

1. Side view
2. End view

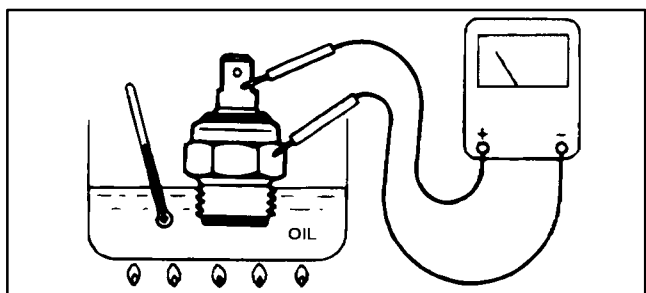


Figure 11

Fuel Sender

The sender is located on top of the fuel tank under the rear screen.

1. Remove gray wire and black ground wire from the sender.
2. Remove truss head screws and lock washers from the sender and fuel tank.
3. Remove sender and gasket from the fuel tank. Clean any fuel from the sender.

Note: Before taking small resistance readings with a digital multimeter, short test leads together. The meter will display a small resistance value. This internal resistance of the meter and test leads should be subtract from the measured value of the component.

**CAUTION**

Make sure sending unit is completely dry (no fuel on it) before testing. Perform test away from the tank to prevent an explosion or fire from sparks.

4. Check resistance of the sender with a multimeter. Resistance with the float in the full position should be 27.5 to 39.5 ohms. Resistance with the float in the empty position should be 240 to 260 ohms.
5. Replace sender as necessary. Reinstall sender into fuel tank. Connect wires.

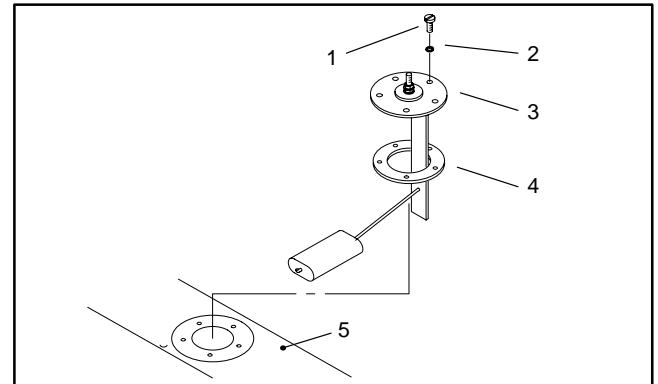


Figure 12

- | | |
|---------------------|--------------|
| 1. Truss head screw | 4. Gasket |
| 2. Lock washer | 5. Fuel tank |
| 3. Fuel sender | |

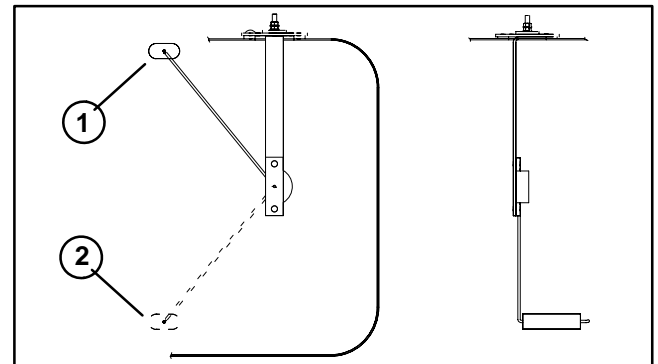


Figure 13

- | | |
|------------------|-------------------|
| 1. Full position | 2. Empty position |
|------------------|-------------------|

Fuel Gauge

The fuel gauge can be tested using a new gauge as a substitute or by the use of a DC voltage source and a variable resistance box.

1. Connect the fuel gauge to the variable resistance and DC voltage source (Fig. 14).
2. Adjust resistance until the gauge needle points to following test points on the gauge (Fig. 14):
 - A. The left edge of the red area (empty); the resistance setting should be from 238 to 242 ohms.
 - B. The right edge of the green area (full); the resistance setting should be from 28 to 38 ohms.
3. Disconnect the voltage source, gauge, and variable resistance.

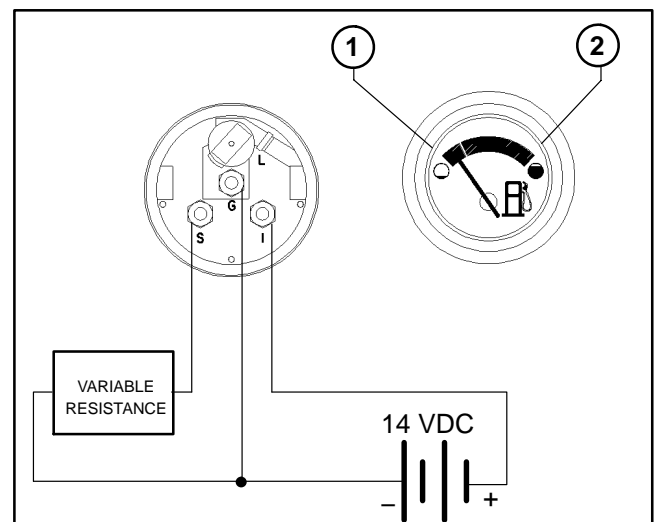


Figure 14

- | | |
|-------------------|------------------|
| 1. Empty position | 2. Full position |
|-------------------|------------------|

H₂O in Fuel Sensor

The sensor is located on the fuel filter assembly, which is inside the center shroud area to the left side of the engine. It energizes a red warning light when too much water has collected in the fuel filter bowl.

1. Make sure engine is OFF. Disconnect fuel stop solenoid from the wiring harness.
2. Disconnect connector from the sensor. Verify circuitry to the sensor at the connector using a multimeter and the following steps:
 - A. Place ignition switch in RUN. Battery voltage from the pin for the yellow/blue wire to chassis ground should be indicated and the red warning light should come on. Turn switch OFF.
 - B. Hold ignition switch in START. Battery voltage from the pin for the black/white wire to chassis ground should be indicated. Turn switch OFF.
 - C. Check continuity from the pin for the black wire to chassis ground. Continuity should be **1 ohm or less**.

- D. Correct any problem circuitry if necessary.
3. Drain fuel filter assembly into a suitable container.
 4. Unscrew fuel filter bowl from the assembly. Remove filter element, gaskets, and O-ring from the assembly. Store seals in a clean place.
 5. Reconnect connector to the sensor. Fill fuel filter bowl with tap water.
 6. Test sensor using the following steps:
 - A. Place ignition switch in RUN. The red warning light should come on. Turn switch OFF.
 - B. Hold ignition switch in START. The red warning light should come on. Turn switch OFF.
 7. Drain water from the fuel filter bowl. Test sensor using the following steps:
 - A. Place ignition switch in RUN. The red warning light should stay off. Turn switch OFF.
 - B. Hold ignition switch in START. The red warning light should stay off. Turn switch OFF.

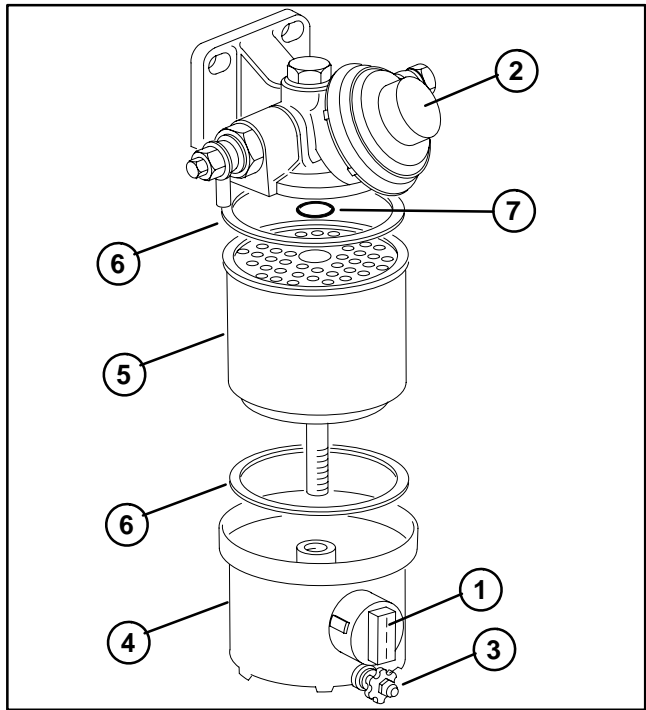


Figure 15

- | | |
|---------------------|-------------------|
| 1. Sensor | 5. Filter element |
| 2. Filter assembly | 6. Gasket |
| 3. Drain plug | 7. O-ring |
| 4. Fuel filter bowl | |

8. Disconnect connector from sensor. Reassemble fuel filter assembly. Reconnect connector to sensor.
9. Replace sensor with new one if necessary.
10. Reconnect fuel stop solenoid to the wiring harness.

High Temperature Warning and Cutout Switches

The high temperature warning and cutout switches are located on the water return pipe above the water pump, which is located on the rear end of the engine block. The warning switch has a green/white wire connected to it. The cutout switch has two orange wires and a violet wire connected to it (Fig. 16).



1. Lower coolant level in the engine and remove the high temperature switch.
2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 17).



3. Check continuity of the switch with a multimeter (ohms setting).
 - A. The high temperature warning switch is normally open and should close between 216 to 226°F (102 to 108°C).
 - B. The high temperature cutout switch is normally closed and should open between 225 to 235°F (107 to 113°C).
4. Allow oil to cool while observing temperature.
 - A. The high temperature warning switch should open between 216 to 226°F (102 to 108°C).
 - B. The high temperature cutout switch should close between 225 to 235°F (107 to 113°C).

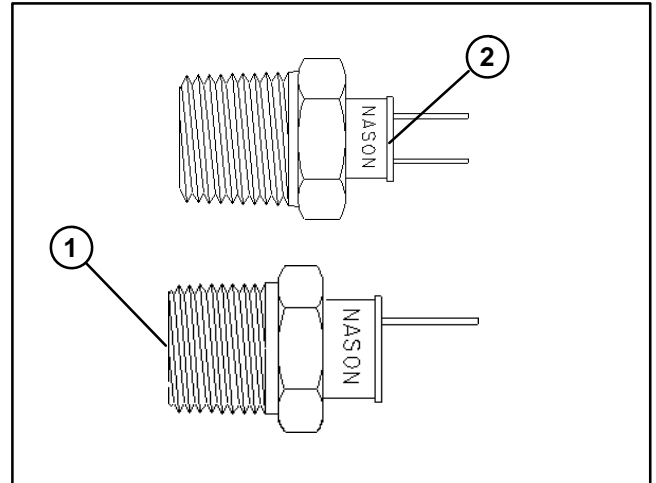


Figure 16

1. High temp warning
2. High temperature cutout

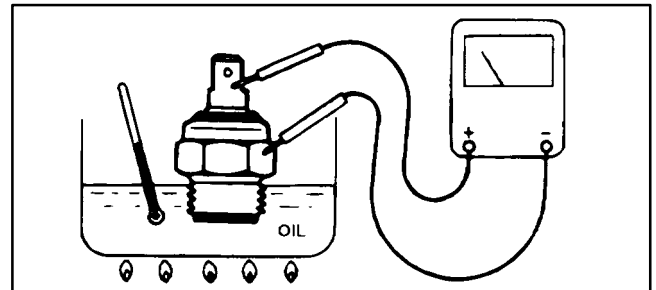


Figure 17

Rear Wheel Drive Solenoid

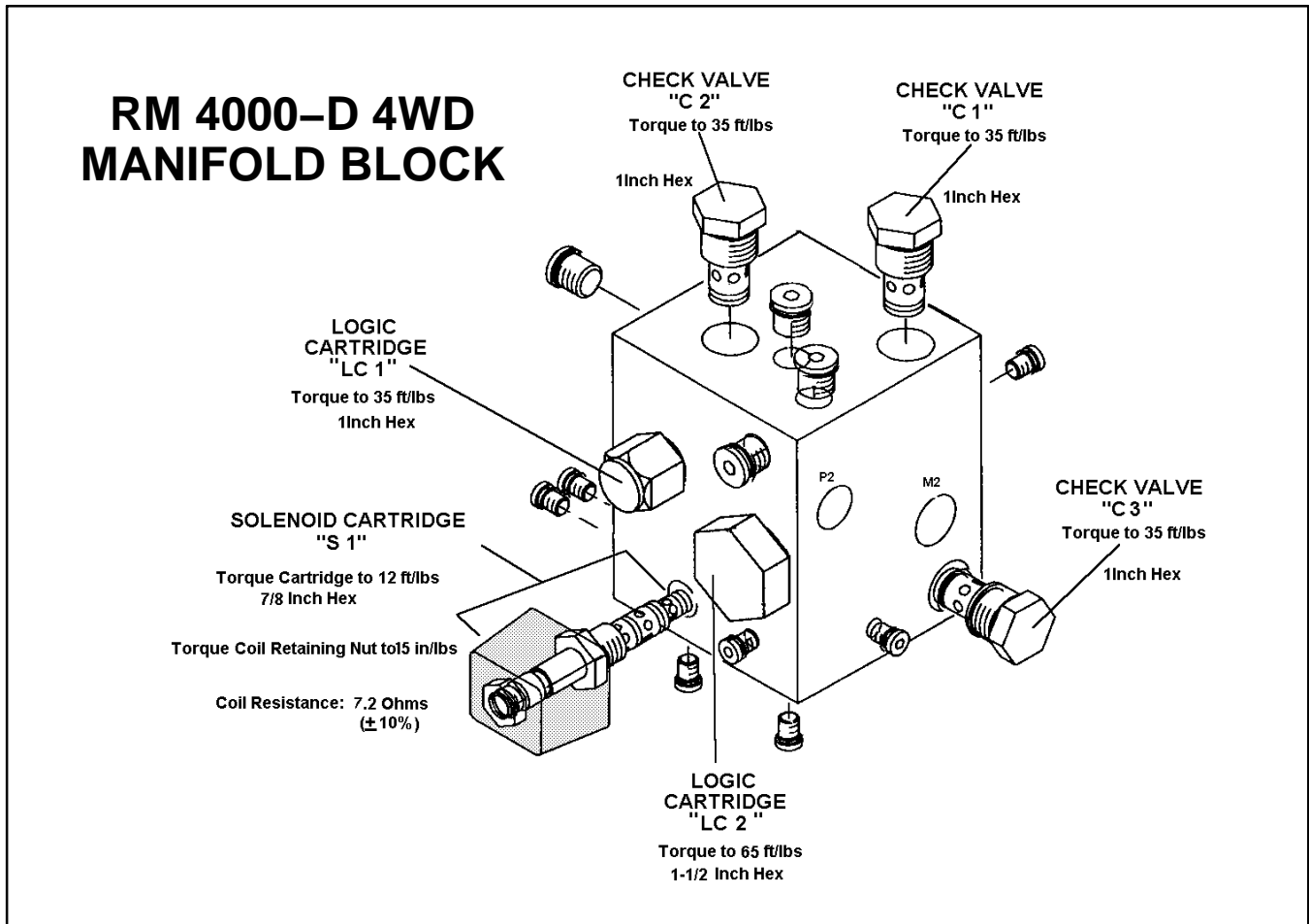


Figure 18

1. Disconnect the wire connector.

Note: Prior to taking small resistance readings with a digital multi meter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

2. Check resistance of coil with a digital multimeter. Resistance should be about 7.2 ohms.

3. Connect a 12 volt battery so the positive (+) battery terminal is connected to colored solenoid lead. Connect the negative (-) battery terminal to black lead. The valve spool should retract completely as 12V DC is applied across the leads.

