



## Service Manual

# Reelmaster<sup>®</sup> 2300-D/2600-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 2300-D/2600-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  
Minneapolis, MN 55420

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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Perkins 100 Series Workshop Manual	

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Safety

Product Records  
and Manuals

Engine

Hydraulic  
System

Electrical  
System

Wheels and  
Brakes

Cutting Units

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## Safety Instructions

The REELMASTER 2300–D/2600–D conforms to the American National Standards Institute’s (ANSI) safety standards for riding mowers when equipped with rear ballast (see Operator’s Manual). Although hazard control and accident prevention are partially 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

Improper use or maintenance by the operator or owner of the machine can result in injury. Reduce the potential for any injury by complying with the following safety instructions.

Use the Model and Serial Number when referring to your machine. If you have questions about this Service Manual, please contact:



**WARNING**

**The engine exhaust contains carbon monoxide, which is an odorless and deadly poison. Carbon monoxide is also known to the state of California to cause birth defects. Do not run engine indoors or in an enclosed area.**

The Toro Company  
 Commercial Service Department  
 8111 Lyndale Avenue South  
 Minneapolis, Minnesota 55420–1196

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, Minnesota 55420–1196

2. Only trained operators, skilled in slope operation and who have read the Operator’s Manual, should operate the machine. Never allow children to operate the machine or adults to operate it without proper instructions.

3. **IMPORTANT:** Always use proper rear ballast as specified in the operator’s manual (see Rear Ballast of the Operator’s Manual).

4. Become familiar with the controls and know how to stop the machine and engine quickly.

5. Do not carry passengers on the machine. Keep everyone, especially children and pets, away from the areas of operation.
6. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is damaged, malfunctioning or illegible, repair or replace it before operating the machine.
7. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing because it could get caught in moving parts and possibly cause personal injury.
8. Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local ordinances and insurance regulations.
9. Make sure the work area is clear of objects which might be picked up and thrown by the reels.
10. Fill the fuel tank with diesel fuel before starting the engine. Avoid spilling any fuel. Since fuel is highly flammable, handle it carefully.
  - A. Use an approved fuel container.
  - B. Do not remove the cap from the fuel tank when engine is hot or running.
  - C. Do not smoke while handling diesel fuel.
  - D. Fill fuel tank outdoors and not over one inch from the top of the tank, (bottom of the filler neck). Do not overfill.

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## While Operating

11. Do not run the engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could be deadly.
12. Sit on the seat when starting and operating the machine.
13. Check interlock switches daily for proper operation (see Checking Interlock Switches of the Operator's Manual). Do not rely entirely on safety switches; shut off engine before getting off the seat. 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.
14. When starting the engine:
  - A. Engage parking brake.
  - B. Be sure traction pedal is in neutral and reel drive is in the disengage position.
  - C. After the engine starts, release parking brake and keep foot off the traction pedal. The machine must not move. If movement is evident, the neutral control linkage is incorrectly adjusted: therefore, shut engine off and adjust until the machine does not move when the traction pedal is released (see Adjusting Transmission for Neutral of the Operator's Manual).
  - D. Hills over 15 degrees should be mowed up and down, not side to side (see Slope Gauge of the Operator's Manual).
  - E. Mowing hills may be dangerous. Hills over 20 degrees should not be mowed (see Slope Gauge of the Operator's Manual).
  - F. Stay alert for holes in terrain and other hidden hazards. Use extreme care when operating close to sand traps, ditches, creeks, steep hillsides or other hazards.
  - G. Reduce speed when making sharp turns. Avoid sudden stops and starts. Use reverse pedal for braking. The cutting units must be lowered when going down slopes for steering control.
  - H. Before backing up, look to the rear and assure that no one is behind the machine. Watch out for traffic when near or crossing roads. Always yield the right of way.
15. Keep hands, feet, and clothing away from moving parts and the reel discharge area. Grass baskets, if so equipped, must be in place during reel operation for maximum safety.
16. 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.
17. Raise the cutting units when driving from one work area to another.
18. Do not touch engine, muffler, exhaust pipe, or hydraulic tank while engine is running or soon after it has stopped. These areas could be hot enough to cause burns.
19. If a cutting unit strikes a solid object or vibrates abnormally, stop cutting unit immediately. Turn the engine off, wait for all motion to stop and inspect for damage. A damaged reel or bedknife must be repaired or replaced before operation is continued.

20. Before getting off the seat:

- A. Move the traction pedal to neutral.
- B. Set the parking brake.
- C. Disengage the cutting units and wait for the reels to stop spinning.

D. Stop the engine and remove the key from the ignition switch.

21. Whenever the machine is left unattended, make sure the reels are not spinning, the key is removed from ignition switch, and the parking brake is set.

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## Maintenance and Service

22. Before servicing or making adjustments to the machine, stop the engine and remove the key from the switch to prevent accidental starting of the engine.

23. When changing attachments, tires or performing other service, use the correct blocks, hoists and jacks. Always chock or block the wheels and use jack stands or solid wood blocks to support the raised machine. If the traction unit is not properly supported by blocks or jack stands, the unit may move or fall resulting in personal injury.

24. Check performance of all interlock switches daily. Do not defeat interlock system. It is for your protection.

25. Ensure the entire machine is in good operating condition. Frequently check and keep all nuts, bolts, screws, and hydraulic fittings tight.

26. Before applying pressure to the hydraulic system, make sure all hydraulic line connectors are tight and all hydraulic hoses and lines are in good condition .

27. 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 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 form of injury or gangrene may result.

28. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping the engine and lowering cutting units to the ground.

29. If major repairs are ever needed or if assistance is desired, contact an Authorized Toro Distributor.

30. Reduce potential fire hazards. Keep the engine area free of excessive grease, grass, leaves, and accumulation of dirt.

31. If the engine must be running to perform a maintenance adjustment, keep hands, feet, clothing, and any other parts of the body away from the cutting units and any moving parts. Keep everyone away.

32. Do not overspeed the engine by changing governor settings. To assure safety and accuracy, have an Authorized Toro Distributor check maximum engine speed with a tachometer.

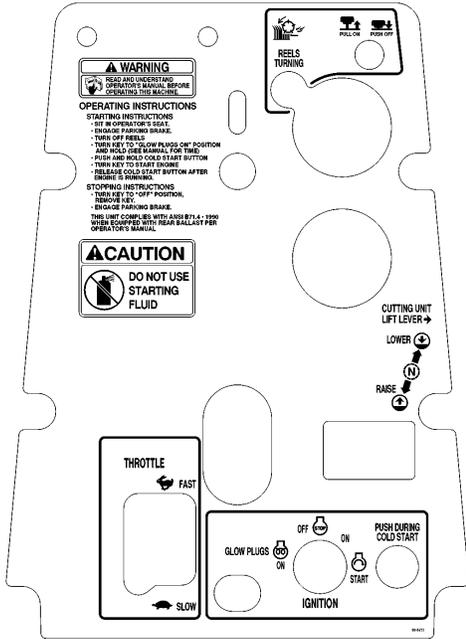
33. The engine must be shut off before checking oil or adding oil to the crankcase.

34. To insure optimum performance and safety, use genuine TORO replacement parts and accessories. Replacement parts and accessories made by other manufacturers could be dangerous, and such use could void the product warranty of The Toro Company.

# Safety and Instruction Decals

The following safety and instruction decals are affixed to the traction unit. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed

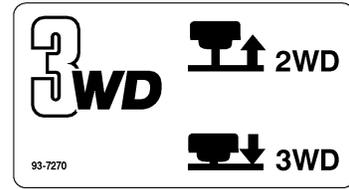
below and in your Parts Catalog. Order replacements from your Authorized Toro Distributor.



**ON INSTRUMENT PANEL**  
(Part No. 94-4985)

CHARGING 20 A
ACCESSORIES 10 A
ENGINE 10 A
OPEN
FUSES

**UNDER CONTROL PANEL**  
(Part No. 93-6902)



**ON LEFT SIDE OF SEAT PANEL**  
(Part No. 92-7270)  
Model 03427 only

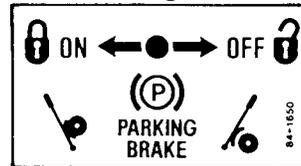
**ON CARRIER FRAME**  
(Part No. 94-3353)

**WARNING! Pinch Point between Carrier Frame and Cutting Unit**



**ON FAN SHROUD**  
(Part No. 77-3100)

**Rotating Parts**

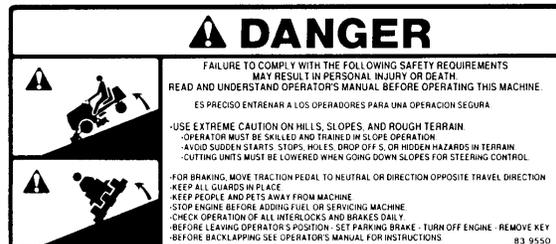


**ON LEFT FENDER**  
(Part No. 84-1650)



**ON LIFT ARMS**  
(Part No. 93-6696)

**WARNING! Spring Loaded Mechanism, Read Disassembly Procedure**



**ON SKIRT PANEL**  
(Part No. 83-9550)

**QUICK REFERENCE AID CHECK/SERVICE**

- ENGINE OIL LEVEL
- ENGINE OIL DRAIN (17mm socket)
- HYDRAULIC OIL LEVEL - center of sight glass
- BELTS (Fan/Water Pump, Hydraulic Pump)
- COOLANT LEVEL FILL
- FUEL - Diesel Only
- GREASE POINTS (11 - 3WD, 12-2WD) ●
- RADIATOR SCREEN
- AIR CLEANER
- WATER SEPARATOR/FUEL FILTER
- BATTERY
- TIRE PRESSURE: 12-16 psi (8 - 1.1 bar)
- FUSES

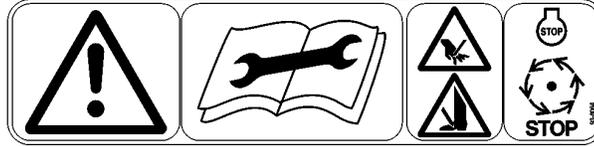
SEE OPERATOR'S MANUAL FOR INITIAL CHARGES	FLUID TYPE	CAPACITY	CHANGE INTERVAL	FILTER PART NO.	
ENGINE OIL	SAE10W-30CD	2.8 L	50 HRS	100 HRS	85-4830 (A)
HYD. CIRCUIT OIL	MOBILFLUID 424	12.5 L	400 HRS	200 HRS	54-0110 (B)
FUEL FILTER	Inspect daily for contaminants & water		200 HRS	200 HRS	93-2195 (C)
AIR CLEANER	Clean every 90 hours		200 HRS	200 HRS	93-2195 (D)
FUEL	NO. 2-Diesel	2XLS	2XLS	2XLS	
COOLANT	50-50 Ethylene glycol/water	4.7 L	5	5	Drain and flush, 2 yrs.

**ON UNDER SEAT**  
(Part No. 93-6903)



**ON INSIDE OF FRONT RIGHT PANEL**  
(Part No. 67-5360)

**DANGER! Rotating Reel Will Cut Hands and Feet.  
See Adjustment Procedures**



**ON SHIELD  
(Part No. 93-8064)**





# Product Records and Manuals

Product Records  
and Manuals

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## Product Records

Record information about your Reelmaster 2300–D/2600–D on the OPERATION AND SERVICE HISTORY REPORT form. Use this information when referring to your machine.

Insert Operator’s Manuals and Parts Catalogs for your Reelmaster 2300–D/2600–D at the end of this section.

# Equivalents and Conversions

## Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
	1/64	0.015625	—	0.397	
1/32	—	0.03125	—	0.794	
	3/64	0.046875	—	1.191	
1/16	—	0.0625	—	1.588	
	5/64	0.078125	—	1.984	
	3/32	0.9375	—	2.381	
	7/64	0.109275	—	2.778	
1/8	—	0.1250	—	3.175	
	9/64	0.140625	—	3.572	
	5/32	0.15625	—	3.969	
	11/64	0.171875	—	4.366	
3/16	—	0.1875	—	4.762	
	13/64	0.203125	—	5.159	
	7/32	0.21875	—	5.556	
	15/64	0.234375	—	5.953	
1/4	—	0.2500	—	6.350	
	17/64	0.265625	—	6.747	
	9/32	0.28125	—	7.144	
	19/64	0.296875	—	7.541	
5/16	—	0.3125	—	7.938	
	21/64	0.328125	—	8.334	
	11/32	0.34375	—	8.731	
	23/64	0.359375	—	9.128	
3/8	—	0.3750	—	9.525	
	25/64	0.390625	—	9.922	
	13/32	0.40625	—	10.319	
	27/64	0.421875	—	10.716	
7/16	—	0.4375	—	11.112	
	29/64	0.453125	—	11.509	
	15/32	0.46875	—	11.906	
	31/64	0.484375	—	12.303	
1/2	—	0.5000	—	12.700	
	<b>1 mm = 0.03937 in.</b>			<b>0.001 in. = 0.0254 mm</b>	

## U.S to Metric Conversions

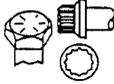
	To Convert	Into	Multiply By
<b>Linear Measurement</b>	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
<b>Area</b>	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square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

# Torque Specifications

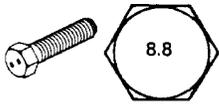
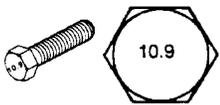
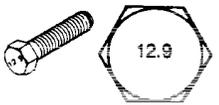
Use these torque values when specific torque values are not given. DO NOT use these values in place of

specified values. Torque values listed are for lubricated threads. Plated threads are considered to be lubricated.

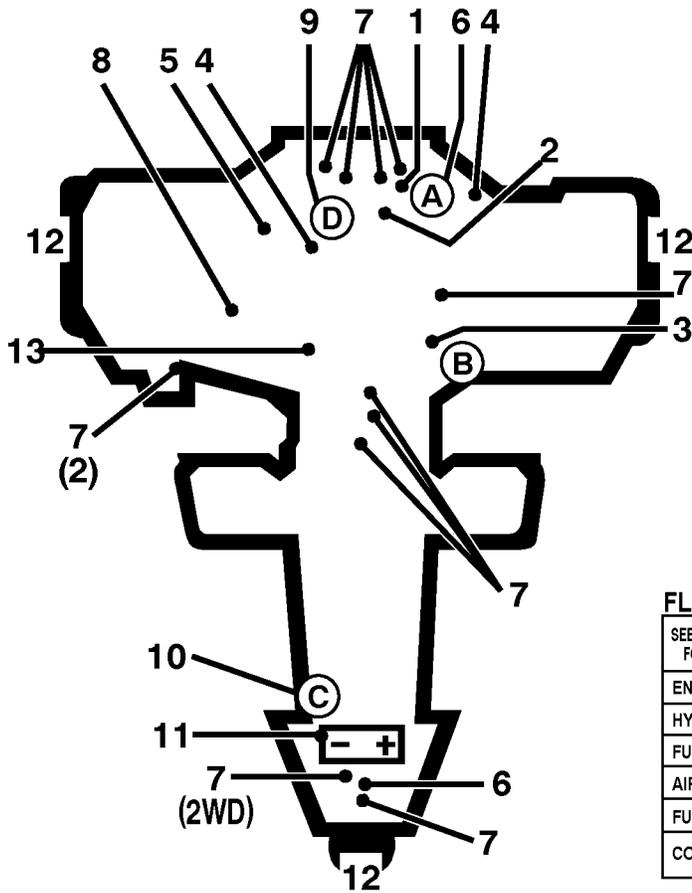
## Capscrew Markings and Torque Values - U.S. Customary

SAE Grade Number	5				8			
Capscrew Head Markings								
Capscrew Body Size	Capscrew Torque - Grade 5				Capscrew Torque - Grade 8			
	Cast Iron		Aluminum		Cast Iron		Aluminum	
	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
1/4-20 -28	7 9	9 12	6 7	8 9	11 13	15 18	9 10	12 14
5/16-18 -24	15 17	20 23	12 14	16 19	22 24	30 33	18 19	24 25
3/8-16 -24	30 30	40 40	20 25	25 35	40 45	55 60	30 35	40 45
7/16-14 -20	45 50	60 65	35 40	45 55	65 70	90 95	50 55	65 75
1/2-13 -20	70 75	95 100	55 60	75 80	95 110	130 150	75 90	100 120
9/16-12 -18	100 110	135 150	80 85	110 115	140 155	190 210	110 125	150 170
5/8-11 -18	135 155	180 210	110 120	150 160	190 215	255 290	150 170	205 230
3/4-10 -16	240 270	325 365	190 210	255 285	340 380	460 515	270 300	365 410
7/8-9 -14	360 390	490 530	280 310	380 420	550 610	745 825	440 490	600 660
1-8 -14	530 590	720 800	420 480	570 650	820 890	1100 1200	660 710	890 960

## Capscrew Markings and Torque Values – Metric

Commercial Steel Class	8.8				10.9				12.9			
Capscrew Head Markings												
Thread Diameter mm	Capscrew Torque - Class 8.8				Capscrew Torque - Class 10.9				Capscrew Torque - Class 12.9			
	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
6	5	9	4	7	9	14	7	11	9	14	7	11
7	9	14	7	11	14	18	11	14	18	23	14	18
8	18	25	14	18	23	32	18	25	27	36	21	28
10	30	40	25	30	45	60	35	45	50	70	40	55
12	55	70	40	55	75	105	60	80	95	125	75	100
14	85	115	65	90	120	160	95	125	145	195	110	150
16	130	180	100	140	175	240	135	190	210	290	165	220
18	170	230	135	180	240	320	185	250	290	400	230	310

# Maintenance Interval Chart



## QUICK REFERENCE AID

### CHECK/SERVICE

1. ENGINE OIL LEVEL
2. ENGINE OIL DRAIN (17mm socket)
3. HYDRAULIC OIL LEVEL - center of sight glass
4. BELTS (Fan/Water Pump, Hydraulic Pump)
5. COOLANT LEVEL FILL
6. FUEL - Diesel Only
7. GREASE POINTS (11 - 3WD, 12 - 2WD) ●
8. RADIATOR SCREEN
9. AIR CLEANER
10. WATER SEPARATOR/FUEL FILTER
11. BATTERY
12. TIRE PRESSURE:  
12-16 psi (.8 - 1.1 bar)
13. FUSES

### FLUID SPECIFICATIONS/CHANGE INTERVALS

SEE OPERATOR'S MANUAL FOR INITIAL CHANGES.	FLUID TYPE	CAPACITY		CHANGE INTERVAL		FILTER PART NO.
		L	QT	FLUID	FILTER	
ENGINE OIL <sup>-10°C to 40°C</sup> <sub>14°F to 104°F</sub>	SAE10W-30CD	2.8	3.0	50 HRS	100 HRS	85-4930 (A)
HYD. CIRCUIT OIL	MOBILFLUID 424	12.5	13	400 HRS	200 HRS	54-0110 (B)
FUEL FILTER	Inspect daily for contaminants & water			200 HRS		Perkins 130366040 (C)
AIR CLEANER	Clean every 50 hours.			200 HRS		93-2195 (D)
FUEL	NO. 2-Diesel	24.5	<sup>6.5</sup> GAL.	Drain and flush, 2 yrs.		
COOLANT	50-50 Ethylene glycol water	4.7	5			

93-6903



EQUIPMENT OPERATION AND SERVICE HISTORY REPORT  
for  
REELMASTER® 2300-D/2600-D

TORO Model and Serial Number: \_\_\_\_\_ - \_\_\_\_\_

Engine Numbers: \_\_\_\_\_

Transmission Numbers: \_\_\_\_\_

Date Purchased: \_\_\_\_\_

Warranty Expires \_\_\_\_\_

Purchased From: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Contacts:            Parts            \_\_\_\_\_

Phone \_\_\_\_\_

Service            \_\_\_\_\_

Phone \_\_\_\_\_

Sales            \_\_\_\_\_

Phone \_\_\_\_\_

*See your TORO Distributor for other Publications, Manuals, and Videos from the TORO company.*

# REELMASTER® 2300-D/2600-D Maintenance Schedule

## Minimum Recommended Maintenance Intervals:

Maintenance Procedure	Maintenance Interval & Service			
Inspect Air Filter, Dust Cup, and Baffle	Every 50hrs	Every 100hrs	Every 200hrs	Every 400hrs
Lubricate All Grease Fittings				
† Change Engine Oil				
† Check Fan and Alternator Belt Tensions	<i>A-Level Service</i>			
† Change Engine Oil and Filter		<i>B-Level Service</i>		
† Check Traction Belt Tension		<i>B-Level Service</i>		
Service Air Filter				
Replace Fuel Filter/Water Separator				
† Replace Hydraulic Filter			<i>C-Level Service</i>	
† Torque Wheel Lug Nuts			<i>C-Level Service</i>	
Replace Hydraulic Fluid				
Check Battery Level/Connections				
Inspect Traction Linkage Movement				
* Inspect Spider Coupling for Wear				<i>D-Level Service</i>
‡ Torque Head Bolts and Adjust Valves				<i>D-Level Service</i>
‡ Check Engine RPM (idle and full throttle)				<i>D-Level Service</i>
† Initial break in at 10 hours				
* Every 400 hours or annually, whichever occurs first				
‡ Initial break in at 50 hours				
Replace all Moving Hoses				
Replace Safety Switches				
Cooling System – Flush/Replace Fluid				
Replace Thermostat				
Fuel Tank – Drain/Flush				
Hydraulic Tank – Drain/Flush				
			<b>Annual Recommendations:</b>	
			<i>Items listed are recommended every 1000 hours or 2 years, whichever occurs first.</i>	

(See Operator's and Service Manuals for specifications and procedures.)

# REELMASTER® 2300-D/2600-D Daily Maintenance Check List

Daily Maintenance: (duplicate this page for routine use)

Unit Designation: \_\_\_\_\_

TORO ID #: \_\_\_\_\_-\_\_\_\_\_

Maintenance Check Item ▼	Daily Maintenance Check For Week Of _____						
	MON	TUES	WED	THURS	FRI	SAT	SUN
	_____HRS	_____HRS	_____HRS	_____HRS	_____HRS	_____HRS	_____HRS
✓ Safety Interlock Operation							
✓ Brake Operation							
✓ Engine Oil Level <sup>1</sup>							
✓ Cooling System Fluid Level <sup>1</sup>							
Drain Water/Fuel Separator							
✓ Air Filter, Dust Cup, and Baffle							
✓ Radiator & Screen for Debris							
✓ Unusual Engine Noises <sup>2</sup>							
✓ Unusual Operating Noises							
✓ Hydraulic System Oil Level <sup>1</sup>							
✓ Hydraulic Hoses for Damage							
✓ Fluid Leaks							
✓ Fuel Level <sup>1</sup>							
✓ Tire Pressure							
✓ Instrument Operation							
✓ Reel-to-Bedknife Adjustment							
✓ Height-of-Cut Adjustment							
Lubricate All Grease Fittings <sup>3</sup>							
Touch-up Damaged Paint							

<sup>1</sup>= Check proper section of Operator's Manual for fluid specifications.

<sup>2</sup>= Check glow plug and injector nozzles, if hard starting, excess smoke or rough running is noted.

<sup>3</sup>= Accomplish immediately after every washing, regardless of the interval listed.

**Notation for areas of concern:**

Inspection performed by: \_\_\_\_\_

Item	Date	Information
1		
2		
3		
4		
5		
6		
7		

(See Operator's and Service Manuals for specifications and procedures.)

# REELMASTER® 2300-D/2600-D Supervisor Maintenance Work Order

Date: \_\_\_\_\_

(Duplicate this page for routine use.)

Unit Designation:	TORO I.D. #: _____
Hours:	Service to perform (circle): <b>A B C D Other</b>
Technician:	

Remarks:

**A – Service (every 50 hours)**

- Inspect Air Filter, Dust Cup, and Baffle
- Lubricate All Grease Fittings
- Change Engine Oil
- Check Fan and Alternator Belt Tension
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**B – Service (every 100 hours)**

- Change Engine Oil Filter
- Check Traction Belt Tension
- A – Service required**
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**C – Service (every 200 hours)**

- Service Air Filter
- Replace Fuel Filter/Water Separator
- Replace Hydraulic Filter
- Torque Wheel Lug Nuts
- A and B – Service required**
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**D – Service (every 400 hours)**

- Replace Hydraulic Fluid
- Check Battery Level/Connections
- Inspect Traction Linkage Movement
- Inspect Spider Coupling for Wear
- Torque Head Bolts and Adjust Valves
- Check Engine RPM (Idle & Full Throttle)
- A, B, and C – Service required**
- \_\_\_\_\_
- \_\_\_\_\_

**Other – Annual Service and Specials**

- Replace Moving Hoses
- Replace Safety Switches (Every 2 yrs)
- Coolant System – Flush/Replace Fluid
- Replace Thermostat
- Fuel Tank – Drain/Flush
- Hydraulic Tank – Drain/Flush
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**Additional Service Items**

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



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Engine

# Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the diesel engine used in the Reelmaster 2300–D/2600–D mower.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Special Tools section. The use of some specialized test equipment is explained. How-

ever, 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 Perkins engines are supplied through your local Perkins/Detroit Diesel dealer. If no parts list is available, be sure to provide your dealer or distributor with the Perkins model and serial number.

# Specifications

Item	Description
Make / Designation	Perkins, vertical in-line, 4-stroke, water-cooled Diesel, 103-07 KL 70275 & KL 70372
Combustion Chamber	IDI special swirl-combustion type
Number of Cylinders	3
Bore x Stroke mm (in.)	67 x 64 (2.64 x 2.52)
Total Displacement cc (cu. in.)	676 (41.23)
Compression Ratio	24:1
Firing Order	1- 2-3
Dry Weight (approximate) kg (lb.)	64 (141)
Fuel	Grade No. 2D diesel fuel (ASTM specification)
Fuel Injection Pump	Bosch type plunger
Governor	Mechanical
Idle Speed (no load)	1400 ± 50 RPM
High Idle (no load)	3200 ± 50 RPM
Fuel Injector Nozzle	Bosch throttle type
Fuel Injection Working Pressure kg/cm <sup>2</sup> (psi)	115 to 125 (1636 to 1778)
Injection Timing	28.5 to 30.5° B.T.D.C.
Engine Oil	SAE 10W30 SF, CD
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity liter (U.S. qt.)	2.8 (3.0) with filter
Water Pump	Belt driven centrifugal type
Cooling System Capacity liter (U.S. qt.)	4.7 (5.0)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 14 AMP
Glow Plug	Sheathed type

# Special Tools

Order special tools from *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (Commercial Products)*.

Some tools may be listed in the Reelmaster 2300–D/2600–D Parts Catalog. Tools may also be available from a local supplier.

---

## Filter Cleaner

Mix with water and use solution to wash the Donaldson air cleaner element.



Figure 1

---

## Diesel Engine Compression Test Kit

This 0 to 1000 PSI gauge allows testing of diesel engines for checking the general operating condition of the engine. The kit includes a case, gauge with hose, glow plug hole adapters, and instructions.

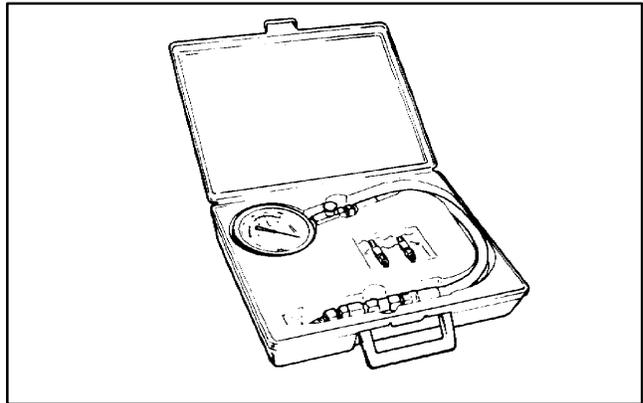


Figure 2

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## Nozzle Tester

This tests the condition and opening pressure of fuel injection nozzles.

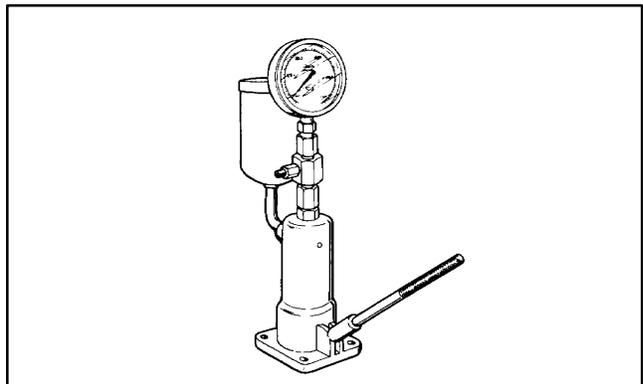


Figure 3

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## Nozzle Test Adapter

This adapter is required to test the fuel injection nozzles.

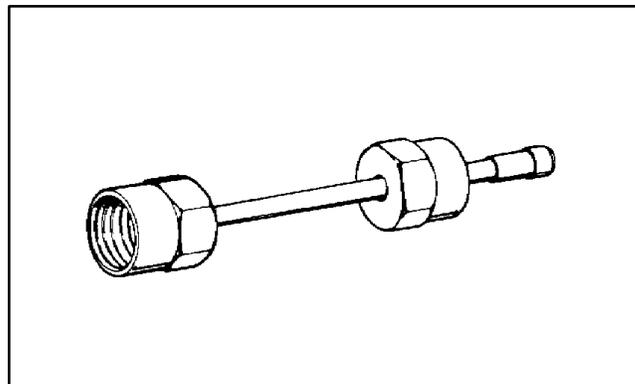


Figure 4

# General Information

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## Fuel Shutoff Valves

These valves should be shut when removing the engine or placing the unit in long term storage.

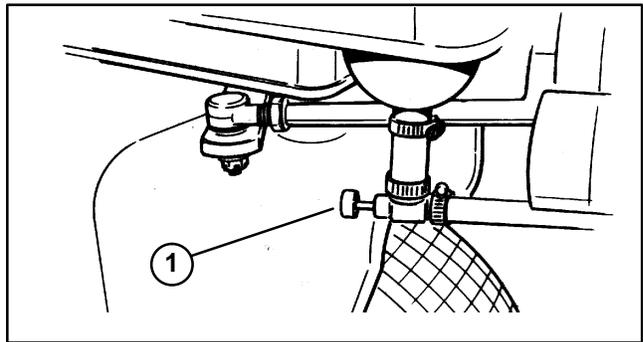


Figure 5

1. Fuel shut off (under the fuel tank)

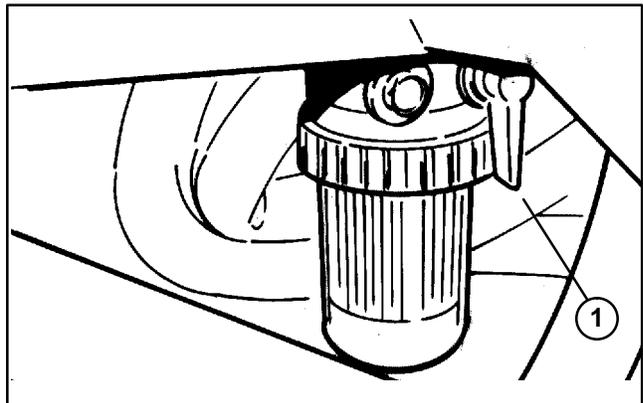


Figure 6

1. Fuel shut off valve (on the fuel filter)

# Adjustments

## Alternator Belt

- Gain access to the alternator belt (Fig 7).
  - Loosen top hose clamp securing the upper portion of the hose connected to the air cleaner (8).
  - Remove cap screws (1) and lock flange nuts (2). Remove hex head screws (3).
  - On European models, remove hex head screws (4) from the guard (5) and air cleaner housing (6).
  - Pull air cleaner housing from the radiator top shroud (7) and hose. Plug air cleaner hose and hose inlet to the air cleaner.
- Loosen bolts securing alternator to the engine and adjusting strap.
- Adjust alternator belt to the proper tension. Tension alternator belt so it deflects 0.20 inch with a 2 to 3 pound load applied midway between the crankshaft and alternator pulleys (Fig. 8).
- Tighten bolts securing the alternator to the engine.
- Reinstall air cleaner housing (Fig 7).

- Unplug air cleaner hose and hose inlet to the air cleaner.
- Place air cleaner housing (6) on the radiator top shroud (7). Reconnect upper end of the air cleaner hose to the air cleaner (8). Align holes to receive fasteners.
- On European models, reinstall hex head screws (4) into guard (5) through the air cleaner housing (6).
- Secure cap screws (1) and lock flange nuts (2) to air cleaner housing and radiator top shroud (7).
- Secure hex head screws (3) into the air cleaner housing and radiator assembly.
- Tighten hose clamp securing the hose to the air cleaner.

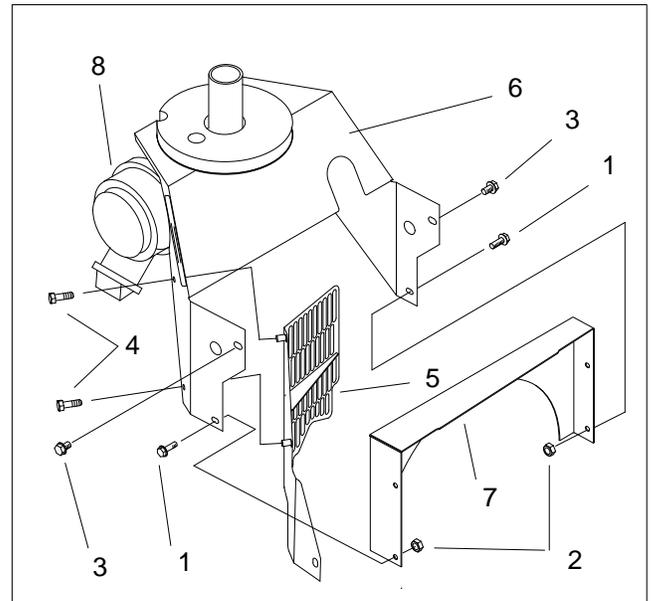


Figure 7

- |                    |                        |
|--------------------|------------------------|
| 1. Cap screw       | 5. Guard (Europe)      |
| 2. Lock flange nut | 6. Air cleaner housing |
| 3. Hex head screw  | 7. Radiator top shroud |
| 4. Hex head screw  | 8. Air cleaner         |

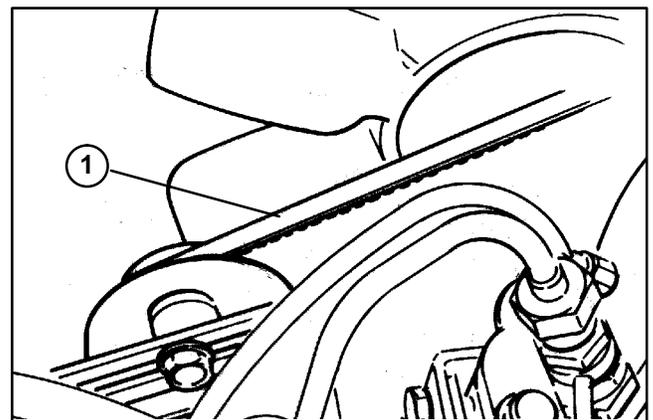


Figure 8

1. Engine belt

## Throttle Linkage

1. Verify high engine speed at  $3200 \pm 50$  RPM with the cold start button depressed.
2. If engine speed is out of specification, loosen cap screw, nut, and throttle cable clamp on the throttle cable bracket enough to allow the cable to slide freely within the bracket.
3. Move throttle lever up fully to the high speed position.
4. Pull cable toward flywheel end of the engine until the governor lever on the engine is up against the high speed adjustment screw. Tighten cap screw and nut securing the throttle cable clamp.
5. Loosen capscrews (1) and nuts (2) securing the throttle stop (3).
6. With the cold start button depressed, carefully adjust low engine speed to  $1400 \pm 50$  RPM with the throttle control lever (4); **adjust low speed stop screw if necessary.**
7. Make sure throttle control lever (4) is down so the governor lever on the engine touches the low speed adjustment screw.
8. Adjust throttle stop (3) until it contacts the bottom of the throttle control lever (4). Tighten cap screws (1) and nuts (2) securing the throttle stop.
9. Make sure governor lever on the engine goes against the high speed adjustment screw when the throttle control lever (4) is moved to the high speed position. When the throttle control lever is moved to the low speed position, the governor lever on the engine should contact the low speed adjustment screw at the same time the throttle control lever contacts the throttle stop (3).

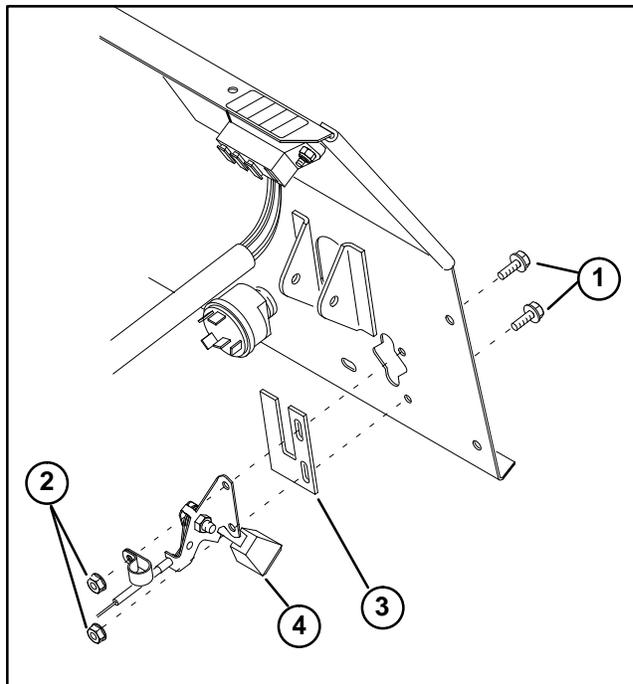


Figure 9

1. Cap screw  
2. Nut

3. Throttle stop  
4. Throttle control leve

# Service and Repairs

## Bleeding the Fuel System

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

1. Park machine on a level surface. Make sure fuel tank is at least half full.
2. Unlatch and raise hood.



### DANGER

Because diesel fuel is flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill the fuel tank while the engine is hot, running, or when the in an enclosed area. Always fill the fuel tank outside. Wipe up any spilled diesel fuel before starting the engine. Store fuel in a clean safety-approved container with its cap on. Use diesel fuel for the engine only and no other purpose.

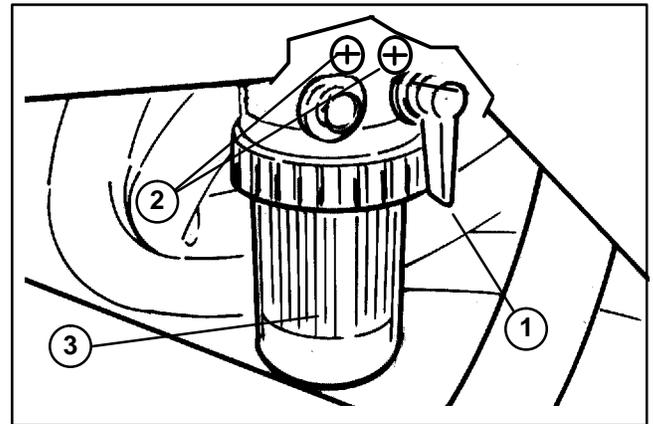


Figure 10

1. Fuel shutoff valve
2. Bleed screws
3. Bowl

3. Open fuel shutoff valve (1) located under the fuel tank and on the fuel filter (Fig. 10).

4. Open both bleed screws (2) located on the side of the fuel filter mounting head. Allow bowl (3) to refill with fuel. Close bleed screws when the bowl is filled (Fig. 10).

5. On the front of the engine by the oil filter, find transfer pump inlet screw location (2). Note fitting angle (5) on the transfer pump inlet and loosen left transfer pump screw (1) only (Fig. 11).

6. When a steady stream of fuel flows out of the transfer pump screw (1), tighten screw and retain noted fitting angle (5) from step 5 above (Fig. 11).

7. Loosen injection pump inlet screw (3) on the front of the engine (Fig. 11).

8. Pump priming lever (4) until a steady stream of fuel flows out of injection pump inlet screw (3), then tighten screw. **Do not over tighten inlet screw** (Fig. 11).

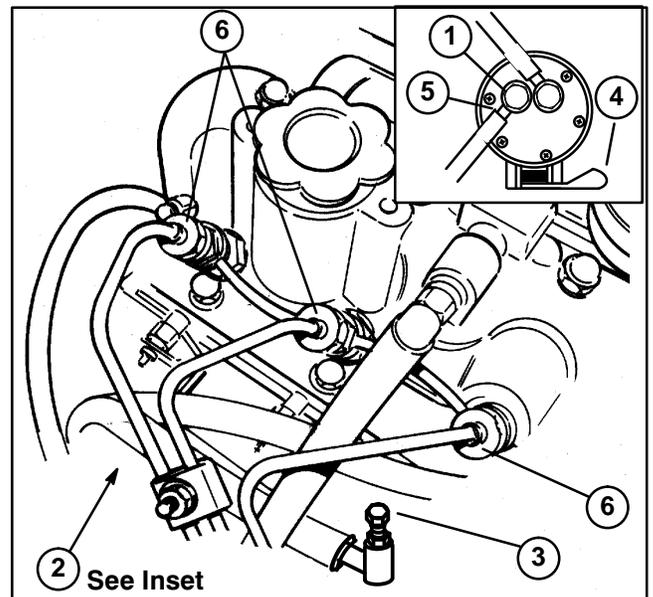


Figure 11

1. Transfer pump screw
2. Transfer pump inlet screw location
3. Injection pump inlet screw
4. Priming lever
5. Note fitting angle
6. Injector nut

9. Start engine. If engine does not run smoothly after several minutes, crack open each injector nut (6) until fuel (with no bubbles) comes out. Torque each injector nut from 14.4 to 18.0 ft-lb (2.0 to 2.5 kg-m).

## Air Cleaner

1. Service the air cleaner filter every 400 hours (more frequently in extreme dusty or dirty conditions). Do not over service air filter.
2. Check air cleaner body (1) for damage which could possibly cause an air leak. Replace damaged air cleaner body.
3. Make sure air cleaner cover (2) is sealing around the air cleaner body (1).
4. Release latches (3) securing the air cleaner cover (2) to the air cleaner body (1). Separate cover from body. Clean inside of air cleaner cover.
5. Gently slide filter element (4) out of the air cleaner body (1) to reduce the amount of dust dislodged. Avoid knocking filter element against air cleaner body.
6. Inspect filter element (4) and discard if damaged. Do not wash or reuse a damaged filter.

### Washing Method

- A. Prepare a solution of filter cleaner and water. Soak filter element (4) in the solution for 15 minutes. Refer to directions on filter cleaner carton for complete information.
- B. After soaking filter element (4) 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 element from the clean side to the dirty side.
- C. Dry filter element (4) using warm flowing air (160°F maximum), or allow element to air-dry. Do not use a light bulb to dry the filter element because damage could result.

### Compressed Air Method



#### CAUTION

Use eye protection such as goggles when using compressed air.

- A. Blow compressed air from the inside to the outside of the dry filter element (4). Do not exceed 100 psi to prevent damage to the filter element.

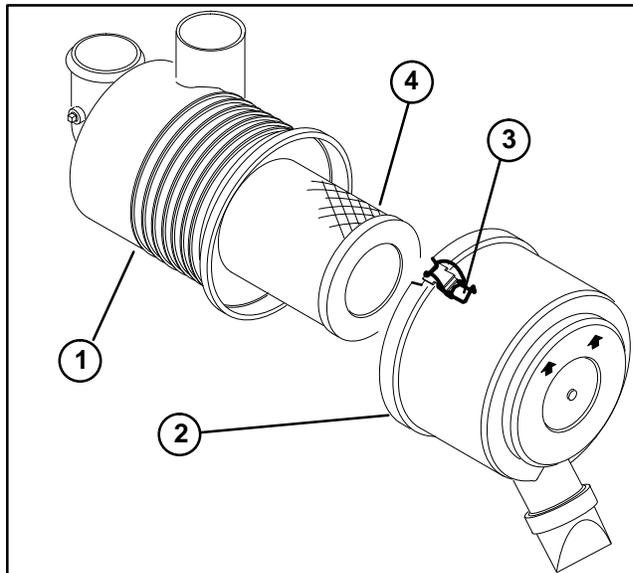


Figure 12

- |                      |                   |
|----------------------|-------------------|
| 1. Air cleaner body  | 3. Latch          |
| 2. Air cleaner cover | 4. Filter element |

- B. Keep air hose nozzle at least 2 inches from the filter element (4). Move nozzle up and down while rotating the filter element. Inspect for holes and tears by looking through the filter element toward a bright light.
7. Inspect new filter element (4) for shipping damage. Check sealing end of new or used filter element. Do not install a damaged filter element.
  8. Insert filter element (4) properly into the air cleaner body (1). Make sure filter element is sealed properly by applying pressure to the outer rim of the filter element when installing. Do not press on the flexible center of the filter element.
  9. Reinstall air cleaner cover (2) and secure latches (3). Make sure cover is positioned with top side up.

## Cleaning the Radiator and Screen

To prevent the engine from overheating, the radiator screen, radiator, and oil cooler must be kept clean. Check these components daily. If necessary, clean any debris off these parts. Clean these components more frequently in dusty dirty conditions.

1. Remove radiator screen (1).
2. Remove four cap screws and nuts that hold the plastic cover to the radiator assembly. Remove plastic cover from the radiator assembly.
3. Loosen both quick release knobs on the front end of the radiator assembly. Now the oil cooler (3) can be removed from the radiator for cleaning.

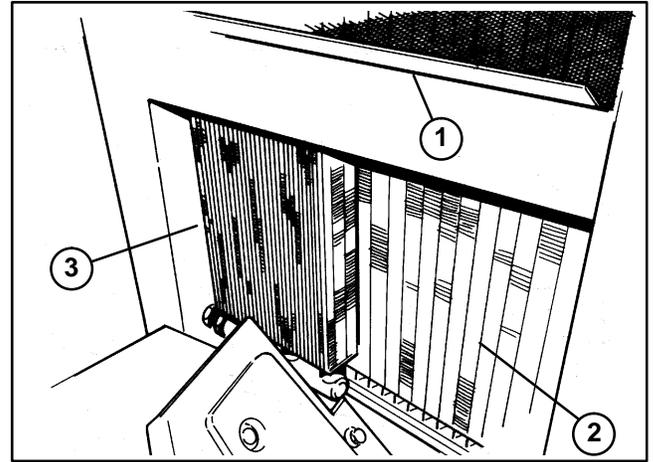


Figure 13

- |                    |               |
|--------------------|---------------|
| 1. Radiator screen | 3. Oil cooler |
| 2. Radiator        |               |



### CAUTION

Use eye protection such as goggles when using compressed air.

4. Working from fan side of radiator (2), either spray the radiator with a hose or blow with compressed air.
5. Thoroughly clean oil cooler (3). Clean off any other debris that may have collected around components.
6. Reinstall the oil cooler (3). Tighten both quick release knobs on the front end of the radiator assembly.
7. Reinstall plastic cover onto the radiator assembly. Reinstall four cap screws and nuts that hold the plastic cover to the radiator assembly. Tighten fasteners
8. Clean radiator screen (1) and reinstall.

## Changing the Engine Oil and Filter

Change oil and filter initially after the first 20 hours of operation. Thereafter, change oil every 50 hours and filter every 100 hours.

1. Position machine on a level surface.
2. Locate engine oil drain plug on the bottom of oil pan and place a collecting pan below it. Remove drain plug and let oil flow into the collecting pan. When the oil stops draining, install drain plug.
3. Locate engine filter on the front of the engine. Remove oil filter. Apply a light coat of clean oil to the new filter seal before screwing it on. **DO NOT OVERTIGHTEN.**

**Note:** The crankcase capacity is approximately 2.8 qts. (3.0 L) with filter. The engine uses any high-quality 10W30 detergent oil having the American Petroleum Institute – API – “service classification” CD.

4. Add oil to the crankcase.
  - A. Remove oil fill cap (Fig. 14) and gradually add small quantities of oil .
  - B. Check oil level frequently until the level reaches the FULL mark on dipstick (Fig 15). When removing the dipstick, wipe it with a clean rag prior to inserting it to check the oil level.
  - C. Push dipstick down into dipstick tube and make sure it is seated fully when finished (Fig 15).

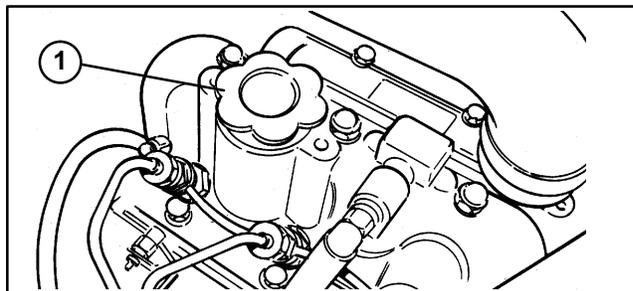


Figure 14  
1. Oil fill cap

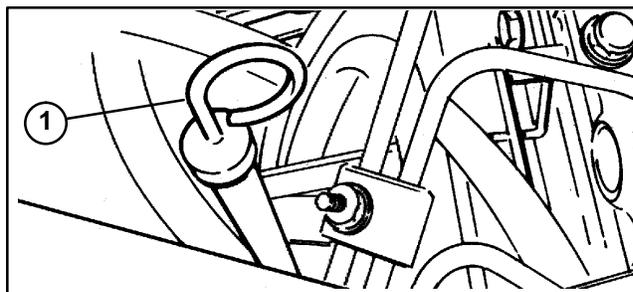


Figure 15  
1. Dipstick

## Checking the Cooling System

e l



### CAUTION

If the engine has been running, pressurized hot coolant or steam can escape when the radiator cap is removed. Burns may result. Do not open radiator cap when the radiator or engine is hot.

- 1.
- 2.

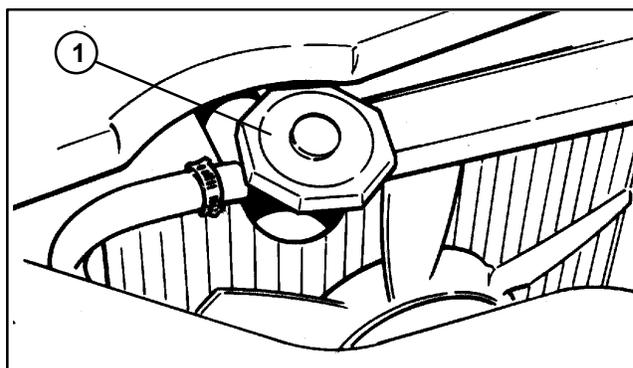


Figure 16  
1. Radiator cap

3. NOT OVERFILL
4. DO

## Engine Removal

1. Park machine on a level surface, lower the cutting units, stop the engine, and remove the key from the start switch. Chock wheels to keep the machine from moving.

2. Disconnect positive (+) and then negative (-) battery cables at the battery.

3. Gain access to the engine.

A. Open and remove hood from the machine.

B. Remove right side panel to gain access to the traction pump drive belt.

C. Remove left rear panel (radiator side) which supports the instrument panel.

4. Remove left fender (1) and fender bracket (2) from the radiator side of the frame (Fig. 17).

A. Remove cap screw (3) and flange nut (4) holding the left foot rest (5) to the left fender.

B. Remove remaining cap screws (3) and flange nuts (4) securing the fender to the fender bracket and frame. Remove fender from the frame.

C. Remove both cap screws (3) and left fender bracket (2) from the frame.

5. Remove cotter pin (1) from adjusting rod (2). Disconnect adjusting rod from brake arm (3) (Fig. 18).

6. Remove cap screws (3) and flange nut (4) securing the left footrest (5) to the frame (Fig. 17). Slide the left foot rest off the adjusting rod (2) (Fig. 18).

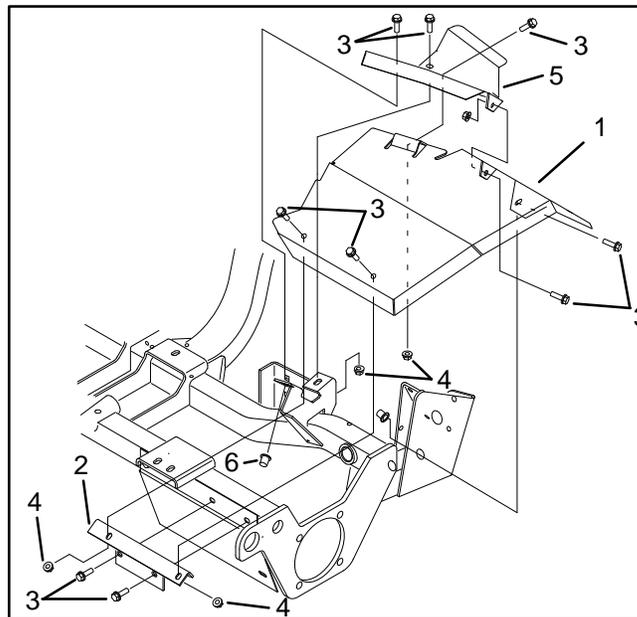


Figure 17

- |                        |                  |
|------------------------|------------------|
| 1. Left fender         | 4. Flange nut    |
| 2. Left fender bracket | 5. Left footrest |
| 3. Cap screw           | 6. Clinch nut    |

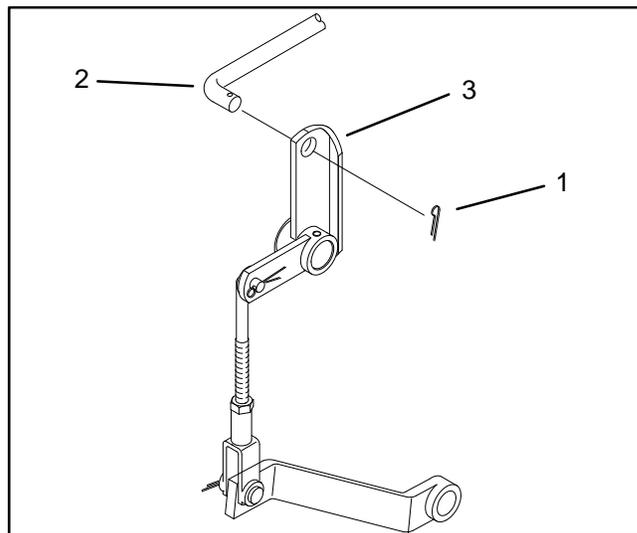


Figure 18

- |                  |              |
|------------------|--------------|
| 1. Cotter pin    | 3. Brake arm |
| 2. Adjusting rod |              |

7. Drain antifreeze from radiator.

A. Slowly remove radiator cap from the radiator.

B. Place drain pan below the radiator pipe plug. Remove pipe plug from the bottom of the radiator. Allow antifreeze to drain into the container.

8. Drain hydraulic reservoir.

A. Clean hydraulic oil filter and area around the filter.

B. Place clean drain pan below hydraulic oil filter to collect the draining hydraulic oil.

C. Remove hydraulic oil filter from bottom of the filter housing with a bottom type filter wrench. Let oil drain into the drain pan; install filter when drained.

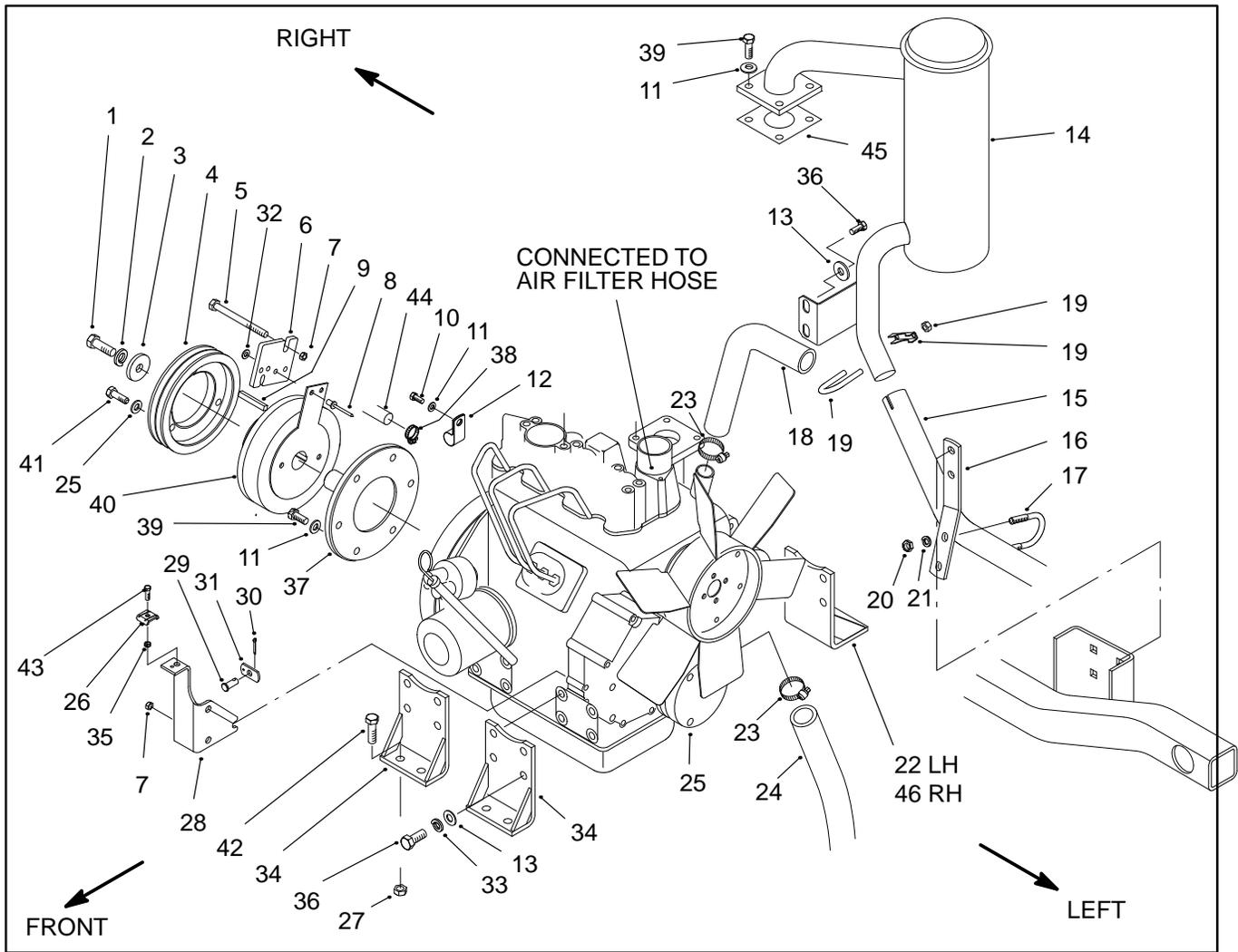


Figure 19

- |                     |                             |                              |
|---------------------|-----------------------------|------------------------------|
| 1. Cap screw        | 17. U-bolt                  | 32. Flat washer              |
| 2. Lock washer      | 18. Upper radiator hose     | 33. Lock washer              |
| 3. Clutch washer    | 19. Muffler clamp           | 34. Front mount bracket      |
| 4. Engine pulley    | 20. Nut                     | 35. Insert nut               |
| 5. Cap screw        | 21. Lock washer             | 36. Cap screw                |
| 6. Wire bracket     | 22. Left rear mount bracket | 37. Clutch spindle           |
| 7. Nut              | 23. Hose clamp              | 38. Hose clamp               |
| 8. Pop rivet        | 24. Lower radiator hose     | 39. Cap screw                |
| 9. Key              | 25. Engine                  | 40. Electric clutch          |
| 10. Cap screw       | 26. Throttle cable clamp    | 41. Cap screw                |
| 11. Flat washer     | 27. Flange nut              | 42. Cap screw                |
| 12. R-clamp         | 28. Throttle cable bracket  | 43. Cap screw                |
| 13. Washer          | 29. Clevis pin              | 44. Fuel hose                |
| 14. Muffler         | 30. Cotter pin              | 45. Muffler gasket           |
| 15. Muffler tube    | 31. Throttle tab            | 46. Right rear mount bracket |
| 16. Muffler bracket |                             |                              |

9. Close fuel shut-off valves under the fuel tank and on the fuel filter.
10. Disconnect hoses from engine (Fig. 19).
  - A. Loosen upper hose clamp securing the air filter hose extending from the engine to the air cleaner.
  - B. Loosen hose clamps (23). Disconnect upper radiator hose (18) and lower radiator hose (24) from the engine.
  - C. Loosen hose clamp (38) and disconnect fuel hose (44) from the lift pump. Plug hose to prevent leakage.
  - D. Loosen hose clamp and disconnect fuel hose (return) from the injector nozzle piping. Plug hose to prevent leakage.

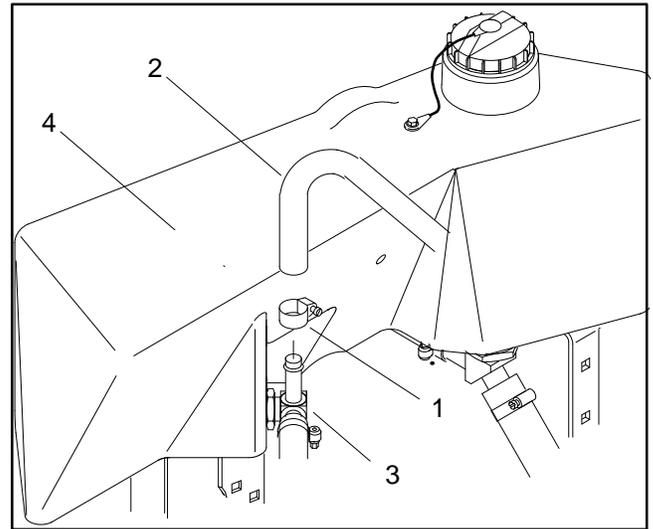


Figure 20

- |                          |                        |
|--------------------------|------------------------|
| 1. Hose clamp            | 3. Hydraulic fitting   |
| 2. Hydraulic return hose | 4. Hydraulic reservoir |



**CAUTION**

**The hydraulic fluid may be hot. To avoid possible burns, allow the hydraulic system to cool before disconnecting hoses.**

11. Disconnect hydraulic hoses to oil cooler.
  - A. Loosen hose clamp (1) and disconnect hydraulic return hose (2) from the hydraulic fitting (3). Plug hose and fitting to prevent leakage and contamination (Fig. 20).
  - B. Loosen hose clamp (1) and disconnect hydraulic supply hose (2) from the hydraulic elbow fitting (3). Plug hose and fitting to prevent leakage and contamination (Fig. 21).

