



# Service Manual

## ProCore® 648

### 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 ProCore 648.

REFER TO THE 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 and Parts Catalogs are available on the internet at [www.toro.com](http://www.toro.com).

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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 SAUER DANFOSS OMEW HYDRAULIC MOTOR SERVICE MANUAL

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# Safety Instructions

The ProCore 648 is designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.



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## Before Operating

1. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the Operator's Manual are available on the internet at [www.Toro.com](http://www.Toro.com).
2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.
3. Assure interlock switches are adjusted correctly so engine cannot be started unless traction lever is in NEUTRAL and coring head is DISENGAGED.
4. Since gasoline is highly flammable, handle it carefully:
  - A. Store fuel in containers specifically designed for this purpose.
  - B. Do not remove machine fuel tank cap while engine is hot or running.
  - C. Do not smoke while handling fuel.
  - D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.
  - E. Wipe up any spilled fuel.

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## While Operating

1. Operator should be standing at the side console when starting the engine and at the handle when operating the machine. Stay away from the coring head when it is engaged.
2. Before starting the engine:
  - A. Engage the parking brake.
  - B. Make sure traction lever is in neutral.
3. After engine is started, release parking brake and apply no pressure to traction lever. Machine must not move. If movement is evident, the traction linkage is adjusted incorrectly. Shut engine off and adjust traction linkage until machine does not move when traction lever is released (see Operator's Manual).
4. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.
5. Do not touch engine, muffler or exhaust pipe while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.
6. Before leaving the operator's position:
  - A. Ensure that traction lever is in neutral.
  - B. Raise coring head and wait for coring head to stop.
  - C. Set parking brake. Stop engine and remove key from ignition switch.
7. Anytime the machine is parked (short or long term), install the service latch to secure the coring head in the raised position. This eliminates the risk of the coring head accidentally lowering to the ground.
8. Do not park on slopes unless wheels are chocked or blocked.

7. Anytime the machine is parked (short or long term), install the service latch to secure the coring head in the raised position. This eliminates the risk of the coring head accidentally lowering to the ground.

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

## Maintenance and Service

1. Before servicing or making adjustments, position machine on level surface, raise coring head, set parking brake, stop engine and remove key from the ignition switch. Install the service latch to secure the coring head in the raised position.

2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

4. Make sure all hydraulic line connectors are tight and all hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.

5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Hydraulic fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

6. Before disconnecting any hydraulic component or performing any work on the hydraulic system, all pressure in system must be relieved. See Relieving Hydraulic System Pressure in the General Information section of Chapter 4 – Hydraulic System.

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

8. Use care when checking or servicing the coring head: wear gloves and use caution.

9. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt.

10. If engine must be running to perform maintenance or make an adjustment, keep hands, feet, clothing and other parts of the body away from all moving machine parts. Keep bystanders away.

11. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed with a tachometer.

12. Shut engine off before checking or adding oil to the engine crankcase.

13. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive battery cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive battery cable first and negative battery cable last.

14. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

15. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

16. At the time of manufacture, the machine conformed to all applicable safety standards. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards, and the warranty may be voided.

17. When changing tires or performing other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions).

# Jacking Instructions



## CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

### Jacking the Front End

1. Set parking brake and chock rear tires to prevent the machine from moving. Install service latch to secure coring head.

**IMPORTANT: To prevent wheel motor damage, DO NOT use front wheel motor as a jacking point.**

2. Position jack securely under the front of the frame (Fig. 1).
3. Jack front of machine off the ground.
4. Position jack stands or hardwood blocks under the front of the frame to support the machine.

### Jacking the Rear End

1. Chock front tire to prevent the machine from moving. Install service latch to secure coring head.

**IMPORTANT: To prevent wheel motor damage, DO NOT use rear wheel motor as a jacking point.**

2. Place jack securely under the frame plate just inside of the rear wheel (Fig. 2).

**NOTE:** If available, a hoist can be used to lift the rear of the ProCore 648. Use eyelets in coring head bearing housings as hoist attachment points (Fig. 3).

3. Jack (or lift) rear of machine off the ground.
4. Position jack stands or hardwood blocks under the frame to support the machine.

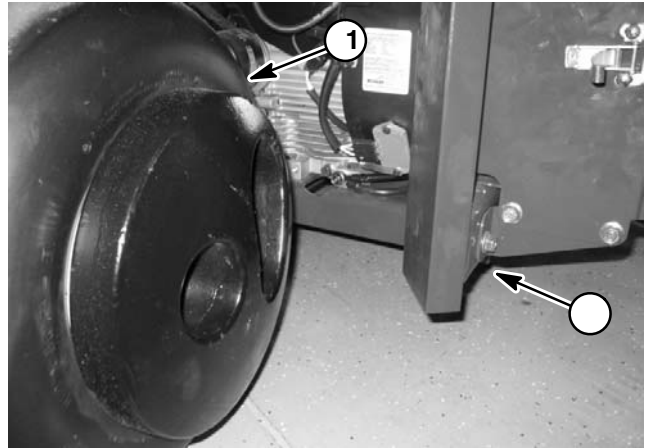


Figure 1

1. Front wheel
2. Frame jacking point

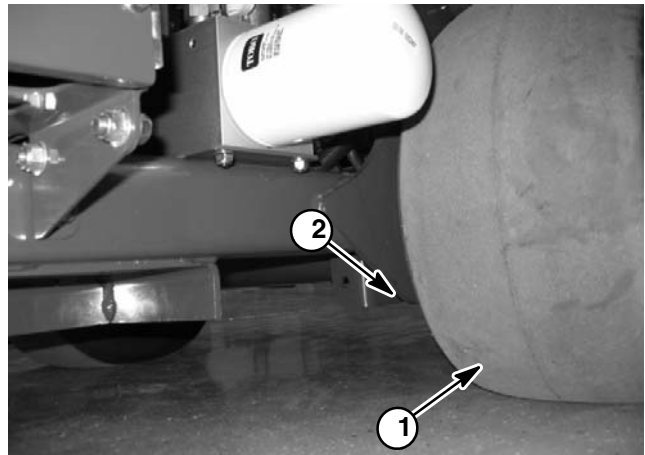


Figure 2

1. Rear wheel
2. Frame jacking point

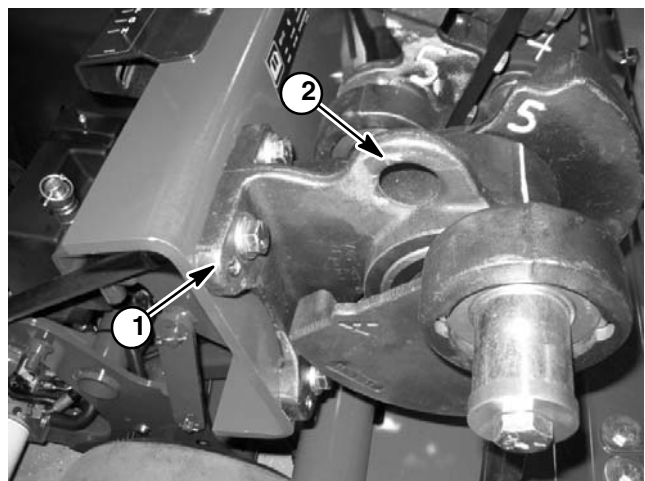


Figure 3

1. Bearing housing
2. Lifting eyelet



# Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the ProCore 648. If any decal becomes illegible or damaged, install a new decal. Part numbers for replacement decals are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

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# Product Records and Maintenance

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## Product Records

Insert Operator’s Manual and Parts Catalog for your ProCore 648 at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your ProCore, insert the Installation Instructions, Operator’s Manuals and Parts Catalogs for those options at the end of this chapter.

## Maintenance

Maintenance procedures and recommended service intervals for the ProCore 648 are covered in the Operator’s Manual. Refer to that publication when performing regular equipment maintenance. Refer to the Engine Operator’s Manual for additional engine specific maintenance procedures.

# 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	0.09375	—	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>	
				33/64	0.515625
				17/32	0.53125
				35/64	0.546875
			9/16	—	0.5625
				37/64	0.578125
				19/32	0.59375
				39/64	0.609375
			5/8	—	0.6250
				41/64	0.640625
				21/32	0.65625
				43/64	0.671875
			11/16	—	0.6875
				45/64	0.703125
				23/32	0.71875
				47/64	0.734375
			3/4	—	0.7500
				49/64	0.765625
				25/32	0.78125
				51/64	0.796875
			13/16	—	0.8125
				53/64	0.828125
				27/32	0.84375
				55/64	0.859375
			7/8	—	0.8750
				57/64	0.890625
				29/32	0.90625
				59/64	0.921875
			15/16	—	0.9375
				61/64	0.953125
				31/32	0.96875
				63/64	0.984375
			1	—	1.000

## 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

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

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

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

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

## Fastener Identification

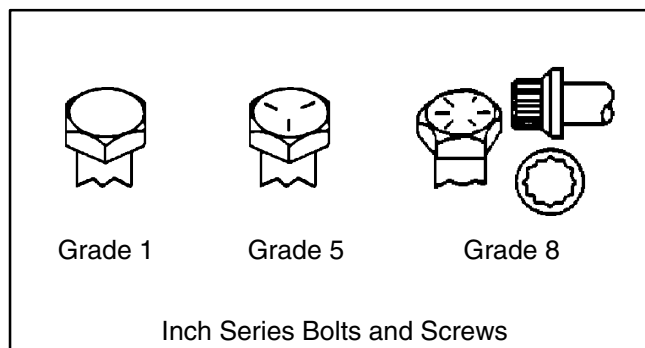


Figure 1

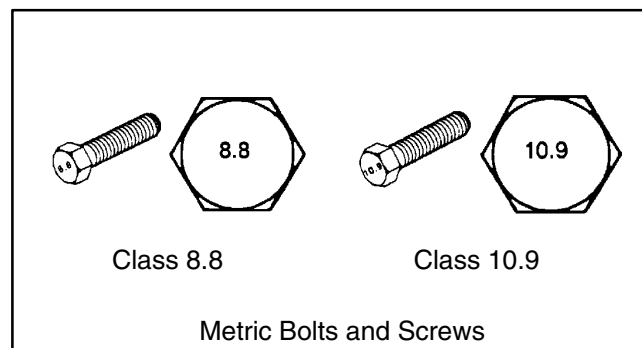


Figure 2

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

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

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

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

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

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

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

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

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

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

## Other Torque Specifications

### SAE Grade 8 Steel Set Screws

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

### Wheel Bolts and Lug Nuts

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

\*\* For steel wheels and non-lubricated fasteners.

### Thread Cutting Screws (Zinc Plated Steel)

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

### Thread Cutting Screws (Zinc Plated Steel)

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

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

## Conversion Factors

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

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





# Kohler Engine

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# Introduction

This Chapter gives information about specifications and repair of the Kohler engine used in the ProCore 648.

General engine maintenance procedures are described in your Operator's Manual. Information on engine troubleshooting, testing, disassembly, and reassembly is identified in the Kohler Engine Service Manual that is included at the end of this section.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kohler Engine Service Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kohler engines are supplied through your local Kohler dealer or distributor.

# Specifications

Item	Description
Make / Designation	Kohler, CH23S, 4–stroke, V–Twin Air Cooled, OHV
Number of Cylinders	2
Bore x Stroke	3.15" x 2.64" (80 mm x 67 mm)
Total Displacement	41.1 Cubic Inches (674 cc)
Compression Ratio	8.5:1
Dry Weight (approximate)	90 Pounds (41 Kilograms)
Fuel	Unleaded, Regular Gasoline (Minimum 87 Octane)
Fuel Tank Capacity	7.5 U.S. Gallons (28.4 Liters)
Governor	Mechanical
Idle Speed (no load)	1400 ± 50 RPM
High Idle (no load)	3400 ± 50 RPM
Engine Oil	See Operator's Manual
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity	2 U.S. Quart (1.9 Liters) with filter
Starter	12 VDC

# General Information

---

## Fuel Shutoff Valve

The fuel shutoff valve located under the fuel tank (Fig. 1) should be closed when removing the fuel tank or engine from the machine. Additionally, close the shutoff valve if the machine is being transported on a trailer or when placing the machine in long term storage.

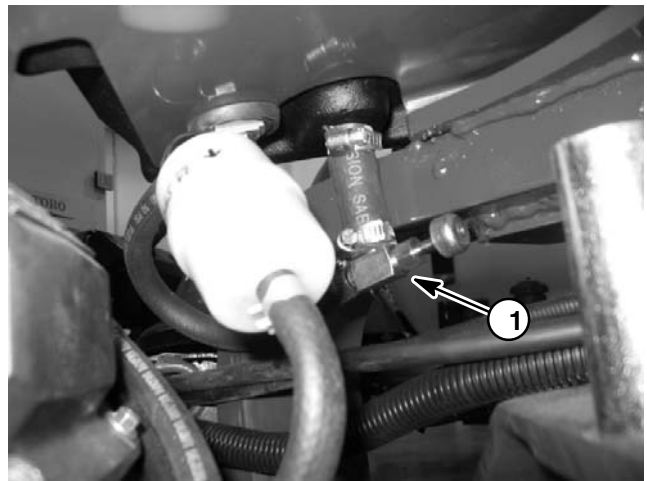


Figure 1

1. Fuel shutoff valve (under the fuel tank)

# Adjustments

## Adjust Choke Control

Proper choke operation is dependent upon proper adjustment of choke control cable.

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch.
2. Remove air cleaner cover from engine to view choke plate in carburetor.
3. Move choke control lever to **RUN** position. Check that choke plate in carburetor is fully open.
4. Move choke control lever to **CHOKE** position. Check that choke plate in carburetor is fully closed.
5. If needed, choke cable can be adjusted by loosening cable clamp screw and repositioning control cable until choke plate operates correctly.
6. Install air cleaner cover to engine.

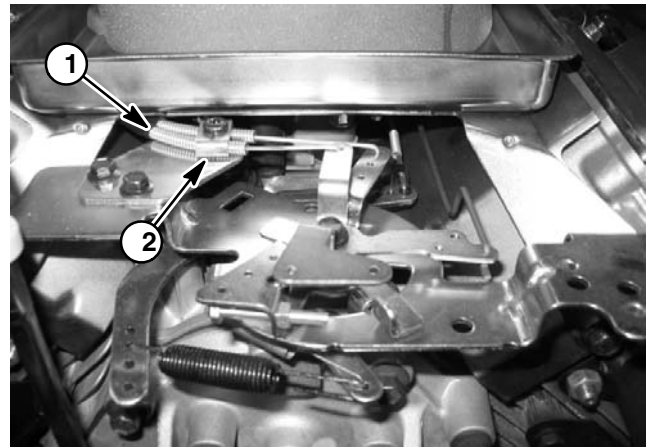


Figure 2

1. Choke cable                      2. Cable clamp

## Adjust Engine Speed

1. Allow engine to reach operating temperature before checking or adjusting engine speed. Park machine on a level surface, fully raise coring head and apply parking brake.
2. With engine running, move throttle control lever to **FAST** (high idle) position.
3. Using a tachometer, check that engine is operating at **3400 ± 50 RPM**.
4. If **high idle speed** is incorrect, adjust high speed screw on governor assembly until high idle is **3400 ± 50 RPM** (Fig. 3).
5. Move throttle control lever to **SLOW** (idle speed) position.
6. Using a tachometer, check that engine is operating at **1400 ± 50 RPM**.
7. For additional information, refer to the Kohler Engine Service Manual that is included at the end of this Chapter.



Figure 3

1. High speed screw

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# Service and Repairs

## Cooling System

To ensure proper engine cooling, make sure the grass screen, cooling fins and other external surfaces of the engine are kept clean at all times.

**NOTE:** Perform this maintenance procedure at the interval specified in the Operator's Manual.

**IMPORTANT:** The engine that powers the ProCore 648 is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked grass screen or a plugged or dirty blower housing will result in engine overheating and engine damage.

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch.

**IMPORTANT:** Never clean engine with pressurized water. Water could enter and contaminate the fuel system.

2. Clean cooling fins on both cylinder heads.

3. Clean grass screen and blower housing of dirt and debris (Fig. 4).

4. If blower housing removal is necessary for cooling system cleaning, engine needs to be removed from machine (see Engine Removal and Installation in this section).

**IMPORTANT:** Never operate engine without the blower housing installed. Overheating and engine damage will result.

5. Make sure grass screen and blower housing are re-installed to the engine if removed.

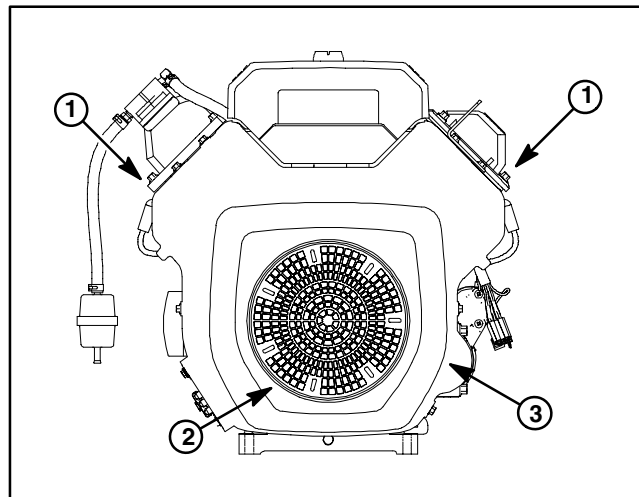


Figure 4

- 1. Cylinder head
- 2. Grass screen
- 3. Blower housing

## Fuel System

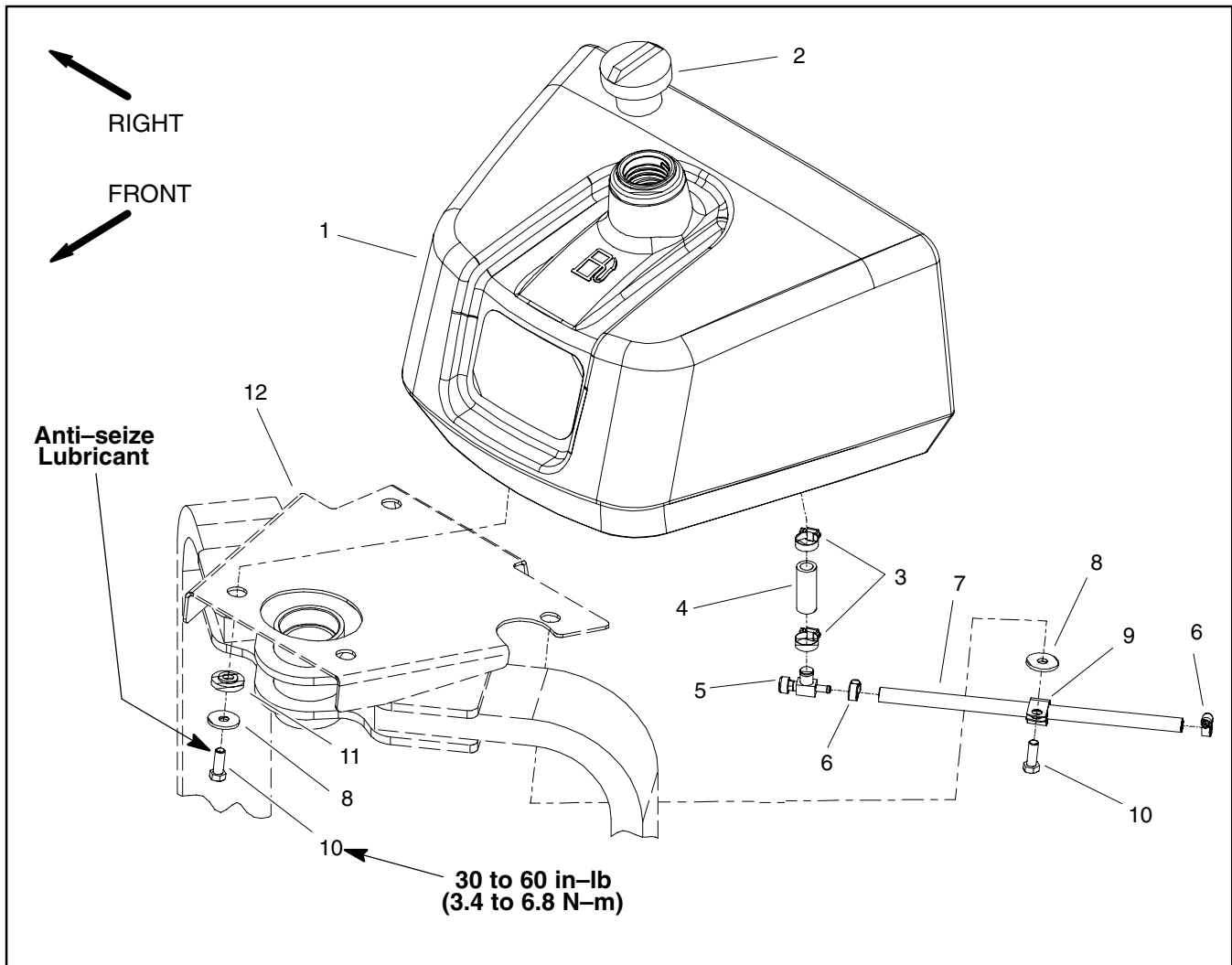


Figure 5

- |               |                         |                             |
|---------------|-------------------------|-----------------------------|
| 1. Fuel tank  | 5. Fuel shut-off valve  | 9. Clamp                    |
| 2. Fuel cap   | 6. Hose clamp           | 10. Cap screw (4 used)      |
| 3. Hose clamp | 7. Fuel hose            | 11. Flange bushing (4 used) |
| 4. Fuel hose  | 8. Flat washer (4 used) | 12. Machine frame           |



## DANGER

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

### Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Operator's Manual. Check fuel lines for deterioration, damage or leaking connections. Replace hoses, clamps and connections as necessary.

### Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Operator's Manual. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

To clean fuel tank, flush tank out with clean solvent. Make sure tank is free of contaminants and debris.



### Fuel Tank Removal (Fig. 5)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Close tank fuel shut-off valve. Disconnect fuel hose from the fuel filter (Fig. 6).
3. Use shut-off valve to empty fuel tank into a suitable container.
4. Remove fuel tank using Figure 5 as a guide.

### Fuel Tank Installation (Fig. 5)

1. Install fuel tank to frame using Figure 5 as a guide. Apply anti-seize lubricant to fuel tank cap screws and torque screws from 30 to 60 in-lb (3.4 to 6.8 N-m).
2. Connect fuel hose to the fuel filter.
3. Fill fuel tank (see Operator's Manual). Open fuel shut-off valve.
4. Return coring head service latch to stored position before using machine.

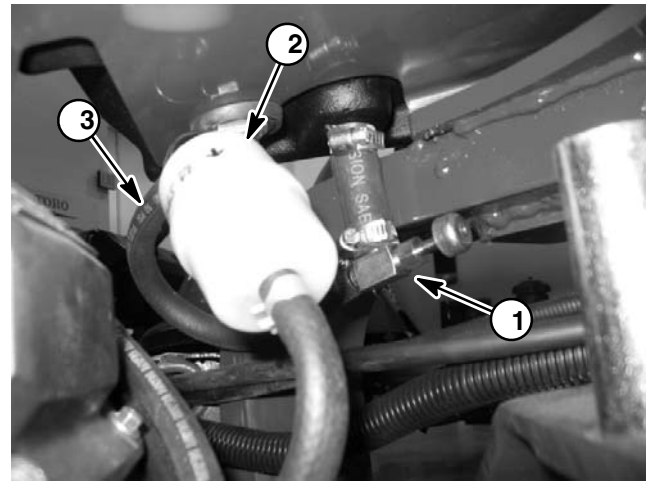


Figure 6

1. Fuel shut-off valve
2. Fuel filter
3. Fuel hose

# Exhaust System

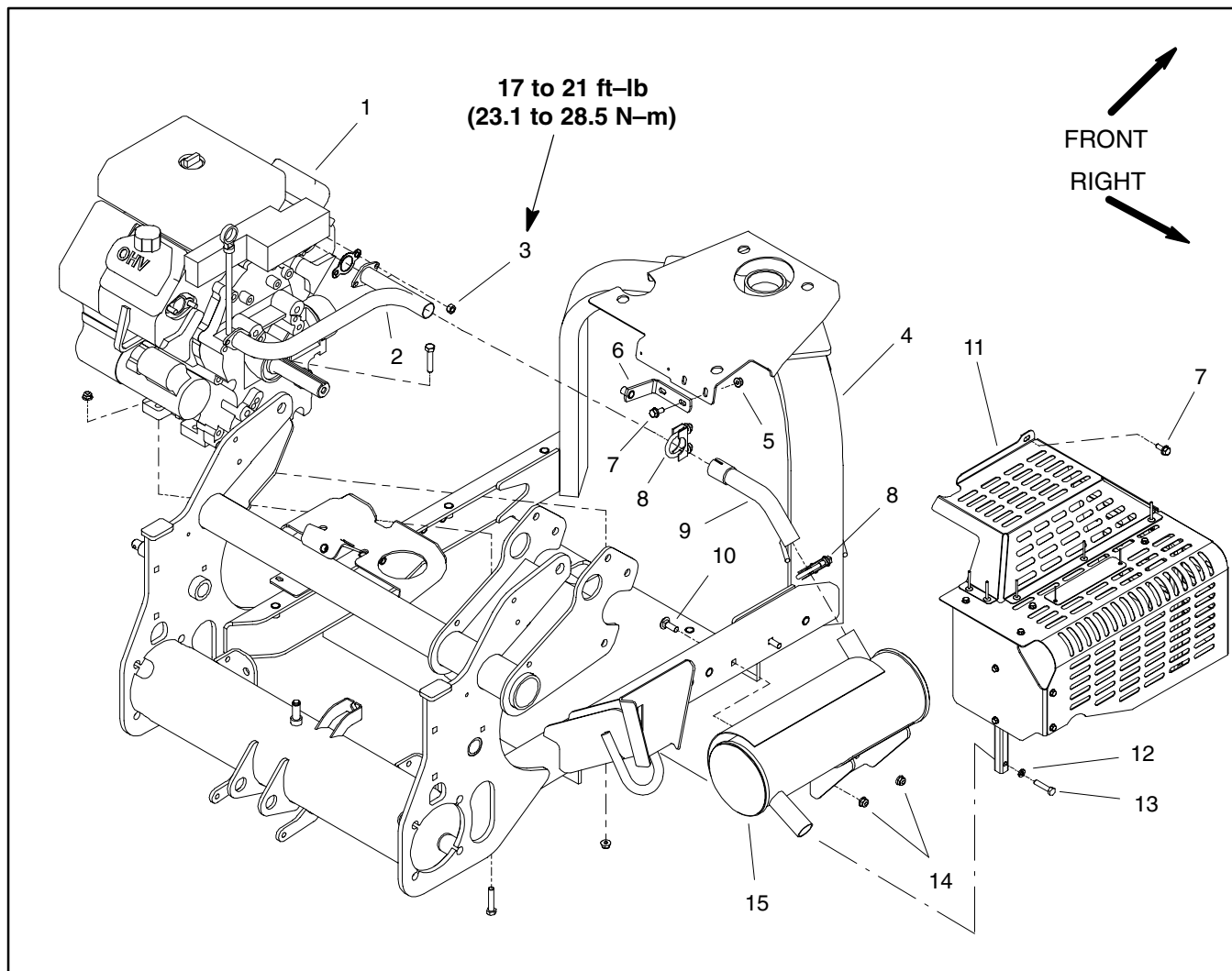
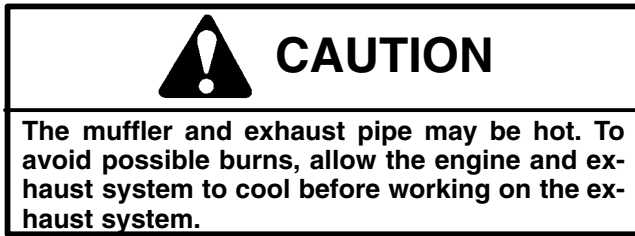


Figure 7

- |                        |                               |                          |
|------------------------|-------------------------------|--------------------------|
| 1. Engine              | 6. Muffler bracket            | 11. Heat shield          |
| 2. Exhaust manifold    | 7. Flange head screw (3 used) | 12. Lock washer (2 used) |
| 3. Hex nut (4 used)    | 8. Muffer clamp (2 used)      | 13. Cap screw (2 used)   |
| 4. Frame               | 9. Exhaust elbow              | 14. Flange nut (2 used)  |
| 5. Flange nut (2 used) | 10. Carriage screw (2 used)   | 15. Muffler              |

## Removal (Fig. 7)



1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove fasteners that secure exhaust heat shield to machine (flange head screw and two (2) cap screws with lock washers). Remove heat shield from machine.
3. Loosen muffler clamps that secure muffler and exhaust elbow.
4. Remove two (2) flange nuts that secure muffler to frame. Retrieve two (2) carriage screws. Remove muffler and exhaust elbow from machine.
5. If exhaust manifold removal is required, remove four (4) hex nuts from the exhaust manifold studs on engine. Separate the exhaust manifold from the engine.
6. Remove exhaust gaskets.

## Installation (Fig. 7)

**NOTE:** Make sure exhaust manifold and engine sealing surfaces are free of debris or damage that may prevent a tight, leak-free seal.

1. If exhaust manifold was removed, place exhaust gaskets on the engine exhaust manifold studs. Secure exhaust manifold to engine with four hex nuts. Torque hex nuts from 17 to 21 ft-lb (23.1 to 28.5 N-m).

**IMPORTANT:** Finger tighten all exhaust system fasteners before securing so there is no preload on exhaust components.

2. Position muffler clamps over exhaust elbow and muffler inlets.
3. Slide exhaust elbow onto exhaust manifold and then slide muffler onto elbow.
4. Secure muffler to frame with two (2) carriage screws and flange nuts.
5. Tighten muffler clamps.
6. Position exhaust heat shield to machine and secure with flange head screw and two (2) cap screws with lock washers.
7. Return coring head service latch to stored position before using machine.