4. If valve spool does not retract, check for binding or damage in valve.

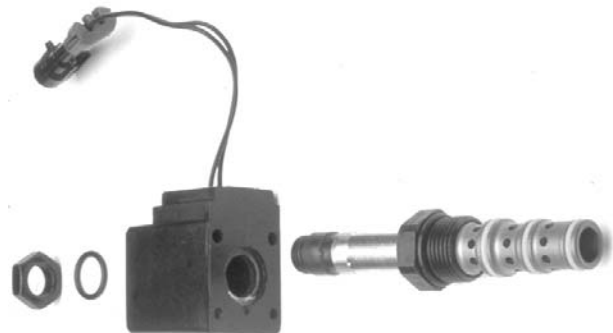


Figure 19

5. If valve operates smoothly, but does not retract when 12V DC is applied to solenoid leads, replace solenoid coil.

6. If valve still does not retract after replacing solenoid coil, replace the valve.

Fuel Stop Solenoid

The solenoid must be energized for the engine to run. It is mounted on the engine block near the injection pump.

In Place Testing

Note: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Disconnect the connector from the solenoid.
2. Make sure that the solenoid linkages move freely and are free of dirt, debris, and corrosion.
3. Using a digital multimeter, touch one lead to the pin of the **black** wire and the other lead to the pin of the **white** wire. The resistance of the **pull coil** should be about 0.258 ohms.
4. Using a digital multimeter, touch one lead to the pin of the **black** wire and the other lead to the pin of the **red** wire. The resistance of the **hold coil** should be about 10.91 ohms.
5. Connect solenoid to the wiring harness.

Live testing

1. Disconnect connector from the solenoid.
2. Make sure that the solenoid linkages move freely and are free of dirt, debris, and corrosion.

Note: The solenoid may be removed from the engine or tested in place.

3. Connect a positive (+) test lead from a 12 VDC source to the pins of the **red** and **white** wires.
4. Touch a negative (-) test lead from the 12 VDC source to the pin of the **black** wire. The solenoid should engage making an audible "click".
5. Remove positive (+) voltage from the pin of the **white** wire. The solenoid should stay engaged.
6. Remove positive (+) voltage from the pin of the **red** wire. The solenoid should release.
7. Reconnect the wires to the solenoid.

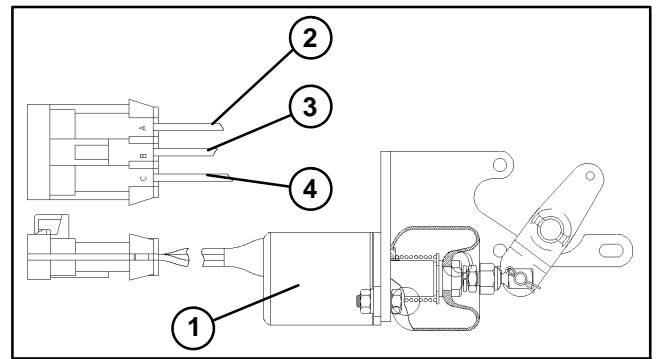


Figure 20

- | | |
|-------------------------|---------------------------|
| 1. Fuel stop solenoid | 3. White wire (pull coil) |
| 2. Red wire (hold coil) | 4. black wire (common) |

Hydraulic Oil Level Switch

The level switch is located on top of the hydraulic reservoir under the seat. It has an electrical connector from the wiring harness with two black, a black/white, and an orange wire.

1. Remove electrical connector from the level switch.
2. Unscrew sender from the cover, and remove it from the reservoir.

Note: Float switch L1 is normally open when the tank is dry (float down). Float switch L2 is normally closed when the tank is dry (float down).

3. Position float switch L2 against its lower float stop.
4. Check for continuity between electrical connector leads associated with the yellow wires.
5. Position float switch L2 against its upper float stop.
6. Check continuity between electrical connector leads associated with the yellow wires. There should be no continuity between connector leads.
7. Replace switch as necessary. Install switch to hydraulic reservoir.

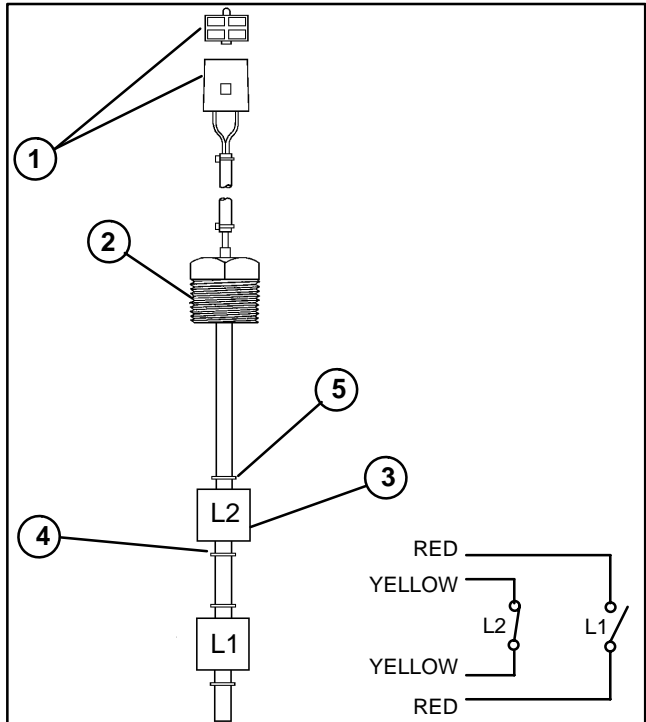


Figure 21

1. Electrical connector
2. Level switch
3. Float switch
4. Lower float stop
5. Upper float stop

Bridge Rectifier

Each rectifier (Fig. 22) contains four diodes which form a single phase bridge rectifier circuit (Fig. 23). The diodes are used for circuit protection from inductive voltage spikes when the alarm relay is deenergized.

Testing

The diodes can be individually tested using a digital multimeter (ohms setting) and the table below.

Red Lead (+) on Terminal	Black Lead (-) on Terminal	Continuity
AC1	+	YES
+	AC1	NO
AC2	+	YES
+	AC2	NO
-	AC1	YES
AC1	-	NO
-	AC2	YES
AC2	-	NO

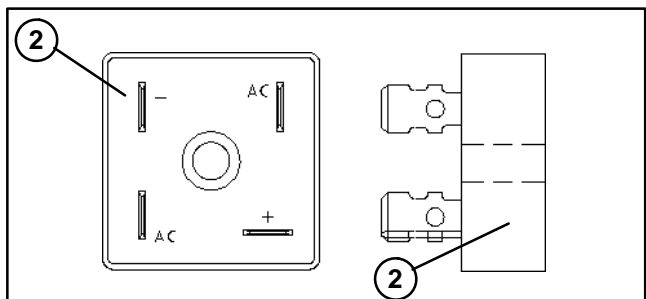


Figure 22

1. Bottom view
2. Side view

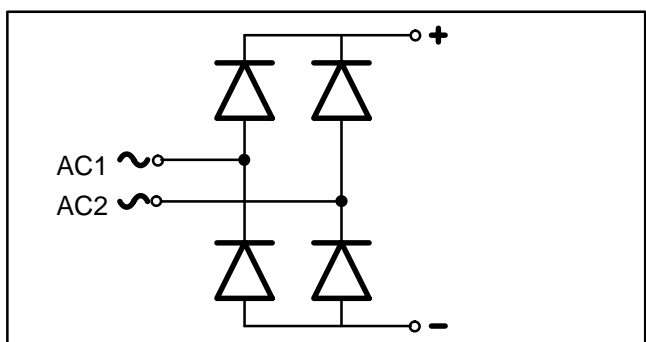


Figure 23

Glow Controller

The controller is located under the right lower corner of the instrument panel.

Controller Operation

When the ignition switch is placed in the RUN position, the controller energizes the glow plugs and lights up the glow lamp for 10 seconds. When the ignition switch is held in the START position, the glow plugs will energize while the switch is held in START and the glow lamp will **not** light. When the ignition switch is released from START to RUN, the glow plugs will deenergize and the glow lamp will remain off.

Controller Checks

1. Make sure there is power from the battery.
 2. Disconnect electrical connector to the fuel solenoid to prevent the engine from starting.
 3. Place ignition switch in the RUN position. Verify the following while in the RUN position:
 - A. Glow indicator lamp is on.
 - B. Glow relay is energized.
 - C. Glow plugs are energized.
 - D. Glow indicator lamp goes out and glow plugs deenergize after 10 seconds.
- Note:** If there is no power to terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform step 4 again (see Electrical Schematics and Diagrams).
4. Place ignition switch in the START position. Verify the following while in the START position:
 - A. Glow indicator lamp is out.
 - B. Glow relay is energized.
 - C. Glow plugs are energized.
 - D. Power to terminal 1 of the glow controller.

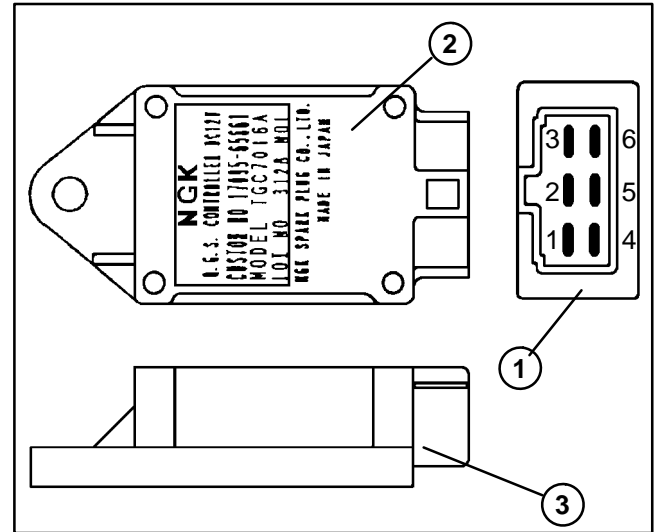


Figure 24

1. End view
2. Top view

3. Side view

5. If any of the conditions in step 3 are not met or power to terminal 1 exists and any of the other conditions in step 4 are not met,
 - A. Verify continuity of the circuitry from the battery to the glow relay and glow plugs (see Electrical Schematics and Diagrams).
 - B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow lamp, glow relay, and ground (see Electrical Schematics and Diagrams).
 - C. Replace parts as necessary
6. Connect electrical connector to the fuel solenoid.

Hydraulic Oil Filter Switch

The oil filter switch is activated by the differential pressure across the oil filter. When differential pressure is between 16 to 20 PSID, a normally open contact closes. An alarm sounds and a warning light comes on at the instrument panel. When the differential pressure drops between 16 to 12 PSID the switch contact opens and the alarm and light go out.

The purpose of the oil filter switch, warning light, and alarm is to detect a clogged oil filter. When the hydraulic oil is cold (below 68°F/15°C), the oil is thicker and causes a greater pressure drop across the filter. This situation will cause the oil filter warning alarm and light to come on. Push the silence button until the hydraulic oil warms up. The warning light will stay on until the oil warms up (about 5 to 15 minutes).

Checks

1. Turn off engine. Disconnect electrical connector from the oil filter switch. Check continuity across the switch. The switch should indicate open.
2. If continuity across the switch indicates open, the switch is good,
 - A. Check that the oil filter element or filter head is not clogged.
 - B. Check circuitry to the alarm and warning light for possible faults.



WARNING

Before disconnecting or performing any work on hydraulic system, all pressure in system must be relieved by stopping the engine and lowering or supporting the box and/or other attachment.

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and do serious damage. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.

3. If continuity across the switch indicates closed, Remove and replace switch with a new one.

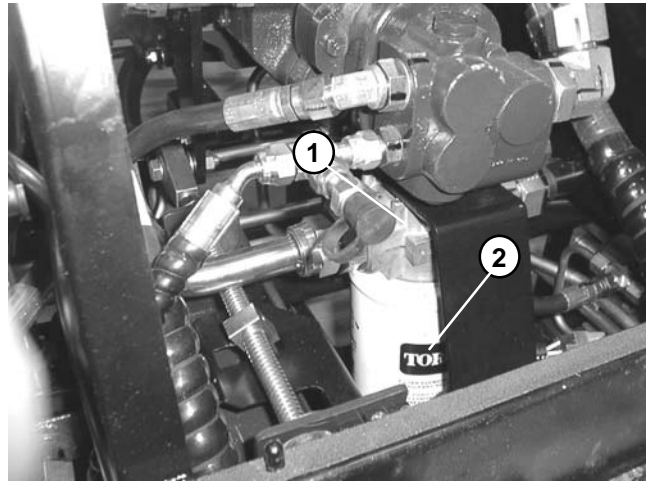


Figure 25

1. Filter head
2. Filter element

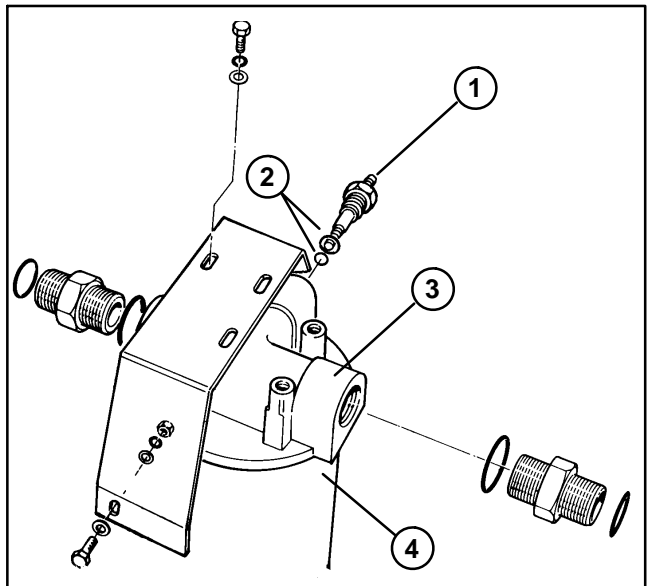


Figure 26

1. Filter switch
2. O-rings
3. Filter head
4. Filter element

Service and Repairs

NOTE: For more component repair information, see **Kubota Workshop Manual, 03 Series, Diesel Engine.**


Battery Storage

If the machine will be stored for more than 30 days

1. Remove the battery and charge it fully (see Battery Service).
2. Either store battery on a shelf or on the machine.
3. Leave cables disconnected if the battery is stored on the machine.
4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will run down more rapidly than if the machine is stored in a location where temperatures are cool.

**WARNING**

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

2. Keep top of battery clean by washing periodically with a brush dipped in ammonia or bicarbonate of soda solution. Flush top surface with water after cleaning. Do not remove the fill cap while cleaning.

3. Battery cables must be tight on terminals to provide good electrical contact.

**WARNING**

Connecting cables to the wrong post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Scrape clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat terminals with petroleum jelly.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.



CAUTION

When working with batteries, use extreme caution to avoid slashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity

Fully charged: 1.265 corrected to 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications

BCI Group Size 24:
650 CCA at 0° F (-17.8° C)
Reserve Capacity of 105 minutes at 25 amp and at 80°F (26.7°C)

Dimensions (not including terminal posts and caps)

Length	10.22 inches (25.96 cm)
Width	6.76 inches (17.17 cm)
Height	9.20 inches (23.39 cm)

Removal

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Remove battery retainer from the battery.
2. Remove lock nut and cap screw from ground cable (-) post first and remove cable from battery. This should prevent short circuiting the battery, other components, or the operators hands.
3. Remove lock nut and cap screw from positive (+) cable post and remove cable from battery.
4. Make sure battery vent caps are on tightly.
5. Remove battery from the battery compartment to a service area. This will minimize possible battery damage and allow better access for inspection and service.

Inspection, Maintenance, and Testing (Fig. 27)

1. Perform following inspections and maintenance:
 - A. Check for cracks caused by overly tight hold-down clamp. Replace battery if cracked and leaking.