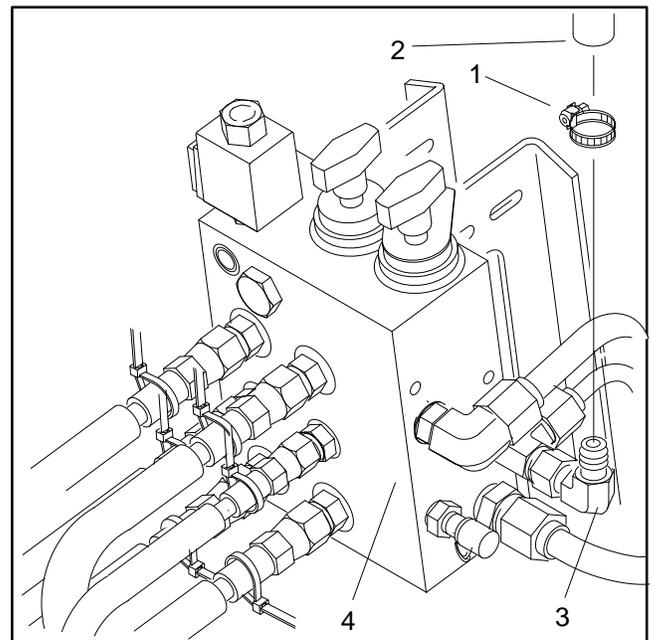


Figure 21

- |                          |                            |
|--------------------------|----------------------------|
| 1. Hose clamp            | 3. Hydraulic elbow fitting |
| 2. Hydraulic supply hose | 4. Hydraulic manifold      |



**CAUTION**

**The muffler and muffler tube may be hot. To avoid possible burns, allow the exhaust system to cool before working on the muffler and muffler tube.**

12. Remove exhaust system (Fig. 19).
  - A. Remove muffler clamp (19) from the muffler (14) and muffler tube (15).
  - B. Loosen nut (20) and U-clamp (17). Separate muffler tube from muffler and slide muffler tube through U-clamp.
  - C. Remove cap screws (36) and washers (13) from the muffler and right rear mount bracket (46).

- D. Remove cap screws (39) and flat washers (11) from the muffler and exhaust manifold. Remove muffler and muffler gasket (53) from the engine.

13. Disconnect throttle cable (Fig. 19).
  - A. Loosen cap screw (43) enough to separate the throttle cable from the throttle cable clamp (30).
  - B. Remove cotter pin (30) from clevis pin (29). Remove clevis pin, throttle tab (31), and throttle cable from the engine governor lever.
  - C. Secure throttle cable away from the engine.

14. Disconnect electrical connections (Fig. 19).

**Note:** Label all electrical leads for reassembly purposes.

- A. Disconnect connector with blue leads from the alternator.
- B. Disconnect connector with blue/white leads from the traction clutch.
- C. Disconnect connector from the front lift cylinder microswitch.
- D. Remove white/black lead from the temperature sender located on the top of the water pump.
- E. Remove tan lead from the high temperature shut down switch located on the water pump behind the fan.
- F. Remove purple lead from the fuel valve solenoid located above the lift pump.
- G. Remove brown lead from the oil pressure switch located on the front of the cylinder head.
- H. Remove white lead from the glow plugs located on the front traction pump side of the cylinder head.
- I. Remove gray, red, and white leads from the engine starter solenoid located on below the exhaust manifold.
- J. Disconnect battery ground from the traction clutch side of the cylinder head or the fan side of the cylinder block.
- K. Remove cap screw (10) and flat washer (11) from R-clamp (12). Pull wiring harness and hydraulic hoses away from the engine to keep them from snagging the engine when it is removed. The harness and hoses may be tied to the reservoir support brackets.

15. Remove radiator assembly.

- A. Support the radiator assembly while removing fasteners.
- B. Remove cap screws (1) and whiz nuts (2) from the radiator rear bracket (3) and frame (4) (Fig. 22).
- C. Remove carriage bolts (1) and whiz nuts (2) from the radiator bracket (3) and frame (4) (Fig. 23).
- D. Pull radiator assembly out and then up from the engine to prevent the engine cooling fan from catching the radiator top and bottom shrouds.

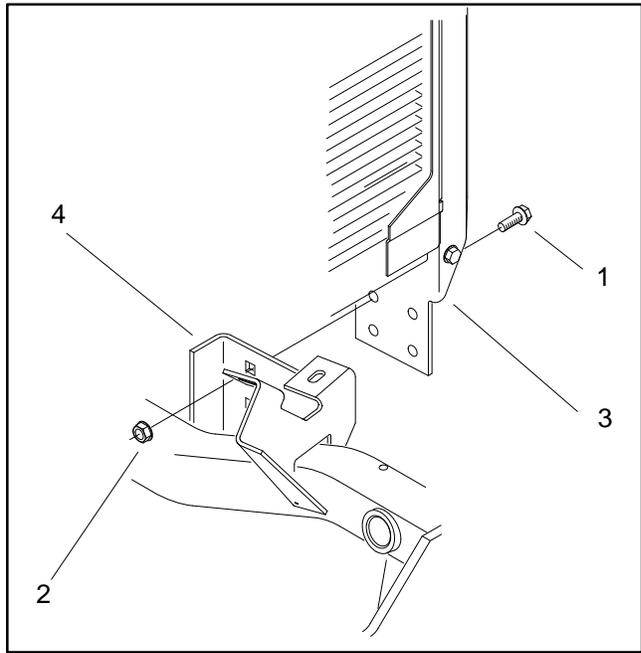


Figure 22

- 1. Cap screws
- 2. Whiz nut
- 3. Radiator rear bracket
- 4. Frame

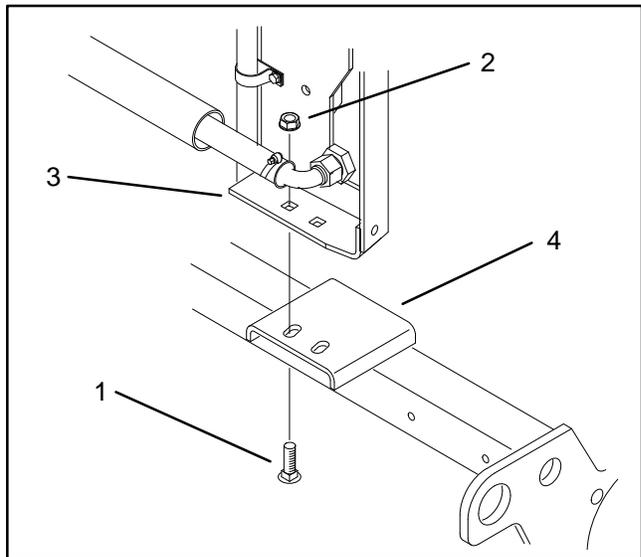


Figure 23

- 1. Carriage bolt
- 2. Whiz nut
- 3. Radiator bracket
- 4. Frame

16. Remove traction pump drive belt as described in Traction (Electric) Clutch of the Service and Repairs section of Chapter 5 – Electrical System.

17. Remove engine (Fig. 19)

A. Attach short section of chain between both lift tabs (1) located on each end of the cylinder head (2) (Fig. 24)

B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine will be supported when the cap screws (42) securing the engine mount brackets (22, 34, and 46) are removed.

C. Remove cap screws (42) and flange nuts (27) from the engine mount brackets (22, 34, and 46) and the frame.

**Note:** One person should operate the chain fall or hoist while another person guides the engine out of the frame.

**Note:** Be careful not to damage the engine, fuel lines, hydraulic hoses, electrical harness or other parts while removing the engine.

D. Remove engine (25) from the frame.

E. Mount engine onto an engine rebuilding stand.

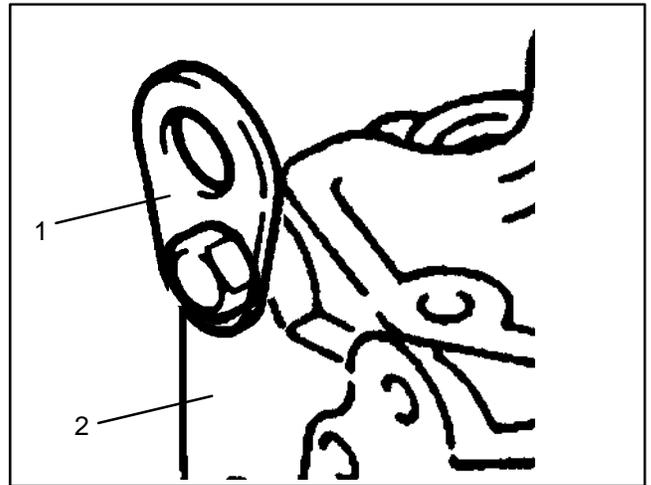


Figure 24

1. Lifting tab

2. Cylinder head

---

## Engine Reinstallation

1. Make sure machine is parked on a level surface with cutting units lowered, and key removed from the start switch. Chock wheels to keep the machine from moving.

2. Make sure that all parts remove from the engine during maintenance or rebuilding are reinstalled to the engine.

3. If mount brackets (22, 34, and 46) were removed re-install them as follows (Fig. 19):

A. For front mount brackets (34), secure brackets to the engine (25) with cap screws (36), lock washers (33) and washers (13). Torque cap screws from 34 to 42 ft–lb (4.7 to 5.8 kg–m).

B. For left rear mount bracket (22), secure bracket to the engine (25) with two cap screws (36), lock washers (33) and washers (13) through the left holes. Leave the right holes open for the muffler. Torque cap screws from 34 to 42 ft–lb (4.7 to 5.8 kg–m).

C. For right rear mount bracket (46), secure brackets to the engine (25) with cap screws (36), lock washers (33) and washers (13). **Leave cap screws loose enough so that the position of the bracket can be adjusted after the engine is installed.**

4. Reinstall engine (Fig. 19)

A. Attach short section of chain between both lift tabs (1) located on each end of the cylinder head (2) (Fig. 24)

B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine will be supported when the engine is removed from the engine rebuilding stand. Remove engine from the engine rebuilding stand.

**Note:** One person should operate chain fall or hoist while another person guides the engine into the frame.

**Note:** Be careful not to damage the engine, fuel lines, hydraulic hoses, electrical harness or other parts while reinstalling the engine.

C. Reinstall engine (25) onto the frame. Make sure fastener holes of the mount brackets (22, 34, and 46) are aligned with the holes on the frame.

D. Secure cap screws (42) and flange nuts (27) to the mount brackets (22, 34, and 46) and frame.

E. On the right rear mount bracket (46), tighten cap screws (36). Torque cap screws from 34 to 42 ft–lb (4.7 to 5.8 kg–m).

5. Reinstall radiator assembly.

A. Place radiator assembly down and then into the engine to prevent the engine cooling fan from catching the radiator top and bottom shrouds.

B. Connect air filter hose extending from the engine to the air cleaner. Tighten hose clamp.

C. Support the radiator assembly while installing the fasteners.

D. Install carriage bolts (1) and whiz nuts (2) to the radiator bracket (3) and frame (4) (Fig. 23).

E. Install cap screws (1) and whiz nuts (2) to the radiator rear bracket (3) and frame (4) (Fig. 22).

6. Reconnect electrical connections (Fig. 19).

A. Untie harness and hoses from the reservoir support brackets. Pull wiring harness and hydraulic hoses into position; keep them from contacting moving parts. Install cap screw (10) and flat washer (11) to R-clamp (12) and tighten to cylinder head.

B. Reconnect connector with blue leads to the alternator.

C. Reconnect connector with blue/white leads to the traction clutch.

D. Reconnect connector to the front lift cylinder microswitch.

E. Reconnect white/black lead to the temperature sender located on the top of the water pump.

F. Reconnect tan lead to the high temperature shut down switch located on the water pump behind the fan.

G. Reconnect purple lead to the fuel valve solenoid located above the lift pump.

H. Reconnect brown lead to the oil pressure switch located on the front of the cylinder head.

I. Reconnect white lead to the glow plugs located on the front right side of the cylinder head.

- J. Reconnect gray, red, and white leads to the engine starter solenoid located on below the exhaust manifold.
- K. Reconnect battery ground to the traction clutch side of the cylinder head or the left side of the cylinder block.
7. Reconnect throttle cable (Fig. 19).
    - A. Run throttle cable to engine (25).
    - B. Reinstall clevis pin (29), throttle tab (30), and throttle cable to the engine governor lever. Reinstall and lock cotter pin (31) to the clevis pin.
    - C. Install throttle cable into the throttle cable clamp (26). Tighten cap screw (43).
  8. Reinstall exhaust system (Fig. 19).
    - A. Position muffler (14) and muffler gasket (45) onto the exhaust manifold. Install capscrews (39) and flat washers (11) to the muffler and exhaust manifold. Tighten cap screws.
    - B. Reinstall cap screws (36) and washers (13) into the muffler and right rear mount bracket (46).
    - C. Slide muffler tube through the U-clamp (17). Connect muffler tube to the muffler. Tighten nut (20) and U-clamp.
    - D. Reinstall muffler clamp (19) to the muffler (14) and muffler tube (15).
  9. Reconnect hydraulic hoses from the oil cooler.
    - A. Unplug hydraulic hose (2) and hydraulic elbow fitting (3). Connect hydraulic supply hose to the hydraulic elbow fitting. Tighten hose clamp (1) (Fig. 21).
    - B. Unplug hydraulic return hose (2) and hydraulic fitting (3). Connect hydraulic return hose to the hydraulic fitting. Tighten hose clamp (1) (Fig. 20).
  10. Connect hoses to the engine (Fig. 19).
    - A. Connect fuel hose (return) to the injector nozzle piping and tighten hose clamp.
    - B. Unplug fuel hose (44). Connect fuel hose to the lift pump and tighten hose clamp (38).
    - C. Connect upper radiator hose (18) and lower radiator hose (24) to the engine. Tighten hose clamps (23).
    - D. Connect air filter hose to the engine (25).
  11. Open fuel shut-off valves under the fuel tank and on the fuel filter.
  12. Fill hydraulic reservoir with hydraulic fluid as described in the General Information section of Chapter 4 – Hydraulic System. Check reservoir for leaks.
  13. Add antifreeze to radiator as described in Checking the Cooling System.
  14. Slide the left foot rest (5) (Fig. 17) onto the adjusting rod (2) (Fig. 18). Reinstall cap screws (3) and flange nut (4) securing the left footrest (5) to the frame. Tighten cap screws (Fig. 17).
  15. Connect adjusting rod to brake arm (3) Install and lock cotter pin (1) to the adjusting rod (2) (Fig. 18).
  16. Reinstall fender bracket (2) and left fender (1) to the radiator side of the frame (Fig. 17).
    - A. Secure both cap screws (3) and left fender bracket (2) to the frame.
    - B. Reinstall remaining cap screws (3) and flange nuts (4) securing the fender to the fender bracket and frame.
    - C. Secure cap screw (3) and flange nut (4) to the left foot rest (5) and the left fender (1).
  17. Replace traction pump drive belt as described in Traction (Electric) Clutch of the Service and Repairs section of Chapter 5 – Electrical System.
  18. Adjust traction pump drive belt as described in the Adjustment section of Chapter 4 – Hydraulic system.
  19. Connect negative (–) and then positive (+) battery cables at the battery.
  20. Adjust hand brake as described in the Adjustment section of Chapter 6 – Wheels and Brakes.
  21. Adjust throttle linkage as described in the Adjustment section of this chapter.
  22. Bleed fuel system. See Bleeding the Fuel System.
  23. Check oil level as described in Changing the Engine Oil and Filter.
  24. Replace access covers to the engine.
    - A. Reinstall left rear panel (radiator side) which supports the instrument panel.
    - B. Reinstall right side panel which accesses the traction pump drive belt.
    - C. Reinstall hood to the machine and close.





# Hydraulic System

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Hydraulic System

# Specifications

Item	Description
Traction Pump Maximum Operating Pressure Maximum Intermittent Pressure Maximum Rated Speed Rated Flow @ Maximum Rated Speed and Pressure	Variable displacement piston pump 3000 PSI (207 bar) 5000 PSI (345 bar) 3600 RPM 17 GPM (64 LPM)
Charge Pump Maximum Operating Pressure Maximum Rated Speed Rated Flow @ Maximum Rated Speed and Pressure Charge Pressure	Gerotor pump 500 PSI (34.5 bar) 3600 RPM 3.5 GPM (13.2 LPM) 100 to 150 PSI (6.9 to 10.0 bar)
Implement (Lift) Relief Valve Implement Relief Pressure	Differential area relief valve 450 – 525 PSI (31.1 to 36.2 bar)
Wheel Motors Maximum Operating Pressure Maximum Intermittent Pressure Maximum Rated Speed Rated Flow @ Maximum Rated Speed and Pressure	Orbital rotor pump (with shuttle valve on left front motor) 2000 PSI (138 bar) 3000 PSI (207 bar) 267 RPM 15 GPM (57 LPM)
Reel Motor Drive Pump Maximum Operating Pressure Maximum Intermittent Pressure Maximum Rated Speed Rated Flow @ Maximum Rated Speed and Pressure	Positive displacement gear type pump 4000 PSI (276 bar) 4400 PSI (304 bar) 4000 RPM 8.5 GPM (32 LPM)
Hydraulic Manifold Relief Valve Cutting Circuit Relief Pressure	Differential area relief valve 2700 to 3300 PSI (186.3 to 227.7 bar)
Reel Motor Cross-over Relief Pressure Maximum Operating Pressure Maximum Intermittent Pressure Maximum Rated Speed Rated Flow @ Maximum Rated Speed and Pressure	Gear motor 1350 to 1650 PSI (93.2 to 113.9 bar) 2250 PSI (155 bar) 3000 PSI (207 bar) 3000 RPM 28.6 GPM (108 LPM)
Lift Control Valve	Spool type directional control valve
Hydraulic Filter	10 Micron spin-on cartridge type
Hydraulic Oil	* Mobil 424/Shell Donax TD or equivalent
Hydraulic Reservoir	Reservoir capacity 2.3 gal. U.S. (8.7 L) Total system capacity approximately 3.3 gal. U.S. (12.5 L)

# 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; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.



### 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 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.

## 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.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	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

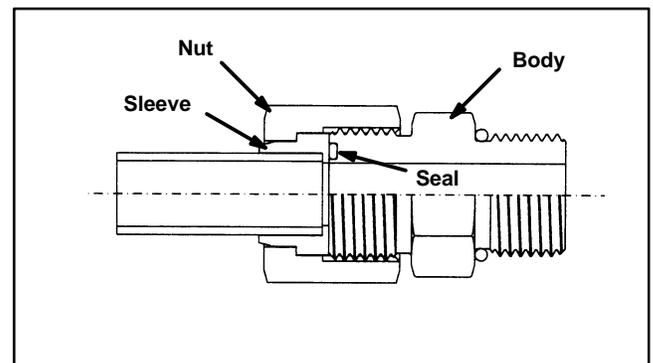


Figure 1

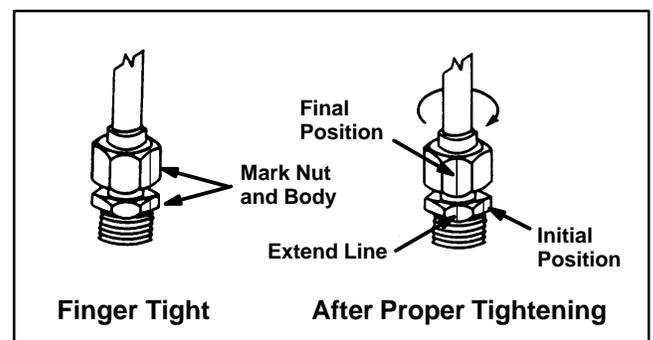


Figure 2

### 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

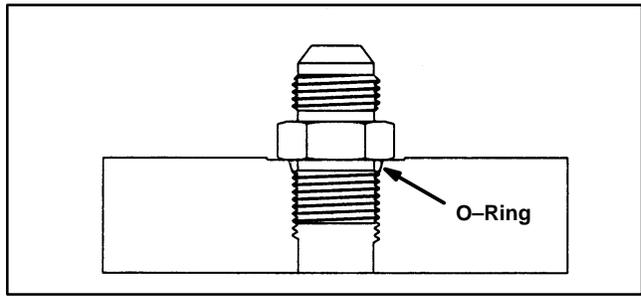


Figure 3

### 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

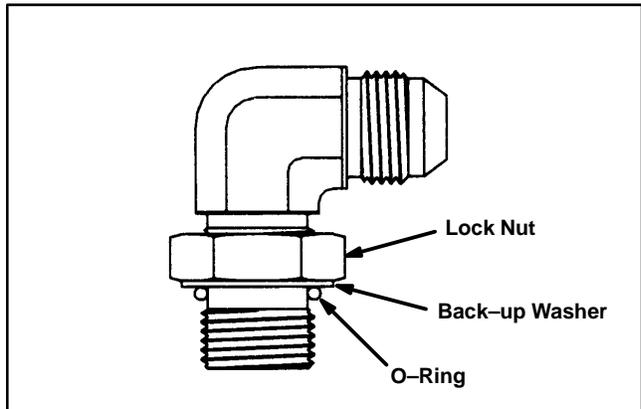


Figure 4

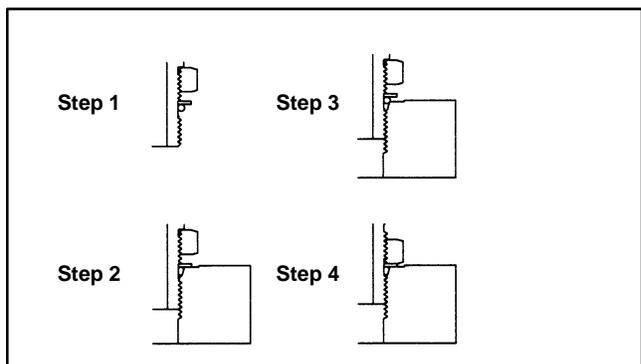


Figure 5

## Checking the Hydraulic System Fluid

The hydraulic system is designed to operate on anti-wear hydraulic fluid. The machine's reservoir is filled at the factory with approximately 3.3 gallons (12.5 liters) of Mobil 424 hydraulic fluid. **Check level of hydraulic fluid before engine is first started and daily thereafter.**

**Group 1 Hydraulic Fluid (Recommended for ambient temperatures consistently below 100° F.):**

### ISO type 46/68 anti-wear hydraulic fluid

Mobil	Mobil Fluid 424
Amoco	Amoco 1000
International Harvester	Hy-Tran
Texaco	TDH
Shell	Donax TD
Union Oil	Hydraulic/Tractor Fluid
Chevron	Tractor Hydraulic Fluid
BP Oil	BP HYD TF
Boron Oil	Eldoran UTH
Exxon	Torque Fluid
Conoco	Power-Tran 3
Kendall	Hyken 052
Phillips	HG Fluid

**Note:** The fluids within this group are interchangeable.

**Group 2 Hydraulic Fluid (Biodegradable):**

### ISO VG 32/46 anti-wear hydraulic fluid

Mobil	EAL 224 H
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**IMPORTANT:** Due to the nature of biodegradable fluids, it is critical that the fluid be changed at the recommended intervals or severe hydraulic component damage may occur.

**Note:** The fluid in this group is not compatible with the fluids in group 1.

**IMPORTANT:** These hydraulic fluids are specified to allow optimal operation of the machine in a wide range of temperatures encountered. The group 1 fluids are a multi-viscosity hydraulic fluids which allows operation at lower temperatures without the increased viscosity that is associated with straight viscosity fluids.

**Note:** When changing from one type of hydraulic fluid to the other, be certain to remove all the old fluid from the system, because some brands of one type are not completely compatible with some brands of the other type of hydraulic fluid.

Reelmaster 2300-D/2600-D

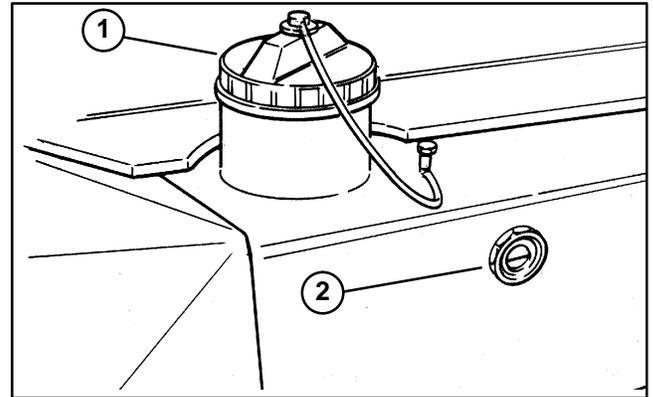


Figure 6

1. Hydraulic reservoir cap    2. Sight gauge

**IMPORTANT:** Use only types of hydraulic fluids specified. Other fluids could cause system damage.

**Note:** A red dye additive for the hydraulic system fluid is available in 2/3 oz bottles. One bottle is sufficient for 4 to 6 gallons (15 to 22 liters) of hydraulic fluid. Order Part No. 44-2500 from your Authorized Toro Distributor.

1. Position machine on a level surface. Make sure engine is off and parking brake is set.
2. Check level of the fluid by viewing into the sight gauge. If the fluid is cold, the level should be at the bottom of the gauge. If the fluid is hot, the level should be at the center of the gauge.
3. If fluid level is not at center of gauge, remove cap from the hydraulic fluid reservoir and slowly fill reservoir with Mobil 424 or equivalent hydraulic fluid until level reaches center of sight gauge. **DO NOT OVERFILL**

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

4. Install reservoir cap. Wipe up any fluid that may have spilled.

## Changing the Hydraulic System Fluid and Filter

The hydraulic system filter must be changed initially, after the first five hours of operation, and thereafter every 200 hours of operation or yearly, whichever comes first. Use a genuine Toro oil filter for replacement. The hydraulic fluid must be changed every 400 hours of operation or yearly, whichever comes first.

1. Park the machine on a level surface, lower the cutting units, set parking brake and turn the engine off.
2. If only the filter is to be changed, remove reservoir cap and insert reservoir plug (Fig. 7), to block outlet. This will retain most of the fluid in reservoir when filter is removed.
3. Clean the area around the hydraulic oil filter. Remove filter from the bottom of the filter housing and allow the oil to flow into a drain pan. Use a bottom type filter wrench. Dispose of the oil filter properly.
4. Apply a film of oil on the filter gasket. Install filter by hand until gasket contacts the mounting head; then tighten filter an additional three-fourths turn.
5. Fill the reservoir to proper level, refer to Checking the Hydraulic System Fluid.
6. Place all controls in neutral or disengaged position and start engine. Run engine at lowest possible RPM to purge the system of air.
7. Run engine until lift cylinders extend and retract and forward and reverse wheel motion is achieved.
8. Stop the engine and check the oil level in reservoir, add oil if necessary.
9. Check all connections for leaks.

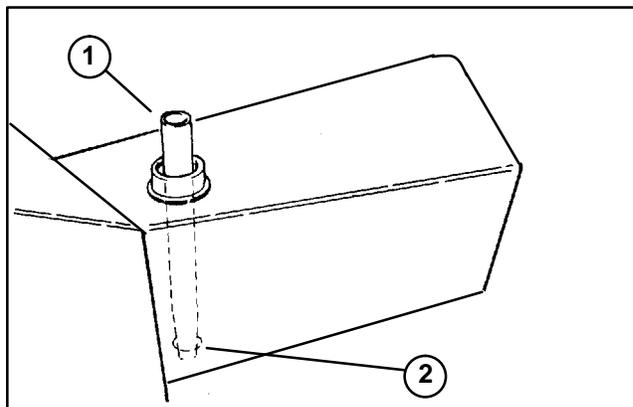


Figure 7

1. Reservoir plug

2. Reservoir outlet

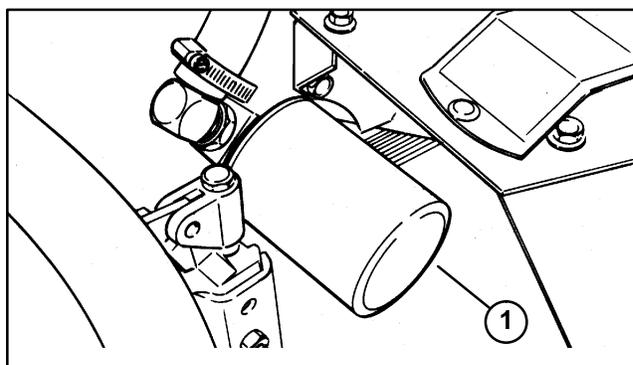


Figure 8

1. Hydraulic oil filter

## Pushing or Towing the Traction Unit

In case of emergency, the Reelmaster 2300-D can be towed for a short distance. However, Toro does not recommend this as a standard procedure.

**IMPORTANT: Do not tow the machine faster than 2-3 mph because drive system may be damaged. If machine must be moved a considerable distance, transport it on a truck or trailer.**

1. Locate by-pass valve on pump and rotate it 90° so the by-pass valve is horizontal.
2. Before the starting engine, close by-pass valve by rotating it 90° so the by-pass valve is vertical. Do not start engine when valve is open.

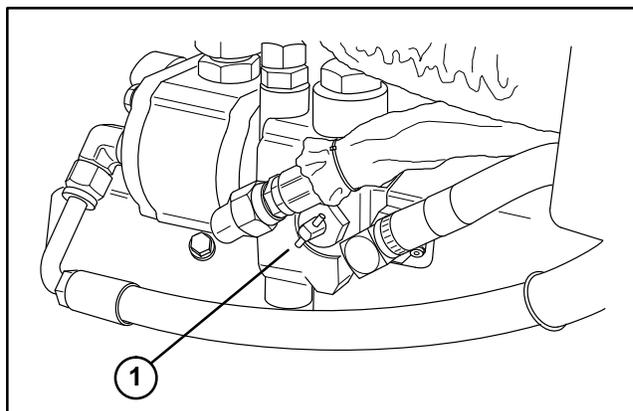
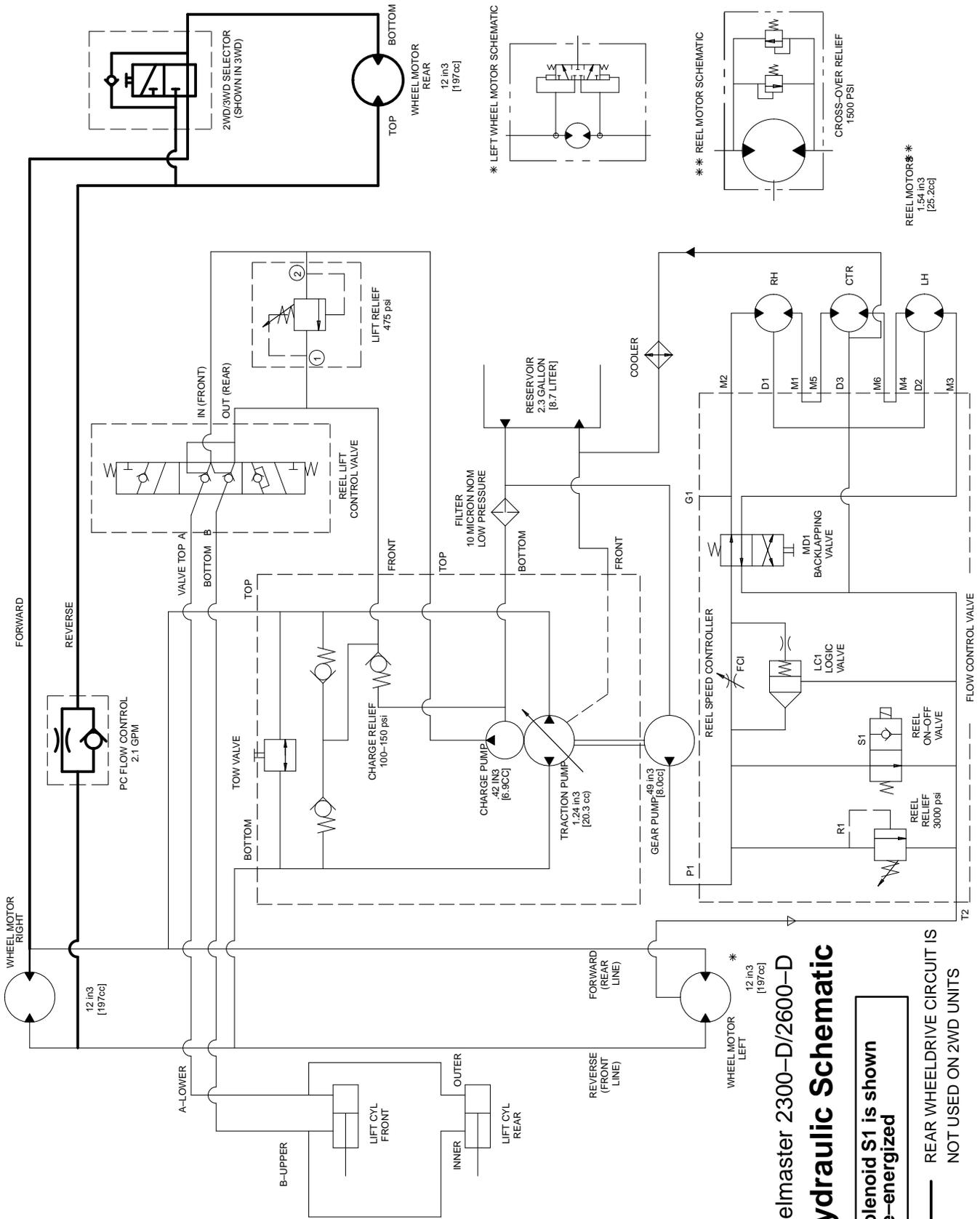


Figure 9

1. By-pass valve

# Hydraulic Schematic



## Reelmaster 2300-D/2600-D Hydraulic Schematic

**Solenoid S1 is shown de-energized**

REAR WHEELDRIVE CIRCUIT IS NOT USED ON 2WD UNITS



# Hydraulic Flow Diagrams

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## Raise Cutting Units

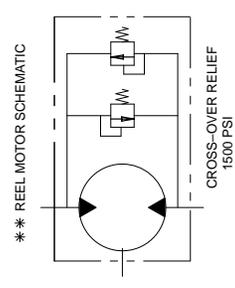
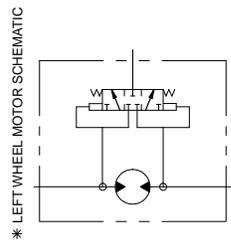
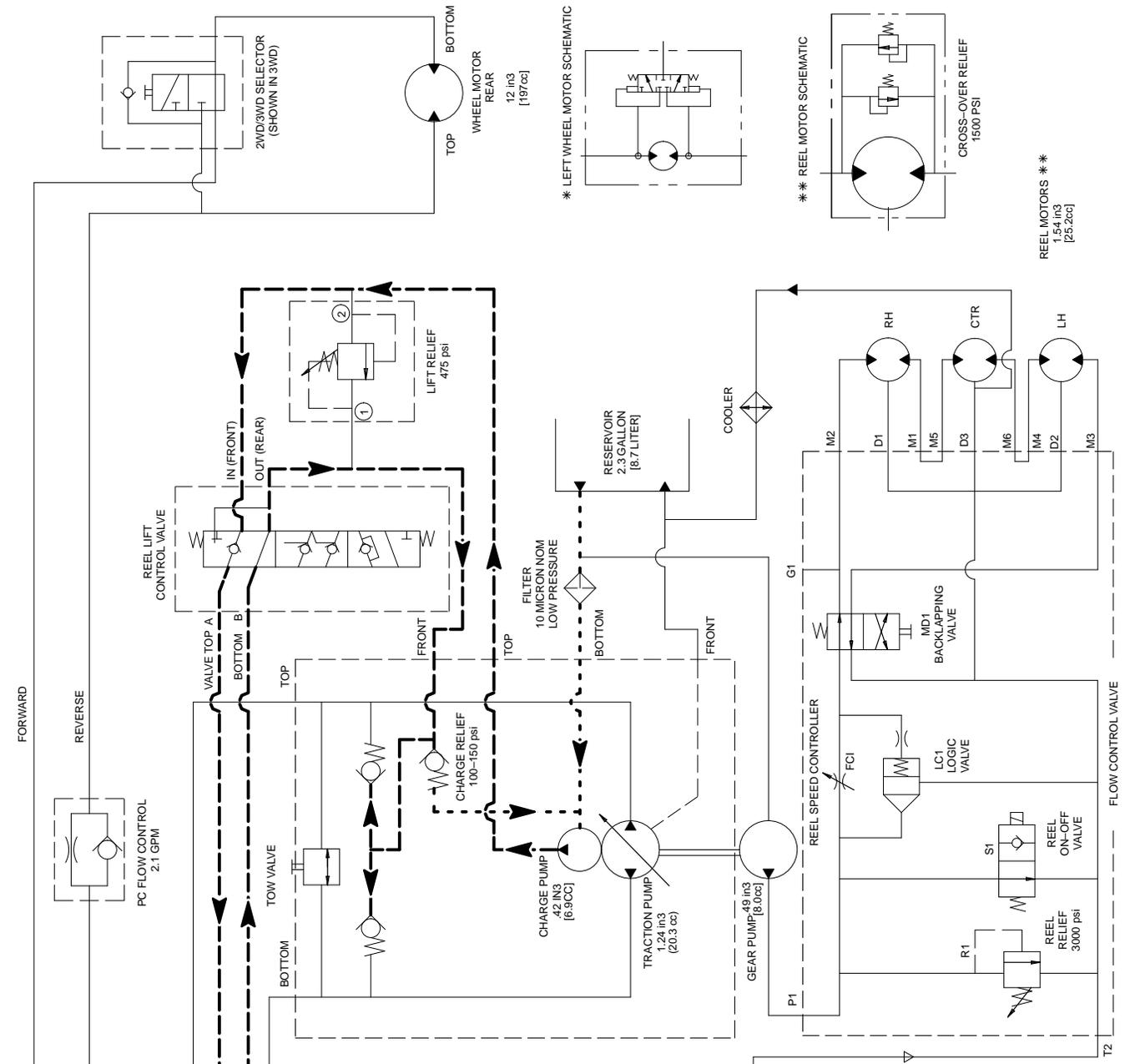
The charge pump is part of the traction pump and is directly coupled to it. It supplies hydraulic pressure for raising and lowering cutting units and maintaining 100 to 150 PSI to the low pressure side of the traction circuit (piston pump). The pump takes its suction through a filter from the reservoir.

During conditions of not lifting or lowering cutting units, flow from the charge pump goes to the control valve and is by-passed (control valve position not shown) directly to the suction of the piston pump and the charge relief valve.

When the cutting units are to be raised, the control valve spool is positioned down and flow is directed out the top of the control valve to the lower and outer portions of the

lift cylinders. Hydraulic pressure against the cylinder pistons pushes the shafts out. At the same time, the pistons push the hydraulic fluid in the upper and inner portions of the lift cylinders out and through the control valve to the piston pump suction. When the control valve lever is released, spring action returns the spool to the center position and by-passes flow back to the piston pump suction. Lift cylinder movement is stopped. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

Circuit operation for lowering the lift cylinders is similar to raising them. However, the control valve spool is shifted up and flow is reversed to and from the lift cylinders, thus moving the cutting units down.



REEL MOTORS \*\*\*  
1.54 in³  
[25.2cc]

## Reelmaster 2300-D/2600-D Raise Cutting Units

- High Pressure
- - - Low Pressure (Charge)
- · · · · Return or Suction
- ▶ Flow

**Solenoid S1 is shown de-energized  
Control valve is positioned up**

---

## Traction Forward

The traction pump is driven by the engine through the pulley, pump drive belt, and electric clutch. The traction circuit of the hydraulic system acts essentially as a closed loop. Taking its suction directly from the return side of the wheel motors of the traction circuit, the traction pump supplies oil flow to the wheel motors through the supply side of the traction circuit.

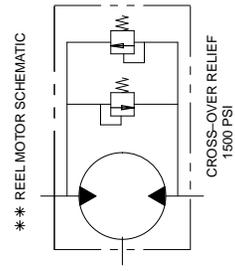
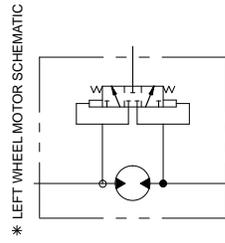
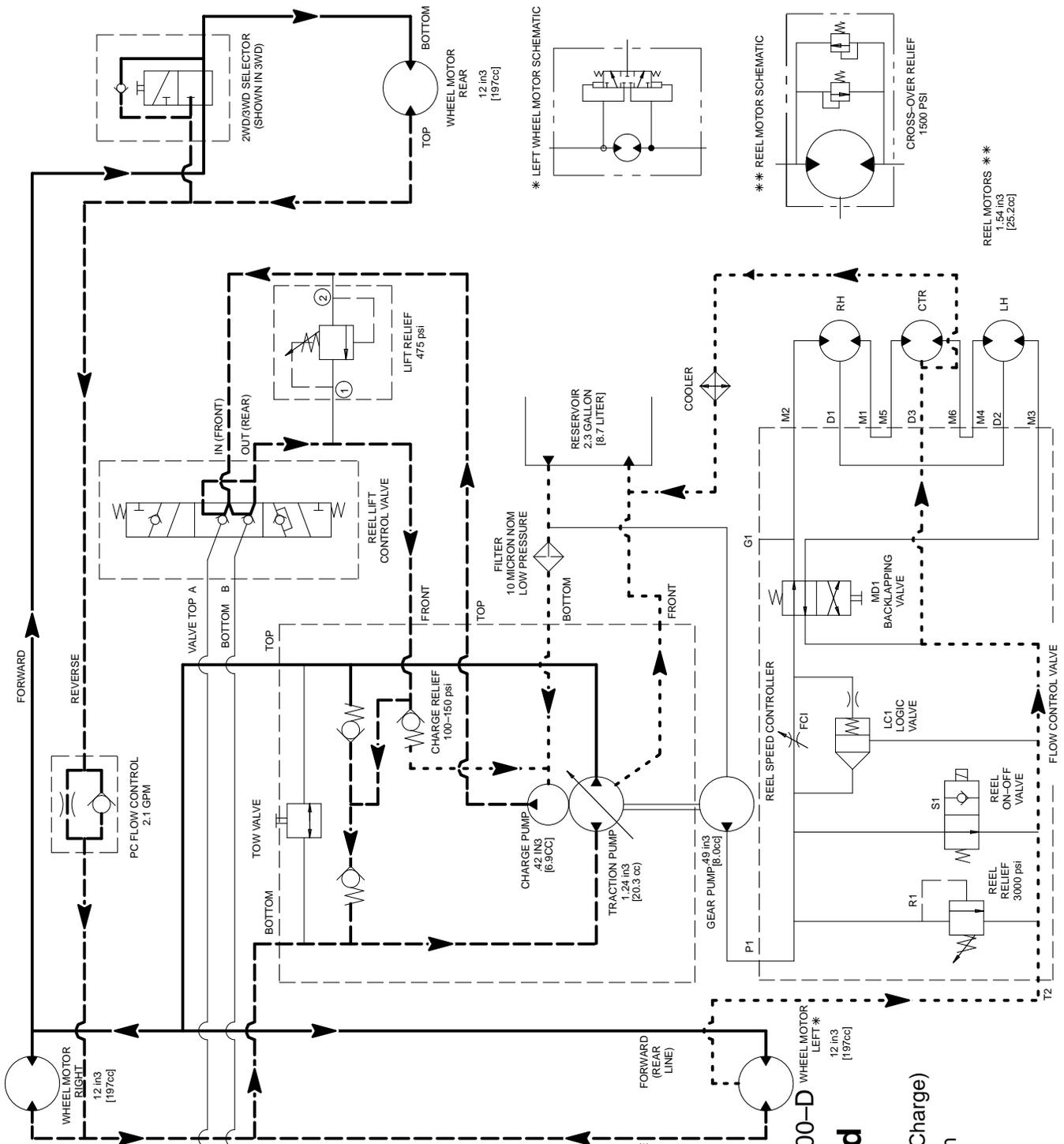
With the engine running, clutch engaged, and traction pedal in the neutral position, the traction pump supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the traction motor so oil flows out the top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the forward direction. The 2WD/3WD selector valve allows flow to the rear wheel in the 3WD position and by-passes the rear wheel in the 2WD position.

Oil flowing out of the wheel motors returns to the bottom port of the traction pump and is continuously pumped out the top port. However, oil flow out of the rear wheel motor must pass through the check valve portion of the PC flow controller before returning to the traction pump.

A small amount of hydraulic oil leaves the traction circuit through the bi-directional shuttle valve in the front left wheel motor. This oil is cooled as it flows through the cooler and returned to the reservoir.

Filtered hydraulic oil is supplied to the traction circuit from the charge pump through the lift control valve and back through the charge circuit check valves. This filtered oil replaces oil losses from flow through the shuttle valve and small amounts of leakage. The charge pump and shuttle valve circuits allow for indirect cooling and filtering of the traction circuit.

In the forward direction, the PC flow controller has a special function. When a unit is moving downhill, the operator will return the traction pedal to the neutral position. In this situation, the front wheel motors act as hydraulic pumps and reverse the oil flow through the traction circuit. The PC flow controller will restrict flow to the rear motor sufficiently, so the reverse flow is by-passed through the 2WD/3WD selector (check) valve around the rear wheel motor. This action will prevent a loss of steering control should the rear motor turn in the reverse direction. As a result, there is no 3WD in reverse



REEL MOTORS \*\*  
1.54 in³  
[25.2cc]

Reelmaster 2300-D/2600-D WHEEL MOTOR LEFT \*

### Traction Forward

- High Pressure
- - - Low Pressure (Charge)
- · · Return or Suction
- ▶ Flow

Solenoid S1 is shown de-energized

Hydraulic System

---

## Traction Reverse

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed and by-passes the rear wheel motor.

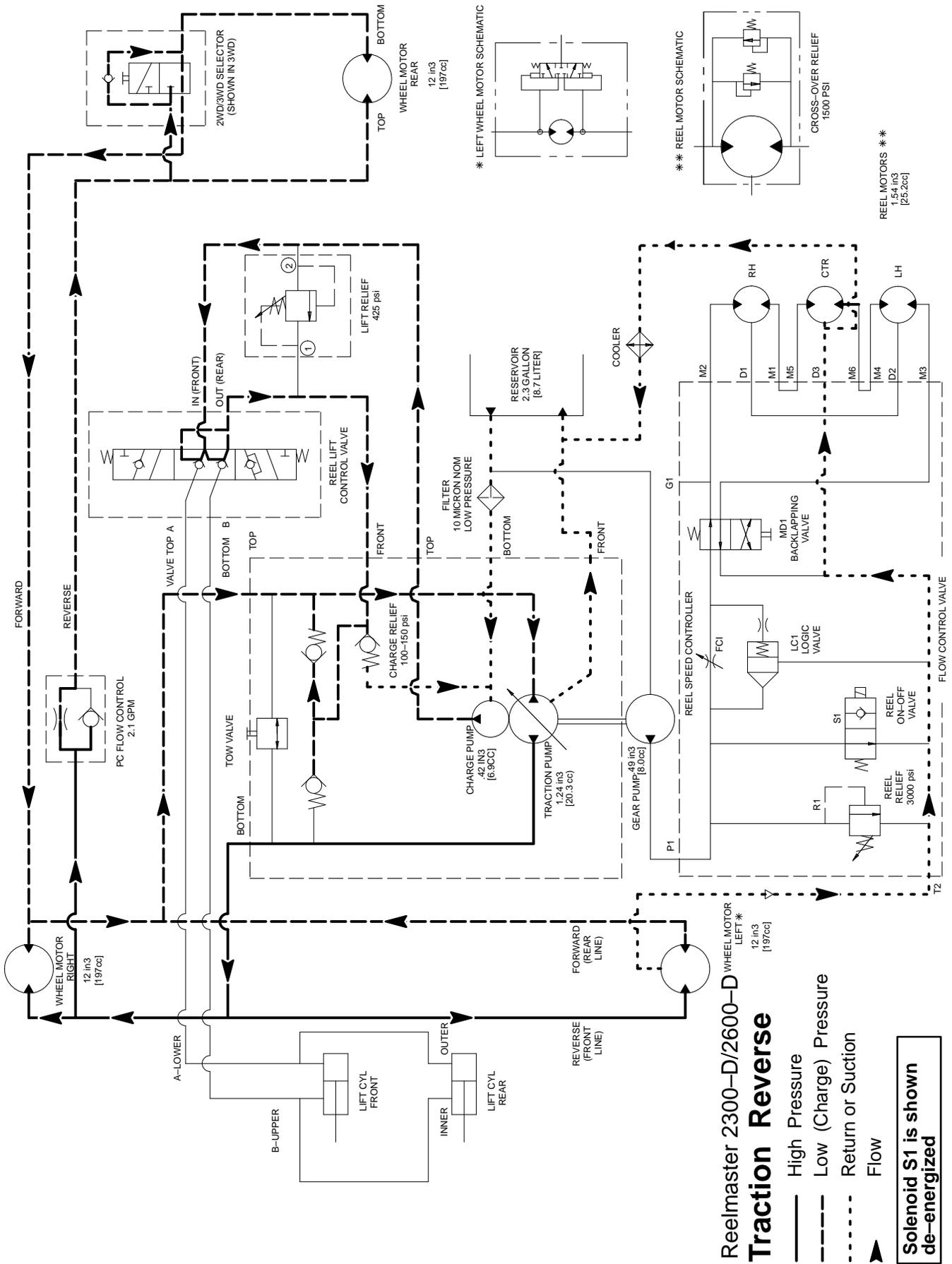
With the engine running, clutch engaged, and traction pedal in the neutral position, the traction pump supplies no flow to the wheel motors. When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the swash plate in the traction motor so oil flows out the bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the reverse direction. The 2WD/3WD selector valve by-passes the rear wheel in both the 2WD and 3WD positions.

Oil flowing out of the wheel motors returns to the top port of the traction pump and is continuously pumped out the

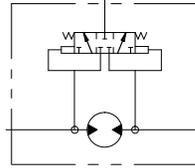
bottom port. However, oil flow to the rear wheel motor is blocked by the check valve portion of the PC flow controller and forced through the restriction before going to the motor. Flow is limited to 2.1 GPM to the rear wheel motor. This flow is sufficient to prevent cavitation on the rear motor in reverse.

Because of the by-passing of the rear wheel motor in reverse and the resistance to flow of the two front wheel motors, all the traction flow is by-passed directly back to the traction pump when the traction pedal is initially pushed in the reverse direction. This direct by-passing of the traction circuit causes a delay in the response of the traction pedal in reverse until traction flow exceeds 2.1 GPM (7.9 LPM) through the PC flow controller.

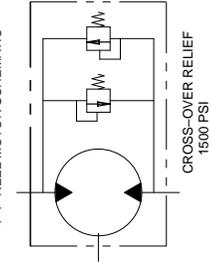
The charge and shuttle valve circuits function the same in reverse as they did in the forward direction.



\* LEFT WHEEL MOTOR SCHEMATIC



\*\*\* REEL MOTOR SCHEMATIC



\*\*\* REEL MOTORS \*\*\*  
1.54 in³ [25.2cc]

Reelmaster 2300-D/2600-D WHEEL MOTOR LEFT \*

**Traction Reverse**

- High Pressure
- - - Low (Charge) Pressure
- · · Return or Suction
- ▶ Flow

**Solenoid S1 is shown de-energized**

---

## Mow

The reel motor drive pump is directly coupled to the the traction pump which is driven directly by the engine through the electric clutch. Taking its suction directly from the reservoir, the reel motor drive pump supplies oil flow to the hydraulic manifold block and to the reel motors.

With the engine running, the clutch engaged, and the cutting unit switch pushed in to the **OFF** position, oil flows into inlet port (P1) and through deenergized solenoid valve (S1) bypassing the reel motors. Oil then flows directly back to the reservoir through the oil cooler.

When the cutting unit switch is pulled out to the **ON** position with the engine running and the clutch engaged, solenoid valve (S1) is energized and shut, hydraulic system pressure builds up, and flow is diverted to the reel motors. Oil flow from port (P1) flows through the 11 position reel speed control valve. Flow across the speed control valve is pressure compensated by the logic car-

tridge valve (LC1). The logic cartridge valve maintains a pressure differential of 75 PSI (5.2 bar) across the speed control valve. Any excess flow above what the speed control valve is set for is bypassed to the reservoir through the logic cartridge valve. With the backlap valve (MD1) in the **mow** position, oil flows through the valve and reel motors which are connected in series. Oil flows through the right, center, and then left reel motor as it turns the motors in the mow direction. The oil then returns to the reservoir.

Relief valve (R1) limits system pressure and is set at 3000 PSI (207 bar). When the valve opens, oil is diverted back to the reservoir.

Backlapping operation is the same as mowing operation, except for the position of the backlap valve (MD1). The backlap valve is in the **backlap** position allowing oil flow through the left, center, and then right reel motor as it turns the motors in the backlap direction.



# Special Tools

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

Some tools may also be available from a local supplier.

## Hydraulic Pressure Test Kit

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Contains one each, 1000, 5000 and 10000 PSI gauges. Use gauges as recommended in Testing section of this chapter.

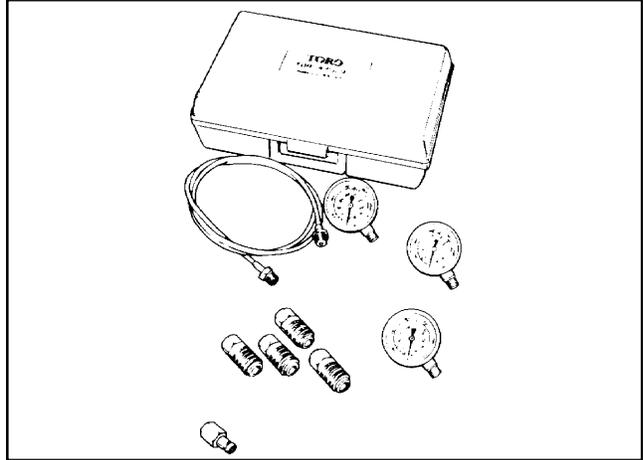


Figure 10

## Hydraulic Tester – Pressure and Flow

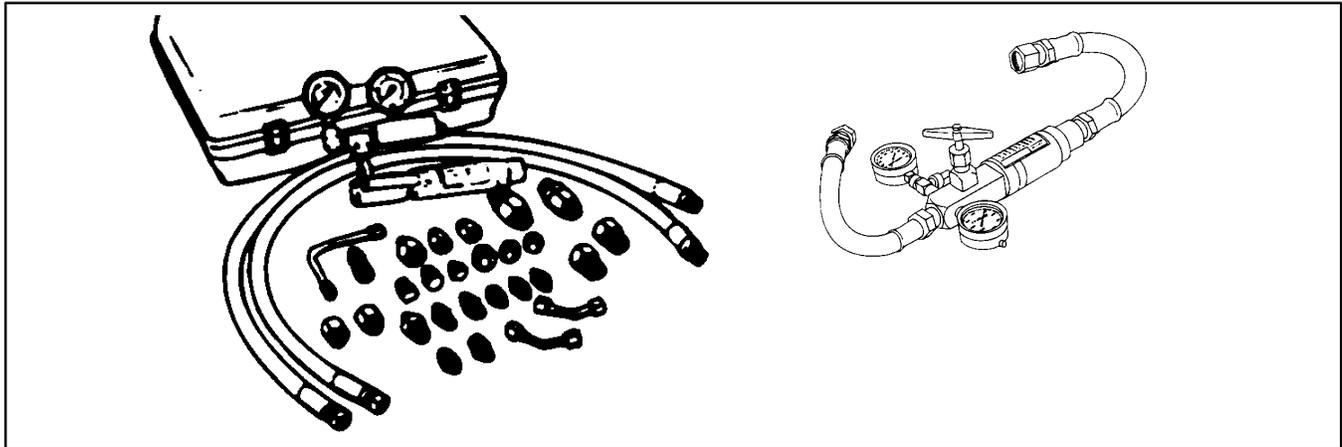


Figure 11

This tester requires o-ring face seal (ORFS) adapter fittings for use on this machine.

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

A protector valve 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 which accommodates pressures beyond the capacity of the low pressure gauge, 0 to 5,000 PSI.
5. **FLOW METER:** This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.
6. **OUTLET HOSE:** A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

# 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 has a potential for 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 Cause
Hydraulic oil leaks	Fitting(s), hose(s), or tube(s) are loose or damaged. O-ring(s) or seal(s) are missing or damaged.
Foaming hydraulic fluid	Oil level in reservoir is low. Hydraulic system has wrong kind of oil. One of the pump suction lines has an air leak.
Hydraulic system operates hot	Transmission pressure is high due to load or brakes applied. Oil level in reservoir is low, or inlet filter is loose or clogged. Oil is contaminated or too light. Heat exchanger is damaged or plugged. By-pass relief is stuck open or air flow is obstructed. Charge pressure is low. Towing by-pass valve is open or defective. Wheel motor(s) or reel motor(s) are worn or damaged. Traction pump is worn or damaged.
Neutral is difficult to find or unit operates in one direction only	External control linkage is misadjusted, disconnected, binding, or damaged. Traction pump is worn or damaged.
Traction response is sluggish	Charge pressure is low. Hydraulic oil is very cold. Towing by-pass valve is open or worn. Brake is not released. Traction pump or wheel motor(s) are worn or damaged.
No traction in either direction	Brake is not released. Oil level in reservoir is low. Towing by-pass valve is open. Charge pressure is low. Traction pump or wheel motor(s) are worn or damaged.

<b>Problem</b>	<b>Possible Cause</b>
Wheel motor will not turn	Internal parts in wheel motor are damaged. Brakes are binding. Key on wheel motor shaft is sheared or missing.
Wheel motor will not hold load in neutral	Make up fluid from charge pump is not available. Flow control setting is wrong for reverse.
Noisy reel motor drive pump (cavitation)	Reservoir oil level is low. Suction line is restricted. Suction line has an air leak.
Reels will not turn	Cross-over relief valve(s) are stuck open. (The other reels will still rotate.) Valve S1 is stuck open. An electrical problem exists. (See Chapter 5–Electrical System) Relief valve R1 is stuck open. LC1 logic valve is stuck open. Reel motor drive pump is damaged.
Reel speed is erratic	Reel to bedknife adjustment is too tight. Reel bearing(s) are damaged.
Reel motor case drain flow is excessive. Flow is greater than 0.7 GPM at 1200 PSI (2.6 LPM at 82.8 bar).	Excessive internal wear in wheel motor exists. Reel bearing(s) are damaged.
Cutting units will not lift or lift slowly	Engine speed is too low. Pump pulley drive belt is loose. Charge pump is damaged. Lift valve control linkage is binding or broken. Lift cylinder bushings bind. Reservoir oil level is low. Inlet filter is loose or clogged. Charge pump pressure or flow is insufficient. Implement relief valve is stuck open. Lift control valve is damaged. Lift cylinders leak internally.
Cutting units raise, but will not stay up	Lift cylinders leak internally. Lift valve leaks.

# 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.)



## CAUTION

**Failure to use gauges with recommended pressure (psi) rating as listed in test procedures could result in damage to gauge and possible personal injury from leaking hot oil.**

### Before Performing Hydraulic Tests

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



## WARNING

**Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by stopping the engine and lowering or supporting the cutting units or other implements.**

**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 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.**

1. Thoroughly clean the machine 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 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 tachometer when making a hydraulic test. Engine speed can affect the accuracy of the tester readings.
4. To prevent damage to tester or components, the inlet and the outlet hoses must be properly connected, and not reversed (tester with pressure and flow capabilities).
5. To minimize the possibility of damaging components, completely open load valve in hydraulic tester (when using tester with pressure and flow capabilities).
6. Install fittings finger tight, far enough to insure that they are not cross-threaded, before tightening with a wrench.
7. Position the tester hoses so that rotating machine parts will not make contact with them and result in hose or tester damage.
8. Check the oil level in the reservoir.
9. Check the control linkage 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: Traction Pump Flow

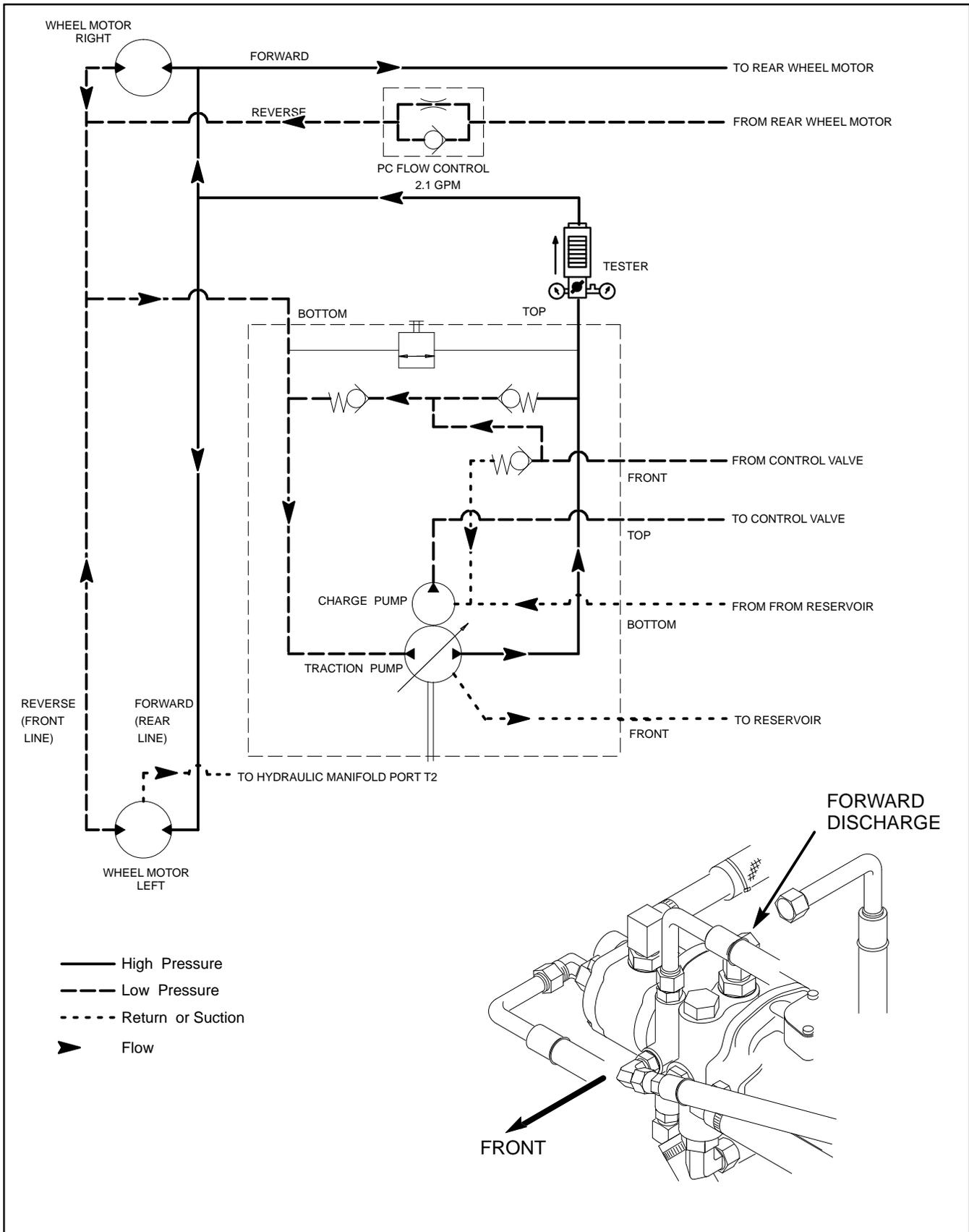


Figure 12

### Procedure for Traction Pump Flow Check:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the cutting units lowered and off. Make sure engine is off.
3. Make sure the hydraulic tank is full.
4. Make sure that traction pedal is adjusted to the neutral position (see Traction Pedal in the Adjustments Section).
5. Make sure that pump drive belt is adjusted properly. (see Hydraulic Pump Drive belt in the Adjustments Section).
6. Block up one front traction wheel off the floor to allow flow through the traction circuit.
7. Chock remaining wheels to prevent movement of the machine.
8. Attach a heavy chain to the rear of the machine frame and something solid in the shop.
9. Make sure parking brake is off.
10. Put 2WD/3WD selector to 2WD so the rear wheel will not spin.