# Engine

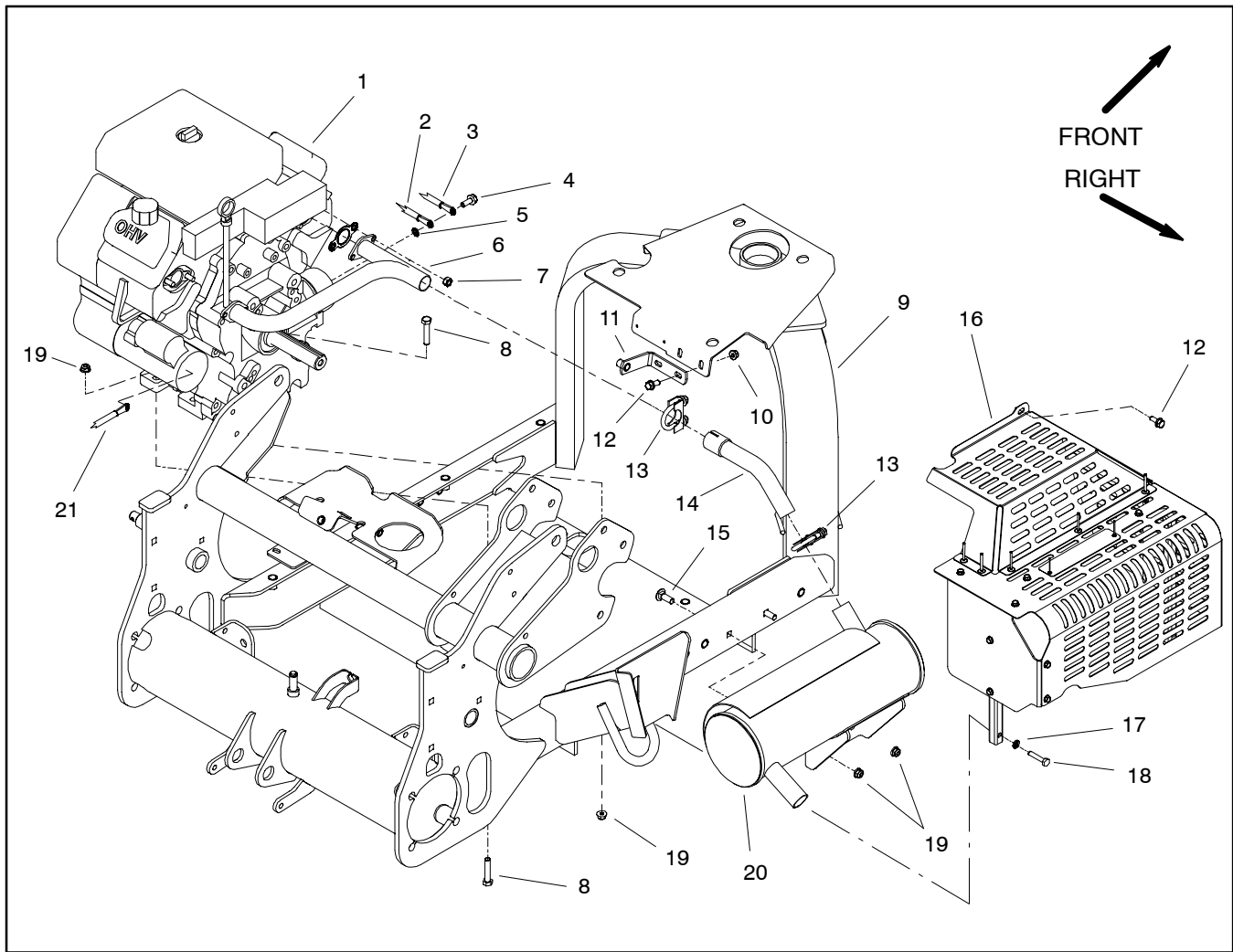


Figure 8

- |                           |                                |                             |
|---------------------------|--------------------------------|-----------------------------|
| 1. Engine                 | 8. Cap screw (4 used)          | 15. Carriage screw (2 used) |
| 2. Negative battery cable | 9. Frame                       | 16. Heat shield             |
| 3. Wire harness ground    | 10. Flange nut (2 used)        | 17. Lock washer (2 used)    |
| 4. Flange screw           | 11. Muffler bracket            | 18. Cap screw (2 used)      |
| 5. Lock washer            | 12. Flange head screw (3 used) | 19. Flange nut (6 used)     |
| 6. Exhaust manifold       | 13. Muffler clamp (2 used)     | 20. Muffler                 |
| 7. Hex nut (4 used)       | 14. Exhaust elbow              | 21. Starter cable           |

## Removal (Fig. 8)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch. Chock wheels to keep the machine from moving.

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

3. Remove pump belt cover from machine (see Operator's Manual).

4. Remove exhaust system (see Exhaust System Removal in this section).

5. Close fuel tank shut-off valve.

6. Loosen hose clamp and disconnect fuel hose from the fuel filter on the front side of the engine. Plug fuel hose to prevent leakage and contamination.

7. Disconnect electrical connections from engine.

**NOTE:** Label all electrical connections for reassembly purposes.

A. Remove harness red wire and positive battery cable from the starter motor solenoid stud (Fig. 9).

B. Disconnect negative battery cable and wire harness ground wire from the front corner of engine base (Fig. 10). Locate and retrieve starwasher from between engine and wire connectors.

C. Unplug machine harness connector from electric clutch.

D. Remove cable tie that secures hourmeter wire to spark plug wire. Position hourmeter wire clear of engine.

E. Unplug machine wire harness connector from engine connector. Position wiring harness away from the engine.


8. Remove primary drive belt (coring head) (see Primary Drive Belt in the Service and Repairs section of Chapter 7 – Coring Head).

9. Remove hydraulic pump drive belt (see Pump Drive Belt in the Service and Repairs section of Chapter 4 – Hydraulic System).

10. Remove engine from machine:

A. Connect a hoist or chain fall to lift tabs located on each of the cylinder heads.

B. Remove four (4) cap screws and flange nuts that secure the engine to the machine frame.

	<b>CAUTION</b>
<b>One person should operate lift or hoist while another person guides the engine out of the machine.</b>	

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

C. Remove engine from the machine.

11. If needed, remove electric clutch (see Electric Clutch in the Service and Repairs section of Chapter 5 – Electrical System) and hydraulic pump drive pulley from engine (Fig. 11).

12. If needed, remove belt tensioning components from engine (see Belt Tensioners in this section).

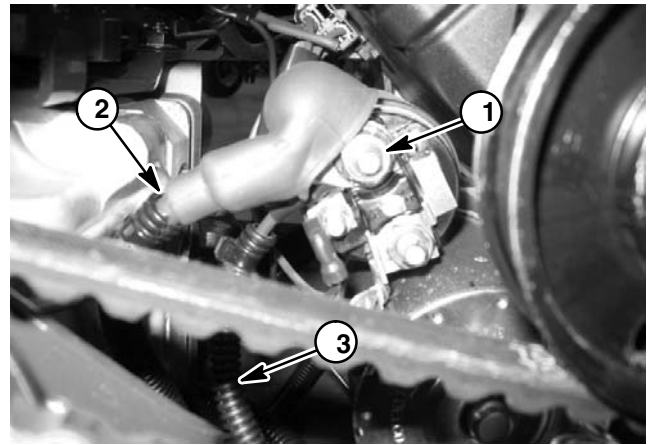


Figure 9

- 1. Solenoid stud
- 2. Positive battery cable
- 3. Harness red wire

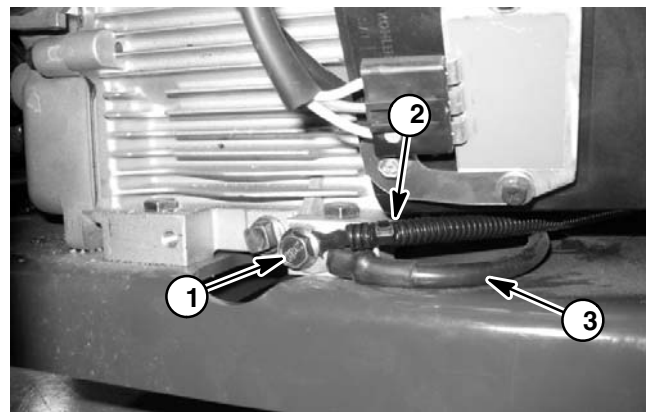


Figure 10

- 1. Flange head screw
- 2. Wire harness ground
- 3. Negative battery cable

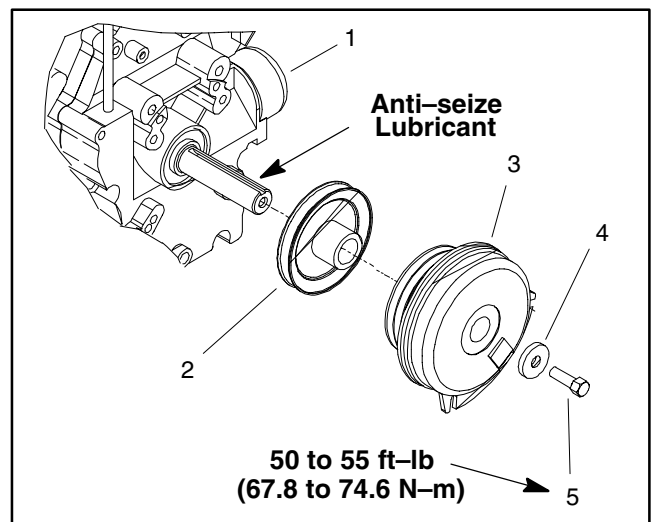


Figure 11

- 1. Engine
- 2. Pump pulley
- 3. Electric clutch
- 4. Hardened washer
- 5. Cap screw

## Installation (Fig. 8)

1. Locate machine on a level surface with key removed from the ignition switch. Chock wheels to keep the machine from moving.

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

3. If electric clutch and hydraulic pump drive pulley were removed from engine crankshaft (Fig. 11):

A. Apply anti-seize lubricant to crankshaft.

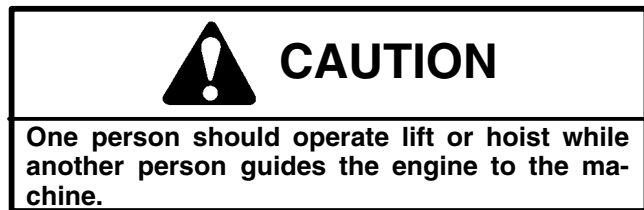
B. Install hydraulic pump drive pulley with the hub away from engine.

C. Slide clutch onto crankshaft and secure to crankshaft with screw and hardened washer. Hold hardened washer with pliers to prevent crankshaft from turning and torque screw from 50 to 55 ft-lb (67.9 to 74.6 N-m).

4. If removed, install belt tensioner components to engine assembly (see Belt Tensioners in this section).

5. Reinstall engine to machine.

A. Connect a hoist or chain fall to lift tabs located on each of the cylinder heads.



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

B. Reinstall engine to the machine. Make sure fastener holes of the engine are aligned with the holes in the machine frame.

C. Secure engine to the frame with four (4) cap screws and flange nuts. The front two (2) cap screws should be positioned down through engine and frame. The rear two (2) cap screws should be up through frame and engine.

6. Reconnect electrical connections to engine:

A. Plug engine wire harness connector into machine harness connector.

B. Wrap hourmeter wire around spark plug wire and secure with cable tie.

C. Position negative battery cable and wire harness ground wire to the front corner of engine base (Fig. 10). Place starwasher between engine and wire connectors and secure with flange head screw.

D. Plug machine harness connector to electric clutch.

E. Connect red wire and positive battery cable to the starter motor solenoid stud (Fig. 9).

7. After engine installation, verify pulley alignment across engine and hydraulic pump pulley faces with a straight edge. If necessary, loosen two (2) set screws on hydraulic pump pulley and adjust location of pulley. Retighten pulley set screws after adjustment.

8. Install hydraulic pump drive belt (see Pump Drive Belt in the Service and Repairs section of Chapter 4 – Hydraulic System).

9. Adjust hydraulic pump drive belt tension (see Operator's Manual).

10. Install primary drive belt (coring head) (see Primary Drive Belt in the Service and Repairs section of Chapter 7 – Coring Head).

11. Remove plug installed in fuel hose during disassembly. Connect fuel hose to the fuel filter and secure with hose clamp.

12. Install exhaust system (see Exhaust System Installation in this section).

13. Check engine oil level (see Operator's Manual).

14. Check all wires, control cables and hoses to make sure that they are not contacted by rotating or moving parts.

15. Connect positive (+) and then negative (-) battery cables at the battery.

16. Install pump belt cover to machine (see Operator's Manual).

17. Open fuel shut-off valve under the fuel tank.

18. Return coring head service latch to stored position before using machine.

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# Belt Tensioners

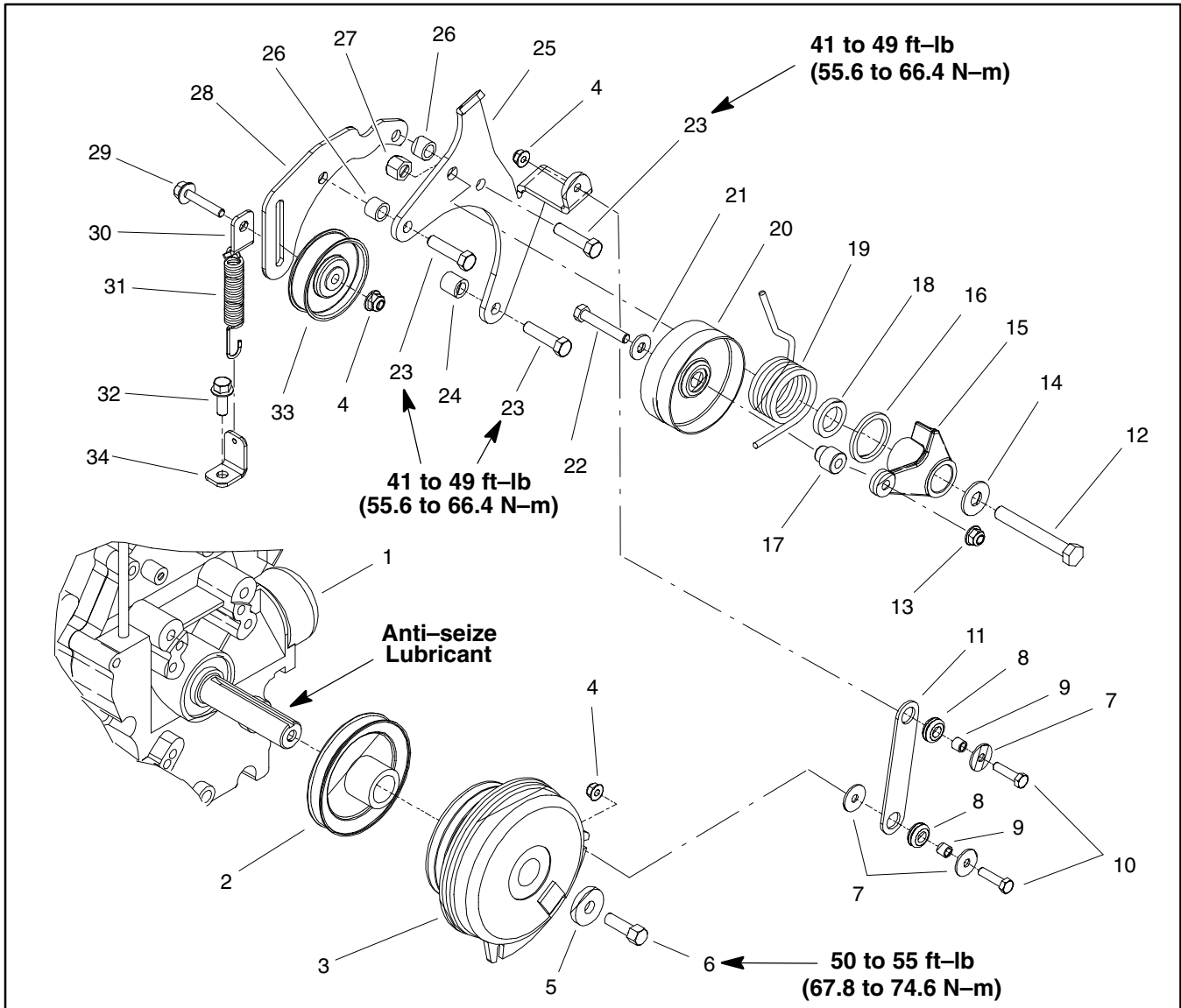


Figure 12

- |                                |                        |  |
|--------------------------------|------------------------|--|
| 1. Engine                      | 13. Flange nut         | 24. Spacer (.750" long)                |
| 2. Hydraulic pump drive pulley | 14. Flat washer        | 25. Idler mounting bracket             |
| 3. Electric clutch             | 15. Idler arm assembly | 26. Spacer (.560" long)                |
| 4. Flange nut                  | 16. Washer             | 27. Lock nut                           |
| 5. Hardened washer             | 17. Idler spacer       | 28. Idler support                      |
| 6. Cap screw                   | 18. Idler arm spacer   | 29. Flange head screw                  |
| 7. Flat washer                 | 19. Torsion spring     | 30. Spring bracket                     |
| 8. Grommet                     | 20. Idler pulley       | 31. Spring                             |
| 9. Spacer                      | 21. Hardened washer    | 32. Flange head screw                  |
| 10. Cap screw                  | 22. Cap screw          | 33. Idler pulley                       |
| 11. Clutch strap               | 23. Cap screw          | 34. Bracket (fastens to machine frame) |



## Removal (Fig. 12)

1. Release tension on idler torsion spring (item 19):



- A. Insert nut driver or small piece of pipe onto the end of the torsion spring.
  - B. Push down on the spring end and unhook the spring from the idler mounting bracket.
2. Remove belt tensioner components from engine as needed using Figure 12 as a guide.

## Installation (Fig. 12)

1. Install belt tensioner components to engine using Figure 12 as a guide.
2. Install the hydraulic pump drive belt and primary drive belt (coring head).
3. Apply tension to idler torsion spring (item 19):
  - A. Insert nut driver or small piece of pipe onto the end of the torsion spring.
  - B. Push down on the spring end and hook the spring under the idler mounting bracket notch. Release the spring slowly to lock it into place.
4. Adjust the hydraulic pump drive belt (see Operator's Manual) and primary drive belt (coring head) (see Primary Drive Belt in the Service and Repairs section of Chapter 7 – Coring Head).

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# Hydraulic System

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Hydraulic System

# Specifications

Item	Description
Traction Pump (P1) Displacement at full stroke (per revolution) Forward relief pressure Reverse relief pressure	Variable displacement piston pump .976 Cubic Inches (16 cc) 2900 PSI (200 Bar) 2900 PSI (200 Bar)
Charge/Lift Pump (P2) Displacement (per revolution) Charge Pressure	Gear pump .37 Cubic Inches (6.1 cc) 40 PSI (2.8 Bar)
Lift System Relief (R1) Pressure	1000 PSI (69 Bar)
Front Wheel Motor Displacement	Orbital rotor motor 24 Cubic Inches (393 cc)
Rear Wheel Motors Displacement	Orbital rotor motor 12 Cubic Inches (197 cc)
Hydraulic Filter	Spin-on cartridge type
Hydraulic Oil	See Operator's Manual
Hydraulic Reservoir Capacity	1.75 U.S. Gal. (6.6 L)
Total Hydraulic System Capacity	3 U.S. Gal. (11.4 L) (Approximate)


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# 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 and 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 wrench and tighten the hose swivel nut onto the fitting with the other wrench.


WARNING

**Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. See Relieving Hydraulic System Pressure in this section.**

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

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	0.75 ± 0.25
6 (3/8 in.)	0.75 ± 0.25
8 (1/2 in.)	0.75 ± 0.25
10 (5/8 in.)	1.00 ± 0.25
12 (3/4 in.)	0.75 ± 0.25
16 (1 in.)	0.75 ± 0.25

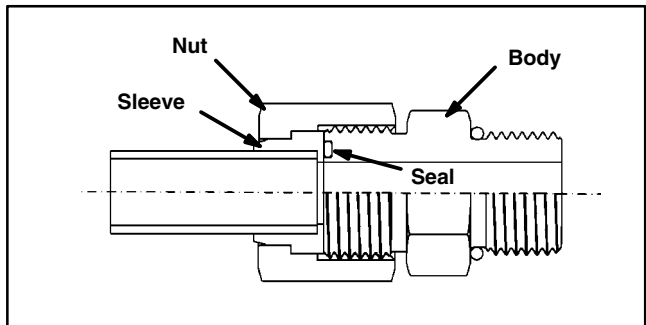


Figure 1

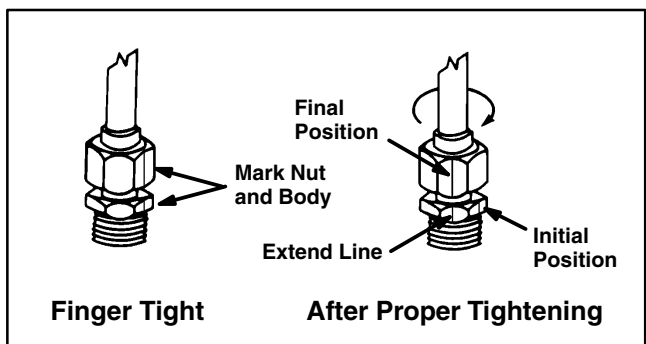


Figure 2

### 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 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

**NOTE:** Installation torque values for non-adjustable fittings are listed in Figure 4. These torque values should **only** be used when a fitting can be accessed with a socket. Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench accuracy and should not be used.

### 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 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

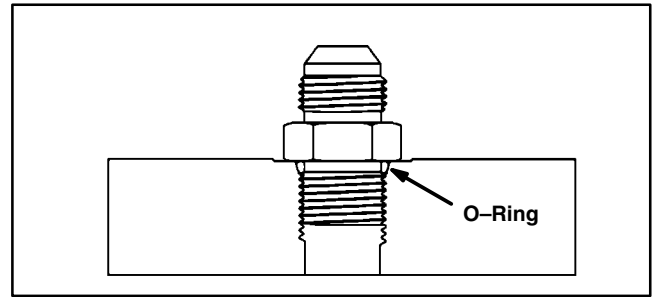


Figure 3

Fitting Size	Installation Torque
4	9–10 ft-lb (12–13 N-m)
6	20–21 ft-lb (27–28 N-m)
8	35–37 ft-lb (47–50 N-m)
10	60–66 ft-lb (81–89 N-m)
12	81–87 ft-lb (110–117 N-m)
16	121–131 ft-lb (164–177 N-m)

Figure 4

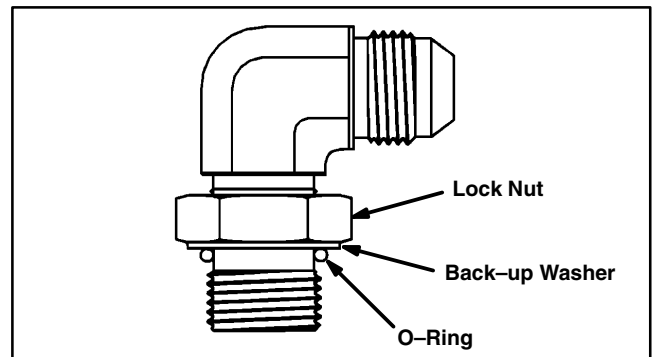


Figure 5

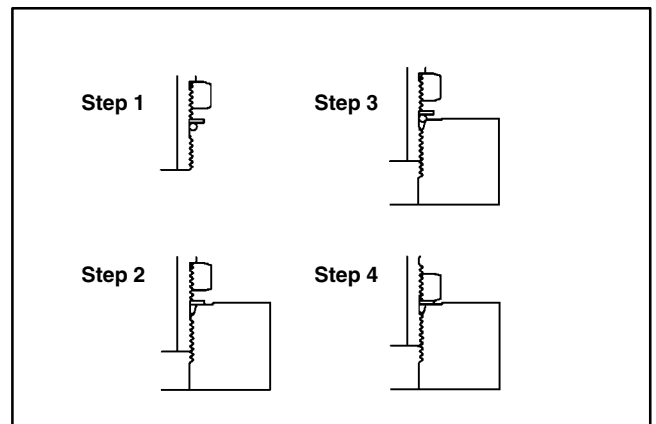


Figure 6

---

## Pushing/Pulling Machine

**IMPORTANT:** If push/pull limits are exceeded, severe damage to the piston (traction) pump may occur.

If it becomes necessary to push/pull the machine, push/pull at a speed **below 1 mph (1.6 kph)**, and for a distance **less than 100 feet (30.5 meters)**. The piston (traction) pump is equipped with a by-pass valve that needs to be rotated counterclockwise (loosened) one turn for pushing/pulling. The by-pass valve should be torqued from 95 to 120 in-lb (10.7 to 13.6 N-m) before the machine is returned to operation.

See Operator's Manual for pushing/pulling procedures.



Figure 7

1. By-pass valve location

---

## Check Hydraulic Fluid

The ProCore 648 hydraulic system is designed to operate on anti-wear hydraulic fluid. The reservoir (Fig. 8) holds about 1.75 gallons (6.6 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.**

See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

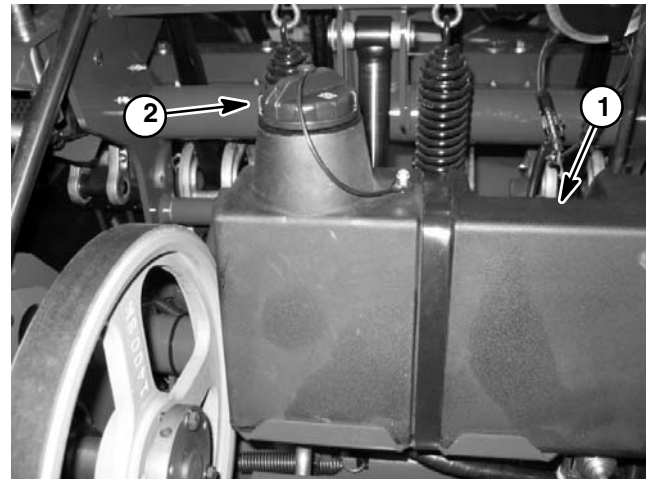


Figure 8

1. Hydraulic reservoir

2. Hydraulic reservoir cap

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## Relieving Hydraulic System Pressure

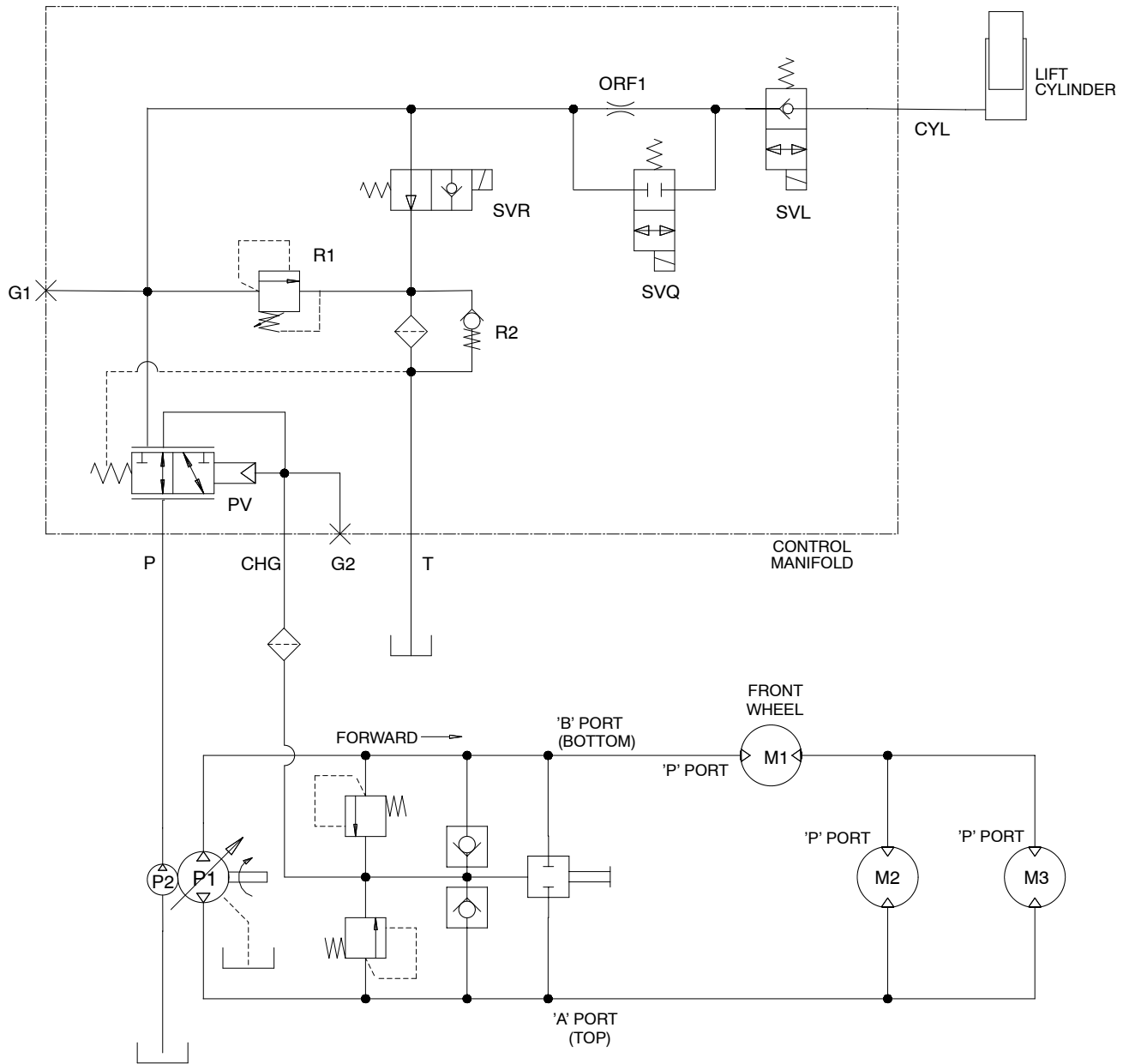
Before disconnecting or performing any work on the hydraulic system, all pressure in the hydraulic system must be relieved. With the coring head fully raised, turn key switch to OFF and allow engine to stop. Secure coring head with service latch.

To relieve hydraulic pressure in traction circuit, move traction lever to both forward and reverse directions.

To relieve lift system pressure, turn key switch to ON (engine not running). Move traction lever to forward direction and depress lower switch on handle to lower coring head onto service latch. Return key switch to OFF when pressure has been relieved. Remove key from the ignition switch.