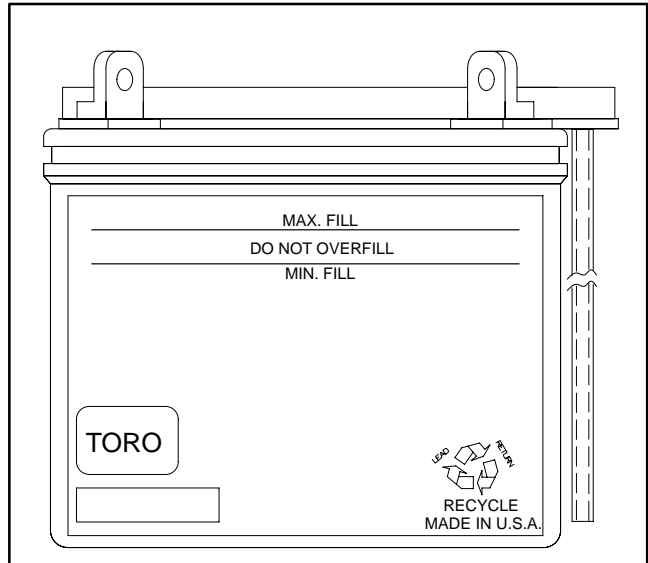


Figure 27

- B. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

- C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

- D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

- E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

- A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature 100°F

Cell Gravity 1.245

100°F minus 80°F equals 20°F
(37.7°C minus 26.7°C equals 11.0°C)

20°F multiply by 0.004/10°F equals 0.008
(11°C multiply by 0.004/5.5°C equals 0.008)

ADD (conversion above) 0.008
Correction to 80°F (26.7°C) 1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.



A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure the battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery

terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
	9.6	70°F (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition switch and all accessories are off.
2. Make sure battery compartment is clean and repainted if necessary.
3. Make sure all battery cables and connections are in good condition and battery clamp or hold down has been repaired or replaced.
4. Place battery in its compartment. Make sure battery is level and flat. Connect positive cable connector onto positive battery post. Tighten cap screw and lock nut with two wrenches.
5. Secure battery retainer. Do not overtighten to prevent cracking or distorting the battery case.
6. Apply a light coat of grease on all battery posts and cable connectors to reduce corrosion after connections are made.

7. Connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

8. Connect negative (ground) cable connector to the negative battery post. Tighten cap screw and lock nut with two wrenches.

Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

 <p>CAUTION</p>
<p>Follow the manufacturer's instructions when using a battery charger.</p>


NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open specific gravity or circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

 <p>CAUTION</p>
<p>Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5°C) before connecting to a charger.</p> <p>Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.</p>

3. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Rear Wheel Drive Solenoid Replacement

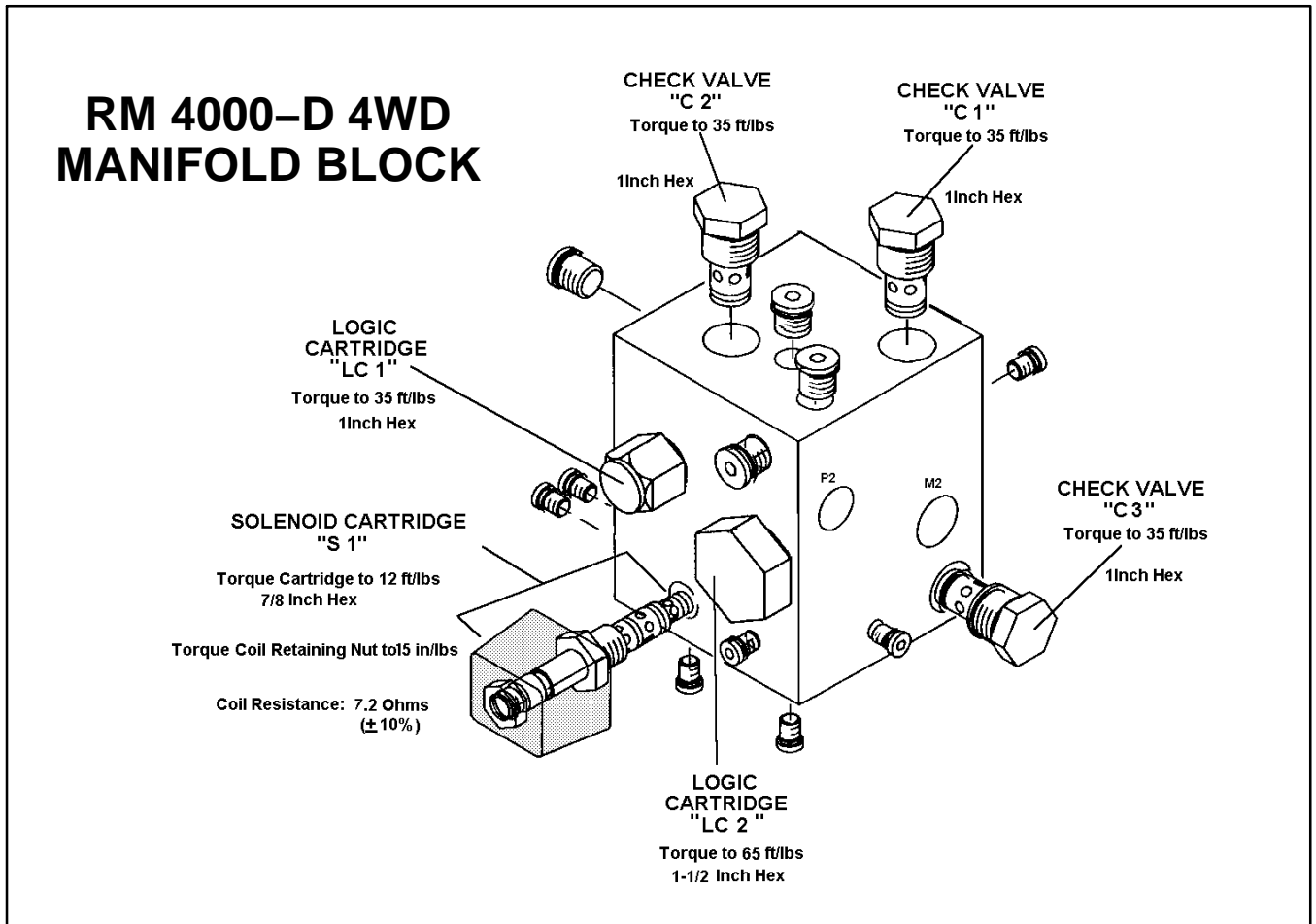


Figure 28

1. Disconnect solenoid electrical connector.
2. Remove nut from solenoid.
3. Remove solenoid coil.
4. Install new solenoid coil. Make sure o-ring is installed at each end of coil. Apply "Loctite 242" or equivalent to threads on end of valve stem before installing nut. Tighten nut to a torque of 15 in-lb (17.3 kg-cm). Over-tightening may damage the solenoid or cause the valve to malfunction.
5. Connect wiring connector.

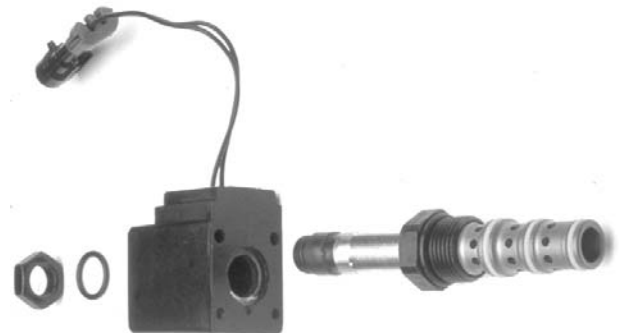


Figure 29

Check Interlock System



CAUTION

Do not disconnect safety switches. They are for the operator's protection. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

1. In a wide open area free of debris and bystanders, lower cutting units to the ground. Stop engine.
2. Sit on the seat and engage parking brake. Turn key and try to start engine with Mow-Backlap lever in both the MOW and BACKLAP positions. If engine cranks, there is a malfunction that must be repaired immediately. If engine does not crank, the cutter drive switch is operating properly.
3. Sit on the seat and disengage the parking brake. Turn key and try to start engine with Mow-Backlap lever in STOP. If engine cranks, there is a malfunction that must be repaired immediately. If engine does not crank, brake switch is operating properly.
4. Engage parking brake, start engine and lower cutting units. Move Mow-Backlap lever to MOW. Raise off the seat; engine should stop within a few seconds, which indicates the interlock system is operating properly. Also raise off the seat with lever in BACKLAP. Engine should stop, indicating interlock system is operating. If engine does not stop, there is a malfunction that must be repaired immediately.
5. Engage parking brake, move Mow-Backlap lever to NEUTRAL, start engine, disengage hand brake and raise off seat. If engine stops, interlock system is operating. If engine does not stop, there is a malfunction that must be repaired immediately.



Axles and Brakes

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Specifications

Item	Description
Front Tire Pressure	13 PSI (0.90 Bar)
Rear Tire Pressure	15 PSI (1.04 Bar)
Front Wheel Nut Torque	60 to 85 ft-lb (8.3 to 11.8 kg-m)
Rear Wheel Nut Torque	30 to 35 ft-lb (4.1 to 4.8 kg-m)
Wheel Planetary Mounting Cap Screw Torque	95-110 ft-lb (13.1 to 15.2 kg-m)
Rear Wheel Toe-in	0.125 inch (0.32 cm)
Wheel Planetary Lubricant (Fig. 1)	SAE 80-90W EP gear lube 30 oz. capacity

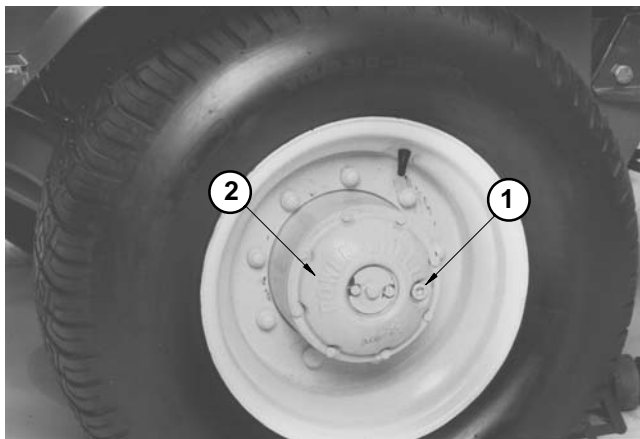


Figure 1

- 1. Check/Fill Plug
- 2. Planetary wheel drive

Adjustments

Hand Brake and Traction Switches

Over time the hand brake cable will stretch and cause the engine not to start. If this happens, adjust the cable.

1. Pull hand brake lever to 3rd click.
2. Pull hand brake up one additional click.
3. Adjust four U-bracket nuts equally so the spring has tension. Adjustment affects operation of traction switches.
4. Adjust four U-bracket nuts so engine will start and run when hand brake is at the fourth click, but will not start or run when hand brake is at second click.

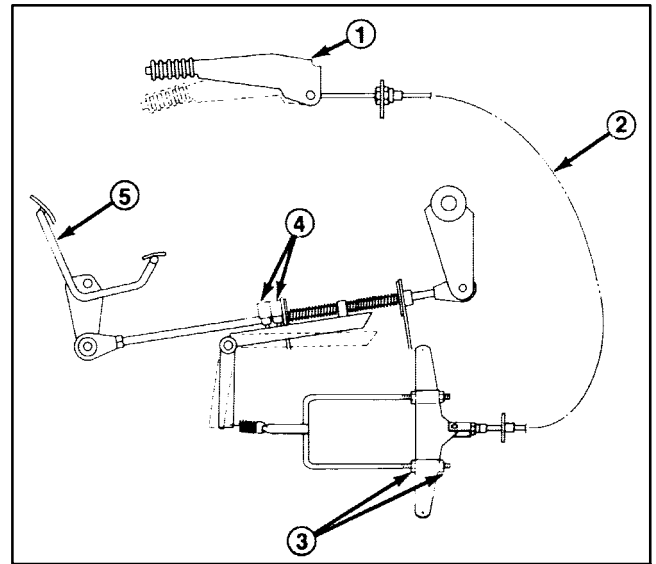


Figure 2

- | | |
|----------------|----------------------|
| 1. Hand brake | 4. Traction switches |
| 2. Brake cable | 5. Traction pedal |
| 3. U-bracket | |

Rear Wheel Toe-In

After every 800 operating hours or annually, check rear wheel toe-in.

1. Measure center-to-center distance (at axle height) at the front and rear of the steering tires (Fig. 3). Front measurement must be 1/8 inch (0.32 cm) less than the rear measurement.
2. Loosen clamps at both ends of the tie rods (Fig. 4).
3. Rotate tie rod to move the front of tire inward or outward.

NOTE: Make sure tie rod clamps are positioned so they do not interfere with steering linkage.

4. Tighten tie rod clamps when the adjustment is correct.



Figure 3

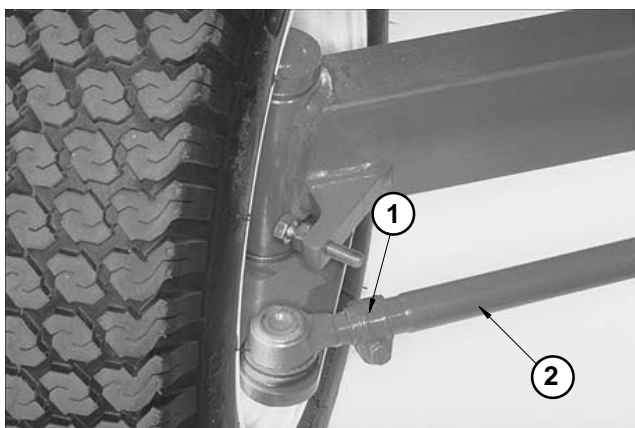


Figure 4

1. Clamp

2. Tie rod

1. Jack up rear of machine until tire is off the. Support machine with jack stands or blocks to prevent it from falling (see Jacking Instructions in Chapter 1 – Safety).
2. Remove dust cap (16) from the end of the wheel spindle.
3. Remove cotter pin (15), slotted nut, and washer (18). Slide wheel off of the spindle shaft.
4. Pull seal (22) out of wheel hub (9).
5. Remove bearings (11 and 21) from both sides of the wheel hub (9). Clean bearings in solvent. Make sure the bearings are in good operating condition. Clean inside of the wheel hub (9). Check bearing cups (10 and 20) for wear, pitting, or other noticeable damage. Replace worn or damaged parts.
6. If bearing cups (10 and 20) were removed from the wheel hub (9), press them into the hub until they seat against the shoulder.
7. Use No. 2 general purpose lithium base grease containing EP additive. Pack both bearings (11 and 21) with grease. Install bearing (21) into the cup (20) on inboard side of wheel hub.

IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the bearing.

8. Lubricate the inside of the new lip seal (22) and press it into the wheel hub.
9. Pack inside of wheel hub with some grease (not full). Install remaining bearing (11) into bearing cup (10).
10. Slide wheel onto the spindle shaft and secure it in place with the flat washer (18), nut (17), and retainer nut (50). **Do not tighten nut or install the cotter pin.**

11. Adjust preload on the wheel bearings (Fig. 6).

A. Tighten jam nut from 75 to 80 in–lb (86 to 270 kg–cm) while turning the hub to seat the bearings and remove all end play.

B. Loosen jam nut until it is away from the tab washer and the hub has end play. Tighten jam nut from 15 to 20 in–lb (17 to 23 kg–cm) while rotating the hub.

C. Put retainer over the jam nut. If the cotter pin hole is not aligned with a retainer slot, remove retainer and reorient it until alignment occurs.