#### CAUTION

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.**

11. Clean hose fitting and disconnect hose from the elbow connection on the top of the traction pump.

**IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor through the tester and into the hose.**

12. Install tester in series with the motor and the disconnected hose. Make sure the flow control valve is fully open.
13. One person should sit on the seat and operate the machine while another person reads the tester. Start engine and move the throttle to full speed ( $3200 \pm 100$  RPM).



#### CAUTION

**Use extreme caution when taking gauge readings. The front tire on the ground will be trying to move the machine forward.**

14. Slowly push traction pedal into fully forward position.
15. Close flow control valve until pressure gauges read **1000 PSI**. Verify pump speed of **2700 RPM** with a phototac.
16. Observe flow gauge.  
  
TESTER READING: minimum flow of **13 GPM**
17. Release traction pedal and turn off machine.
18. Disconnect tester from elbow connection and hose. Reconnect hose to elbow connection.
19. If specifications are not met, the traction pump needs to be repaired or replaced as necessary.

# TEST NO. 2: Charge Pump Flow and Implement Relief Pressure

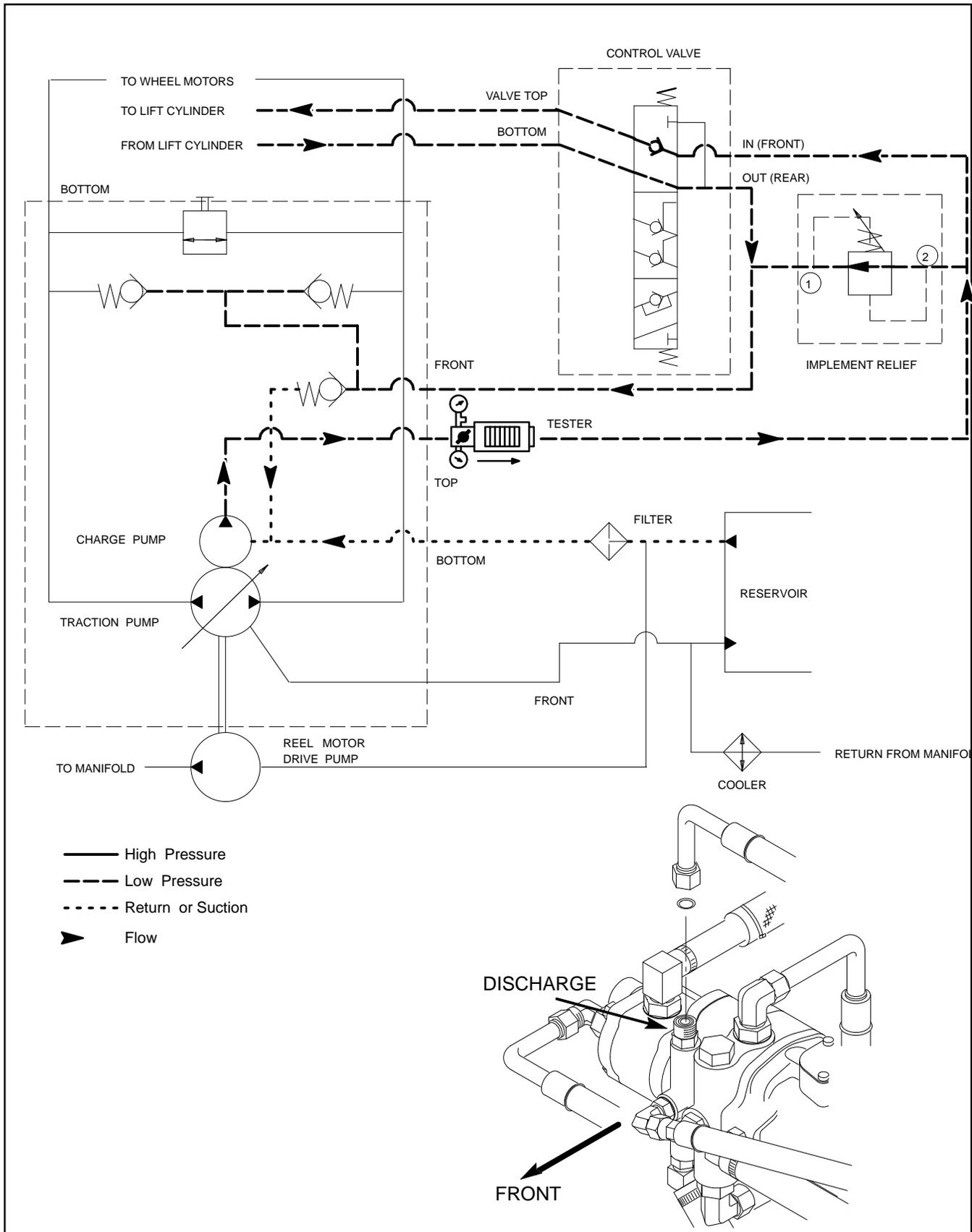


Figure 13

**Procedure for Charge Pump Flow Check:**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.
3. Make sure the hydraulic tank is full.

 **CAUTION**  
Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

4. Disconnect outside top hose from the discharge fitting of the charge pump. Connect gage end of tester to the pump discharge fitting.
5. Connect the other end of the tester to the disconnected hose.

 **CAUTION**  
Make sure that all hoses are free of the fly-wheel after installation.

6. Operate engine at full speed (**3200 ± 100 RPM**).
7. Make sure hydraulic oil is at operating temperature.
8. Make sure that traction pedal and lift valve are in neutral and the parking brake is engaged.
9. Watch flow and pressure gauges carefully while slowly closing the flow control valve until the pressure gauge reads **500 PSI**.
10. **Minimum** flow gauge reading should be **2.5 GPM**. If specification is not met, repair or replace pump.

**Procedure for Implement Relief Check:**

 **CAUTION**  
Do not allow charge pressure to exceed **650 PSI**.

1. Fully open control valve on the tester.

2. Operate engine at full speed (**3200 ± 100 RPM**).
3. Make sure hydraulic oil is at operating temperature.
4. Watch pressure gauge carefully. Make sure lift lever to the cutting units is in the neutral position. Record the pressure.
5. While holding the lift lever in the raised position, watch the pressure gauge. Record pressure the relief valve opens at.
6. Return lift lever to neutral position. Shut off engine.
7. Subtract the relief valve closed pressure from the relief valve open pressure (see example below). The difference should be from **450 to 500 PSI**.
  - A. If this specification is not met, adjust relief valve.
  - B. If this specification is met, go to step 9.

Example Calculation	PRESSURE
Relief Valve Open (Lever to Raise)	620
Relief Valve Closed (Lever in Neutral)	150
Open less Closed Pressure ( <b>450 to 500 PSI</b> )	470

8. Adjusting the relief valve pressure as follows:
  - A. Remove the cap from the relief valve.
  - B. To increase the relief valve pressure set point, use an allen wrench and turn set screw slightly clockwise.
  - C. To decrease the relief valve pressure set point, use an allen wrench and turn set screw slightly counterclockwise.
  - D. Repeat steps 1 through 8 above until the relief valve pressure set point is correct. Reinstall cap on valve when valve is set properly.
  - E. If the relief valve pressure set point can not be adjusted to specification, go to step 9 and replace the relief valve.

**Note:** If the pressure and flow are within specification but the cutting units do not lift or lift slowly, check for mechanical binding or internal leakage of the lift cylinder.

9. Disconnect tester from the pump and hose. Reconnect hose to the pump.

# TEST NO. 3: Charge Pump Relief Pressure

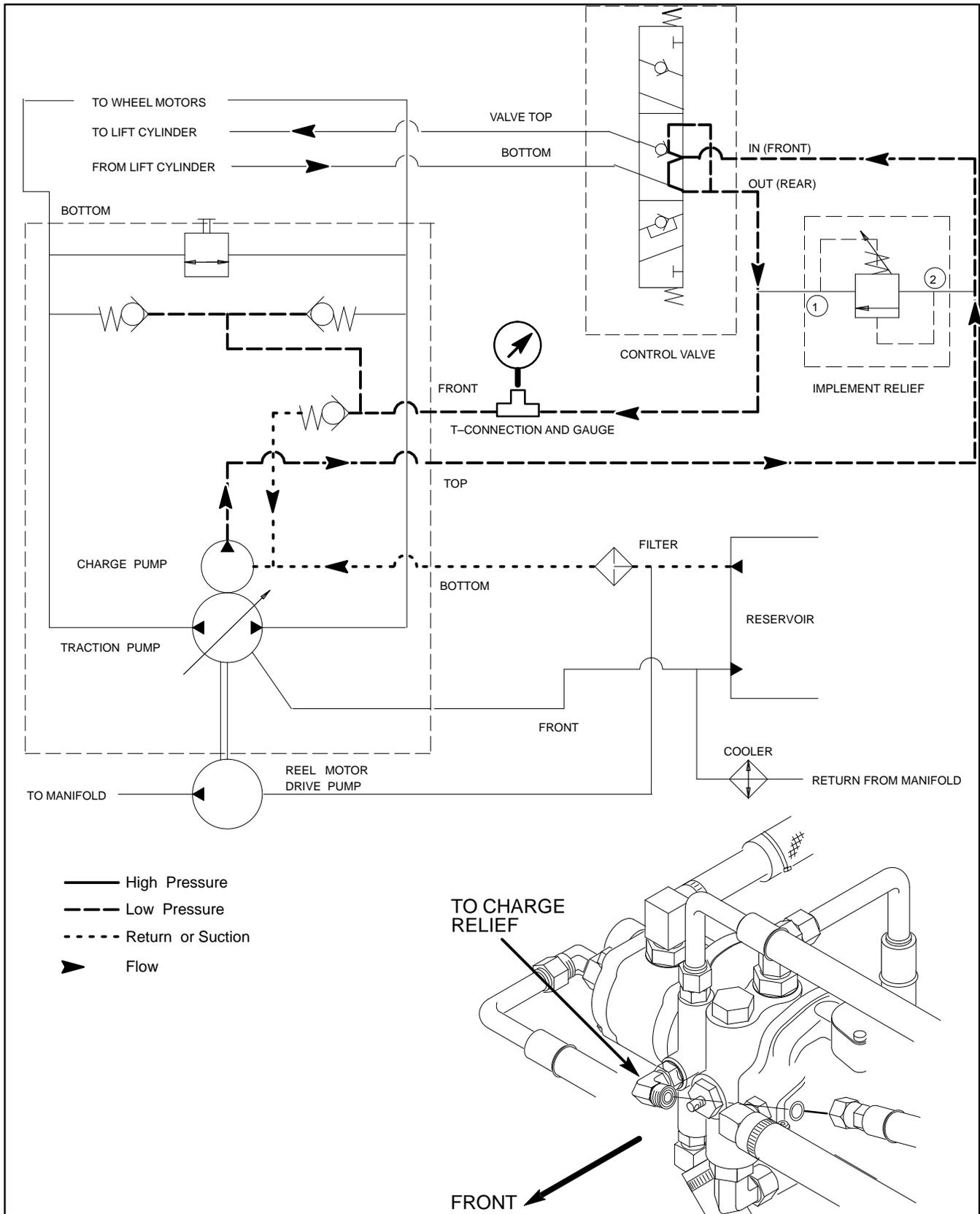


Figure 14

### Procedure for Charge Pump Relief Check:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.
3. Make sure the hydraulic tank is full.



#### CAUTION

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.**

4. Disconnect hose from the front fitting of the charge pump leading to the control valve. Connect T-connector and gauge to the pump and hose fitting.



#### CAUTION

**Make sure that all hoses are free of the fly-wheel after installation.**

5. Operate engine at full speed (**3200 ± 100 RPM**).
6. Make sure hydraulic oil is at operating temperature.
7. Make sure that traction pedal and lift valve are in neutral and the parking brake is engaged.
8. Pressure gauge should read from **100 to 150 PSI**. If Specification is not met, replace charge relief valve.
9. Shut off engine.
10. Disconnect gauge and T-connection from the pump and hose. Reconnect hose to the pump.

# TEST NO. 4: Reel Drive Pump Efficiency

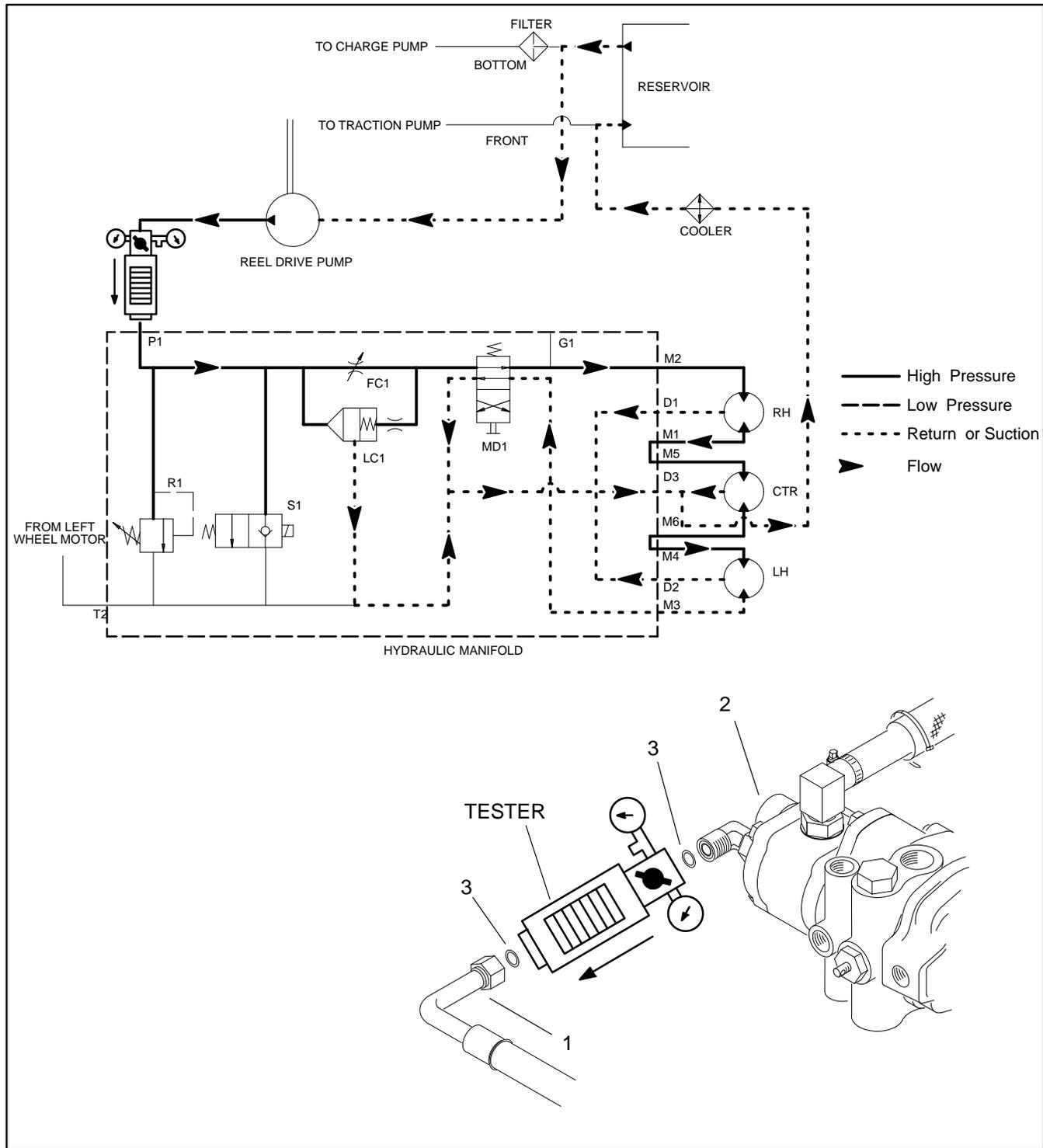


Figure 15

1. Hose fitting

2. Reel drive pump

3. O-ring

### Procedure for Reel Drive Pump Efficiency Check:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.
3. Make sure the hydraulic tank is full.



4. Clean hose connection and reel drive pump. Disconnect hose connection on the reel drive pump leading port P1 on the hydraulic manifold.

**IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the pump through the tester and into the valve block.**

5. Install tester in series with reel drive pump and the disconnected hose leading to port P1 of the hydraulic manifold. Make sure the flow control valve is fully open.
6. Make sure backlap knob on the valve block is in the **mow** position.
7. Make sure tester load valve is fully before starting the engine.
8. Start engine and move throttle to full speed (3200 ± 100 RPM). **Do not engage the cutting units.**
9. Watch pressure gauge carefully while slowly closing the flow control valve until **1500 PSI** is obtained. Verify with a phototac that the pump speed is **2900 RPM**.
10. Flow indication should be **5.4 GPM** minimum.
11. Shut off engine.
12. Disconnect tester from manifold and hose. Reconnect hose to the pump.
13. If flow was less than **5.4 GPM** or a pressure of **1500 PSI** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove pump and repair or replace as necessary.

**TEST NO. 5: Manifold Relief Valve Pressure**

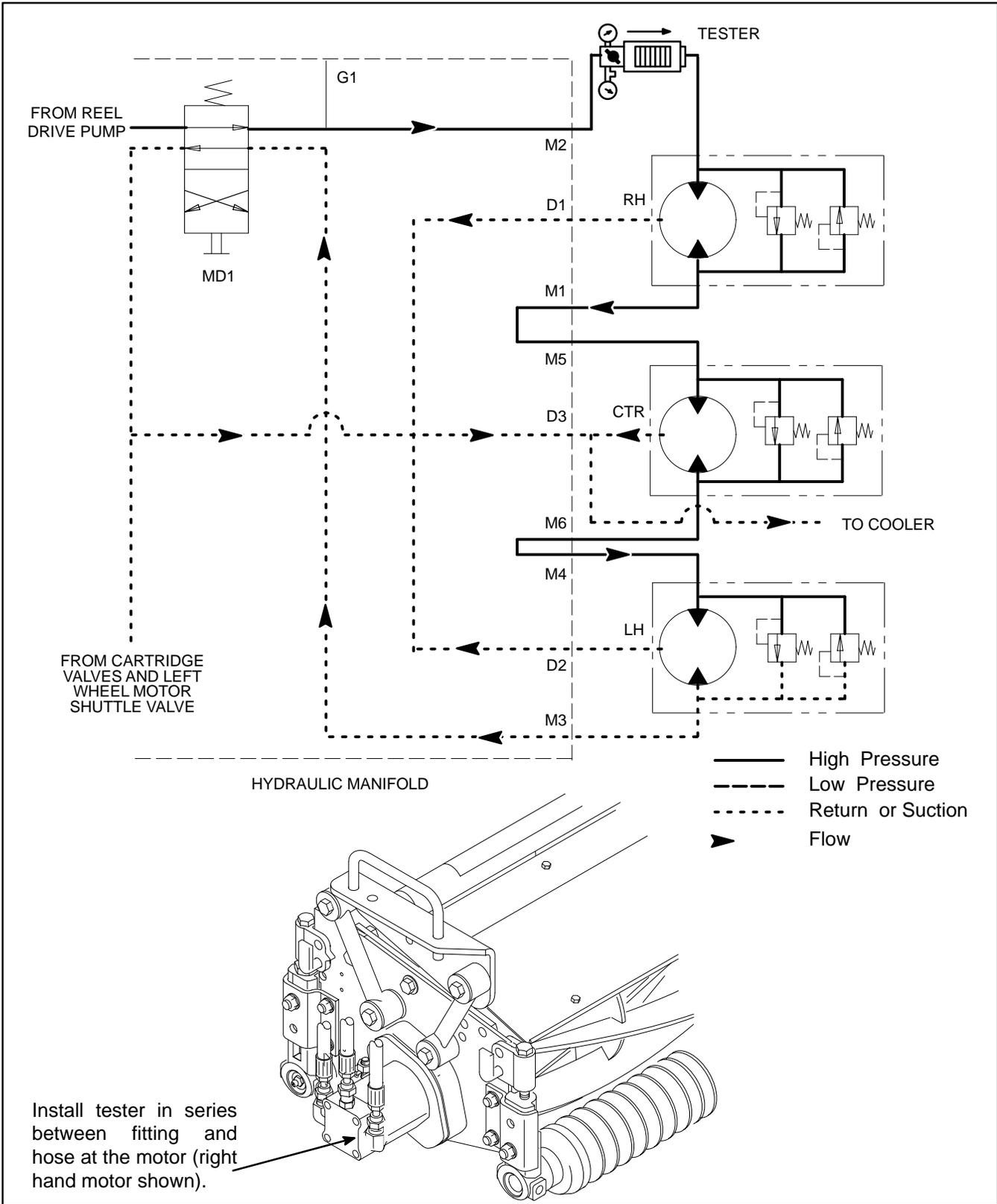


Figure 16

**Procedure for Manifold Relief Valve Pressure Check:**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.
3. Make sure the hydraulic tank is full.



4. Clean hose connection and right hand reel motor. Disconnect the hose leading from the right hand reel motor to port M2 on the hydraulic manifold.

**IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the hose through the tester and into the motor.**

5. Install tester in series with the hose and motor. Make sure the flow control valve is fully open.
6. Make sure backlap knob on the valve block is in the mow position. Make sure reel speed knob is set to position 9 or greater.



7. Start engine and move throttle to full speed (3200 ± 100 RPM). Engage the cutting units.
8. Watch pressure gauge carefully while slowly closing the flow control valve until the manifold relief opens.
9. System pressure should be from **2700 to 3300 PSI**.
  - A. If specification is not met, adjust relief valve.
  - B. If this specification is met, go to step 11.
10. Adjusting the relief valve pressure as follows:
  - A. Remove the cap from the relief valve.
  - B. To increase the relief valve pressure set point, use an allen wrench and turn set screw slightly clockwise.
  - C. To decrease the relief valve pressure set point, use an allen wrench and turn set screw slightly counterclockwise.
  - D. Repeat steps 1 through 10 above until the relief valve pressure set point is correct. Reinstall cap on valve when valve is set properly.
  - E. If the relief valve pressure set point can not be adjusted to specification, go to step 11 and replace the relief valve.
11. Disengage cutting units. Shut off engine.
12. Disconnect tester from manifold and hose. Reconnect hose to the pump.

**TEST NO. 6: Cross-over Relief Pressures**

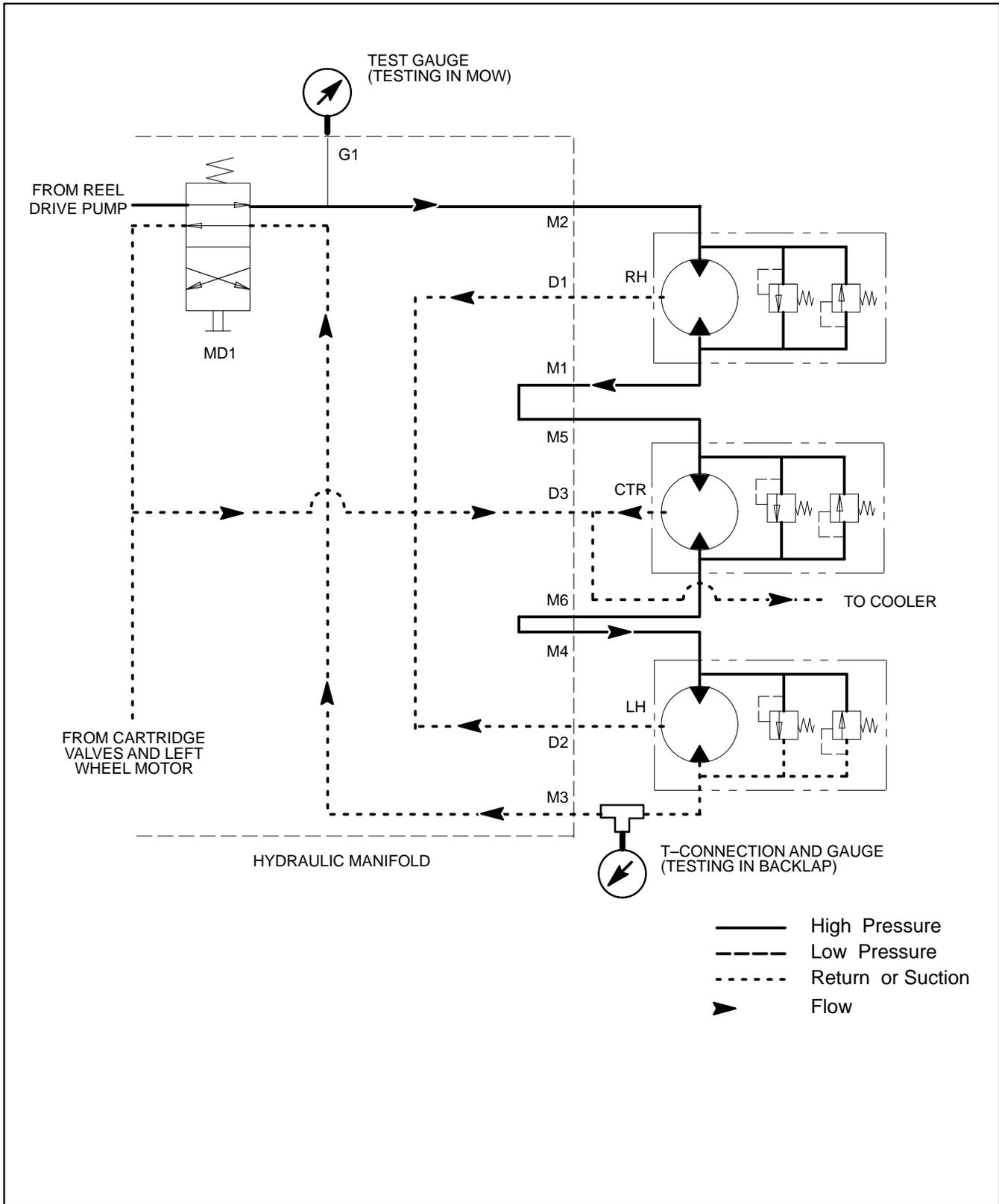


Figure 17

**Procedure for Cross-over Relief Pressures Check:**

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 with the cutting units lowered. Make sure engine is off and parking brake is engaged. Back bedknives off all reels.



**CAUTION**

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.**

3. Clean manifold port G1. Remove cap and install pressure gauge in manifold port G1.
4. Put a block of wood between the blades of the cutting unit being tested to prevent the reel from rotating.
5. Make sure backlap knob on the valve block is in the **mow** position.
6. One person should sit on the seat and operate the machine while another person reads the tester. Start engine and set throttle to full speed (3200 ± 100 RPM).



**CAUTION**

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



**CAUTION**

**Do not allow system pressure to exceed 1700 PSI. Shut off unit to prevent an over pressure condition.**

7. Engage cutting units. Observe pressure gauge.

Motor Position	Pressure Range (PSI)
Right Hand	1500 to 1600
Rear	1540 to 1640
Left Hand	1580 to 1680

8. Disengage cutting units and stop engine. If specifications are not met, replace cross-over relief. If specifications are met, remove block of wood from cutting unit and repeat test on other reels in mow direction.

9. Remove test gauge and put cap on manifold port G1.

**IMPORTANT: Each reel motor has two cross over reliefs. Test reliefs in the backlap direction only if they are expected to be the problem. After testing cross over reliefs in the backlap direction, make sure the reel motor couplings are torqued (see Hydraulic Motor Removal and Installation of Chapter 7 – Cutting Units and Reel Motor in the Service and Repair section).**

10. Clean left-hand reel motor and its hose connection leading to manifold port M3. Disconnect hose connection and install pressure gauge with a T-connection between the hose connection and the motor.

11. Make sure backlap knob on the valve block is in the **backlap** position.

12. One person should sit on the seat and operate the machine while another person reads the gauge. Start engine and move the throttle to full speed (**3200 ± 100 RPM**).



**CAUTION**

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



**CAUTION**

**Do not allow system pressure to exceed 1700 PSI. Shut off unit to prevent an over pressure condition.**

13. Engage cutting units. Observe pressure gauge.

Motor Position	Pressure Range (PSI)
Right Hand	1580 to 1680
Rear	1540 to 1640
Left Hand	1500 to 1600

14. Disengage cutting units and stop engine. If specifications are not met, the cross-over relief needs replacing. Remove block of wood from cutting unit and repeat test on other reels in the same direction of flow.

15. Remove test gauge and reconnect hose to motor. Adjust bed bedknife to reel on all cutting units (see Adjustment section of Chapter 7 – Cutting Units).

**TEST NO. 7: Reel Motor Case Drain**

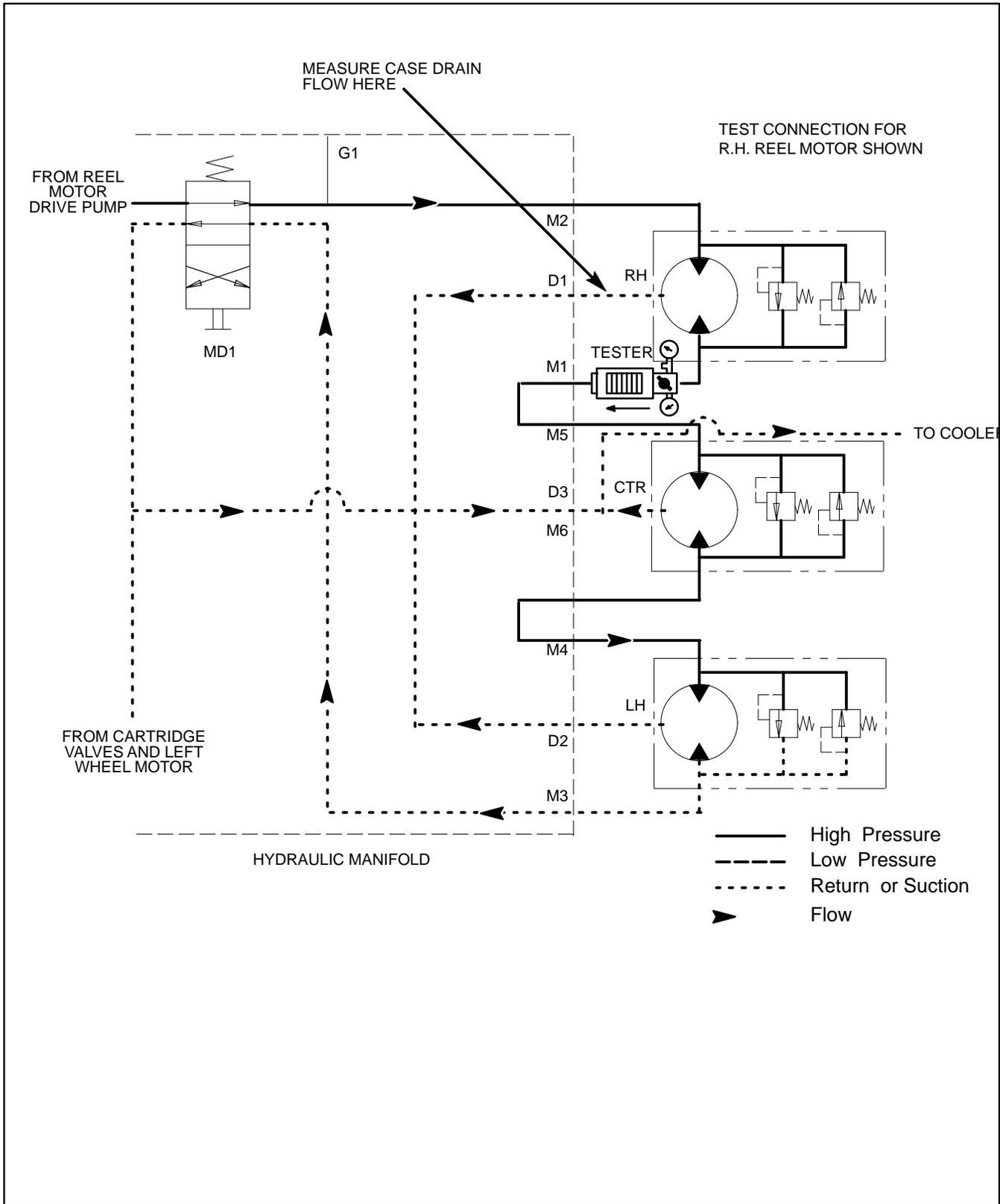


Figure 18

**Procedure for Reel Motor Case Drain Check:**

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 with the cutting units lowered. Make sure engine is off and the parking brake is engaged.



**CAUTION**

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.**

Motor Position	Manifold Port (Case Drain)	Manifold Port (Motor Return)
Right Hand	D1	M1
Left Hand	D2	M3
Rear	D3	M6

3. On suspected bad motor, clean hose connection and disconnect hose from motor that returns to the manifold (see table).

**IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor through the tester and into the hose.**

4. Install tester in series with the motor and the disconnected return hose. Make sure the flow control valve is fully open.
5. Make sure backlap knob on the valve block is in the **now** position.
6. One person should sit on the seat and operate the machine while another person reads the tester. Start engine and move the throttle to full speed (3200 ± 100 RPM).



**CAUTION**

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

7. Engage reels by pulling the knob on the instrument panel **out**. While watching pressure gauges, slowly close flow control valve until a pressure of **1200 PSI** is obtained.
8. Disengage cutting units and stop engine.
9. Clean hose fitting and disconnect hose from case drain on the manifold block (see table). Plug the manifold port.
10. Put case drain hose into 1 quart container graduated in ounces (1 liter container graduated in milliliters).
11. One person should sit on the seat and operate the machine while another person holds the hose and reads the tester. Start engine and move the throttle to full speed (3200 ± 100 RPM).
12. While sitting on seat, engage cutting units by pulling the knob on the instrument panel **out**. Make sure gauge pressure still reads **1200 PSI**. After **15** seconds, push knob on the instrument panel **in** to disengage cutting units. Stop the engine.
13. Measure the amount of oil collected in the container. Divide the number of ounces collected by **32** to get gallons per minute. (Divide the number of milliliters collected by **250** to get liters per minute).
14. Disconnect tester from motor and hose. Reconnect hose to the pump.
15. Remove cap from manifold fitting. Reconnect case drain hose to the motor.
16. If flow was greater than **0.7 GPM** (2.6 LPM), repair or replace the reel motor as necessary.

# Adjustments

## Transmission for Neutral

If the machine “creeps” when the traction control pedal is in the neutral position, the neutral return mechanism must be adjusted.

1. Block up under the frame so one of the front wheels is off the floor. Place selector control in two wheel drive position.
2. Start engine, move throttle to SLOW and check front wheel that is off shop floor; it must not be rotating. Loosen pump plate nuts and rotate pump plate until creep does not occur in either direction. When wheel stops rotating, tighten nuts locking adjustment. Verify the adjustment with throttle in SLOW and FAST position.
3. Should the wheel continue to rotate, check for the following:
  - A. Ball bearing is loose or worn out.
  - B. Loose or missing fasteners.
  - C. Worn fasteners.
  - D. Pump lever loose on control shaft.
  - E. Weak or damaged leaf springs. Replace.
  - F. Internal pump component malfunction.
4. After adjusting the pump plate, check neutral switch operation and if necessary, adjust as follows:
  - A. Loosen locknut securing switch adjusting screw. Thread away from switch until capscrew head clears switch.
  - B. Rotate adjusting screw toward switch until circuit through switch is made. Then, turn adjusting screw an additional 2–1/2 turns.
  - C. Tighten locknut

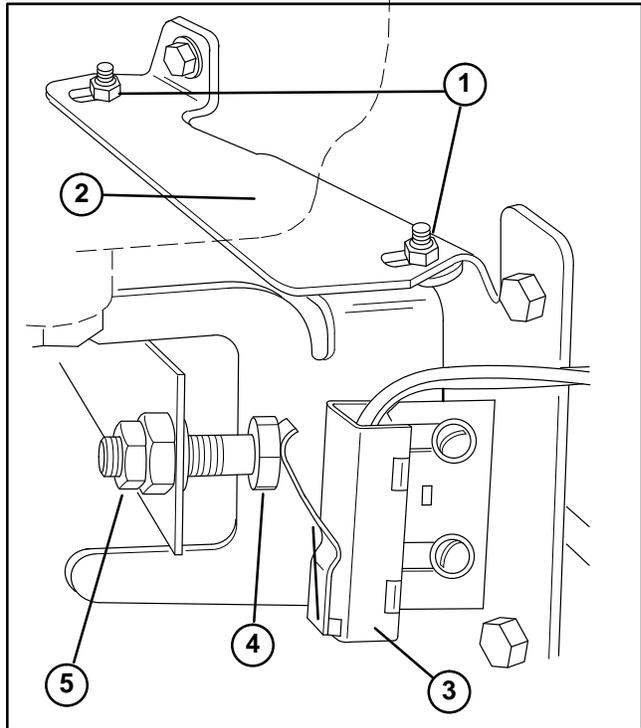


Figure 19

- |                   |                    |
|-------------------|--------------------|
| 1. Pump plate nut | 4. Adjusting screw |
| 2. Pump           | 5. Lock nut        |
| 3. Neutral switch |                    |

## Traction Pedal

If traction pedal stop cam contacts the footrest when pushed fully forward or maximum forward traction speed is unattainable, an adjustment to the traction pedal linkage is required.

1. To expose traction rod, remove screws securing right fender to frame and remove fender.
2. Loosen jam nuts on each end of traction rod.
3. Rotate rod until pedal stop cam clearance is from 0.03 to 0.09 inch (0.8 to 2.3 mm) with the pedal depressed.
4. Retighten jam nuts securing traction rod adjustment.

**IMPORTANT: Verify reverse speed with one front wheel off the ground in 2WD and the engine at high idle. Reverse wheel speed should be from 120 to 140 RPM. Damage may result to rear motor if this speed is exceeded.**

5. The stop for reverse travel (under pedal) may be adjusted for slower travel.

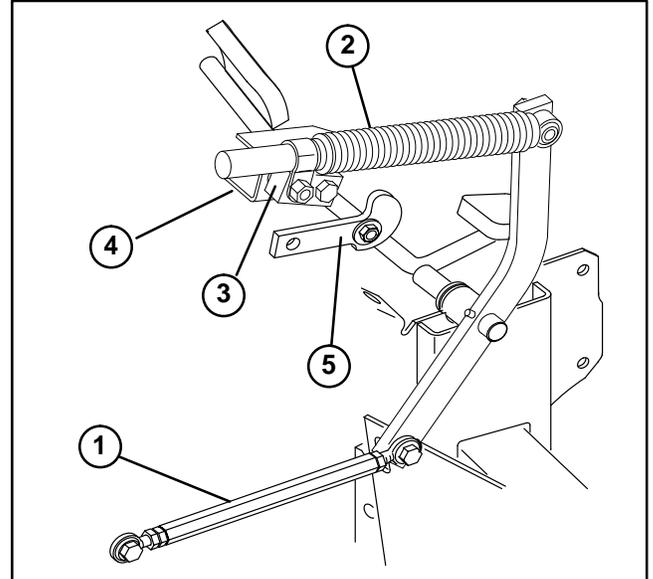


Figure 20

- |                 |                   |
|-----------------|-------------------|
| 1. Traction rod | 4. Damper bracket |
| 2. Damper       | 5. Pedal cam stop |
| 3. Damper pivot |                   |

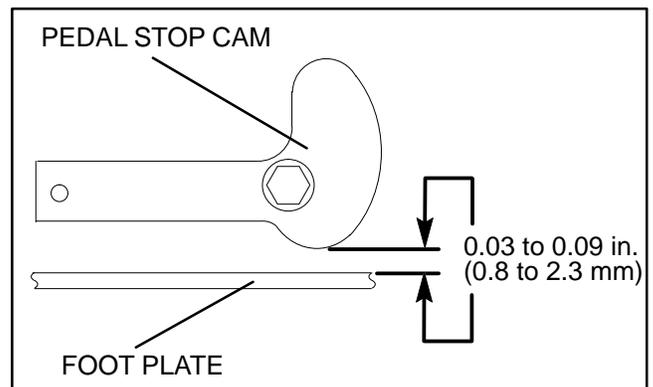


Figure 21

## Traction Pedal Damper (Fig. 20)

1. To expose traction pedal damper, remove right hand panel.
2. Loosen locknut securing damper pivot to the damper bracket.
3. Depress traction pedal fully forward and hold.
4. Fully compress damper and then release it allowing it to extend 0.08 inch (2.0 mm). Tighten locknut securing the damper pivot to the damper bracket.
5. When traction pedal is fully depressed in reverse direction, traction pedal must contact reverse stop so the damper does not act as the stop in either direction.

## Hydraulic Pump Drive Belt

Make sure pump belt is properly tensioned to assure proper operation of the machine and prevent unnecessary wear. On new belts, check tension after 8 hours operation.

A new hydraulic pump belt should be tensioned so it deflects 0.120 inch with a 15 to 17 pound load applied midway in span of belt. A used belt should be tensioned so that it deflects 0.120 inch with a 11 to 13 pound load applied midway in span of belt.

**Note:** Tighten belt to eliminate slippage (squealing under load) but do not overtighten.

1. Tighten nut on adjustment rod until desired belt tension is attained.

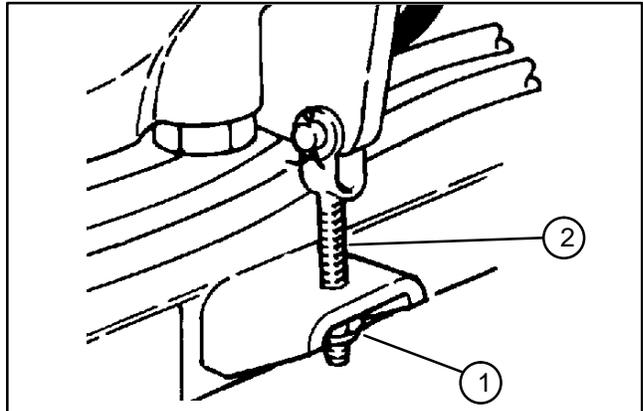


Figure 22

1. Nut

2. Adjustment rod

# Service and Repairs

## Traction/Charge Pump

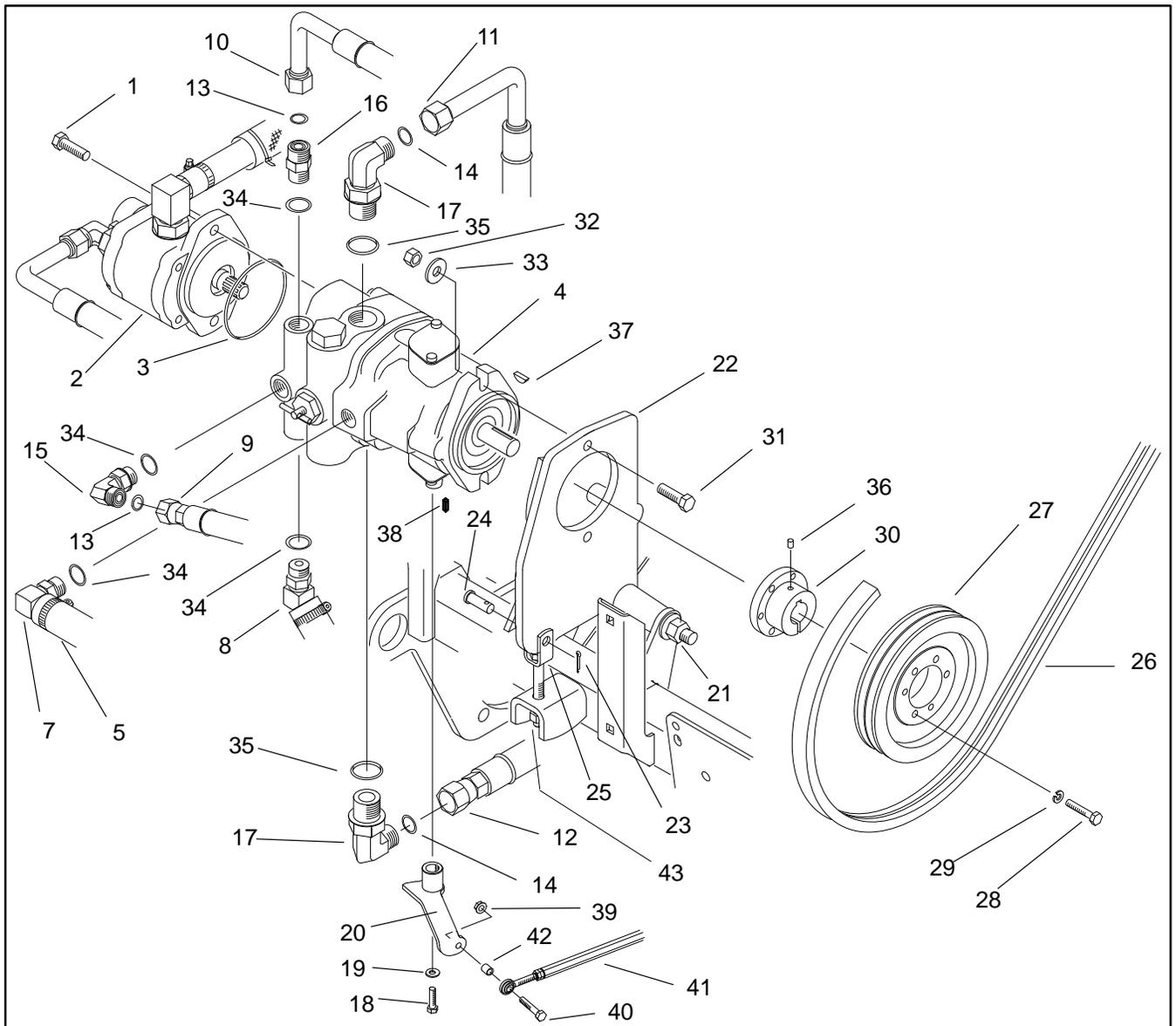


Figure 23

- |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|
| 1. Cap screw             | 16. Hydraulic fitting    | 30. Tapered lock bushing |
| 2. Reel motor drive pump | 17. Hydraulic fitting    | 31. Cap screw            |
| 3. O-ring                | 18. Cap screw            | 32. Lock nut             |
| 4. Traction/charge pump  | 19. Flat washer          | 33. Washer               |
| 5. Hose                  | 20. Pump lever assembly  | 34. O-ring               |
| 6. Hose                  | 21. Lock nut             | 35. O-ring               |
| 7. Hydraulic fitting     | 22. Pump mount           | 36. Set screw            |
| 8. Hydraulic fitting     | 23. Cotter pin           | 37. Key                  |
| 9. Hose connection       | 24. Clevis pin           | 38. Key                  |
| 10. Hose connection      | 25. Belt adjustment yoke | 39. Lock nut             |
| 11. Hose connection      | 26. Pump drive belt      | 40. Cap screw            |
| 12. Hose connection      | 27. Pulley               | 41. Pump control rod     |
| 13. O-ring               | 28. Cap screw            | 42. Spacer               |
| 14. O-ring               | 29. Lock washer          | 43. Nut                  |
| 15. Hydraulic fitting    |                          |                          |

Hydraulic System

## Removal (Fig. 23)

1. Before removing any parts, park the machine on a level surface, engage parking brake, lower cutting units and stop engine. Remove key from the ignition switch.



2. Clean pump assembly and hydraulic connections. Label all hose connections for reassembly purposes. Put caps or plugs on any hydraulic lines or fittings left open or exposed. Install plug into the hydraulic reservoir.

3. Remove both cap screws (1) from the pump assembly. Carefully separate the reel motor drive pump (2) and O-ring (3) from the traction/charge pump (4). Position reel motor drive pump away from traction/charge pump.

4. Remove hoses (5 and 6) from hydraulic fittings (7 and 8). Remove hose connections (9, 10, 11, and 12) from hydraulic fittings (15, 16, and 17). Allow hoses to drain to a suitable container.

5. Remove cap screw (40) and lock nut (39) from the pump control rod (41), spacer (42), and pump lever assembly (20).

6. Loosen lock nut (21) at the pump mount (22) and nut (43) at the belt adjustment yoke (25). Remove cotter pin (23) and clevis pin (24) from the belt adjustment yoke.

7. Tilt pump mount (22) and remove pump drive belt (26) from the pulley (27).

8. Remove cap screws (28) and lock washers (29) from the pulley (27) and taper lock bushing (30). Run cap screws into tapped holes in the pulley, then drive pulley off the taper lock bushing.

9. Support traction/charge pump (4). Remove both cap screws (31), lock nuts (32), and washers (33) from the traction/charge pump and pump mount (22). Separate traction/charge pump from the pump mount.

**Note:** Steps 10 and 11 may be performed depending on the extent of the pump repair.

10. Remove fittings (7, 8, 15, 16, and 17) and O-rings (34 and 35) from the traction/charge pump (4).

11. Unscrew set screw (36) enough to loosen tapered lock bushing (30). Slide tapered lock bushing off the pump shaft. Remove key (37) from pump shaft.

## Installation (Fig. 23)

1. Mount the traction/charge pump (4) to the pump mount (22). Place both cap screws (31) through the pump mount and pump base. Install washers (33) and lock nuts (32) onto cap screws. Tighten cap screws.

2. Place key (37) in the keyway on the pump shaft. Slide taper lock bushing (30) into place on the pump shaft. Tighten set screw (36).

3. Insert cap screws (28) through washers (29) and pulley (27). Install pulley to taper lock bushing (30). Start cap screws into bushing and leave cap screws loose.

4. Loosen set screw (36) and adjust pulley (27) so the gap between the pulley and pump mount is 0.20 inch. Evenly torque cap screws from 90 to 120 in-lb. (104 to 138 kg-cm) three times each. Readjust as required.

5. Make sure mounting and O-ring sealing surfaces on reel motor drive pump (2) and traction/charge pump (4) are clean.

6. Inspect O-ring (3) and replace if damaged or worn. Apply clean hydraulic oil to O-ring. Place O-ring on reel motor drive pump (2).

7. Position reel motor drive pump (1) to traction/charge pump (4). Secure reel motor drive pump to traction/charge pump with cap screws (1).

8. Coat all O-rings with clean hydraulic oil. Install hydraulic fittings (7, 8, 15, and 16) and O-rings (34) into the traction/charge pump (4). Torque these fittings from 23 to 27 ft-lb and as close to their original position.

9. Coat all O-rings with clean hydraulic oil. Install hydraulic fittings (17) and O-rings (35) into the traction/charge pump (4). Tighten these fittings as close to their original position as possible.

10. Connect hoses (5 and 6) to hydraulic fittings (7 and 8); tighten both hose clamps. Connect hose connections (9, 10, 11, and 12) to hydraulic fittings (15, 16, and 17). Tighten all hose connections.

11. Replace cap screw (40) through the pump control rod (41), spacer (42) and pump lever assembly (20). Secure lock nut (39) to the capscrew and tighten.

12. Install pump drive belt (26) onto pulley (27). Align the holes of the mounting plate (22) with the holes of the belt adjustment yoke (25) and slide clevis pin (24) through holes. Secure clevis pin with the cotter pin (23).

13. Adjust pump drive belt (see Adjustments section). Tighten lock nut (21) and torque from 60 to 70 ft-lb (8.3 to 9.7 kg-m).

14. Remove plug from the hydraulic reservoir.

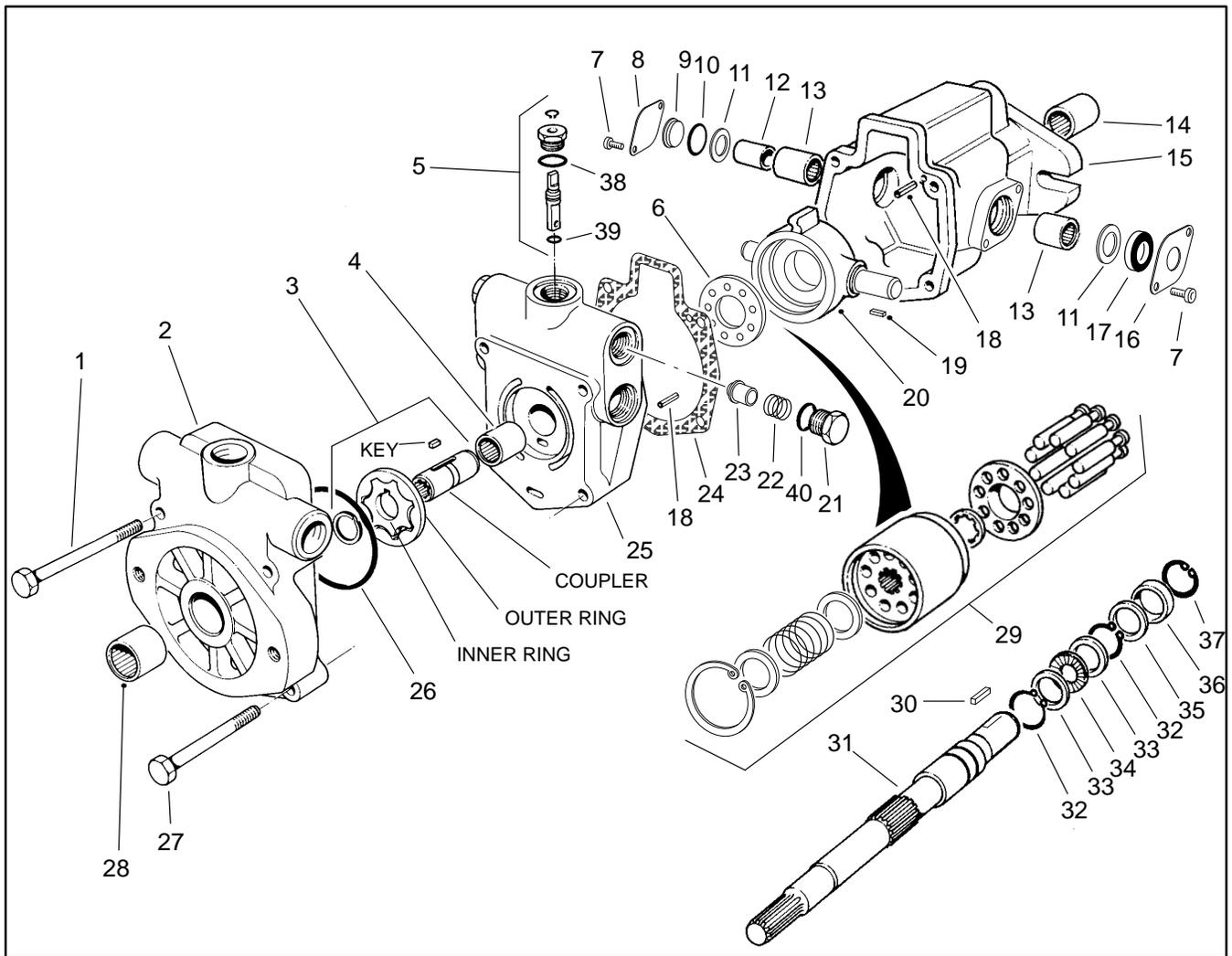


Figure 24

- |                                 |                        |                        |
|---------------------------------|------------------------|------------------------|
| 1. Cap screw                    | 15. Housing assembly   | 28. Bearing            |
| 2. Charge pump adapter assembly | 16. Seal cover         | 29. Rotating parts kit |
| 3. Gerotor assembly             | 17. Shaft seal         | 30. Key                |
| 4. Bearing                      | 18. Dowel pin          | 31. Drive shaft        |
| 5. Valve assembly               | 19. Key                | 32. Retaining ring     |
| 6. Valve plate                  | 20. Camplate           | 33. Bearing race       |
| 7. Screw                        | 21. Plug               | 34. Thrust bearing     |
| 8. Trunnion cover               | 22. Spring             | 35. Washer             |
| 9. O-ring cover                 | 23. Seat               | 36. Shaft seal         |
| 10. O-ring                      | 24. Gasket             | 37. Retaining ring     |
| 11. Washer                      | 25. Backplate assembly | 38. O-ring             |
| 12. Inner race                  | 26. O-ring             | 39. O-ring             |
| 13. Bearing                     | 27. Cap screw          | 40. O-ring             |
| 14. Bearing                     |                        |                        |

### Disassembly (Fig. 24)

1. Position pump into a vise with protected jaws so the charge pump drive shaft is pointed up. Clamp onto the mounting flange of the traction pump.
2. Remove cap screws (1 and 27) and slide charge pump adapter assembly (2) from the backplate assembly (25) clear of the shaft (31) and gerotor assembly (3).
3. Remove O-ring (26) from the charge pump adapter assembly (2).
4. Remove outer ring from either the inner ring of the gerotor assembly (3) or the charge pump adapter assembly (2). Further disassembly of the gerotor assembly is not necessary.

5. The charge pump adapter assembly (2) can be disassembled as follows (see Fig. 25):

- A. Unscrew and remove spring retainer from the charge pump adapter assembly.
- B. Remove spring and cup poppet from the charge pump adapter assembly.

6. Remove gerotor assembly (3) inner ring and coupler from the shaft (31).

7. Lift backplate assembly (25) up and off from the shaft (31) and housing assembly (15). Remove valve plate (6) from the backplate assembly or rotating parts kit (29).

8. Remove valve assembly (5) and O-rings (38 and 39) from the backplate assembly (25). Disassembly of the valve assembly is not necessary.

9. Remove both plugs (21), O-rings (40), spring (22), and seats (23) from the backplate assembly (25).

10. Remove gasket (24) from the housing (15) or backplate assembly (25).

**Note:** To remove the rotating parts kit (29) from the shaft (31), a table or workbench with a hole in the working surface is required for the protruding shaft.

11. The rotating parts kit (29) can be removed from the shaft (31) as follows:

- A. Hold rotating parts kit (29) in place and remove the pump from the vise.
- B. Position the housing assembly (15) end of the pump up and lower the shaft (31) through the hole in the table or workbench. Allow rotating parts kit (29) to rest on the table.
- C. Remove rotating parts kit (29) by lifting away the housing assembly (15) and shaft (31).

12. The rotating parts kit (29) can be disassembled as follows (see Fig. 26):

- A. Remove nine piston assemblies, spider, and spider pivot from the piston block.

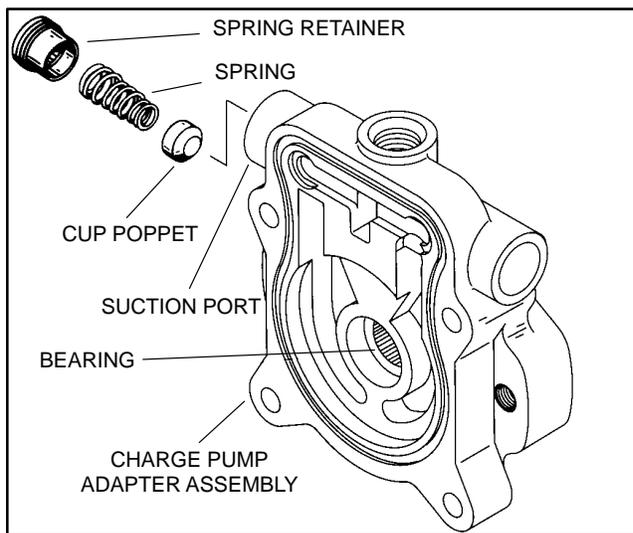


Figure 25

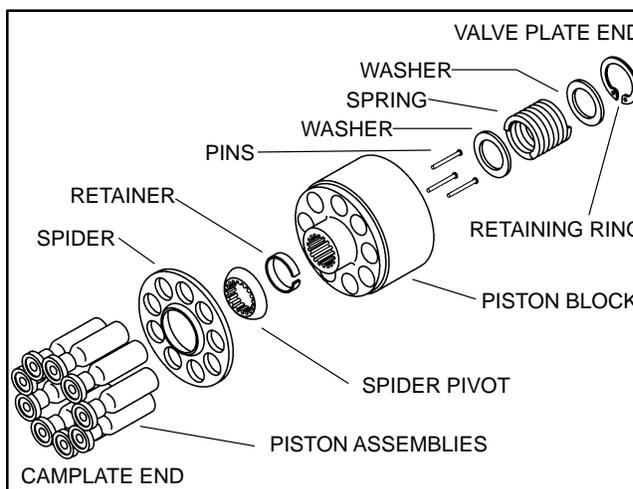


Figure 26

B. Use the following parts to disassemble the piston block:

- 2 5/16 in. I.D. × 15/16 in. O.D. flat washers
- 1 5/16 in. × 2-7/8 in. N.C. cap screw
- 1 5/16 in. N.C. nut

C. Place cap screw through one of the flat washers. Insert cap screw through the center of the piston block. Install second flat washer onto the cap screw so the washer rests on the three pins. Screw nut onto the cap screw.

D. Compress spring by tightening the nut onto the cap screw. Remove the retaining ring from the piston block.

E. Slide washer, spring, second washer, three pins, and retainer from the piston block.

**CAUTION**

**Be careful when removing the spring from the piston block; the spring is highly compressed. Safely compress the spring before removing the retaining ring.**

13. Remove retaining ring (37) from the bore on the flange end of the housing assembly (15). Press the shaft (31), shaft seal (36), and washer (35) from the housing assembly.

14. Remove retaining ring (32), washer (35), thrust bearing (34), second washer (35), and second retaining ring (32) from the shaft (31).

15. Remove screws (7), trunnion cover (8), O-ring cover (9), O-ring (10), washer (11), inner race (12), and bearing (13). Remove screws (7), seal cover (16), shaft seal (17), washer (11), and bearing (13).

16. Position camplate (20) to one side and remove from the housing assembly (15).

### Inspection



1. Wash all parts in solvent. Dry parts with compressed air.

2. Inspect charge pump adapter assembly (see Fig. 25).

A. Check relief valve seat inside suction port. Make sure that seat is smooth and free of burrs or other defects. Relief valve spring must not be damaged.

B. Bearing needles must remain in bearing cage and move freely. Verify that bearing depth on the flange side meets the dimension in Figure 27.

C. Make sure gerotor pocket inside the pump is not excessively scored.

3. Inspect backplate assembly (25) (see Fig. 24).

A. Bearing needles must remain in bearing cage and move freely. Verify that bearing height on the numbered end meets the dimension in Figure 28.