# Hydraulic Schematic



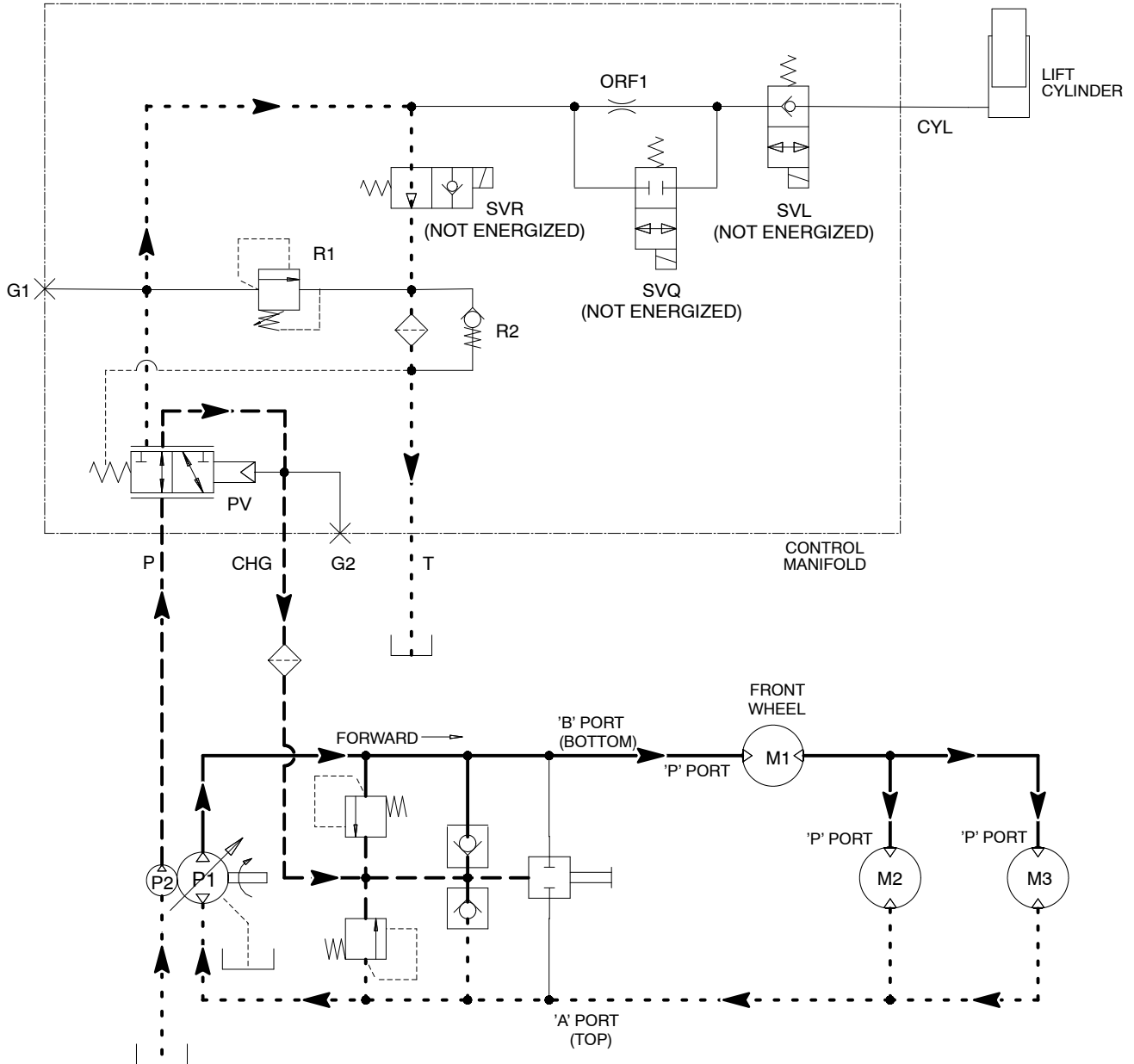
COMPONENT	CIR	GPM	PSI
P1	.98	10.5	2900
P2	.37	4.1	-
PV	-	-	40
R1	-	-	1000
R2	-	-	40
M1	23.8	-	-
M2	12.1	-	-
M3	12.1	-	-
ORF1	∅.050	-	-

ProCore 648

## Hydraulic Schematic

All solenoids are shown as de-energized

# Hydraulic Flow Diagrams



## Traction Circuit (Forward Shown)

- Working Pressure
- - - Low Pressure (Charge)
- · · Return or Suction
- Flow

---

## Traction Circuit

The traction (piston) pump (P1) is driven by the engine through the pulleys and pump drive belt. 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 (piston) pump supplies oil flow to the wheel motors through the supply side of the traction circuit.

The gear pump (P2) is attached to the traction pump and is directly coupled to it. The gear pump provides charge oil to replace small amounts of traction pump internal oil leakage. Hydraulic charge oil is supplied to the traction circuit from the gear pump, through the lift control manifold (manifold port P, proportional valve PV and manifold port CHG) and past the charge circuit check valve in the return side of the traction circuit. Proportional valve PV ensures that sufficient gear pump flow is always available for the charge oil needs of the traction circuit. Gear pump flow in excess of charge circuit needs is available to raise/lower the coring head. After charge and raise/lower requirements are met, excess P2 flow is directed to the hydraulic reservoir through the hydraulic oil filter.

### Forward Direction

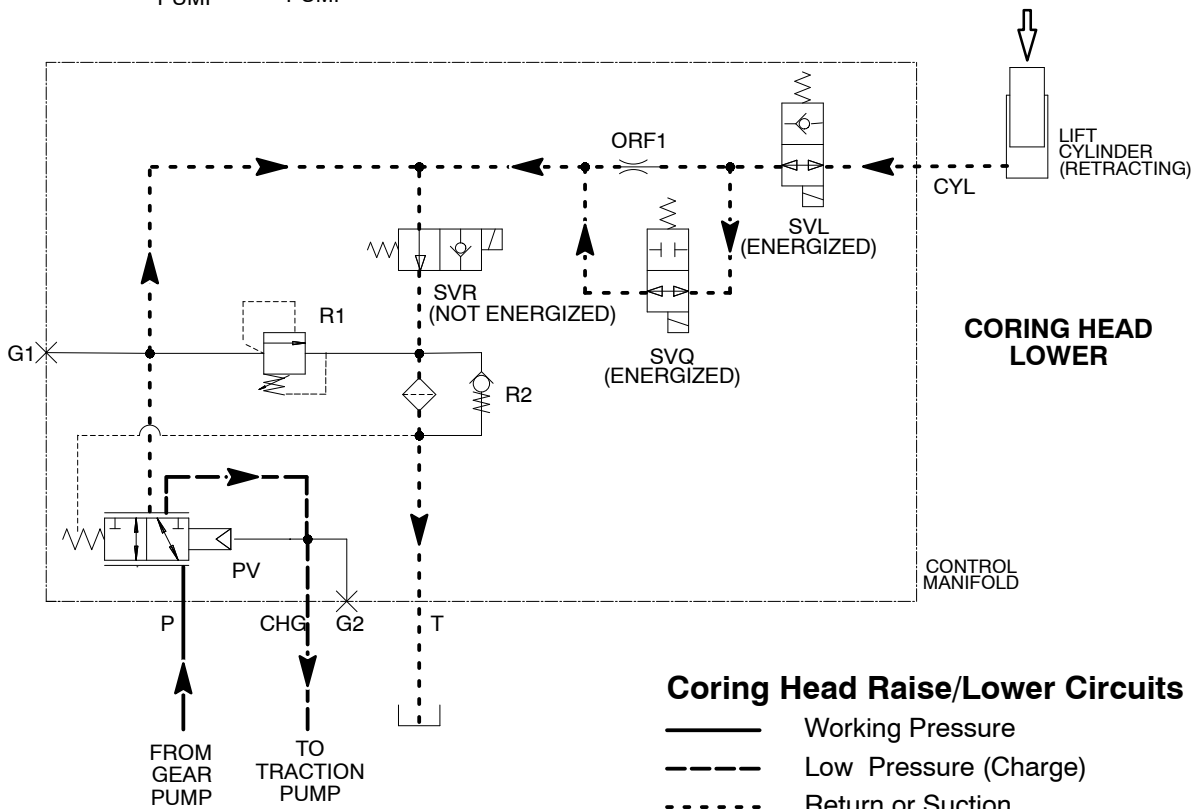
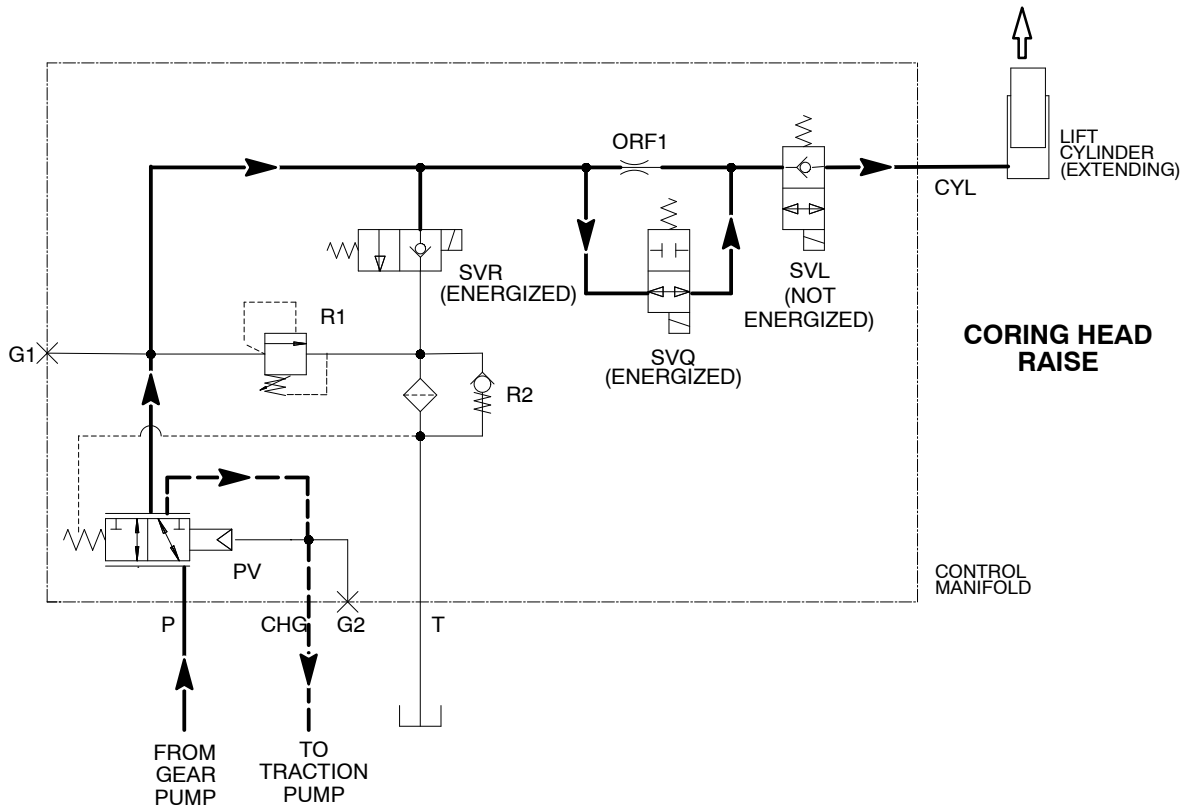
With the engine running and the traction lever in the neutral position, the traction pump supplies no flow to the wheel motors. When the traction lever is moved to the forward position, the linkage from the lever positions the swash plate in the traction pump so oil flows out the lower port of the pump. Oil flow from the pump is directed to the wheel motors (front motor first and then rear motors) and turns them in the forward direction. Maximum forward traction pressure is limited by a 2900 PSI (200 Bar) relief valve located in the bottom of the pump assembly.

Oil flowing from the rear wheel motors returns to the top port of the traction pump and is continuously pumped out the bottom port as long as the traction lever is held in the forward direction.

### Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. When the traction lever is moved to the reverse position, the linkage from the lever positions the swash plate in the traction motor so oil flows out the upper port of the pump. Oil flow from the pump goes to the wheel motors (rear motors first and then front motor) and turns them in the reverse direction. Maximum reverse traction pressure is limited by a 2900 PSI (200 Bar) relief valve located in the top of the pump assembly.

Oil flowing from the wheel motors returns to the bottom port of the traction pump and is continuously pumped out the top port as long as the traction lever is held in the reverse direction.



### Coring Head Raise/Lower Circuits

- Working Pressure
- - - Low Pressure (Charge)
- · · Return or Suction
- Flow

## Coring Head Raise/Lower Circuits

The gear pump (P2) is attached to the traction pump (P1) and is directly coupled to it. The gear pump supplies hydraulic flow for maintaining charge pressure of 40 PSI (2.8 Bar) to the low pressure side of the traction circuit and also for raising the aerator coring head. The gear pump takes its suction from the hydraulic reservoir.

Maximum lift/lower circuit pressure is limited to 1000 PSI (69 Bar) by relief valve R1 in the lift control manifold.

Flow from gear pump (P2) goes to the lift control manifold (port P) and is directed to pressure compensating valve (PV). Valve PV ensures that sufficient hydraulic flow is always available to the traction circuit for charge oil. When not raising the coring head, gear pump flow in excess of charge circuit needs is directed to the hydraulic oil filter and then returns to the hydraulic reservoir.

### Raise Coring Head

When the coring head is to be raised (e.g. traction lever is released from forward or raise/lower switch is pressed to raise), solenoid valves SVR and SVQ in the hydraulic manifold are energized. The valve shift of SVR prevents gear pump flow return to the reservoir. The valve shift of SVQ allows oil flow to bypass the control manifold orifice (ORF1) for more immediate cylinder movement. Oil flows through the load holding check valve in solenoid valve SVL to direct gear pump flow out of control manifold port CYL to the lift cylinder. Hydraulic pressure against the lift cylinder rod extends the cylinder and raises the coring head.

When the raise input ends (e.g. coring head is fully raised or raise/lower switch is released), solenoid valves SVR and SVQ in the hydraulic manifold are de-energized. The valve shift of SVR allows flow return to the reservoir. The valve shift of SVQ removes the bypass to orifice (ORF1). The load holding check valve in solenoid valve SVL prevents oil flow from the lift cylinder. Without flow to or from the lift cylinder, the cylinder and coring head positions are held in place.

### Lower Coring Head

When the coring head is to be lowered (e.g. raise/lower switch is pressed to lower), solenoid valves SVQ and SVL in the hydraulic manifold are energized. The valve shift of SVQ allows oil flow to bypass the control manifold orifice (ORF1) for more immediate cylinder movement. The valve shift of SVL allows a path for oil flow from the lift cylinder. The weight of the coring head and tension of the weight transfer springs cause the lift cylinder to retract and the coring head to lower. Oil flowing from the retracting lift cylinder returns to the reservoir.

When the coring head reaches the aerating position, solenoid valves SVQ and SVL in the hydraulic manifold are de-energized. The valve shift of SVQ removes the bypass to orifice (ORF1). The valve shift of SVL prevents oil flow from the lift cylinder. Without flow from the lift cylinder, the cylinder and coring head are held in place.

### True Core™ Ground Following System

When aerating with the ground follow switch in the ON position, the True Core™ Ground Following System hydraulically adjusts the coring head position to ensure aerating depth consistency over undulating surfaces. The head high limit and head low limit switches on the depth actuator assembly are opened or closed depending on movement of the turf guards over ground irregularities. These switches are used as inputs for the aerator control module to energize or de-energize solenoid valves SVR and SVL in the hydraulic manifold. As these solenoid valves are energized or de-energized, the coring head is raised or lowered as described above.

The control manifold orifice (ORF1) restricts oil flow to and from the lift cylinder to allow more accurate ground following. Solenoid valve SVQ is always de-energized when coring head is in the lowered, aerating position.

If the ground follow switch is turned to the OFF position, the coring head lowers to the manual coring head stops and the ground following operation is not functional. Solenoid valve SVL is always energized while aerating when the ground follow switch is in the OFF position.

# Special Tools

Order these special tools from your Toro Distributor.

---

## Hydraulic Pressure Test Kit

Toro Part Number: **TOR47009**

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 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.



Figure 9

---

## Hydraulic Tester (Pressure and Flow)

Toro Part Number: **TOR214678**

This tester requires O-ring Face Seal (ORFS) adapter fittings for use on this machine (see Hydraulic Test Fitting Kit - TOR4079 in this section).

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.



Figure 10

## Hydraulic Test Fitting Kit

Part Number: **TOR4079**

This kit includes a variety of O-ring Face Seal fittings to enable connection of test gauges to the ProCore 648 hydraulic system.

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








TORO TEST FITTING KIT (NO. TOR4079)			
FITTING	TOOL NUMBER	FITTING	TOOL NUMBER
	Swivel Nut Run Tee (2 ea.) Size Toro No. No. 4 TOR4079-3 No. 6 TOR4079-12 No. 8 TOR4079-4 No. 10 TOR4079-5		Union (1 ea.) Size Toro No. No. 6 to No. 8 TOR4079-8 No. 10 to No. 8 TOR4079-2 No. 8 to No. 8 TOR4079-9
	Plug (2 ea.) Size Toro No. No. 4 TOR4079-13 No. 6 TOR4079-14 No. 8 TOR4079-15 No. 10 TOR4079-16		Reducer (1 ea.) Size Toro No. No. 10 to No. 8 TOR4079-7 No. 12 to No. 8 TOR4079-6
	Cap (2 ea.) Size Toro No. No. 4 TOR4079-17 No. 6 TOR4079-18 No. 8 TOR4079-19 No. 10 TOR4079-20		Test Cap Fitting (2 ea.) Size Toro No. No. 4 TOR4079-10 No. 6 TOR4079-11 No. 8 TOR4079-21 No. 10 TOR4079-1
			Test Fitting (2 ea.) Size Toro No. 7/16-20 ORB TOR4079-22 1/8" Pipe Thd. TOR4079-23

Figure 11

## Wheel Hub Puller

Part Number: **TOR4097**

The wheel hub puller allows safe removal of the wheel hub from the shaft of wheel motors.



Figure 12

# 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 hydraulic 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.  Pump suction line(s) has an air leak.
Hydraulic system operates hot	Traction system pressure is high due to excessive load.  Oil level in reservoir is low.  Traction pump by-pass valve is open or defective.  Excessive dirt and debris on hydraulic components.  Oil is contaminated or too light.  Charge pressure is low.  Air trapped in traction circuit.  Wheel 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.  Excess air in the traction lines.  Traction pump is worn or damaged.
Traction response is sluggish	Hydraulic oil is very cold.  Traction pump by-pass valve is open or worn.  Engine speed is too low.  Pump drive belt is loose or worn.  Charge pressure is low.  Traction pump or wheel motor(s) are worn or damaged.




Problem	Possible Cause
No traction in either direction	Parking brake is engaged. Oil level in reservoir is low. Traction pump by-pass valve is open. Pump drive belt is loose, worn or broken. Traction cable broken or damaged. Charge pressure is low. Hydraulic pump pulley not secure to pump shaft. Traction pump or wheel motor(s) are worn or damaged.
Wheel motor will not turn	Parking brake is engaged (rear wheel motors). Key on wheel motor shaft is sheared or missing. Internal parts in wheel motor are damaged.
Wheel motor will not hold load in neutral	Make up fluid from charge pump is not available. Wheel motor(s) is/are worn or damaged.
Coring head will not lift or lifts slowly	System reset switch needs to be pressed. Engine speed is too low. Reservoir oil level is low. Pump pulley drive belt is loose or worn. Lift cylinder is binding. Coring head is binding. Lift control manifold relief valve (R1) is stuck open. Lift control manifold orifice (ORF1) is damaged or plugged. Lift control manifold SVQ cartridge valve solenoid is not being energized. Gear pump (P2) is worn or damaged.
Coring head raises, but will not stay up	Lift control manifold SVL cartridge stuck open. Lift control manifold SVL cartridge valve leaks.

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# 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 Special Tools section in this Chapter).

 <b>CAUTION</b>
<b>Failure to use gauges with recommended pressure (PSI/Bar) rating as listed in test procedures could result in damage to gauge and possible personal injury from leaking hot oil.</b>

## Before Performing Hydraulic Tests

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

## Precautions For Hydraulic Testing

 <b>WARNING</b>
<b>Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section of this chapter.</b>
<b>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.</b>

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. Hydraulic system contamination will cause excessive wear of hydraulic 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 will affect the accuracy of hydraulic test results.

4. Because the hydraulic pump is belt driven, check for proper pump belt adjustment before performing any hydraulic test. Check pump speed with a phototac when performing hydraulic pump flow tests.

5. To prevent damage to tester or components, the inlet and the outlet hoses must be properly connected, and not reversed (when using tester with flow and pressure capabilities).

6. When using hydraulic tester with flow and pressure capabilities, completely open load valve in hydraulic tester before starting engine. This will minimize the possibility of component damage.

7. Install fittings finger tight, far enough to insure that they are not cross-threaded, before tightening with a wrench.

8. To prevent hose or tester damage, position the tester hoses so that moving machine parts will not make contact with them.

9. Check and adjust the oil level in the reservoir after connecting hydraulic test equipment.

10. Check the control linkage for improper adjustment, binding or broken parts. Make sure control linkage is functioning properly before conducting hydraulic tests.

11. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

# Charge Pressure Test (Using Pressure Gauge)

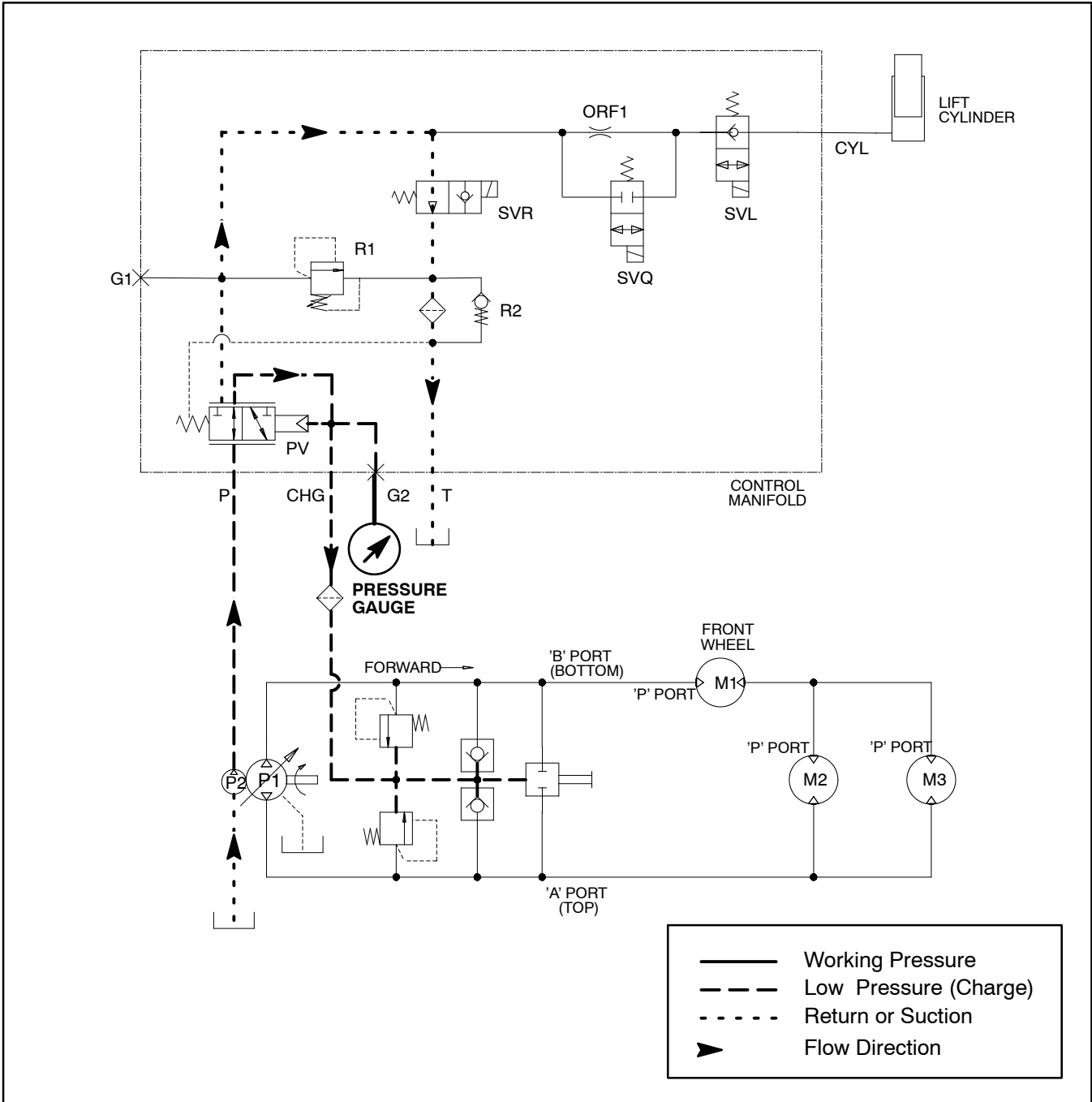


Figure 13

### Procedure for Charge Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the coring head fully raised. Make sure engine is off and the parking brake is engaged. Secure coring head with service latch.
3. Read Precautions For Hydraulic Testing in this section.



4. Connect pressure gauge to the hydraulic control manifold G2 port quick fitting (Fig. 14).



5. Make sure that traction lever is in neutral and the parking brake is engaged.
6. Start engine and operate engine at full speed (**3400 ± 50 RPM**).
7. Pressure gauge should read approximately **40 PSI (2.8 Bar)**. Record pressure reading.
8. Turn off engine.
9. If specification is not met, inspect proportional valve PV in control manifold.
10. A dynamic charge pressure test can be performed as follows:
  - A. Leave pressure gauge connected to hydraulic control manifold G2 port.
  - B. Disengage parking brake. Start engine and operate at full speed (**3400 ± 50 RPM**). Move the traction lever fully forward.

C. While machine is moving, monitor the charge pressure reading on the pressure gauge (do not activate the lift control while monitoring pressure).

D. The charge pressure should drop no more than 15% from initial test reading (Step 8 above). A pressure drop of more than 15% indicates a traction circuit problem (e.g. damaged or leaking proportional valve (PV), worn or damaged piston pump (P1)).

11. Shut off engine.

12. Disconnect pressure gauge from hydraulic control manifold port G2.

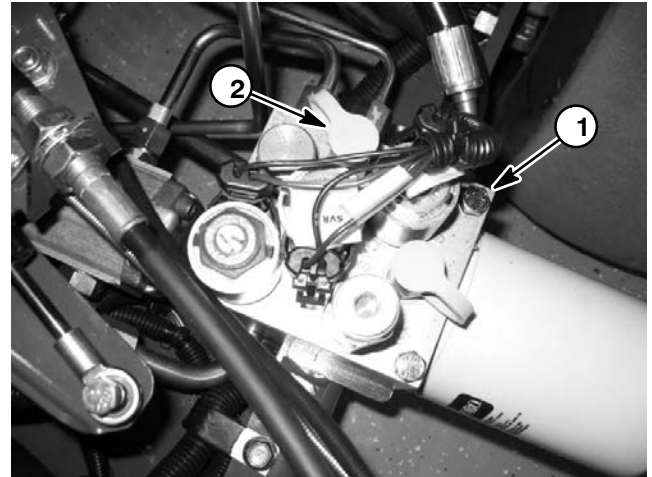


Figure 14

1. Hydraulic manifold
2. G2 port quick fitting

# Coring Head Raise/Lower Relief (R1) Pressure Test (Using Pressure Gauge)

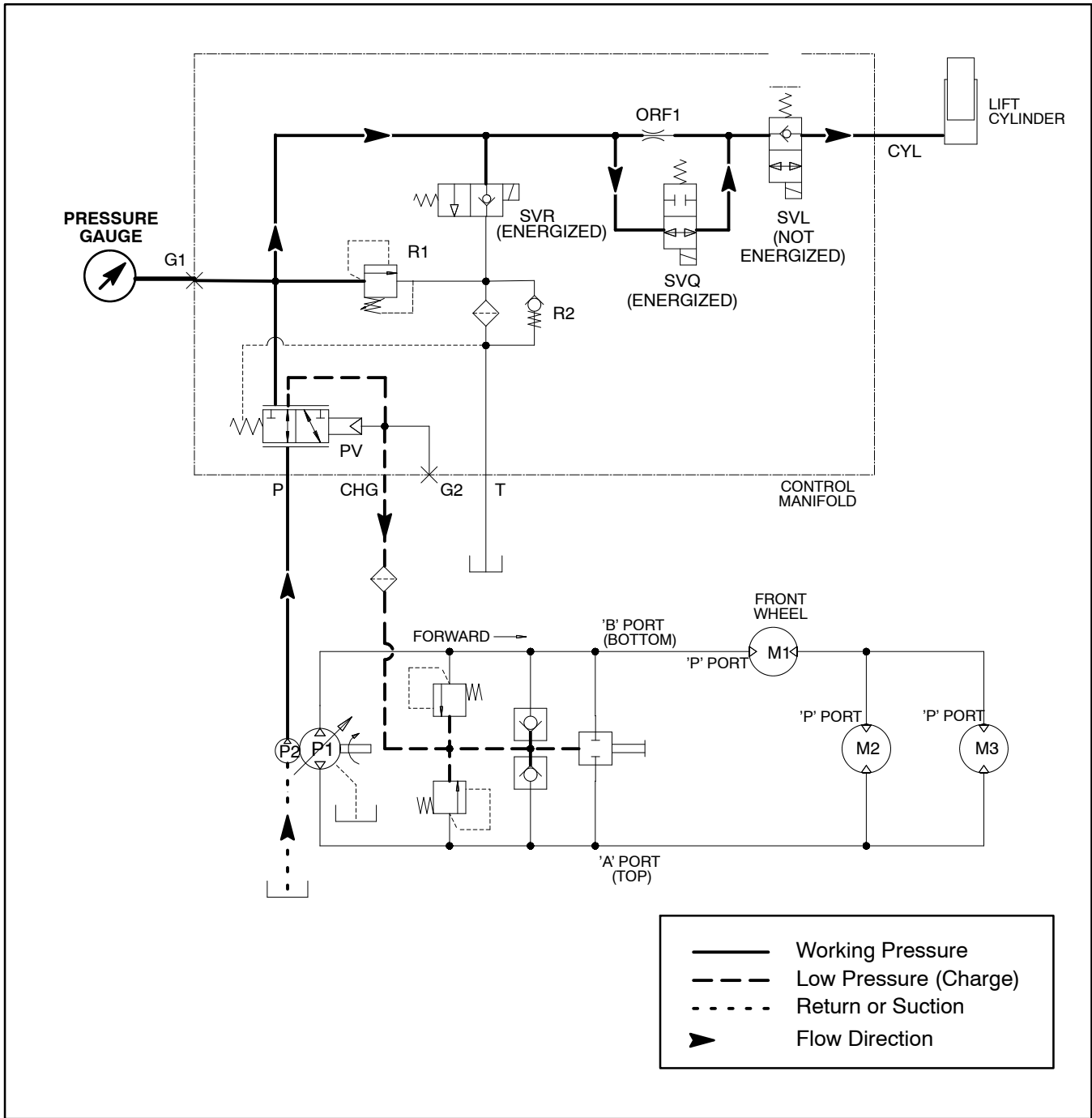


Figure 15

**Procedure for Coring Head Raise/Lower Relief (R1) Pressure Test:**

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the coring head fully raised. Make sure engine is off and the parking brake is engaged.
3. Read Precautions For Hydraulic Testing in this section.