D. Insert cotter pin. Bend both legs of the cotter pin and tap out of the way. Install the cap.

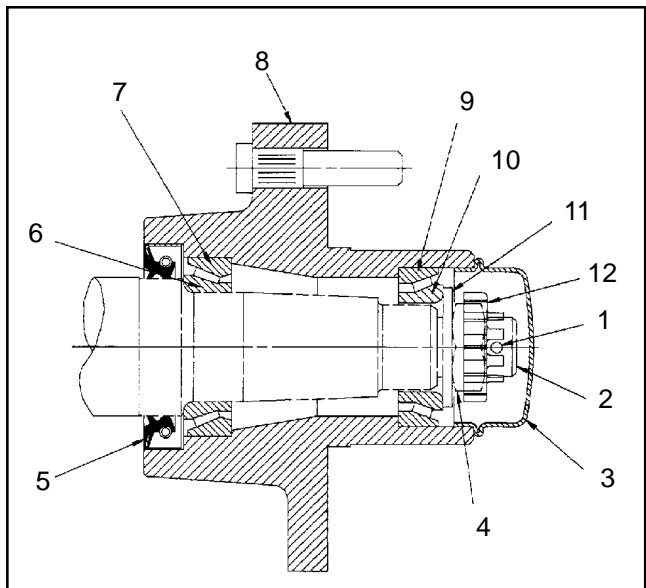


Figure 6

- | | |
|-----------------------|------------------------|
| 1. Cotter pin | 8. Wheel hub |
| 2. Spindle | 9. Outer bearing cup |
| 3. Cap | 10. Outer bearing cone |
| 4. Washer | 11. Washer |
| 5. Seal | 12. Retainer |
| 6. Inner bearing cone | 13. Jam nut |
| 7. Inner bearing cup | |

Planetary Wheel Drive

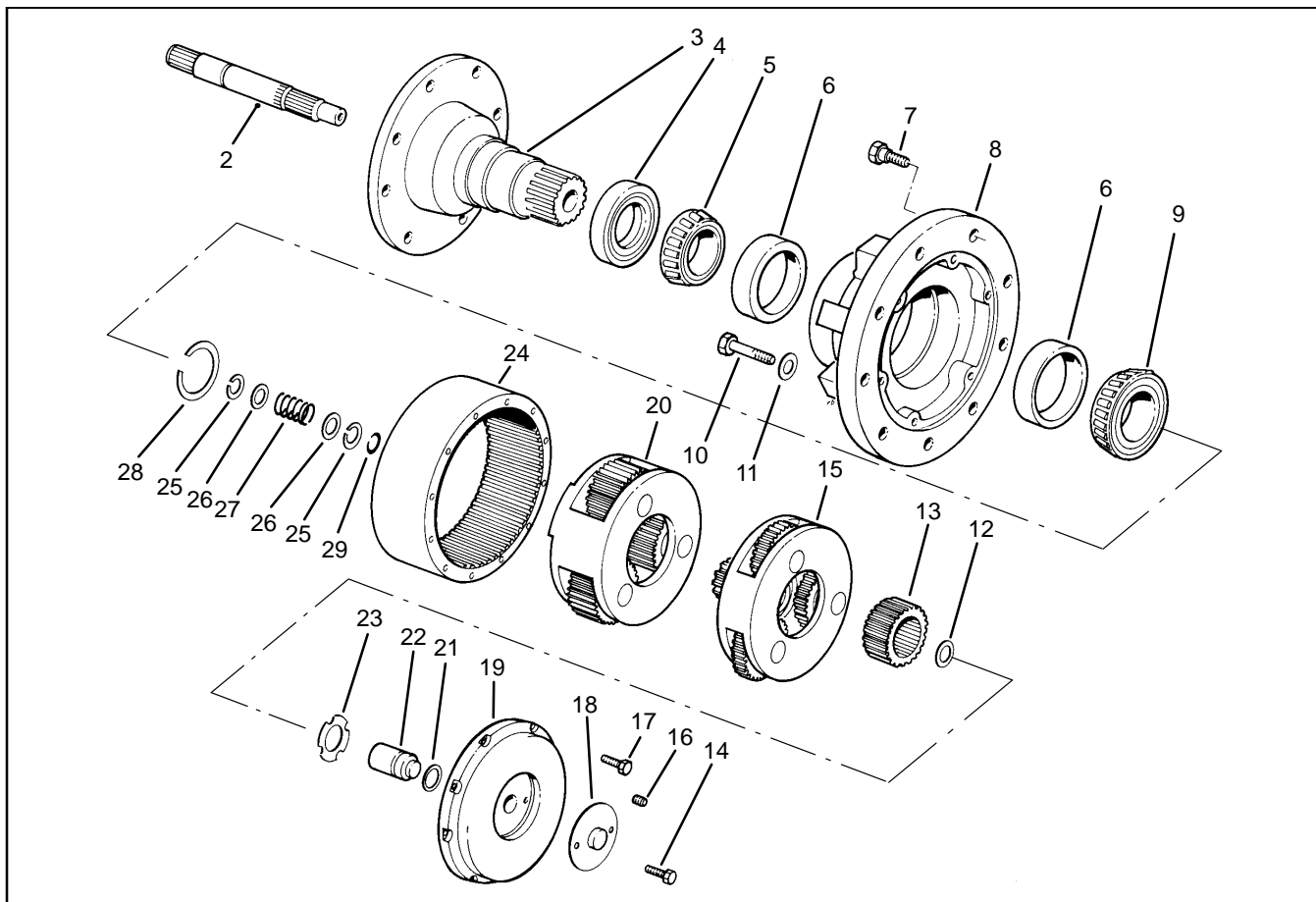


Figure 7

- | | | |
|-------------------|--------------------------------|------------------------|
| 1. Coupling | 11. Flat washer | 21. O-ring |
| 2. Input shaft | 12. Thrust washer | 22. Disengage plunger |
| 3. Spindle | 13. Primary sun gear | 23. Thrust washer |
| 4. Oil seal | 14. Hex head bolt | 24. Ring gear |
| 5. Bearing cone | 15. Primary carrier assembly | 25. Retaining ring |
| 6. Bearing cup | 16. Pipe plug | 26. Washer |
| 7. Wheel bolt | 17. Hex head bolt | 27. Disengage spring |
| 8. Hub | 18. Disengage cover | 28. Retaining ring kit |
| 9. Bearing cone | 19. Large cover | 29. Retaining ring |
| 10. Hex head bolt | 20. Secondary carrier assembly | |

Disassemble Planetary Wheel Drive

1. Slide coupling (1) from the splines on the input shaft (2).
2. Position assembly upright on the face of spindle (3). Remove disengage cover (18).
3. Remove bolts (17) and large cover (19). The disengage plunger (22) usually remains with the cover. Remove plunger and O-ring from the cover on the end of the input shaft.
4. A thrust washer (23) will usually remain in position on the thrust face of the cover.
5. Remove primary sun gear (13) and thrust washer (12) from the end of the input shaft. Remove primary carrier assembly (15).
6. Remove secondary carrier assembly (20). It may be necessary to remove the ring gear (24) first if difficulty is encountered in removing the carrier.
7. Remove input shaft (2) from the spindle (3). Remove retaining rings, washers, and spring from the input shaft only if replacement is required.
8. Remove 6 or 12 bolts from the hub and ring gear. Remove ring gear (24). It may be necessary to strike ring gear with a rubber mallet to loosen from hub.

NOTE: Use snap ring expander tool to remove the retaining ring.

9. Remove large retaining ring (28) from in front of the tapered bearing. Lift hub (8) from the spindle. If bearings are not a loose fit, it may be necessary to press spindle from the hub.
10. Remove oil seal (4) and bearing cones (5 and 9) from the hub. Inspect bearing cups (6) in position and remove only if replacement is required.

Assembly of the Planetary Wheel Drive

1. Press a **new** bearing cup (6) into each side of the hub (8).
2. Assemble bearing cone (5) into the cup (6) at the seal end of the hub. Press a **new** oil seal (4) into the hub.
3. Position spindle (3) upright on bench. Lubricate lips of oil seal (4) and lower hub onto the spindle. Hub (8) should be centered as it is lowered over the spindle to prevent seal damage.
4. Assemble bearing cone (9) over the spindle and into the bearing cup (6). Select thickest retaining ring (28)

that can be assembled into the ring grooves of the spindle shaft above the bearing cone. Bearing should have from 0.000 to 0.006 inches (0.00 to 0.15mm) of end play when the proper retaining ring is installed.

5. Assemble retaining ring (25) in the groove opposite pilot end of the input shaft (2). Assemble washer (26), spring (27), second washer (26), second retaining ring (25), and third retaining ring (29) in the middle groove of the input shaft. Some shafts have a shoulder and require only one retaining ring.
6. Assemble splined end of the input shaft down into the spindle.
7. Assemble secondary carrier splines over the splined end of spindle.
8. Apply a bead of RTV compound or equivalent to the hub face that mates with ring gear (24). Assemble end of the ring gear having 6 or 12 bolt holes against the hub with the bolt holes of the hub and ring gear aligned. Assemble six 3/8–24x1–7/8 inch hex head bolts. Torque bolts from 39 to 49 ft–lb (5.4 to 6.8 kg–m). If grade 8 bolts are used, torque bolts from 52 to 60 ft–lb (7.2 to 8.3 kg–m). Grade 8 bolts can be identified by the 6 radial lines on bolt head.
9. Assemble primary carrier and sun gear into the ring gear. It is necessary to rotate the carrier and pinion to align the sun gear teeth with the secondary pinion and primary pinions with ring gear teeth. Assemble primary sun gear (13) over the input shaft. Rotate sun gear to align the shaft to gear splines and gear teeth.
10. Assemble small thrust washer (12) over the input shaft and against the shoulder of shaft.
11. Assemble O-ring (21) in the groove of the disengage plunger (22). Assemble plunger over the end of input shaft and against the thrust washer.
12. Lubricate O-ring in the groove of the engage plunger. Assemble thrust washer (23) with tangs engaged with the large cover (19). Apply a bead of RTV compound or equivalent to the end face of the ring gear. Assemble cover over the plunger as holes of cover and ring gear are aligned. Assemble eight 5/16–18x1 inch hex head bolts. Torque bolts from 20 to 25 ft–lb (2.8 to 3.5 kg–m).
13. If the wheel is to be used to drive the vehicle, assemble disengage cover (18) with the dimpled center protruding out. Assemble and torque two 5/16–18x3/4 inch bolts. Torque bolts from 10 to 20 (1.4 to 2.8 kg–m).
14. Invert Power Wheel assembly. Assemble coupling (1) with the counterbore out to the input shaft.



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Specifications

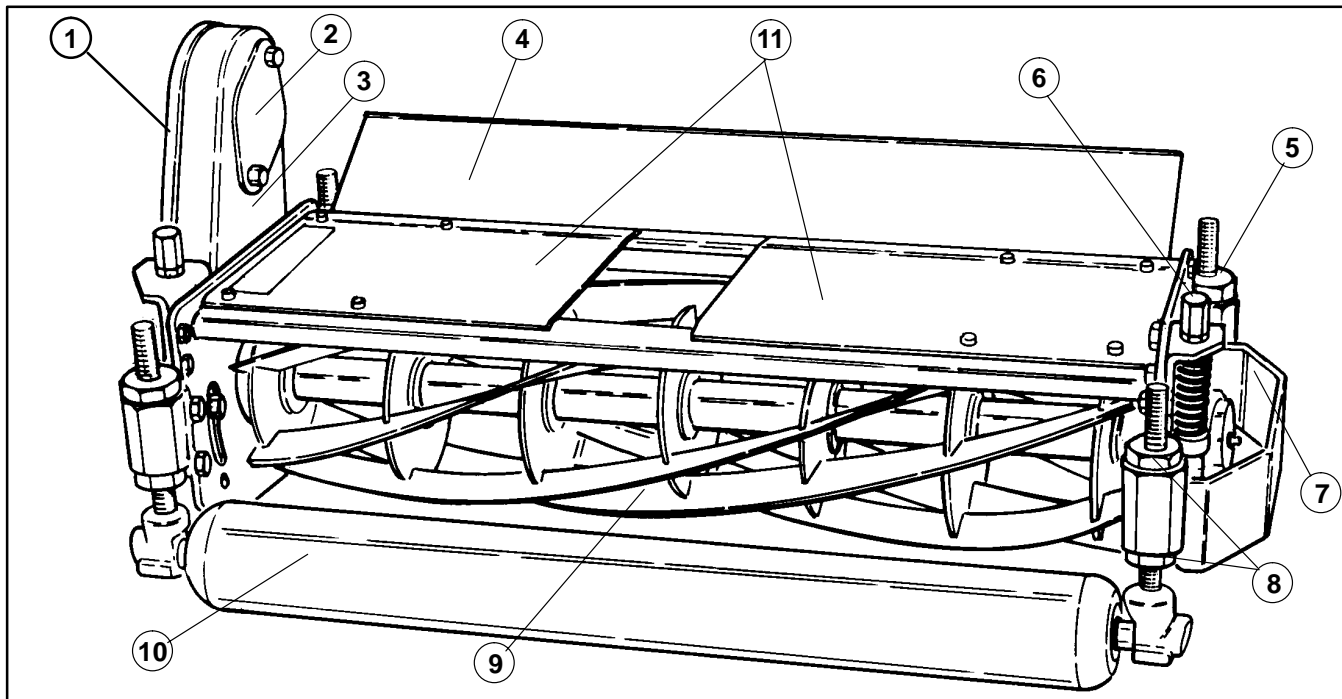


Figure 1

- | | | |
|------------------------|-------------------------------------|---------------------------|
| 1. Drive housing cover | 5. Rear roller adjuster (both ends) | 9. Reel |
| 2. drive housing | 6. Reel-to-bedknife adjuster | 10. Optional front roller |
| 3. Drive plate shield | 7. Guard | 11. Top covers |
| 4. Grass deflector | 8. cone nut | |

Construction: The frame is welded steel. The reel uses heavy duty, self-aligning ball bearings. The heavy duty steel rear roller has tapered roller bearings. The rear roller and bedbar are isolated and mounted in rubber bushings for quiet, vibration-free operation. Adjustable deflector shields are standard. Stainless steel components are used at key points for added durability.

Reel Configuration: The 5, 7, and 11 blade heavy duty welded reels all have 8 inch (20.3 cm) diameters and are 29-3/4 in. (75.5 cm) wide.

Bedknife/Bedbar Assembly: A replaceable, single edged, alloy steel bedknife is induction hardened. The bedknife is fastened with steel screws to a precision ground surface on the high strength, fabricated steel bedbar. The stress-relieved machined bedbar is mounted with four (4) vibration isolation bushings.

Bedknife to Reel Adjustment: Two lockable lead screw adjusters at each side of the frame adjust the reel to bedknife contact.

Rear Roller: 3-1/2 inch (89 mm) diameter steel roller has greaseable tapered roller bearings. A double lip oil seal and wear sleeve isolates grit and moisture from the bearings.

Height-of-Cut: 5 Blade – 1 to 3 inches (25 to 76 mm).
7 Blade – 1/2 to 1-3/4 inch (9.5 to 45 mm). 11 Blade – 3/8 to 3/4 inch (9.5 to 19 mm).

Height-of-Cut Adjustment: Quick adjustment and positive locking is provided by locking type cone nuts. Gauge marks of 1/4 inch (6.3 mm) are provided as a reference for easy changes of height-of-cut.

Clip (variable to match cutting conditions):

5 Blade Cutting Unit: 0.176 inch per mph
(0.352 inch at 2 mph to 1.32 inch at 7.5 mph)

7 Blade Cutting Unit: 0.126 inch per mph
(0.252 inch at 2 mph to 0.945 inch at 7.5 mph)

11 Blade Cutting Unit: 0.080 inch per mph
(0.16 inch at 2 mph to 0.600 inch at 7.5 mph)

Lubrication: Easily accessible grease fittings for bearings and all major pivot points are provided.

Drive: The reel drive motor turns a maintenance-free cog belt that drives the reel. Drive pulley and cog belt are encased in a drive housing for safety and protection from contamination.

Grass Deflector Shields: Shields are fully adjustable.

Special Tools

Order special tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*.

Some tools may be listed in the Reelmaster 4000–D Parts Catalog. Some tools may also be available from a local supplier.

Gauge Bar Assembly

Use gauge bar to set final height-of-cut (floating cutting units with front rollers only).