B. Check that the roll pin is tight and meets the height in Figure 28.

C. Replace entire assembly as a unit.

4. Inspect camplate assembly (20) (see Fig. 24). There should be no signs of scoring on the piston shoe surfaces.

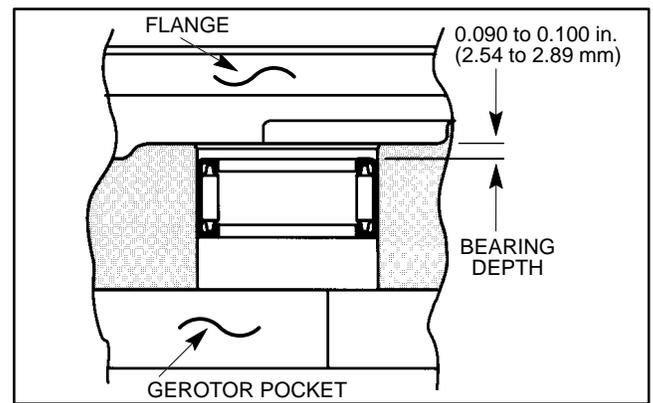


Figure 27

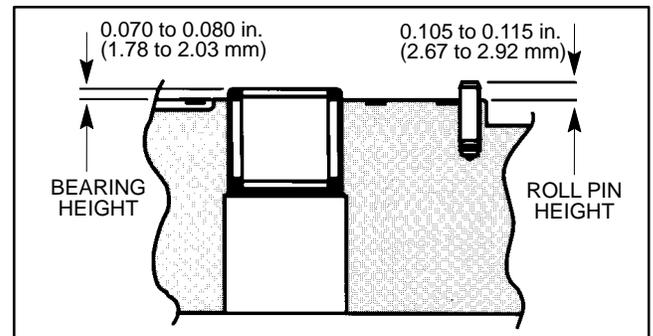


Figure 28

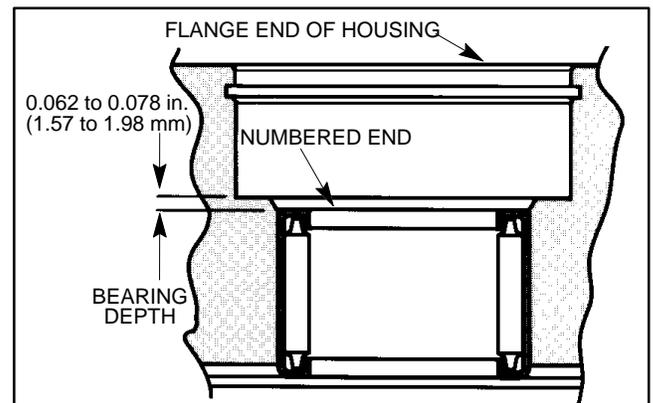


Figure 29

5. Inspect housing assembly (15) (see Fig. 24).

A. Verify that bearing depth on the numbered end meets the dimension in Figure 29.

B. Bearing needles must move freely and remain in their cage.

6. Inspect rotating parts kit (see Fig. 26).

A. Verify that piston O.D. finish shows no wear or deep scratches. Piston shoes should fit snugly onto the ball end of the pistons. The shoe surface that contacts the camplate should be smooth and flat. **Do not lap piston shoes.**

B. Examine the mutual contact surfaces on the spider and spider pivot; both contact areas should be smooth and free of wear.

C. The piston block surface that makes contact with the valve plate should be smooth and free of deep scratches. **Do not lap piston shoes.**

D. The bore areas of the piston block should be free of scoring and contamination. Pistons should move freely in the bore areas.

### Reassembly (Fig. 24)

1. Make sure all parts are clean. Lubricate all critical moving parts and O-rings with clean hydraulic oil.

2. If necessary, press new bearing (14) into housing assembly (15) to the dimension shown in Figure 29.

3. Insert camplate (20) into the housing assembly (15).

4. On the short trunnion side of the camplate (20), install bearing (13) with numbered side to the inside of the pump. Install inner race (12) with the chamfer towards the inside of the pump. Install washer (11), O-ring (10), O-ring cover (9), and trunnion cover (8). Secure trunnion cover with two screws (7) torque them from 36 to 48 in-lb (42 to 55 kg-cm).

5. On the long trunnion side of the camplate (20), install bearing (13) with numbered side to the inside of the pump. Install washer (11) and press shaft seal (17) into place. Secure seal cover (16) with two screws (7) and torque them from 36 to 48 in-lb (42 to 55 kg-cm).

6. Install retaining ring (32) towards the keyed end of the shaft (31). Slide washer (33), thrust bearing (34), second washer (33), and second retaining ring (32) into place over the splined end of the shaft.

7. Position washer (35) and shaft seal (36) onto the shaft (31) from the keyed end.

8. Install shaft (31) into the housing assembly (15) from the flanged end. Press shaft seal (36) into position with a seal driver. Install retaining ring (37) into the flanged end of the housing assembly (15).

9. Reassemble rotating parts kit as follows (Fig. 26):

A. Use the following parts to reassemble the piston block:

2 5/16 in. I.D. × 15/16 in. O.D. flat washers

1 5/16 in. × 2-7/8 in. N.C. cap screw

1 5/16 in. N.C. nut

B. Compress retainer and install into the spline of the piston block.

C. Position the head end of pins towards the inside of the block. Install the three pins into the special grooves in the piston block.

D. Install a washer, spring, and second washer into the piston block.

E. Place cap screw through one of the flat washers. Insert cap screw through the center of the piston block. Install second flat washer onto the cap screw so the washer rests on the three pins. Screw nut onto the cap screw.

F. Compress spring by tightening the nut onto the cap screw. Install the retaining ring into the piston block.

G. Unscrew the nut and remove washer and cap screw from the piston block.

H. Install spider pivot onto the three pins and place the spider on the spider pivot.

I. Insert piston assemblies through the spider and into the piston block with the piston shoes resting on the spider.

10. Set rotating kit assembly (29) on a working surface with the piston shoes facing up. Insert shaft (31) through the rotating kit assembly with the flanged end of the housing assembly up. Position rotating kit assembly into the housing assembly.

11. Make sure piston block and shaft (31) splines are aligned. Make sure piston block is engaged fully so the piston shoes are in contact with the camplate (20). **Make sure all parts are in their proper position before proceeding to the next step.**

12. Hold rotating kit assembly (29) in place, and clamp housing assembly (15) with the flange end down into a vise with protected jaws. Install gasket (24) and two dowel pins (18) into the housing assembly (15).

13. If necessary, press new bearing (4) or roll pin into backplate assembly (25) to the dimension shown in Figure 28. Bearing should be installed with numbered end outward. Roll pin should be installed with split oriented away from the bearing.

14. Install seat (23) and spring (22) into backplate (25). Install new O-ring (40) and plug (21) into the backplate assembly. Torque plug from 95 to 105 ft-lb (13.1 to 14.5 kg-m).
15. Install new O-rings (38 and 39) and valve assembly (5) into the backplate assembly (25). Torque valve assembly from 27 to 30 ft-lb (3.7 to 4.1 kg-m).
16. Coat valve plate (6) with light coat of petroleum jelly on the steel side. Align the valve plate to the roll pin on the backplate (25). Install steel side of the valve plate to the backplate.
17. Install backplate assembly (25) to the housing assembly (15). Make sure gasket (24), valve plate (6), and dowel pins (18) stay in place.
18. Install inner ring and coupler of gerotor assembly (3) into the backplate assembly (25) so that the V-groove on the coupler end enters the backplate assembly first. Lubricate the inner ring of the gerotor.
19. Reassemble charge pump adapter assembly (2) as follows (see Fig. 25):
  - A. Install cup poppet, spring, and spring retainer into the charge pump adapter assembly.
  - B. Torque retainer from 5 to 7 ft-lb (0.7 to 1.0 kg-m).
20. Coat O-ring (26) and outer ring of gerotor assembly (3) with a light coat of petroleum jelly. Install O-ring and outer ring onto the charge pump adapter assembly (2). Install charge pump adapter plate onto the backplate assembly (25). Make sure O-ring and outer ring of gerotor assembly stay in place.
21. Secure charge pump adapter assembly (2) and backplate assembly (25) to the housing assembly (15) with cap screws (1 and 27). Torque cap screws from 17 to 20 ft-lb ( 2.3 to 22.8 kg-m).

## Wheel Motor

### Front Wheel Removal (Fig. 30)

1. Before removing any parts from the hydraulic system, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



### CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove wheel and brake assembly from unit (see Repair section of Chapter 6 – Wheels and Brakes).

3. Clean wheel motor (1) and hydraulic connections. Label all tube hose connections for reassembly purposes. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

4. Disconnect tube connections (2 and 3) from hydraulic fittings (5 and 6). On the left-hand wheel motor, also disconnect hose connection (4) from hydraulic fitting (7). Allow hydraulic oil to drain from tubes and hose into a suitable container.

5. Support wheel motor (1). Remove four cap screws (10) and lock nuts (11) from support frame (12). Remove brake bracket (13), grass shield (14), and spacers (15). Pull wheel motor from the support frame.

6. Remove hydraulic fittings (5 and 6) and O-ring from the wheel motor (1). On the left-hand wheel motor, also remove hydraulic fitting (7) from the wheel motor.

### Front Wheel Installation (Fig. 30)

1. Place and support wheel motor (1) into the support frame (12). Insert four cap screws (10) through the support frame and wheel motor.

2. Slide spacers (15), grass shield (14), and brake bracket (13) onto the cap screws (10) and wheel motor (1). Tighten lock nuts (11) onto cap screws.

3. Install hydraulic fittings (5 and 6) onto the wheel motor (1). On the left-hand wheel motor, also install hydraulic fitting (7) onto the wheel motor. Tighten hydraulic fittings.

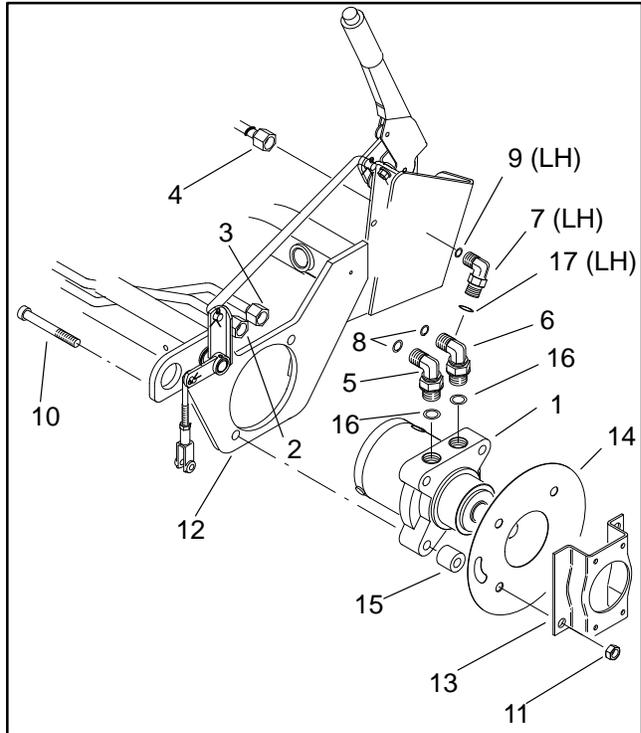


Figure 30

- |                      |                   |
|----------------------|-------------------|
| 1. Wheel motor       | 10. Cap screw     |
| 2. Tube connection   | 11. Lock nut      |
| 3. Tube connection   | 12. Support frame |
| 4. Hose connection   | 13. Brake bracket |
| 5. Hydraulic fitting | 14. Grass shield  |
| 6. Hydraulic fitting | 15. Spacer        |
| 7. Hydraulic fitting | 16. O-ring        |
| 8. O-ring            | 17. O-ring        |
| 9. O-ring            |                   |

4. Install tube connections (2 and 3) to hydraulic fittings (5 and 6). On the left-hand motor, also install hose connection (4) to hydraulic fitting (7). Tighten connections.

5. Install wheel and brake to unit (see Repair section of Chapter 6 – Wheels and Brakes).

### 3WD Rear Wheel Removal (Fig. 31)

1. Before removing any parts from the hydraulic system, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



2. Clean wheel motor (1) and hydraulic connection. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

3. Remove wheel and wheel hub from unit (see Repair section of Chapter 6 – Wheels and Brakes).

4. Disconnect hose connection (2) from hydraulic fittings (3). Remove O-ring (4). Allow hydraulic oil to drain from the hose into a suitable container.

5. Support wheel motor (1). Remove four cap screws (5) and lock nuts (6) from the rear wheel fork (7). Pull wheel motor from the rear wheel fork.

6. Remove hydraulic fitting (3) and O-ring (8) from the wheel motor (1).

### Rear Wheel Installation (Fig. 31)

1. Place and support wheel motor (1) into the rear wheel fork (7). Insert four cap screws (5) through the rear wheel fork and wheel motor.

2. Tighten lock nuts (6) onto cap screws (5).

3. Install hydraulic fitting (3) and O-ring (8) onto the wheel motor (1). Tighten hydraulic fitting.

4. Install O-ring (4) while connecting hose connections (2) onto the hydraulic fitting (8). Tighten connection.

5. Install wheel and wheel hub to unit (see Repair section of Chapter 6 – Wheels and Brakes).

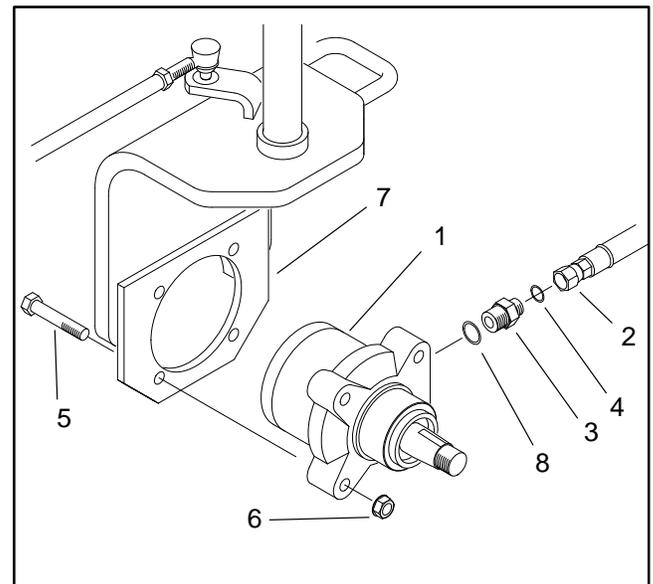


Figure 31

- |                      |                    |
|----------------------|--------------------|
| 1. Wheel motor       | 5. Cap screw       |
| 2. Hose connection   | 6. Lock nut        |
| 3. Hydraulic fitting | 7. Rear wheel fork |
| 4. O-ring            | 8. O-ring          |

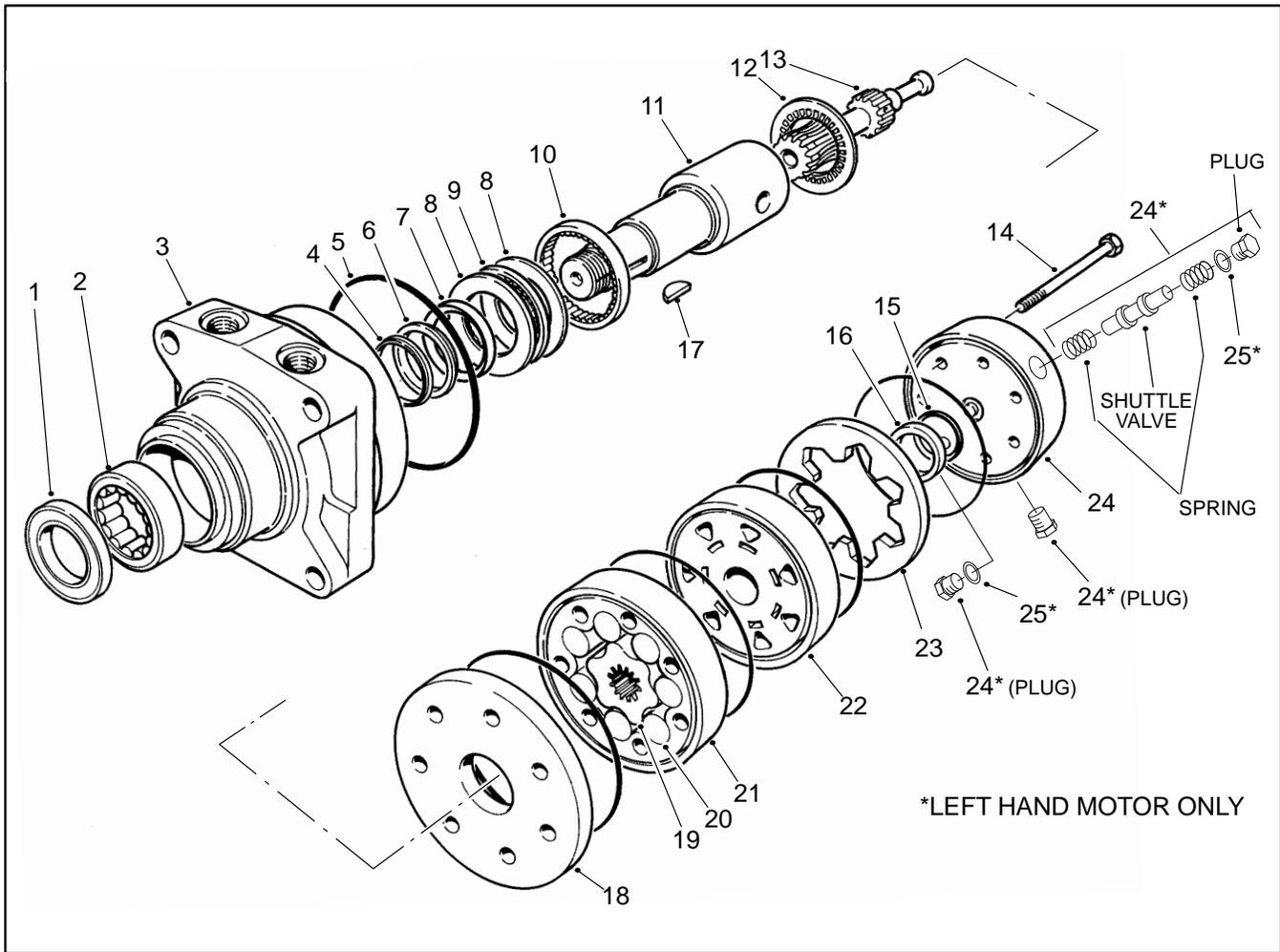


Figure 32

- 1. Dirt and water seal
- 2. Outer bearing
- 3. Housing
- 4. Backup washer
- 5. Seal ring
- 6. Backup washer
- 7. Inner seal
- 8. Thrust washer
- 9. Thrust bearing

- 10. Inner bearing
- 11. Coupling shaft
- 12. Thrust bearing
- 13. Drive link
- 14. Cap screw
- 15. Commutator seal
- 16. Commutator
- 17. Woodruff key

- 18. Wear plate
- 19. Rotor
- 20. Vane
- 21. Stator
- 22. Manifold
- 23. Commutator ring
- 24. End cover assembly
- 25. O-ring

\*LEFT HAND MOTOR ONLY

Disassembly (Fig. 32)



**WARNING**

If the wheel motor is not held firmly in the vise, it could dislodge during service and cause injury.

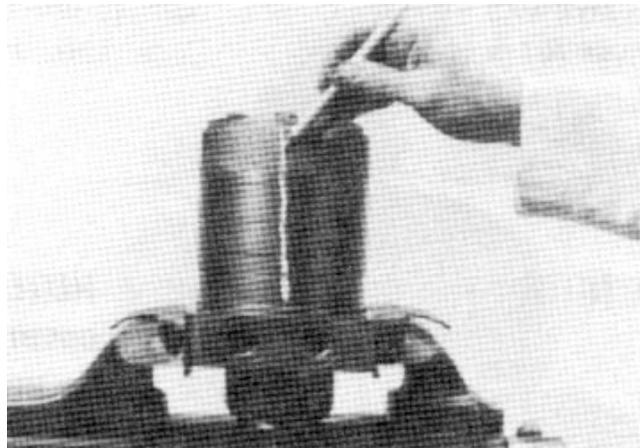


Figure 33

1. Place wheel motor in a soft jawed vise with the coupling shaft (11) pointed down and the vise jaws clamping firmly on the sides of the housing (3).
2. Scribe an alignment mark down and across the wheel motor components from the end cover (24) to the housing (3) for facilitating reassembly (Fig. 33). If included in end cover, loosen both shuttle valve plugs (left-hand motor only) for disassembly later.

3. Remove seven cap screws (14). Remove end cover assembly (24) and seal ring (5).

**Note:** Be ready to catch the shuttle valve or relief valve components that will fall out of the end cover valve cavity when the plugs are removed.

**Note:** O-ring (25) is not included in the seal kit, but can be serviced separately if required.

**Note:** The insert and, if included, the orifice plug in the end cover assembly (24) must not be removed as they are serviced as an integral part of the end cover.

4. If the end cover (24) is equipped with shuttle valve components (left-hand motor only), remove both previously loosened plugs and O-rings (25).

5. Remove commutator ring (23).



6. Remove commutator (16) and commutator seal (15). Remove commutator seal from the commutator using an air hose to blow air into the ring groove until the commutator seal is lifted out (Fig. 34)

**Note:** The manifold (22) is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to make sure that same surface is reassembled against the rotor set.

7. Remove manifold (22). Remove seal rings (5) that are on both sides of the manifold.

**Note:** The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures.

**Note:** Marking all rotor components and mating spline components for exact repositioning at assembly will make sure maximum wear life and performance of rotor set and wheel motor.

8. Mark surface of rotor (19) and stator (21) that is facing up with etching ink or a grease pencil before removing from the wheel motor. This will make sure correct reassembly of the rotor into the stator and the rotor set into wheel motor.

9. Remove rotor set and wearplate (18) together, and retain the rotor set in its assembled form with the same vane (20) to stator (21) contact surfaces. The drive link (13) may come away from the coupling shaft (11) with the rotor set and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor (19) and wearplate (Fig. 35).



Figure 34

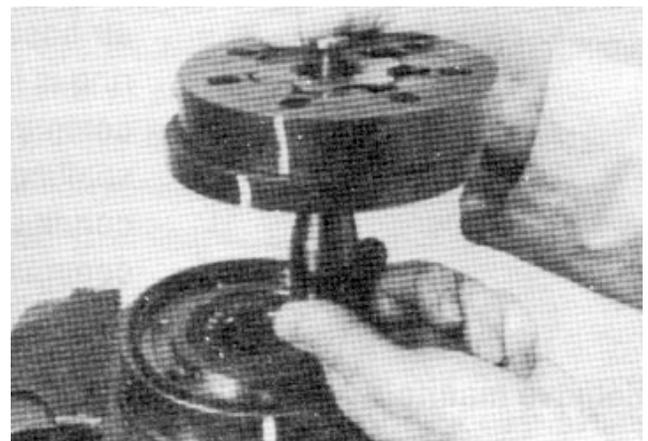


Figure 35

10. Remove seal ring (5) that is between the rotor set and wearplate.

11. Remove drive link (13) from the coupling shaft (11) if it was not removed with rotor set and wear plate (18). Remove seal ring (5) from housing (3).

12. Remove thrust bearing (12) from the top of the coupling shaft (11).

13. Check exposed portion of coupling shaft (11) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the dirt and water seal (1) and outer bearing (2). Crocus cloth or fine emery paper may be used.

14. Remove coupling shaft (11); push on the output end of the shaft. Remove seal ring (5) from housing (3).

15. Remove housing (3) from the vise and invert it. Remove dirt and water seal (1). A blind hole bearing or seal puller is required.

### Inspection (Fig. 32)

1. Inspect bolts (14) for damaged threads and sealing rings under the bolt head. Replace if damaged (Fig. 36).

**Note:** A polished pattern (not scratches) on the cover from rotation of the commutator (16) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.



### CAUTION

Use eye protection such as goggles when using compressed air

2. Thoroughly wash end cover (24) in proper solvent and blow dry. Make sure the end cover valve apertures, including the internal orifice plug, are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary (Fig. 37).

3. Inspect commutator ring (23) for cracks and burrs. Replace commutator ring as necessary.

4. Inspect commutator (16) for cracks, burrs, wear, scoring, chipping, and peening. If any of these conditions exist, replace commutator and commutator ring (23) as a matched set.

5. Inspect manifold (22) for cracks, surface scoring, peening, chipping. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal.

**Note:** The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures.

6. Inspect the rotor set in its assembled form for nicks, scoring, and chipping on any surface. Inspect for broken and worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set.

7. Place rotor set and wear plate (18) on a flat surface and center the rotor (19) in the stator (21) such that two rotor lobes (180 degrees apart) and a roller vane (20) center line are on the same stator center line. Check the rotor lobe to roller vane clearance with a feeler gage at this common center line. If there is more than 0.005 inch (0.13 mm) of clearance, replace the entire rotor set (Fig. 38).

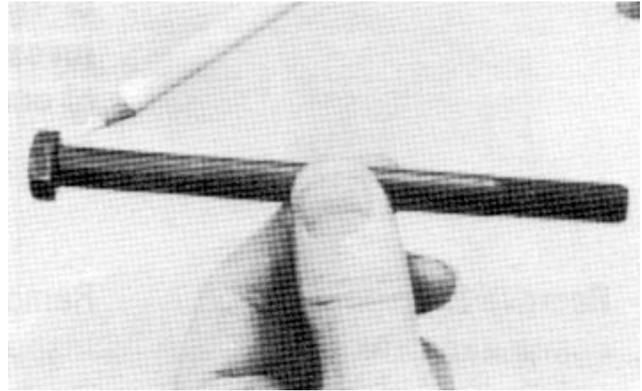


Figure 36



Figure 37

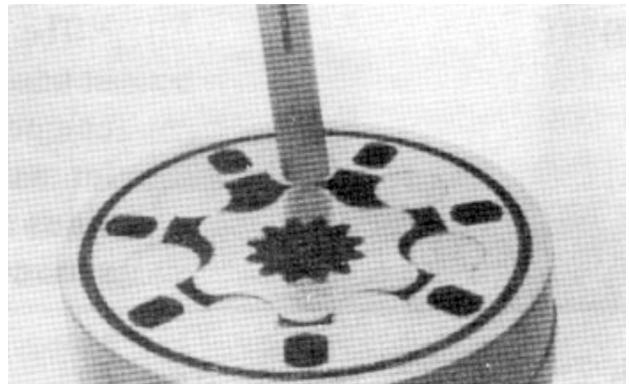


Figure 38



Figure 39

8. Inspect the wearplate (18) for cracks, peening, and scoring. A polished pattern on the wear plate from rotor rotation is normal. Replace as necessary.

9. Inspect drive link (13) for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts of the rotor (19) or coupling shaft (11). Replace as necessary (Fig. 39).

10. Inspect thrust bearing (12) for wear, peening, corrosion and a full complement of retained rollers. Replace as necessary.

11. Inspect coupling shaft (11) internal and external splines and keyway for damage and wear. Inspect bearing and sealing surfaces of the coupling shaft for chipping, nicks, grooves, severe wear, corrosion, and discoloration. Replace coupling shaft if any of these conditions exist. Minor shaft wear in seal area is permissible. If wear exceeds 0.020 inch (0.51 mm) diametrically, replace coupling shaft. A slight "polish" is permissible on the shaft bearing areas (Fig. 40).

**Note:** Do not remove inner bearing (10), thrust washers (8), thrust bearing (9), inner seal (7), backup washers (6 and 4), and outer bearing (2) from the housing (3). These parts should be inspected in place.

12. Inspect housing (3) for cracks. Inspect machined surfaces for nicks, burrs, peening, and corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly (Fig. 41).

13. If the housing (3) has passed inspection to this point, inspect outer bearing (2), inner bearing (10), thrust washers (8), and thrust bearing (9). Bearing rollers must be firmly retained in the bearing cages but must rotate and orbit freely. All rollers and thrust washers must be free of peening and corrosion. If any bearing or thrust washer does not pass inspection, replace the housing (3) as a complete assembly (Fig. 42).

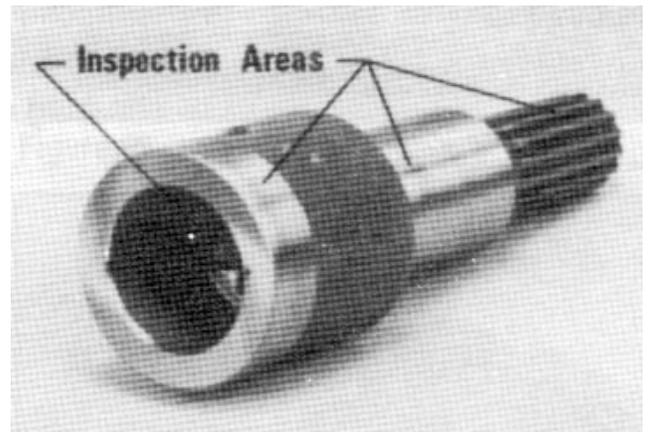


Figure 40



Figure 41

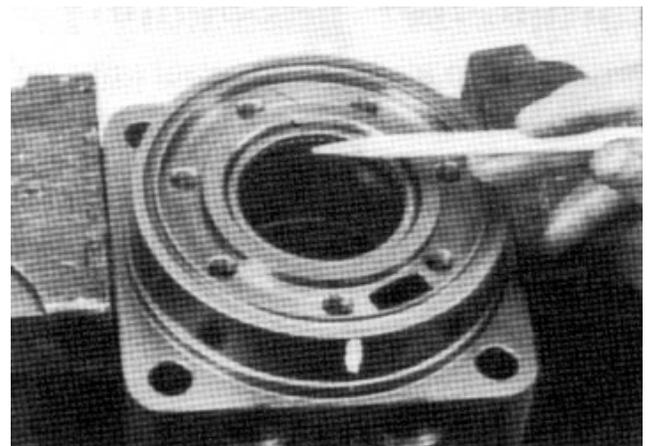


Figure 42

## Reassembly (Fig. 32)

1. Lubricate all seals and seal rings with clean hydraulic oil before assembly.



### WARNING

Since they are flammable, be extremely careful when using any solvent. Even a small explosion or fire could cause injury or death.



### CAUTION

Use eye protection such as goggles when using compressed air

2. Wash all parts in a clean petroleum-based solvent before assembly. Blow parts dry with compressed air.
3. Press a new dirt and water seal (1) into the housing (3) outer bearing counterbore. Press seal in with the lip facing out and until the seal is 0.020 inch (0.51 mm) below the end of housing.
4. Place housing (3) into a soft jawed vise with the coupling shaft bore down; clamp against the mounting flange.

**IMPORTANT:** Early model wheel motors that do not have backup washer (6) when inspected must be assembled with a new backup washer (4), new backup washer (6), and new seal (7).

5. A housing (3) that does not require replacement will require that the two thrust washers (8) and thrust bearing (9) be unseated and vertical to the counterbore and the new backup washer (4), new backup washer (6), and new seal (7) be worked around the thrust bearing package and placed into their respective counterbores (Fig. 44 and 43). The seal lip must face out of the seal counterbore and toward the inside of wheel motor (Fig. 45). Be sure the thrust bearing package is resealed correctly after assembly of the new seal and backup washers.

6. Apply masking tape around splines or keyway on coupling shaft (11) to prevent damage to seal.

**IMPORTANT:** The outer bearing (2) is not lubricated by the system's hydraulic fluid. Make sure it is thoroughly packed with the recommended grease.



Figure 43

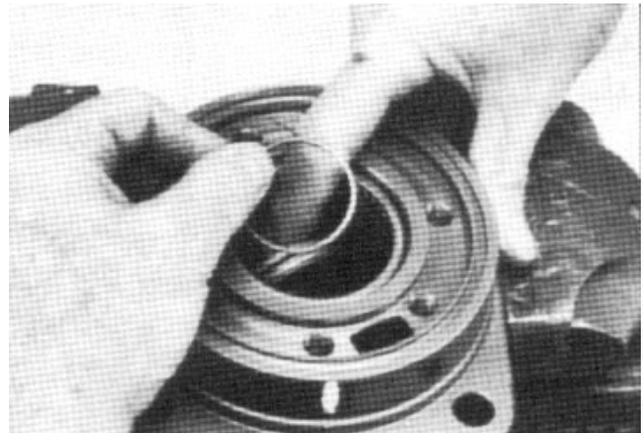


Figure 44

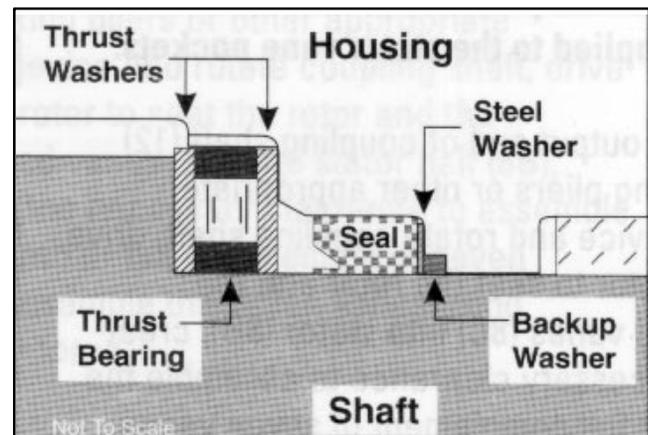


Figure 45

**Note:** Coupling shaft (11) should be approximately 0.10 inch (2.54 mm) below the housing wear plate surface to allow the assembly of thrust bearing (12). The coupling shaft must rotate smoothly on the thrust bearing (9) and thrust washer (8) (Fig. 46).

7. Make sure that a generous amount of clean corrosion resistant grease has been applied to the outer bearing (2). Install the coupling shaft (11) into housing (3), and seat shaft against the second thrust washer (8).

8. Install thrust bearing (12) onto the end of coupling shaft (11).

9. Apply a small amount of clean grease to a new seal ring (5) and insert it into the housing (3) seal ring groove.

**Note:** One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of 3/8–24 UNF 2A bolts so they are 0.5 inch (12.7 mm) or longer than cap screw (14).

**Note:** Use any alignment marks put on the coupling shaft (11) and drive link (13) before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

10. Install drive link (13) with the long splined end down into the coupling shaft (11). Engage the drive link splines so they mesh with the coupling shaft splines (Fig. 47).

11. Assemble wear plate (18) over the drive link (13) and alignment studs onto the housing (3).

12. Apply a small amount of clean grease to a new seal ring (5) and assemble it into the seal ring groove on the wear plate side of the stator (21).

**Note:** The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures.

**Note:** It may be necessary to turn one alignment stud out of the housing (3) temporarily to assemble rotor set over the drive link (13).

**Note:** The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor–drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set seal ring groove faces toward the wear plate (18).

13. Install assembled rotor set onto wear plate (18) with rotor (19) counterbore and seal ring side down. The splines should mesh with the drive link (13) splines.

14. If disassembled rotor (19), stator (21), and vanes (20) cannot be readily assembled by hand, assemble with the following procedures:

A. Place stator (21) onto wear plate (18) with seal ring (5) side down. Be sure the seal ring is in place.

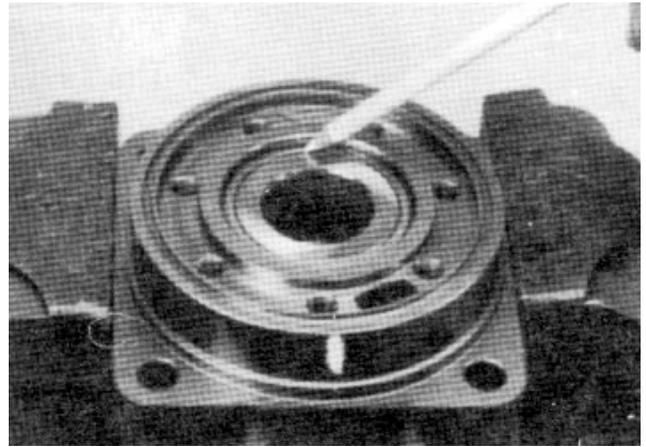


Figure 46

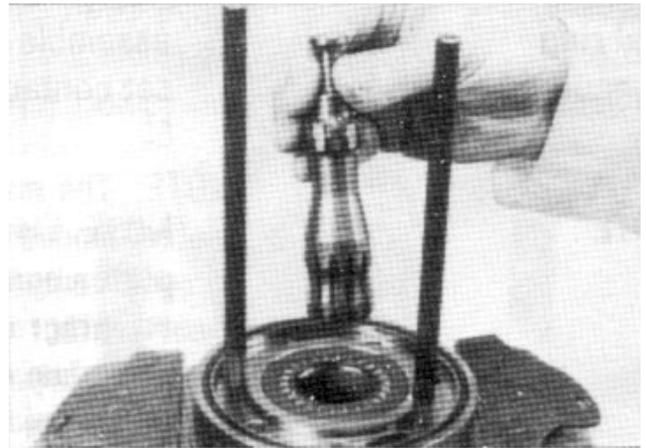


Figure 47

B. If assembly alignment studs are not being utilized, align stator (21) bolt holes with wear plate (18) and housing (3) bolt holes. Screw two cap screws (14) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

**Note:** If the manifold (22) side of the rotor (19) was etched during wheel motor disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

C. Place rotor (19) with counterbore down, if applicable, into stator (21), and then onto wearplate (18) so rotor splines mesh with drive link (13) splines.

**IMPORTANT: Do not force rotor vanes into place, the coating applied to stator vane pockets could shear off.**

D. Assemble six vanes (20), or as many vanes that will readily assemble into the stator vane pockets.

E. Grasp the output end of coupling shaft (11) with locking pliers or other appropriate turning device. Rotate coupling shaft, drive link (13), and rotor (19) to seat the rotor and the assembled vanes (20) into the stator (21). This rotation should create the necessary clearance to assemble the seventh or remaining vanes. Use minimum force when assembling the remaining vane(s).

F. Remove the two assembled bolts (14) if used to retain stator and wear plate.

**Note:** The manifold (22) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has its series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.

15. Apply clean grease to a new seal ring (5) and assemble it in the seal ring groove in the rotor set contact side of manifold (22).

16. Assemble the manifold (22) over the alignment studs and drive link (13) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.

17. Apply grease to a new seal ring (5) and insert it in the seal ring groove exposed on the manifold (22).

18. Assemble the commutator ring (6) over alignment studs onto the manifold (22) (Fig. 48).

19. Assemble a new commutator seal (15) flat side up, into commutator (16) and assemble commutator over the end of drive link (13) onto manifold (22) with seal ring side up.

20. If shuttle valve components items (left-hand motor only) were removed from the end cover (24), screw a plug with a new O-ring (25), loosely into one end of the valve cavity in the end cover. Insert spring, valve, and second spring into the other end of the valve cavity. Turn second plug with a new O-ring (25) loosely into the end cover valve cavity. A 3/16-inch allen wrench is required (Fig. 49).

**Note:** If the end cover (24) has a valve shuttle, use line that was previously scribed on the end cover to radially align it into its original position.

21. Assemble new seal ring (5) into end cover (24) and assemble end cover over the alignment studs and onto the commutator set (Fig. 50).

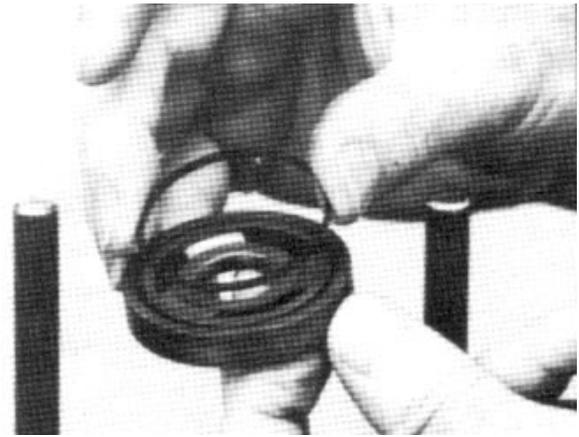


Figure 48



Figure 49

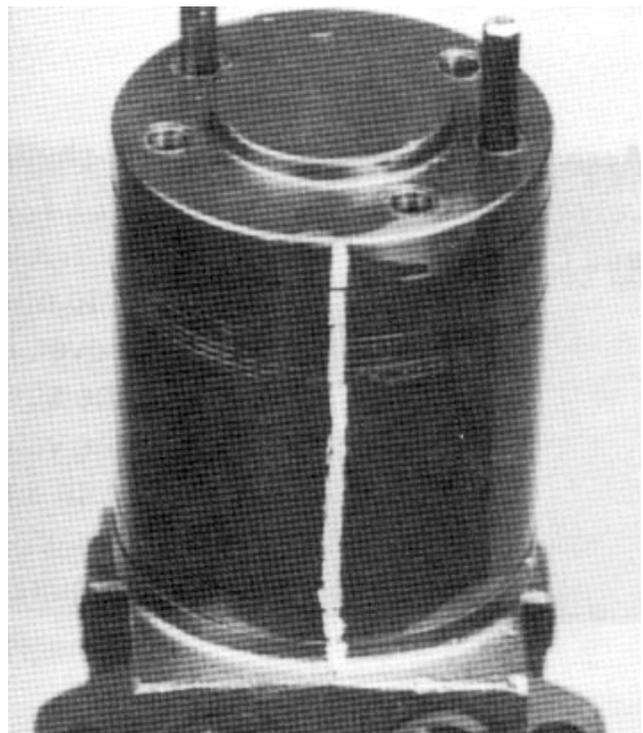


Figure 50

**Note:** The cap screws (14) required for use with the shuttle valve (left-hand motor only) end cover (24) are longer than the bolts required with standard end cover. Refer to Toro Parts Catalog for correct service part number if replacement is required.

22. Assemble seven cap screws (14) and screw them in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 45 to 55 ft-lb (6.2 to 7.6 kg-m).

23. Torque the two shuttle valve plugs in the end cover (24) from 9 to 12 ft-lb (1.2 to 1.6 kg-m) if end cover is so equipped.

24. Check motor shaft for rotation. Torque require to rotate shaft should not exceed 50 ft-lb (6.9 kg-m).

## 2WD/3WD Two Position Valve

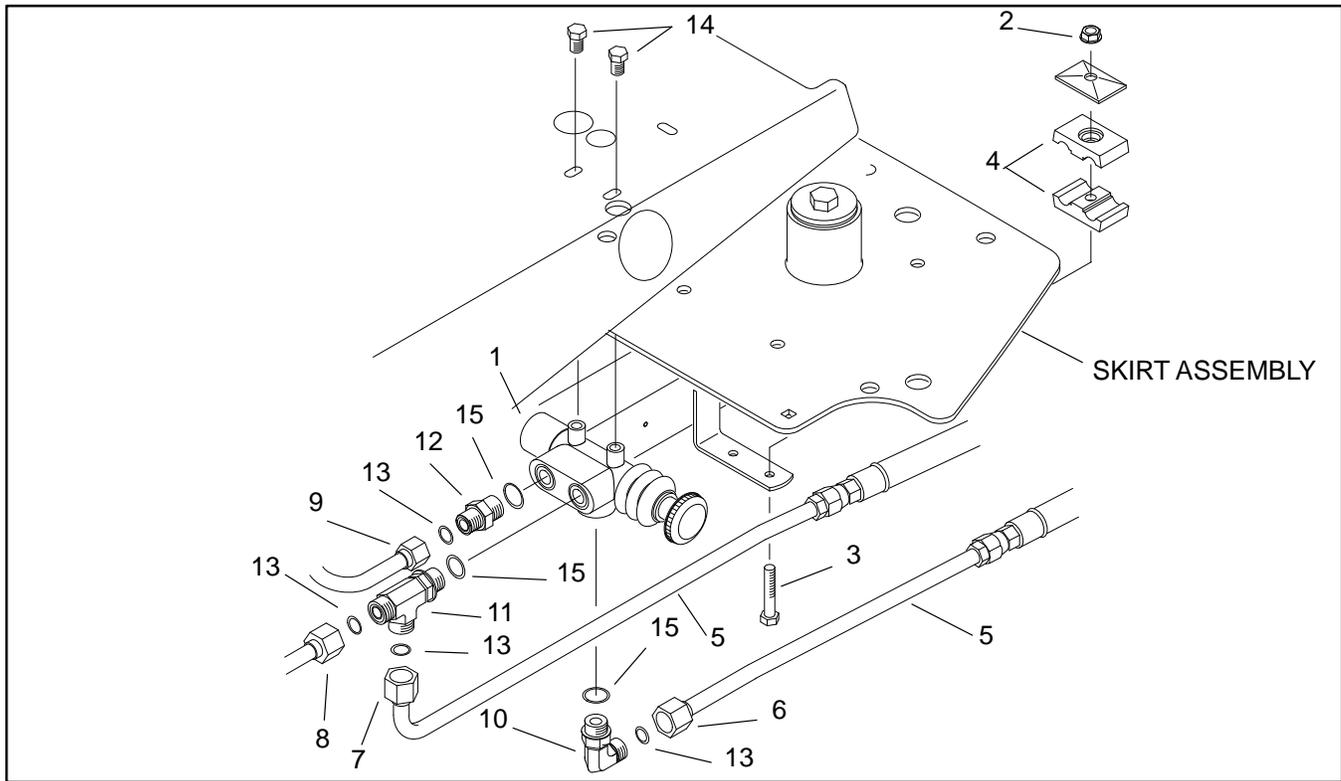


Figure 51

- |                       |                         |                       |
|-----------------------|-------------------------|-----------------------|
| 1. Two position valve | 6. Hydraulic connection | 11. Hydraulic fitting |
| 2. Nut                | 7. Hydraulic connection | 12. Hydraulic fitting |
| 3. Cap screw          | 8. Hydraulic connection | 13. O-ring            |
| 4. Tub clamp          | 9. Hydraulic connection | 14. Cap screw         |
| 5. Hydraulic tube     | 10. Hydraulic fitting   | 15. O-ring            |

### Removal (Fig. 51)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.

5. Disconnect hydraulic connections (6, 7, 8 and 9) from hydraulic fittings (10, 11, and 12). Allow hydraulic oil to drain from tubes into a suitable container.

6. Remove cap screws (14) from two position valve (1).

7. Remove fittings (10, 11, and 12) and O-rings (15) from two position valve (1).



### CAUTION

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.**

### Installation (Fig. 51)

1. Install hydraulic fittings (10, 11, and 12) and O-rings (15) into two position valve (1).

2. Secure cap screws (14) to two position valve (1) through the skirt assembly.

3. Install hydraulic connections (6, 7, 8 and 9) to hydraulic fittings (10, 11, and 12) and tighten fittings.

4. Tighten nut (2) and cap screw (3) so the tube clamps (4) will prevent movement of the hydraulic tubes (5).

2. Clean two position valve (1) and hydraulic fittings.

3. Put caps or plugs on any hydraulic lines or fittings left open or exposed. Put labels on disconnected hydraulic lines and hoses for proper reassembly.

4. Loosen nut (2) and cap screw (3) so the tubes clamps (4) will allow movement of the hydraulic tubes (5).

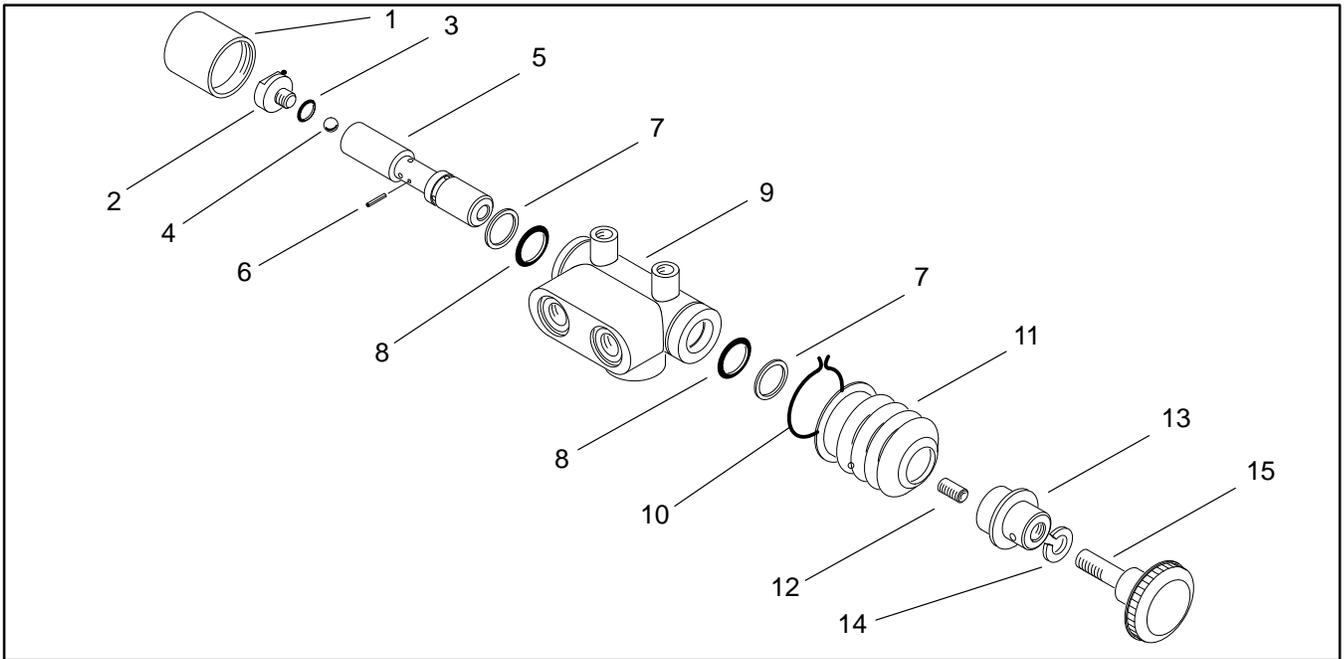


Figure 52

- 1. Valve cap
- 2. Plug
- 3. O-ring
- 4. Ball
- 5. Spool

- 6. Spring pin
- 7. Back-up ring
- 8. O-ring
- 9. Valve housing
- 10. Boot retainer

- 11. Boot
- 12. Set screw
- 13. Valve stop
- 14. Lock washer
- 15. Knob

### Disassembly (Fig. 52)

1. Wash valve in solvent and thoroughly dry. Mount valve carefully in a vise ensuring the mounting pads are against the vise jaws.
2. Remove boot retainer (10) from the valve housing (9).
3. Carefully remove valve cap (1) from the valve housing (9). The valve cap is press fitted.
4. Secure valve stop (13) and remove plug (2) and O-ring (3) from the spool (5).
5. Hold knob (15) and carefully slide spool (5) out of the valve housing (9).

**Note:** The valve stop (13) and set screw are loctited together and should remain together when removed from the spool (5).

6. Separate valve stop (13) and set screw (12) from the spool (5). Carefully remove boot (11) from the valve stop.
7. Remove spring pin (6) and ball (4) from the spool (5) being careful no to scratch or damage the spool. Also, be careful not to drop the ball.
8. Remove back-up rings (7) and O-rings (8) from the valve housing with a hooked scribe or thin screw driver. Be careful not to scratch the bore surface.

### Inspection (Fig. 52)



**CAUTION**

**Use eye protection such as goggles when using compressed air**

1. Wash all parts in solvent. Dry parts with compressed air.
2. Inspect spool (5) for bending and flatness. Signs of wear on one side of the spool may indicate it's bent. Replace a worn or damaged spool if necessary.
3. Inspect parts for wear or damage, and replace if necessary.

### Reassembly (Fig. 52)

1. Coat all new O-rings and back-up rings with hydraulic oil. Install new O-rings (8) and new back-up rings (7) into the bore of the valve housing (9).
2. Install ball (4) and spring pin (6) into the spool (5) so the ball is held in by the pin. Make sure both ends of the spring pin are flush with the sides of the spool.
3. Carefully install boot (12) onto the valve stop (13).

A. If the valve stop (13) and set screw (7) did not separate during disassembly, screw them into the spool (5) and torque valve stop from 85 to 100 in-lb.

B. If the valve stop (13) and set screw (7) separated during disassembly, screw the set screw completely into the spool (5). Then loctite the exposed threads and screw the valve stop onto the set screw and spool. Torque valve stop from 85 to 100 in-lb.

4. Coat spool (5) with clean hydraulic oil and carefully push and twist spool into the valve housing (9). Ensuring not to damage the seals.

5. Install plug (2) and new O-ring (3) into the spool (5). Torque plug from 85 to 100 in-lb.

6. Press valve cap (1) onto valve housing (9). If the valve cap is damaged or will not fit tightly onto the the valve housing, replace the valve cap with a new one.

## Reel Motor Drive Pump

### Removal (Fig. 53)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



2. Clean reel motor drive pump (1) and hydraulic connections. Install plug into the hydraulic reservoir. Label all hose connections for reassembly purposes. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

3. Loosen hose clamp (2) and remove hose (3) from fitting (4). Allow hydraulic oil to drain from hose into a suitable container.

4. Disconnect hose (5) from elbow fitting (6).. Allow hydraulic oil to drain from hose into a suitable container.

5. Remove fittings (4 and 6) and O-rings (8 and 9) from the pump.

6. Support reel motor drive pump (1) and remove two cap screws (10). Separate reel motor drive pump (1) and O-ring (11) from the traction pump (12).

### Installation (Fig. 53)

1. Make sure mounting and O-ring sealing surfaces on reel motor drive pump (1) and traction pump (12) are clean.

2. Replace all O-rings with new ones. Apply clean hydraulic oil to all O-rings.

3. Place O-ring (11) on reel motor drive pump (1).

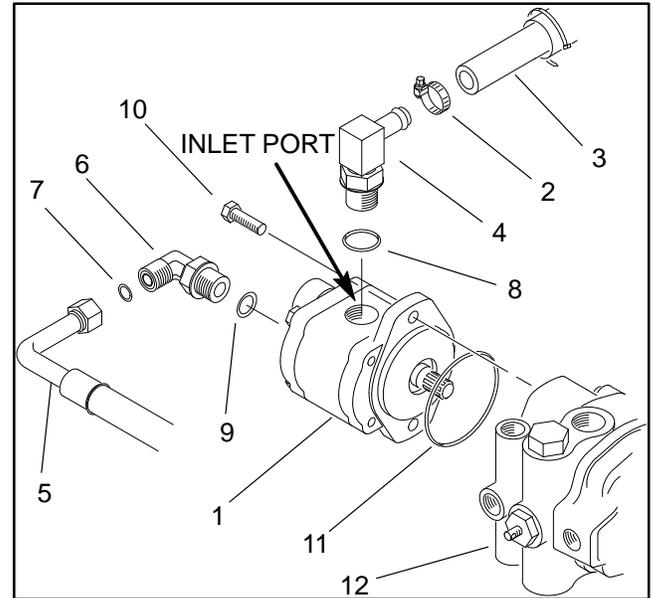


Figure 53

- |                          |                   |
|--------------------------|-------------------|
| 1. Reel motor drive pump | 7. O-ring         |
| 2. Hose clamp            | 8. O-ring         |
| 3. Hose                  | 9. O-ring         |
| 4. Fitting               | 10. Cap screw     |
| 5. Hose                  | 11. O-ring        |
| 6. Elbow fitting         | 12. Traction pump |

4. Position reel motor drive pump (1) to traction pump (12); the inlet port should be facing up.

5. Secure reel motor drive pump (1) to traction pump (12) with cap screws (10). Torque cap screws from 27 to 31 ft-lb (3.7 to 4.3 kg-m).

6. Inspect threads and sealing surfaces of connectors. Replace any damaged or worn connectors.

7. Install O-rings (8 and 9). Install fitting (4) and orient to the 2 o'clock position. Install elbow connector (6) and orient to the 45° down.

8. Secure hose (3) to connector (4) and tighten hose clamp (2). Secure hose (5) to elbow fitting (6) and tighten hose connector.

9. Remove plug from hydraulic reservoir.

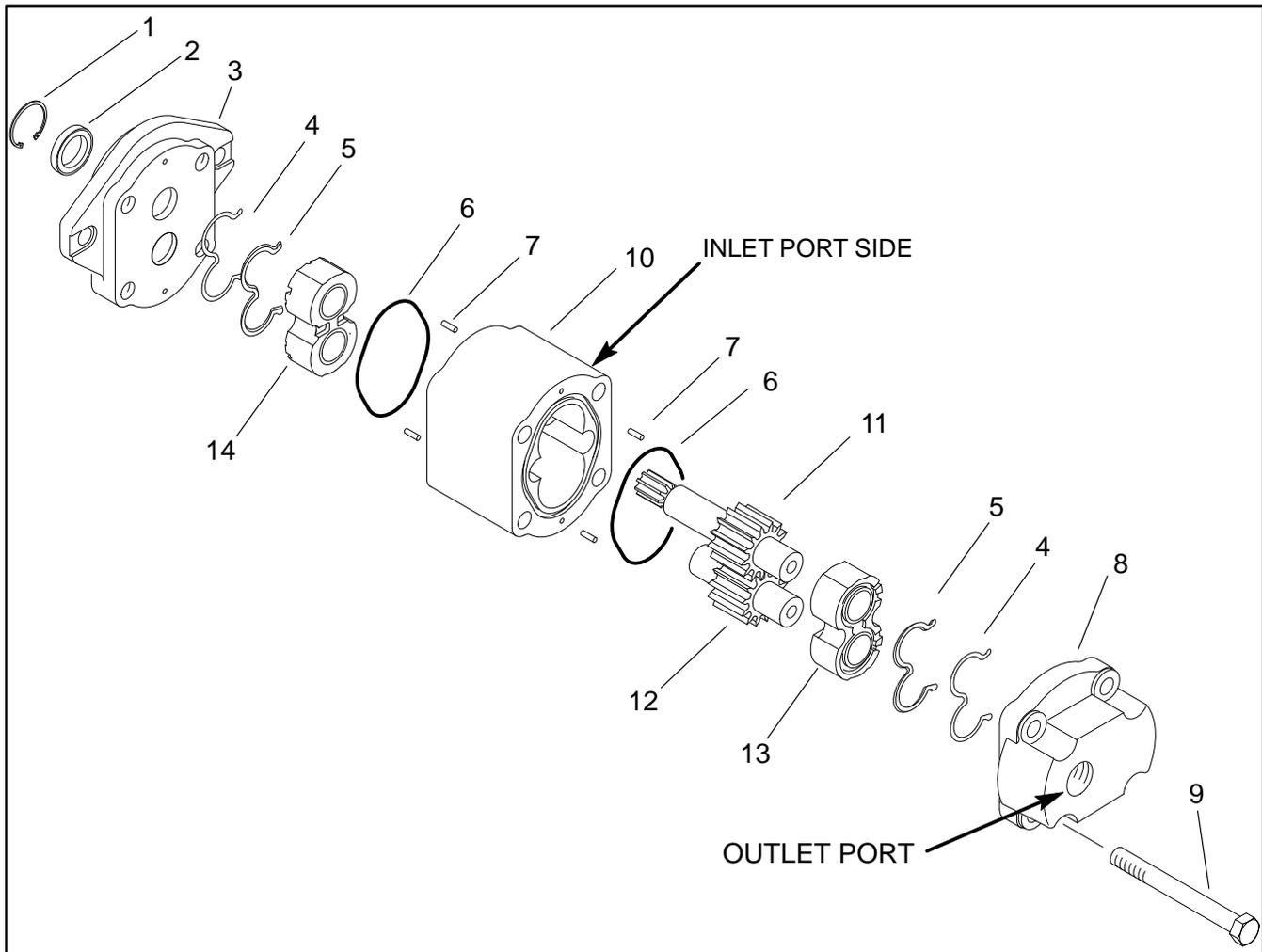


Figure 54

- 1. Retaining ring
- 2. Shaft seal
- 3. Mounting flange
- 4. Backup ring
- 5. E-seal

- 6. O-ring
- 7. Dowel pin
- 8. End cover
- 9. Bolt
- 10. Gear housing

- 11. Drive gear
- 12. Idler gear
- 13. Rear bearing block
- 14. Front bearing block

### Disassembly (Fig. 54)

1. Tape the shaft end of the drive gear (11) to prevent damaging the shaft seal when the shaft is removed or reinstalled.
2. Matchmark the inlet side of the gear housing (10) with the mounting flange (3) and the end cover (8) with the gear housing (10) to make sure proper orientation of these three parts during reassembly.
3. Position the pump with the drive end facing down.
4. Remove the four bolts (9). Lift off the end cover (8) and the two dowel pins (7) and set them aside.
5. Remove the gear housing (10) ensuring the rear bearing block (13), front bearing block (14), drive gear (11), and idler gear (12) remain together. Remove the remaining two dowel pins from the gear housing.

6. Remove the rear bearing block (13) from the drive and idler gear shafts.

7. Remove the idler gear (12).

8. Remove the drive gear (11) shaft slowly from the mounting flange (3). Remove the front bearing block (14) from the drive gear (11) shaft.

### Shaft Seal Replacement (Fig. 54)

1. Place the mounting flange (3) on a clean working surface with the shaft seal up (2). Remove the retaining ring (1).

**Note:** Avoid scratching or marring the shaft seal bore in the mounting flange (3). Large scratches may cause the shaft seal (2) to leak around the outer diameter of the seal.

2. Remove the shaft seal (2). Clean any contamination from the seal bore.

3. Place a new shaft seal (2) with the part number side up into the seal bore. Apply uniform pressure to the face of the shaft seal while pressing it into the bore. This method should prevent damage or misalignment of the seal in the bore.

4. Install new retaining ring (1) into the mounting flange.

#### **E–seal and Backup Ring Replacement (Fig. 54)**

1. Place the front bearing block (14) on a clean surface. Remove the old backup ring (4) and E–seal (5). Clean any contamination from the E–seal groove.

2. Apply a light coat of petroleum jelly in the E–seal groove of the front bearing block (14) and on the flat side of the E–seal (5) to help keep the seals in place during assembly.

3. Place the E–seal (5) with its flat side up into the seal groove on the front bearing block (14). Place the backup ring (4) into the groove made by the E–seal and bearing block. Make sure the notches in the center of the backup ring and E–seal line up so that the backup ring sits flush with the E–seal.

4. Repeat the above steps for the rear bearing block.

#### **O–ring Replacement (Fig. 54)**

1. Remove the old O–rings (6) from the gear housing. Clean any contamination from the O–ring groove.

2. Apply a light coat of petroleum jelly in the O–ring grooves of the gear housing (10). Place a new O–ring (6) in each groove.

#### **Reassembly (Fig. 54)**

1. Place the mounting flange (3) with the shaft seal (2) side down onto a clean working surface. Make sure that the back side of the mounting flange is free of any contamination.

2. Place the front bearing block (14) with its seal side down onto the mounting flange (3). The open side of the E–seal (5) must point away from the matchmark on the inlet side of the mounting flange.

3. Apply a light coating of oil to the exposed face of the front bearing block (14). Make sure the tape is on the shaft end of the drive gear (10). Insert the shaft end of the drive gear (11) slowly through the front bearing block (14) and the shaft seal (2) being careful not to damage the shaft seal.