4. Connect pressure gauge to the hydraulic control manifold G1 port quick fitting (Fig. 14).
5. Remove rear hood (see Operator's Manual).
6. Locate and disconnect proximity switch #1. This switch is secured to the switch mounting bracket located on right rear frame plate.
7. Make sure that traction lever is in the neutral position and the parking brake is engaged.
8. With proximity switch #1 disconnected, system pressure will increase to relief (R1) pressure shortly after the engine is started.
9. Start and run engine at full speed (**3400 ± 50 RPM**). Watch the pressure gauge and note pressure when the relief valve (R1) opens.
10. Shut off engine. Record measured relief valve (R1) pressure.
11. Pressure gauge should read approximately **1000 PSI (69 Bar)**.
12. If measured relief pressure is incorrect, adjust relief valve (R1) as follows:

**NOTE:** Do not remove lift relief valve from the hydraulic manifold for adjustment.

- A. Remove the cap from the relief valve (Fig. 17).
- B. If measured relief pressure is too high, decrease relief valve pressure setting by using an allen wrench to turn adjustment socket counterclockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

C. If measured relief pressure is too low, check for restriction in gear pump intake line or leakage in lift cylinder. If pump intake line is not restricted and lift cylinder is not leaking, increase the relief valve pressure setting. Use an allen wrench and turn adjustment socket clockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

D. Reinstall cap on relief valve after adjustment.

E. Repeat steps 9 through 11 above until the relief valve pressure setting is correct.

F. If the relief valve pressure setting cannot be adjusted to specification, the relief valve (R1), gear pump or lift cylinder should be suspected of wear or damage.

13. When testing is complete, disconnect pressure gauge from the hydraulic manifold G1 fitting. Reconnect proximity switch #1. Install rear hood.

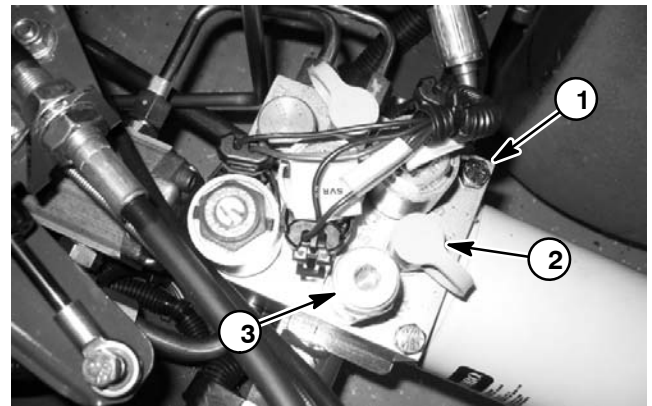


Figure 16

1. Hydraulic manifold
2. G1 port quick fitting
3. Relief valve (R1)

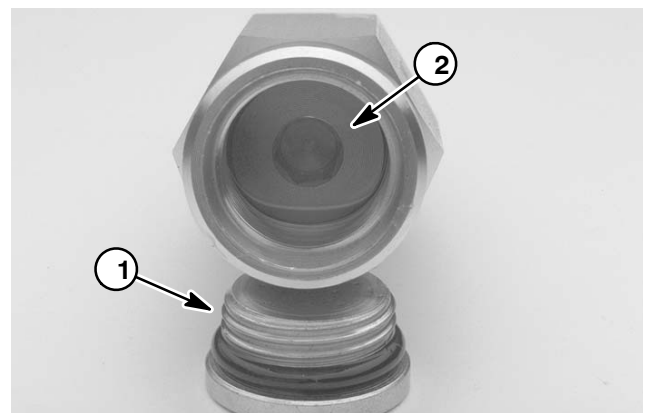


Figure 17

1. Relief valve cap
2. Adjustment socket

## Traction (Piston) Pump (P1) Flow Test (Using Tester With Flow Meter and Pressure Gauge)

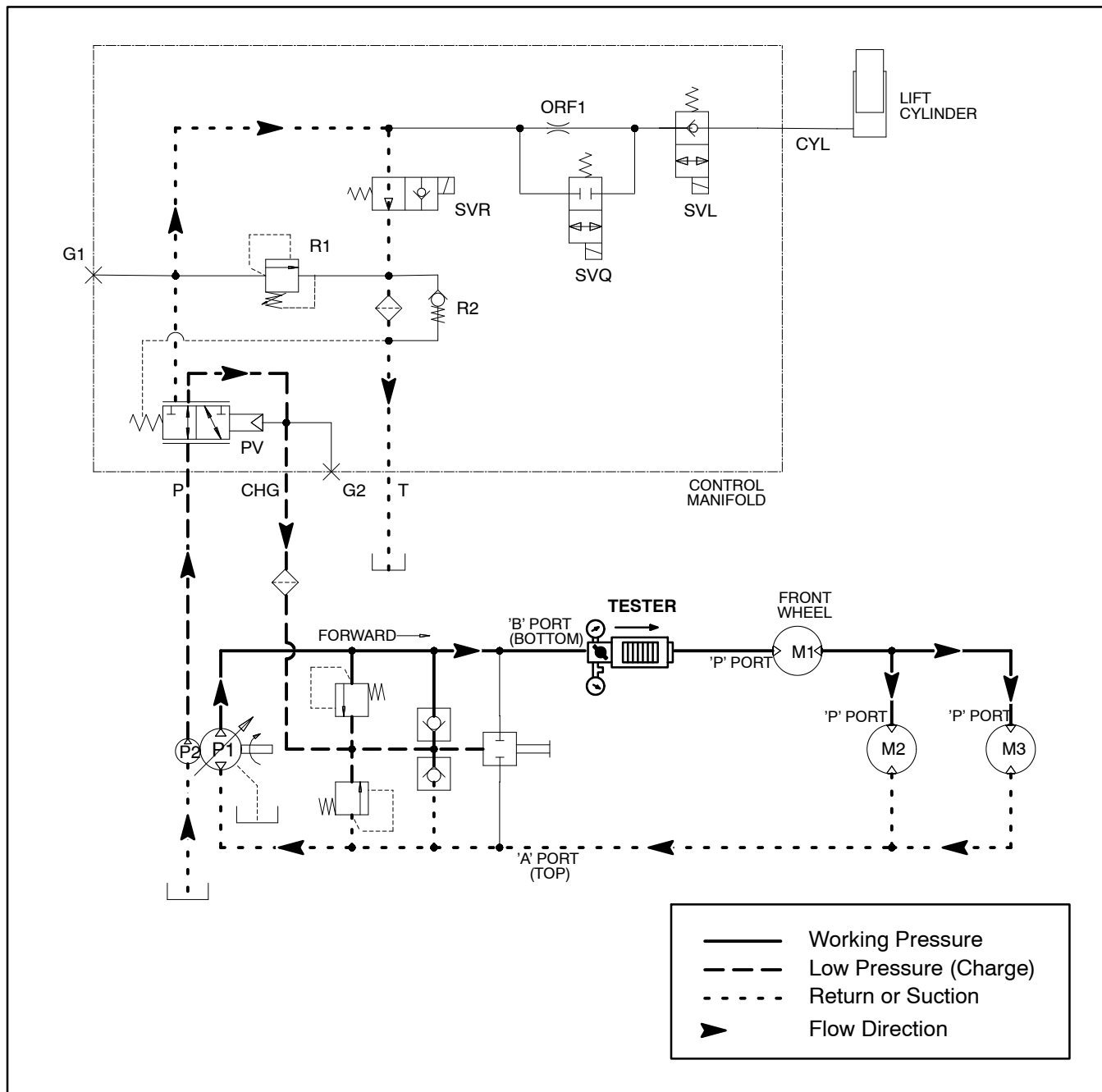


Figure 18

### Procedure for Traction (Piston) Pump (P1) Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the coring head fully raised. Make sure engine is off and parking brake is disengaged. Secure coring head with service latch.
3. Read Precautions For Hydraulic Testing in this section.
4. Remove pump control assembly from traction pump (see Hydraulic (Traction/Charge) Pump Removal in the Service and Repairs section of this chapter). Position pump control assembly away from pump.
5. Make sure that hydraulic pump drive belt is adjusted properly (see Operator's Manual).



6. Lift or jack machine so all wheels are off the floor to allow flow through the traction circuit. Support machine with jackstands or blocking.

7. Attach a heavy chain to the rear of the machine frame and something immovable in the shop to prevent the machine from moving during testing.



8. Clean hose fitting and disconnect hydraulic hose from the lower 45° fitting on the rear side of the traction pump (Fig. 19).

**NOTE:** An alternate testing location would be at the hydraulic hose connection to the P1 port of the front wheel motor.

**IMPORTANT:** Make sure oil flow indicator arrow on the flow meter is showing that the oil will flow from the traction pump, through the tester and into the disconnected hose.

9. Install hydraulic tester with flow meter and pressure gauges in series with the traction pump and the disconnected hose. **Make sure flow control valve on the tester is fully open.**

10. Check and adjust the oil level in the reservoir after connecting hydraulic tester.

11. One person should operate the machine while another person reads the tester.

12. Start and run engine at full speed ( $3400 \pm 50$  RPM).



**IMPORTANT:** Do not rotate the traction pump trunnion shaft clockwise (reverse) during testing.

13. Using a wrench, slowly rotate traction pump trunnion shaft counter-clockwise to the fully forward position.

14. While holding trunnion shaft fully counter-clockwise, close flow control valve on tester until pressure gauge reads **1000 PSI**. As flow control valve is being closed, engine speed will drop to approximately 3200 RPM. Verify that pump speed is approximately **2500 RPM** with a phototac. Observe flow gauge.

**TESTER READING:** A pump in good condition should have a flow of approximately **9.5 GPM**

15. Open flow control valve on tester, return trunnion shaft to the neutral position and turn off engine. Record results of hydraulic flow test.

16. If flow is less than **7.6 GPM** or a pressure of **1000 PSI** cannot be obtained, consider that a pump problem exists.

**NOTE:** Forward traction circuit relief pressure can be determined with the same tester connections as this test. See TEST NO. 4: Traction Circuit Relief Pressure.

17. When testing is complete, disconnect tester from lower 45° fitting and hydraulic hose. Reconnect hose to fitting. Secure pump control assembly to traction pump (see Hydraulic (Traction/Charge) Pump Installation in the Service and Repairs section of this chapter).

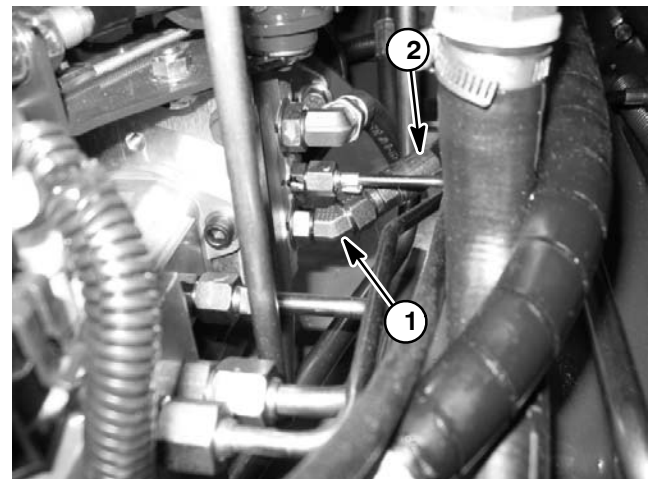


Figure 19

1. Lower 45° fitting      2. Hydraulic hose

# Traction Circuit Relief Pressure Test (Using Tester With Flow Meter and Pressure Gauge)

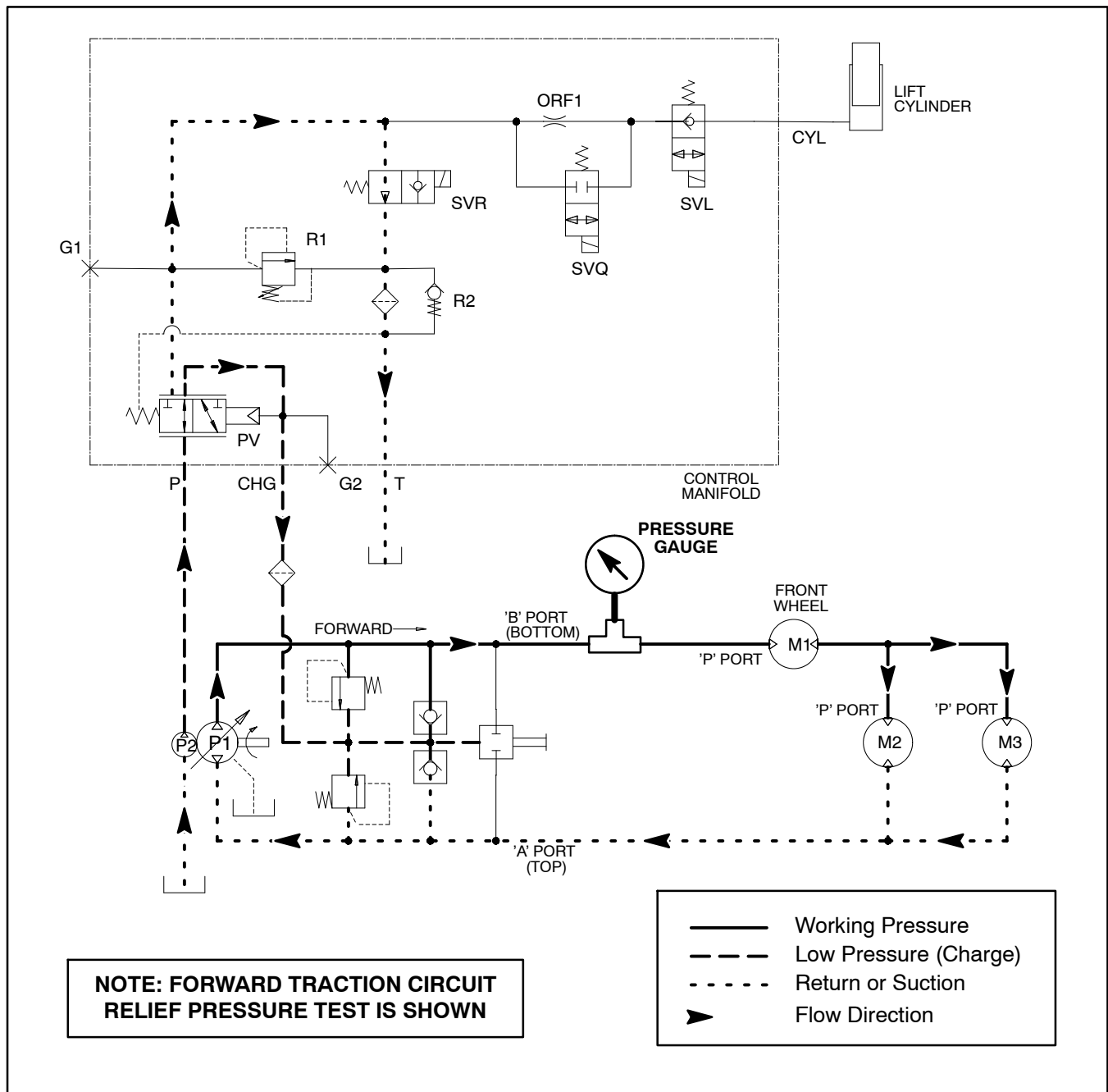


Figure 20

### Procedure for Traction Circuit Relief Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure that traction lever is adjusted to the neutral position (see Operator's Manual).
2. Park machine on a level surface with the coring head fully raised. Make sure engine is off and parking brake is engaged. Secure coring head with service latch.
3. Read Precautions For Hydraulic Testing in this section.
4. Set the aerator spacing lever to the transport position.
5. Make sure that hydraulic pump drive belt is adjusted properly (see Operator's Manual).
6. Lift or jack front of machine so front wheel is off the floor. Support front of machine with jackstands or blocking.



7. Clean hose fitting and disconnect appropriate hydraulic hose from fitting on the rear side of the traction pump (Fig. 21):

A. For forward direction relief pressure test, disconnect hose from lower 45° fitting. **NOTE:** forward relief pressure can also be measured with hydraulic tester installed as described in TEST NO. 3: Traction (Piston) Pump Flow. Make sure flow control valve on the tester is fully open.

**NOTE:** An alternate testing location for forward direction relief would be at the hydraulic hose connection to the front wheel motor P1 port.

B. For reverse direction relief pressure test, disconnect hose from upper 90° fitting.

**NOTE:** An alternate testing location for reverse direction relief would be at the diagnostic port on the hydraulic tube between the rear wheel motors.

8. Install Tee-fitting with pressure gauge between the traction pump and the disconnected hose.
9. Check and adjust the oil level in the reservoir after connecting pressure gauge.

10. One person should operate the machine while another person reads the gauge.

11. Make sure that parking brake is engaged. Start and run engine at full speed (**3400 ± 50 RPM**).



12. Slowly move traction lever fully in direction of relief valve to be tested (forward or reverse).

**IMPORTANT: DO NOT hold system at relief for more than 4 seconds.**

13. Watch the pressure gauge and record pressure when the traction circuit relief valve opens.

**TESTER READING:** pressure approximately **2900 PSI** in both forward and reverse direction.

14. Release traction lever and turn off engine. Record results of hydraulic pressure test.

15. If traction pressure is too low, inspect relief valves in piston (traction) pump (see the HYDRO-GEAR BDP-10A/16A/21L HYDROSTATIC PUMPS SERVICE AND REPAIR MANUAL at the end of this chapter). Clean or replace relief valves as necessary as they are not adjustable. If relief valves are in good condition, piston (traction) pump should be suspected of wear and inefficiency.

**NOTE:** Forward and reverse relief valves are identical. Relief valves can be switched in piston (traction) pump to help in identifying a faulty relief valve.

16. Disconnect Tee-fitting with pressure gauge from pump fitting and hydraulic hose. Reconnect hose to pump fitting.

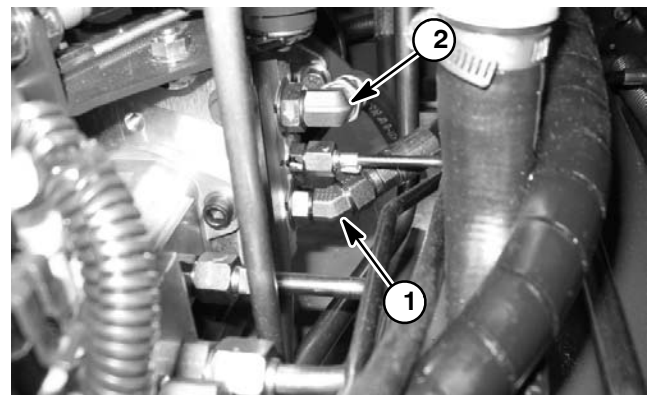


Figure 21

1. Lower 45° fitting

2. Upper 90° fitting

# Gear Pump (P2) Flow Test (Using Tester With Flow Meter and Pressure Gauge)

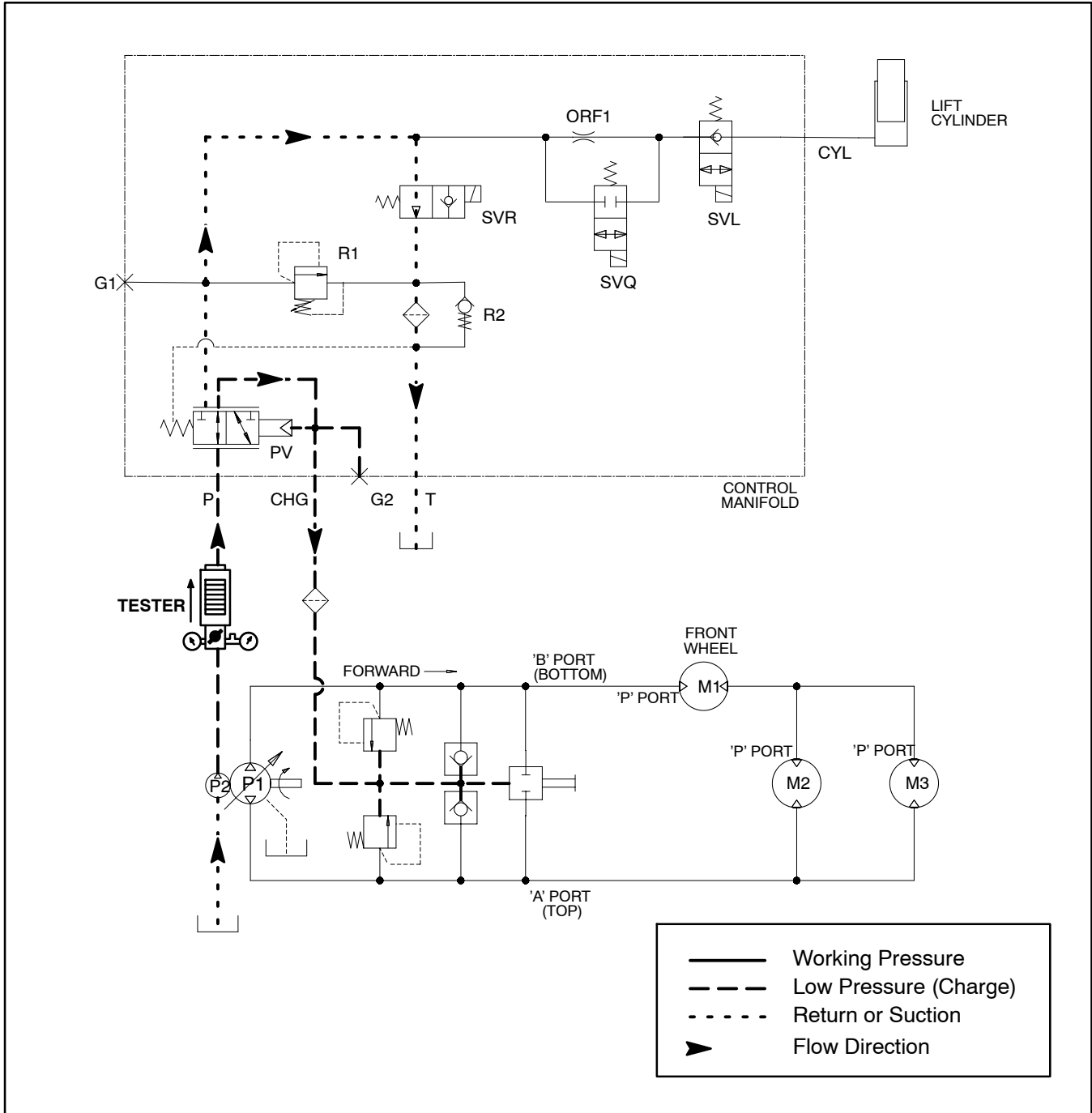


Figure 22

### Procedure for Gear Pump (P2) Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the coring head fully raised. Make sure engine is off and the parking brake is engaged. Secure coring head with service latch.
3. Read Precautions For Hydraulic Testing in this section.



4. Remove hydraulic tube that connects the gear pump (P2) outlet to port P of hydraulic manifold (Fig. 23).

**IMPORTANT: Make sure oil flow indicator arrow on the flow meter is showing that oil will flow from the gear pump, through the tester and into hydraulic manifold port P.**

5. Install elbows to fittings on pump and manifold to allow connection of hydraulic tester with flow meter and pressure gauges to fittings. Install hydraulic tester in place of the removed hydraulic tube between the gear pump (P2) outlet and port P in the hydraulic manifold. **Make sure flow control valve on the tester is fully open.**
6. Make sure that traction lever is in neutral and the parking brake is engaged.

7. Start and operate engine at full speed (**3400 ± 50 RPM**).
8. Watch flow and pressure gauges carefully while slowly closing the flow control valve until pressure gauge reads **500 PSI**.
9. Flow gauge reading should be approximately **4 GPM**.
10. Open flow control valve on tester and turn off engine. Record results of hydraulic pressure test.
11. If specification is not met, repair or replace gear pump.
12. Disconnect tester from the pump and control manifold. Reconnect hydraulic tube to the pump and manifold.

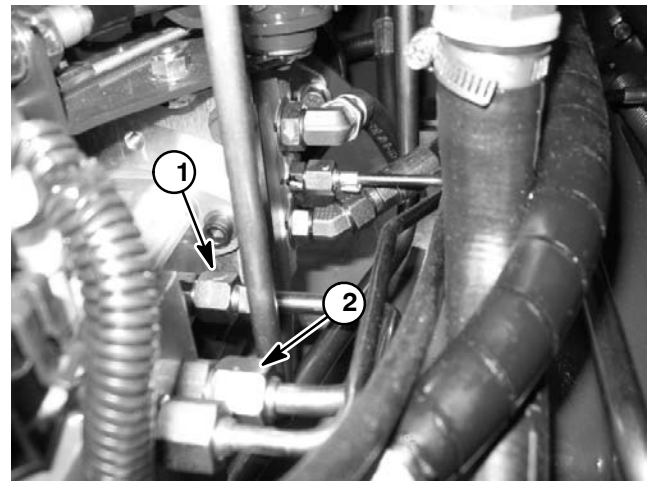


Figure 23

1. Gear pump outlet
2. Manifold port P

# Wheel Motor Efficiency Test (Using Tester With Flow Meter and Pressure Gauge)

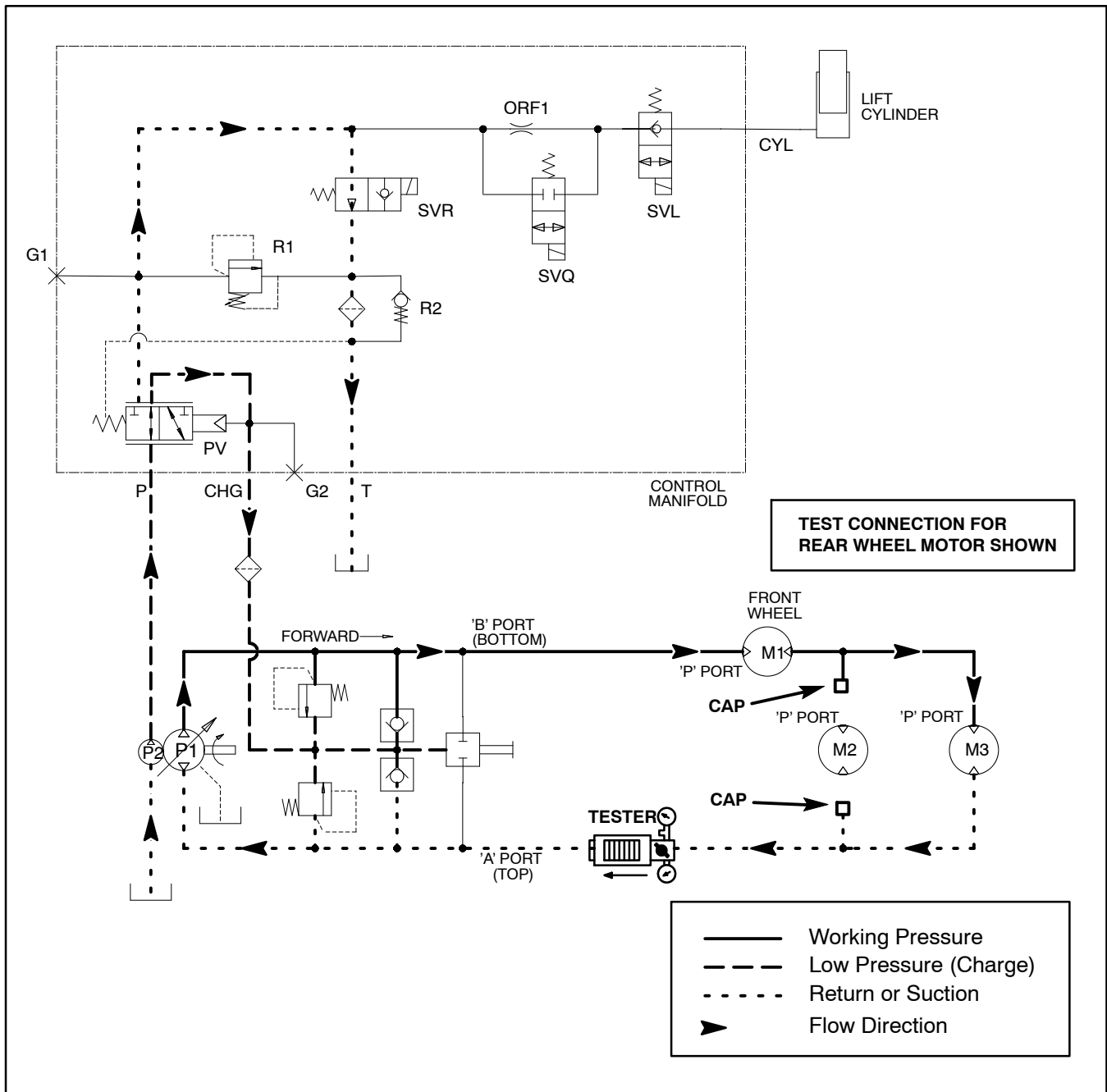


Figure 24

**NOTE:** Over a period of time, a wheel motor can wear internally. A worn motor will be less efficient and eventually, will allow the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect overall machine performance.

### Procedure for Wheel Motor Efficiency Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic reservoir is full.
2. Make sure that traction lever is adjusted to the neutral position (see Operator's Manual).
3. Park machine on a level surface with the coring head fully raised. Make sure engine is off and the parking brake is engaged. Secure coring head with service latch.
4. Read Precautions For Hydraulic Testing in this section.



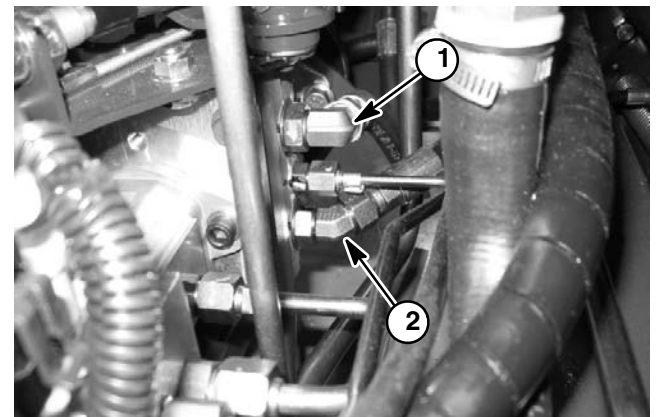
5. Attach a heavy chain between the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
6. If front wheel motor requires testing:
  - A. Both rear wheel motors should have hydraulic lines connected. Block up both rear wheels off the ground. Release parking brake so rear wheels can turn.
  - B. Position front wheel on the ground. Immobilize front wheel to prevent it from turning.
7. If a rear wheel motor requires testing:
  - A. Disconnect both hydraulic lines from rear wheel motor that is **not** being tested. Cap disconnected hydraulic lines and plug wheel motor ports to prevent contamination.
  - B. Front wheel motor should have hydraulic lines connected. Block up front wheel off the ground.
  - C. Make sure parking brake is engaged to prevent rear wheel rotation.
8. Clean hose fitting and disconnect hose from upper 90° fitting on traction pump (Fig. 25).

**IMPORTANT:** Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the wheel motor, through the tester and into the traction pump fitting.

9. Install hydraulic tester with flow meter and pressure gauges between the disconnected hose and traction pump. Make sure flow control valve on the tester is fully open.
10. Start engine and move throttle to full speed (**3400 ± 50 RPM**).