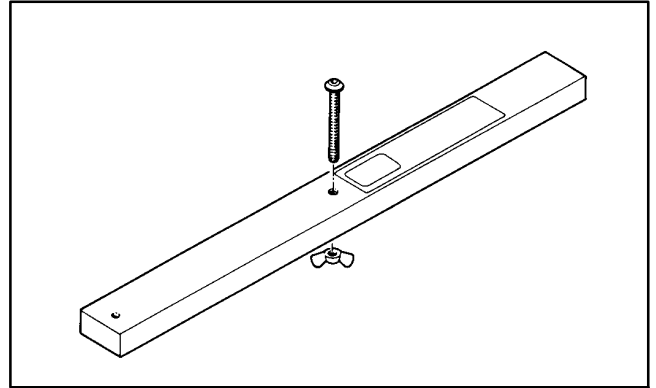


Figure 2

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

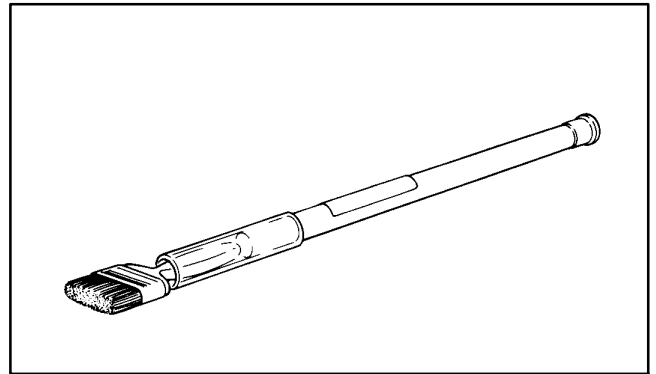


Figure 3

Bedknife Screw Tool

Fits Toro bedknife attaching screws. Use with torque wrench to secure bedknife to bedbar. With clean bedbar threads and new screws, tighten to a torque of 250 to 300 in–lb (288 to 346 kg–cm).

Note: Remove all rust, scale and corrosion from bedbar surface before installing bedknife.

IMPORTANT: Do not use an air impact wrench with this tool.

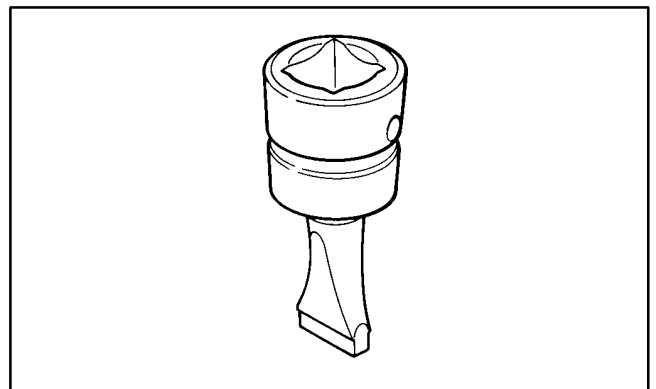


Figure 4

Adjustments



CAUTION

Never install or work on the cutting units or lift arms with the traction unit engine running. Always stop the engine and remove the key first.

Adjust Reel to Bedknife Contact

The cutting units will provide optimum mowing performance when adjusted and maintained correctly. Keeping a precise reel to bedknife adjustment (light contact), at each end of the cutting unit will produce a continual self-sharpening action. Therefore, sharp cutting edges are maintained, good quality of cut assured, and the need for corrective re-sharpening reduced.

Note: Before adjusting height-of-cut and each day before operating, check reel to bedknife contact regardless if previous quality of cut had been acceptable.



CAUTION

Before adjusting reel to bedknife, raise and fully latch cutting units. Remove key from the ignition switch. Keep others off machine while adjusting cutting units.

Note: A 3/4-inch wrench is required for making the reel to bedknife adjustment.



CAUTION

When adjusting the cutting units, wear heavy gloves and use care when turning reels by hand. Sharp edges can cut or pinch hands or fingers.

1. Rotate reel slowly and carefully while listening for light contact across the full length of the reel and bedknife.
2. If no contact is determined, loosen adjuster locking nut on each adjuster (Fig. 5). Turn each adjuster knob equally and clockwise until light contact is felt and heard.

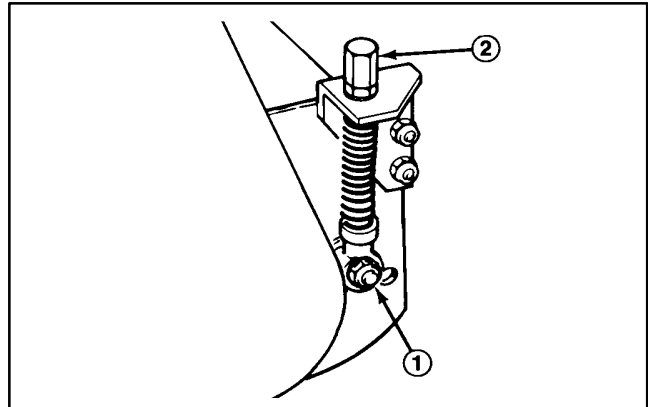


Figure 5

1. Adjuster locking nut
2. Adjustment knob

IMPORTANT: Adjusted correctly so that the reel will cut a piece of paper approximately 0.003 inch (0.076mm) thick across its entire length.

3. If excessive contact is determined, turn each adjusting knob equally and counter-clockwise until no contact is noticed. Then turn both adjusting knobs equally and clockwise until light contact is felt and heard between the reel and bedknife. **Final adjustment should always be in the tightening (clockwise) direction.**

IMPORTANT: Cutting units with excessive contact between the reel and bedknife are noisy, consume excessive power, shorten component life and result in overall poor performance. Light contact between the reel and bedknife, once the cutting unit is warmed up, provides optimum mowing performance and component life.

4. Tighten adjuster locking nuts when adjustments are complete.

Height-of-Cut Adjustment (Floating Cutting Unit)

Overview of Procedure:

1. Adjust reel to bedknife contact
2. Level rear roller to reel
3. Adjust initial height-of-cut using gauge bar.

1. Adjust reel to bedknife contact on all cutting units. (see Adjust Reel to Bedknife Contact).

2. Level rear roller to the reel.

A. Start engine and lower the cutting unit onto a flat surface such as a piece of 3/4-inch (1.9 cm) plate steel of at least 20 x 30 inches (50 x 76 cm). Stop engine and remove key from ignition switch. Lock cutting units in the fixed position by loosening the jam nut on the lockout pin (Fig. 6) and screwing the pin into the hole in pivot arm (Fig. 7). Tighten nut to secure lockout. Raise front rollers up so they do not contact the flat surface.

Note: Using a bar 3/8inch (9.5 mm) thicker than height-of-cut provides the proper bedknife attitude (heeled "up" in back), which is required for excellent low height-of-cut performance.

B. Insert a piece of bar stock 25 to 28 inches (64 to 71 cm) long and approximately 3/8 inch (9.5 mm) thicker than the desired height-of-cut under the reel and up against the bedknife cutting edge. The reel (not bedknife) must contact the bar stock along its full length (Fig. 8).

C. Loosen rear roller jam nuts and adjusting knobs. Push roller down against the flat surface. At this point the reel should contact the bar stock, and the rear roller should contact the flat surface. Contact should exist along the entire length of the reel and rear roller. Tighten rear roller adjustment knobs and jam nuts. Make sure roller and reel are both still making contact after the jam nuts have been tightened. Check roll contact by trying to slide paper between the roller and the flat surface.

D. Rear roller is now leveled to the reel.

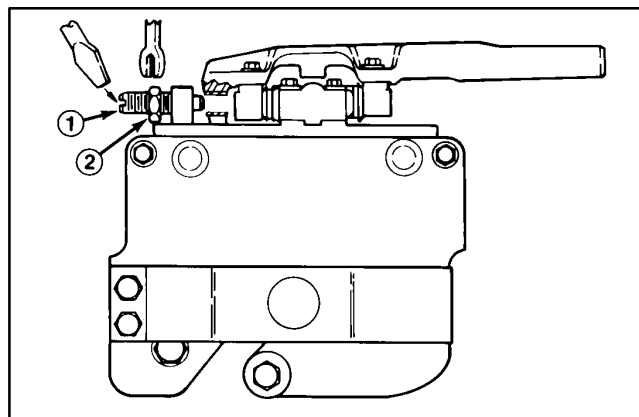


Figure 6

Cutting Unit Float Position

1. Lockout pin
2. Jam nut

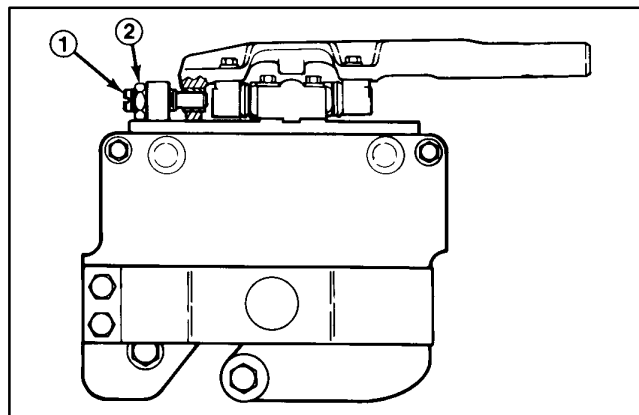


Figure 7

Cutting Unit Fixed Position

1. Lockout pin
2. Jam nut

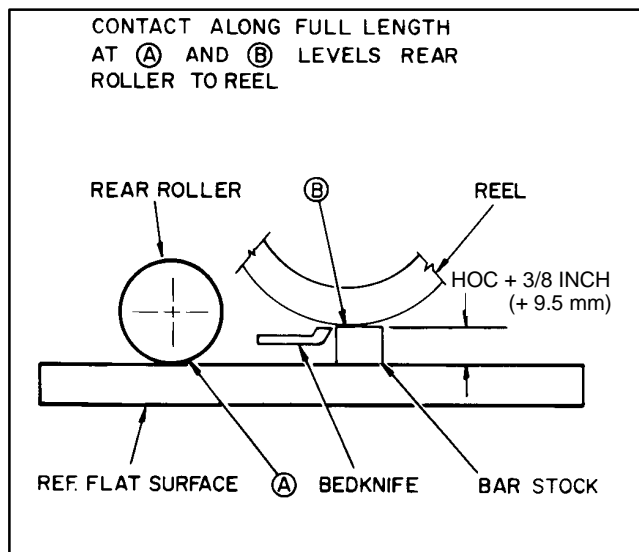


Figure 8

Leveling Rear Roller to Reel

3. Make final height-of-cut adjustment with gauge bar.

A. Raise cutting units and lock in the transport position. Shut off the engine and remove the key from the ignition switch.

B. Use gauge bar (Toro Part No. 59-7900) to set final height-of-cut by adjusting the front roller only.

C. Loosen gauge bar jam nut and adjust screw to set dimension between underside of screw head and gauge bar for desired height-of-cut (Fig. 9). Tighten jam nut to secure the adjustment. Hook screw head over cutting edge of the bedknife and position bar against bottom of front roller (Fig. 10).

D. Loosen front roller nuts, and adjust both ends of the front roller until it contacts the gauge bar at both ends. With the gauge bar held firmly against the bottom of the rollers, adjust front roller so the screw head slips just over the lip of the bedknife (Fig. 10). Tighten front roller nuts.

IMPORTANT: When set properly, the front and rear rollers will contact the gauge bar and the screw head will be snug over bedknife cutting edge when checked at both ends of the reel.

E. Loosen lockout pin so cutting unit can float freely (Fig. 6).

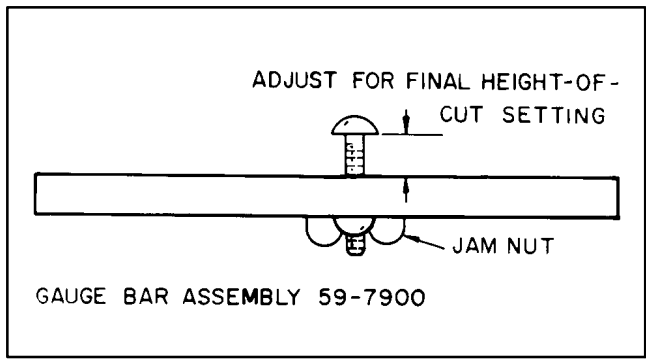


Figure 9
Gauge Bar Assembly

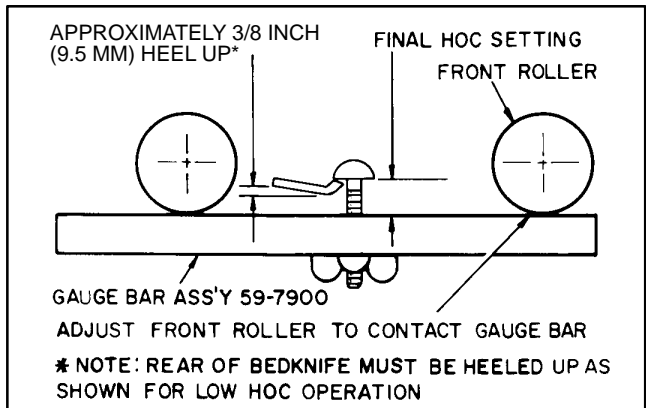


Figure 10
Final Height-of-Cut Adjustment Using Gauge Bar

Quick Method For Changing Height-of-Cut After Initial Set Up of a Floating Cutting Unit

If the reel to bedknife adjustment has been set in STEP 1 of Height-of-Cut Adjustment (Floating Cutting Unit) and the rear roller leveled to the reel in STEP 2 of Height-of-Cut Adjustment (Floating Cutting Unit), the cutting unit may be quickly changed from one height-of-cut to another by using the gauge bar (Part #59-7900) and adjusting the front roller only. In many

cases, an entire machine can be done quickly by using the gauge bar to set the front roller of one cutting unit. The remaining cutting units can then be set by loosening their front roller jam nuts and turning each front roller adjustment knob the same number of turns and in the same direction as the first unit.

Adjust Height-of-Cut (Fixed Cutting Unit)

1. Adjust reel to bedknife contact (see Adjust Reel to Bedknife Contact).

2. Loosen nuts securing skids or front roller and raise to highest position.

3. Loosen jam nuts securing rear roller. Lower roller beyond desired height-of-cut (assures proper bedknife attitude).

4. Lower cutting unit onto a flat surface such as a piece of 3/4-inch (1.9 cm) plate steel of at least 20 x 30 inches (50 x 76 cm). Shut off engine and remove the key.

5. Insert piece of bar stock, 25 to 28 inches (64 to 71cm) long with thickness equal to desired height-of-cut, under the entire length of the reel and next to bedknife (Fig. 11).

6. Adjust rear roller adjustment knobs and jam nuts until the full length of the rear roller contacts the flat surface, and the full length of the reel (not bedknife) contacts the bar stock. Tighten rear roller knobs and jam nuts.

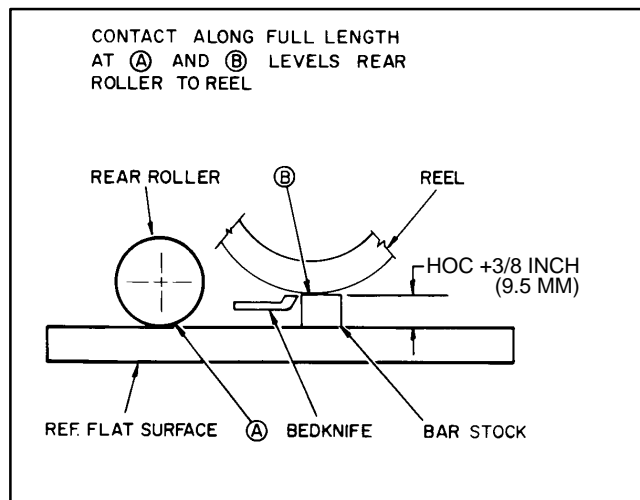


Figure 11

Adjust Skids and Front Roller (Fixed Cutting Unit)

If the skid kit or front rollers are installed, make the following adjustments to prevent them from pushing down uncut grass or scalping on undulating terrain:

Note: Skids are used only with the cutting unit in the fixed position. Front rollers may be used with the cutting unit in either the fixed or floating position.

1. Lock each cutting unit in the fixed position, and adjust reel to bedknife contact and height-of-cut (see Adjust Reel to Bedknife Contact and Adjust Height-of-Cut).

2. Position cutting units on a flat, level surface such as a piece of 3/4-inch (1.9 cm) plate steel of at least 20 x 30 inches (50 x 76 cm).