4. Place the shaft of the idler gear (12) into the remaining position of the front bearing block (14). Apply a light coating of oil the back face of the drive and idler gears.

5. Place the rear bearing block (13) with the seal side on the drive and idler gear shaft ends. Make sure that the open side of the E–seal (5) is pointing towards the inlet of the pump.

6. Install the two dowel pins (7) into the mounting flange (3).

7. Align the matchmarks on the gear housing (10) and mounting flange (3). Place the gear housing with the mounting flange side down and the inlet port on the open side of the E–seal (5) over the rear bearing block (13). Slide the gear housing down over the gears and front bearing block (14).

8. Make sure the rear bearing block (13) face sits just below the back face of the gear housing (3). If the rear bearing block sits higher than the rear face of the gear housing, remove the gear housing. Check that the E–seal (5), backup ring (4), or O–ring (6) did not shift out of place during assembly.

9. Place the remaining two dowel pins (7) into the rear of the gear housing (3). Align matchmarks and set end cover (8) on the rear of the gear housing.

10. Insert the four bolts (9) through the bolt holes in the end cover (8) and gear housing (3). Hand tighten each bolt and torque to 40 ft–lb (5.5 kg–m).

11. Place a small amount of oil in the inlet of the pump. rotate the drive shaft away from the inlet one revolution. If the drive shaft binds, disassemble the pump and then reassemble it. The pump is ready for use.

## Reel Motor

### Removal (Fig. 55)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



### CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove reel motor from cutting unit (see Repair section of Chapter 7 – Cutting Units).

3. Unscrew lock nut (1) and remove coupling (2) from reel motor (3) using a puller.

4. Clean motor, fittings, and hose connections.

**Note:** The position of the fittings on the reel motor is critical to reconnecting hydraulic hoses.

5. Label all hose connections (4) for reassembly purposes. Matchmark reel motor and all hydraulic fittings (5) for reassembly purposes.

6. Remove hose connections (4) from hydraulic fittings (5). Allow hydraulic oil to drain from hose into a suitable container. Put caps or plugs on disconnected hoses to prevent contamination.

7. Remove hydraulic fittings (5) and O-rings (7) from reel motor (3).

### Installation (Fig. 55)

1. Install coupling (2) and secure lock nut (1) to the reel motor (3) and torque to 35 ft-lb (4.8 kg-m).

2. Make sure hydraulic fitting ports and O-ring sealing surfaces on the reel motor (3) are clean.

3. Apply clean hydraulic oil to all O-rings.

4. Inspect threads and sealing surfaces of hydraulic fittings (5). Replace any damaged or worn fittings.

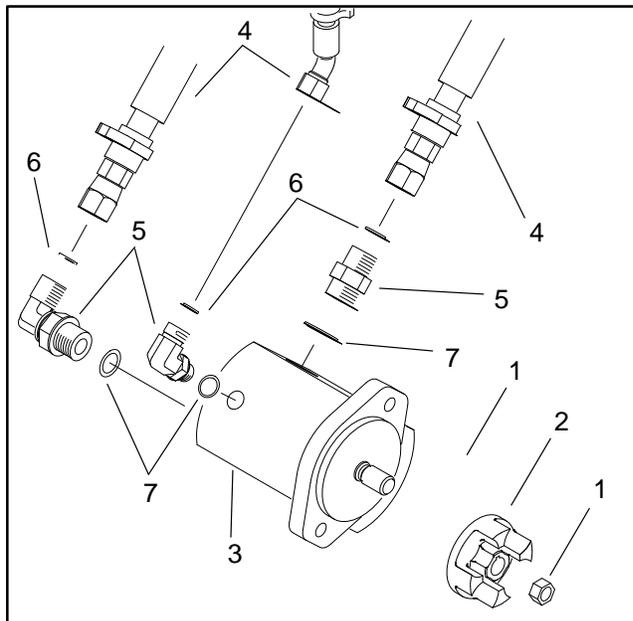


Figure 55

- |                    |                       |
|--------------------|-----------------------|
| 1. Lock nut        | 5. Hydraulic fittings |
| 2. Coupling        | 6. O-ring             |
| 3. Reel motor      | 7. O-ring             |
| 4. Hose connection |                       |

5. Place O-ring (7) on face seal of hydraulic fitting (5). Secure hydraulic fitting to the reel motor (3) ensuring that the matchmarks are aligned. Repeat this step for the remaining hydraulic fittings.

6. Inspect threads and sealing surfaces of hose connections (4). Replace any damaged or worn connections.

7. Secure hose connection (4) to the hydraulic fitting (5). Repeat this step for the remaining hydraulic fittings.

8. Install reel motor to cutting unit (see Repair section of Chapter 7 – Cutting Units).

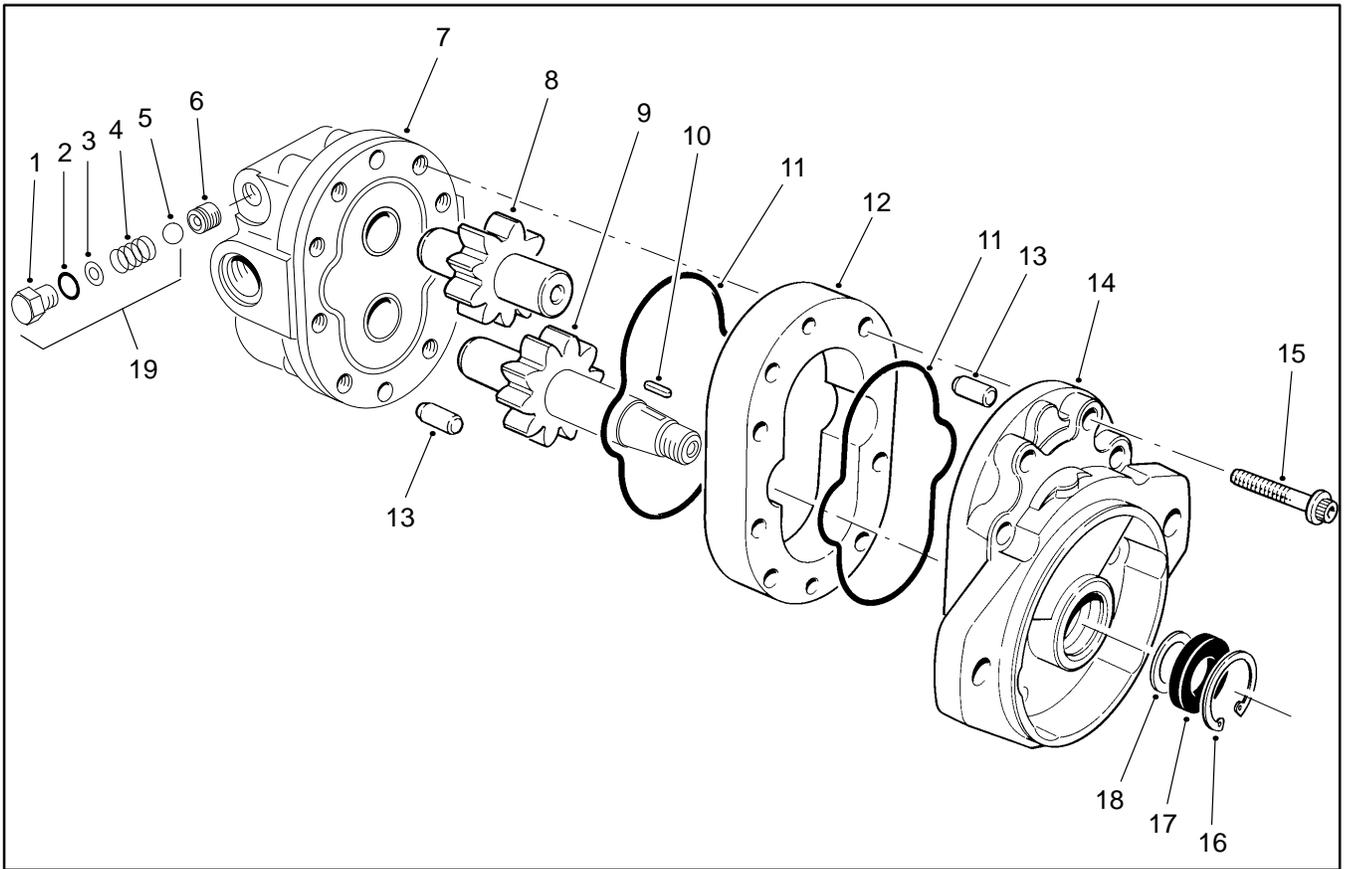


Figure 56

- 1. Plug
- 2. O-ring
- 3. Shim
- 4. Spring
- 5. Ball
- 6. Relief valve seal
- 7. Backplate

- 8. Idler gear assembly
- 9. Drive gear assembly
- 10. Key
- 11. O-ring
- 12. Body
- 13. Alignment pin

- 14. Frontplate
- 15. Screw
- 16. Retaining ring
- 17. Oil seal
- 18. Backup washer
- 19. Relief valve assembly (# 1 thru 5)

**Disassembly (Fig. 56)**

1. Make sure key (10) is removed from the drive gear (9) shaft.
2. Matchmark frontplate (14), body (12), and backplate (7) to assure proper reassembly.
3. Secure the motor in a vise with the drive shaft up.
4. Remove all eight screws (15).
5. Remove the motor from the vise. Remove the frontplate (14) from the body (12). A wooden block or soft face hammer might be used the gently tap the motor when freeing the frontplate (14).
6. Remove alignment pin (13) from the body (12). Remove drive gear (9) and idler gear (8) from the body (12).

7. Remove body (12) from the backplate (7). Remove O-rings (11) from the body (12) and backplate (7).
8. Remove Alignment pin (13) from the backplate (7).
9. Remove retaining ring (16), oil seal (17), and backup washer (18) from the frontplate (14).

**IMPORTANT: Do not remove the relief valve assembly (19) unless testing shows it to be faulty. The relief valve assembly must be replaced as a complete unit. Both relief valve seals (6) are sealed in place with loctite; do not remove them.**

10. Remove plug (1), O-ring (2), shim (3), spring (4), and ball (5) from the backplate (7).

### Inspection (Fig. 56)

1. Remove all nicks and burrs from all parts with an emery cloth



2. Clean all parts with solvent. Dry all parts with compressed air.
3. Inspect drive gear (9) shaft for a broken or chipped keyway.
4. Inspect drive gear (9) and idler gear (8) shafts at the bushing points and seal area for rough surfaces and excessive wear.
5. Replace drive gear (9) or idler gear (8) if the shaft in the bushing area diameter measures less than 0.748 in. (19.0 mm). A single gear may be replaced separately.
6. The drive gear (9) and idler gear (8) face should be free of excessive scoring and wear.
7. Replace drive gear (9) or idler gear (8) if gear width is less than 1.140 in. (29.96 mm).
8. Make sure that retaining rings are in the grooves on both sides of the gear for both the drive gear (9) and idler gear (8).
9. Break sharp edges of gear teeth with emery cloth.
10. Replace backplate (7) and frontplate (14) if bushing inside diameters exceed 0.755 in. (19.2 mm). The bushings are not available as replacement items.
11. The face of the backplate (7) and frontplate (14) should be free of excessive scoring. Replace if scoring a depth of 0.0015 in. (0.038 mm).
12. Replace body (12) if the inside diameter of the gear pockets exceeds 1.713 in. (43.5 mm).

13. Make sure both plugs (1) are secure if they or the backplate is not being replaced.

### Reassembly (Fig. 56)

1. If replacing the relief valve assembly (19), install ball (5), spring (4), shim (3), O-ring (2), and plug (1) into the backplate (7). Hand tighten plug (1) and then torque from 10 to 12 ft-lb (1.38 to 1.66 kg-m).
2. Coat O-ring (11) lightly with petroleum jelly and install in groove on the front plate (14).
3. Apply a thin coat of petroleum jelly to both gear pockets of the body (12). Install alignment pin (13) into body (12).
4. Align matchmarks and slip body (12) onto front plate (14) until alignment pin (13) is engaged.
5. Dip idler gear (8) and drive gear (9) into clean hydraulic oil and slip into front plate (14) bushings.
6. Coat O-ring (11) lightly with petroleum jelly and install in groove on the back plate (7).
7. Install alignment pin (13) into back plate (7).
8. Align matchmarks and slip back plate (7) over gear shafts onto body (12) until alignment pin (13) is engaged.
9. Hand tighten cap screws (15) and torque in a criss-cross pattern from 25 to 28 ft-lb (3.46 to 3.87 kg-m).
10. Place washer (18) over the drive shaft into the front plate (14) housing. Apply a liberal coat of hydraulic oil to the oil seal (17). Install oil seal (17) over the drive shaft being careful not to cut the rubber seal lips.
11. Place 1-1/16 inch O.D. sleeve over the drive shaft and press in the oil seal (17) until the retaining ring groove appears.
12. Press retaining ring (16) into the housing using the sleeve until it seats in the groove.

## Hydraulic Manifold

### Removal (Fig. 57)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



### CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Raise and remove hood to get access to the manifold.

**Note:** The ports on the manifold are marked for easy identification of components. Example: R1 is the reel circuit relief valve and G1 is the test gauge injury connection port. (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

3. If necessary, the hydraulic manifold can be removed (Figure 57):

A. Disconnect solenoid valve (9) and micro switch (4) electrical connectors.

B. Clean manifold and hydraulic connections. Disconnect hydraulic lines. Label all connections for reassembly.

C. Allow hydraulic lines to drain into a suitable container. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

D. Remove cap screws (10) from the hydraulic manifold.

E. Support hydraulic manifold (6) and remove flange screws (7) from the hydraulic manifold. Remove hydraulic manifold from the cylinder support bracket (8).

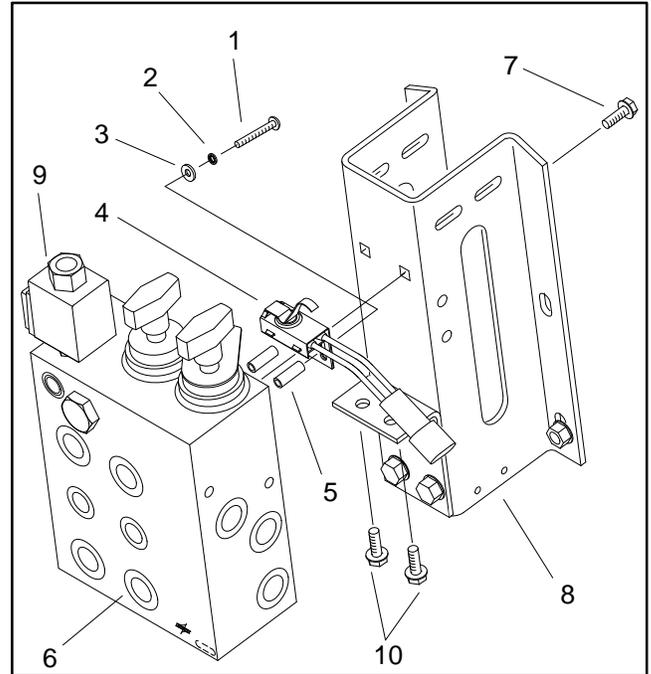


Figure 57

- |                 |                             |
|-----------------|-----------------------------|
| 1. Screw        | 6. Hydraulic manifold       |
| 2. Lock washer  | 7. Flange screw             |
| 3. Flat washer  | 8. Cylinder support bracket |
| 4. Micro switch | 9. Solenoid valve           |
| 5. Spacer       | 10. Cap screw               |

### Installation (Fig. 57)

1. Secure hydraulic manifold (6) to the cylinder support bracket (8) with cap screws (10) and flange screws (7).

2. Make sure all hydraulic connections, ports, and fittings are clean.

3. Connect hydraulic lines to the manifold. Tighten all hydraulic fittings and connections.

4. Reconnect solenoid valve (9) and micro switch (4) electrical connectors.

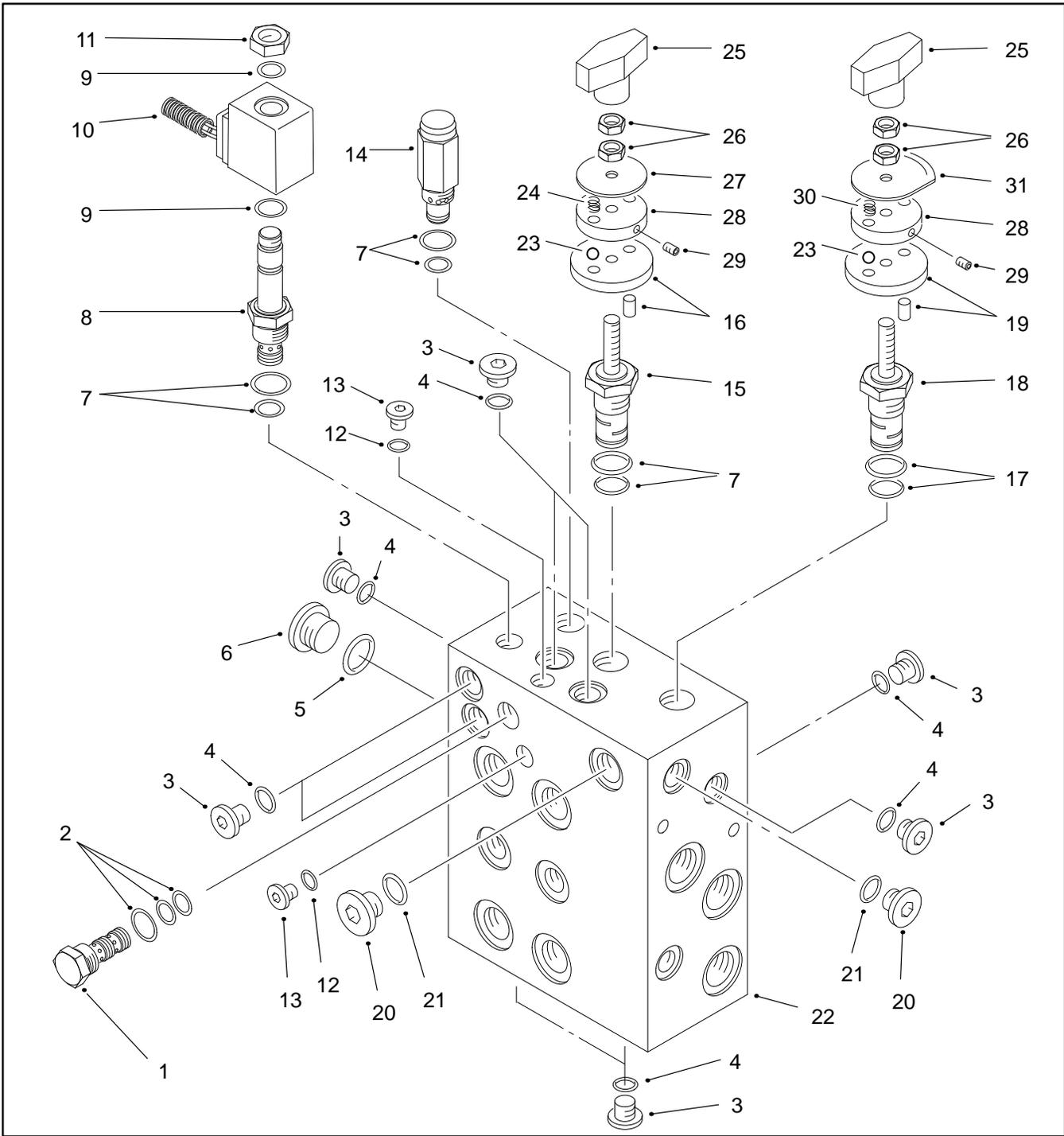


Figure 58

- 1. Cartridge (logic) valve
- 2. Seal kit
- 3. Plug
- 4. O-ring
- 5. O-ring
- 6. Plug
- 7. Seal kit
- 8. Spool valve
- 9. O-ring
- 10. Solenoid coil
- 11. Nut

- 12. O-ring
- 13. Plug
- 14. Cartridge (relief) valve
- 15. Spool (flow control) valve
- 16. Locating plate w/ pin
- 17. Seal kit
- 18. Spool (two position directional) valve
- 19. Locating plate w/ pin
- 20. Plug
- 21. O-ring

- 22. Manifold body
- 23. Ball (2 per assembly)
- 24. Spring (2 per assembly)
- 25. Knob
- 26. Jam nuts
- 27. Indicator plate
- 28. Detent plate
- 29. Set screw
- 30. Spring (2 per assembly)
- 31. Indicator plate

## Solenoid Valve (Fig. 58)

1. Make sure the manifold is clean before removing the spool valve (8).
2. Remove the spool valve (8):
  - A. Remove the nut (11) from the spool valve (8).
  - B. Remove the solenoid coil (10) and both O-rings (9).

**Note:** Use care when handling the spool valve. slight bending or distortion of the stem tube can cause binding and malfunction.

- C. Remove spool valve (8) with a deep socket wrench. Remove seal kit (7).
3. Visually inspect the port in the manifold (22) for damage to the sealing surfaces, damaged threads, and contamination.
  4. Visually inspect spool valve for damaged sealing surfaces and contamination.
    - A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.
    - B. If spool valve (8) sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.



5. Clean spool valve (8) using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Use a probe to push the internal spool in and out 20 to 30 times to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Use compressed air for cleaning.
6. Reinstall the spool valve (8):
  - A. Lubricate new O-ring and backup ring of seal kit (7) with clean hydraulic oil and install. The O-ring and backup ring must be arranged properly on the spool valve (8) for proper operation and sealing.
  - B. Thread spool valve (8) carefully into port (S1). The valve should go in easily without binding.

**Note:** Use care when handling the spool valve (8). slight bending or distortion of the stem tube can cause binding and malfunction.

- C. Torque spool valve (8) using a deep socket to 35 ft–lb (4.8 kg–m).
- D. Make sure a new O-ring (9) is at each end of the solenoid coil (10). install solenoid coil to the spool valve (8). Apply "Loctite 242" or equivalent to the threads of the spool valve: torque nut (11) to 15 in–lb (17 kg–cm).
- E. If problems still exit, remove valve and clean again or replace valve.

## Cartridge (Logic and Relief) Valves (Fig. 58)

1. Make sure the manifold is clean before removing the cartridge valve (1 or 14) and seal kit (2 or 7).
2. Remove the cartridge valve (1 or 14).
3. Visually inspect the port in the manifold (22) for damage to the sealing surfaces, damaged threads, and contamination.
4. Visually inspect cartridge valve (1 or 14) for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

B. If sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.



5. Clean cartridge valve (1 of 14) using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Use compressed air for cleaning.
6. Reinstall the cartridge valve (1 or 14):
  - A. Lubricate new O-ring and backup ring of seal kit (7) with clean hydraulic oil and install. The O-ring and backup ring must be arranged properly on the cartridge valve (1 or 14) for proper operation and sealing.

B. Thread cartridge valve (1 or 14) carefully into the applicable port (LC1 or R1). The valve should go in easily without binding. Torque the valve to 35 ft–lb (4.8 kg–m).

### Spool (Flow Control and Two Position Directional) Valves (Fig. 58)

1. Remove knob assembly:

A. Unscrew and remove knob (25). Remove both jam nuts (26).

B. Slide off applicable indicator plate (27 or 31) being careful not to lose springs (24 or 30). Remove spring.

C. Loosen set screw (29) and slide detent plate (28) off the applicable spool valve (15 or 18) stem.

D. Remove the applicable locating plate with pin (16 or 19) from the spool valve (15 or 18) stem and manifold block (22).

2. Make sure the manifold is clean before removing the spool valve (15 or 18).

3. Remove the spool valve (15 or 18) and seal kit (7 or 17).

4. Visually inspect the port in the manifold (22) for damage to the sealing surfaces, damaged threads, and contamination.

5. Visually inspect spool valve (15 or 18) for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

B. If sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.



### CAUTION

**Use eye protection such as goggles when using compressed air**

6. If necessary, clean spool valve (15 or 18) using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Use compressed air for cleaning.

7. Reinstall the spool valve (15 or 18):

A. Lubricate new O–ring and backup ring of seal kit (7 or 17) with clean hydraulic oil and install. The O–ring and backup ring of seal kit must be arranged properly on the spool valve (15 or 18) for proper operation and sealing.

B. Thread spool valve (15 or 18) carefully into the applicable port (FC1 or MD1). The valve should go in easily without binding. Torque valve to 35 ft–lb (4.8 kg–m).

8. Reinstall knob assembly:

A. Install applicable locating plate (16 or 19) so that the pin seats into the locating hole.

B. Turn the threaded spool valve (15 or 18) stem carefully clockwise until it stops.

C. Face detent plate (28) counterbore down. Thread detent plate (28) down onto the valve stem until it is stopped by the locating plate (16 or 19). Turn detent plate (28) back counterclockwise 1/4 turn.

D. Center one detent plate hole over a locating plate indentation. Drop a ball (23) into each hole, then drop a spring (24 or 30) into each hole.

E. On spool (flow control) valve (15), place indicator plate (27) over the detent plate (28). Make sure the arrow points to the right at 45°.

F. On spool (two position directional) valve (18), place indicator plate (31) over the detent plate (28). Make sure the arrow points directly at the number 1 on the locating plate (16).

G. While pushing down on the indicator plate (27 or 31) and compressing the springs (24 or 30), thread down a jam nut (26). While tightening the set screw (29), tighten jam nut (26) at the same time using a 7/16 – inch wrench

H. Thread second jam nut (26) all the way down the valve (15 or 18) stem. Apply "Loctite 242" or equivalent the valve stem threads. Screw knob (25) all the way down until it hits the upper jam nut (26).

I. On spool (flow control) valve (15), turn knob (25) counterclockwise until the arrow points at the number "5". Simultaneously tighten upper jam nut (26) and turn knob so it is tight and the arrow is pointing at the number "1" on the locating plate (16).

J. On spool (two position directional) valve (18), turn knob (25) counterclockwise so the arrow is 90° with the back of the manifold body (22). Simultaneously tighten upper jam nut (26) and turn knob so it is tight and the arrow is pointing 45° to the right in line with the indicator plate (31).

# Front Lift Cylinder

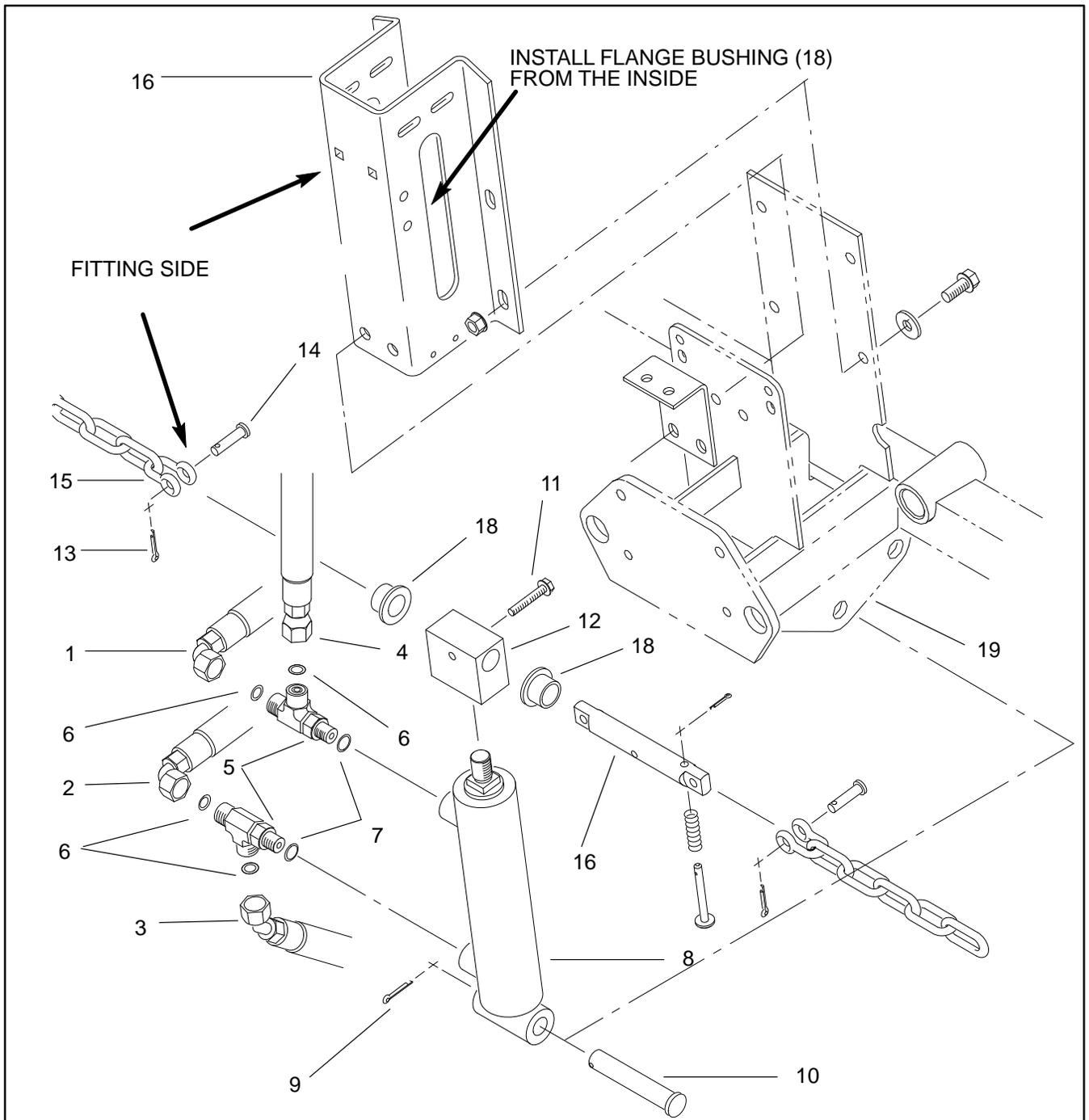


Figure 59

- |                       |                  |                              |
|-----------------------|------------------|------------------------------|
| 1. Hose connection    | 8. Lift cylinder | 15. Clevis                   |
| 2. Hose connection    | 9. Cotter pin    | 16. Cylinder guide           |
| 3. Hose connection    | 10. Clevis pin   | 17. Cylinder support bracket |
| 4. Hose connection    | 11. Cap screw    | 18. Flange bushings          |
| 5. Hydraulic fittings | 12. Lift hub     | 19. Valve mount bracket      |
| 6. O-ring             | 13. Cotter pin   | 20. Clevis                   |
| 7. O-ring             | 14. Clevis pin   |                              |

Hydraulic System

## Removal (Fig. 59)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



2. Raise and remove hood to get access to the front lift cylinder. Label all connections for reassembly.

3. Disconnect hose connections (1), (2), (3), and (4) from hydraulic fittings (5). Allow hoses to drain into a suitable container.

4. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

5. Remove hydraulic fittings (5) and O-rings (7) from the lift cylinder (8).

6. Remove cotter pin (9) from the clevis pin (10). Pull clevis pin from the lift cylinder (8).

7. Remove cap screw (11) from the lift hub (12). Remove cotter pin (13) and clevis pin (14) from the clevis (15) that is on the hydraulic fitting side of the cylinder guide (15).

8. Support lift cylinder (8) and slide cylinder guide (16) from the lift hub (12).

A. Reach up from the bottom and rotate lift cylinder so the bottom port comes out of the slot in the frame.

B. Drop lift cylinder down and out from the frame. Lift hub from the cylinder support bracket (17).

9. Remove flange bushings (18) from the cylinder support bracket (17).

10. Remove lift hub (12) from the lift cylinder (8).

## Installation (Fig. 59)

1. Thread lift hub (12) onto lift cylinder (8).

2. Position lift cylinder (8) inside the cylinder support bracket (17) and valve mount bracket (19). Make sure the inlet and outlet ports of the lift cylinder face the fitting side of the cylinder support bracket.

3. Align lift cylinder (8) holes with holes at bottom of the valve mount bracket (18). Slide clevis pin (14) through holes and secure pin with cotter pin (9).

4. Align lift hub (12) holes with the slots on the cylinder support bracket (17). Install flange bushings (18) into the cylinder support bracket slots.

5. Make sure flange bushings (18) are aligned with the lift hub (12) holes. Slide cylinder guide (16) through the cylinder support bracket (17), flange bushings (18), and lift hub (12).

6. Secure cylinder guide (16) by screwing cap screw (11) fully into lift hub (12).

7. Secure clevis (15) to the cylinder guide (16) with clevis pin (4) and cotter pin (13).

8. Slide clevis pin (10) through the valve mount bracket (19) and lift cylinder (8). Install and lock cotter pin (9) into the clevis pin.

9. Install hydraulic fittings (5) and O-rings (7) into the lift cylinder (8).

10. Remove caps or plugs from disconnected hoses. Connect hose connections (1), (2), (3), and (4) to hydraulic fittings (5). Tighten hose connections

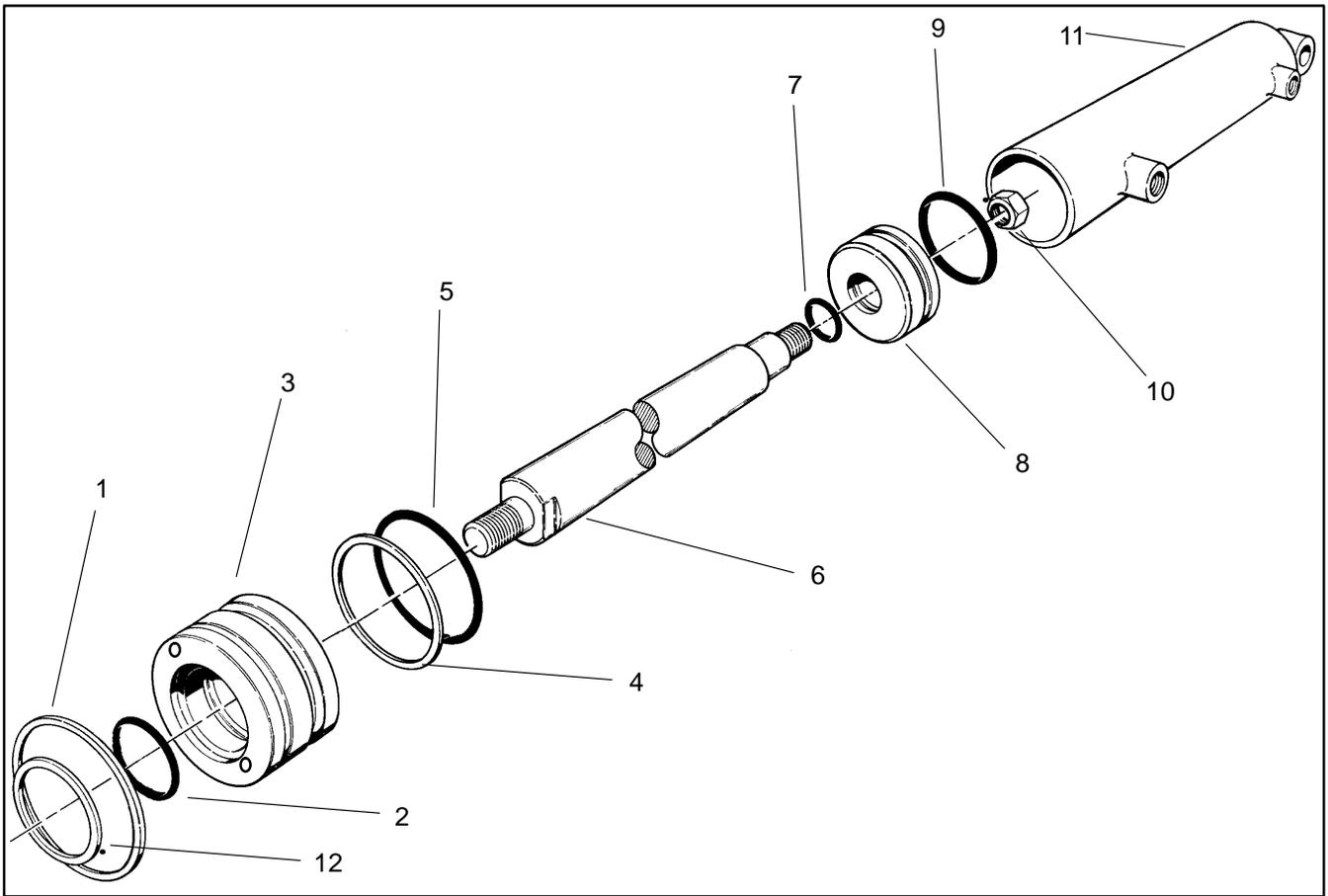


Figure 60

- |                   |           |               |
|-------------------|-----------|---------------|
| 1. retaining ring | 5. O-ring | 9. Uni-ring   |
| 2. O-ring         | 6. Shaft  | 10. Lock nut  |
| 3. Head           | 7. O-ring | 11. Barrel    |
| 4. Backup washer  | 8. Piston | 12. Dust seal |

**Disassembly (Fig. 60)**

1. Remove oil from the cylinder into a drain pan by **slowly** pumping the cylinder shaft (6). Plug both ports and clean the outside of the lift cylinder.

**IMPORTANT: Prevent damage when clamping the lift cylinder into a vise; clamp on the pivot only. Do not close vise enough to distort barrel (11).**

2. Mount lift cylinder in a vise so that the shaft (6) end tilts up slightly. Remove and discard dust seal (12).

3. Rotate head (3) with a spanner wrench and remove retaining ring (1) as shown in Figure 61.

4. Grasp end of shaft (6); extract shaft, head (3), and piston (8) by carefully twisting and pulling on the shaft.

**IMPORTANT: Do not clamp vise jaws against shaft (6) surface. Protect shaft surface before mounting in the vise.**

5. Mount shaft (6) securely in a vise by clamping vise on the flats of the shaft. Remove locknut (10) and piston (8) from the shaft. Slide head (3) off the shaft.

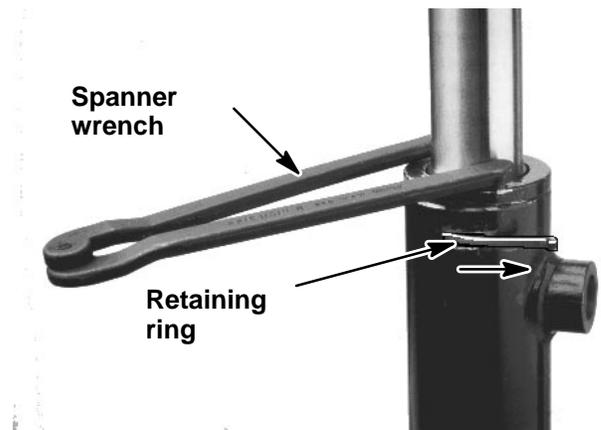


Figure 61  
Removing retaining ring

6. Remove and discard O-ring (7) and uni-ring (9) from the piston (8). Remove and discard both O-rings (2 and 5) and backup washer (4) from the head (3).

### Inspection (Fig. 60)



1. Wash all parts in solvent. Dry parts with compressed air.
2. Inspect internal surface of barrel (11) for deep scratches, out-of-roundness, and bending. Replace if worn or damaged.
3. Inspect head (3), shaft (6), and piston (8) for excessive pitting, scoring, and wear. Replace any worn or damaged parts.

### Reassembly (Fig. 60)

1. Coat all O-rings, uni-ring, and backup washer lightly with hydraulic oil. Install new O-ring (7) and uni-ring (9) to the piston (8). Install O-rings (2 and 5) and backup washer (4) to the head (3).

**IMPORTANT: Do not clamp vise jaws against shaft (6) surface. Protect shaft surface before mounting in the vise.**

2. Mount shaft (6) securely in a vise by clamping vise on the ends of the shaft. Slide head (3) onto the shaft. Install piston (8) and locknut (10) onto the shaft and tighten lock nut (10).
3. Remove shaft (6) from the vise.

**IMPORTANT: Prevent damage when clamping the barrel (11) into a vise; clamp on the pivot end only. Do not close vise enough to distort barrel.**

4. Mount barrel (11) in a vise so that the shaft end tilts up slightly.
5. Coat all internal lift cylinder parts with a light coat of hydraulic oil. Slide piston (8), shaft (6), and head (3) assembly into barrel (11) being careful not to damage the seals.
6. Secure head (3) in barrel (11) by installing retaining ring (1). Align key slot in head with the access groove in the barrel. Rotate head clockwise as far as the retaining ring will allow. The offset end of the retaining ring will be against the left side of the barrel groove as shown in Figure 62.

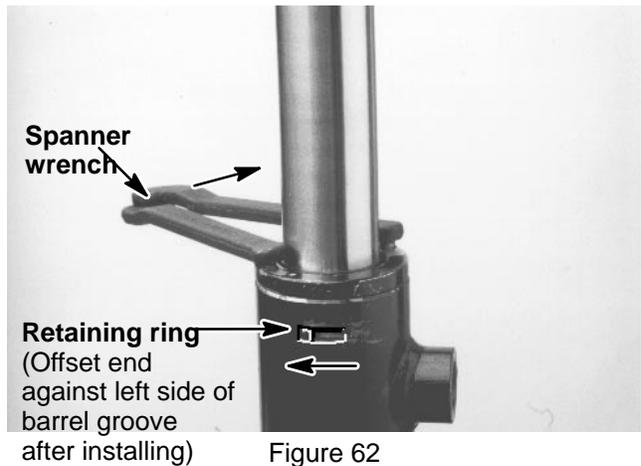


Figure 62  
Installing retaining ring

## Rear Lift Cylinder

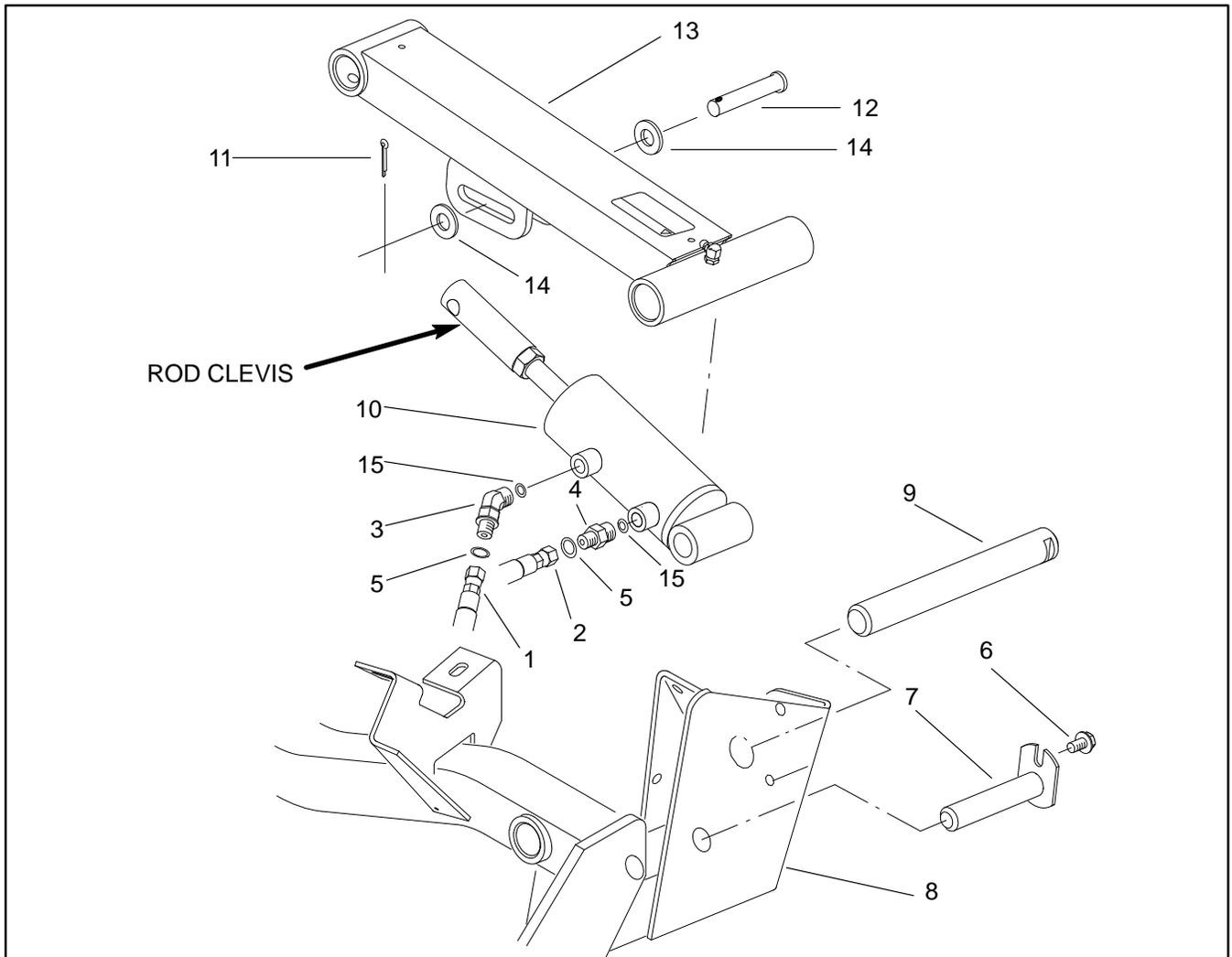


Figure 63

1. Hose connection
2. Hose connection
3. Hydraulic fitting
4. Hydraulic fitting
5. O-ring

6. Cap screw
7. Ram pivot pin
8. Pivot support
9. Lift pivot shaft
10. Lift cylinder

11. Cotter pin
12. Clevis pin
13. Lift arm
14. Flat washer
15. O-ring

### Removal (Fig. 63)

1. Before removing any parts from the hydraulic manifold, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



#### CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.



#### CAUTION

The rear lift cylinder is located near the muffler exhaust pipe. To avoid possible burns, allow the exhaust pipe to cool before working on the rear lift cylinder.

2. Label all connections for reassembly. Disconnect hose connections (1 and 2) from hydraulic fittings (3 and 4). Allow hoses to drain into a suitable container.

3. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
4. Remove cap screw (6) and ram pivot pin (7) from pivot support (8). Slide lift pivot shaft (9) from pivot support.
5. Rotate lift cylinder (10) while swinging the lift cylinder down from the pivot support (8), so the hydraulic fittings (3) and (4) are clear the exhaust pipe.
6. Remove cotter pin (11) from clevis pin (12). Support lift cylinder (10) and slide clevis pin out of the lift arm (13) removing flat washers (14).
7. Remove hydraulic fittings (3) and (4) and O-rings (15) from the lift cylinder (10).

### Installation (Fig. 63)

1. Coat new O-rings lightly with clean hydraulic oil. Install hydraulic fittings (3) and (4) and new O-rings (15) on the lift cylinder (10).
2. Position lift cylinder (10) inside pivot support (8). Slide lift pivot shaft (9) through pivot support and lift cylinder. Make sure lift pivot groove is aligned to accept the ram pivot pin (7). Install ram pivot pin (7) and cap screw (6).
3. Swing the lift cylinder (10) up so its clevis is positioned between the lift arm (13) slots. Slide a flat washer (14) onto the clevis pin (12). Slide clevis pin through the lift arm slots and the lift cylinder (10) clevis. Install re-

maining flat washer and then cotter pin (11) onto the clevis pin.

4. Install hose connections (1 and 2) onto hydraulic fittings (3 and 4). Tighten hose connections.
5. If rod clevis (14) has been removed, verify that the distance between the carrier frame rollers (bumpers on later models) and the foot step is about 1/4-inch (6 mm) with the cutting units fully raised. Adjust rod clevis as necessary. (Fig. 63)
  - A. Lower cutting units. Engage parking brake, stop the engine, and remove key from the ignition switch.
  - B. Remove cotter pin (11) from clevis pin (12). Slide clevis pin out of the lift arm (13) removing flat washers (14) (Fig. 64).
  - C. Separate rod clevis from lift arm (13) (Fig. 63).
  - D. Loosen jam nut (13) and adjust rod clevis (14) as necessary (Fig. 64). Tighten jam nut.
  - E. Position rod clevis into lift arm (13) (Fig. 63).
  - F. Install clevis pin (12) and flat washers (14) into the lift arm (13) and rod clevis. Secure clevis pin with cotter pin (11) (Fig. 63).
  - G. Check distance between the carrier frame rollers (bumpers on later models) and the foot step as described above.

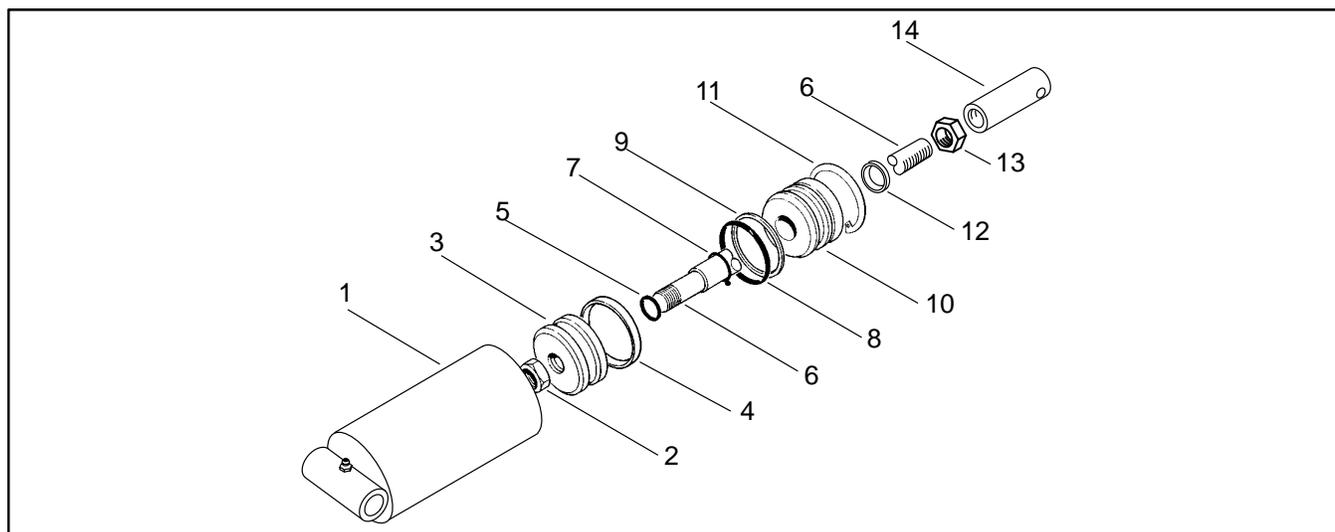


Figure 64

- |             |                  |                    |
|-------------|------------------|--------------------|
| 1. Barrel   | 6. Shaft         | 11. Retaining ring |
| 2. Lock nut | 7. O-ring        | 12. Dust seal      |
| 3. Piston   | 8. O-ring        | 13. Jam nut        |
| 4. Uni-ring | 9. Backup washer | 14. Rod clevis     |
| 5. O-ring   | 10. Head         |                    |

**Disassembly (Fig. 64)**

1. Remove oil from cylinder into a drain pan by **slowly** pumping the cylinder shaft (6). Plug both ports and clean the outside of the lift cylinder.

**IMPORTANT: Prevent damage when clamping the lift cylinder into a vise; clamp on the pivot end only. Do not close vise enough to distort the barrel (1).**

2. Mount lift cylinder in a vise so that the shaft (6) end tilts up slightly.

3. Remove retaining ring (11) from the barrel (1).

4. Grasp clevis rod (14); extract shaft (6), head (10), and piston (3) by carefully twisting and pulling on the shaft out from the barrel (1).

**IMPORTANT: Do not clamp vise jaws against shaft surface. Protect shaft surface before mounting in the vise.**

5. Mount shaft (6) securely in a vise. Remove locknut (2) and piston (3) from the shaft. Slide head (10) off the shaft.

6. Remove and discard uni-ring (4) and O-ring (5) from the piston (3). Remove and discard dust seal (12), backup washer (9), and O-rings (7 and 8) from the head (10).

**Note:** If the rod clevis (14) is to be removed from the shaft (6), note the number of threads exposed between the jam nut (13) and the smooth surface of the shaft to help reassembly.

7. Loosen jam nut (13) and remove clevis if necessary.

**Inspection (Fig. 64)**

1. Wash all parts in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel (1) for deep scratches, out-of-roundness, and bending. Replace if worn or damaged.

3. Inspect head (10), shaft (6), and piston (3) for excessive pitting, scoring, and wear. Replace any worn or damaged parts.

**Reassembly (Fig. 64)**

1. Coat new dust seal, uni-ring, backup washer, and all O-rings lightly with hydraulic oil. Install new O-ring (5) and uni-ring (4) to the piston (3). Install O-rings (7) and (8) and backup washer (9) to the head (10). Press dust seal (12) into head (10).

**IMPORTANT: Do not clamp vise jaws against shaft (6) surface. Protect shaft surface before mounting in the vise.**

2. Mount shaft (6) securely in a vise. Adjust clevis (14) and jam nut (13) so the number of threads exposed between the jam nut (13) and the smooth surface of the shaft is the same as noted during disassembly. The jam nut must be tight against rod clevis for this adjustment.

3. Coat shaft (6) lightly with hydraulic oil. Slide head (10) onto the shaft being careful not to damage O-ring (7) and dust seal (12).

4. Install piston (3) onto the shaft being careful not to damage O-ring (5). Install locknut (2) onto the shaft and tighten.

5. Remove shaft (6) from the vise.

**IMPORTANT: Prevent damage when clamping the barrel (1) into a vise; clamp on the pivot end only. Do not close vise enough to distort barrel.**

6. Mount barrel (1) in a vise so that the shaft end tilts up slightly.

7. Coat all internal lift cylinder parts with a light coat of hydraulic oil. Slide piston (3), shaft (6), and head (10) assembly into barrel (1) being careful not to damage the seals.

8. Secure head (3) in barrel (11) by installing retaining ring (1) into barrel groove.

## Control and Implement Relief Valves

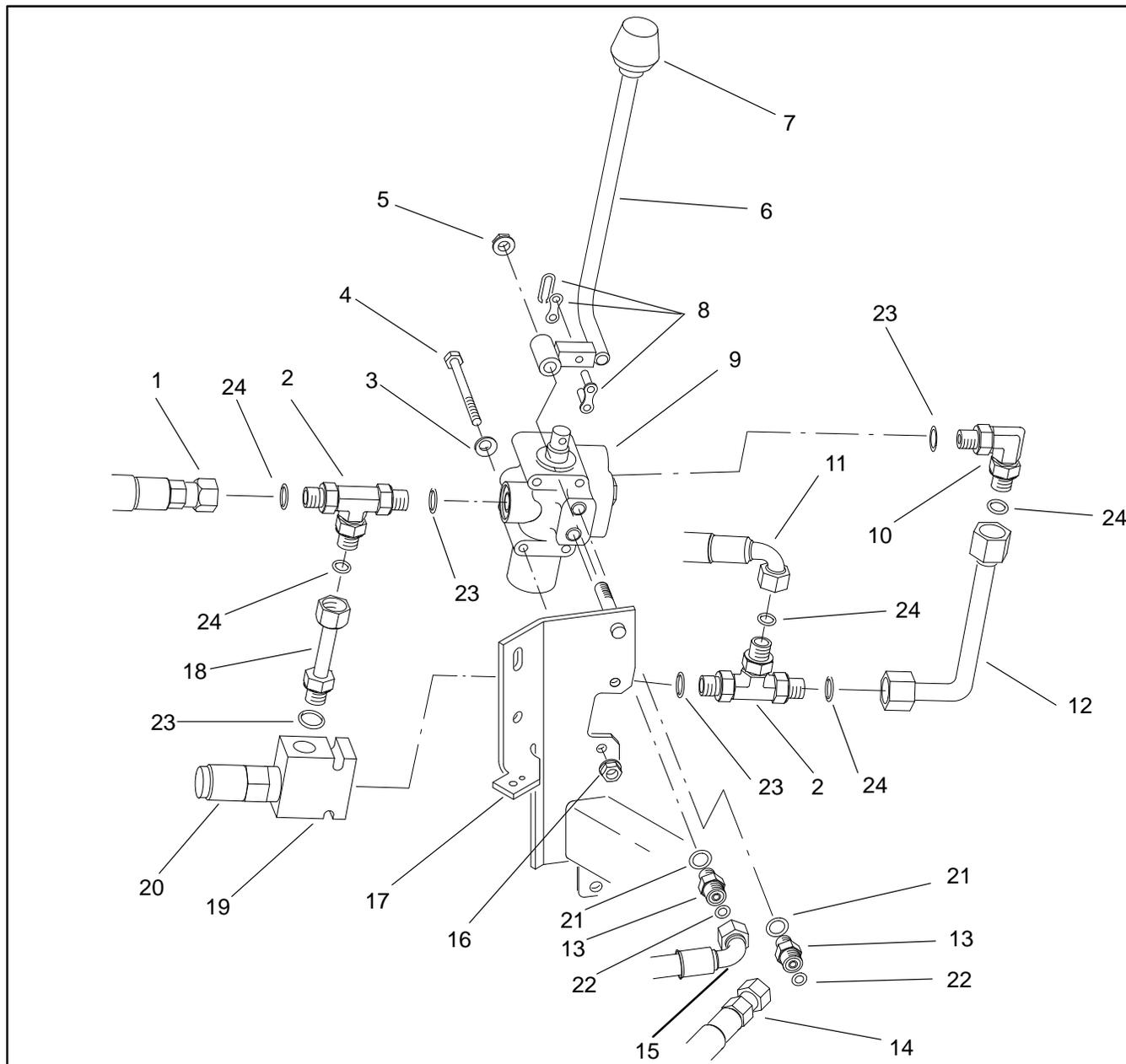


Figure 65

- |                             |                       |                            |
|-----------------------------|-----------------------|----------------------------|
| 1. Hose connection          | 9. Control valve      | 17. Support bracket        |
| 2. Hydraulic fitting        | 10. Hydraulic fitting | 18. Tube                   |
| 3. Washer                   | 11. Hose connection   | 19. Relief valve body      |
| 4. Cap screw                | 12. Tube              | 20. Relief valve cartridge |
| 5. Lock nut                 | 13. Hydraulic fitting | 21. O-ring                 |
| 6. Valve lever              | 14. Hose connection   | 22. O-ring                 |
| 7. Knob                     | 15. Hose connection   | 23. O-ring                 |
| 8. Connecting link assembly | 16. Lock nut          | 24. O-ring                 |

1. Before removing any parts from the control lift valve assembly, park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove the key from the ignition switch.



2. Remove side panels lift hood to gain access to the control valve and relief valve.

### Control Valve Removal (Fig. 65)

1. Disconnect hose connections (1, 11, 14, and 15) from hydraulic fittings (2 and 13). Allow hoses to drain to a suitable container.
2. Remove lock nuts (5 and 16). Slide cap screw (4) and washer (3) from the control valve (9).
3. Slide control valve (9) from the support bracket (17) and remove from the unit.
4. Unsnap and remove connecting link assembly (8). Remove valve lever (6) from the control valve (9).
5. Disconnect tube (18) from hydraulic fitting (2). Disconnect tube (12) from hydraulic fitting (10).
6. Remove hydraulic fittings (2, 10, and 13) and O-rings (21 and 23) from the control valve (9).

### Control Valve Installation (Fig. 65)

1. Install O-rings (21 and 23) and hydraulic fittings (2, 10, and 13) to the control valve (9).
2. Install tube (12) to hydraulic fitting (10). Connect tube (18) to hydraulic fitting (24).
3. Install valve lever (6) to the control valve (9) by snapping the connecting link assembly (8) to the valve lever and control valve.

4. Position control valve (9) into unit and slide onto support bracket (17).

5. Slide cap screw (4) into control valve (9) and install washer (3). Secure lock nuts (5 and 16).

6. Connect hose connections (1, 11, 14, and 15) to hydraulic fittings (2 and 13) and tighten connections.

### Relief Valve Removal (Fig. 65)

**Note:** This procedure may be used if only the relief valve needs removal from the unit.

1. Disconnect hose connection (11) from hydraulic fitting (2). Allow hose to drain to a suitable container.
2. Disconnect tube (18) from hydraulic fitting (2). Allow fitting to drain to a suitable container.
3. Remove relief valve body (19) and hydraulic fitting (2) from tube (12).
4. Remove hydraulic fitting (2), tube (18) and both O-rings (23) from the relief valve body (19).

### Relief Valve Installation (Fig. 65)

**Note:** This procedure may be used if only the relief valve has been removed from the unit.

1. Install hydraulic fitting (2) and O-ring (23) to the relief valve body (19).
2. Install tube (18) and O-ring (23) to the relief valve body (19).
3. Set relief valve body (19) and attachments into the unit.
4. Connect tube (18) to hydraulic fitting (2).
5. Connect tube (12) to hydraulic fitting (2).
6. Connect hose connection (11) to hydraulic fitting (2).

### Control Valve Disassembly (Fig. 66)

1. Wash control valve in solvent and dry it thoroughly.
  2. Mount control valve into a vise so the mounting pads are against the jaws of the vice and snap ring (14) faces up.
- Note:** Remove check valve seat (5) only if it needs replacement; it is press fitted in.
3. Remove plug (1) and O-ring (2) from the valve body (7). Remove spring (3), ball (4), cam pin (6).
  4. Repeat step 3 for the other plug (1).
  5. Remove snap ring (14) from the bottom of the valve body (7). Remove spool snap ring (13), spring retainer (10), spacer (12), and spring (11).
  6. Push and twist spool (8) carefully out of the valve body (7). Set spool aside.
  7. Remove O-rings (9) using a soft hooked scribe or a thin screwdriver and being careful not to scratch the valve bore finish.

### Control Valve Inspection (Fig. 66)



1. Wash all parts in solvent. Dry parts with compressed air.
2. Inspect spool (8) for bending and flatness. Signs of wear on one side of the spool may indicate it's bent. Replace a worn or damaged spool if necessary.
3. Inspect parts for wear or damage, and replace if necessary.

### Control Valve Reassembly (Fig. 66)

1. Coat all new O-rings with hydraulic oil. Install new O-rings (9) into the bore of the valve body (7).
2. Coat spool (8) lightly with hydraulic oil. Push and twist spool carefully into the valve body (7). Avoid damaging O-rings (9).