11. Slowly push traction lever in **forward** direction until **1000 PSI** is displayed on the pressure gauge. Make sure that wheel motor being tested does not rotate.
12. Wheel motor internal leakage will be shown on flow meter in GPM. Flow should be **less than 1.5 GPM** for the tested wheel motor.
13. Release traction lever and turn off engine. Record results of hydraulic flow test.
14. If specifications are not met, the tested wheel motor needs to be repaired or replaced as necessary.
15. Reconnect hydraulic lines to wheel motor.
16. If additional wheel motor(s) require testing, complete steps 6 to 14 for the remaining wheel motor(s).
17. Disconnect tester from machine. Reconnect hose to pump connection.



1. Upper 90° fitting      2. Lower 45° fitting

# Service and Repairs

## General Precautions for Removing and Installing Hydraulic System Components

### Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hoses connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.



### CAUTION

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

3. Put caps or plugs on any hydraulic lines, hydraulic fittings or hydraulic components left open or exposed to prevent hydraulic system contamination.
4. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.
5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

### After Repair or Replacement of Components

1. Check oil level in the hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System).
2. Lubricate O-rings and seals with clean hydraulic oil before installing hydraulic components.
3. Make sure caps or plugs are removed from the hydraulic tubes, hydraulic fittings and components before reconnecting.
4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).
5. After repairs, check control linkages and cables for proper adjustment, binding and/or broken parts.
6. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Hydraulic System Start Up in this section).
7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

## Check Hydraulic Lines and Hoses



### WARNING

**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.**

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and/or chemical deterioration. Make all necessary repairs before operating machine.



## Flush 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 EnviroSyn H. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Remove pump belt cover from machine (see Operator's Manual).

**NOTE:** The hydraulic reservoir will drain when the hydraulic oil filter is removed from the hydraulic manifold.

3. Clean area around filter mounting area (Fig. 26). Remove filter from hydraulic manifold and drain reservoir into a suitable container. Drain hydraulic system. Drain all hoses, tubes and components while the system is warm. Discard filter.

4. Inspect and clean reservoir (see Hydraulic Reservoir in this section).

5. Make sure filter mounting surface is clean. Apply hydraulic oil to gasket on the new filter. Screw filter on until gasket contacts mounting surface of manifold, then tighten filter half a turn.

**NOTE:** Use biodegradable fluid, such as Mobil EAL EnviroSyn H, for this step if you are changing to this type of fluid. Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

6. Fill hydraulic reservoir.

7. Disconnect and ground both spark plug wires to prevent engine from starting.

8. Turn ignition key switch to start position; engage starter for ten (10) seconds to prime hydraulic pumps. Repeat this step again.

9. Reattach both spark plug wires.

10. Start engine and let it idle at low speed for a minimum of two (2) minutes.

11. Increase engine speed to high idle for minimum of one (1) minute under no load.

12. Lower and raise coring head several times.

13. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary.

14. Install pump belt cover to machine (see Operator's Manual).

15. Operate the machine for two (2) hours under normal operating conditions.

16. Check condition of hydraulic oil. If the fluid shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 13 again.

17. Resume normal operation and follow recommended maintenance intervals.

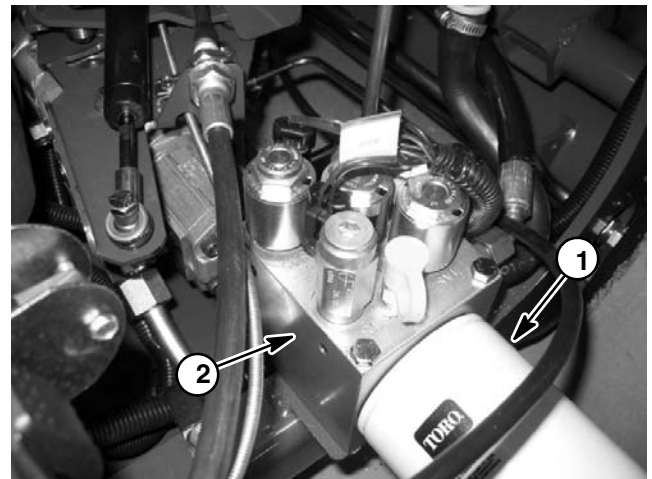


Figure 26

1. Hydraulic filter

2. Hydraulic manifold

---

## Hydraulic System Start-up

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

1. After the hydraulic system components have been properly installed and if the hydraulic pump was rebuilt or replaced, make sure traction pump housing is at least half full of clean hydraulic oil (see Operator's Manual for oil specifications).
2. Make sure all hydraulic connections and lines are secured tightly.
3. Make sure hydraulic reservoir is full. Add correct oil if necessary (see Operator's Manual). Drain, flush and refill hydraulic system reservoir and change oil filter if component failure was severe or if system is contaminated.
4. After repairs, check control linkage for proper adjustment, binding or broken parts. Correct any problems before proceeding.
5. Disconnect and ground both engine spark plug wires to prevent engine from starting.
6. Make sure traction lever is in **neutral**. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pump. Repeat this step again.
7. Reattach both spark plug wires.
8. Apply parking brake and make sure traction lever is in **neutral**. Start engine and run at low idle. The charge pump should pick up oil and fill the hydraulic system.
9. If traction circuit was repaired (e.g. hydrostat or wheel motor was replaced), bleed the traction circuit to evacuate air from the circuit:

**NOTE:** Before bleeding the traction circuit, review the following procedure (steps A through L) completely.

- A. Stop engine and relieve pressure in traction circuit by moving traction lever to both forward and reverse direction.
- B. Jack up machine from floor and support machine with jack stands or blocking to allow wheels to turn freely.

C. Attach a heavy chain between the rear of the machine frame and something immovable in the shop to prevent the machine from moving during the bleeding process.

**IMPORTANT:** Make sure oil flow indicator arrow on the flow gauge is showing that oil will flow from the test port of traction line and through the tester.

D. Connect inlet end of hydraulic tester with flow meter and pressure gauges to test port in upper traction line (Fig. 27). Place outlet end of tester in a drain container. Make sure that flow control valve on the tester is fully closed.

E. Check hydraulic reservoir level and fill if necessary.

F. Start engine and move traction lever to the forward direction to allow the wheels to rotate slowly.

**NOTE:** Bleeding the traction circuit might require approximately five (5) minutes of running.

**IMPORTANT:** When bleeding the traction circuit, tester valve should be barely open which will allow a slow stream of oil from tester outlet.

G. While traction lever is held in the forward direction (wheels turning), have second person slowly open valve on tester very slightly to allow air out of traction circuit. Air in the traction circuit will be indicated by foamy oil coming from the outlet end of the tester.

H. While bleeding the traction circuit, if more than .5 gallon (1.9 liters) of oil is removed, close tester valve and release traction lever. Check hydraulic oil reservoir level and fill if necessary. Continue with bleeding procedure.

I. When all evidence of foamy oil has been evacuated from the traction circuit, close tester valve, release traction lever and stop engine.

J. Remove tester from traction circuit test port. Check hydraulic reservoir level and fill if necessary.

K. If the hydrostat or a wheel motor was replaced or rebuilt, start engine and operate the traction system so the wheels rotate slowly for 10 minutes.

L. Lower machine to ground. Remove chain from rear of machine.

10. Start engine and operate the traction system at varying speeds for a 10 minute period.

11. Stop the machine. Check hydraulic reservoir level and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

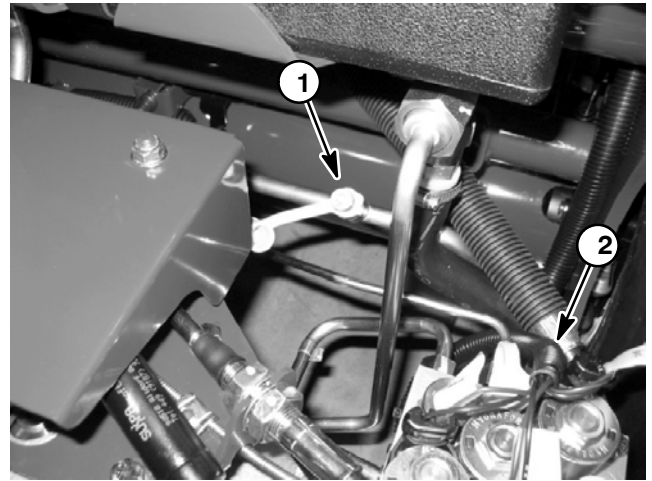


Figure 27

1. Test port

2. Hydraulic manifold

# Hydraulic Pump Drive Belt

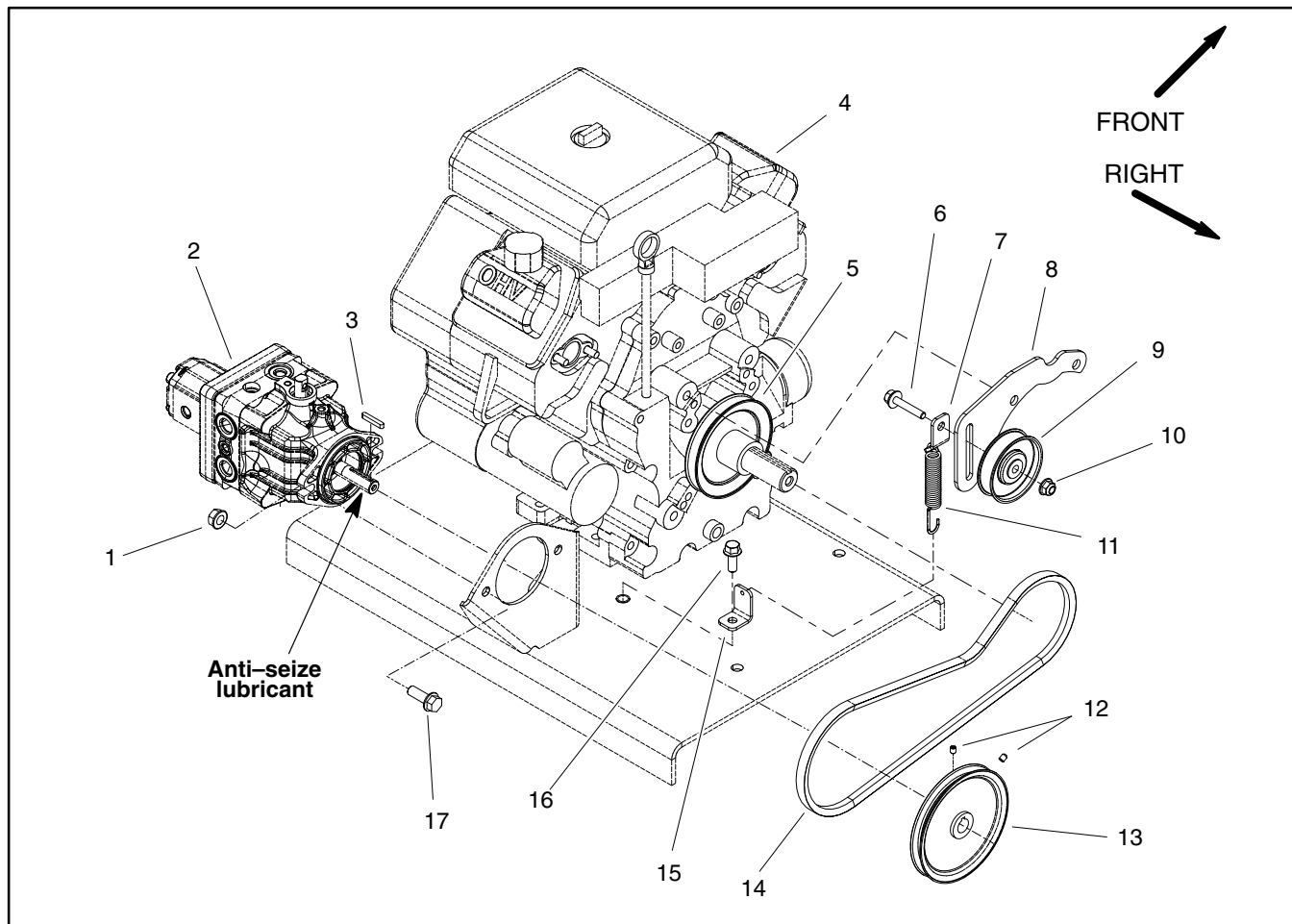


Figure 27

- |                                     |                          |                                |
|-------------------------------------|--------------------------|--------------------------------|
| 1. Flange nut (2 used)              | 7. Spring bracket        | 13. Hydraulic pump pulley      |
| 2. Hydraulic (traction/charge) pump | 8. Idler support bracket | 14. Pump drive belt            |
| 3. Key                              | 9. Idler pulley          | 15. L bracket                  |
| 4. Engine                           | 10. Flange nut           | 16. Flange head screw          |
| 5. Engine pulley                    | 11. Tensioning spring    | 17. Flange head screw (2 used) |
| 6. Flange head screw                | 12. Set screw            |                                |

### Drive Belt Removal (Fig. 27)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove pump belt cover from machine (see Operator's Manual).
3. Remove coring head primary drive belt from electric clutch (see Primary Drive Belt Removal in Service and Repairs section of Chapter 7 – Coring Head).
4. Loosen the flange head screw (item 6) and flange nut (item 10) that secure the drive belt idler pulley (item 11). Lift idler pulley to allow removal of drive belt from the pulleys and the machine.

### Drive Belt Installation (Fig. 27)

1. Install pump drive belt to pulleys.
2. Lift idler pulley and insert pump drive belt under idler.
3. Allow tensioning spring to apply tension to idler pulley. Tighten flange head screw (item 6) and flange nut (item 10) to secure belt adjustment.
4. Install coring head primary drive belt to electric clutch (see Primary Drive Belt Installation in Service and Repairs section of Chapter 7 – Coring Head).
5. Install pump belt cover to machine (see Operator's Manual).

# Hydraulic Pump Control Assembly

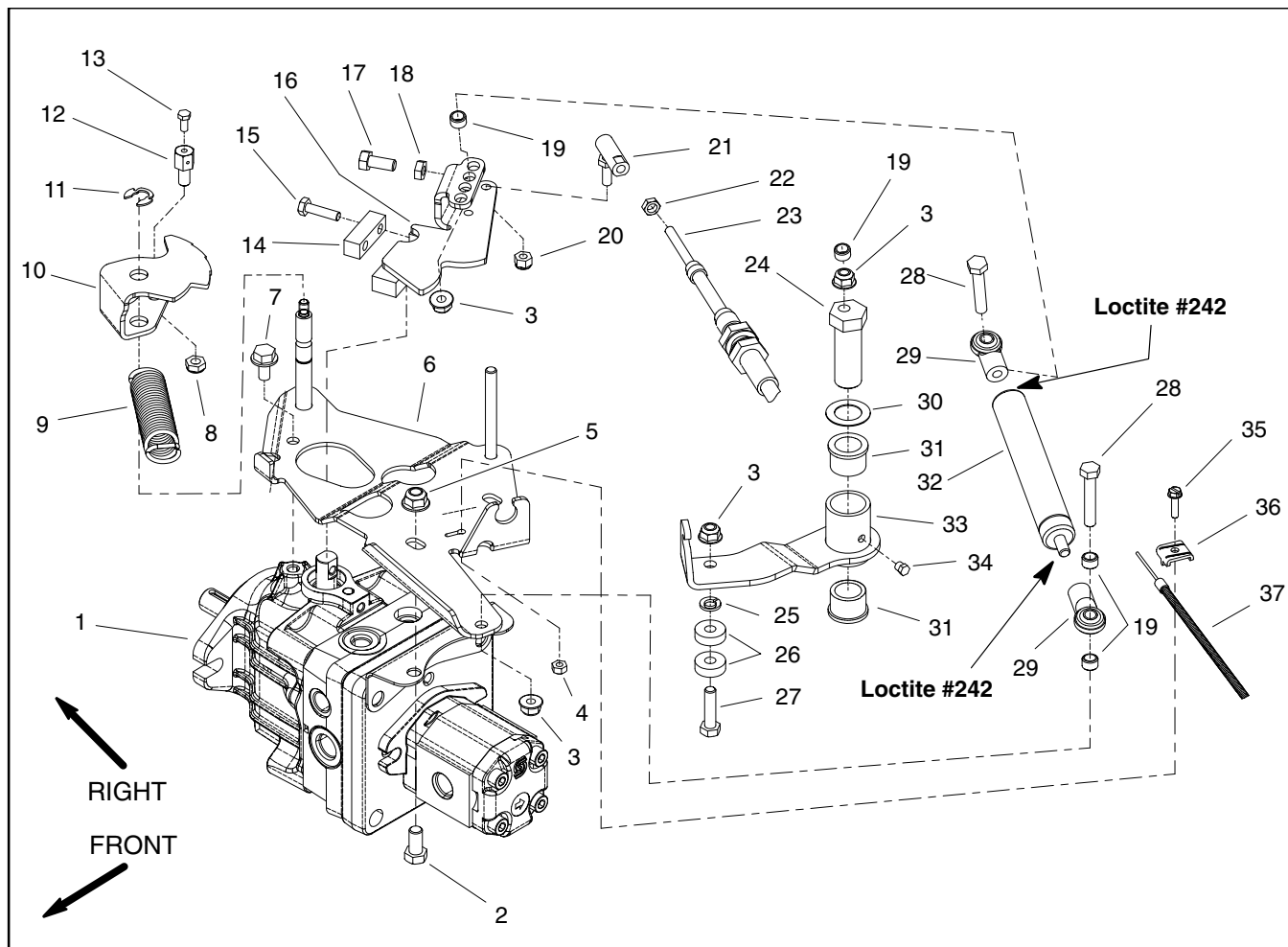


Figure 28

- |                          |                                |                           |
|--------------------------|--------------------------------|---------------------------|
| 1. Hydraulic pump        | 14. Trunnion clamp             | 26. Ball bearing          |
| 2. Cap screw (2 used)    | 15. Socket head screw (2 used) | 27. Cap screw             |
| 3. Flange nut            | 16. Pump lever                 | 28. Cap screw             |
| 4. Lock nut              | 17. Cap screw                  | 29. Spherical rod end     |
| 5. Flange nut (2 used)   | 18. Jam nut                    | 30. Thrust washer         |
| 6. Control bracket       | 19. Traction lever spacer      | 31. Flange bushing        |
| 7. Washer head screw     | 20. Lock nut                   | 32. Damper                |
| 8. Lock nut              | 21. Ball joint                 | 33. Neutral lever         |
| 9. Extension spring      | 22. Jam nut                    | 34. Plug                  |
| 10. Speed selector pivot | 23. Stroke control cable       | 35. Washer head screw     |
| 11. Retaining ring       | 24. Traction stud              | 36. Cable clamp           |
| 12. Swivel               | 25. Lock washer                | 37. Spacing control cable |
| 13. Cap screw            |                                |                           |

### Disassembly (Fig. 28)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove pump belt cover from machine (see Operator's Manual).
3. Remove two (2) lock nuts that secure pump shield to pump (Fig. 29). Remove shield from pump. Locate and retrieve two (2) flat washers from tops of studs on pump control assembly.



4. Remove components from pump control assembly as needed using Figures 28, 29 and 30 as guides.

### Assembly (Fig. 28)

1. Install removed components to pump control assembly using Figures 28, 29 and 30 as guides.
  - A. If rod ends were removed from damper, apply Loctite #242 to threads of damper shaft before installing rod ends.
  - B. Damper should be secured to third hole from outer end of traction lever (Fig. 30).
2. Place two (2) flat washers to tops of studs on pump control assembly. Position pump shield to pump and secure with two (2) lock nuts.
3. Install pump belt cover to machine (see Operator's Manual).
4. Check traction drive for neutral and adjust if needed (see Operator's Manual).
5. Operate machine and verify hole spacing accuracy. Adjust if needed (see Operator's Manual).

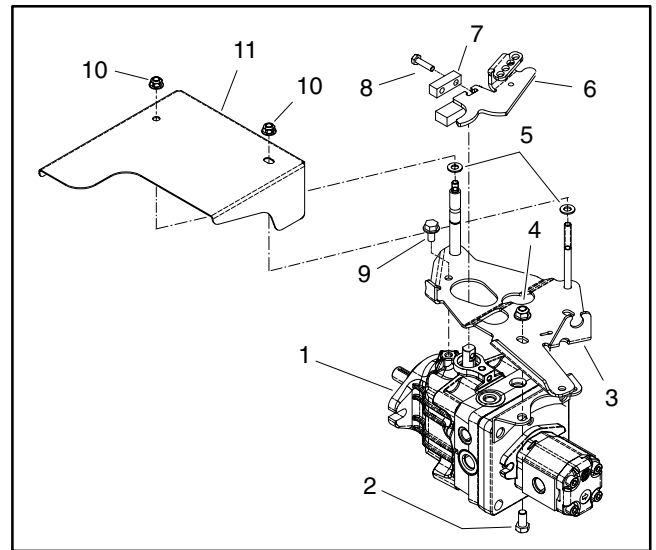


Figure 29

- |                        |                             |
|------------------------|-----------------------------|
| 1. Hydraulic pump      | 7. Trunnion clamp           |
| 2. Cap screw (2 used)  | 8. Socket hd screw (2 used) |
| 3. Control bracket     | 9. Washer head screw        |
| 4. Flange nut (2 used) | 10. Lock nut                |
| 5. Flat washer         | 11. Pump shield             |
| 6. Pump lever          |                             |

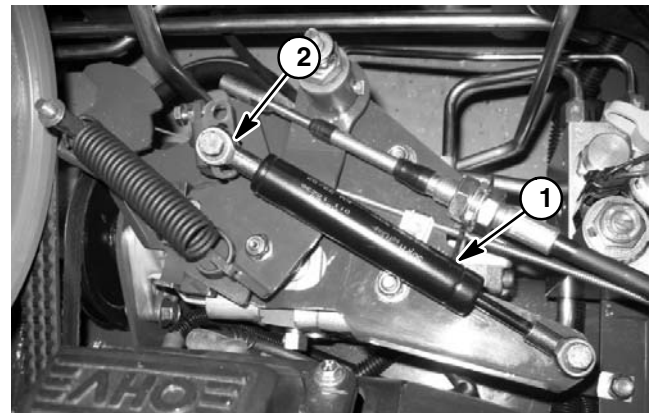


Figure 30

1. Damper
2. Rod end location

## Hydraulic (Traction/Charge) Pump

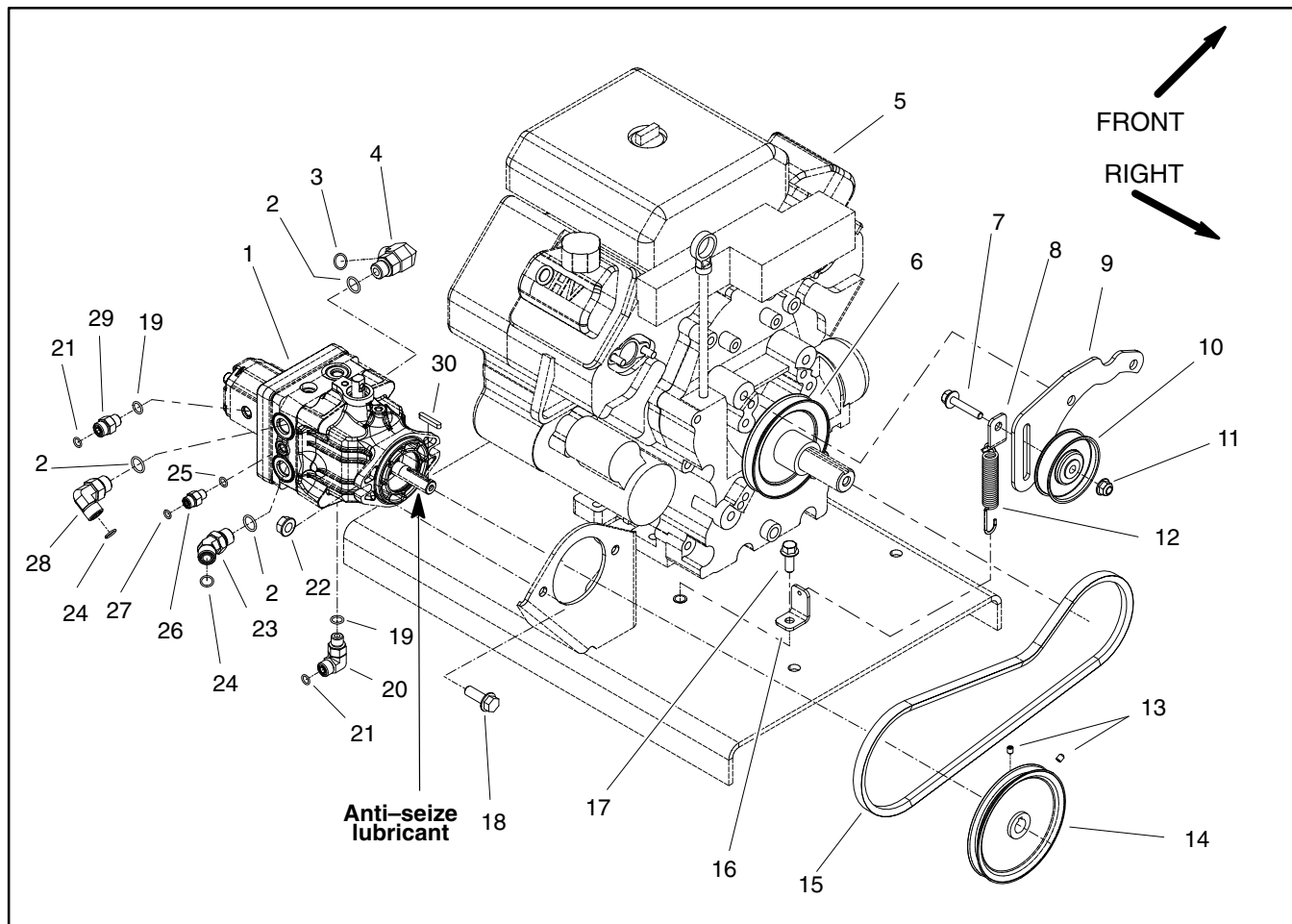


Figure 31

- |                                     |                                |                           |
|-------------------------------------|--------------------------------|---------------------------|
| 1. Hydraulic (traction/charge) pump | 11. Flange nut                 | 21. O-ring                |
| 2. O-ring                           | 12. Tensioning spring          | 22. Flange nut (2 used)   |
| 3. O-ring                           | 13. Set screw                  | 23. 45° hydraulic fitting |
| 4. 90° hydraulic fitting            | 14. Pump pulley                | 24. O-ring                |
| 5. Engine                           | 15. Pump drive belt            | 25. O-ring                |
| 6. Engine pulley                    | 16. L bracket                  | 26. Hydraulic adapter     |
| 7. Flange head screw                | 17. Flange head screw          | 27. O-ring                |
| 8. Spring bracket                   | 18. Flange head screw (2 used) | 28. 90° hydraulic fitting |
| 9. Idler support bracket            | 19. O-ring                     | 29. Hydraulic fitting     |
| 10. Idler pulley                    | 20. 90° hydraulic fitting      | 30. Key                   |

### Removal (Fig. 31)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.



## CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.



2. Remove pump belt cover from machine (see Operator's Manual).

3. Loosen the flange head screw (item 7) and flange nut (item 11) that secure the drive belt idler pulley (item 10). Lift idler pulley to allow removal of drive belt from the hydraulic pump pulley.

**IMPORTANT: Before loosening pump pulley, mark position of the pulley on the hydraulic pump shaft. Pulley position is critical for proper alignment of the hydraulic pump drive belt.**

4. Loosen two (2) set screws that secure pump pulley to the hydraulic pump shaft. Slide pulley from the pump shaft. Locate and remove key from pump shaft.

5. Remove two (2) lock nuts that secure pump shield to pump (Fig. 32). Remove shield from pump. Locate and retrieve two (2) flat washers from tops of studs on pump control assembly.

6. Disconnect hydraulic pump controls (Fig. 32 and 33) from the pump as follows:

	<b>CAUTION</b>
<b>The extension spring is under tension and may cause personal injury during removal. Use caution when removing spring from neutral lever.</b>	

A. Remove extension spring from the neutral lever.

B. Loosen two (2) socket head screws (item 8, Fig. 32) that secure pump lever to pump trunnion shaft.

C. Remove two (2) cap screws with flange nuts (items 2 and 4, Fig. 32) and washer head screw (item 9, Fig. 32) that secures control bracket to hydraulic pump.

D. Carefully lift pump control assembly and position away from pump.

7. Disconnect all hydraulic hoses and tubes connected to the hydraulic fittings on the hydraulic pump assembly. Allow hoses to drain into a suitable container. Plug or cap openings of pump and hoses to prevent contamination.

	<b>CAUTION</b>
<b>Support hydraulic pump when removing it from the pump support to prevent the pump from falling and causing personal injury.</b>	

8. Remove both flange head screws and flange nuts securing the hydraulic pump to the pump support. Lift pump assembly from the machine.

**NOTE:** If hydraulic fittings are to be removed from hydraulic pump, note correct orientation of fittings before loosening the fittings.

9. Remove hydraulic fittings and o-rings from the pump as required.

10. Discard all removed o-rings.

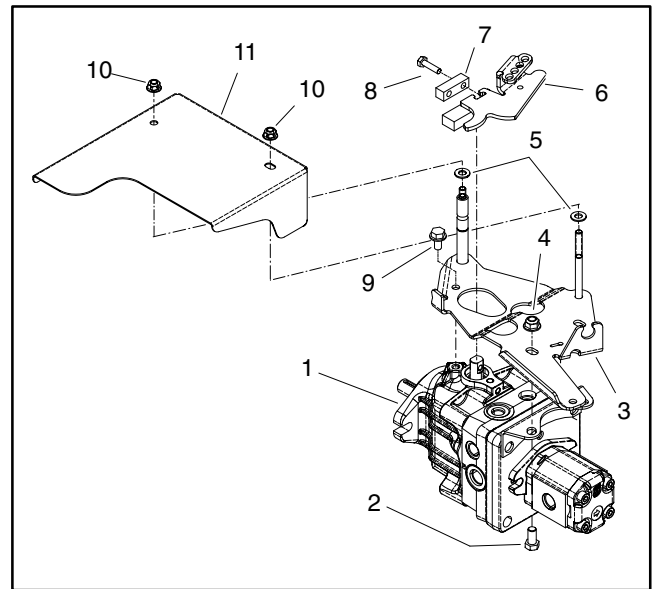


Figure 32

- |                        |                             |
|------------------------|-----------------------------|
| 1. Hydraulic pump      | 7. Trunnion clamp           |
| 2. Cap screw (2 used)  | 8. Socket hd screw (2 used) |
| 3. Control bracket     | 9. Washer head screw        |
| 4. Flange nut (2 used) | 10. Lock nut                |
| 5. Flat washer         | 11. Pump shield             |
| 6. Pump lever          |                             |

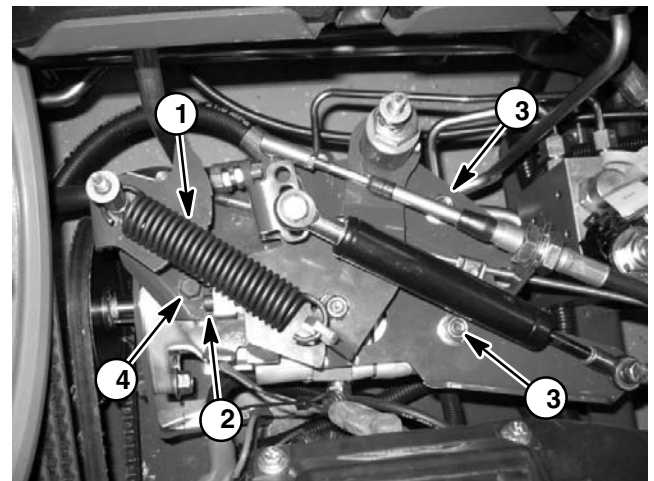


Figure 33

- |                      |                         |
|----------------------|-------------------------|
| 1. Extension spring  | 3. Flange nut/cap screw |
| 2. Socket head screw | 4. Washer head screw    |

## Installation (Fig. 31)

1. Install hydraulic fittings with new o-rings to the hydraulic pump. Orientate the fittings as noted during disassembly.