Note: Proper adjustment is achieved when the cutting unit does not scalp the grass in normal mowing conditions and yet is set high enough not to mar the turf and create undue wear on the skids or rollers. Skids and front rollers used to prevent scalping should not ride on the ground.

3. Adjust each skid or front roller so it is 1/8 to 1/4 in. (3 to 6 mm) or higher above the level surface. Allow greater clearance at the higher height-of-cut settings.

A. The front roller is adjusted in the same manner as the rear roller.

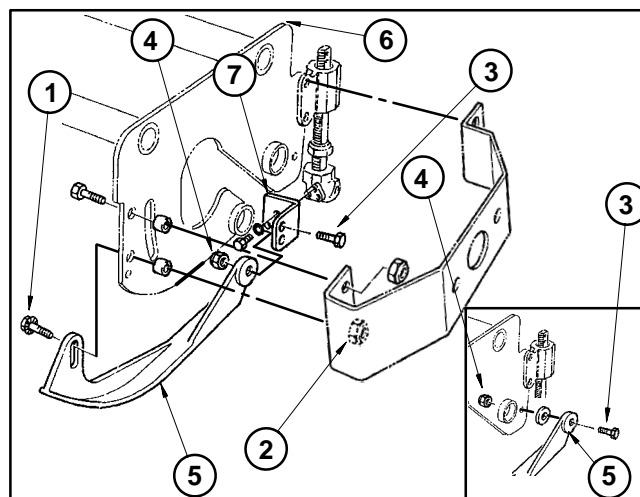


Figure 12

- | | |
|--------------|-----------------|
| 1. Cap screw | 5. Skid |
| 2. Lock nut | 6. Side plate |
| 3. Cap screw | 7. Skid bracket |
| 4. Lock nut | |

B. The skid is adjusted by loosening cap screws and lock washers securing the skid to the side plate and skid bracket. On some units, the rear of the skid may be mounted to the side plate with a spacer (Fig. 12).

Service and Repairs



CAUTION

Never remove, install, or work on the cutting units or lift arms with the traction unit engine running. Stop engine and remove key from ignition switch first.

Backlapping



CAUTION

During backlap operation the reels are under power. Contact with rotating reels can result in personal injury. Do not adjust cutting units while the engine and reels are operating.

Two people are required to perform backlapping. One person sits on the seat to operate the controls (operator) and the other performs the backlapping operation. Good communication between each person is necessary. Instruct operator to stop the reels and shut the engine off when adjustment is necessary.

Use a good grade of medium grit (80 coarseness) lapping compound with a water soluble carrier. Mix dry lapping compound with liquid detergent until it has a free-flowing consistency.

Note: Before starting the engine, raise grass deflector on the center cutting unit and tighten fasteners to retain the deflector in the raised position.

Operator Duties:

1. Sit on seat and engage parking brake.
2. Start engine and run at minimum throttle. Lower either the center and two front cutting units, the left hand cutting unit, or the right hand cutting unit.
3. When both side cutting units are up and latched (automatically shut off) with the center and front cutting units down, backlap the center cutting unit from the rear of the machine with the long handled brush. Backlap front cutting units from the front of the machine.
4. Wait for 2nd person's instruction to engage reels in backlap mode, then pull mow-backlap lever to the BACKLAP position and hold.
5. Follow 2nd person's instructions. Be prepared to stop reels and engine quickly in case of an emergency.

2nd Person's Duties:

1. Instruct operator when to start and stop the reels.



CAUTION

Never use a short-handle paint brush to apply backlapping compound. A rotating reel can pull a short-handle paint brush and the users hand into the reel causing serious personal injury.

2. Dip 3-inch (76 mm) wide paint brush attached to Toro Part No. 29-9200 Handle Assembly into lapping compound. Stand clear and instruct operator to engage the reel into the backlap mode.

3. Apply lapping compound evenly over the full length of the reel. Make sure all reel blades are covered. Whenever noise of reel against the bedknife begins to disappear or, an uneven concentration of material appears on the reel, redistribute the compound with the brush.

4. When it becomes necessary to adjust the reel to the bedknife, instruct operator to disengage reel, stop engine, and remove key from the ignition switch. Make adjustment only after the reels have stopped rotating.

5. Backlap each reel until the cutting edges are sharp, even on all blades. Achieve a minimum of 1/32 inch (0.79 mm) land area on newly sharpened reel assemblies. Normally, a reel need only be backlapped for approximately 3 minutes.

6. Upon completion, stop reel and turn off engine. Remove key from the ignition switch. Wash unit thoroughly with a low pressure stream of water to remove all lapping material. Allow reel to dry. **Lubricate grease fittings.**

7. Check sharpness of the reel and bedknife with news paper strips. Light reel to bedknife contact should shear the paper cleanly across the reel's entire width. If the paper is not sheared acceptably, continue backlapping.

8. Proceed backlapping the remaining cutting units.

Note: See Toro Sharpening Manual (Part #80-300PT) for additional backlapping information.

Hydraulic Motor Installation

1. Install drive plate shield onto the reel drive motor flange. Be sure the widest portion of the shield is at the top (Fig. 13).

IMPORTANT: Make sure motor pulley set screws are tight on the motor shaft before installing the motor onto the cutting unit (Fig. 14).

2. Insert reel drive motor pulley through the housing, and slip cutting unit drive belt over the pulley (Fig. 13).

Note: Proper belt tension is achieved when the belt deflects about 1/8 inch (3 mm) at the mid-point when 7 lb (31 N) of force is applied.

3. Insert two (2) reel drive motor mounting bolts (heads on the inside of the drive housing with flat washer on the top bolt through the reel motor flange holes. Thread locknuts onto the bolts. Rotate reel motor upward in the slotted hole in the housing to tension the drive belt. Tighten fasteners to 25 ft-lbs (34 Nm). NOTE: (Fig. 15).

IMPORTANT: Rotate motors by hand only. Never place a bar between hose fittings on the hydraulic motors; motor damage may result.

4. Install gasket and drive housing cover after making sure the ends of the gasket are at the bottom of the housing to allow for drainage.

IMPORTANT: When hydraulic motors have been mounted to the cutting units, make sure hydraulic hoses lay flat and do not contact the frame of the machine when the cutting units are in the raised position. There should also be sufficient slack so hoses are above and not in contact with the floatation kit. If hoses appear twisted once the hydraulic motors have been mounted and the belts tightened, loosen swivel nuts at the motor and reposition hoses. This can greatly increase the life of the hoses. With cutting units down, all cutting unit hoses should have a flat natural lay and be free from twist.

Note: Refer to the Traction Unit Operator's Manual for instructions on setting the adjustable hydraulic counterbalance.

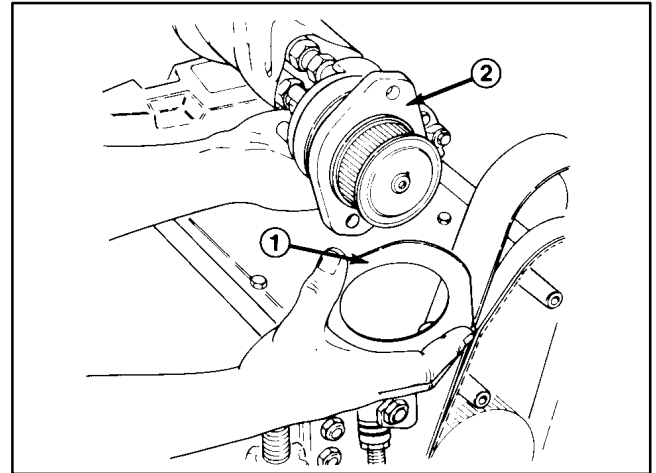


Figure 13

1. Drive plate shield 2. Reel drive motor flange

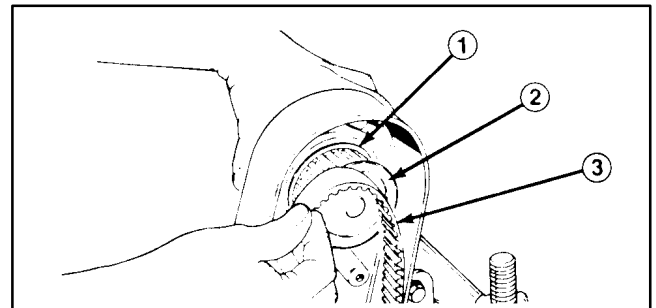


Figure 14

1. Hydraulic motor 3. Drive belt
2. Motor pulley

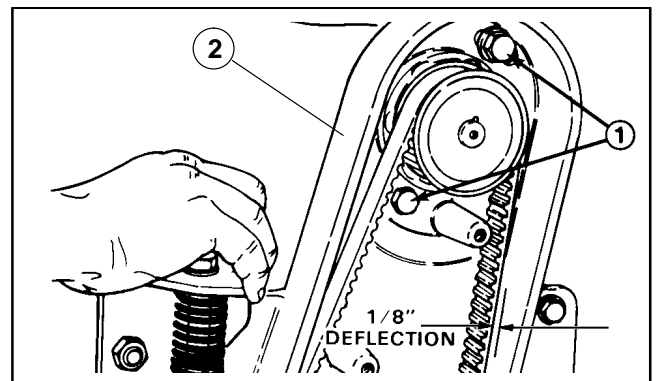


Figure 15

1. Mounting bolts 2. Drive housing

Bedknife/Bedbar

Disassembly

1. Remove shoulder bolts, bushings and spacers from each end of the unit. Remove bedbar/bedknife assembly (Fig. 16).

2. Remove mounting screws for the bedknife. Separate bedknife from the bedbar. Discard screws (Fig. 17).

Assembly

1. Clean bedknife mounting face on the bedbar thoroughly of all rust and scale. Remove any material on the mounting face of the bedbar that will affect a good match-up with the bedknife.

2. Before installation, apply a coating of anti-seize lubricant to the threads of the bedknife mounting screws.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

3. Begin with the center screw and tighten alternate screws toward each end using a torque wrench and bedknife screw tool. Tighten screws to a torque of 250 to 300 in-lb (288 to 345 kg-m). Make sure bedknife is flat against the bedbar (Fig. 18).

4. Install bedbar/bedknife assembly to the cutting unit.

Grinding

Variations in the mounting surface of a bedbar causes a new bedknife not be perfectly flat after installation. This makes it is necessary to backlap or grind a new bedknife after installation to the bedbar. Follow existing angle that was ground into the bedknife. Grind only enough to make sure the top surface is true (Fig. 19).

1. Remove the bedbar from the cutting unit.
2. Keep the bedknife fastened to the bedbar when grinding.
3. Follow the grinder manufacturer's instructions for set-up and operation of the grinder.

Note: When grinding, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder.

Bedknife Grinding Specifications	
Relief Angle	5°
Relief Angle Range	3° to 6°
Front Angle	15°
Front Angle Range	13° to 17°

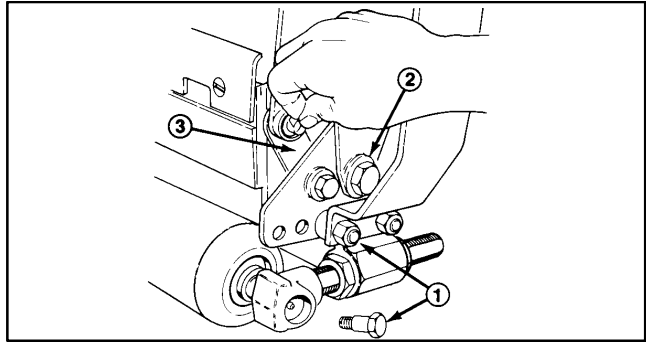


Figure 16

1. Shoulder bolt (2 each side)
2. Bushing
3. Spacer

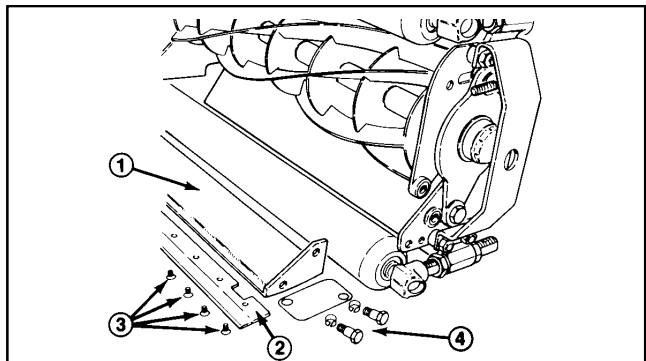


Figure 17

1. Bedbar
2. Bedknife
3. Mounting screws
4. Mounting fasteners

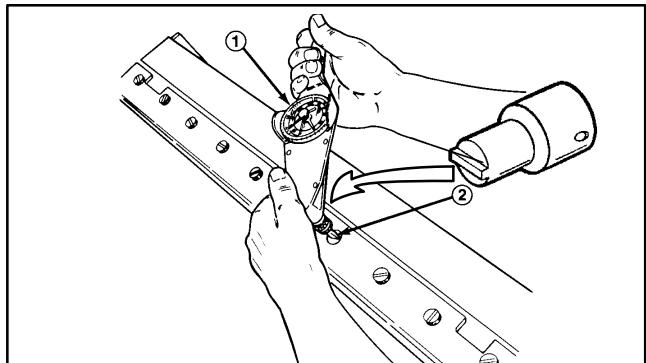


Figure 18

1. Torque wrench
2. Bedknife screw tool

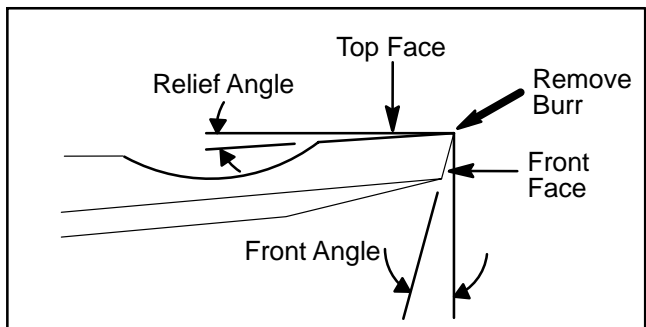


Figure 19

Reel Assembly

Disassembly

1. Remove the guards from each end of the cutting unit and the front and rear roller assemblies (Fig. 20).
2. Remove shoulder bolts, bushings and spacers from each end of the unit and remove the bedbar/bedknife assembly (Fig. 21).
3. Remove inboard locknut from the adjuster pin, the fasteners for the bracket and remove the adjusting handle assembly from the side plate (Fig. 21).
4. Disassemble cone nut from the shoulder bolt securing the bearing housing to the side plate. Remove belle-ville washer and bolt. Slide bearing housing off the reel shaft (Fig. 22).
5. Disassemble cone nut from the shoulder bolt securing the bearing housing to the side plate, remove the belle-ville washer and bolt and slide the bearing housing off the reel shaft (Fig. 22).