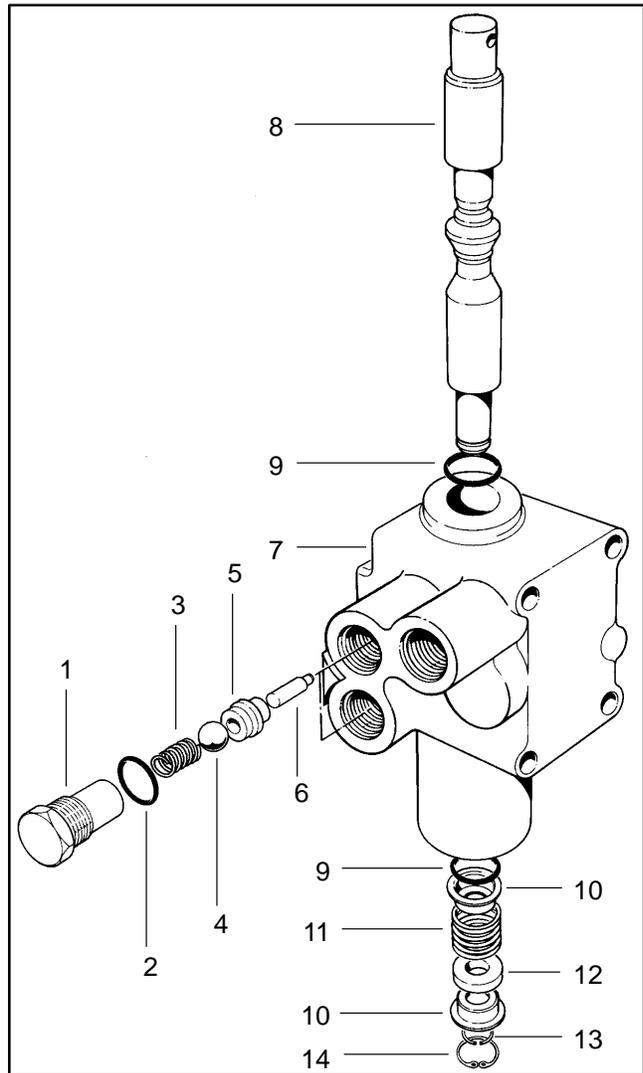


Figure 66

- |                     |                     |
|---------------------|---------------------|
| 1. Plug             | 8. Spool            |
| 2. O-ring           | 9. O-ring           |
| 3. Spring           | 10. Spring retainer |
| 4. Ball             | 11. Spring          |
| 5. Check valve seat | 12. Spacer          |
| 6. Cam pin          | 13. Spool snap ring |
| 7. Body             | 14. Snap ring       |

3. Install spring retainer (10), spring (11), spacer (12), other spring retainer (10), and spool snap ring (13) onto the spool (8). Install snap ring (14) into the valve body (7).

4. If check valve seat (5) was damaged and removed, press fit it into the valve body (7).

5. Install cam pin (6), ball (4), and spring (3). Place new O-ring (2) on plug (1) and install them into the valve body (7). Tighten plug (1).

6. Repeat steps 4 and 5 for the other plug (1) and valve assembly.

# Hydraulic Reservoir

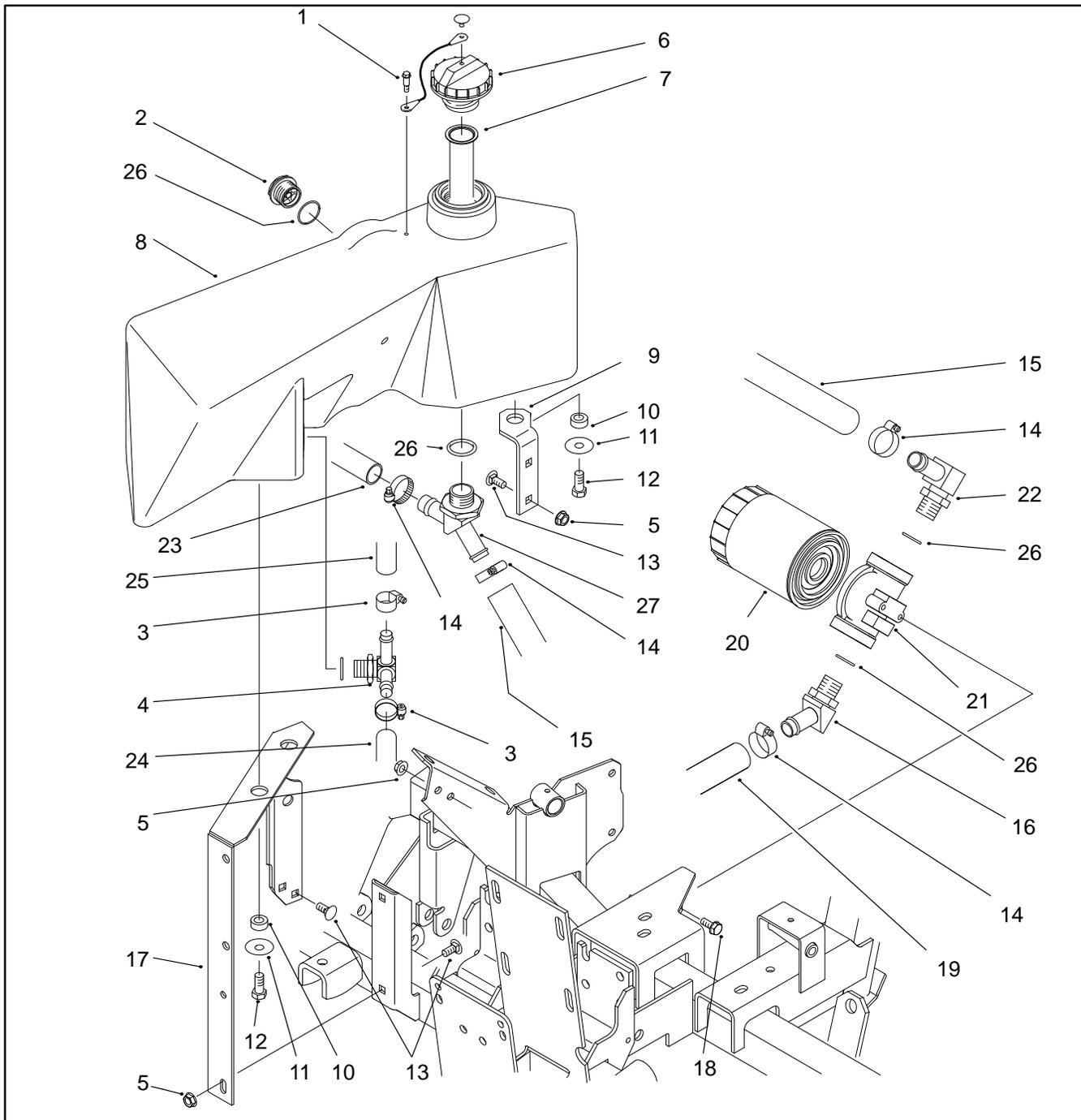


Figure 67

- |                   |                       |                        |
|-------------------|-----------------------|------------------------|
| 1. Shoulder screw | 10. Grommet           | 19. Hydraulic hose     |
| 2. Sight glass    | 11. Flat washer       | 20. Oil filter element |
| 3. Hose clamp     | 12. Cap screw         | 21. Oil filter head    |
| 4. Barb fitting   | 13. Carriage screw    | 22. 90° fitting        |
| 5. Flange nut     | 14. Hose clamp        | 23. Hydraulic hose     |
| 6. Cap assembly   | 15. Hydraulic hose    | 24. Hydraulic hose     |
| 7. Filler screen  | 16. Hydraulic fitting | 25. Hydraulic hose     |
| 8. Hydraulic tank | 17. U-bracket support | 26. O-ring             |
| 9. Tank bracket   | 18. Cap screw         | 27. Hydraulic fitting  |

Hydraulic System

### **Inspecting Reservoir Parts (Fig. 67)**

1. Clean tank (1) and filler screen (7) with solvent.
2. Inspect tank (1) for leaks, cracks, or other damage.
3. Replace hydraulic hoses if worn or leaking.
4. Make sure cap screws (12) are secure. If loose, remove and reinstall cap screws with loctite.
5. Make sure all bracket fasteners are tight.

## Flushing the Hydraulic System

**IMPORTANT:** Flush the hydraulic system any time there is a severe component failure or the system is contaminated (oil appears milky or black or contains metal particles).

**IMPORTANT:** Flush hydraulic system when changing from petroleum base hydraulic fluid, such as Mobil 424, to biodegradable fluid, such as Mobil EAL 224H. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface. Lower cutting units, stop engine, engage parking brake and remove key from ignition switch.
2. Clean area around filter mounting area. Remove filter and drain reservoir into a suitable container. Drain hydraulic system, Make sure lift cylinders, hoses, and tube lines are drained while the system is warm. Discard filter.
3. Inspect and clean reservoir (see Inspecting Reservoir Parts).
4. Make sure filter mounting surface is clean. Apply hydraulic oil to gasket on the new filter. Screw filter on until gasket contacts mounting plate, then tighten filter half a turn.

**Note:** Use biodegradable fluid, such as Mobil EAL 224H, for this step if you are changing to this type of fluid. Use only hydraulic fluids specified in Checking Hydraulic System Fluid (see General section of this chapter). Other fluids could cause system damage.

5. Fill hydraulic reservoir.
6. Disconnect electrical connector to the fuel stop solenoid to prevent engine from starting.
7. Turn ignition key switch; engage starter for ten (10) seconds to the prime pump. Repeat this step again.
8. Connect electrical connector to the fuel stop solenoid.
9. Start engine and let it idle at low speed for a minimum of two (2) minutes.
10. Increase engine speed to high idle for minimum of one (1) minute under no load.

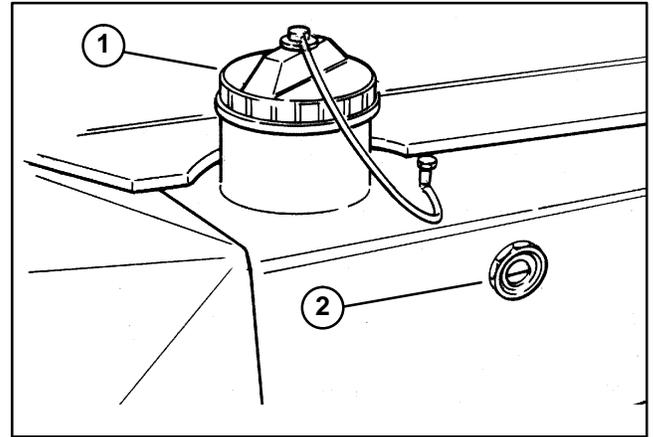


Figure 68

1. Hydraulic reservoir cap
2. Sight gauge

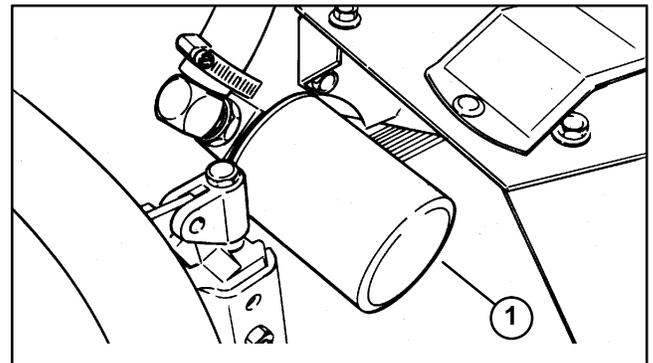


Figure 69

1. Hydraulic filter

11. Raise and lower cutting units several times.
12. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary.
13. Operate the machine for two (2) hours under normal operating conditions.
14. Check condition of hydraulic oil. If the flushing fluid shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 14 again.
15. Assume normal operation and follow recommended maintenance intervals.

---

## Hydraulic System Start-up

**Note:** When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or lift cylinders, it is important that this start-up procedure be used. This procedure reduces the chance of damaging the system or its components from not purging the system of air.

1. After the hydraulic system components have been properly installed and if the traction pump was rebuilt or replaced, make sure traction pump housing is at least half full of clean hydraulic oil.
2. Make sure all hydraulic connections and lines are secured tightly.
3. Make sure hydraulic reservoir is full. Add correct oil if necessary (see Checking the Hydraulic System Fluid). Drain, flush, and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated.
4. Disconnect electrical connector to the fuel stop solenoid to prevent engine from starting.
5. After repairs, check control linkage for proper adjustment, binding, or broken parts.
6. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Turn ignition key switch; engage starter for fifteen (15) seconds to the prime pump.
7. Connect electrical connector to the fuel stop solenoid.
8. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Start engine and run it at low idle. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.



### CAUTION

**Be careful when operating the cutting unit reels. Contact with the reel or other moving parts can result in personal injury.**

9. After the hydraulic system starts to show signs of fill, accomplish the following:
  - A. If a reel motor was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for 10 minutes in **both** directions.
  - B. If a reel motor drive pump was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for 10 minutes.
  - C. If a traction pump or a wheel motor was replaced or rebuilt, run the traction unit so the wheels slowly turn for 10 minutes.
10. Operate the traction unit and cutting unit by gradually increasing their work load to full over a 10 minute period.
11. Stop the machine. Check reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

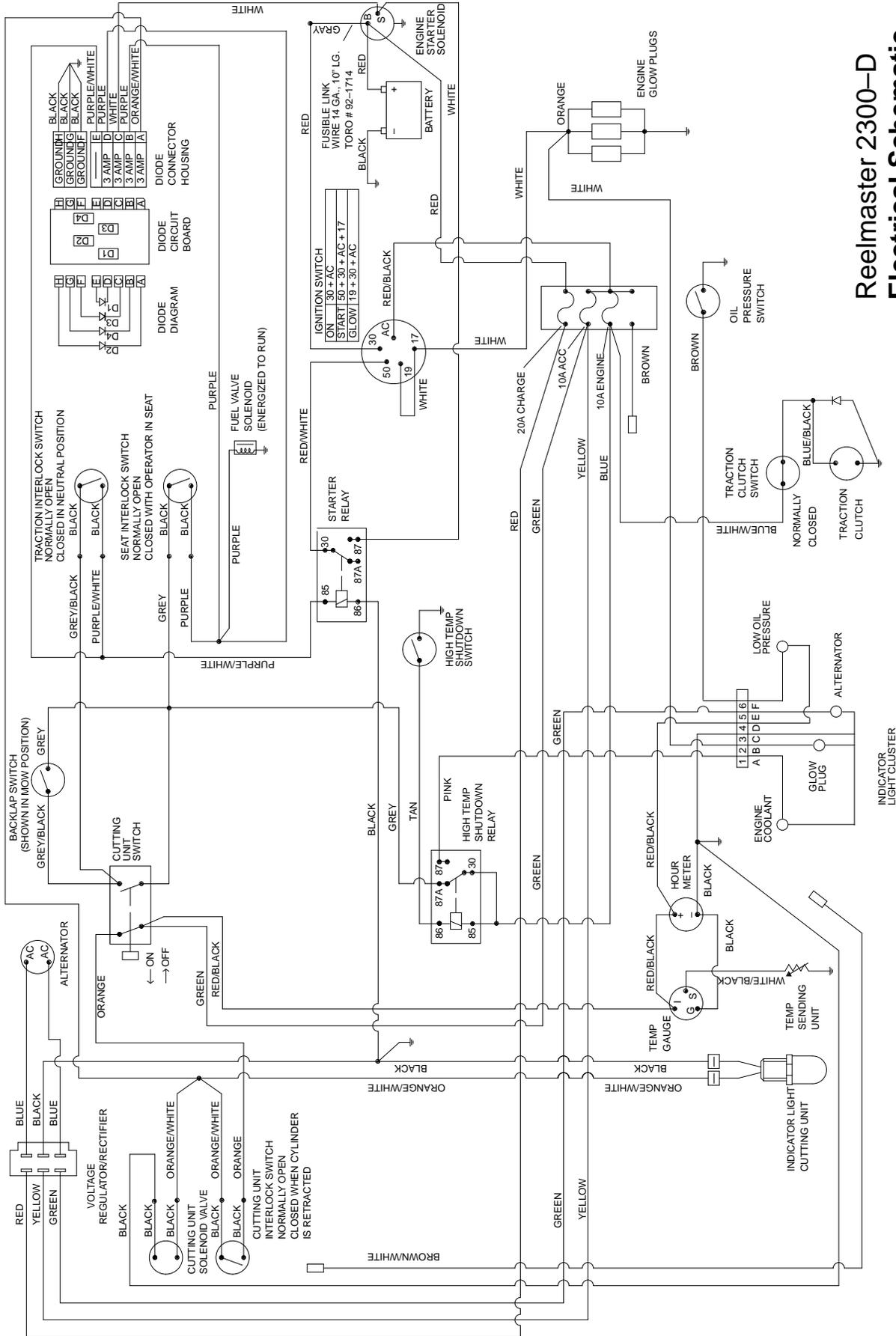


# Electrical System

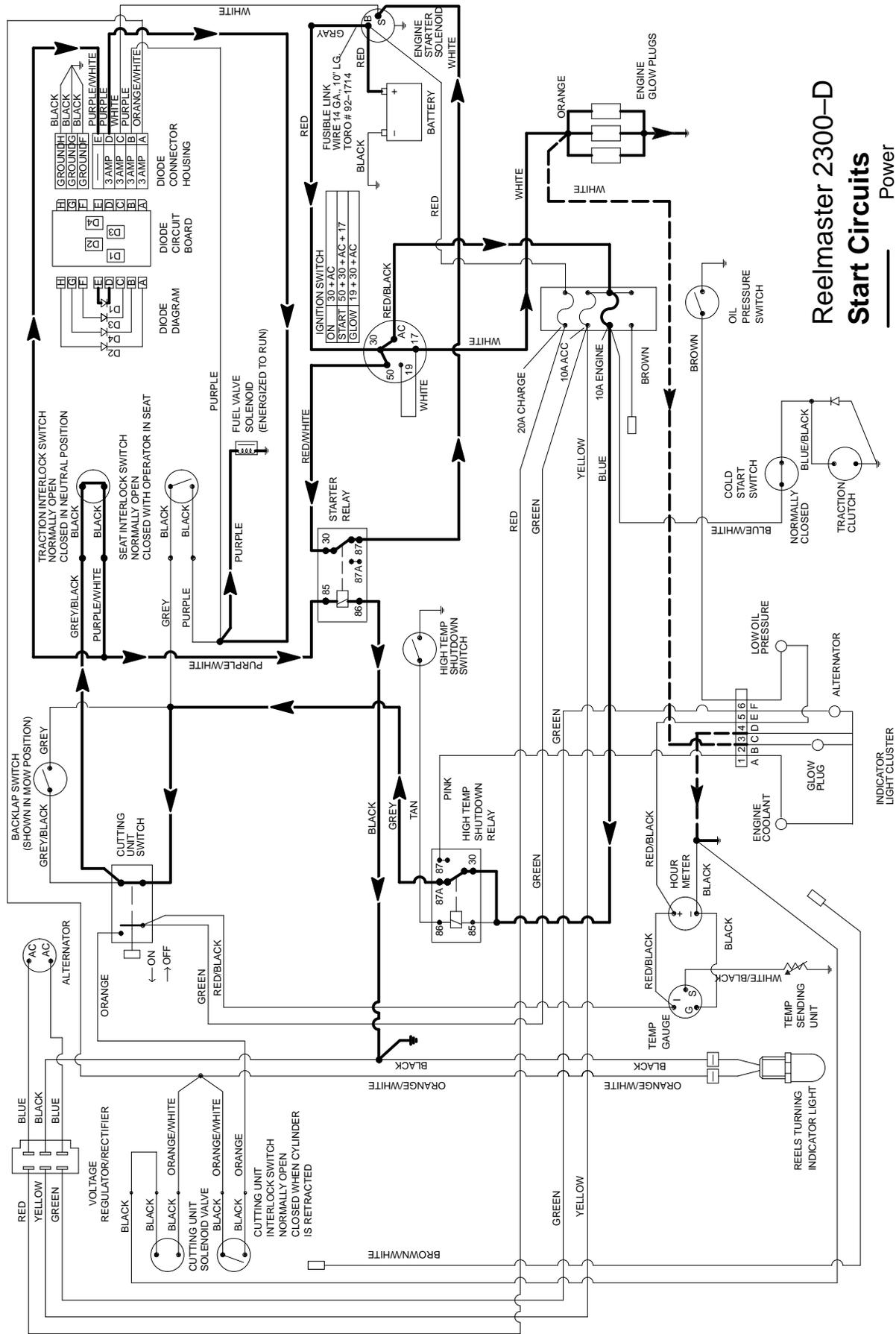
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# Wiring Schematics



## Reelmaster 2300-D Electrical Schematic

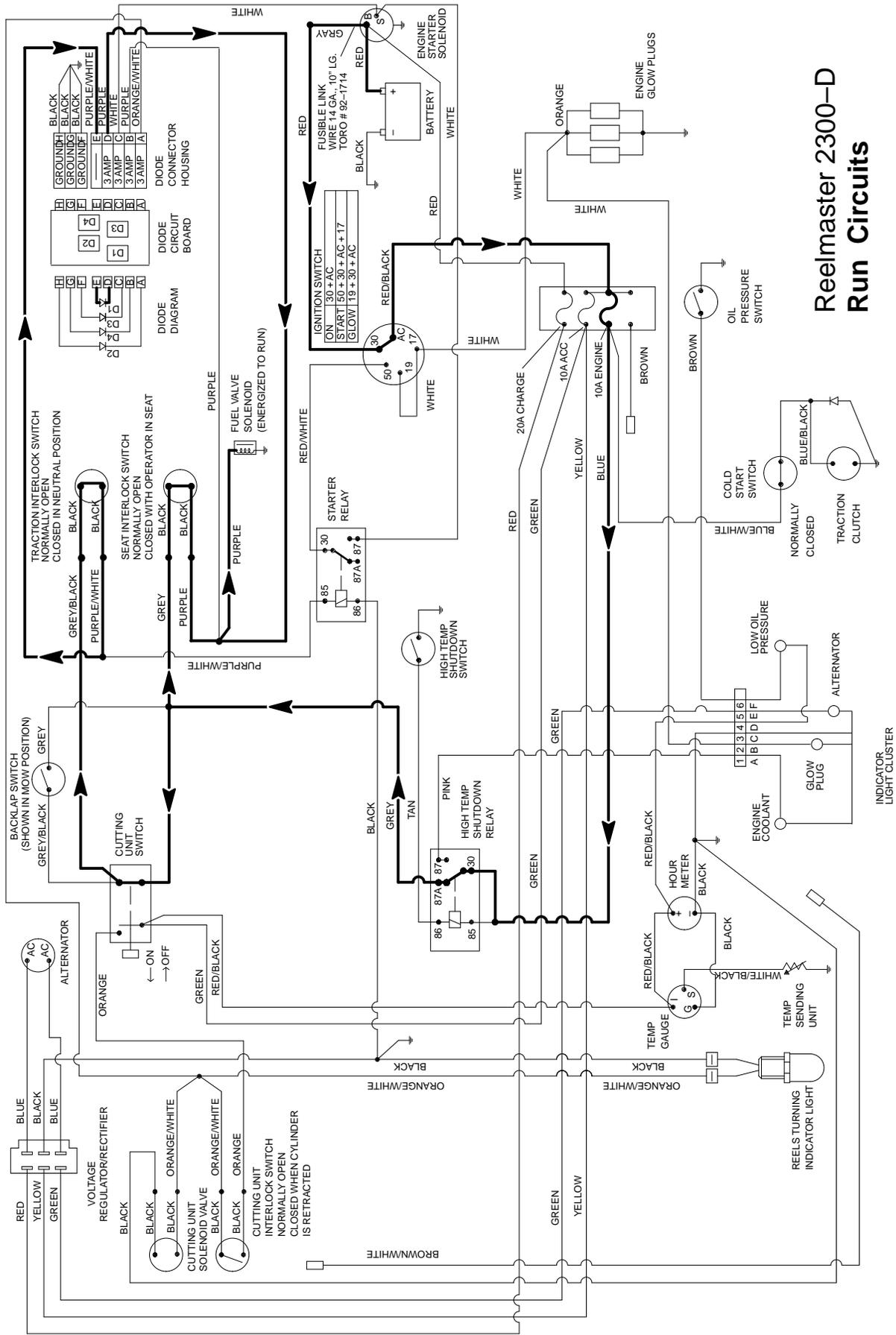


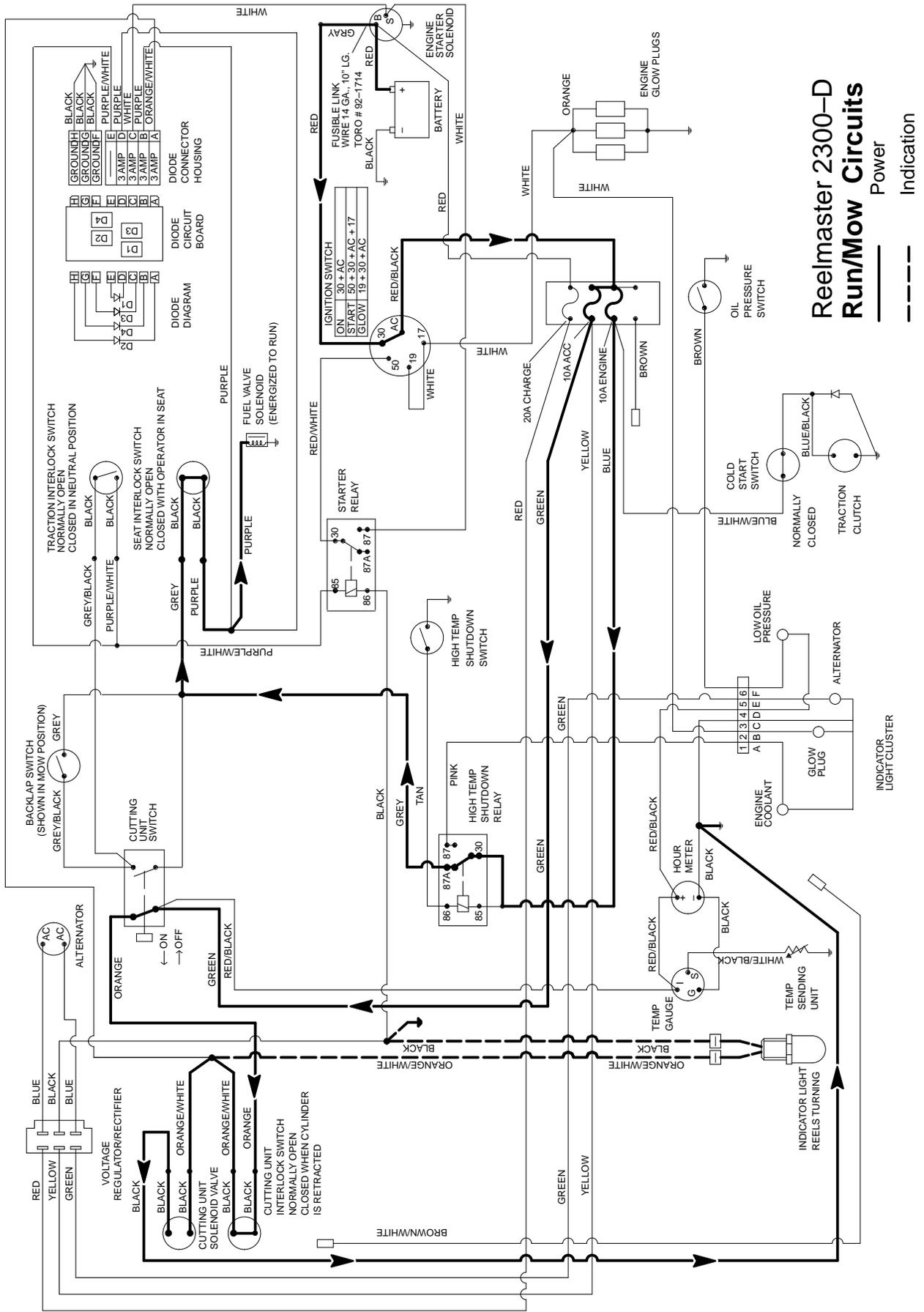
# Reelmaster 2300-D Start Circuits

Power  
Indication

Electrical System

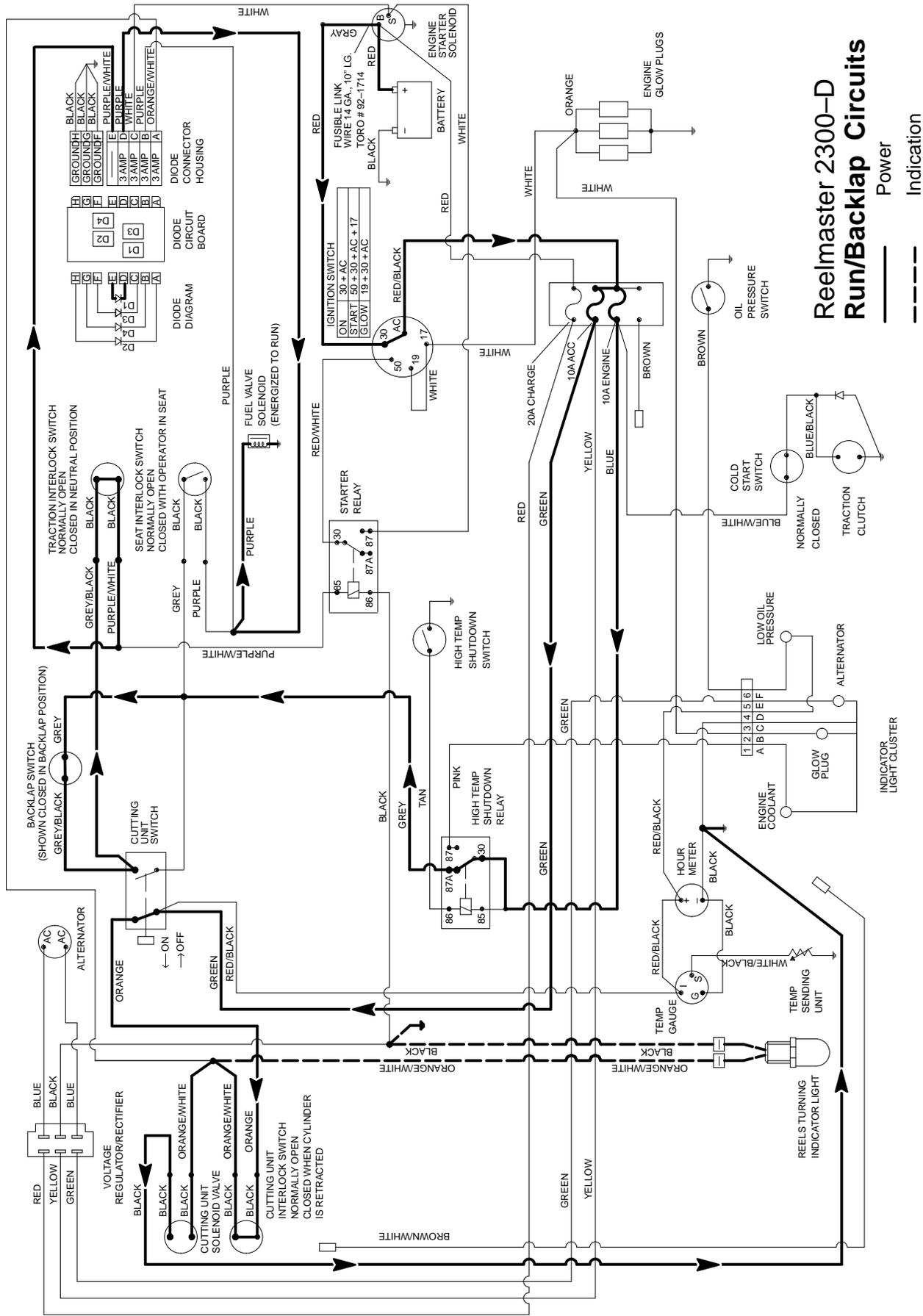
# Reelmaster 2300-D Run Circuits

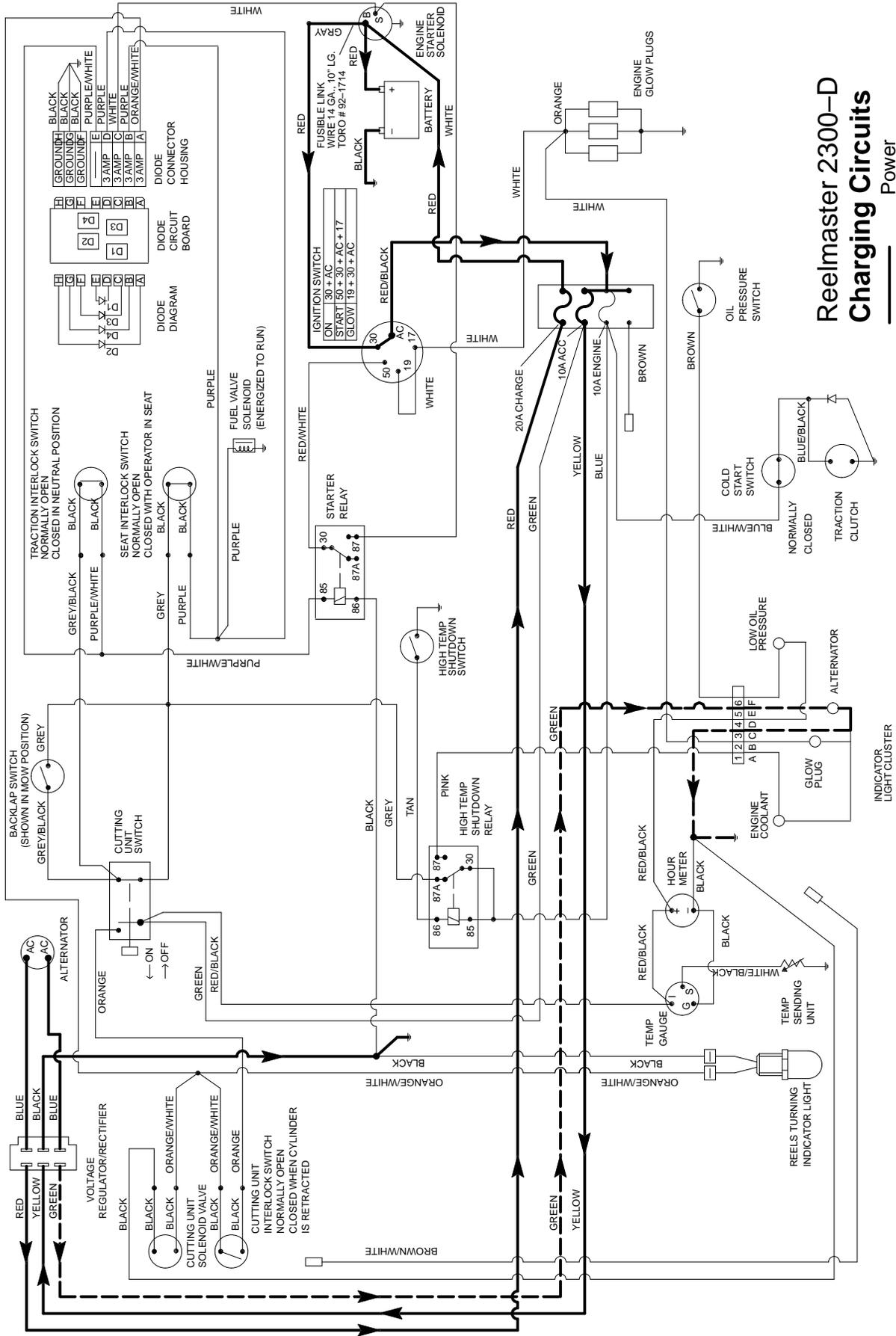




# Reelmaster 2300-D Run/Mow Circuits

Power  
Indication

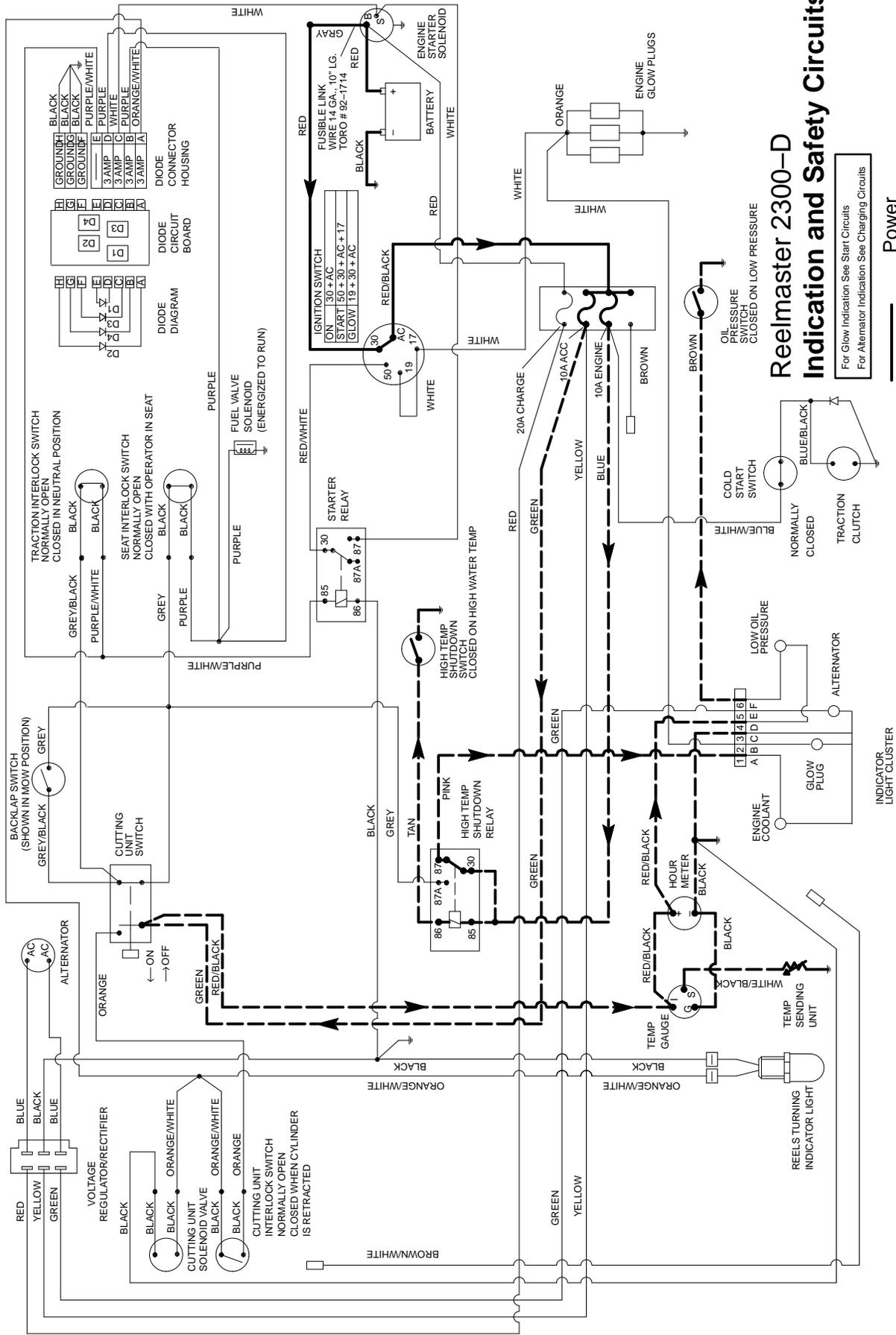




# Reelmaster 2300-D Charging Circuits

Power ———  
Indication - - -

**Electrical System**



# Reelmaster 2300-D Indication and Safety Circuits

# Special Tools

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

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.

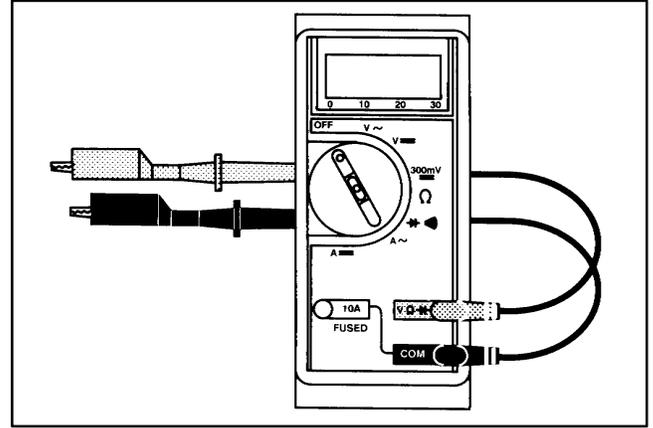


Figure 1

## Skin-Over Grease

Special non-conductive grease which forms a light protective skin which helps waterproof electrical switches and contacts.

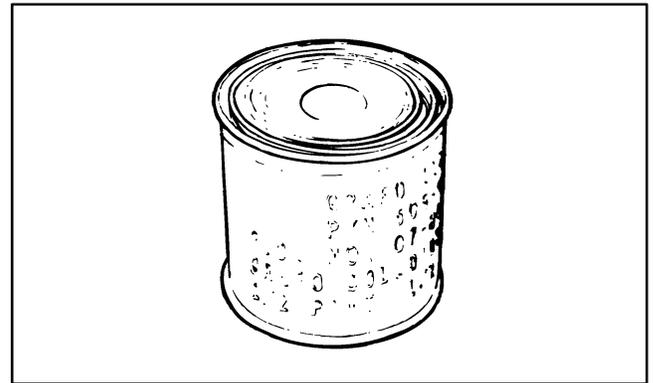


Figure 2

# 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 Wiring Schematics 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).	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid. Starter is faulty causing incomplete circuit for solenoid.
Nothing happens when start attempt is made.	Cutting unit switch is <b>ON</b> (pulled out) or faulty. Battery is dead. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Fusible link is open. Wiring to the start circuit (see Wiring Schematics) components is loose, corroded, or damaged. Ignition switch is faulty. Starter relay is faulty. Starter solenoid is faulty. Engine fuse (10 amp) is open. Fuse block is faulty. High temperature shutdown relay and/or switch are faulty. Traction (neutral) interlock switch out of adjustment or faulty.

## Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	<p>Wiring to start circuits (see Wiring Schematics) is loose, corroded, or damaged.</p> <p>Diode (D1) circuit board/connector housing is open if engine starts with operator in the seat.</p> <p>Fuel valve solenoid is faulty.</p> <p>Glow plugs are faulty.</p> <p>Engine or fuel system is malfunctioning (see Chapter 6 – Engine).</p> <p>Engine and fuel may be too cold.</p>
Engine cranks (but should not) with the traction pedal out of the neutral position.	<p>Traction (neutral) interlock switch is out of adjustment, faulty, or short circuited.</p> <p>Diode (D1) circuit board/connector housing is short circuited.</p>
Engine cranks (but should not) with the cutting unit switch <b>ON</b> (pulled out).	<p>Backlap/mow switch is in the backlap position.</p> <p>Cutting unit switch is faulty or short circuited.</p>

## General Run and Transport Problems

Problem	Possible Causes
<p>Engine continues to run (but should not) when the traction pedal is depressed with no operator on the seat.</p>	<p>Seat switch is faulty, out of adjustment, or short circuited.</p> <p>Traction (neutral) interlock switch is out of adjustment, faulty, or short circuited.</p>
<p>Engine kills when the traction pedal is depressed or the cutting unit switch is pulled <b>ON</b> with the operator in the seat.</p>	<p>Operator is sitting too far forward on the seat (seat switch not depressed).</p> <p>Seat hinge, support pin, or spring binding is preventing the seat switch from closing.</p> <p>Seat switch is faulty or out of adjustment.</p> <p>Seat switch wiring is loose, corroded, or damaged.</p>
<p>Battery does not charge.</p>	<p>Wiring to the charging circuits (see Wiring Schematics) components is loose, corroded, or damaged.</p> <p>Voltage regulator/rectifier is faulty.</p> <p>Alternator is faulty.</p> <p>Charge fuse (20 amp) is open.</p> <p>Fuse block is faulty.</p> <p>Battery is dead .</p>
<p>Engine kills during operation (operator sitting on seat).</p>	<p>Operator moved too far forward on the seat (seat switch not depressed).</p> <p>Engine overheated.</p> <p>Wiring to the run circuits (see Wiring Schematics) components became broken or disconnected.</p>

## Cutting Unit Operating Problems

Problem	Possible Causes
Engine Continues to run (but should not) when the cutting unit switch is <b>ON</b> with no operator in the seat.	<p>Backlap switch is in the backlap position.</p> <p>Backlap switch is faulty or out of adjustment.</p> <p>Wiring to the run/mow/backlap circuits (see Wiring Schematics) components is loose, corroded, or damaged.</p> <p>Seat switch is faulty, out of adjustment, or short circuited.</p>
Cutting units run (but should not) when raised. However, they shut off with the cutting unit switch	Cutting unit interlock switch is faulty.
Cutting units shut off when raised. However, they do not shut off with the cutting unit switch.	Cutting unit switch is faulty or short circuited.
Cutting units do not engage.	<p>Wiring to run/mow/backlap circuits (see Wiring Schematics) components is loose, corroded, or damaged.</p> <p>ACC fuse (10 amp) is open.</p> <p>Fuse block is faulty.</p> <p>Cutting units are not lowered.</p> <p>Cutting unit switch is faulty.</p> <p>Cutting unit interlock switch is faulty.</p> <p>Cutting solenoid valve is faulty.</p>

## Verify Interlock System Operation



### CAUTION

**The interlock switches are for the operator's protection; do not disconnect them. Check the operation of the switches daily to assure the interlock system is operating. If a switch is defective, replace it before operating the machine. Regardless if switches are operating properly or not, replace them every two years to assure maximum safety.**

1. Move the machine to a wide open area free of debris and bystanders. Raise the cutting units and stop the engine. Engage the parking brake. Keep hands and feet away from cutting units.
2. Make sure the mow/backlap knob is in the mow position (turned counterclockwise). Sit on the seat. Pull the cutting unit switch to the ON position. Try to start the engine. If the engine cranks, there may be a malfunction in the interlock system. Repair the problem immediately. If the engine does not crank, proceed to step 3.
3. Make sure the mow/backlap knob is in the mow position (turned counterclockwise), the traction pedal is in neutral, and the cutting unit switch is pushed to the OFF position. With the operator off the seat, start the engine. Depress the traction pedal with the operator out of the seat, the engine should stop. If the engine does not

stop, there may be a malfunction in the interlock system. Repair the problem immediately. If the engine does stop, proceed to step 4.

4. Make sure the mow/backlap knob is in the mow position (turned counterclockwise), the traction pedal is in neutral, and the cutting unit switch is pushed to the OFF position. With the operator off the seat, start the engine. Pull the cutting unit switch to the ON position, the engine should stop. If the engine does not stop, there may be a malfunction in the interlock system. Repair the problem immediately. If the engine does stop, proceed to step 5.

5. Make sure the mow/backlap knob is in the backlap position (turned clockwise), the traction pedal is in neutral, and the cutting unit switch is pushed to the OFF position. With the operator off the seat, start the engine. Pull the cutting unit switch to the ON position, the engine should **not** stop. If the engine does stop, there may be a malfunction in the interlock system. Repair the problem immediately. If the engine does not stop, proceed to step 6.

6. With the cutting units in the raised position, sit on the seat and start the engine. Pull the cutting unit switch to the ON position. Lower the cutting units to the ground. The cutting unit reels should turn and the reels turning light should glow when the cutting units are lowered. Raise the cutting units and verify that the reels stop and the reels turning light is out. If the reels do not stop, there may be a malfunction in the interlock system. Repair the problem immediately.

# Electrical System Quick Checks

## Battery Test (Open Circuit Test)

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

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60° to 100° F. 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

## Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if a charging system has an output, but not its capacity.

Tool required: Digital multimeter set to DC volts.

Test instructions: Connect the positive (+) meter lead to the positive battery post, and the negative (-) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

**Note:** Upon starting the engine, the battery voltage will drop and then increase once the engine is running.

**Note:** Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at 3200 RPM. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

Test results should be (example):

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30v
Battery Voltage after 3 Minute Charge	= 12.80v
Difference	= +0.50 v

## Glow Plug System Test

This is a fast, simple test that can help you determine a glow plug system's integrity and operation. The test should be run anytime hard starting (cold) is encountered on a diesel engine equipped with a glow plug system.

Tool(s) required: Digital multimeter and/or AC/DC current transducer (Hall Effect).

Test instructions: Properly connect the current transducer to the digital multimeter (refer to manufacturer's

instructions). Set the multimeter on the volts scale. With the key off (or Glow Switch in the OFF position), place the current transducer around the main glow plug power supply wire(s) and read the meter prior to activating glow plug system. Adjust the transducer to read zero (if applicable). Cycle the glow plug system at least two times (per instructions in Operator's Manual) and record the final results.

The Reelmaster 2300-D glow plug system should have a reading of about **21 Amps**.

---

## Starting System Test

This is an excellent test to use when a “slow crank/no start” problem is encountered. It will tell you if the problem is due to an electrical open, short or high resistance in the starter circuit.

NOTE: The Battery condition and state of charge must be checked before testing the starter system.

Tool(s) required: Digital multimeter and/or AC/DC current transducer (Hall Effect).

Test instructions: Properly connect current transducer to the digital multimeter (refer to manufacturers instruc-

tions). Set the multimeter on volts scale. With the key off, place the current transducer around the main negative (-) battery cable and read the meter prior to activating the starter system. Adjust the transducer to read zero (if applicable). Crank the engine for at least 3 seconds and record the results. Typical starter system draw for the RM 2300-D is about **155 Amps at 65° F**.

If current draw is significantly higher than listed, check for a shorted condition. If current draw is significantly lower than listed, check for high resistance.

# 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: Electrical troubleshooting of any 12 Volt power connection can also be performed through voltage drop tests without disconnecting the component.

NOTE: See the **Perkins 100 Series Workshop Manual** for more component testing information.


CAUTION

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

## Ignition Key Switch

The ignition (key) switch has four positions (GLOW, OFF, ON, 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 all circuits are being completed while the key is moved to each position. Verify continuity between switch terminals.

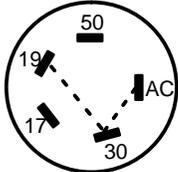
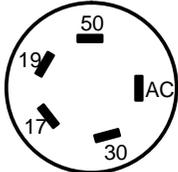
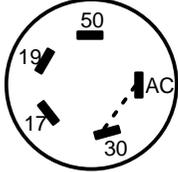
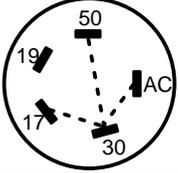
POSITION	CONTINUITY AMONG TERMINALS
GLOW (3)	 <span style="float: right;">30+19+AC</span>
OFF (0)	 <span style="float: right;">NONE</span>
ON (1)	 <span style="float: right;">30+AC</span>
START (2)	 <span style="float: right;">30+17+50+AC</span>

Figure 3

## Starter and High Temperature Shut Down Relays

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 80 to 90 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 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 from and multimeter leads from relay terminals.

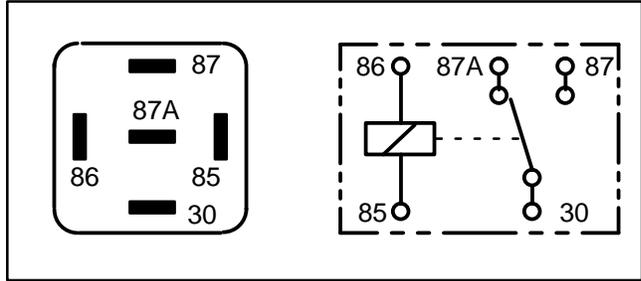


Figure 4

## High Temperature Shutdown Switch

The switch is located on top of the water pump. The pump is on the left end of the engine inside of the fan pulley assembly. There is a tan wire attached to the switch.

1. Lower the coolant level in the engine and remove the high temperature shutdown switch.

2. Put the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 6).

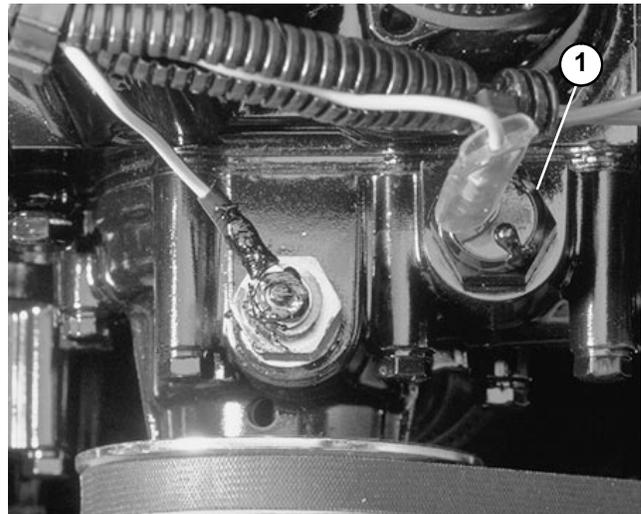


Figure 5

1. High temperature shutdown switch



3. Check the continuity of the switch with a multimeter (ohms setting). The switch is normally open and should close at 206 to 218°F (97 to 103°C).

4. Allow the oil to cool. The switch should open at 194°F (90°C).

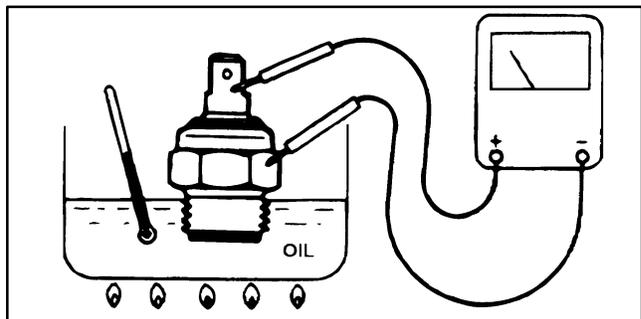


Figure 6

## Oil Pressure Switch

The switch is located on the front cylinder head above the injection pump and governor assembly. It is a normally closed switch and opens with pressure. The operating range for the switch is 2.8 to 5.7 PSI (0.2 to 0.4 kg/cm<sup>2</sup>).

### Testing with the engine off

1. Turn the ignition switch to ON. The oil pressure lamp should be on.
2. If the lamp is not on, disconnect the brown wire from the switch and ground it to the engine block.
3. If the lamp comes on the switch is bad.
4. If the lamp does not come on after step 2, check the indicating circuit (see Indicating and Safety Circuits).

### Testing with the engine on

1. If the lamp is on with the engine running, shut off the engine **immediately**.
2. Disconnect the brown wire from the switch.
3. Turn the ignition switch to ON. The oil pressure lamp should go out.
4. If the light is still on, check for short circuiting in the indication circuit (see Indicating and Safety Circuits).
5. Return ignition switch to OFF and connect the brown wire to the switch.

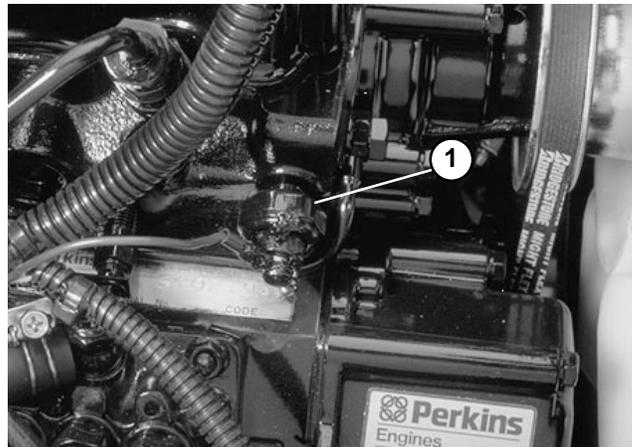


Figure 7

#### 1. Oil pressure switch

6. Remove switch and install test gauge in the oil pressure switch port.
7. Start the engine and check for a **minimum** of 30 psi at 1400 RPM. If the engine oil pressure is low, shut off the engine **immediately**.
8. Shut off the engine and remove the test gauge.
9. If the engine oil pressure is good, replace the switch.

## Hour Meter

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 other terminal of the hour meter.
3. The hour meter should move a 1/10 of an hour in six minutes.
4. Disconnect the voltage source from the hour meter.

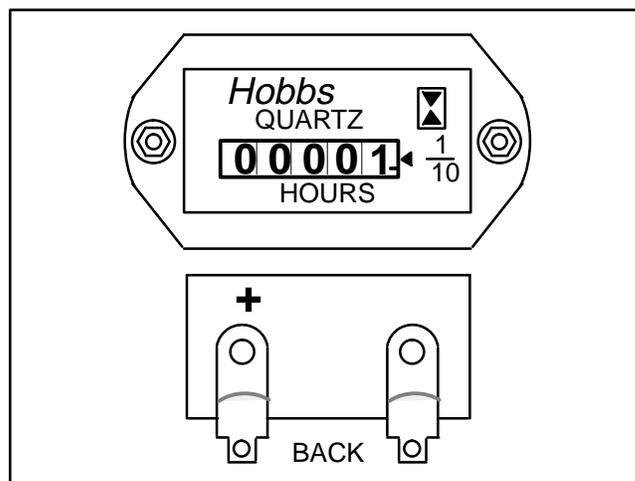


Figure 8

## Indicator Lights and Circuits

**Note:** Individual light bulbs can be tested by removing them from the lighting cluster and applying 12 VDC to their wiring terminals.

### Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running when the oil pressure drops below 4 PSI (0.3 kg/cm<sup>2</sup>).

1. Disconnect the brown wire from the oil pressure switch.
2. Ground the brown wire to the engine block.
3. Turn the ignition switch to ON; the light should come on.
4. Turn the ignition switch to OFF and connect the brown wire to the oil pressure switch.

### High Temperature (Water) Shutdown Light

The temperature light should come on only if the high temperature shutdown switch and relay have stopped the engine when the coolant temperature is above 206°F (97°C). The ignition switch must be in either the ON or START position for the light to come on.

1. Disconnect the tan wire from the high temperature shutdown switch.
2. Ground the tan wire to the engine block.
3. Turn the ignition switch to ON; the light should come on and the high temperature shutdown relay should click.
4. Turn the ignition switch to OFF and connect the tan wire to the high temperature shutdown switch.

### Glow Light

The glow light should come on with the ignition in the GLOW or START position.

1. Turn the ignition switch to GLOW or START; the light should come on.
2. Turn the ignition switch to OFF.

### Battery Light

The battery light should come on when the ignition switch is in ON with the engine not running or with an improperly operating charging circuit while the engine is running.

1. Turn ignition switch to ON; the light should come on.
2. Turn ignition switch to OFF.

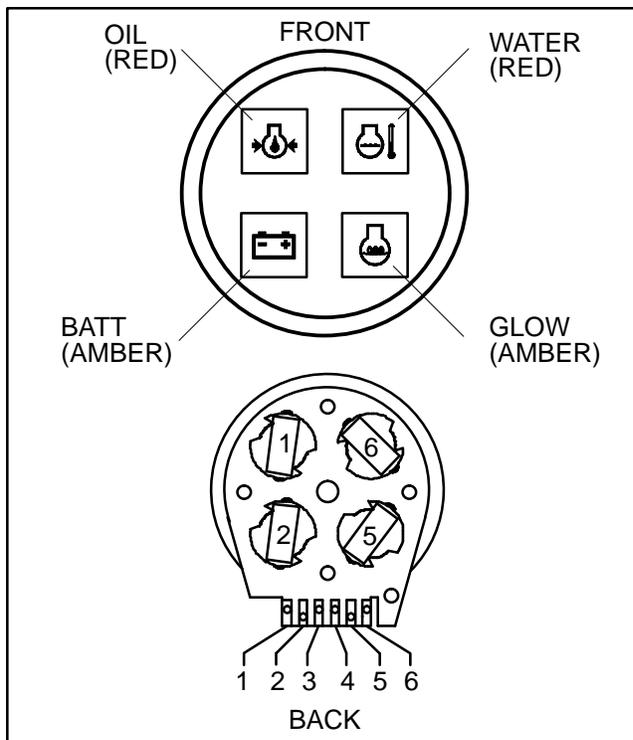


Figure 9

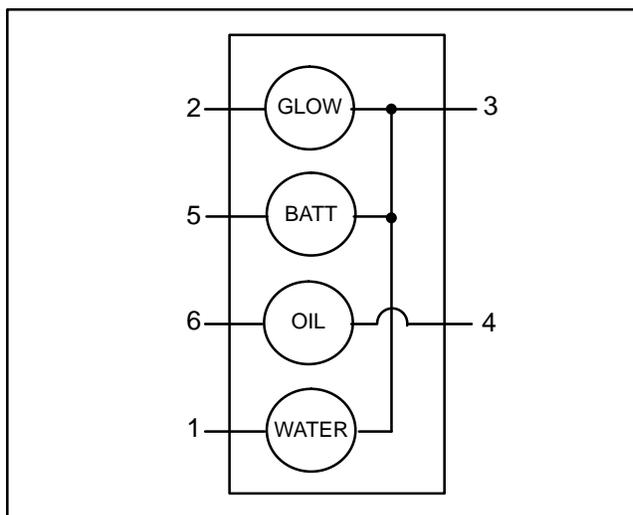


Figure 10

## Temperature Sending Unit

The switch is located on top of the water pump. The pump is on the left end of the engine inside of the fan pulley assembly. There is a white/black wire attached to the switch.

1. Lower the coolant level in the engine and remove the high temperature sending unit.
2. Put the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 12).



### CAUTION

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

3. Check the resistance of the sender with a multimeter (ohms setting) as the temperature increases. The following resistance readings should be indicated:

158 to 202 OHM at 130°F (54°C)

63 to 79 OHM at 180°F (82°C)

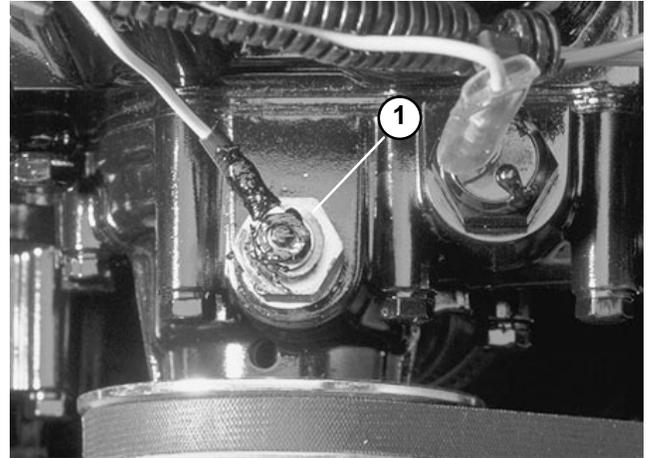


Figure 11

1. Temperature sending unit

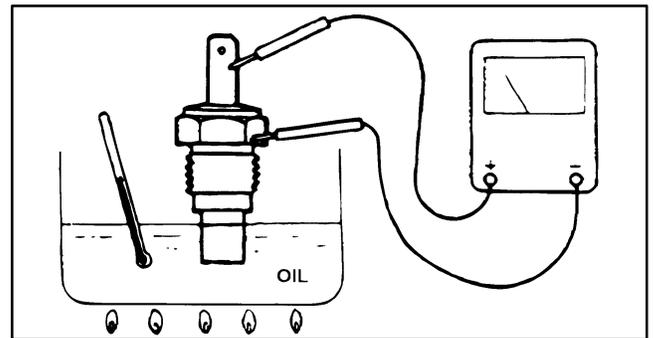


Figure 12

## Temperature Gauge

The temperature 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 temperature gauge to the variable resistance and DC voltage source (Fig. 13).
2. Adjust the resistance until the gauge needle points to the 180°F tic mark; the resistance setting should be from 63 to 79 ohms.
3. Disconnect the voltage source, gauge, and variable resistance.