2. Position hydraulic pump assembly to the frame pump support. Secure pump to the pump support with two (2) flange head screws and flange nuts.

3. Make sure the bore of the pump pulley is clean. Apply anti-seize lubricant to the hydraulic pump shaft. Position key to pump shaft and slide pulley onto pump shaft with the pulley hub toward the pump. Position pulley to the marked position on the pump shaft.

4. Apply Loctite 242 (or equivalent) to pulley set screws and secure pulley to pump shaft with two (2) set screws.

5. Remove any caps or plugs that were placed in pump openings, hydraulic hoses or hydraulic tubes during the pump removal procedure. Connect hydraulic hoses and tubes to hydraulic pump.

6. Install hydraulic pump controls (Fig. 32 and 33) to the pump as follows:

A. Carefully position pump control assembly to pump. Make sure pump lever with attached trunnion clamp is placed over pump trunnion shaft.

B. Secure control bracket to hydraulic pump with two (2) cap screws with flange nuts and washer head screw.

C. Secure pump lever to pump trunnion shaft with two (2) socket head screws.



D. Install extension spring to the neutral lever.

7. Place two (2) flat washers to tops of studs on pump control assembly. Position pump shield to pump and secure with two (2) lock nuts.

8. Lift idler pulley and install drive belt to the pump pulley. Adjust drive belt tension (see Operator's Manual).

9. Install pump belt cover to machine (see Operator's Manual).

10. Follow Hydraulic System Start-up procedures.

11. Check traction drive for neutral and adjust if needed (see Operator's Manual).

12. Operate machine and check hole spacing. Adjust if needed (see Operator's Manual).

## Hydraulic (Traction/Charge) Pump Service

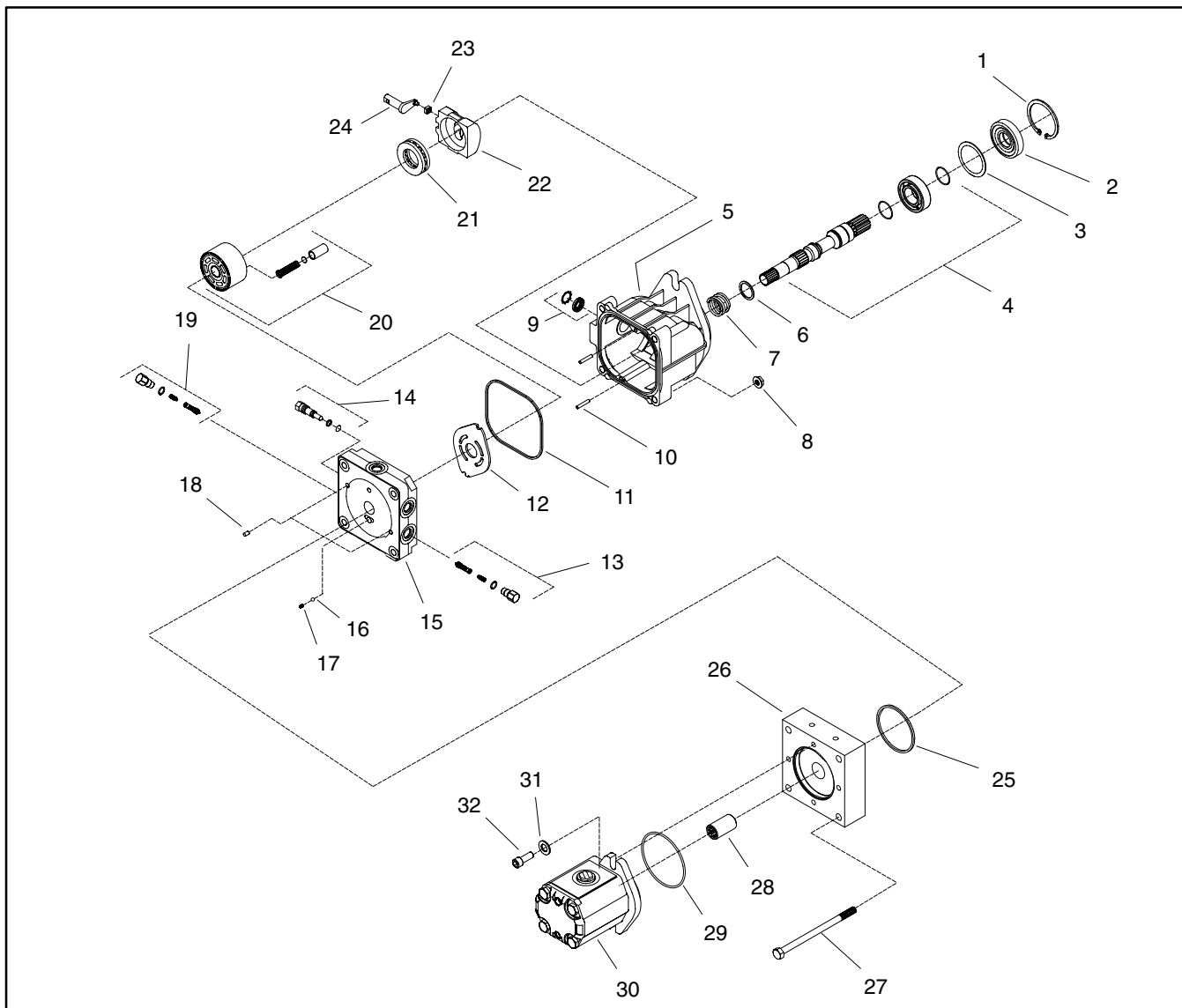


Figure 34

- |                      |                           |                                  |
|----------------------|---------------------------|----------------------------------|
| 1. Retaining ring    | 12. Valve plate           | 23. Guide slot                   |
| 2. Seal              | 13. Forward relief valve  | 24. Trunnion arm                 |
| 3. Spacer            | 14. By-pass valve         | 25. Ring                         |
| 4. Pump shaft kit    | 15. Endcap kit            | 26. Adapter plate                |
| 5. Pump housing      | 16. Check ball (2 used)   | 27. Flange head screw (4 used)   |
| 6. Thrust washer     | 17. Check spring (2 used) | 28. Coupler                      |
| 7. Spring block      | 18. Pin (2 used)          | 29. O-ring                       |
| 8. Nut (4 used)      | 19. Reverse relief valve  | 30. Gear pump (P2) (charge/lift) |
| 9. Trunnion seal kit | 20. Cylinder block kit    | 31. Washer (2 used)              |
| 10. Pin (2 used)     | 21. Thrust bearing        | 32. Cap screw (2 used)           |
| 11. O-ring           | 22. Swash plate           |                                  |

**NOTE:** For repair of the hydraulic (traction/charge) pump, see the HYDRO-GEAR BDP-10A/16A/21L HYDROSTATIC PUMPS SERVICE AND REPAIR MANUAL (hydrostat) and the SAUER DANFOSS GROUP 2 GEAR PUMPS AND MOTORS SERVICE MANUAL (gear pump) at the end of this chapter.

## Wheel Motors

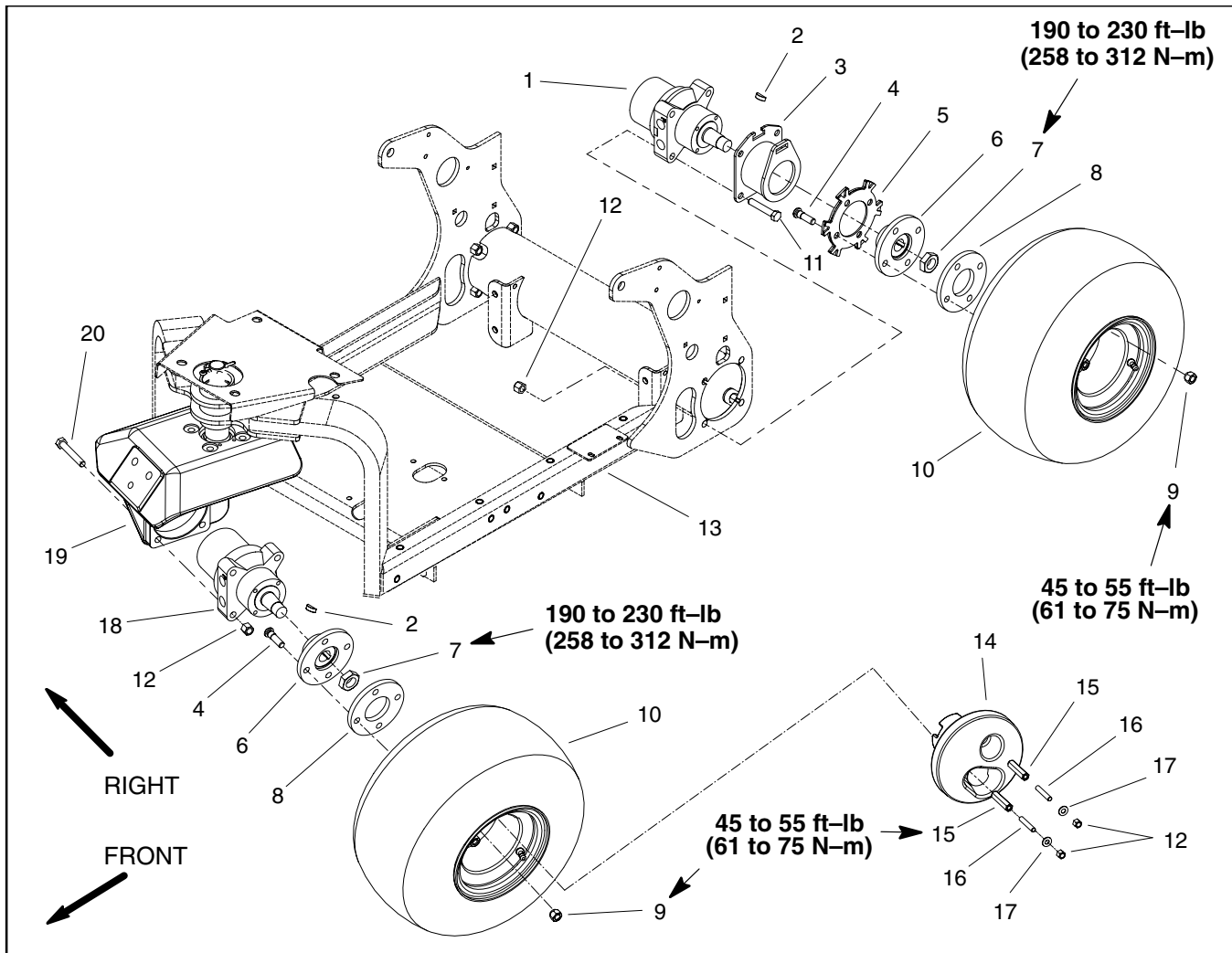


Figure 35

- |                                   |                                       |                          |
|-----------------------------------|---------------------------------------|--------------------------|
| 1. Rear wheel motor (LH shown)    | 8. Bearing plate                      | 15. Wheel weight adapter |
| 2. Woodruff key                   | 9. Lug nut                            | 16. Stud                 |
| 3. Parking latch support (2 used) | 10. Tire and wheel assembly           | 17. Thrust washer        |
| 4. Stud (4 used per wheel)        | 11. Cap screw (4 used per rear motor) | 18. Front wheel motor    |
| 5. Parking latch disc (2 used)    | 12. Lock nut (4 used per motor)       | 19. Front fork           |
| 6. Wheel hub                      | 13. Frame                             | 20. Cap screw (4 used)   |
| 7. Lock nut                       | 14. Front wheel weight                |                          |

### Removal (Fig. 35)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.



## CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

2. Remove wheel from machine (see Wheel Removal in Service and Repairs section of Chapter 6 – Chassis).

**IMPORTANT: To prevent damage to hydraulic motor, DO NOT hit wheel hub or motor with a hammer during wheel hub removal or installation.**

3. Loosen nut that secures wheel hub to motor shaft. Use wheel hub puller (see Special Tools) to free wheel hub assembly from motor shaft. Remove nut and hub assembly from motor shaft. Locate and retrieve woodruff key from motor shaft.

A. Front wheel hub assembly includes wheel hub, bearing plate and wheel studs.

B. Rear wheel hub assembly includes wheel hub, bearing plate, parking latch disc and wheel studs.

4. Clean wheel motor and hydraulic connections. Label hydraulic lines for assembly purposes.

5. Disconnect hydraulic lines from hydraulic fittings on motor to be removed. Allow hydraulic oil to drain from lines into a suitable container. Put caps or plugs on open hydraulic lines and fittings to prevent contamination.

6. If rear wheel motor is being removed, pull hair pin that secures parking latch link to parking latch bar (Fig. 36). Slide link from bar and position link away from parking latch support.

7. Support wheel motor. Remove four (4) cap screws and lock nuts that secure motor to frame. If rear wheel motor is being removed, remove parking latch support and parking latch bar. Pull wheel motor from the machine.

**NOTE:** If hydraulic fittings are to be removed from wheel motor, note correct orientation of fittings before loosening the fittings.

8. If required, remove hydraulic fittings and o-rings from the wheel motor. Discard o-rings.

### Installation (Fig. 35)

1. If removed, install hydraulic fittings with new o-rings into the wheel motor. Orientate the fittings as noted during disassembly.

2. Position and support wheel motor to the frame.

A. On front wheel motor, insert four (4) cap screws through front fork holes and then through motor flange. Secure motor to front fork with lock nuts.

B. On rear wheel motor, insert four (4) cap screws through holes in parking latch support (with parking latch bar installed) and then through motor flange and frame. Secure motor to frame with lock nuts.

3. If rear wheel motor was removed, slide parking latch link through parking latch bar and secure with hair pin (Fig. 36).

4. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

5. Install hydraulic lines to hydraulic fittings on wheel motor. Tighten connections.

6. Make sure that wheel motor shaft and wheel hub taper are thoroughly cleaned.

7. Install woodruff key into motor shaft keyslot. Slide wheel hub assembly onto motor shaft. Secure wheel hub to motor shaft with nut. Torque nut from 190 to 230 ft–lbs (258 to 312 N–m).

A. Front hub assembly includes wheel hub, bearing plate and wheel studs.

B. Rear hub assembly includes wheel hub, bearing plate, parking latch disc and wheel studs.

8. Install wheel to machine (see Wheel Installation in Service and Repairs section of Chapter 6 – Chassis). Tighten lug nuts from 45 to 55 ft–lb (61 to 75 N–m).

9. Follow Hydraulic System Start-up procedures.

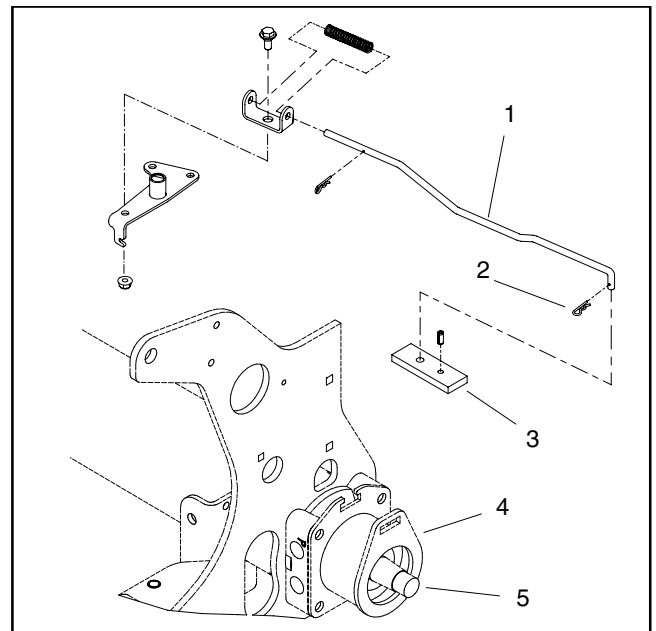


Figure 36

- |                       |                          |
|-----------------------|--------------------------|
| 1. Parking latch link | 4. Parking latch support |
| 2. Hair pin           | 5. Wheel motor shaft     |
| 3. Parking latch bar  |                          |

## Wheel Motor Service

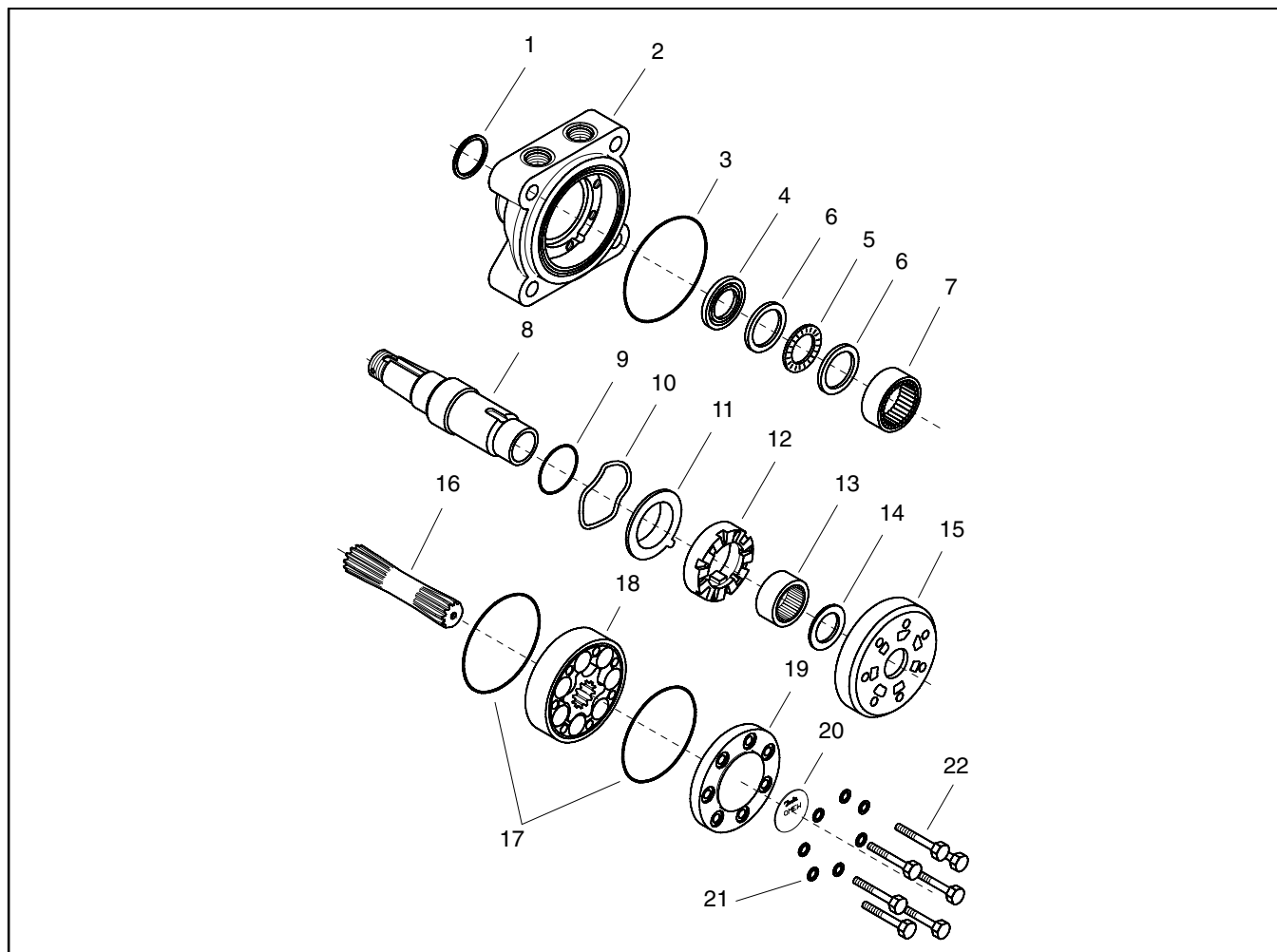


Figure 37

- |                         |                       |                         |
|-------------------------|-----------------------|-------------------------|
| 1. Dust seal            | 9. O-ring             | 16. Cardan shaft        |
| 2. Housing              | 10. Spring washer     | 17. O-ring              |
| 3. O-ring               | 11. Balance plate     | 18. Gearwheel set       |
| 4. Shaft seal           | 12. Disc valve        | 19. End cover           |
| 5. Axial needle bearing | 13. Needle bearing    | 20. Name plate          |
| 6. Bearing race         | 14. Bearing race      | 21. Washer (7 used)     |
| 7. Needle bearing       | 15. Distributor plate | 22. Cap screws (7 used) |
| 8. Shaft                |                       |                         |

**NOTE:** The three wheel motors on the ProCore 648 are similar in construction but are different from each other. The front wheel motor (24 c.i. per revolution) has a different displacement than the rear motors and has a counter-clockwise direction for the forward direction. The right and left rear wheel motors have the same displacement (12 c.i. per revolution) but have different rotation for the forward direction: the right rear has a clockwise drive direction for forward and the left rear has a counter-clockwise direction. Displacement and primary rotation (forward) direction are identified on the motor name plate.

**NOTE:** For repair of the wheel motors, see the SAUER DANFOSS OMEW HYDRAULIC MOTOR SERVICE MANUAL at the end of this chapter.

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# Hydraulic Lift Control Manifold

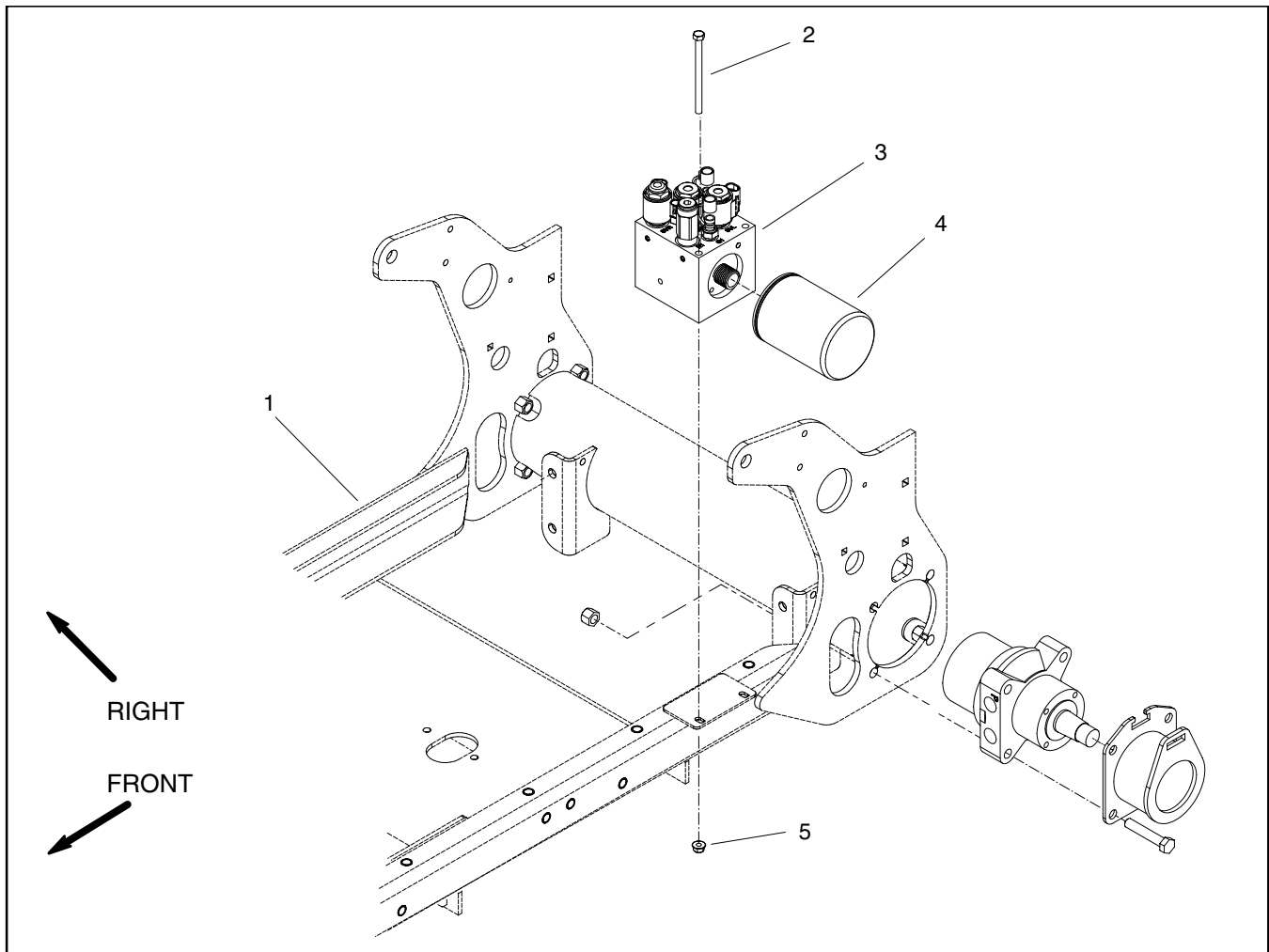


Figure 38

- 1. Main frame
- 2. Cap screws (2 used)

- 3. Hydraulic lift control manifold
- 4. Hydraulic oil filter

- 5. Flange nut (2 used)



### Removal (Fig. 38)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

**CAUTION**

**Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.**

**NOTE:** The ports on the manifold are marked for easy identification of components. Example: P is the pump connection port and R1 is the location for the relief valve (See Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each manifold port location).

2. Disconnect solenoid valve electrical connectors.

**NOTE:** The hydraulic reservoir will drain when the hydraulic oil filter is removed from the hydraulic manifold.

3. Clean area around hydraulic filter mounting area. Remove filter from hydraulic manifold and drain reservoir into a suitable container. Discard filter.

4. Clean manifold and hydraulic connections. Disconnect hydraulic lines. Label all connections for assembly.

5. Allow hydraulic lines to drain into a suitable container. Put caps or plugs on disconnected hoses and fittings to prevent contamination. Discard any removed o-rings.

6. Remove two (2) cap screws and flange nuts that secure hydraulic manifold to the frame mounting bracket.

7. Remove hydraulic manifold from the machine.

8. Remove hydraulic fittings from manifold as needed (Fig. 39).

### Installation (Fig. 38)

1. Position hydraulic manifold to the frame mounting bracket. Install two (2) cap screws and flange nuts but do not tighten.

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

3. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

4. Lightly oil new o-rings for hydraulic fitting and hose locations.

5. Correctly connect hydraulic fittings and lines to the manifold. Tighten all hydraulic fittings and connections.

6. Secure hydraulic manifold by tightening two (2) cap screws and flange nuts.

7. Reconnect solenoid valve electrical connectors.

8. Follow Hydraulic System Start-up procedures.

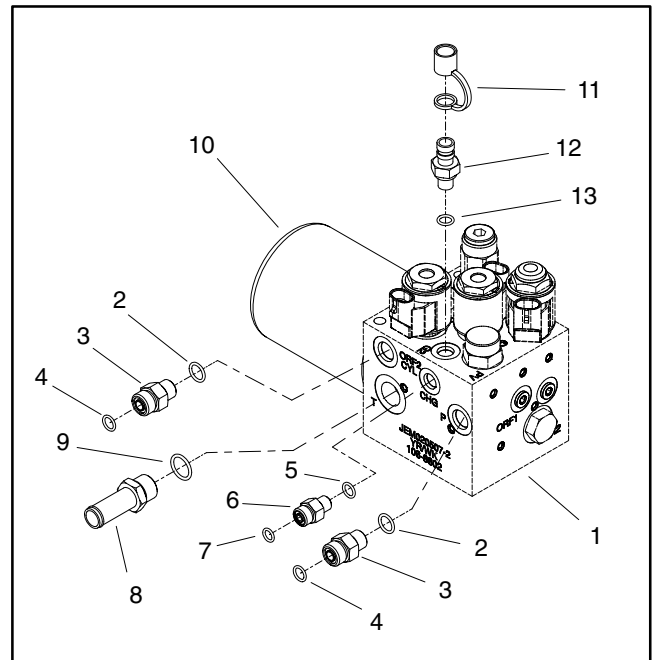


Figure 39

- |                       |                            |
|-----------------------|----------------------------|
| 1. Hydraulic manifold | 8. Barbed fitting          |
| 2. O-ring             | 9. O-ring                  |
| 3. Hydraulic fitting  | 10. Hydraulic oil filter   |
| 4. O-ring             | 11. Dust cap (2 used)      |
| 5. O-ring             | 12. Quick fitting (2 used) |
| 6. Hydraulic fitting  | 13. O-ring (2 used)        |
| 7. O-ring             |                            |

## Hydraulic Lift Control Manifold Service

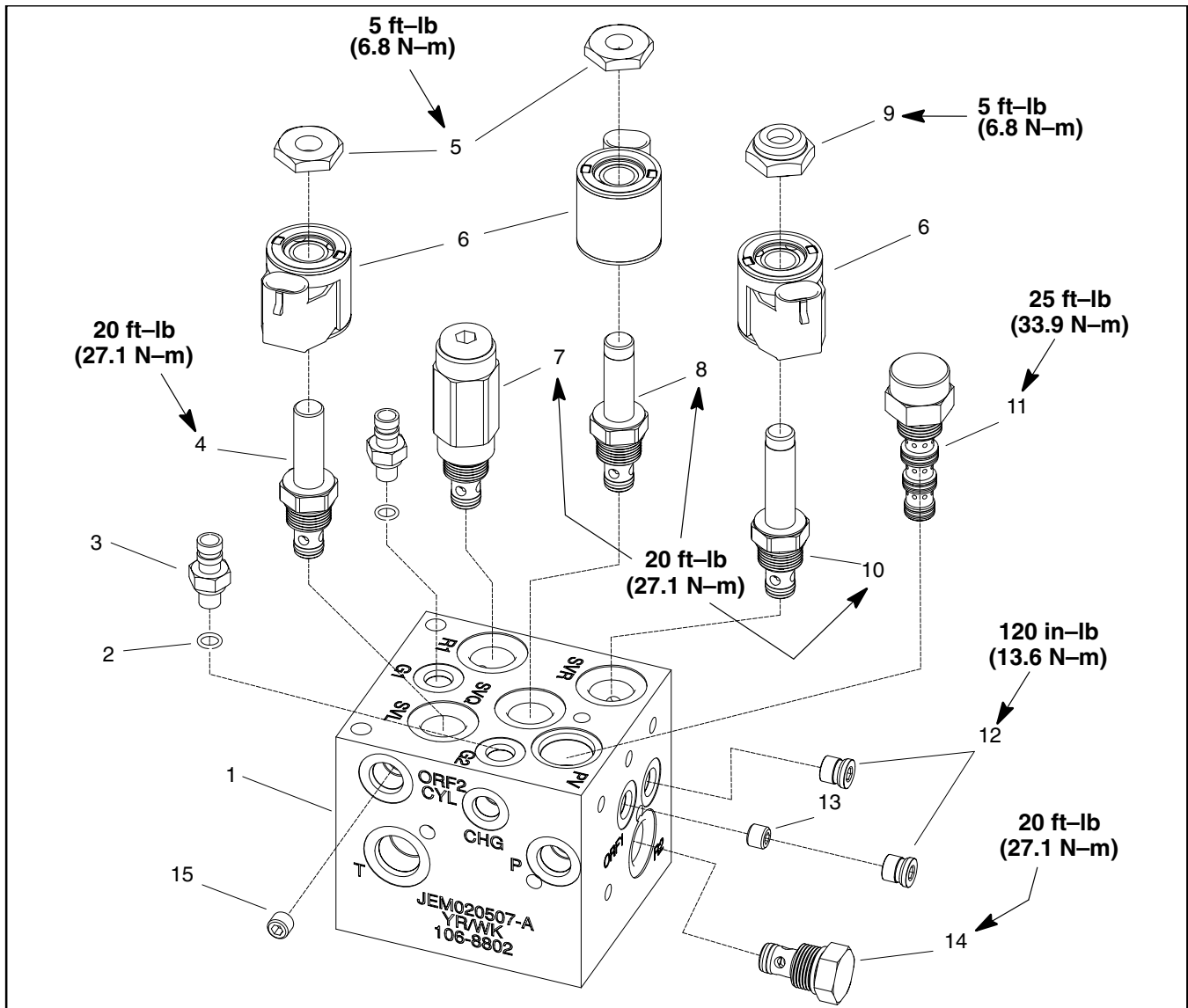


Figure 40

- |                                    |                               |  |
|------------------------------------|-------------------------------|--|
| 1. Hydraulic lift control manifold | 6. Solenoid coil              | 11. Pres. compensating valve (PV port) |
| 2. O-ring                          | 7. Relief valve (R1 port)     | 12. #4 plug (zero leak)                |
| 3. Quick fitting (2 used)          | 8. Solenoid valve (SVQ port)  | 13. Orifice plug                       |
| 4. Solenoid valve (SVL port)       | 9. Nut                        | 14. Check valve                        |
| 5. Nut                             | 10. Solenoid valve (SVR port) | 15. Plug                               |

**NOTE:** The ports on the manifold are marked for easy identification of components. Example: P is the pump connection port and R1 is the location for the relief valve (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port).