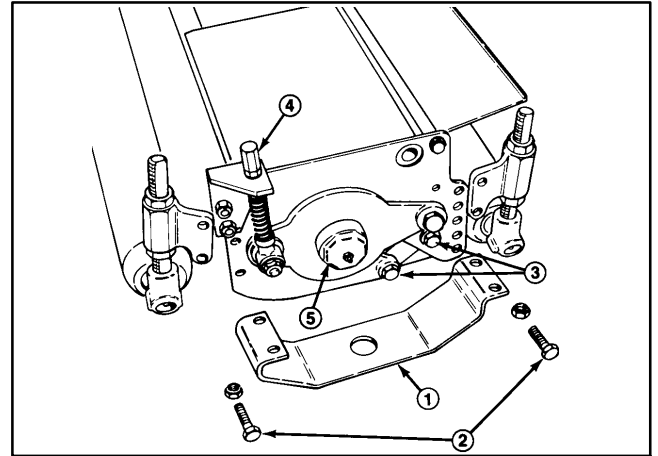


Figure 20

- | | |
|-----------------------|-----------------------|
| 1. Guard | 3. Adjusting assembly |
| 2. Mounting fasteners | 4. Dust cap |

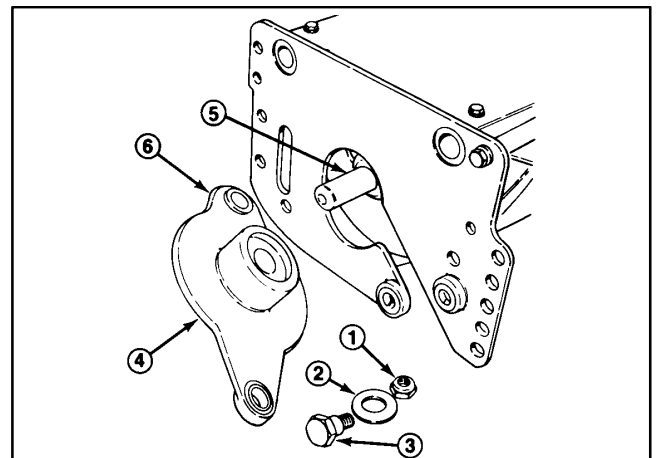


Figure 21

- | | |
|----------------------|--------------------|
| 1. Lock nut | 4. Bearing housing |
| 2. Belleville washer | 5. Reel shaft |
| 3. Shoulder bolt | 6. Flange housing |

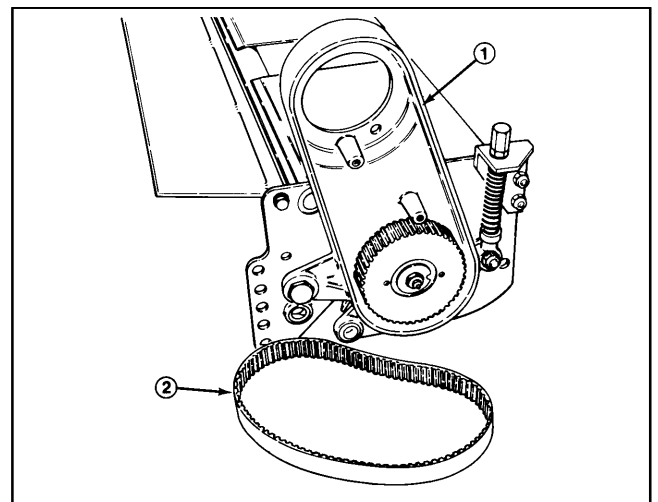


Figure 22

- | | |
|------------------|---------------|
| 1. Drive housing | 2. Drive belt |
|------------------|---------------|

6. Disassemble cover from the drive housing and remove the drive belt from the housing (Fig. 23).

Note: Reel capscrew is assembled with a thread locking compound

7. Remove reel capscrew, toothed washer, and pulley washer from the reel shaft (Fig. 23).

8. Remove driven pulley from the reel shaft using a puller. Remove woodruff key from the reel shaft (Fig. 23).

9. Remove adjustment assembly and cone nut, belle-ville washer, and shoulder bolt securing the drive housing to the side plate. Remove drive housing (Fig. 23).

10. Slide reel assembly out of the slots in the side plates.

11. Inspect bearings and grease seals in their housings as follows:

A. Seals must be free of cracks and tears. Replace seals as necessary.

B. Bearing roller balls must be free of deformation and scoring. Replace bearing if necessary.

C. Bearing must spin freely and have minimal axial play. Replace bearing if necessary.

12. Remove retaining ring from inside the drive housing. Pry outer seal out of the belt drive case side. Press bearing and rear seal out from the outer side of the housing.

13. Remove the dust cap (Fig. 20). Press the bearing and seal out of the housing.

Inspection

1. Inspect reel as follows:

A. Check reel shaft for bending and distortion by placing the shaft ends in V-blocks. Replace reel if necessary.

B. Check reel blades for bending or cracking. Replace reel if necessary.

C. Check service limit of reel diameter (see Reel Grinding Specifications in Preparing Reel for Grinding).

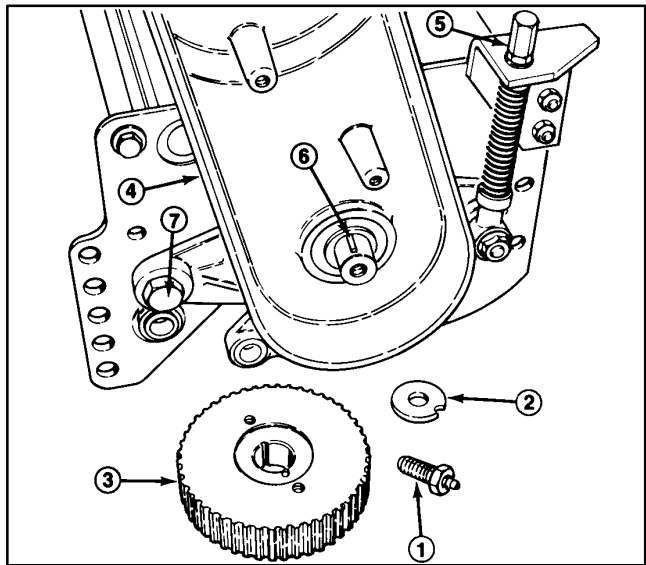


Figure 23

- | | |
|------------------|----------------------------|
| 1. Cap screw | 5. Adjustment handle |
| 2. Pulley washer | 6. Woodruff key |
| 3. Driven pulley | 7. Drive housing fasteners |
| 4. Drive housing | |

Assembly

1. Inspect flange bushings in the mounting holes of the drive housing and bearing housing for wear (Fig. 21). Replace, if necessary.

2. Assemble outer seal (lip facing in to retain grease) into the drive housing using Loctite 242 (or equivalent) retaining compound on the outer diameter. Apply a light coat of oil to the seal lips and insert the bearing assembly through the seal from the opposite side (Fig. 23).

3. Apply a light coating of oil to the inner seal lips and install (lip facing away from the bearing and toward the reel) in the housing. Install retaining ring to secure the assembly in the housing (Fig. 23).

4. Apply a light coat of oil to the seal lips of the seal for the bearing housing and install (lip facing away from the bearing) over the bearing assembly (Fig. 23).

5. Insert bearing and seal in the housing and install the dust cap into the housing.

6. Assemble reel assembly to the frame. Ensure shield washer is installed on the drive housing end of the reel shaft. Align drive pin on reel shaft with slot in bearing and slide the drive housing onto the shaft.

7. Insert shoulder bolt through the Belleville washer and rear housing mounting hole. Slide bolt through the side plate mounting hole (Fig. 21). Install the cone nut locknut onto the bolt. Tighten the cone nut to 45 to 55 ft-lbs (6.2 to 7.6 kg-m).

8. Align the drive pin on the reel shaft with the notch in the bearing inner race and slide the bearing housing over the opposite end of the reel shaft. Insert the shoulder bolt and Belleville washer through the rear bearing housing mounting hole. Slide the bolt through the side plate mounting hole. Install the cone onto the bolt. Tighten the cone nut to 45 to 55 ft-lbs (6.2 to 7.6 kg-m).

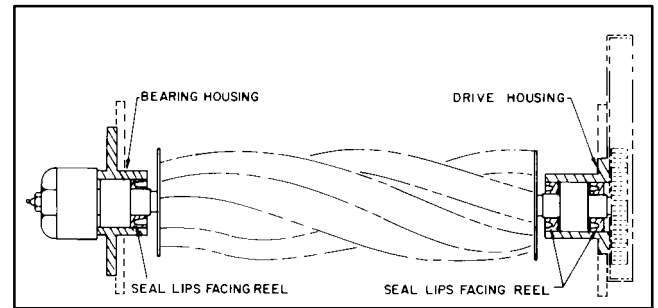


Figure 24

9. Install woodruff key in the drive housing end of the reel shaft and install the driven pulley onto the shaft.

10. Ensure slot in the pulley washer is aligned with the roll pin in the pulley and install the washer, toothed washer and reel capscrew (Fig. 22). Apply a medium strength thread locking compound to the reel capscrew during assembly. Torque the capscrew to 45 to 55 ft-lb (6.2 to 7.6 kg-m).

11. Install reel adjustment assemblies to each side plate. Install roll pins before tightening fasteners.

12. Install bedbar/bedknife assembly.

13. Install front and rear roller assemblies or skids.

14. Adjust reel to the bedknife (see Reel to Bedknife. Adjust height-of-cut (see Adjust Height-of-Cut).

Preparing a Reel for Grinding

Note: Check to make sure the reel bearings are in good condition before grinding the reel. Make sure the cutting unit frame and roller brackets are true and not bent or damaged.

1. Remove the bedbar assembly (Bedknife/Bedbar Disassembly).
2. Remove parts as necessary to mount the cutting unit into the grinder (e.g., front roller, front roller brackets).
3. Follow the grinder manufacturer's instructions for set-up and operation of the grinder.

Note: The cutting unit must be aligned so the grinding wheel will travel parallel to the reel shaft. This will result in the reel being ground to the desired cylinder shape.

Note: When grinding, be careful to not overheat the reel blades. Remove small amounts of material with each pass of the grinder.

4. After completing the grinding process:

- A. Install parts that were removed to mount the cutting unit onto grinder.
- B. Install bedbar assembly (see Bedknife/Bedbar Assembly).
- C. Do a complete cutting unit set-up and adjustment procedure (see Adjustments section).

Reel Grinding Specifications	
Nominal Reel Diameter	8 in (206 mm)
Service Limit Reel Diameter	7.2 in (182 mm)
Blade Relief Angle	30°
Relief Angle Range	20° to 40°
Blade Land Width	0.060 in (1.5 mm)
Land Width Range	0.050 to 0.090 in (1.3 to 2.3 mm)
Max. Reel Taper	0.060 in (1.5 mm)

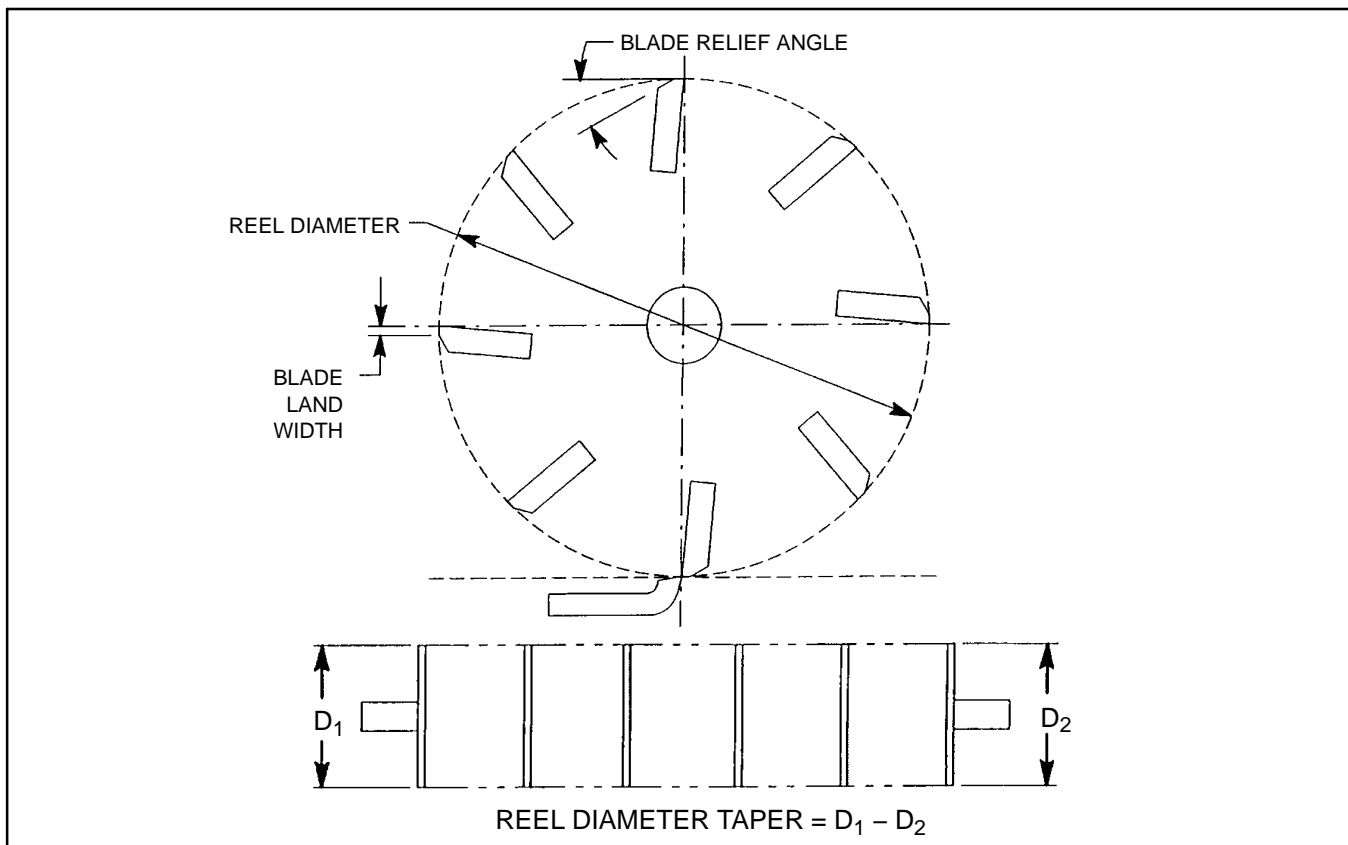


Figure 25

Front and Rear Rollers

Note: Front and rear rollers can be removed and installed in the same manner.

Removal

Note: Front and rear rollers can be removed using either of two methods.

1. Remove roller adjustment housing from side plate (Fig. 26).

A. Remove mounting fasteners securing both guards and roller adjustment housings to the side plate.

B. Pull housings from roller shafts.

2. Remove collar assembly from roller adjustment housing (Fig. 27)

A. Unscrew upper cone nut from the collar assembly.

B. Drop collar assembly out of the adjustment housing.

C. Separate both collar assemblies from both ends of the roller shaft.

Installation

IMPORTANT:When assembling a new roller to the cutting unit, mount roller so that the roller shaft "locknut" is on the right side of the cutting unit. (As viewed by the operator sitting on seat of machine). This prevents the lock nut from loosening during operation (Fig. 27).

1. Install roller adjustment housing to the side plate (Fig. 26).

A. Install roller adjustment housings to both ends of the roller shaft.

B. Position roller adjustment housing and guard to the side plate. Make sure mounting holes are aligned properly. Secure guards and housings to the side plate with mounting fasteners.