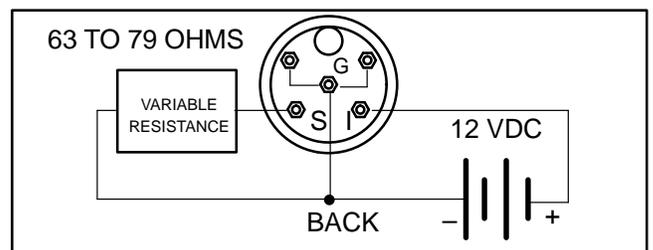


Figure 13

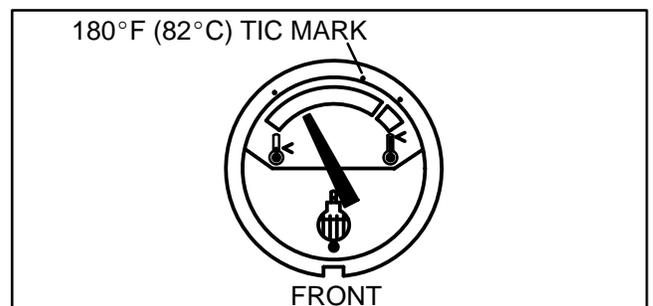


Figure 14

## Diode Circuit Board

The circuit board contains four diodes. Three diodes are used for circuit protection from inductive voltage spikes. The remaining diode is used as part of the safety circuit logic.

### Diode D1

This diode allows a current path through the traction interlock switch when the seat interlock switch is open. The engine can be started and run with no operator in the seat when the traction pedal is in the neutral position.

Possible indications of diode failure may be: The engine will crank but not start with the operator out of the seat with the traction pedal in neutral, the engine will shut down when the operator leaves the seat with the cutting unit switch in the off position and the traction pedal in neutral, or the engine cranks with the traction pedal not in neutral.

### Diode D2

This diode protects the cutting unit switch, interlock switch, and indicator light from inductive voltage spikes caused by the cutting unit solenoid valve.

Possible indications of diode failure may be the failure or repeated failure of those components above associated with the cutting unit solenoid valve circuit.

### Diode D3

This diode protects the ignition switch and starter relay contacts from induction voltage spikes caused by the starter solenoid.

Possible indications of diode failure may be the failure or repeated failure of those components above associated with the starter solenoid circuit.

### Diode D4

This diode protects the seat interlock switch and cutting unit switch from induction voltage spikes caused by the fuel valve solenoid.

Possible indications of diode failure may be the failure or repeated failure seat interlock switch.

### Testing

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

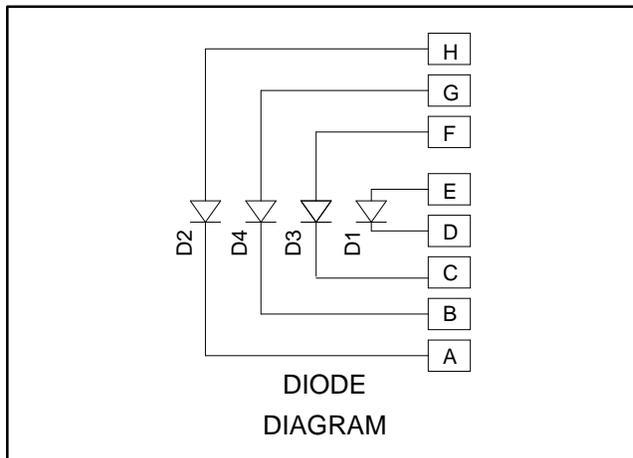


Figure 15

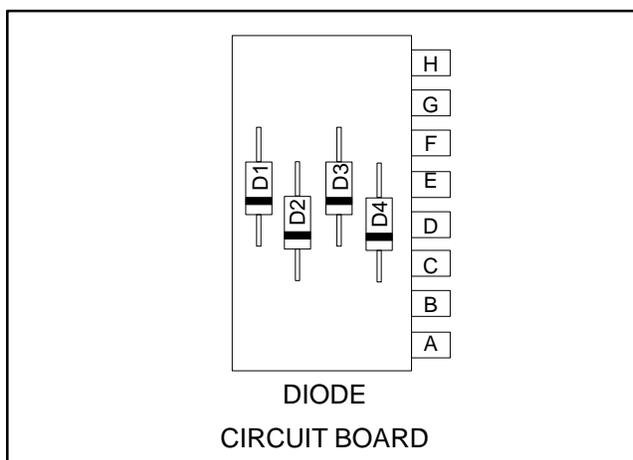


Figure 16

Red Lead (+) on Terminal	Black Lead (-) on Terminal	Continuity
H	A	YES
A	H	NO
G	B	YES
B	G	NO
F	C	YES
C	F	NO
E	D	YES
D	E	NO

## Fuel Valve Solenoid

The fuel valve solenoid must be energized for the engine to run. It is mounted on the engine block next to the injection pump and has a purple wire attached to it.

### 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 wire from the solenoid.
2. Using a digital multimeter, ground one lead to the engine block and connect the other to the solenoid terminal.
3. The resistance should be about 11.5 ohms.
4. Connect the wire to the solenoid.

### Live testing

1. Disconnect the wire from the solenoid.

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

2. Connect a positive (+) test lead from a 12 VDC source to the solenoid terminal.
3. Touch a negative (-) test lead from the 12 VDC source to the solenoid body. The plunger should retract making an audible "click".
4. Disconnect the test leads from the solenoid.
5. Connect the wire to the solenoid if tested in place.

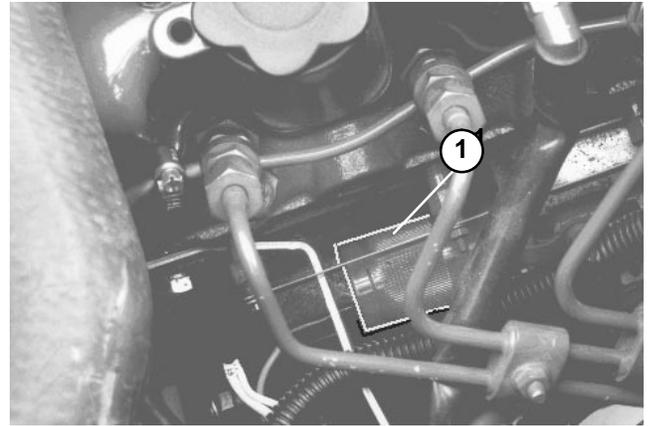


Figure 17  
(!) u01 C-100 9810n83

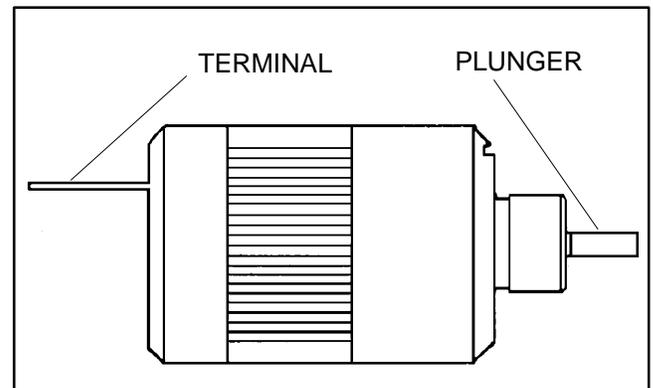


Figure 18

## Cutting Unit Solenoid Valve Coil

**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 solenoid valve electrical connector.
2. Measure resistance between the two connector terminals. The resistance should be about 7.2 ohms.
3. Connect solenoid valve electrical connector.

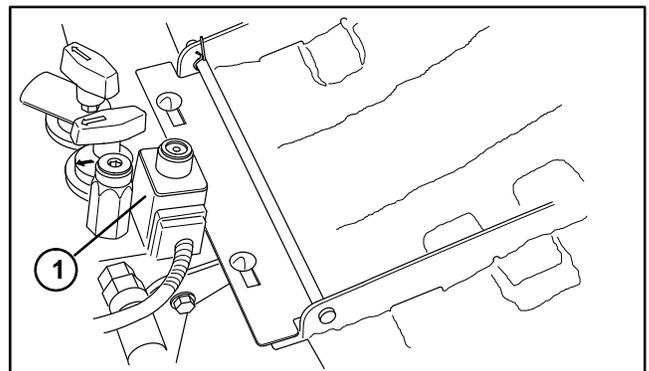


Figure 19  
1. Solenoid Valve Coil

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## Traction (Electric) Clutch

**Note:** When disconnecting the clutch, use the electrical connector that connects the clutch directly to the wiring harness. Do not use the connector attached to the traction clutch switch. This connector contains a diode in the circuit which will give incorrect resistance readings

### Deenergized 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 clutch electrical connector from the wiring harness.
2. Using a digital multimeter, measure the resistance between the connector terminals. The resistance should be from 3.0 to 4.0 ohms.

3. Connect the clutch electrical connector to the wiring harness.

**Note:** Low resistance may be accompanied by the 10 amp engine fuse blowing from drawing high current. High resistance may be accompanied by the clutch not engaging from drawing insufficient current.

### Live Testing

1. Disconnect the clutch electrical connector from the wiring harness.
2. Connect a 12 VDC source across the electrical connector terminals. The clutch should engage with a distinct audible "click".
3. Disconnect the 12 VDC source from the connector terminals.
4. Connect the clutch electrical connector to the wiring harness.

---

## Traction (Neutral) Interlock Switch

The traction interlock switch is normally open and closes when the traction pedal in in the neutral position.

1. Disconnect the electrical connector to the switch.
2. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
3. With the engine off, slowly push the traction pedal in the forward and reverse direction while watching the multimeter. Continuity should be broken in the forward and reverse directions.
4. Allow the traction pedal to return to the neutral position. There should be continuity across the terminals.
5. Reconnect the electrical connector to the switch.

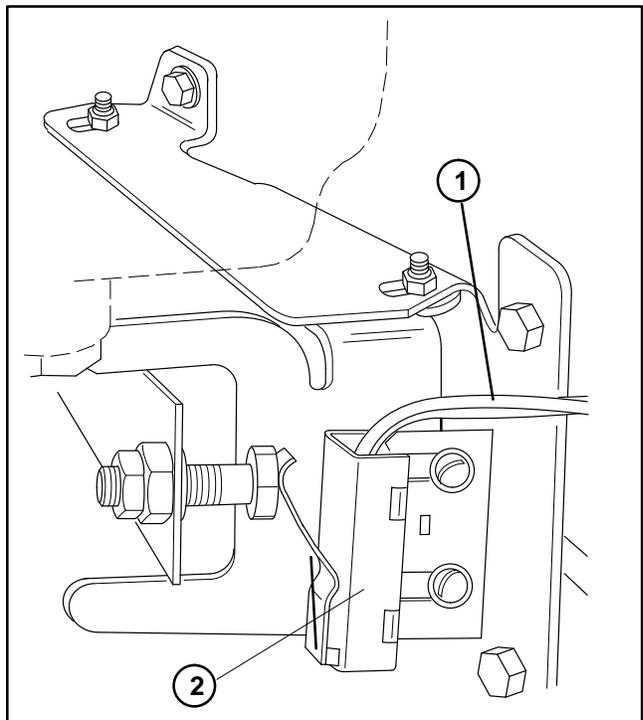


Figure 20

1. Connector leads

2. Interlock switch

## Seat Interlock Switch

This switch is a normally open switch that closes when the operator is on the seat. If the cutting unit switch or traction interlock switch is open and the operator raises out of the seat, the engine will stop. The switch and its electrical connector are located under the skirt below the seat.

1. Disconnect switch electrical connector.
2. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

**Note:** Make sure the compression spring and pin hold the seat off the switch when there is no operator in the seat.

3. With the seat lowered and no operator in the seat, there should be no continuity between the terminals.
4. Have an operator slowly sit in the seat. There should be continuity as the seat approaches the bottom of its travel.
5. Connect switch electrical connector.

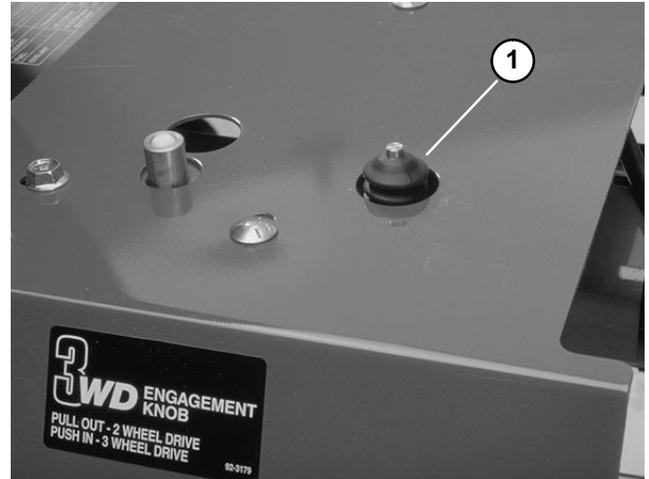


Figure 21

1. Seat interlock switch

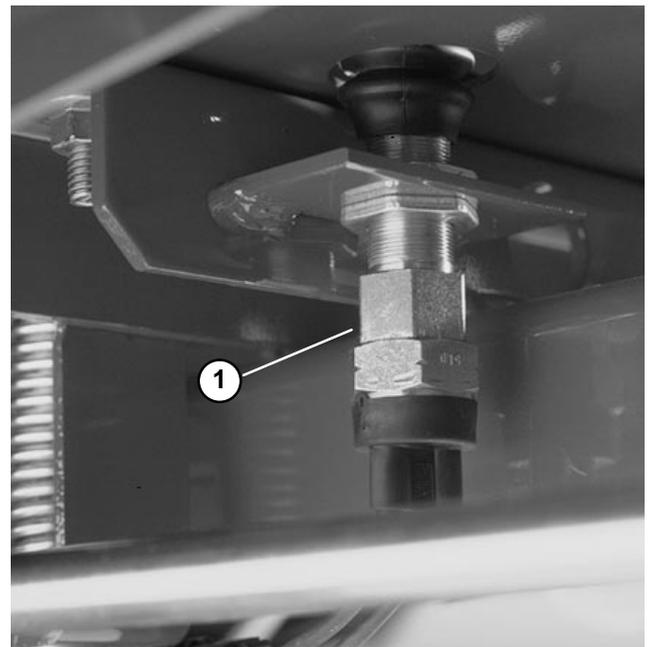


Figure 22

1. Seat interlock switch

## Cutting Unit Interlock Switch

This switch is normally open and closes when the lift cylinder is retracted (cutting units lowered). The switch and its electrical connector are located behind and below the hydraulic manifold on the cylinder support bracket.

1. Disconnect switch electrical connector.
2. With the cutting units lowered, check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals. There should be continuity across the switch.
3. Raise the cutting units and check the continuity of the switch. There should be no continuity across the switch with the lift cylinder extended.
4. Connect switch electrical connector.

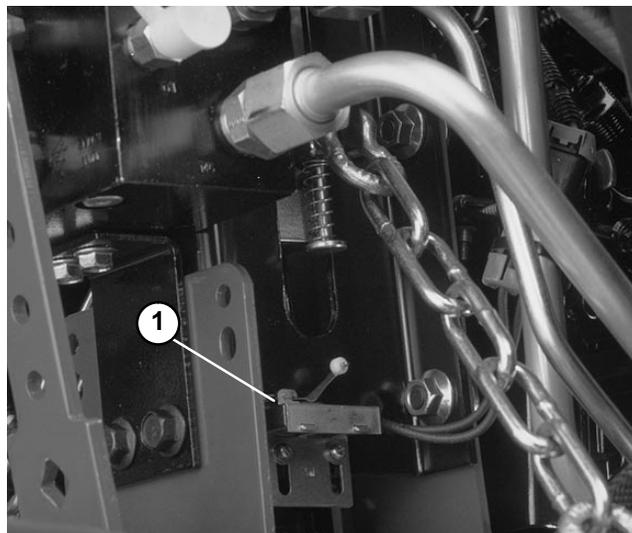


Figure 23

1. Cutting unit interlock switch

## Backlap Switch

The backlap switch is located on the hydraulic manifold. It is normally open and is closed when the backlap knob is turned clockwise to the backlap position.

1. Disconnect the electrical connector.
2. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
3. With the engine off, turn the backlap knob clockwise to the backlap position while watching the multimeter. Continuity should be made as the switch closes.
4. Turn the backlap knob counterclockwise to the mow position while watching the multimeter. Continuity should be broken as the switch opens.
5. Reconnect the electrical connector.

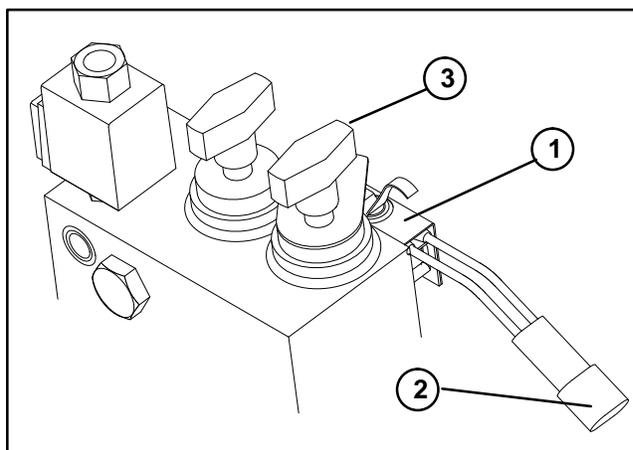


Figure 24

1. Backlap switch
2. Connector
3. Backlap knob

# Service and Repairs

NOTE: See the Perkins 100 Series Workshop Manual for more component repair information.

## 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 55 Battery:  
450 Amp Cranking Performance at 0°F (-17.8°C)  
60 Minute Reserve Capacity at 80°F (26.7°C)

## Removal

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

1. Remove the battery hold-down clamp. Slide battery forward.
2. Disconnect the ground cable (-) first to prevent short circuiting the battery, other components, or the operator's hands. Disconnect the positive (+) cable.
3. Make sure that the filler caps are on tightly.
4. 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

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

- 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 the vent holes to the filler caps and make sure the caps are on tightly.**

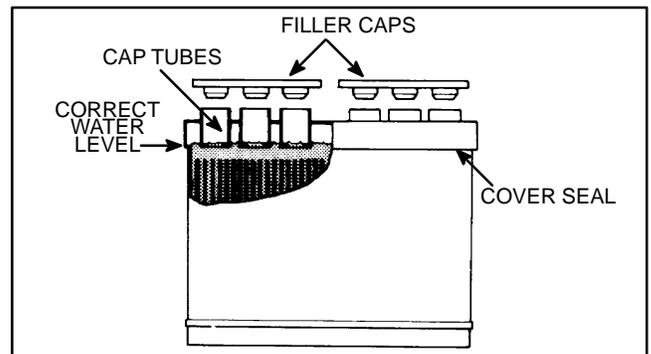


Figure 25

- 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 the 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 to the bottom of the cap tubes. 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  
 ADD (20° above 80°F) 0.008  
 Correction to 80°F 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 12.0 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 rating (see Fig. 25) 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	
	70°F (and up)	21.1°C (and up)
9.6	70°F (and up)	21.1°C (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 the ignition switch and all accessories are off.
2. Make sure the battery compartment is clean and repainted if necessary.
3. Make sure all battery cables and connection are in good condition and that the battery hold down clamp has been repaired or replaced.
4. Lift seat and place the battery near its compartment. Push the positive cable connector onto positive battery post. Do not hammer; this will damage the battery. Tighten bolts with two wrenches.
5. Place the battery in its compartment and make sure it is level and flat. Tighten the battery hold-down bolts uniformly 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 the negative (ground) cable connector to the negative battery post.

## 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.



**CAUTION**

Follow the manufacturer's instructions when using a battery charging.

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

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

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

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



## CAUTION

**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.**

**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.**

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.

## Cutting Unit Solenoid Valve Coil

The solenoid valve coil can be easily replaced without opening the hydraulic system.

### Removal

1. Disconnect the electrical connector.
2. Remove the nut from the spool assembly.
3. Slide the coil assembly and O-rings from the spool assembly. Discard the coil assembly and O-rings.
4. Clean any corrosion or dirt from the spool assembly.

### Installation

1. Coat new O-rings lightly with petroleum jelly. Slide new O-rings and new coil assembly onto the spool assembly. Align the coil assembly evenly with the manifold body.
2. Apply Loctite 242 or equivalent to the threads. Screw the nut onto the spool assembly and torque to 15 in-lb (17 KG-CM). Do not over tighten.
3. Connect the electrical connector.

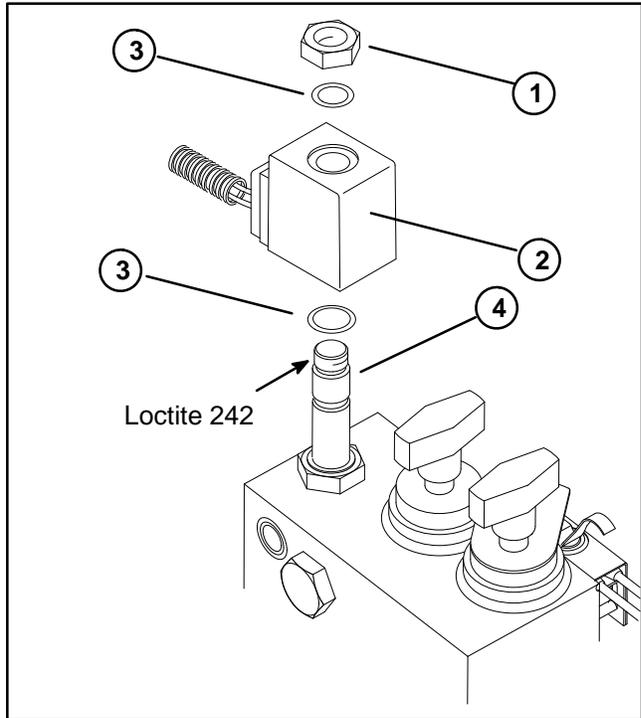


Figure 26

- |                  |                   |
|------------------|-------------------|
| 1. Nut           | 3. O-ring         |
| 2. Coil assembly | 4. Spool assembly |

## Traction (Electric) Clutch (Fig. 27 through 31)

The clutch circuit is normally energized when the engine is starting or running. When energized, an electromagnet pulls the armature into contact with the rotor to drive the pulley and the traction motor through a fan belt.

Failure to engage the clutch is likely caused by too large of a clutch air gap, a circuit fault in the clutch electromagnet, or another electrical problem (see Wiring Schematics).

**Note:** The air gap is not adjustable. The clutch must be serviced as a whole and individual parts can not be replaced.

### Removal

1. Make sure the engine is off and the fuel solenoid is disconnected.
2. Lift the hood and disconnect the clutch electrical connection. Make sure the connection is free of the cable harness and the R-bracket holding it to the engine block.
3. Remove the right and left front panels to access the clutch and U-bracket support.
4. Remove the flanged nut securing the dampener to the traction arm. Remove nut, lock washer and flat washer securing the dampener to the U-bracket support. Remove the dampener (Fig 27).
5. Remove the two bolts, flat washers, and grommets holding the tank to the U-bracket support. Remove the nuts, carriage bolts, and U-bracket support from the frame (Fig. 29).
6. Loosen nut on adjusting yoke. Remove the cotter and clevis pins from the adjusting yoke. Tilt pump mount and remove the pump belt (Fig 28).
7. Remove long capscrew with the jam nut from engine block. Retain the position of the jam nut on the capscrew (Fig. 30).
8. Remove the spindle with the clutch attached by alternately loosening all spindle capscrews and then pulling on the clutch (Fig. 30). When the spindle is free of the fly wheel, slide it up along the flywheel and rotate it out to clear the traction pedal and foot rest.
9. Remove the capscrews, lock washers, and pulley from the clutch (Fig. 30).
10. Remove the capscrew, lockwasher, and flat washer from the spindle. Slide the clutch and key from the clutch spindle (Fig. 30).

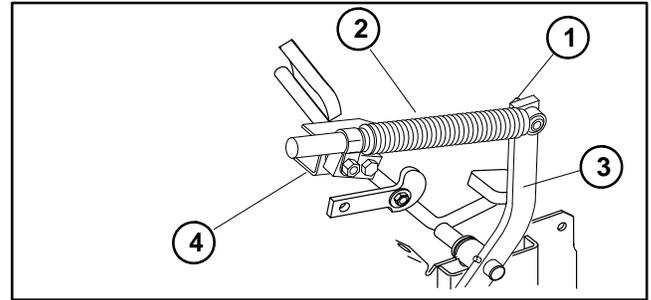


Figure 27

- |                |                      |
|----------------|----------------------|
| 1. Flanged nut | 3. Traction arm      |
| 2. Dampener    | 4. U-bracket support |

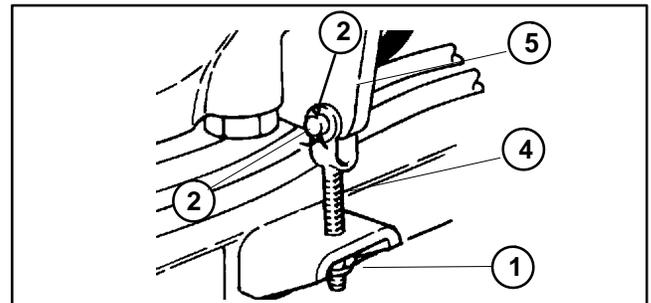


Figure 28

- |               |                   |
|---------------|-------------------|
| 1. Nut        | 4. Adjusting yoke |
| 2. Cotter pin | 5. Pump mount     |
| 3. Clevis pin |                   |

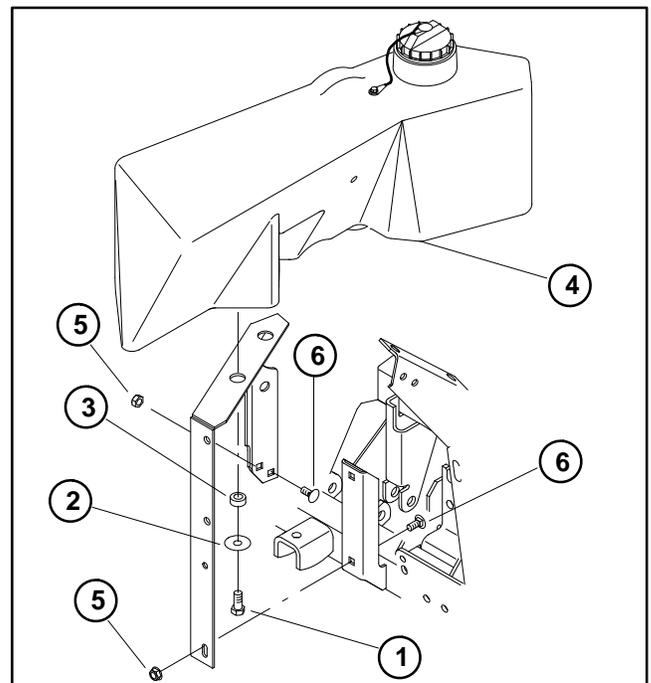


Figure 29

- |                |                   |                  |
|----------------|-------------------|------------------|
| 1. Capscrew    | 3. Grommet        | 5. Nut           |
| 2. Flat washer | 4. Hydraulic tank | 6. Carriage bolt |

## Installation

1. When installing a new clutch, remove the wire bracket from the old clutch and install it with the flat washers and new pop rivets on the new clutch. Run the wires through the bracket and tie wrap to them to the bracket as on the original clutch. **Make sure wires are tight against the clutch wire bracket or they will catch in the spindle bolts** (Fig. 30).

2. Make sure the spindle is free of dirt and rust. Insert the capscrews with flat washers through the spindle base from the shaft side (Fig. 30).

3. Apply never seize to the spindle shaft and keyway. Slide the clutch rotor (Fig. 31) onto the spindle shaft with the bracket side towards the spindle base (Fig. 30). Make sure that the capscrews with the flat washers stay in the spindle holes.

4. Apply never seize to the key. Insert the key into the keyway. Slide the armature (Fig. 31) onto the shaft and key (Fig. 30).

5. Place the the capscrews through the lock washers and secure the pulley to the clutch. Place the lock washer and large flat washer onto the capscrew and secure them to the shaft; torque from 40 to 50 ft-lb (Fig. 30).

6. Place the clutch and spindle up to the flywheel. Screw one of the capscrews into the flywheel to support the spindle during alignment. Secure all the capscrews while pushing the spindle into the flywheel; tighten in a crisscross pattern (Fig. 30).

7. Align the wire bracket with the long capscrew into their original position. Secure the long capscrew and jam nut through the bracket into the engine block (Fig. 30).

8. Run the electrical connector through the R-bracket with the cable harness and reconnect. Make sure the wires do not make contact with moving parts of the clutch and that the R-bracket capscrew is tight.

9. Tilt the pump mount and install the belt to the clutch and pump pulleys. Align the adjusting yoke with the pump mount holes and secure with the clevis and cotter pins (Fig. 28). Adjust the belt (see Adjustments section of Chapter 4 – Hydraulic System).

10. Secure the U-bracket support to the frame using the carriage bolts and nuts. Place the two capscrews

through the flat washers and grommets; apply loctite to capscrew threads. Secure the hydraulic tank to the U-bracket support with the two capscrews (Fig. 29).

11. Attach the dampener to the traction pedal and U-bracket support (Fig. 27). Adjust the traction pedal (see Adjustments section of Chapter 4 – Hydraulic System).

12. Replace and secure panels to the unit. Reconnect the fuel solenoid.

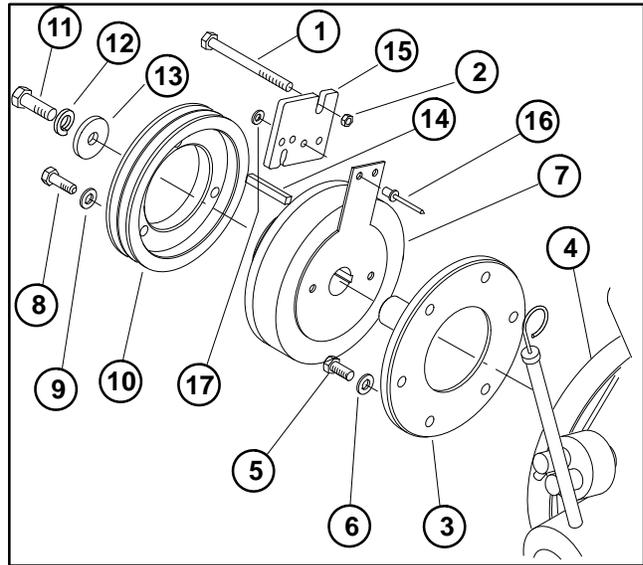


Figure 30

- |                   |                 |                  |
|-------------------|-----------------|------------------|
| 1. Long capscrew  | 7. Clutch       | 13. Flat washer  |
| 2. Jam nut        | 8. Capscrew     | 14. Key          |
| 3. Clutch spindle | 9. Lock washer  | 15. Wire bracket |
| 4. Flywheel       | 10. Pulley      | 16. Pop rivet    |
| 5. Capscrew       | 11. Capscrew    | 17. Flat washer  |
| 6. Flat washer    | 12. Lock washer |                  |

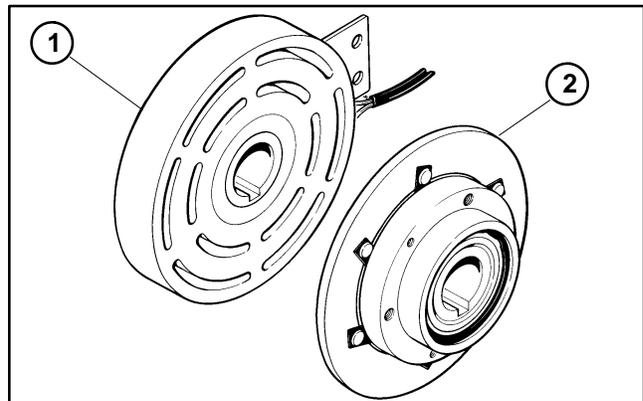


Figure 31

- |          |             |
|----------|-------------|
| 1. Rotor | 2. Armature |
|----------|-------------|



# Wheels and Brakes

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Wheels and Brakes

# Specifications

Item	Description
Front tire pressure	12 to 16 PSI, (0.83 to 1.10 bar)
Rear tire pressure 2 ply (Older models) 4 ply (Newer models)	8 to 10 PSI, (0.55 to 0.69 bar) 12 to 16 PSI, (0.83 to 1.10 bar)
Front and rear wheel lug nut torque	45 to 65 ft-lb, (6.22 to 8.98 kg-m)
Wheel planetary mounting cap screw torque	250 to 400 ft-lb, (34.6 to 55.3 kg-m)

# Adjustments

## Hand Brake

1. Ensure machine is parked on a level surface with the cutting units lowered. Ensure engine is off.
2. Jack up the front of the machine and support it from under the frame with jack stands. Remove both front wheels.
3. Make sure brake is in the OFF position.
4. Turn by-pass valve on traction pump to the by-pass position as described in the General Information section of Chapter 4 – Hydraulic System.
5. Loosen jam nut (1) on the clevis (2).
6. Adjust brake arm lever distance.
  - A. Remove cotter pin (3) securing the clevis (2) to the upper brake arm lever (4). Disconnect clevis from the upper brake arm lever.
  - B. Rotate clevis one turn at a time (clockwise) to decrease the distance between the upper brake arm lever and lower brake arm lever (5).
  - C. Install clevis to upper brake arm lever. Install cotter pin to clevis.
  - D. Repeat steps 6.A. through 6.C. until the brake shoes firmly contact the brake drums (the wheel will not turn by hand).
  - E. When the wheel will not turn by hand, back the brake shoes off the brake drum. Remove cotter pin securing top of the clevis to the upper brake arm lever. Disconnect clevis from the upper brake arm lever.
  - F. Rotate clevis one turn at a time (counterclockwise) to increase the distance between the upper brake arm lever and lower brake arm lever by 5/8-inch.
7. Install clevis (2) to the upper brake arm lever (4). Install and lock cotter pin (3) into the clevis. Tighten jam nut (1).
8. Repeat procedure for the other wheel.
9. Check brake adjustment and adjust again as necessary.
10. Install wheels.

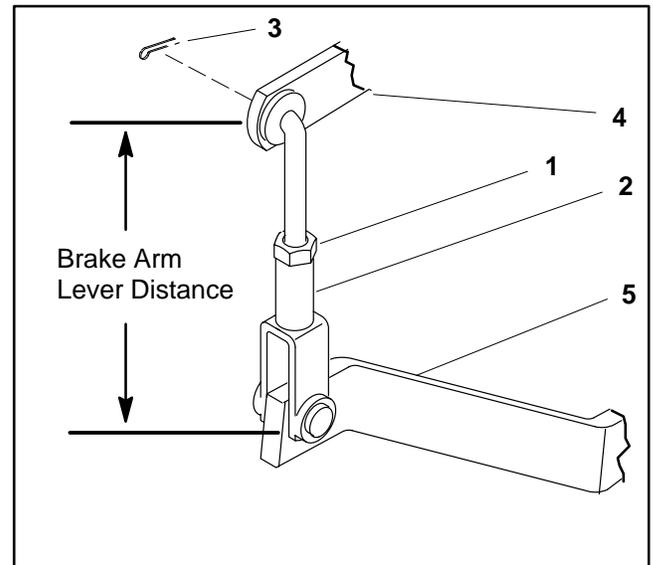


Figure 1

- |               |                          |
|---------------|--------------------------|
| 1. Jam nut    | 4. Upper brake arm lever |
| 2. Clevis     | 5. Lower brake arm lever |
| 3. Cotter pin |                          |

11. Turn by-pass valve on traction pump to the closed position as described in the General Information section of Chapter 4 – Hydraulic System.
12. After any brake adjustment, operate the vehicle at a low speed (one mph or less) and check that brakes engage equally on both wheels. Readjust as necessary.

# Service and Repairs

## Rear Wheel (3WD)

### Removal

1. Park machine on a level surface. Ensure engine is off. Set hand brake and block front wheels.
2. Lift rear wheel off the ground using a jack. Secure back of the frame.
3. Remove lug nuts from the wheel hub studs. Slide off wheel assembly.
4. Remove lock nut from the wheel motor shaft.

**IMPORTANT: DO NOT hit wheel hub with a hammer during removal or installation. Hammering may cause damage to the wheel motor.**

5. Mount a wheel puller to the wheel hub studs and remove the wheel hub off the wheel motor shaft. Remove the woodruff key.

6. Remove rust from all parts with a wire brush prior to installation. Clean all parts. Replace any worn or damaged parts.

### Installation

1. Install woodruff key and wheel hub onto the wheel motor shaft.
2. Install lock nut to wheel motor shaft and tighten to a torque of 250 to 400 ft-lb (34.6 to 55.3 kg-m).
3. Install wheel assembly and secure the lug nuts to the wheel hub studs.
4. Tighten lug nuts evenly in a crossing pattern to a torque of 45 to 65 ft-lb (6.22 to 8.98 kg-m).

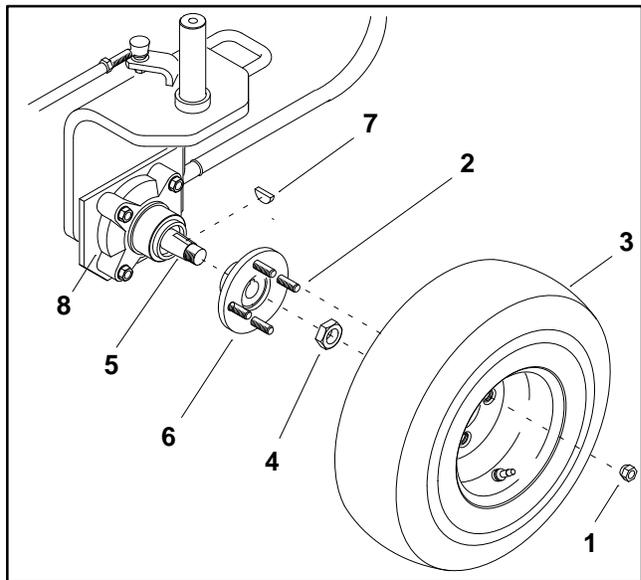


Figure 2

- |                   |                      |
|-------------------|----------------------|
| 1. Lug nut        | 5. Wheel motor shaft |
| 2. Wheel hub stud | 6. Wheel hub         |
| 3. Wheel assembly | 7. Woodruff key      |
| 4. Lock nut       | 8. Wheel motor       |

## Rear Wheel (2WD)

### Removal

1. Park machine on a level surface. Ensure engine is off. Set hand brake and block front wheels.
2. Lift rear wheel off the ground using a jack. Secure back of the frame.
3. Remove lock nut (1) and flat washer (2) from the castor axle (3). Slide castor axle from the castor fork (4) and remove wheel.
4. If the wheel was removed because of bad bearings, proceed as follows:
  - A. Remove spacer (5) from the rim (6).
  - B. Pull bearings (7) from the rim.

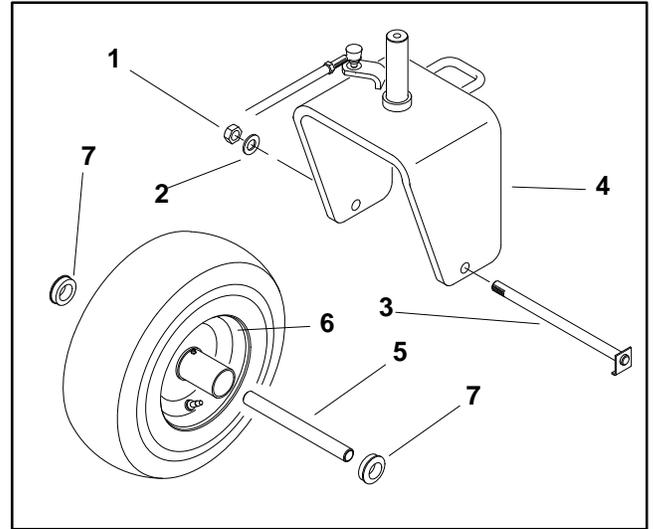


Figure 3

- |                |            |
|----------------|------------|
| 1. Lock nut    | 5. Spacer  |
| 2. Flat washer | 6. Rim     |
| 3. Castor axle | 7. Bearing |
| 4. Castor fork |            |

### Installation

1. If the bearings (7) were removed from the rim (6), replace with new bearings as follows:
  - A. Press a new bearing into one side of the rim until the flange of outer race is flush with the rim.
  - B. Slide spacer (5) through the bearing until the end of the spacer is flush with the outside of the bearing inner race.
  - C. Press the remaining new bearing (7) into the other side of the rim and over the spacer so the flange of outer race is flush with the rim.
  - D. The spacer must not extend beyond the inner race of either bearing.
2. Install wheel and slide castor axle (3) through the castor fork (4) and wheel.
3. Secure flat washer (2) and lock nut (1) to the castor axle (3). Torque lock nut from 45 to 65 ft-lb (6.2 to 9.0 kg-m).

## Front Wheel and Brake

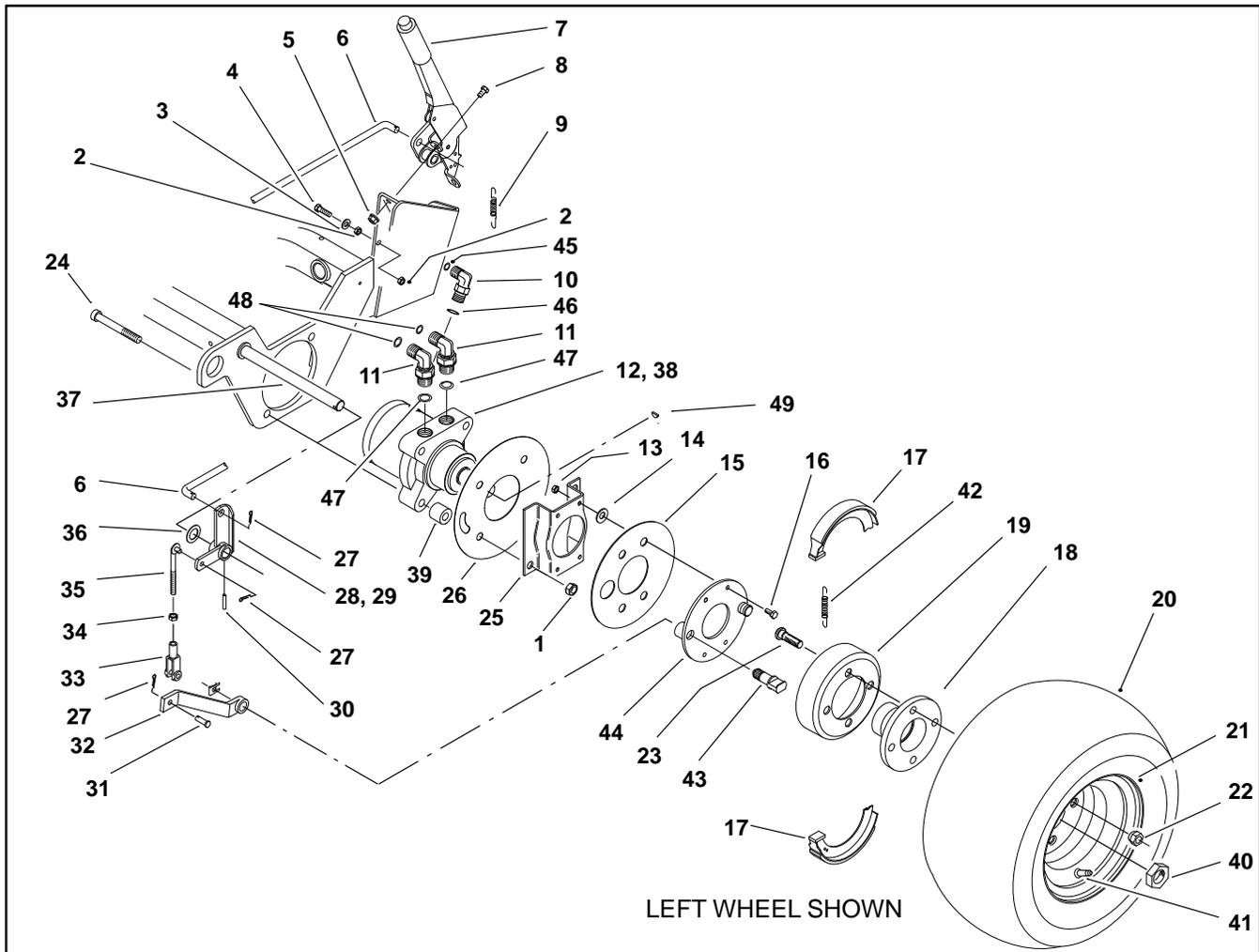


Figure 4

- |                           |                             |                      |
|---------------------------|-----------------------------|----------------------|
| 1. Lock nut               | 18. Wheel hub               | 34. Hex nut          |
| 2. Lock nut               | 19. Brake drum              | 35. Adjusting rod    |
| 3. Flat washer            | 20. Lug tire                | 36. thrust washer    |
| 4. Hex head screw         | 21. Lock rim                | 37. Brake shaft      |
| 5. Flange nut             | 22. Lug nut                 | 38. Wheel motor (LH) |
| 6. Adjusting rod          | 23. Wheel hub stud          | 39. Spacer           |
| 7. Parking brake assembly | 24. Socket head screw       | 40. Lock nut         |
| 8. Flanged screw          | 25. Brake bracket           | 41. Valve stem       |
| 9. Spring                 | 26. Wheel shield            | 42. Extension spring |
| 10. Hydraulic fitting     | 27. Cotter pin              | 43. Pivot pin        |
| 11. Elbow fitting         | 28. Brake arm assembly (RH) | 44. Brake plate      |
| 12. Wheel motor (RH)      | 29. Brake arm assembly (LH) | 45. O-ring           |
| 13. Lock nut              | 30. Roll pin                | 46. O-ring           |
| 14. Flat washer           | 31. Clevis pin              | 47. O-ring           |
| 15. Grass brake shield    | 32. Brake lever assembly    | 48. O-ring           |
| 16. Hex head screw        | 33. Clevis                  | 49. Key              |
| 17. Brake shoe            |                             |                      |

### Removal

1. Park machine on a level surface. Ensure engine is off.
2. Make sure brake is in the OFF position.

3. Lift front wheel off the ground using a jack. Block front and rear of other wheels.

4. Remove lug nuts (22) and tire and rim assembly (20 and 21). Remove lock nut (40) from wheel hub (18).

**IMPORTANT: DO NOT hit wheel hub (18) with a hammer during removal or installation. Hammering may cause damage to the wheel motor (12 or 38).**

5. Use a puller to remove the wheel hub (18) and brake drum (19). Remove the key (49) from the wheel motor shaft.
6. Remove brake extension springs (42) from brake shoes (17). Remove brake shoes from brake plate (44).
7. Remove cotter pin (27) from the clevis pin (31). Remove clevis pin from the brake lever assembly (32). Separate brake lever assembly from the clevis (33).
8. Remove hex head screws (16) and lock nuts (13) holding the brake plate (44) and grass brake shield (15) to the brake bracket (25).

**IMPORTANT: DO NOT remove brake lever assembly (32) from the brake plate (44)..**

9. Remove brake plate (44), flat washers (14), and grass brake shield (15) from the brake bracket (25).
10. Remove rust from all parts with a wire brush prior to installation. Clean all parts. Inspect brake shoe contact surfaces of the brake drum for excessive wear. Replace any worn or damaged parts.

## Installation

1. Secure flat washers (14), grass brake shield (15), and brake plate (44) to the brake bracket (25) with the hex head screws (16) and lock nuts (13). Tighten fasteners.
2. Connect brake lever assembly (32) to the clevis (33). Install clevis pin (31) through the brake lever assembly and clevis. Install and lock cotter pin (27) into the clevis pin (31).
3. Install brake shoes (17) onto the brake plate (44). Install extension springs (42) into the holes on each end of the brake shoes. Springs should be installed in opposite directions of each other.
4. Mount key (49) in the wheel motor shaft, then install the wheel hub (18) and the brake drum (19) onto the wheel motor shaft.
5. Install the lock nut (40) onto the wheel motor shaft and tighten to torque of 250 to 400 ft-lb (34.6 to 55.3 kg-m).
6. Adjust and check brakes.
7. Install tire and wheel assembly (items 20 and 21) and secure the lug nuts (22) to the wheel hub studs (23). Tighten lug nuts evenly in a crossing pattern to a torque of 45 to 65 ft-lb (6.22 to 8.98 kg-m).





# Cutting Units

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		Reel Removal and Bearing Replacement .....	22
		Preparing a Reel for Grinding .....	24
		Fixed Side Plate Assembly .....	25
		Skid Kit Installation .....	26

# Specifications

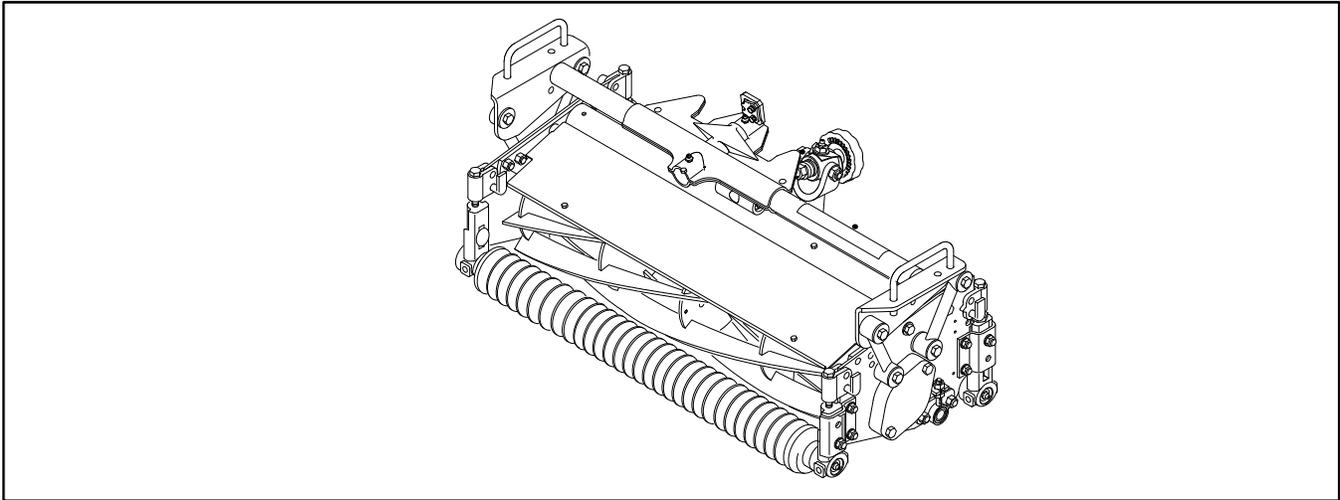


Figure 1

**MOUNTING:** All cutting units are supported by equal length independent lift arms and are interchangeable to all three cutting unit positions.

**REEL CONSTRUCTION:** 5 or 8 blades of 7" (18 cm) diameter welded to 5 stamped steel spiders. Reels are mounted on greaseable self-aligning ball bearings. The RM2300-D reel is 27 inches long and the RM2600-D reel is 32 inches long.

**HEIGHT OF CUT RANGE:**

**Floating Cutting Unit** – 1/4" to 1-3/4"  
(6.4mm to 44.4mm)

**Fixed Cutting Unit** – 1/2" to 2-5/8"  
(12.7 mm to 65.6 mm)

**POWER:** Reel motors allow easy removal from or installation onto the cutting unit. Cutting units can be driven from either end.

**HEIGHT-OF-CUT & ROLLER ADJUSTMENT:**

Height-of-cut adjustment is made with the rear roller by a quick locating pin and/or threaded micro-adjustment. Front roller position is adjustable to 3 locations to set cutting unit attitude.

**BEDKNIFE AND BEDBAR ADJUSTMENT:** A single knob screw adjustment for bedknife to reel is located at the center of the bedbar. The adjustment knob detent allows 0.001 inch bedknife movement for each indexed position.

**CLIP FREQUENCY:** With variable speed set to maximum rpm:

5 blade at 880 reel rpm moving 4 mph (6.4 km/h)  
.96" (24.4 mm) clip.

5 blade at 880 reel rpm moving 5 mph (8 km/h)  
1.19" (30.3 mm) clip.

8 blade at 880 reel rpm moving 4 mph (6.4 km/h)  
.60" (15.2 mm) clip.

8 blade at 880 reel rpm moving 5 mph (8 km/h)  
.75" (19.1 mm) clip.

**RM2300-D OPTIONAL EQUIPMENT:**

Full Roller Kit	Model No. 03440
Sectional Roller Kit	Model No. 03445
Wiehle Roller Kit	Model No. 03450
Anti-Scalp Roller Kit	Model No. 03447
Grass Basket Kit	Model No. 03443
Roller Scraper Kit	Part No. 60-9560
Comb Kit	Part No. 67-9400
Fixed Kit	Part No. 93-6915
Skid Kit	Part No. 94-3664

**RM2600-D OPTIONAL EQUIPMENT:**

Sectional Roller Kit	Model No. 03476
Wiehle Roller Kit	Model No. 03475
Anti-Scalp Roller Kit	Model No. 03477
Roller Scraper Kit	Model No. 03478
Fixed Kit	Part No. 93-6915
Skid Kit	Part No. 94-3664

**CUTTING UNIT LIFT:** Hydraulic lift has an automatic reel shut off. All units are controlled from one lever.

**SUSPENSION SYSTEM:** Adjustable counterbalance spring provide for a fully floating suspension. L-I-N-K-S<sup>™</sup> cutting unit suspension system provides fore and aft oscillation. Main center pivot allows side-to-side oscillation. With optional Fixed Kit (Part No. 93-6915), cutting units can be locked into fixed (fore/aft) position for use with skids or anti-scalp rollers.

# Special Tools

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

Some tools may have been supplied with your machine or available as TORO parts. Some tools may also be available from a local supplier.

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## Gauge Bar Assembly

Use gauge bar to verify height of cut.

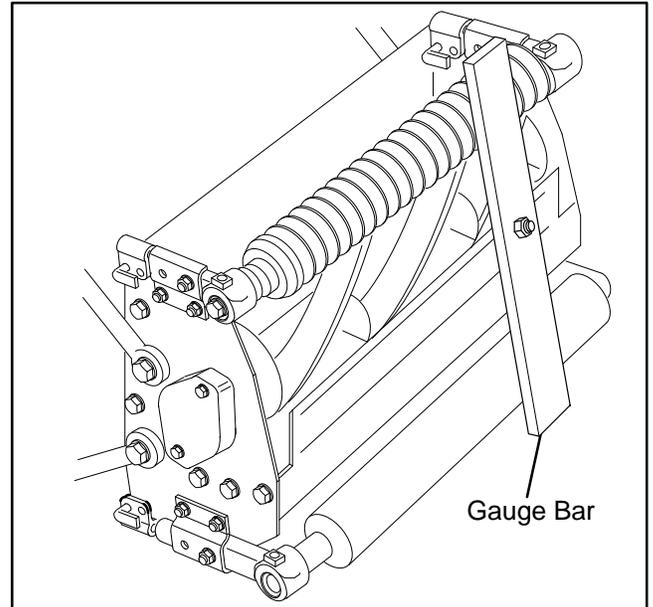


Figure 2

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## Handle Assembly

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

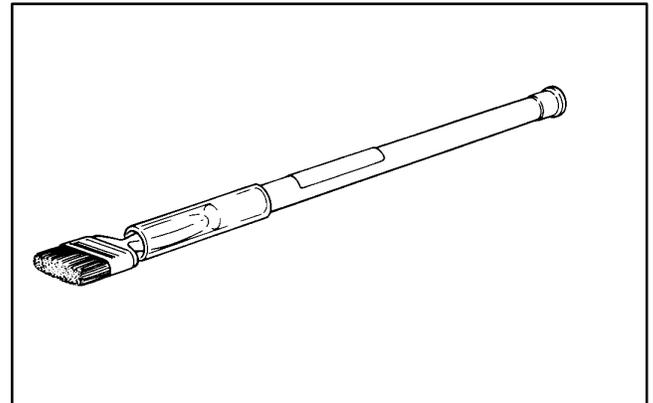


Figure 3

---

## Bedknife Screw Tool

This screwdriver-type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

DO NOT use an air or manual impact wrench with this tool.

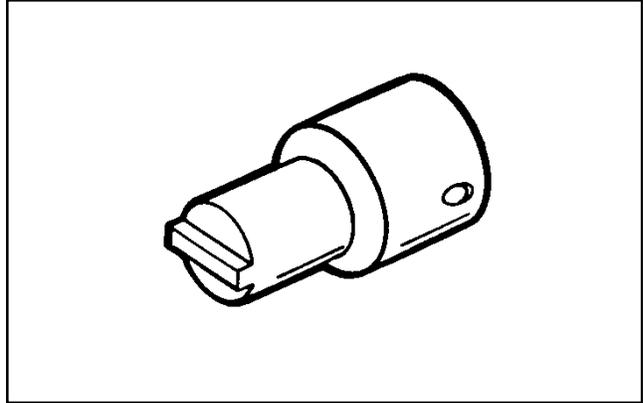


Figure 4

# Troubleshooting

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine. It is important to remember that the lower the height of cut, the more critical these factors are.

Remember that the “effective” or actual height of cut depends on cutting unit weight and turf conditions. Effective height of cut will be different than the bench set height of cut.

## Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
1. Engine maximum governed speed.	Check maximum governed engine speed. Adjust speed to specifications if necessary. If engine is not running at specified maximum governed RPM, reel speed settings may not match ground speed.
2. Reel speed and ground speed.	<p>Adjust reel speed to setting shown on REEL SPEED SETTINGS graph for the number of reel blades (5 or 8) and the desired ground speed (see Operator’s Manual).</p> <p>All reels should rotate at about the same speed. All cutting units should have equal bedknife to reel contact. If checking RPM, do not run reel too long without cutting grass, or bedknife and/or reel may overheat and “rifle”.</p> <p>See other items in Troubleshooting section of Chapter 4 – Hydraulic System.</p>
3. Cutting unit counter balance tension adjustment.	<p>The counter balance spring on each cutting unit lift arm can be adjusted to compensate for different turf conditions. Decreased counter balance tension will help keep the cutting units on the ground when mowing at higher speeds, and it helps maintain a uniform height of cut in rough conditions or in areas of thatch build up. Increased counterbalance tension will improve traction by increasing weight on the front tires.</p> <p>Also, the spring may be adjusted at the cutting unit pivot point. Raising the spring at the lift tab decreases the cutting unit weight at the outboard end. Lowering the spring at the lift tab increases the cutting unit weight at the outboard end.</p> <p>NOTE: Decreased counter balance tension may lower the actual or “effective” height of cut.</p>
4. Tire pressure.	Check each tire’s pressure. Adjust to pressures specified in Specifications section of Chapter 6 – Wheels and Brakes.

Factor	Possible Problem/Correction
5. Reel bearing condition.	All reels should rotate freely. Make sure bearings are properly lubricated. Replace bearings if worn or damaged.
6. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded cutting edges or "rifling" <b>cannot</b> be corrected by tightening bedknife to reel contact. Grind reel to remove taper and/or rifling (grooved or wavy appearance). Grind bedknife to sharpen and/or remove rifling. (Most common cause of rifling is bedknife to reel contact that is <b>too tight</b> .) NOTE: New bedknife must be ground or backlapped after installing on bedbar.
7. Bedknife to reel adjustment.	Check bedknife to reel contact daily. Bedknife must have light contact all across reel. No contact will cause cutting edges to become dull. Excessive contact accelerates wear; quality of cut may be adversely affected.  Slightly dull cutting edges may be corrected by backlapping, Excessively dull cutting edges must be corrected by grinding the reel and bedknife.
8. Front roller position.	Make sure front rollers on all cutting units are in the same position.
9. Rear roller parallel to reel.	Rear roller must be set so that it is parallel with the reel before setting height of cut.
10. Height of cut.	Make sure all cutting units are set at the same height of cut. Set units as specified in the Operator's Manual.
11. Bedbar stability.	Check bedbar end bushings, adjuster pivot bushings and nylon flanged bushings for wear or damage.  Check adjustment knob to make sure detent holds adjustment.
12. Number of reel blades.	Use cutting unit model with correct number of blades for clip frequency and optimum quality of cut range (see Specifications).
13. Cutting unit alignment and ground following.	Check lift arms and cutting unit pivot linkages for wear, damage, binding, or bent pivot pins.
14. Roller condition.	All rollers should rotate freely. Make sure bearings are properly lubricated. Replace bearings if worn damaged.

# 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.

## Lift Arm Counterbalance Spring



## WARNING

Use caution when tensioning springs as they are under heavy load. Do not move lift lever, cutting units can lower without the engine running.

1. Raise cutting units to relieve tension on the counterbalance springs.
2. **Make sure machine is shut off and parking brake is set.**
3. Remove cotter pin and clevis pin securing the spring shackle to the counterbalance arm. **Do not remove the other clevis pin .**
4. Move shackle up or down the counter balance arm until it aligns with the desired hole of the arm.

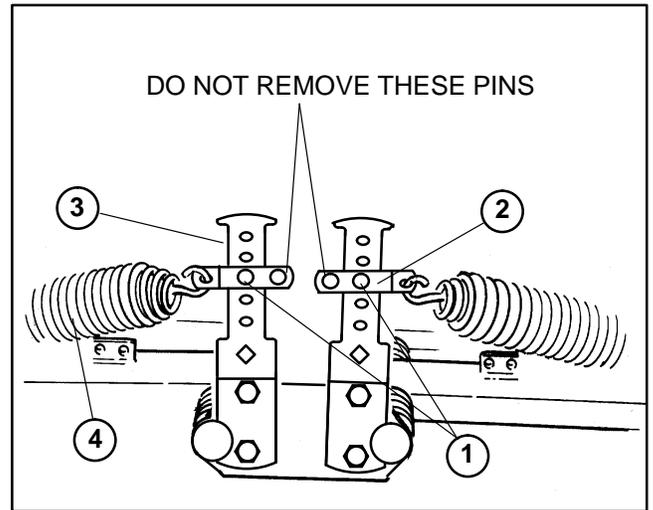


Figure 5

- |                            |                          |
|----------------------------|--------------------------|
| 1. Clevis pin & cotter pin | 3. Counterbalance arm    |
| 2. Spring Shackle          | 4. Counterbalance spring |

Counterbalance Arm Hole Position	Application
Middle Hole	for 5 blade reels
Second Hole from Top	for 8 blade reels without baskets
Top Hole	for 8 blade reels with baskets

**IMPORTANT:** These are recommended settings. Readjust spring positions to attain optimum performance. By raising spring locations on counterbalance arms, cutting unit weight on ground is reduced and traction is increased.

5. Reinstall clevis pin through the desired hole, then attach cotter pin.

## Height-of-Cut and Leveling Rear Roller

**Note:** Both floating and fixed cutting units can use this method for making height of cut adjustments and leveling both front and back rollers.