**NOTE:** The ProCore 648 hydraulic lift control manifold uses two zero leak plugs (item 12). These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an o-ring (not shown) as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plug, torque 120 in-lb (13.6 N-m).

## Hydraulic Manifold Service

1. Make sure the manifold is clean before removing any cartridge valve.
2. If solenoid cartridge is being serviced, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve.

 <b>CAUTION</b>
<b>Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.</b>

**IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.**

3. Remove cartridge valve with a deep socket wrench. Note correct location for o-rings, sealing rings and backup rings. Remove and discard seal kit from valve.
4. Visually inspect the manifold port for damage to the sealing surfaces, damaged threads and contamination.
5. Visually inspect cartridge 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 valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

 <b>CAUTION</b>
<b>Use eye protection such as goggles when using compressed air for cartridge valve cleaning.</b>

 <b>CAUTION</b>
<b>Abrupt movement of internal spools can cause stored fluid to be released suddenly.</b>

6. Clean cartridge valve by submerging valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Reinstall the cartridge valve:

A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The o-rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

**IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction.**

B. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

C. Torque cartridge valve using a deep socket to valves identified in Figure 40.

8. If solenoid cartridge was removed, carefully install solenoid coil onto the cartridge valve. Install nut and torque nut to 5 ft-lb (6.8 N-m).

9. After assembly, if problems still exist, remove valve and clean again or replace valve.

# Lift Cylinder

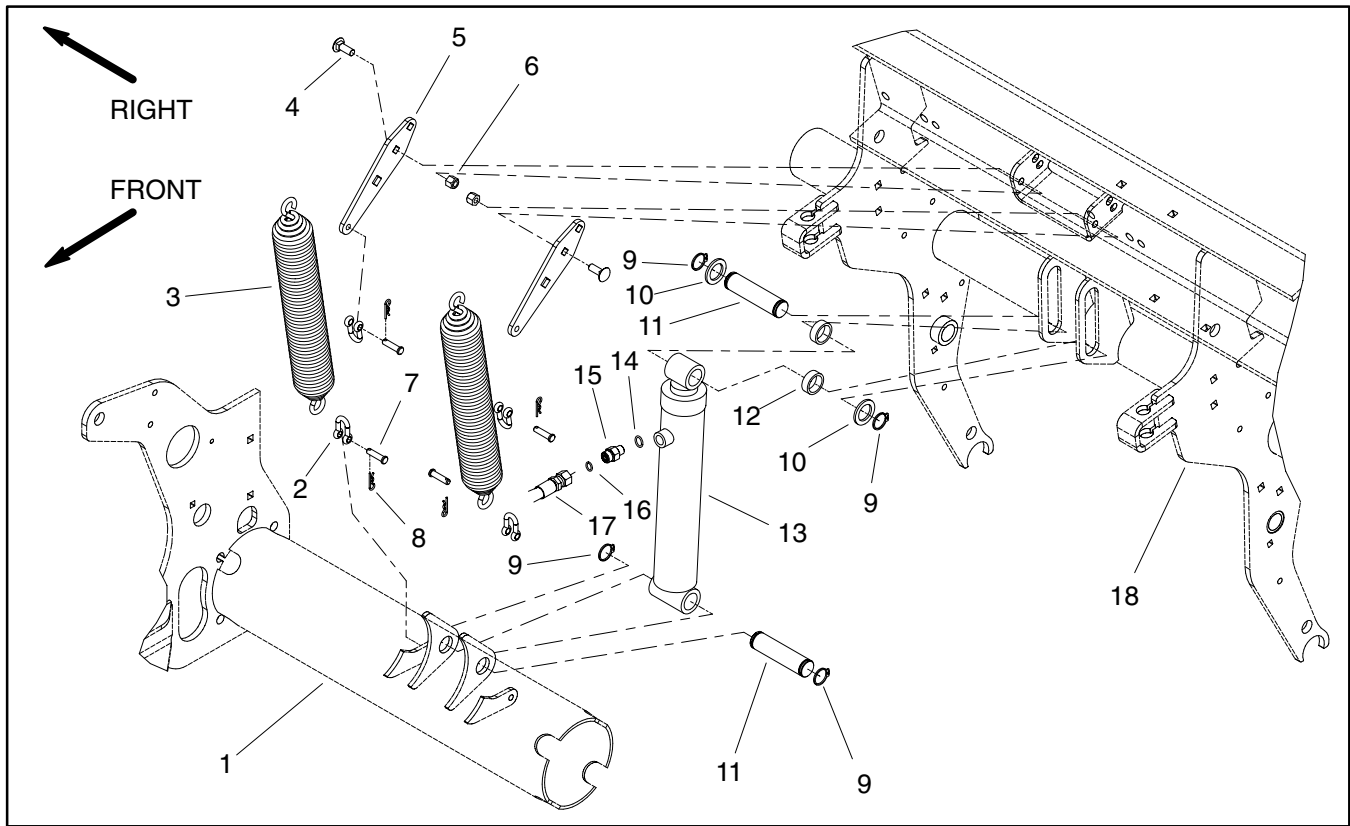


Figure 41

- |                              |                        |                       |
|------------------------------|------------------------|-----------------------|
| 1. Main frame                | 7. Clevis pin (4 used) | 13. Lift cylinder     |
| 2. Shackle (4 used)          | 8. Hair pin (4 used)   | 14. O-ring            |
| 3. Extension spring (2 used) | 9. Retaining ring      | 15. Hydraulic fitting |
| 4. Carriage screw (4 used)   | 10. Thrust washer      | 16. O-ring            |
| 5. Spring plate (2 used)     | 11. Cylinder pin       | 17. Hydraulic hose    |
| 6. Flange nut (4 used)       | 12. Spacer (2 used)    | 18. Coring head frame |

## Removal (Fig. 41)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove rear hood (see Operator's Manual).
3. Remove tine heads from stomper arms to allow coring head to be fully lowered.

4. Disconnect the lower end of one extension spring (item 2) from frame:

A. Remove service latch from coring head. Turn key switch to ON (engine not running). Move traction lever to forward direction and depress lower switch on handle to fully lower coring head.

B. Loosen, but do not remove, both flange nuts (item 6) that secure the spring plate (item 5) for one of the extension springs.


C. Using a 1/2" breaker bar, hold spring plate (item 5) to prevent it from moving and remove **upper** flange nut and carriage screw (item 4) from spring plate and coring head frame (Fig. 42).

D. Using lower carriage screw and flange nut as a pivot, carefully release tension on extension spring by rotating spring plate with breaker bar.

E. Remove hair pin (item 8) and clevis pin (item 7) that secure spring shackle (item 2) to frame.



5. Start engine and allow coring head to fully raise. Turn engine off. Secure coring head with service latch.

	CAUTION
<p><b>Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.</b></p>	

6. Release hydraulic pressure in lift cylinder:

A. Turn key switch to ON (engine not running).

B. Move traction lever to forward direction and depress lower switch on handle to lower coring head onto service latch.

7. Disconnect hydraulic hose from hydraulic fitting on lift cylinder. Locate and discard o-ring from between hose and fitting. Allow hose to drain into a suitable container.

8. Plug disconnected hose and fitting to prevent contamination.

9. Remove one retaining ring from the upper cylinder pin. Pull upper cylinder pin from the lift cylinder and coring head frame. Locate and retrieve spacer and thrust washer from each side of cylinder pivot (Fig. 43).

10. Remove one retaining ring from the lower cylinder pin on the side of the disconnected extension spring. Support lift cylinder and slide lower cylinder pin from the lift cylinder and machine frame.

11. Remove lift cylinder from the machine.

12. If needed, remove hydraulic fitting and o-ring from the lift cylinder. Discard o-ring.

### Installation (Fig. 41)

1. If removed, install hydraulic fitting and new o-ring into lift cylinder.

2. Position lift cylinder to the machine mounting points. Make sure the port of the lift cylinder faces the front of the machine.

3. Align lower lift cylinder mounting hole with frame mount. Install cylinder pin and secure with retaining ring.

4. Align upper lift cylinder pivot with slots in the coring head frame. Install cylinder pin making sure that a spacer is on each side of the cylinder pivot and a thrust washer is positioned between coring head frame and retaining ring (Fig. 43). Secure with retaining ring.

5. Remove plugs from disconnected hose and fitting.

6. Connect hydraulic hose with new o-ring to hydraulic fitting on lift cylinder. Tighten hose connection.

7. Install disconnected extension spring to machine in reverse order of disassembly.

8. Install rear hood.

9. Install tine heads to stomper arms (see Operator's Manual).

10. Follow Hydraulic System Start-up procedures.

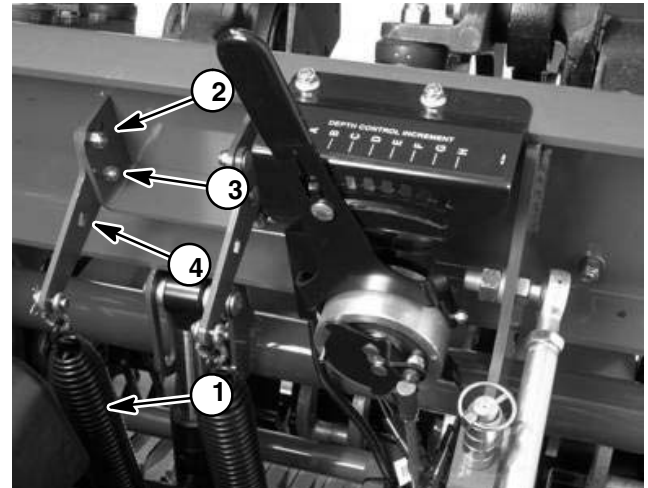


Figure 42

- |                         |                         |
|-------------------------|-------------------------|
| 1. Extension spring     | 3. Lower carriage screw |
| 2. Upper carriage screw | 4. 1/2" drive hole      |

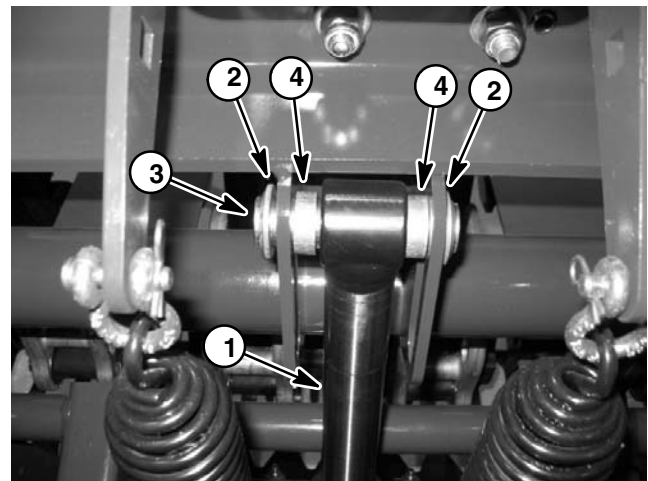


Figure 43

- |                        |                 |
|------------------------|-----------------|
| 1. Lift cylinder shaft | 3. Cylinder pin |
| 2. Thrust washer       | 4. Spacer       |

## Lift Cylinder Service

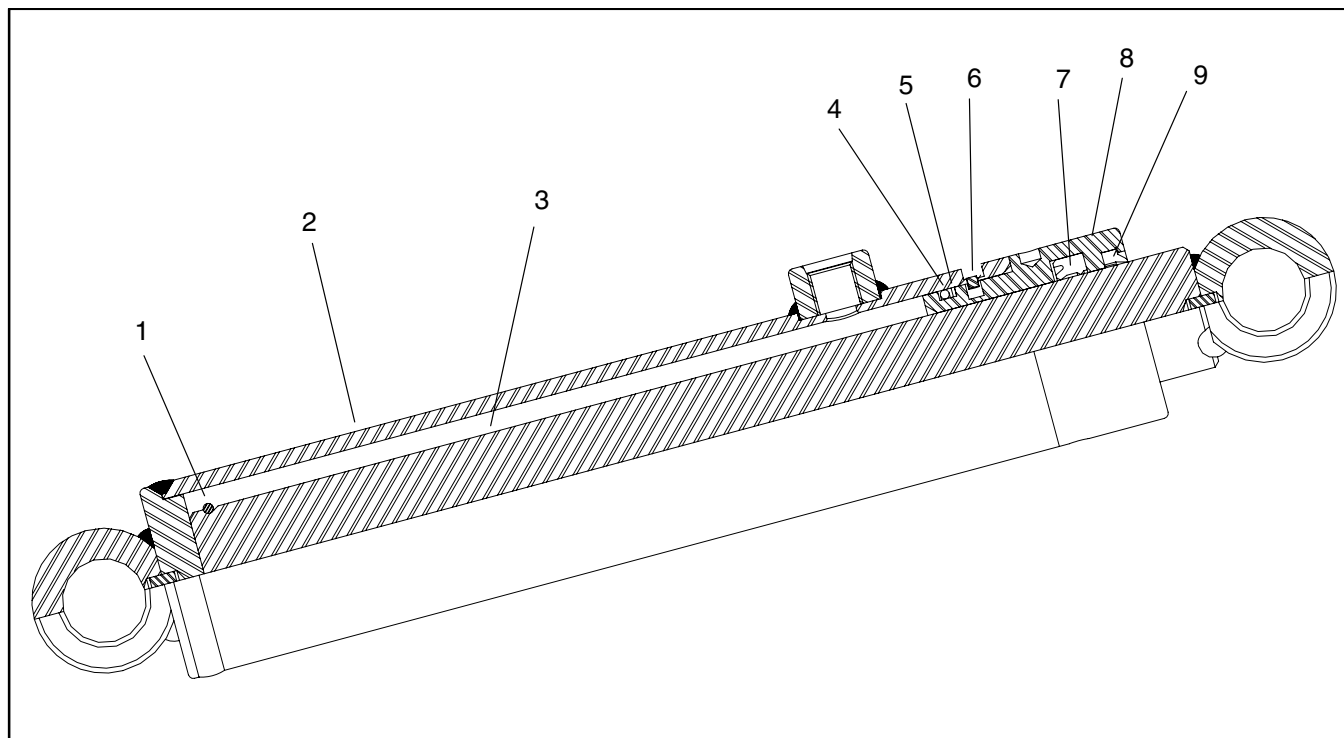


Figure 44

- 1. Retaining ring
- 2. Cylinder tube
- 3. Rod

- 4. O-ring
- 5. Backup ring
- 6. Retaining ring

- 7. Seal
- 8. Head
- 9. Wiper

### Disassembly (Fig. 44)

1. Remove oil from the lift cylinder into a drain pan by **slowly** pumping the cylinder rod. Plug port 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 tube.**

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

3. Rotate head (item 8) with a spanner wrench and remove retaining ring (item 6) as shown in Figure 45.

4. Grasp end of rod; extract rod and head by carefully twisting and pulling on the rod.

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

5. Mount rod securely in a vise by clamping vise on the flats of the pivot. Remove retaining ring (item 1) and carefully slide head from the shaft.

6. Remove and discard o-ring (item 4), backup ring (item 5), seal (item 7) and wiper (item 9) from the head.

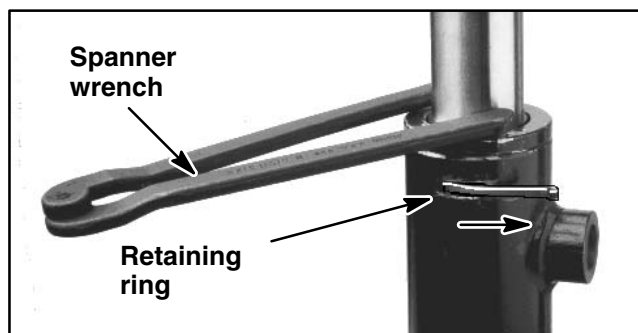


Figure 45

## Inspection



1. Wash all parts in solvent. Dry parts with compressed air.
2. Inspect internal surface of tube for deep scratches, out-of-roundness and bending. Replace if worn or damaged.
3. Inspect rod and head for excessive pitting, scoring or wear. Replace any worn or damaged parts.

### Assembly (Fig. 44)

1. Coat new o-ring (item 4), backup ring (item 5), seal (item 7) and wiper (item 9) with hydraulic oil. Install sealing components to the head.

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

2. Mount rod securely in a vise by clamping vise on the pivot end of the shaft. Carefully slide head assembly onto the rod. Install retaining ring (item 1).
3. Remove rod assembly from vise.

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

4. Mount tube in a vise so that the rod end tilts up slightly.
5. Coat all internal lift cylinder parts with a light coating of hydraulic oil. Slide rod and head assembly into tube being careful not to damage the seals.
6. Secure head in tube by installing retaining ring (item 6). Align key slot in head with the access groove in the tube. 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 tube groove as shown in Figure 46.

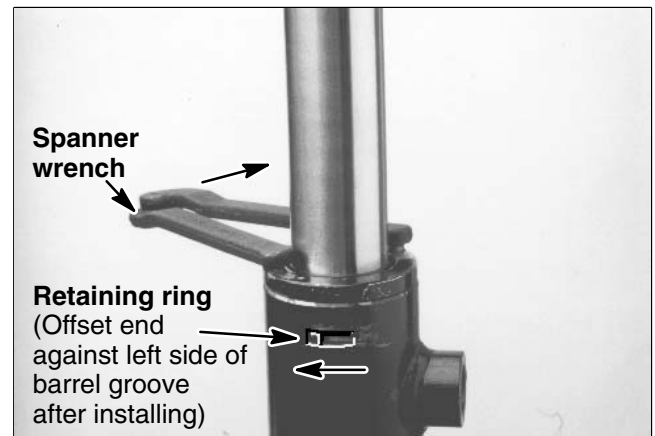


Figure 46

## Hydraulic Reservoir

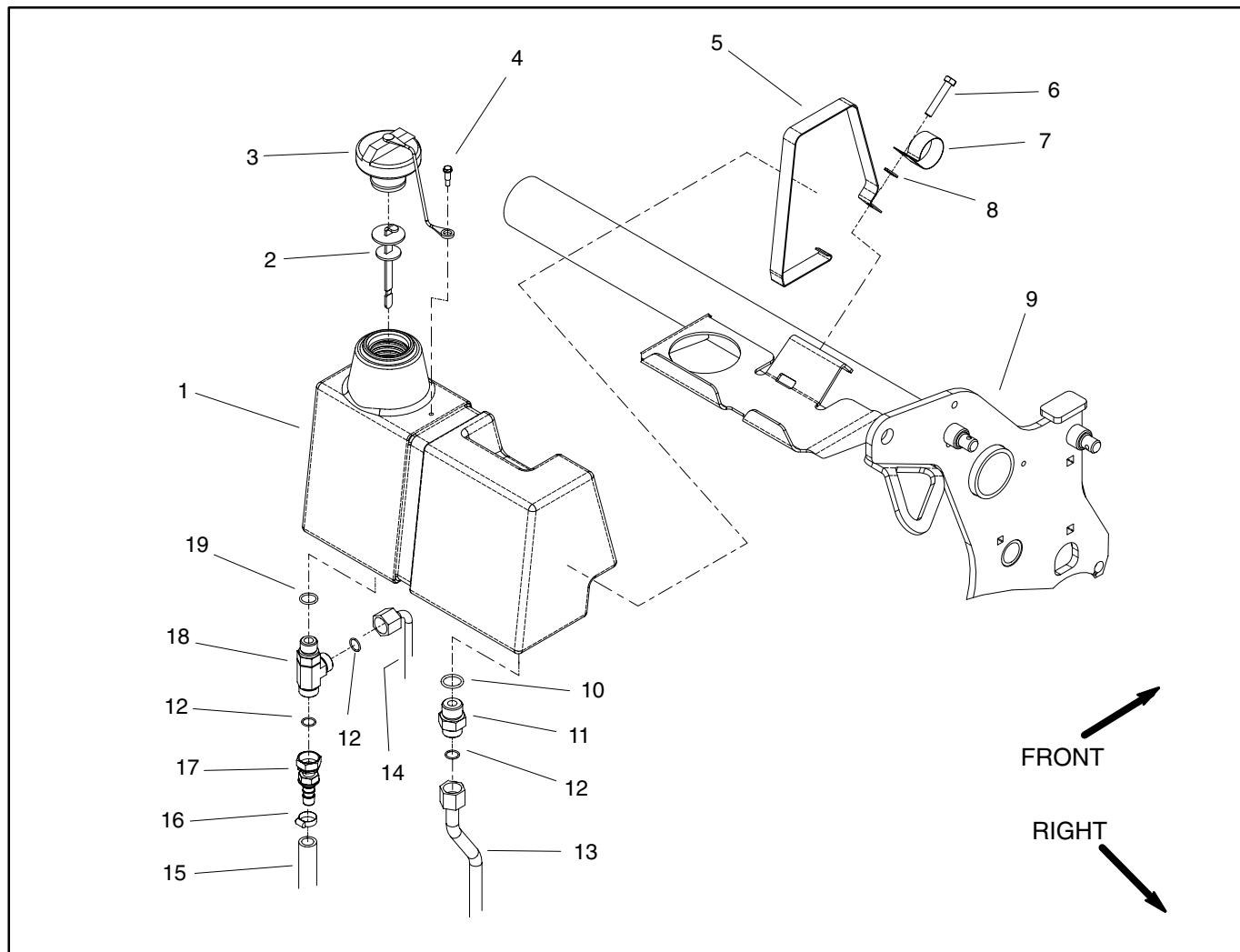


Figure 47

1. Hydraulic reservoir
2. Dipstick
3. Cap
4. Shoulder screw
5. Tank strap
6. Cap screw
7. J clip

8. Flat washer
9. Frame
10. O-ring
11. Hydraulic adapter
12. O-ring
13. Hydraulic tube

14. Hydraulic tube
15. Suction hose
16. Hose clamp
17. Hydraulic barb fitting
18. Hydraulic tee fitting
19. O-ring

### Inspecting Reservoir (Fig. 47)

1. Clean hydraulic reservoir with solvent.
2. Inspect reservoir for leaks, cracks or other damage.
3. Replace any hydraulic hose, tube or fitting if damaged or leaking.
4. Make sure cap screw (item 6) that secures tank strap is tight.





# Electrical System

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## Electrical Diagrams

The electrical schematic, electrical circuit drawings and wire harness drawings for the ProCore 648 are located in Chapter 8 – Electrical Diagrams.

# Circuit Operation

**NOTE:** This section provides information concerning three sequential, electrical circuits that are used on the ProCore 648. Use these descriptions along with the electrical diagrams and schematics found in Chapter 8 – Electrical Diagrams to better understand circuit operation.

---

## OK to Lower Circuit (Fig. 1)

The "OK to lower" circuit is one of the inputs used by the aerator control module to allow current output to the raise and lower hydraulic solenoid valves (SVL, SVR and SVQ). This circuit is composed of the manual raise/lower switch, the neutral switch (latch) relay, the latching relay, the reverse proximity switch and diode D1. "OK to lower" circuit protection is provided by fuse F3.

### Traction Lever in Neutral or Reverse

When the traction lever is in either the neutral or reverse position, the reverse proximity switch is closed which allows the neutral switch (latch) relay to be energized. This energized relay prevents an "OK to lower" input for the aerator control so the coring head remains in the raised position. The "OK to lower" LED on the aerator control module will not be illuminated.

### Begin Aerating (Traction Lever in Forward)

To begin aerating, the operator moves the traction lever to the forward direction which opens the reverse proximity switch and de-energizes the neutral switch (latch) relay. When the manual raise/lower switch is pressed to the lower position, a complete circuit is formed to allow the latching relay to be energized which allows an "OK to lower" input for the aerator control. The "OK to lower" LED on the aerator control module will be illuminated. The aerator control module will provide output to the SVQ and SVL solenoid valves to lower the coring head.

### Aerating (Traction Lever in Forward)

Once the "OK to lower" circuit has initially been closed by the manual raise/lower switch, the latching relay and diode D1 allow a latch circuit to keep the latching relay energized. The manual raise/lower switch in the middle, aerate position along with the energized latching relay provide a closed path for the "OK to lower" input to the aerator control module. The "OK to lower" LED on the aerator control module will continue to be illuminated while aerating.

The "OK to lower" input to the aerator control module will remain closed until either the operator presses the manual raise/lower switch to the raise position or the traction lever is moved to the neutral or reverse position.

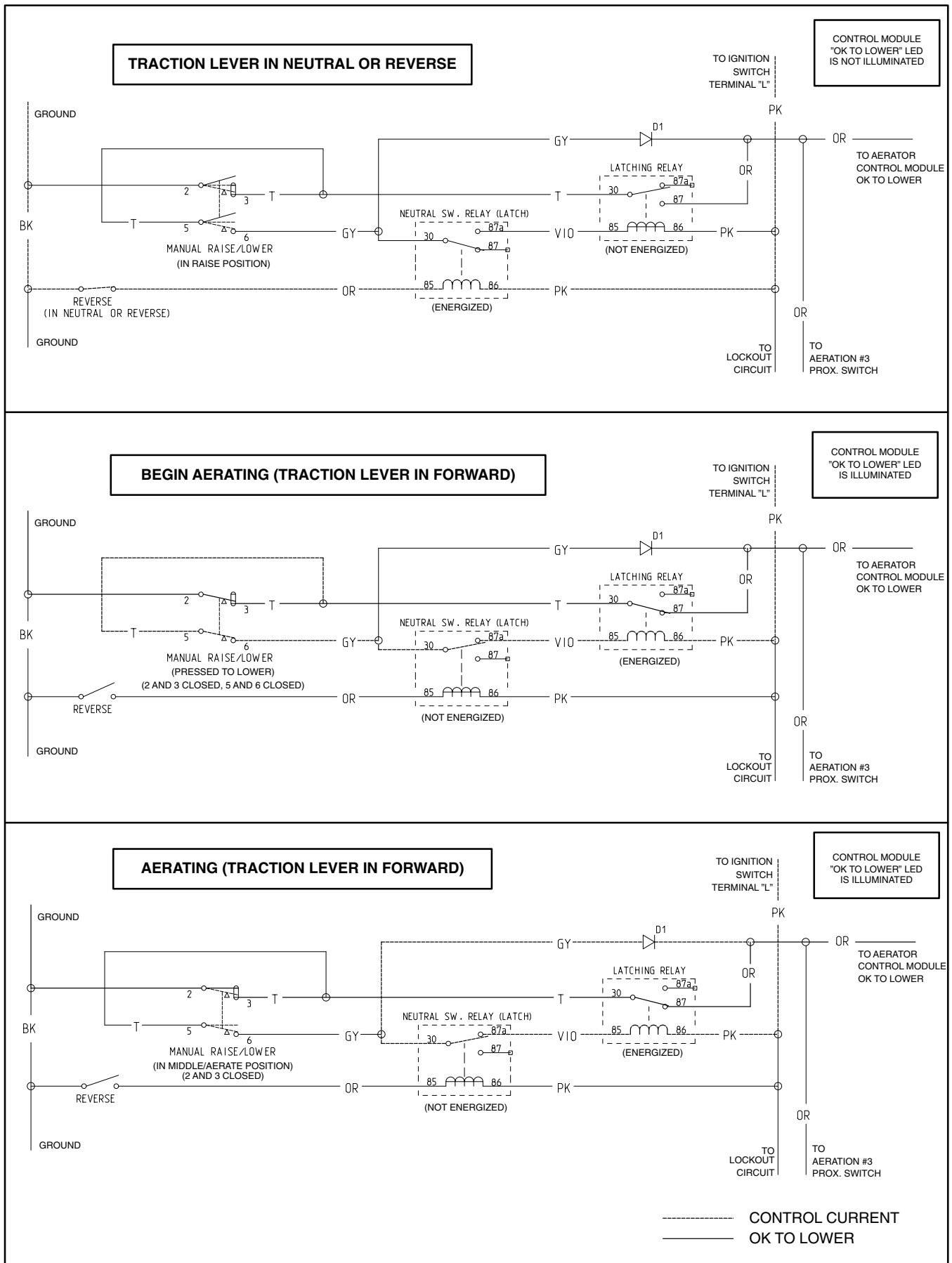


Figure 1

Electrical System

---

## Lockout Circuit (Fig. 2)

The lockout circuit is used on the ProCore to provide current for the raise and lower hydraulic solenoid valves (SVL, SVR and SVQ). This circuit is composed of the transport limit #2 proximity switch, the lockout relay, the lockout latch relay, the lift/reset switch and diode D2. When this circuit is closed, current is provided to the aerator control module to allow energizing of the solenoid valves. Lockout circuit protection is provided by fuse F3.