2. Install collar assembly to the roller adjustment housing (Fig. 27)

A. Install both collar assemblies to both ends of the roller shaft.

B. Make sure cone nut is on collar assembly with the cone facing up. Slide collar assembly into each adjustment housing.

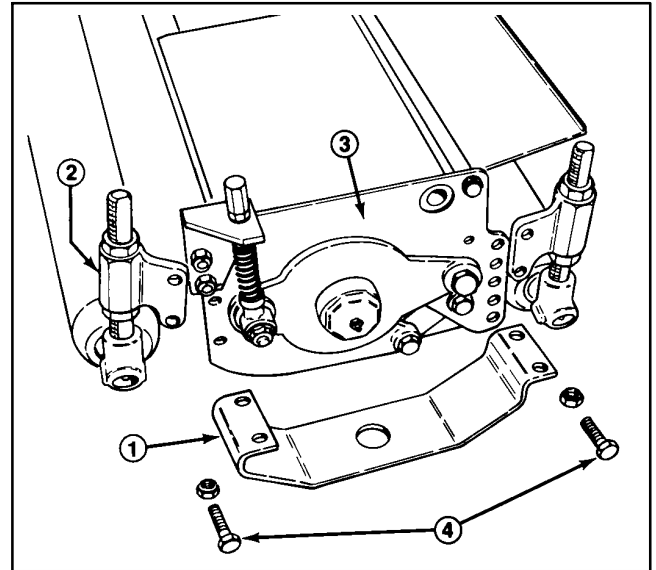


Figure 26

- | | |
|------------------------------|-----------------------|
| 1. Guard | 3. Side plate |
| 2. Roller adjustment housing | 4. Mounting fasteners |

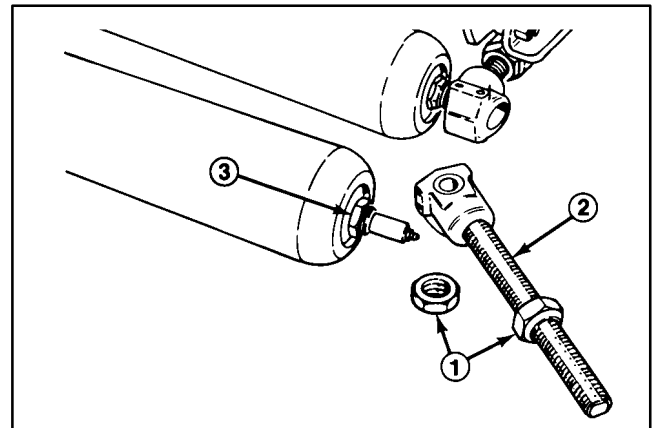


Figure 27

- | | |
|--------------------|-------------|
| 1. Cone nut | 3. Lock nut |
| 2. Collar assembly | |

C. Thread cone nut onto each collar assembly with the cone facing down.

D. Adjust height-of-cut (see Adjust Height-of-Cut).

Roller Bearing Replacement

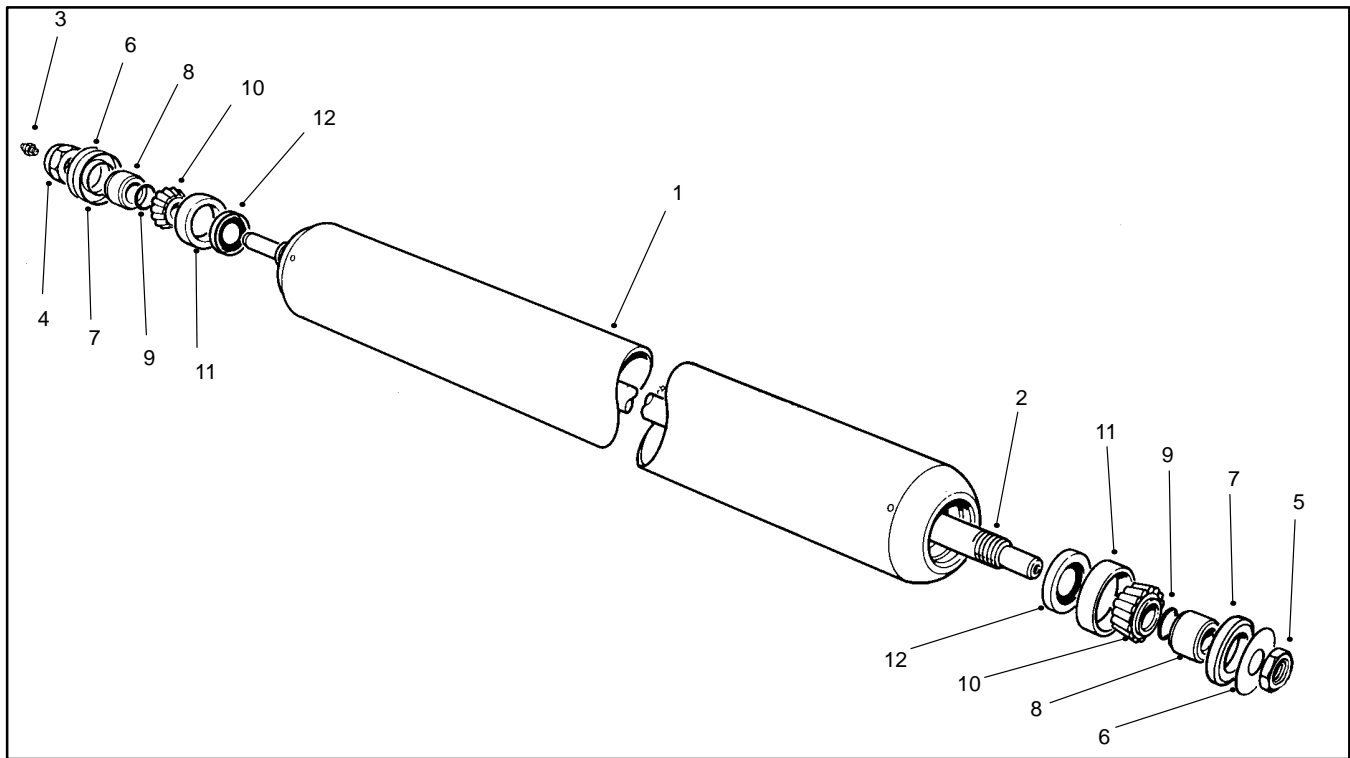


Figure 28

- | | | |
|-------------------------------------|----------------------|-----------------------|
| 1. Roller tube (front roller shown) | 5. Jam nut | 9. O-ring |
| 2. Roller shaft | 6. Thrust washer | 10. Bearing cone |
| 3. Grease fitting | 7. Outer grease seal | 11. Bearing cup |
| 4. Lock nut | 8. Wear sleeve | 12. Inner grease seal |

Removal

1. Clean roller around the shaft, grease fittings, and bearing thoroughly. Both ends of the roller should be free of dirt and debris.
2. Secure roller tube in a vise keeping it level.
3. Remove both grease fittings before removing the bearings.
4. Remove jam nut, lock nut, and both thrust washers from the roller shaft. Pull both outer grease seals from inside the roller tube.
5. Use a soft hammer to pound the shaft, wear sleeve, O-ring, and bearing cone out of the roller tube. Remove wear sleeve, O-ring, and bearing cone from the shaft.
6. Pull remaining wear sleeve, O-ring, and bearing cone from the roller.
7. Pull both inner grease seals from inside the roller tube. Discard all four grease seals and both O-rings.
8. If disassembling a rear roller, pour oil from the inside the roller into a suitable container.



WARNING

If removing bearing cups from a rear roller with an arc welder, make sure the entire roller is free of oil. Clean inside and out side thoroughly.

Note: An electric arc welder can be used to shrink the bearing cup to simply its removal. Only a small arc in one location on the cup is required.

9. Remove both bearing cups from the roller tube.

Installation

IMPORTANT: Replace both bearing cones and cups with new ones, since both bearing cones and cups may be damaged during removal.

1. Make sure all parts are cleaned thoroughly. Inside of roller tube should be free of dirt and debris.
2. On the front roller, press **new** inner grease seals into the roller tube with the garter spring of the seal facing away from the center of the roller (Fig. 29).

3. On the rear, wiehle, and sectional rollers, press **new** inner grease seals into the roller tube with the garter spring of the seal facing towards the center of the roller (Fig. 30).

4. Press both bearing cups into the roller tube with the narrow end of the taper facing the inside of the roller tube.

5. Secure roller tube in a vise so it is level.

6. If assembling a rear roller, fill inside of the roller tube with 6 oz. (200 ml) of SAE 90 oil.

7. Make sure roller shaft is free of nicks and burrs that could damage the grease seals. Make sure grease passages are clear.

8. Apply antiseize lubricant to the roller shaft. Insert shaft through the roller tube and grease seals **making sure not to damage the seals**.

9. Install both bearing cones to the roller shaft and into the bearing cups.

10. Apply thin coat of No. 2 general purpose lithium base grease to both **new** O-rings. Install O-rings to roller shaft. Install both wear sleeves to the shaft so recessed end fits over the O-ring.

11. On the front roller, press **new** outer grease seal into the roller with the garter spring of the seal facing away from the center of the roller (Fig. 29).

12. On the rear, wiehle, and sectional rollers, press **new** outer grease seal into the roller tube with the garter spring of the seal facing towards the center of the roller (Fig. 30).

13. Place thrust washer on each end of the roller shaft.

14. Apply Loctite 271 (or equivalent) to the threads on the roller shaft with the shorter length. Tighten jam nut all the way to the end of the threads. **Allow Loctite to cure before proceeding further.**

15. Install lock nut to the other end of the shaft. Torque lock nut while rotating shaft from 20 to 25 ft-lb (2.8 to 3.5 kg-m) to seat the bearings. Back off lock nut.

Note: Starting torque may exceed 10 ft-lb (1.4 kg-m) when torquing the lock nut the second time. This torque will fall once the nut starts to turn.

16. Torque lock nut while rotating shaft from 10 to 15 ft-lb (1.4 to 2.1 kg-m) a second time.

17. Install grease fittings. Lubricate each bearing with at least 1 oz. (33 ml) of No. 2 general purpose lithium base grease.

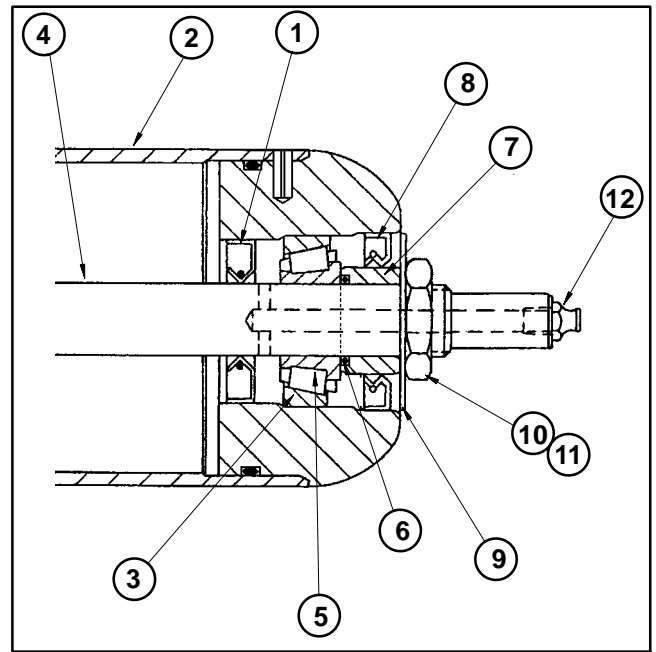


Figure 29

- | | |
|----------------------|----------------------|
| 1. Inner grease seal | 7. Wear sleeve |
| 2. Roller tube | 8. Outer grease seal |
| 3. Bearing cup | 9. Thrust washer |
| 4. Roller shaft | 10. Jam nut |
| 5. Bearing cones | 11. Lock nut |
| 6. O-ring | 12. Grease fitting |

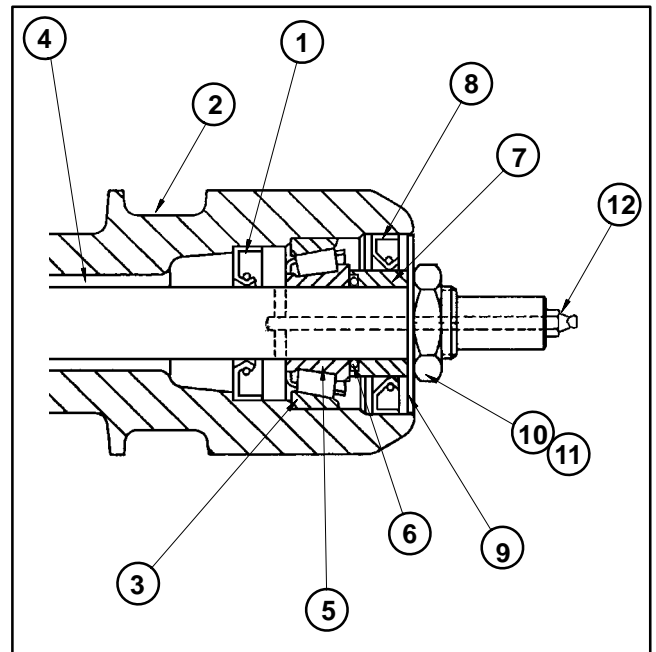


Figure 30

- | | |
|----------------------|----------------------|
| 1. Inner grease seal | 7. Wear sleeve |
| 2. Roller tube | 8. Outer grease seal |
| 3. Bearing cup | 9. Thrust washer |
| 4. Roller shaft | 10. Jam nut |
| 5. Bearing cones | 11. Lock nut |
| 6. O-ring | 12. Grease fitting |

Lubrication

Use a hand-operated grease gun and No. 2 general purpose grease to lubricate the eight grease fittings.

IMPORTANT: Before washing the machine, shut off the engine and remove the key. Toro recommends daily lubrication of reels and rollers immediately after washing the machine. This helps to minimize water entering the reel and roller bearings. If the cutting units are washed in the raised position be sure to lower them to the ground after washing. This allows water to drain from the ends of the rollers and reel bearing housings.

1. Wipe each grease fitting with a clean rag before greasing.

IMPORTANT: Applying too much pressure will ruin the seals and leaking grease could cause damage to grass.

2. Lubricate reel shaft and roller bearings daily with 3 or 4 pumps of grease. Daily lubrication of these fittings purges water and other contaminants, increasing service life and maintaining excellent quality-of-cut (Fig 31).

3. Lubricate floatation kit pivots (Fig. 32) and Fixed head pivots (Fig. 33) weekly with one pump of grease.

4. Wipe excess grease from the fittings.

Note: When greasing roller bearings—grease forced from bearings will not be visible around the roller shaft.

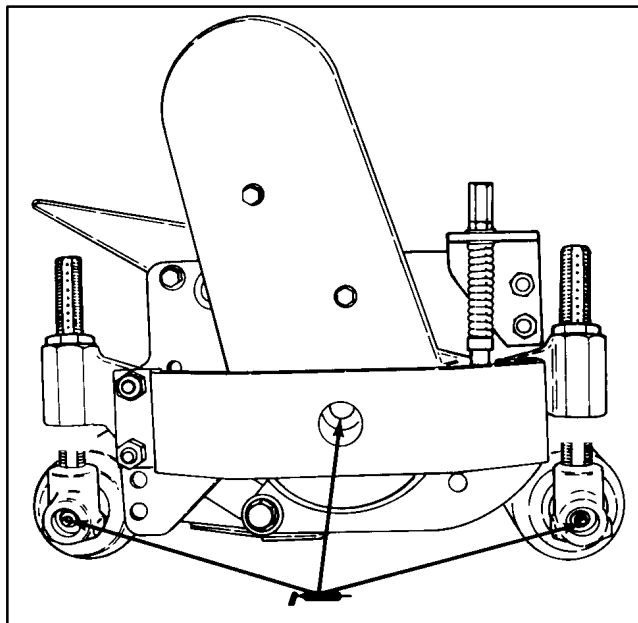


Figure 31

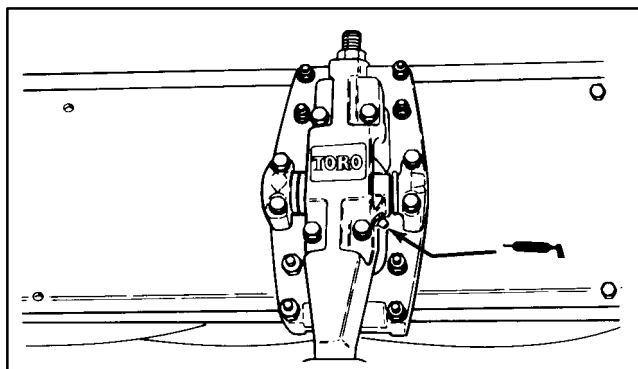


Figure 32

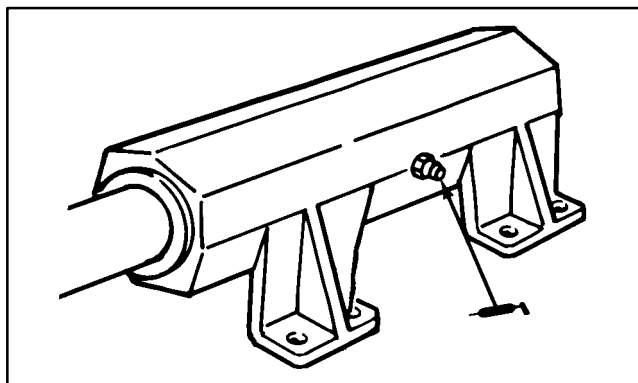


Figure 33



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