1. Position cutting unit on a flat level table or board.
2. Slightly loosen (crack) nut securing each roller bracket to the angle bracket.
3. For the rear roller, adjust support cap screw to achieve  $5/8" \pm 1/16$  (15.9 mm  $\pm$  1.6) dimension between both Height-of-Cut supports and rear roller brackets.
4. For the front roller, adjust support cap screw to achieve  $1" \pm 1/16$  (25.4 mm  $\pm$  1.6) dimension between both Height-of-Cut supports and front roller brackets.
5. For the rear roller, remove hairpin cotters securing rear Height-of-Cut pins and reinstall in the  $1/2"$  setting as indicated on the rear Height-of-Cut plate.
6. For the front roller, remove hairpin cotters securing front Height-of-Cut pins and reinstall in the  $1/4"$  setting as indicated on the front Height-of-Cut plate to allow clearance between front roller and table.
7. Position a  $1/2"$  or thicker bar under the reel blades and against the front face of the bedknife. Make sure bar covers the full length of reel blades.
8. Verify that rear roller is level, by attempting to insert a piece of paper under each end of roller. The paper should not fit between the roller and the table.
9. Level rear roller by adjusting the appropriate support cap screw on rear roller supports until the roller is parallel and the entire length of roller contacts the table. A piece of paper inserted between the roller and the table should not fit.
10. When roller is level, adjust both rollers to desired Height-of-Cut with pins. **Tighten nuts securing roller brackets and replace hairpin cotters to the Height of cut pins.**

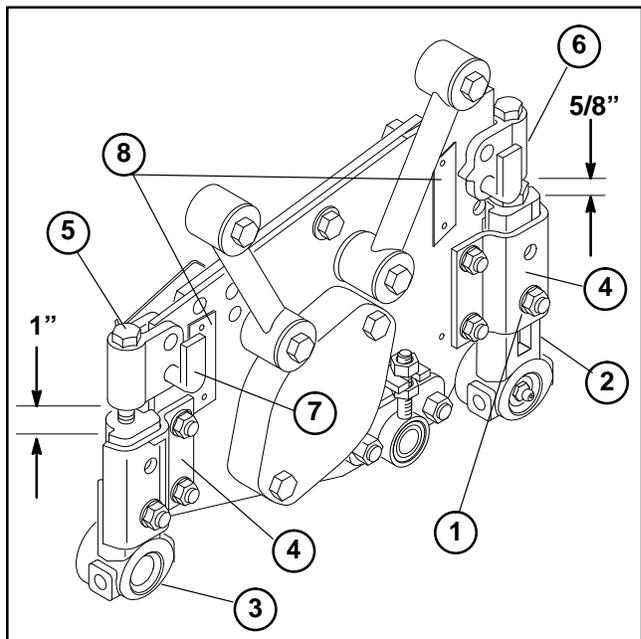


Figure 6

- |                         |                          |
|-------------------------|--------------------------|
| 1. Nut                  | 5. Support capscrew      |
| 2. Rear roller bracket  | 6. Height-of-Cut support |
| 3. Front roller bracket | 7. Height-of-Cut pins    |
| 4. Angle bracket        | 8. Height-of Cut plate   |

## Bedknife Parallel to Reel (Fig. 7 through Fig. 9)

1. Remove any reel contact by turning the bedknife adjustment knob counterclockwise (Fig. 7). Tip cutting unit to gain access to the reel and bedknife (Fig. 8).

2. On either end of reel, insert a long strip of dry newspaper between reel and bedknife. While slowly rotating reel into bedknife, turn bedknife adjusting knob clockwise, one click at a time until paper is pinched lightly, which results in a slight drag when paper is pulled.

3. Check for light contact at other end of reel using paper. If light contact is not evident, proceed to next step.

4. Loosen both carriage bolts on bedbar adjuster (Fig.9).

5. Adjust nuts to move bedbar adjuster up or down until paper is pinched along entire bedknife surface, when bedknife adjustment knob is adjusted to no more than two clicks beyond first contact of reel bedknife (Fig.9).

6. Tighten nuts and carriage bolts and verify adjustment.

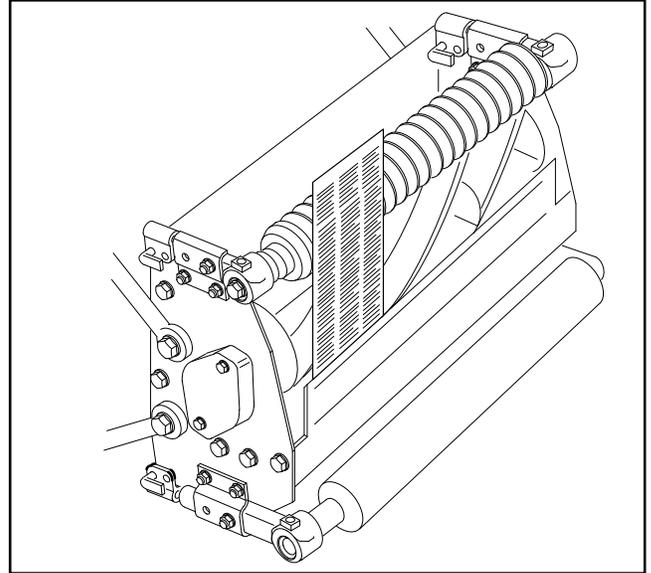


Figure 8

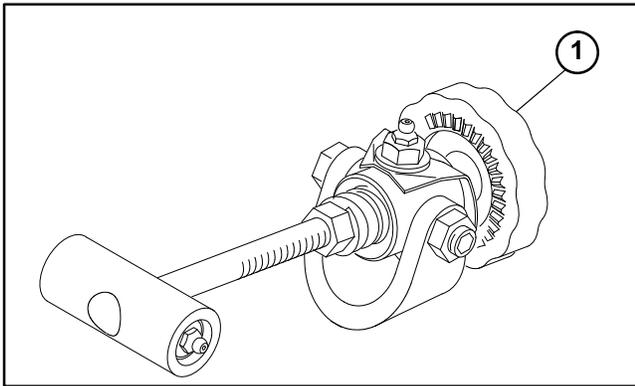


Figure 7

1. Bedknife adjusting screw

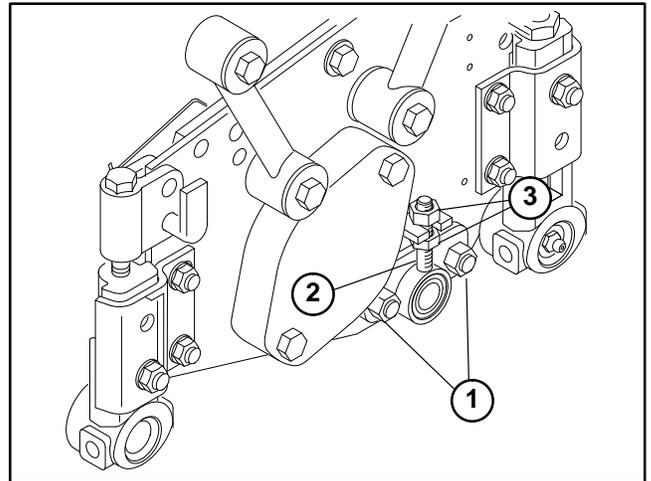


Figure 9

1. Carriage bolts  
2. Bedbar adjuster

3. Adjustment nuts

## Height-of-Cut and Front Roller Level

1. On gauge bar, set head of screw to desired Height-of-Cut. This measurement is from bar face to underside of screw head. Gauge bar (Toro Part No. 13-8199) may be obtained from your local Toro Distributor.
2. Slightly loosen (crack) nuts securing each front roller bracket to the angle bracket.
3. Place the bar across the front and rear rollers and adjust both front roller support capscrews until the underside of the head of screw on the gauge bar engages the bedknife cutting edge. Do this on both ends of reel.
4. Tighten all nuts securing the roller brackets.

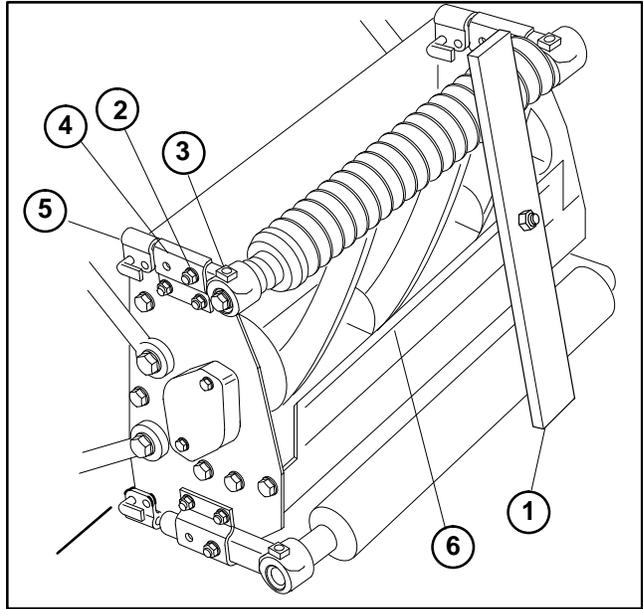


Figure 10

- |                             |                                   |
|-----------------------------|-----------------------------------|
| 1. Gauge bar                | 5. Front roller support cap screw |
| 2. Front roller bracket nut | 6. Bedknife                       |
| 3. Front roller bracket     |                                   |
| 4. Angle bracket            |                                   |

# Service and Repairs

## Greasing Bearings, Bushings, and Pivot Points (Fig. 11 and Fig. 12)

**Note:** Each cutting unit has (8) grease fittings (with optional front roller installed) that must be lubricated regularly with No. 2 General Purpose Lithium Base Grease.

**Note:** On earlier production cutting units the grease fittings for the reels are located on the inside of the cutting unit. Later production models have the grease fittings located on the outside portion of the bearing housing.

1. The grease fitting locations and quantities are:
  - A. Bedknife adjuster (2) (Fig. 11). Grease these fittings every 50 hours.
  - B. Reel bearings (inside sideplate), (2) and front and rear rollers (2 ea.) (Fig. 12). Grease these fittings every 8 hours.

**IMPORTANT:** Lubricating cutting units immediately after washing helps purge water out of bearings and increases bearing life.

2. Wipe each grease fitting with a clean rag.
3. Apply grease until pressure is felt against the handle.
4. **Wipe excess grease away.**

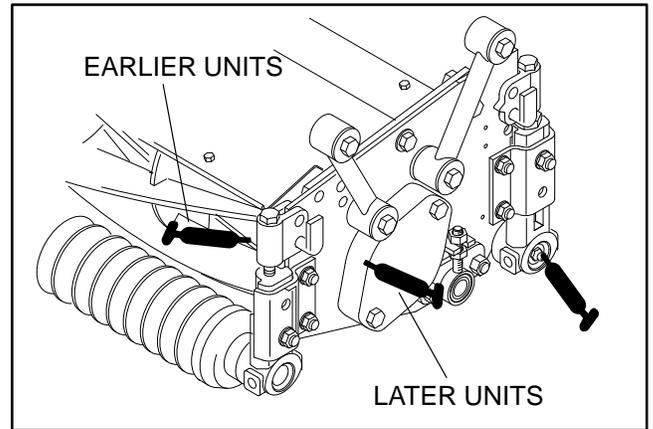


Figure 12

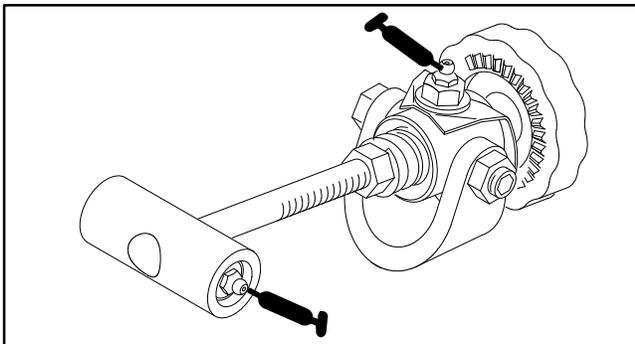


Figure 11

## Backlapping



### DANGER

#### TO AVOID PERSONAL INJURY OR DEATH:

- Never place hands or feet in reel area while engine is running.
- While backlapping, reels may stall and then restart.
- Do not attempt to restart reels by hand or foot.
- Do not adjust reels while engine is running.
- If reel stalls, stop engine before attempting to clear reel.
- Reel motors are connected in series, moving one motor moves the other two.

1. Position machine on a clean, level surface, lower the cutting units, stop the engine, engage parking brake and remove key from the ignition switch.
2. Unlatch and raise hood to expose the controls.
3. Rotate backlap knob, on valve block, clockwise to backlap position. Rotate reel speed knob to position 1.
4. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units. Start engine and set engine to low idle speed.
5. Engage reels by pulling out knob on instrument panel.



### CAUTION

Be careful when lapping the reel because contact with the reel or other moving parts can result in personal injury.

6. Apply lapping compound with a long handled brush.

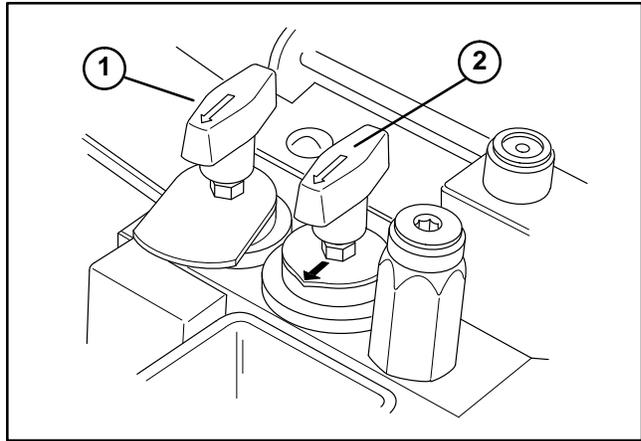


Figure 13

1. Backlap knob
2. Reel speed knob

7. To make an adjustment to the cutting units while backlapping, turn reels OFF by pushing in on the knob on instrument panel and turning the engine OFF. After adjustments have been completed, repeat steps 4–6.

8. When backlap operation is completed, rotate backlap knob counter-clockwise to the MOW position, set reel speed controls to the desired mowing setting and wash all lapping compound off the cutting units.

**Note:** Additional instructions and procedures on Backlapping are available in the TORO Sharpening Reel & Rotary Mowers Manual Form No. 80–300SC.

**Note:** For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

## Hydraulic Motor Removal and Installation

### Removal

1. Remove two capscrews holding the hydraulic motor to the bearing housing.
2. Remove hydraulic motor and spider coupling from the bearing housing.
3. Position the hydraulic motor away from the cutting unit prior to removing or working on the cutting unit.

### Inspection

1. Inspect spider coupling for wear. Replace worn coupling with new one.
2. Check coupling inside bearing housing. If coupling is loose remove and check for worn threads. Replace coupling if threads are worn. Reinstall coupling (see Reel Removal and Bearing Replacement, Install Reel).

### Installation

**Note:** The cutting unit can be installed with the hydraulic motor driving the unit from the other side. If so, remove the bearing housing cap screws, cover, and cover gasket; reinstall them on the opposite bearing housing from the motor.

1. Dip spider coupling in No. 2 General Purpose Lithium Base Grease. Reinstall spider coupling into the bearing housing.
2. Reinstall hydraulic motor.
  - A. On models without the O-ring, clean bearing housing face and place a bead of RTV around the face of the housing to form a seal. Mount hydraulic motor to the bearing housing. Secure motor with the two capscrews.
  - B. On models with O-rings, replace if necessary. Make sure O-ring is on the front plate of the motor. Mount hydraulic motor to the bearing housing. Secure motor with the two capscrews.
3. Grease bearing housing sufficiently to fill housing with grease (see Greasing Bearings, Bushings, and Pivot Points).

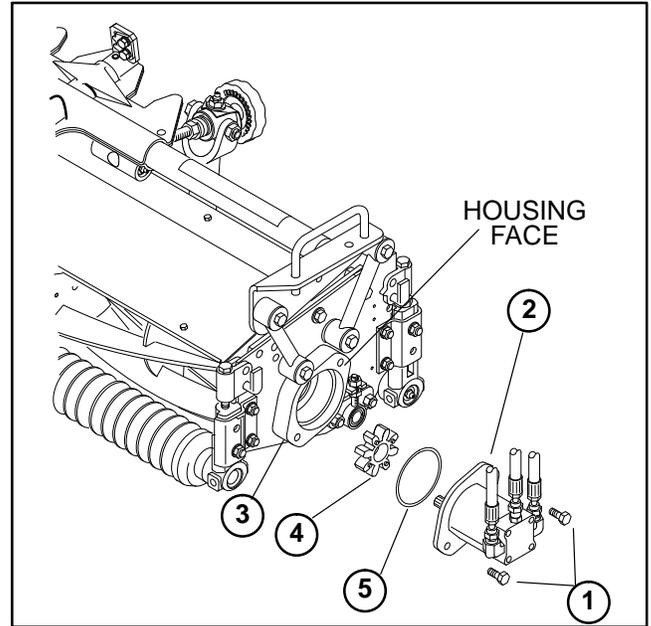


Figure 14

- |                    |                    |
|--------------------|--------------------|
| 1. Capscrew        | 4. Spider coupling |
| 2. Hydraulic motor | 5. O-ring          |
| 3. Bearing housing |                    |

## Cutting Unit Removal and Installation (Fig. 15 through Fig. 18)

### Remove Cutting Unit

1. Raise cutting units to relieve the tension on the counterbalance springs.
2. **Make sure traction unit is shut off and parking brake is set.**



### WARNING

Use caution when relieving tension or tensioning springs as they are under heavy load. Do not move lift lever, cutting units can lower without the engine running.

3. Loosen top cap screw. Put breaker bar in the square hole and hold tension of spring (Fig. 15).
4. Remove bottom cap screw and slowly relieve the remaining tension on the spring (Fig. 15).
5. Remove capscrews, lock washers, and lift tab securing the spring to the carrier frame. Remove spring from the carrier frame (Fig. 16).
6. Note from which hole on the lift tab the spring is removed from.

**Note:** On rear cutting unit, also remove the thrust washer. The thrust washer is located between the rear of the carrier frame and the flat washer.

7. Remove flange head cap screw and flat washer from the pivot rod (Fig. 17).
8. Disconnect tipper chain on front carrier frame (Fig. 18). Slide carrier frame off the pivot rod.

### Install Cutting Unit

1. Place thrust washer on pivot rod (front cutting units only), and slide carrier frame onto pivot rod (Fig. 17).

**Note:** On rear cutting unit, reinstall thrust washer between the rear of the carrier frame and the flat washer.

2. Secure flat washer and flange head cap screw onto pivot rod (Fig. 17).
3. Connect tipper chain to the front carrier frame (Fig. 18).

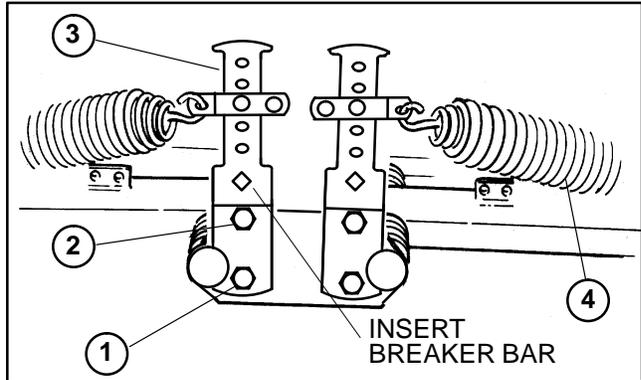


Figure 15

- |                    |                          |
|--------------------|--------------------------|
| 1. Bottom capscrew | 3. Counterbalance arm    |
| 2. Top capscrew    | 4. Counterbalance spring |

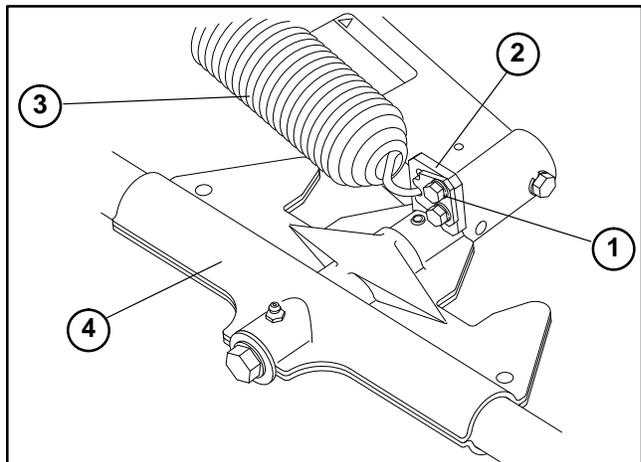


Figure 16

- |                             |                  |
|-----------------------------|------------------|
| 1. Capscrew and lock washer | 3. Spring        |
| 2. Lift tab                 | 4. Carrier frame |

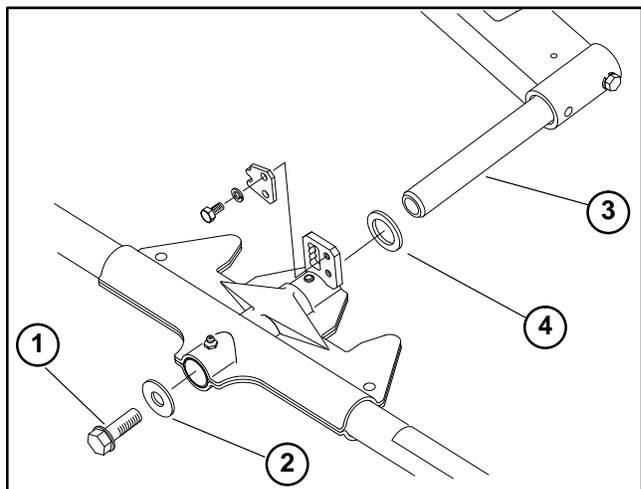


Figure 17

- |                         |                  |
|-------------------------|------------------|
| 1. Flange head capscrew | 3. Pivot rod     |
| 2. Flat washer          | 4. Thrust washer |

**Note:** On rear counterbalance spring, make sure that the vinyl cover is on prior to reinstalling the spring.

4. Make sure one end of spring is secured to the spring shackle and the other end is hooked into the lift tab hole noted in step 6.

5. Secure counterbalance spring and lift tab to the carrier frame with the capscrews and lock washers (Fig. 16).

6. Insert a breaker bar into the square hole in the counterbalance arm, and pivot the counterbalance arm back to its original position aligning the cap screw hole (fig. 15).

7. Secure bottom of counter balance arm to frame with the bottom capscrew. Tighten top cap screw (Fig. 15)

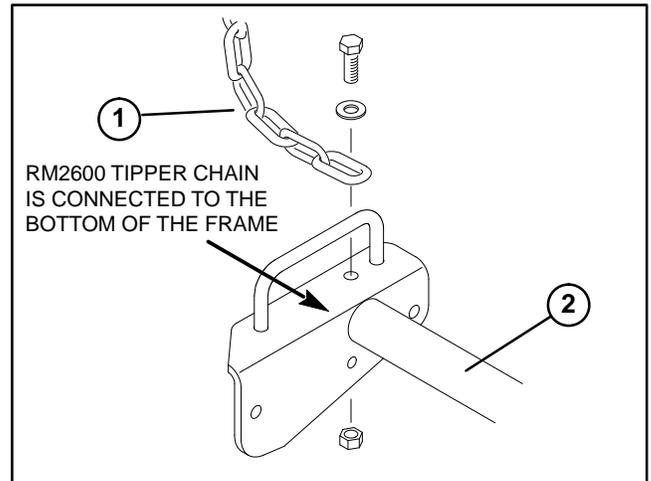


Figure 18

1. Tipper chain

2. Carrier frame

## Bedbar Removal and Installation (Fig. 19 through Fig. 21)

### Bedbar Removal

1. Turn bedknife adjusting handle to loosen bedknife to reel contact (Fig. 19).
2. Remove both jam nuts and hex socket set screws from the bedbar yoke (Fig. 19)
3. Unscrew adjusting handle (left-hand threaded) until it is removed from the cutting unit (Fig. 19).
4. Loosen both adjusting lock nuts on the adjusting housing (Fig. 20).
5. Remove both carriage bolts and nuts from the adjusting housing (Fig. 20).
6. Remove both carriage bolts and nuts from the bedbar housing. Remove bedbar from the cutting unit (Fig. 21).
7. Remove capscrew, lock washer, flat washer, and spacer from the end of the bedbar (Fig. 21).
8. Remove adjusting housing and bedbar housing from the bed bar. Remove bedbar washer (Fig. 21).
9. Sharpen or replace bedknife as necessary (see **Bedknife Replacement and Grinding**).

### Bedbar Installation

1. Inspect flanged bushings and bushing assemblies for wear; replace if necessary (Fig. 21).
2. Clean and apply anti-seize lubricant to both bedbar pivots. Install bedbar washer on the bedbar (Fig. 21)
3. Install bedbar adjusting housing and bedbar housing on the bed bar. Reinstall spacer, flat washer, lock washer, and cap screw on the bedbar (Fig. 21).
4. Install bedbar assembly on the cutting unit.
5. Secure bedbar housing to the cutting unit with both carriage bolts and nuts (Fig. 21). Secure adjusting housing to the cutting unit with both carriage bolts and nuts (Fig. 20).
6. Tighten both adjusting lock nuts on the adjusting housing (Fig. 20).
7. Install adjusting handle on the cutting unit by screwing it in (Fig. 19).
8. Apply Never Seize to both hex socket set screws. Seat both hex socket set screws into the bedbar yoke and tapered seats of the pivot hub with a slight preload (Fig. 19).

### Cutting Units

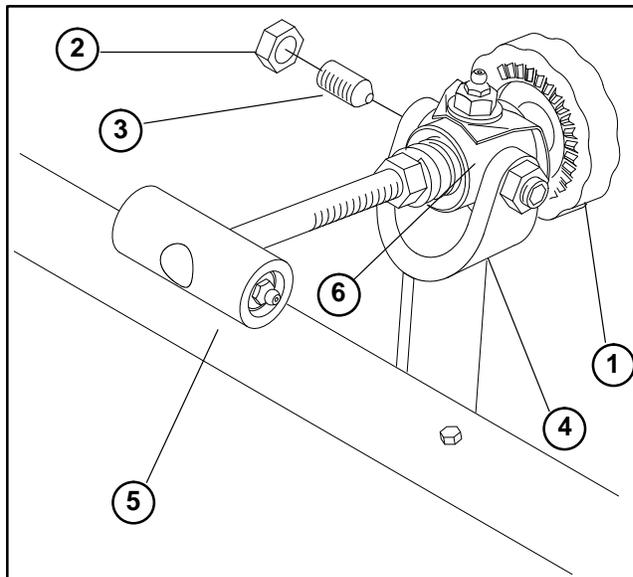


Figure 19

- |                         |                 |
|-------------------------|-----------------|
| 1. Adjusting handle     | 4. Bedbar yoke  |
| 2. Jam nut              | 5. Cutting unit |
| 3. Hex socket set screw | 6. Pivot hub    |

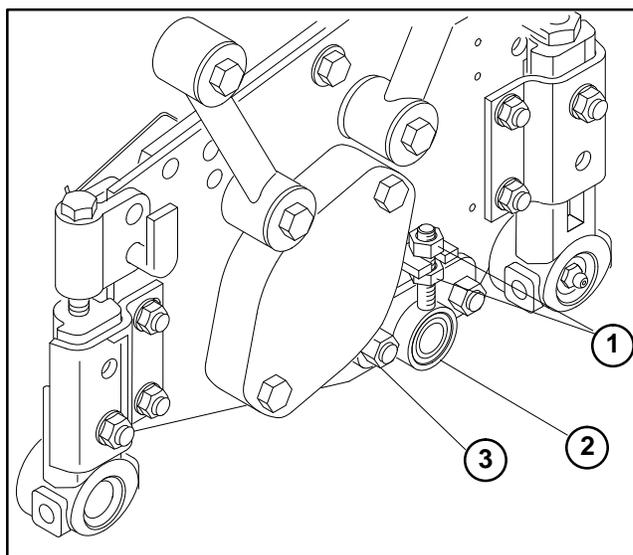


Figure 20

- |                       |                          |
|-----------------------|--------------------------|
| 1. Adjusting lock nut | 3. Carriage bolt and nut |
| 2. Adjusting housing  |                          |

9. Tighten jam nuts onto the hex socket set screws. The handle should be centered within the bedbar yoke. The handle should turn freely with a good solid clicking action.
10. Adjust bedknife to reel (see Bedknife to Parallel to Reel Adjustment).

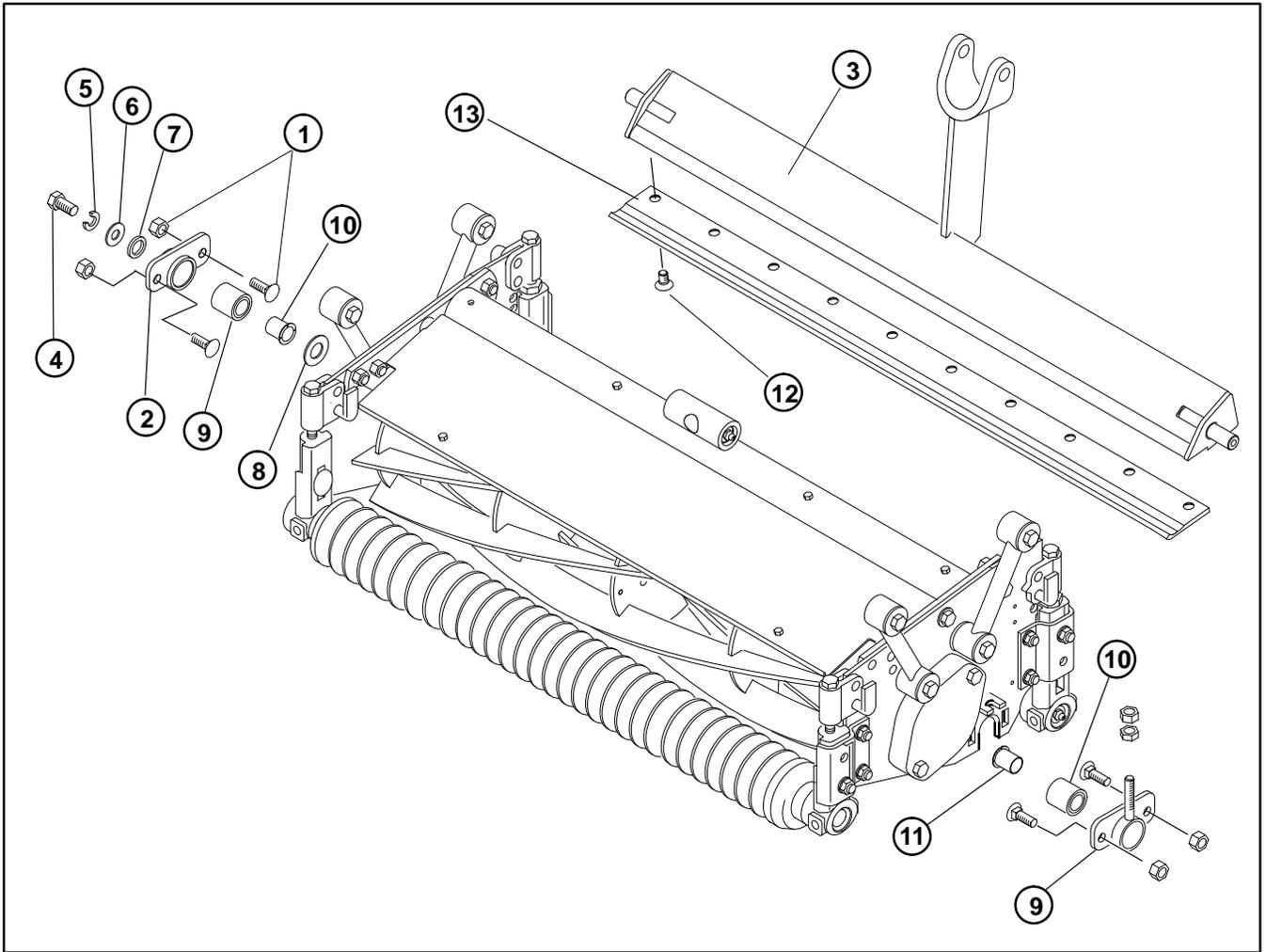


Figure 21

- 1. Carriage bolt and nut
- 2. Bedbar housing
- 3. Bedbar
- 4. Capscrew
- 5. Lock washer

- 6. Flat washer
- 7. Spacer
- 8. Bedbar washer
- 9. Adjusting housing

- 10. Bushing assembly
- 11. Flanged bushing
- 12. Bedknife screw
- 13. Bedknife

## Bedknife Replacement and Grinding (Fig. 22 and Fig. 23)

1. Remove bedbar from cutting unit (see Bedbar Removal and Installation).
2. Remove bedknife screws and remove bedknife.
3. Remove all rust, scale and corrosion from bedbar surface before installing new bedknife.
4. Install new bedknife:
  - A. Make sure bedbar threads are clean.
  - B. Use new screws. Apply anti-seize lubricant to screw threads before installing.

**IMPORTANT:** DO NOT use an impact wrench .

- C. Tighten screws to a torque of 250 to 300 in-lb (288 to 345 kg-cm) working from the center toward each end of the bedbar (Fig. 22).
5. Since there can be variations in the mounting surface of the bedbar, a new bedknife will not be perfectly flat after it is installed. Because of this, it is necessary to backlap or grind a new bedknife after installing it to the bedbar. Follow the existing angle that was ground into the bedknife and grind only enough to make sure the top surface is true.

### Regrinding Bedknife

Remove bedbar / bedknife assembly from cutting unit before attempting to regrind a used bedknife (see Bedbar Removal and Installation).

**Note:** When grinding, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder.

**Note:** If the height of cut is 1/2-inch or lower on the cutting unit, the front angle can be increased to 30° for improved performance.

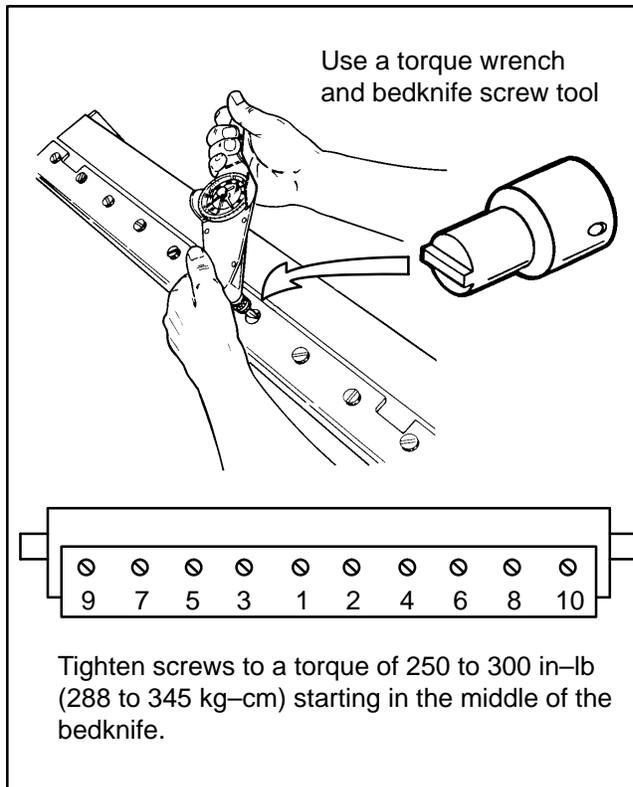


Figure 22

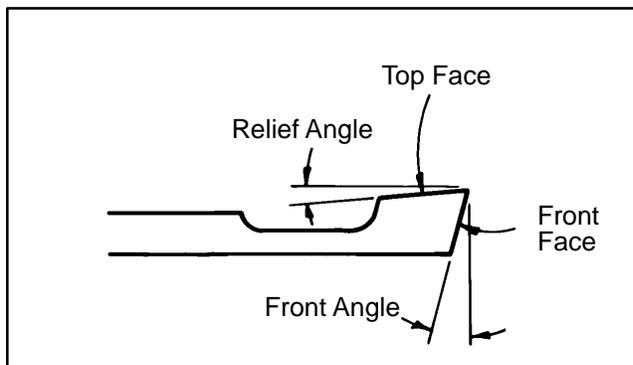


Figure 23

Bedknife Regrinding Specifications	
Relief Angle	5°
Relief Angle Range	3° to 6°
Front Angle	15° (see Note above)
Front Angle Range	13° to 17°

## Roller Removal and Installation

**Note:** This section can be used for both the front and rear rollers.

### Roller Removal

1. Remove both height-of-cut pins and hairpin cotters from each roller bracket.
2. Remove both locknuts from the capscrews securing each angle bracket to the cutting unit.
3. Remove capscrews from both angle brackets and the cutting unit.
4. Separate roller assembly, roller brackets, and angle brackets from the cutting unit.
5. Remove roller brackets from the roller assembly.

### Roller Installation

1. Inspect flanged bushing and bushings for wear; replace if necessary.

**Note:** The flanged end of the flanged bushing must face inside toward the roller when the roller bracket is installed onto the cutting unit.

**Note:** A soft hammer may be needed to tap the roller bracket into position on the hex adjustment nut of the roller.

2. Insert smaller diameter roller shaft into the flanged bushing, bushing, and roller bracket. **Make sure hex of the roller bracket mates with the hex adjustment nut on the roller.**

3. Insert the other end of the roller shaft into the other bushing and roller bracket. **Make sure hex of the roller bracket mates with the hex adjustment nut on the roller.**

4. Hold one roller bracket stationary and use the other bracket as a wrench to loosen or tighten bearing clearance. The roller must not exceed 5 in-lb (5.8 kg-cm) rolling torque and have no bearing end play.

5. Make sure roller brackets are aligned prior to installing them onto the cutting unit. If necessary after bearing adjustment, align roller brackets as follows:

- A. Remove roller bracket on the side with the flanged bushing.
- B. Replace roller bracket so it is aligned to within  $\pm$  one hex flat of the roller adjustment nut.
- C. Align both roller brackets.

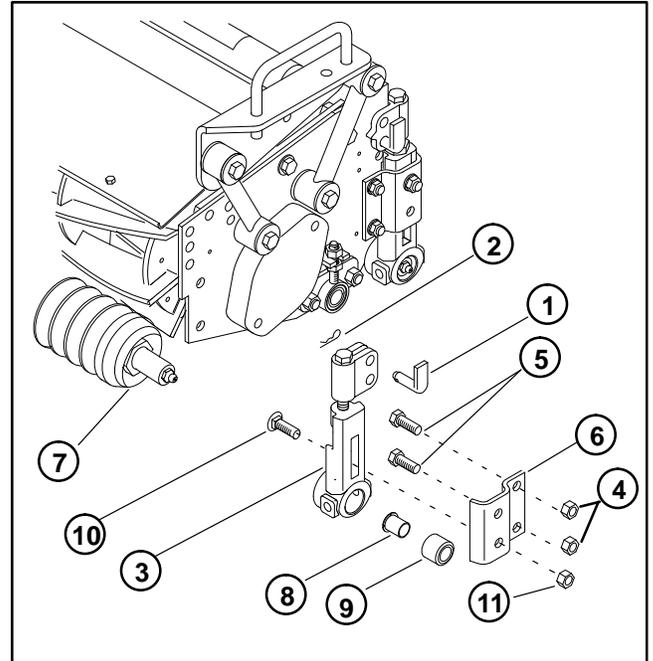


Figure 24

- |                      |                          |
|----------------------|--------------------------|
| 1. Height-of-cut pin | 7. Front roller assembly |
| 2. Hairpin cotter    | 8. Flanged bushing       |
| 3. Roller bracket    | 9. Bushing               |
| 4. Lock nut          | 10. Carriage bolt        |
| 5. Capscrew          | 11. Lock nut             |
| 6. Angle bracket     |                          |

6. Mount roller, roller brackets, and angle brackets to the cutting unit. Secure roller brackets and angle brackets to the cutting unit with capscrews.
7. Install both height-of-cut pins and hairpin cotters.
8. Install both locknuts to the capscrews, and secure each angle bracket to the cutting unit.
9. Adjust roller level (see Height-of-Cut and Leveling Both Rollers).

## Roller Bearing and Seal Replacement

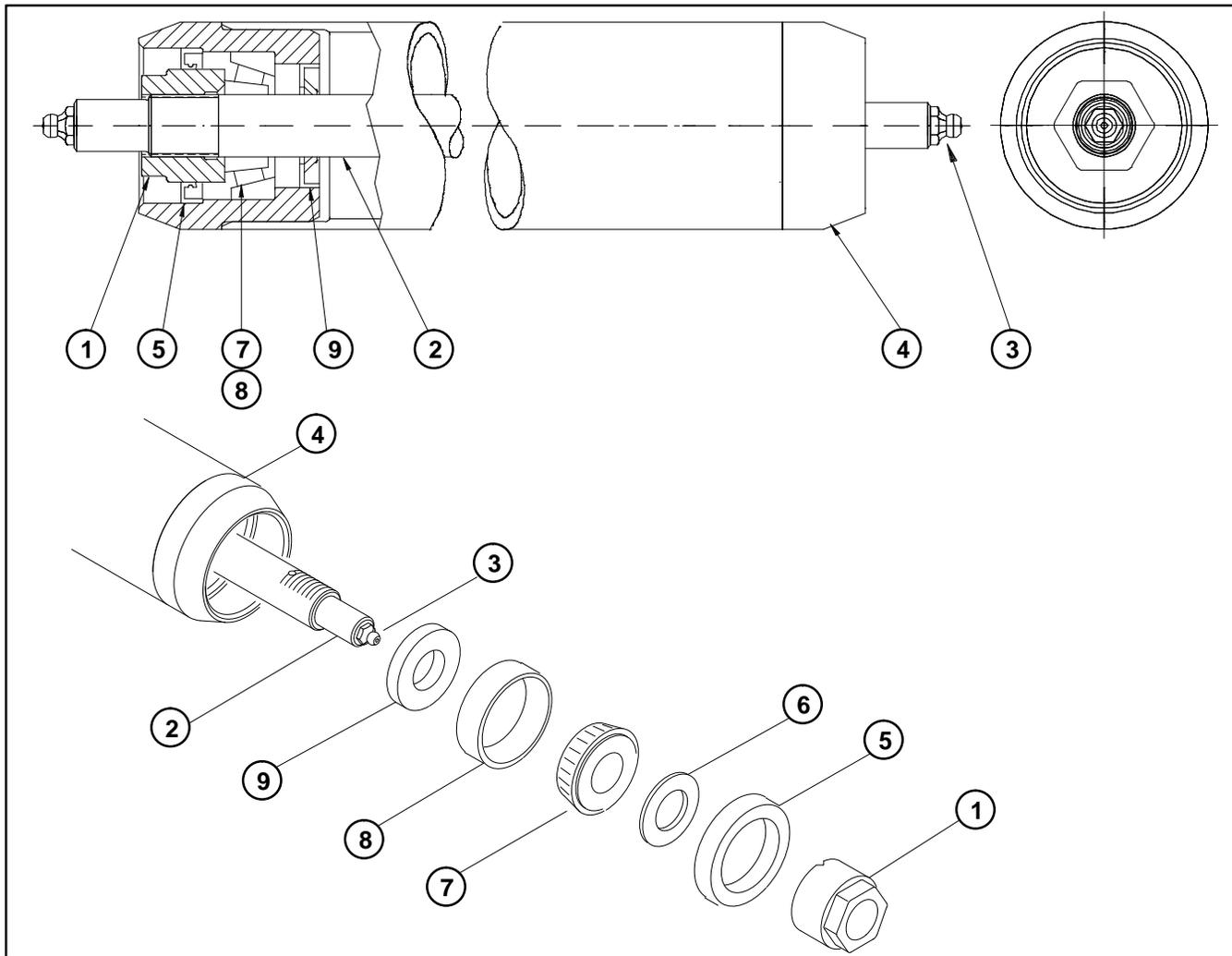


Figure 25

- 1. Adjustment nut
- 2. Roller shaft
- 3. Grease fitting

- 4. Full roller
- 5. Outer seal
- 6. Shim washer

- 7. Bearing cone
- 8. Bearing cup
- 9. Inner seal

**Note:** A rear (full) roller is shown. Bearing and seal configurations are the same for full and wiehle rollers. The wiehle roller **does not** have the a inner seal and shim washer. The shim washer is not used on all full rollers.

### Remove Seals and Bearings

1. Clean inside roller around both adjusting nuts and roller shaft ends. Both areas should be free of dirt and debris.
2. Remove an adjusting nut from one end of the roller shaft.
3. Keep roller level and slide the shaft with the remaining adjusting nut out of the roller.

4. If disassembling a full roller, pour the oil from inside the roller into a suitable container.
5. Secure roller in a vise.
6. Remove outer seals and shim washers (if installed).
7. Remove both bearing cones

**Note:** An electric arc welder can be used to shrink the bearing cup to simplify its removal. Only a small arc in one location on the cup is required.

8. Remove both bearing cups from the roller. Remove both inner seals (if installed).
9. Discard seals and bearings.

## Install New Seals and Bearings

1. Make sure all parts are clean prior to installing bearings and seals.
2. Install inner seals onto both ends of the roller shaft (if previously installed).
3. Press both bearing cups into the roller. Make sure narrow end of taper faces inside of the roller.
4. Keep roller level and secured roller in a vise.
5. If assembling a full roller, fill the inside of roller tube with 6 oz. of SAE 90 oil.
6. Pack both bearing cones with No. 2 general purpose lithium base grease.
7. Install a bearing cone into the bearing cup at each end of the roller shaft. Then install shim washer if it was previously installed.
8. Install outer seal onto each end of the roller shaft. Make sure hard surface of seal faces out.
9. Slide the roller shaft through the roller.
10. Install remaining adjustment nut and tighten it to seat both bearings. Roller should be rotated to seat both bearings.
11. Back off both adjustment nuts to allow the roller to spin freely. Tighten both adjustment nuts again to a maximum of 5 in-lb (5.8 kg-cm) rolling torque with no bearing end play.
12. Grease both bearings (see Greasing Bearings, Bushings, and Pivot Points ).

## Reel Removal and Bearing Replacement

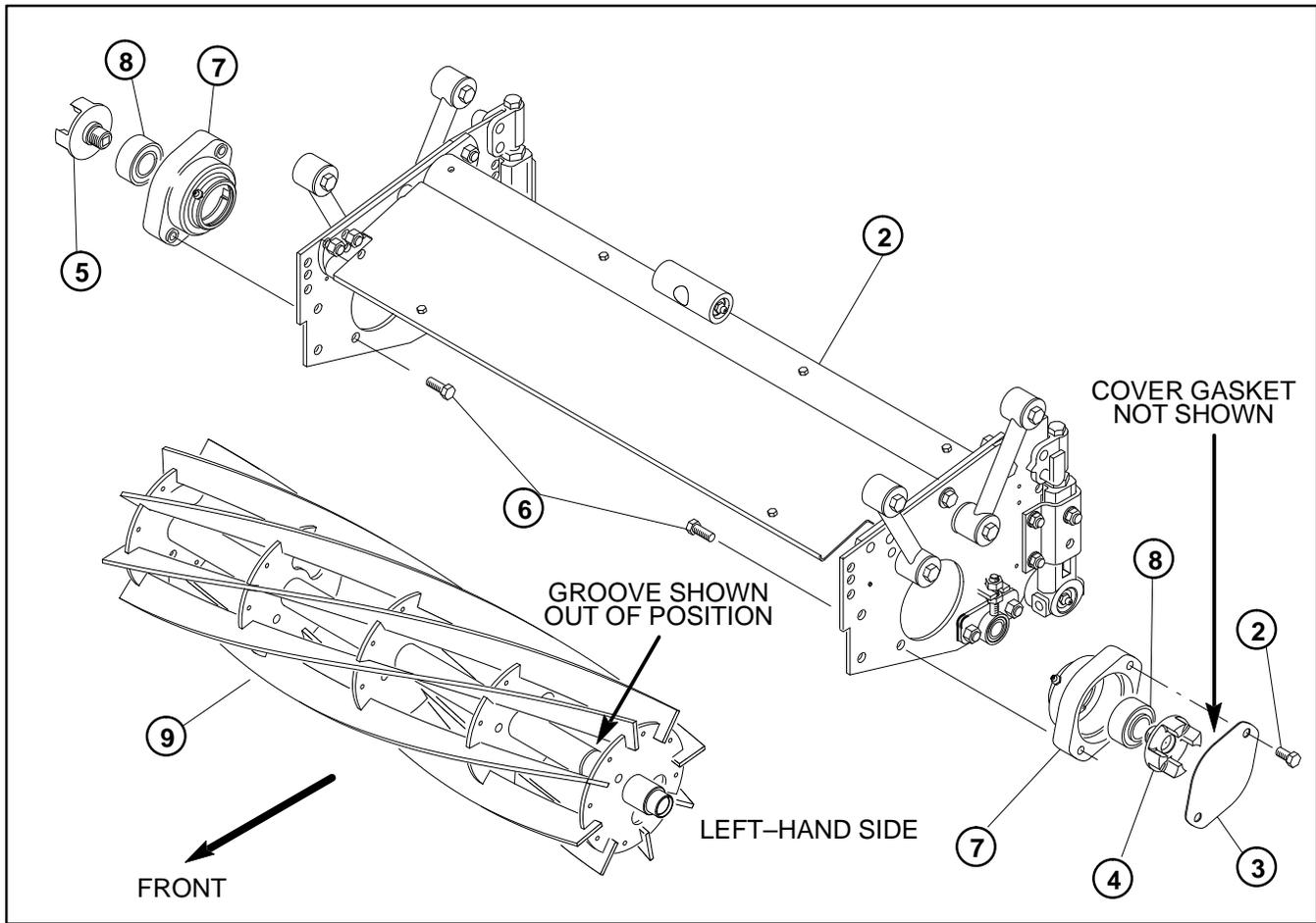


Figure 26

- 1. Cutting unit
- 2. Capscrew
- 3. Bearing cover

- 4. Male coupling (LH)
- 5. Male coupling (RH)
- 6. Capscrew

- 7. Bearing housing
- 8. Bearing
- 9. Reel

### Remove Reel

1. Remove bedbar assembly from cutting unit (see Bedbar Removal and Installation).
2. Remove front roller from cutting unit (see Roller Removal and Installation).
3. Remove capscrews, bearing cover, and cover gasket from the bearing housing.

**Note:** A 3/8-inch drive ratchet with an extension will fit into the square hole of the coupling.

4. Unscrew male coupling (LH) from the reel. **This coupling is left hand threaded.**
5. Unscrew male coupling (RH) from the reel. **This coupling is right hand threaded.**

**IMPORTANT:** Support reel to prevent it from dropping when the bearing housings are removed.

### Cutting Units

6. Remove capscrews from both bearing housings. Pull bearing housings and bearings from reel.
7. Rotate bearings within the bearing housings, and remove bearings from both bearing housings through the loading grooves.
8. Remove reel from cutting unit.

### Inspect Reel

1. Replace reel if the diameter has decreased to the service limit (see Reel Grinding Specification in Preparing Reel For Grinding)
2. Replace reel if blades are bent or cracked.
3. Check for a bent reel shaft by placing the reel shaft ends in V-blocks. Replace reel if the reel shaft is bent.

## Install Reel

1. Inspect bearings and replace if worn or damaged.
2. Make sure bearing seating surfaces and threads on reel shaft ends are clean. Apply anti-seize lubricant to both bearing seating surfaces.
3. Align reel inside the cutting unit with the bearing housing holes. The reel must be positioned so that the grooved end of the shaft (left-hand threads) is on the left side of the cutting unit (Fig. 26).
4. Clean inside of the bearing housing before installing.
5. Install bearing into bearing housing as follows:
  - A. Load bearing through loading grooves.
  - B. Position bearing so its outer grease holes will be 90° to the loading grooves.
  - C. Rotate bearing inside of the housing so the extended part of the inner race is facing the inside of the housing.
6. Slide the bearings and bearing housings onto the reel shaft.
7. On earlier production models, make sure bearing housings are installed with the grease fittings pointing to the front of the cutting unit.
8. Secure bearing housings and bearings on the reel shaft ends and cutting unit with the capscrews. Alternate evenly between capscrews when when tightening.
9. Degrease threaded end of male couplings and reel shaft. Make sure grease is completely removed
  - A. Apply removable Loctite 242 or equivalent to the threads.
  - B. **Do not get Loctite on the bearing seal.**
10. Screw male coupling (RH) from the reel. **This coupling is right hand threaded.**
11. Screw male coupling (LH) from the reel. **This coupling is left hand threaded.**
12. Torque both couplings from 55 to 65 ft-lb (7.6 to 9.0 kg-m).
13. Install front roller to cutting unit (see Roller Removal and Installation).
14. Install bedbar assembly to cutting unit (see Bedbar Removal and Installation).
15. Complete cutting unit set-up and adjustment sequence (see Adjustments section).
16. Grease both bearings (see Greasing Bearings, Bushings, and Pivot Points ).

## Preparing a Reel for Grinding

**Note:** Check to make sure reel bearings are in good condition and properly adjusted before grinding reel.

1. Remove bedbar assembly (see Bedbar Removal and Installation).
2. Remove front roller and brackets (see Roller Removal and Installation).

**Note:** Most reel grinders require that the rear roller assembly be mounted to the cutting unit for proper support in the reel grinder. The rear roller must be parallel to the reel shaft to remove taper when grinding, or the cutting unit must be aligned so the grinding wheel will travel parallel to the reel shaft. This will result in the 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.

3. After completing grinding process:

- A. Install front roller and brackets (see Roller Removal and Installation).
- B. Install bedbar assembly (see Bedbar Removal and Installation).
- C. Complete cutting unit set-up and adjustment sequence (see Adjustments section).

Reel Grinding Specifications	
Nominal Reel Diameter	7" (178 mm)
Service Limit Reel Diameter	6.2" (158 mm)
Blade Relief Angle	30°
Relief Angle Range	20° to 40°
Blade Land Width	.060" (1.5 mm)
Land Width Range	.050" to .090" (1.3 to 2.3 mm)
Max. Reel Taper	.060" (1.5 mm)

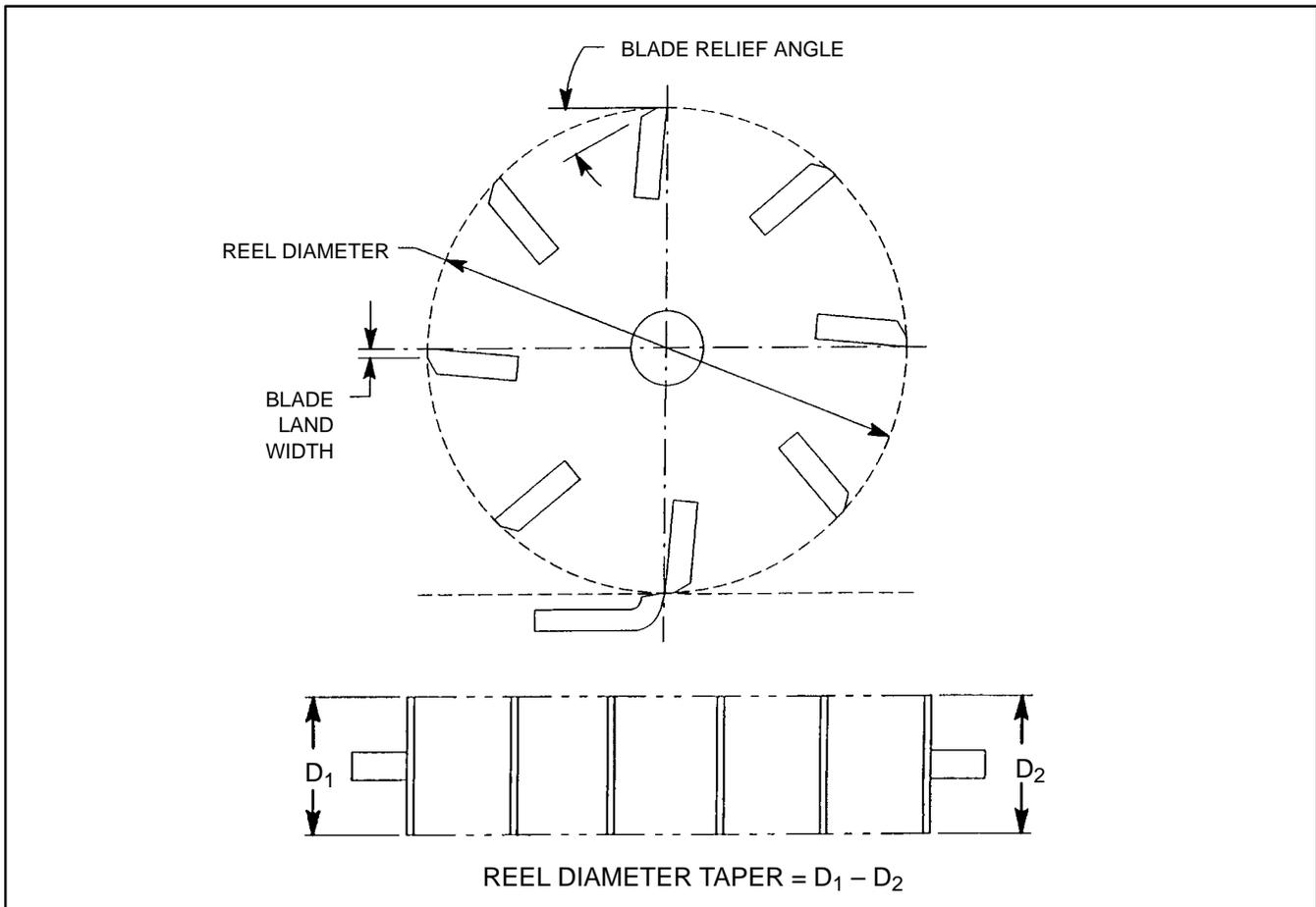


Figure 27

## Fixed Side Plate Installation (Fig. 28 and Fig. 29)

1. Remove pop rivets and rear height-of-cut plates from both sides of the cutting unit (Fig. 28).
2. Remove lock nuts, capscrews, and both links from the cutting unit (Fig. 28).
3. Align fixed side plate with holes on the cutting unit (Fig. 29).
4. Attach new capscrews, washers, and flanged lock nuts to the fixed side plate and the cutting unit (Fig. 29).
5. Tighten lock nuts and capscrews
6. Fasten new height-of-cut plate to the cutting unit with new pop rivets (Fig. 29).
7. Repeat steps 1. through 6. for the other side of the cutting unit.

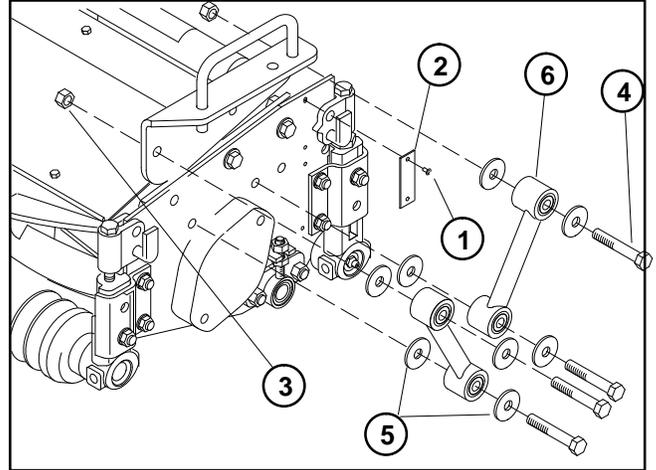


Figure 28

- |                        |             |
|------------------------|-------------|
| 1. Pop rivet           | 4. Capscrew |
| 2. Height-of-cut plate | 5. Washer   |
| 3. Lock nut            | 6. Link     |

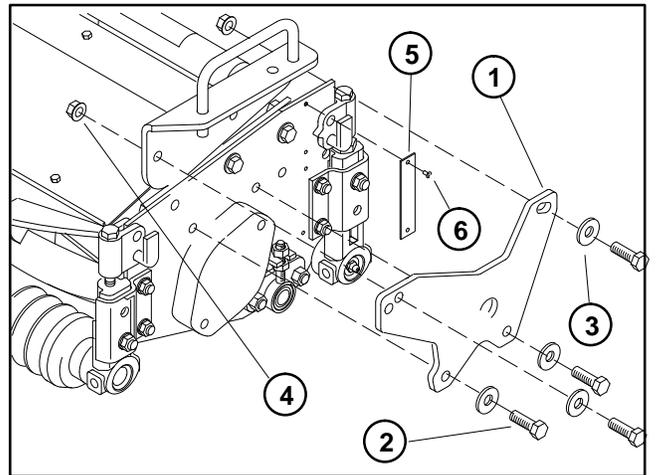


Figure 29

- |                     |                        |
|---------------------|------------------------|
| 1. Fixed side plate | 4. Flanged lock nut    |
| 2. Capscrews        | 5. Height-of-cut plate |
| 3. Washers          | 6. Pop rivet           |

## Skid Kit Installation

1. Remove front roller from the cutting unit (see Roller Removal and Installation).
2. Align skid slots with the angle bracket holes on the cutting unit.
3. Secure skid to the cutting unit with both flange head screws, flat washers, and lock nuts.
4. Adjust skid height as necessary by loosening lock nuts and flange head screws, then retighten fasteners.

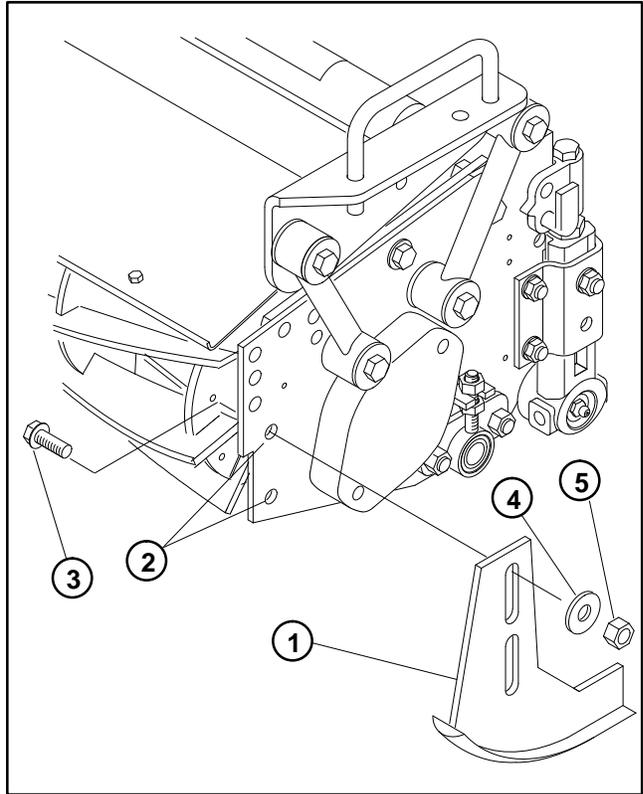


Figure 30

- |                        |                |
|------------------------|----------------|
| 1. Skid                | 4. Flat washer |
| 2. Angle bracket holes | 5. Lock nut    |
| 3. Flange head screw   |                |

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