### Coring Head Raised

With the coring head in the raised position, the transport limit #2 proximity switch is closed which completes the lockout circuit. Hydraulic solenoid valve operation is possible at this time which allows the coring head to be lowered and aeration to occur.

### Aerating

Once the lockout circuit has initially been closed by transport limit #2 proximity switch, the lockout latch relay and diode D2 allow a latch circuit to keep the lockout relay energized and hydraulic solenoid valve operation to continue while aerating.

### Coring Head Stranded

If the coring head is stranded in the lowered position (e.g. the engine runs out of gas while aerating), the transport limit #2 proximity switch will be open and will prevent the relays in the lockout circuit from energizing. In this situation, no current will be available to the solenoid valves so the coring head cannot be raised. Pressing the lift/reset switch provides the necessary ground path for completing the lockout circuit. Once the lockout circuit is closed, solenoid valve operation is resumed to allow the coring head to raise.

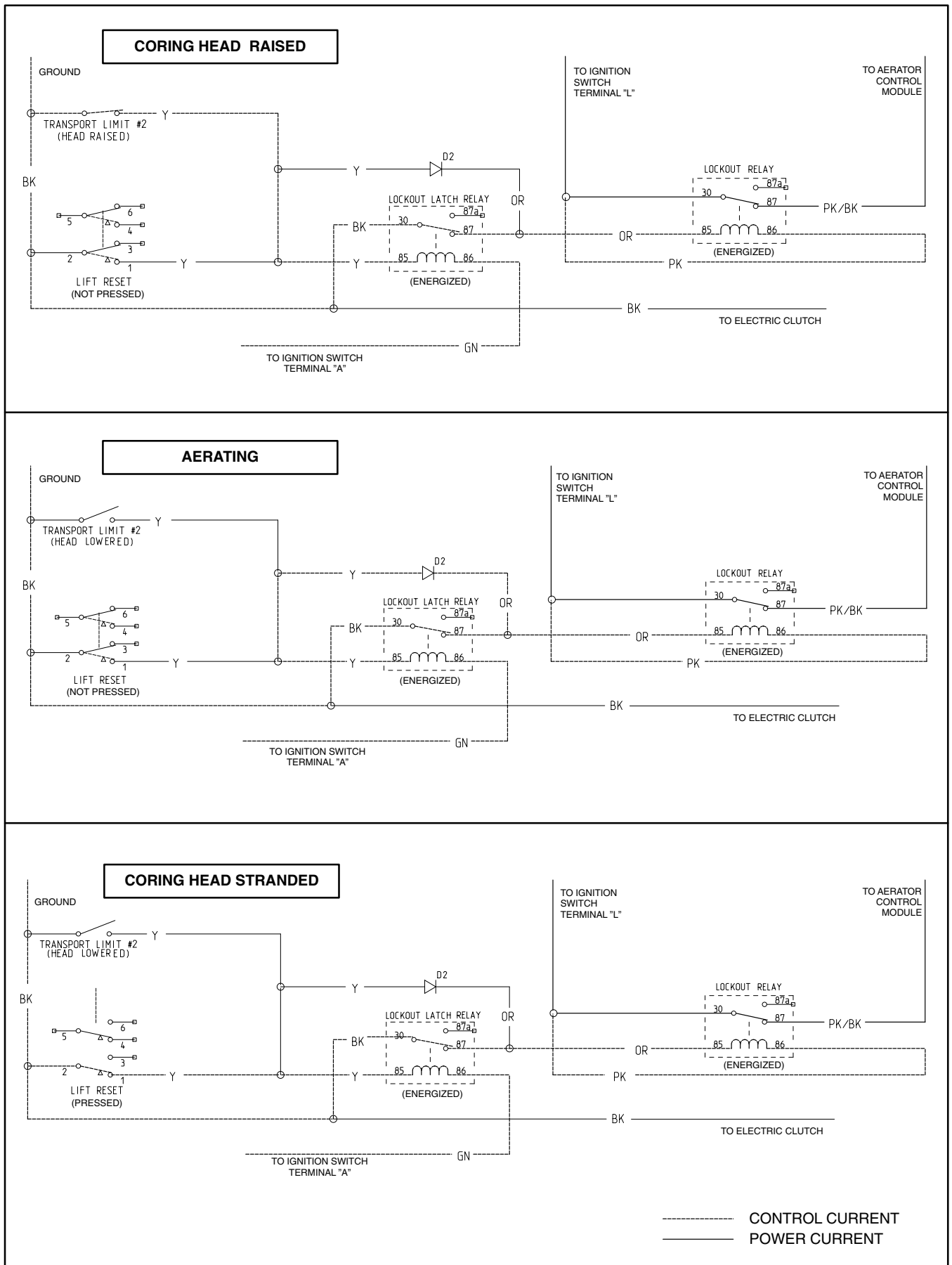


Figure 2

## Electric Clutch Circuit (Fig. 3)

The electric clutch circuit is used on the ProCore to provide current for the electric clutch which rotates the coring crankshaft. This circuit is composed of the aeration #3 proximity switch, the clutch relay, the electric clutch and diode D3. The electric clutch circuit relies on the operation of the "OK to lower" circuit for completing the clutch circuit (See OK to Lower Circuit in this section). Electric clutch circuit protection is provided by fuse F2.

### Not Aerating (Clutch not Engaged)

Whenever the coring head is in the raised position, the aeration #3 proximity switch is open and the clutch relay is not energized. The electric clutch will not be energized so rotation of the coring crankshaft does not occur.

### Aerating (Clutch Engaged)

The clutch relay will be energized as the coring head is lowered to the point when the aeration #3 proximity switch closes. This closed proximity switch provides a complete circuit if the "OK to lower" circuit is closed. Once the clutch relay is energized, current is provided to the clutch and rotation of the coring crankshaft begins.

The clutch will continue to be energized until either:

- A. The coring head is raised which opens the aeration #3 proximity switch.
- B. The "OK to lower" circuit opens (e.g. the operator releases the traction lever while aerating).

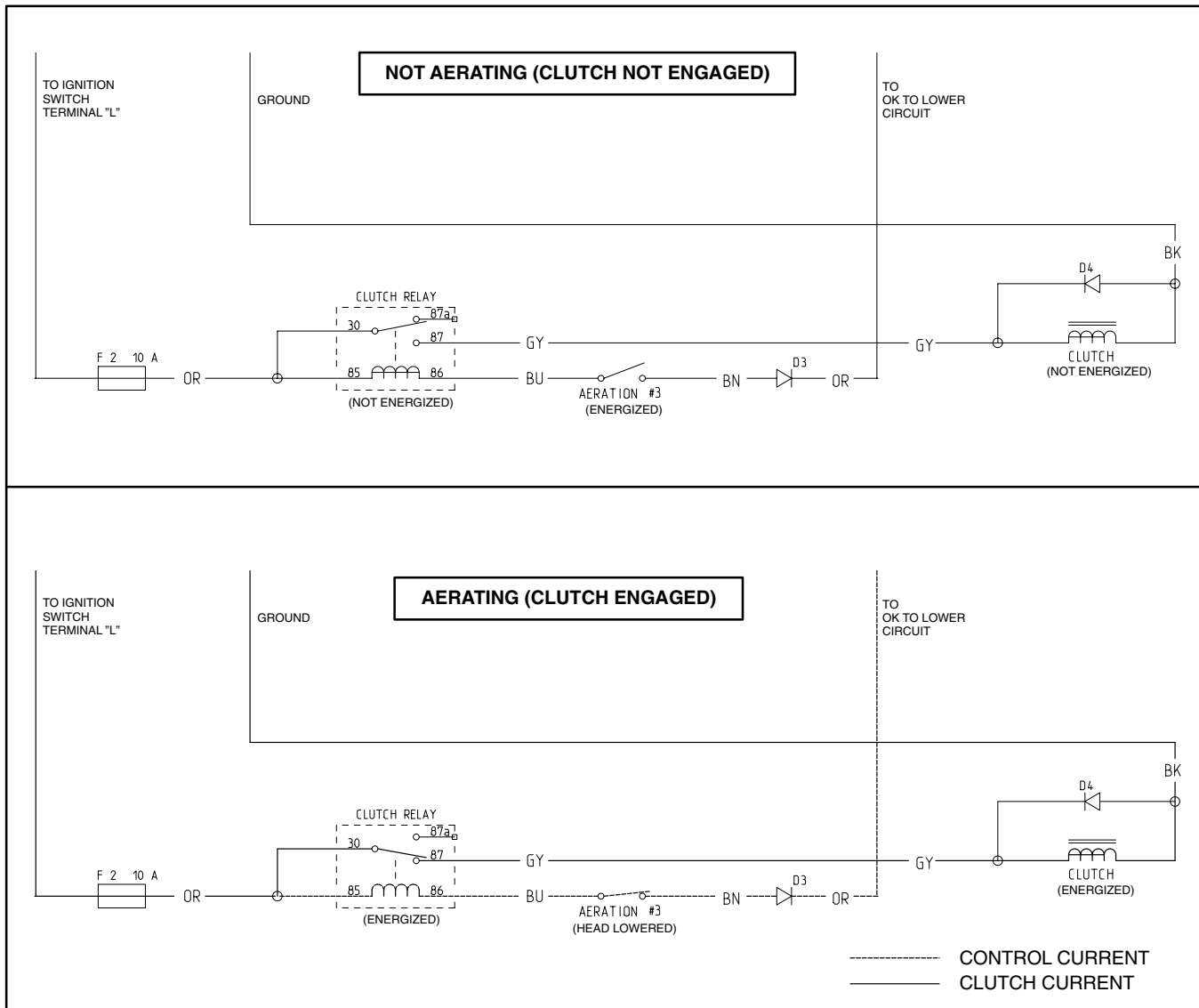


Figure 3

# Special Tools

## Multimeter

The multimeter can test electrical components and circuits for current (amps), resistance (ohms) 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.

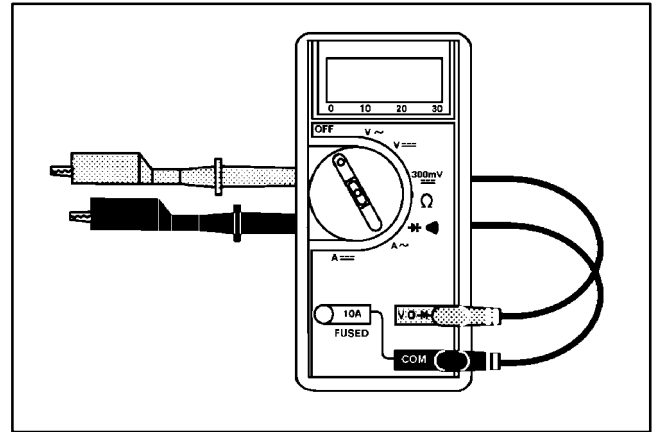


Figure 4

## Battery Terminal Protector

Battery Terminal Protector (Toro Part No. 107–0392) is an aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after battery cable has been secured to battery terminal.



Figure 5

## Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.



Figure 6

Electrical System

# 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 (see Chapter 8 – Electrical Diagrams) and components used on this machine.

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

## Starting Problems

Problem	Possible Causes
<p>Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).</p>	<p>Battery charge is low.</p> <p>Battery cables are loose or corroded.</p> <p>Battery ground to frame is loose or corroded.</p> <p>Wiring at starter is faulty.</p> <p>Starter solenoid is faulty.</p> <p>Starter mounting bolts are loose or not supplying a sufficient ground for solenoid.</p> <p>Starter is faulty.</p>
<p>Nothing happens when start attempt is made (traction lever must be in neutral position for successful start).</p>	<p>Traction lever is not in the neutral position.</p> <p>Battery cables are loose or corroded.</p> <p>Battery ground to frame is loose or corroded.</p> <p>Battery is dead.</p> <p>Fuse F1 (20 amp) is open.</p> <p>Wiring to start circuit components is loose, corroded, or damaged (see Chapter 8 – Electrical Diagrams).</p> <p>Neutral proximity switch is out of adjustment or faulty.</p> <p>Sensing plate on traction lever is loose.</p> <p>Neutral switch relay is faulty.</p> <p>Ignition switch is faulty.</p> <p>Fuse block is faulty.</p> <p>Starter solenoid is faulty.</p>



## Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Circuit wiring to engine magneto is grounded (see Chapter 8 – Electrical Diagrams). Circuit wiring to carburetor solenoid is loose, corroded, or damaged (see Chapter 8 – Electrical Diagrams). Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Engine). Engine may be too cold.
Engine cranks (but should not) with the traction lever out of the neutral position.	Neutral proximity switch is out of adjustment or faulty. Neutral proximity switch wiring is faulty. Sensing plate on traction lever is loose or damaged.

## General Run Problems

Problem	Possible Causes
Battery does not charge.	Wiring to the charging circuit components is loose, corroded, or damaged (see Chapter 8 – Electrical Diagrams). Ignition switch is faulty. Alternator is faulty (see Chapter 3 – Kohler Engine). Battery is dead.
Engine kills during operation.	Ignition switch is faulty. Circuit wiring to engine magneto is damaged (see Chapter 8 – Electrical Diagrams). Circuit wiring to carburetor solenoid is loose, corroded, or damaged (see Chapter 8 – Electrical Diagrams). Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Engine).

## Coring Head Operating Problems

Problem	Possible Causes
Coring head runs (but should not) when raised.	Aeration #3 proximity switch is faulty or out of adjustment.
Coring head does not lower.	Fuse F3 (10 Amp) or F4 (2 Amp) is/are faulty. Raise/lower switch is faulty. SVL valve solenoid is faulty. Aerator Control Module is faulty. "OK to lower" circuit is not functioning (see OK to Lower Circuit in Circuit Operation section of this chapter). Hydraulic problem exists (see Chapter 4 – Hydraulic System).
Coring head does not raise.	Fuse F3 (10 Amp) or F4 (2 Amp) is/are faulty. Lift reset switch needs to be reset. Raise/lower switch is faulty. SVR or SVQ valve solenoid is faulty. Aerator Control Module is faulty. Hydraulic problem exists (see Chapter 4 – Hydraulic System).
Electric clutch does not engage.	Fuse F2 (10 Amp) is faulty. Coring head is not lowered. Clutch relay is faulty. Aeration #3 proximity switch is faulty or out of adjustment. Circuit wiring to electric clutch is loose, corroded, or damaged (see Chapter 8 – Electrical Diagrams). Diode D3 is faulty. Electric clutch is faulty.
Electric clutch is noisy.	Clutch is loose on engine crankshaft. Clutch strap is loose or damaged. Broken leaf spring(s) on clutch. Failed clutch bearing(s).
Clutch is slipping.	Lubricant has contaminated clutch lining material. Gap between clutch rotor and armature is excessive.

# 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 (16° to 38° C). The ignition key should be in the OFF position 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 the 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 should 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 3400 RPM (high idle). 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	= 12.25 v
Battery Voltage after 3 Minute Charge	= 12.80 v
Difference	= +0.55 v

---

## Check Operation of Safety Interlock System



### CAUTION

**Do not disconnect interlock switches. They are for the operator's protection. Check operation of the switches daily to make sure the interlock system is operating correctly. If a switch is not operating properly, adjust or replace it before operating the machine.**

Interlock switch operation is described in the ProCore 648 Operator's Manual. The ProCore is equipped with an Aerator Control Module which monitors interlock switch operation. Information on this Control Module is described in the Operator's Manual and in the Component Testing section of this Chapter. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

The Safety Interlock System of the ProCore 648 ensures the following operations:


1. The engine should crank only when the traction lever is in the neutral position.
2. When aerating, if the traction lever is released from the forward position (moved to the neutral or reverse position), the coring head should automatically raise and the coring crankshaft should stop rotating.
3. If the coring head is stranded in the lowered position, the coring head will not raise unless the lift reset switch is depressed.

# 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 be performed through voltage drop tests without disconnecting the component.

**NOTE:** See the Kohler Engine Service Manual for engine 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 Switch

The ignition (key) switch has three positions (OFF, RUN, and START) (Fig. 7). The terminals are marked as shown in Figure 8.

### Testing

The circuitry of the ignition switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position.

Unplug wire harness connectors from switch and verify continuity between switch terminals. Reconnect the harness connectors to the switch after testing.

POSITION	CIRCUIT
OFF	G + M + A
RUN	B + L + A
START	B + L + S

The Aerator Control Module monitors the operation of the ignition switch. If the ignition switch is in the ON position, the Module power input LED should be illuminated. If the ignition switch is in the START position, the Module start output LED should also be illuminated.

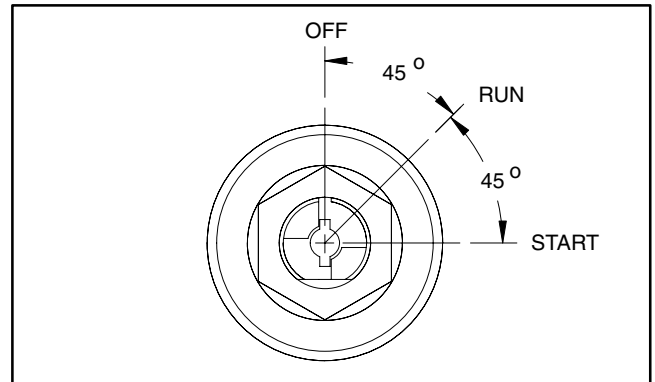


Figure 7

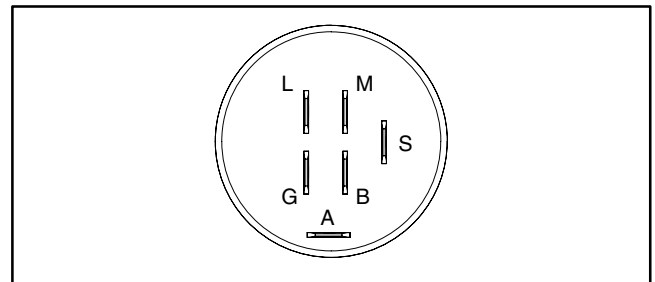


Figure 8

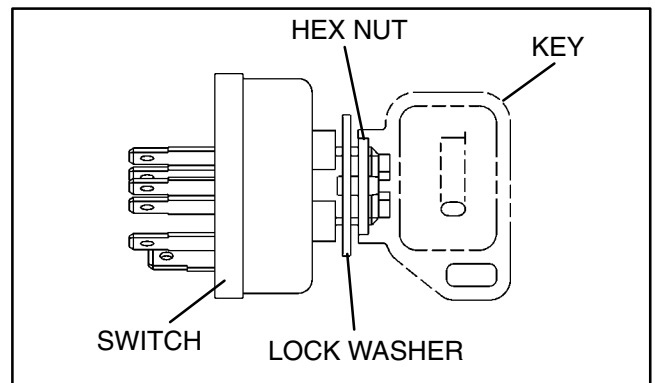


Figure 9

Electrical System

## Engine Oil Pressure Indicator Light

The engine oil pressure indicator light is located on the handle control panel (Fig. 10). The indicator 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 if the engine oil pressure is insufficient.

**IMPORTANT: If the engine oil pressure indicator light comes on when the engine is running, shut engine off immediately.**

### Testing

1. Turn the ignition switch to ON. The engine oil pressure indicator light should be on.
2. If the light is not on, locate the oil pressure switch on the engine and disconnect the wire from the switch. Ground the disconnected wire to the engine block.
3. If the light comes on, the oil pressure switch is faulty.
4. If the light does not come on, check the indicator light and indicating circuit (see Electrical Schematic in Chapter 8 – Electrical Diagrams).

### Testing Indicator Light

1. Apply 12 VDC to terminal 1A (Fig. 11).
2. Ground terminal 1B (Fig. 11).
3. Indicator light should illuminate.

**NOTE:** For engine oil pressure switch information, refer to the Kohler Engine Service Manual at the end of Chapter 3 – Engine.



Figure 10

1. Oil pressure indicator light

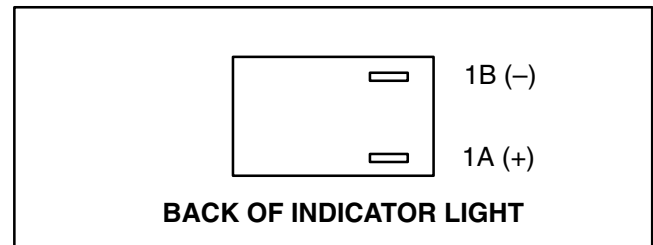


Figure 11

## Hour Meter

The hour meter used on the ProCore 648 uses an inductive pickup wire connected to the rear spark plug wire to sense when the engine is running. The hour meter should increase 1/10 of an hour every six (6) minutes of engine running time.

The hour meter uses its own internal battery and therefore, is not connected to the ProCore 12 volt electrical system. The hour meter battery is not replaceable.

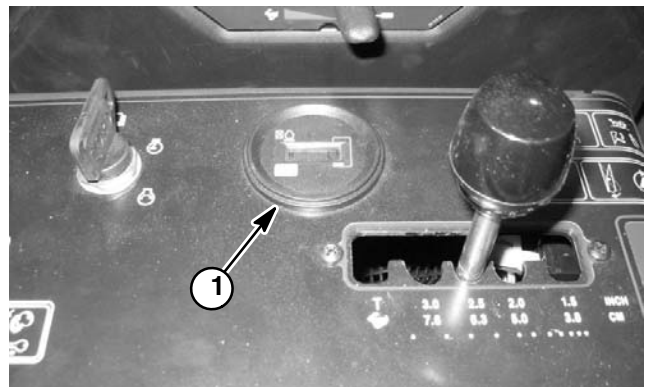


Figure 12

1. Hour meter

## Relays

Six (6) relays are used on the ProCore 648. Four (4) of these relays are attached under the control panel next to the battery (Fig. 13): lockout relay, clutch relay, neutral switch (start) relay and lockout latch relay. The remaining two (2) relays are attached under the handle console (Fig. 14): neutral switch (latch) relay and latching relay. The six relays are identical. The relays are identified by a tag on the wire harness relay connector.

See the Circuit Operation section of this Chapter for information on relay operation.

### Testing

**NOTE:** Prior to taking small resistance readings with a digital multimeter, short the meter 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. Locate relay to be tested. Disconnect the machine wire harness connector from the relay.
2. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 15). Resistance should be between 70 and 90 ohms.
3. 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.
4. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.
6. Disconnect voltage and multimeter leads from the relay terminals. Reconnect relay to machine wire harness.

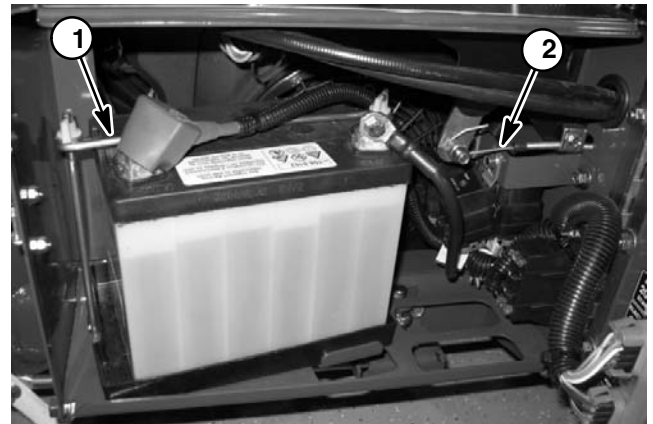


Figure 13

1. Battery
2. Relay location

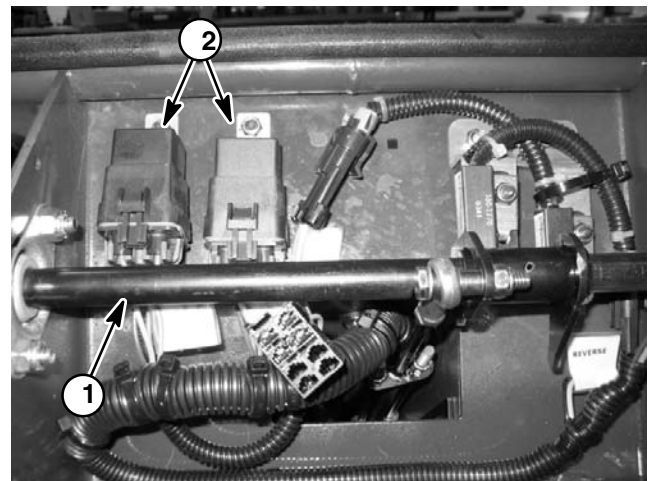


Figure 14

1. Traction lever
2. Relay

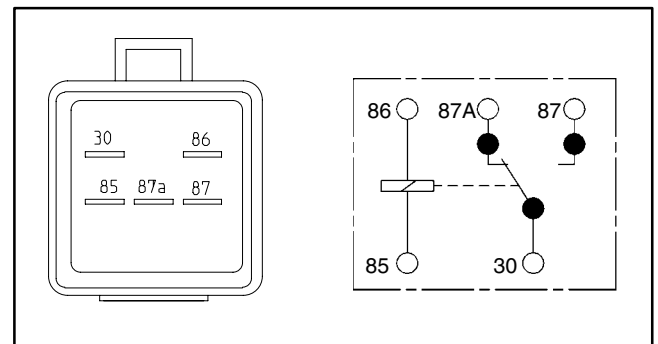


Figure 15

## Manual Raise/Lower Switch

The manual raise/lower switch is located on the handle control panel (Fig. 16). This rocker switch is one of the components in the "OK to lower" circuit which is one of the aerator control module inputs. See OK to Lower Circuit in the Circuit Operation section of this chapter for additional raise/lower switch information.

The switch terminals are marked as shown in Figure 17. The circuitry of the raise/lower switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
RAISE	NONE	NONE
MIDDLE/ AERATE	2 + 3	NONE
LOWER (MOMENTARY)	2 + 3	5 + 6

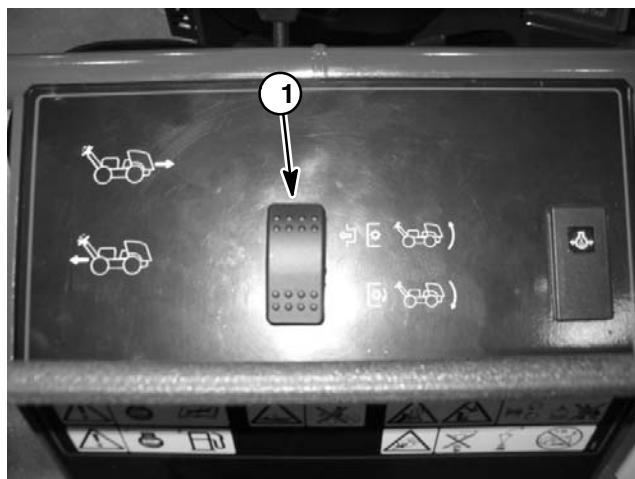


Figure 16

1. Manual raise/lower switch

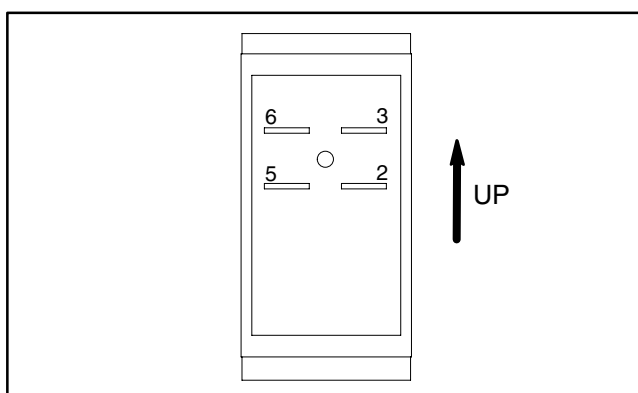


Figure 17



## Ground Follow Switch

The ground follow switch is located on the side of the control panel (Fig. 18). This rocker switch allows the True Core™ ground following system to be turned on/off. The switch is retained in position by a cap screw and nut placed in the switch guard to prevent accidental switch movement. In the normal, upper switch position, the True Core™ ground following system is ON. The True Core™ ground following system is OFF when the switch is in the lower position.

The switch terminals are marked as shown in Figure 19. The circuitry of the ground follow switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
UP (ON)	2 + 3	5 + 6
DOWN (OFF)	1 + 2	4 + 5

The Aerator Control Module monitors the operation of the ground follow switch. If the ground follow switch is in the ON (up) position, the Control Module ground follow LED should be illuminated when the ignition switch is ON (Fig. 20). If the ground follow switch is in the OFF (lower) position, the Module ground follow output LED should not be illuminated.

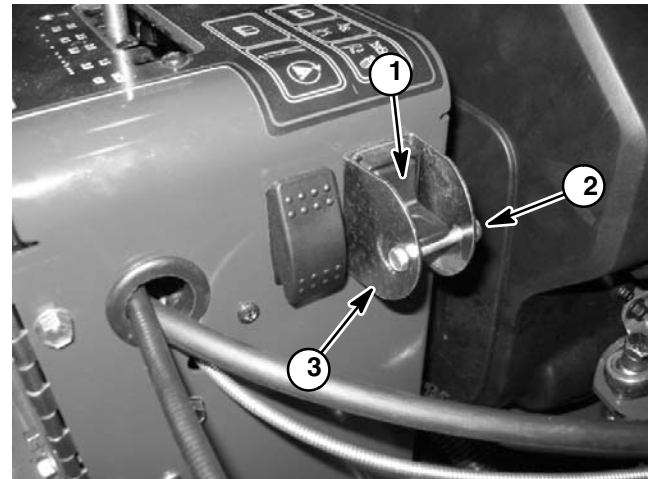


Figure 18

1. Ground follow switch
2. Cap screw & nut
3. Switch guard

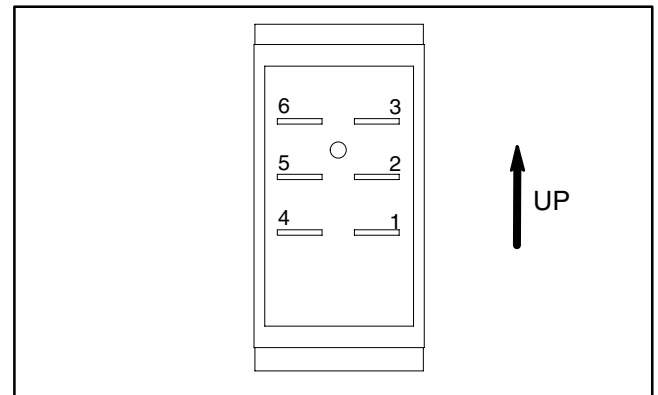


Figure 19

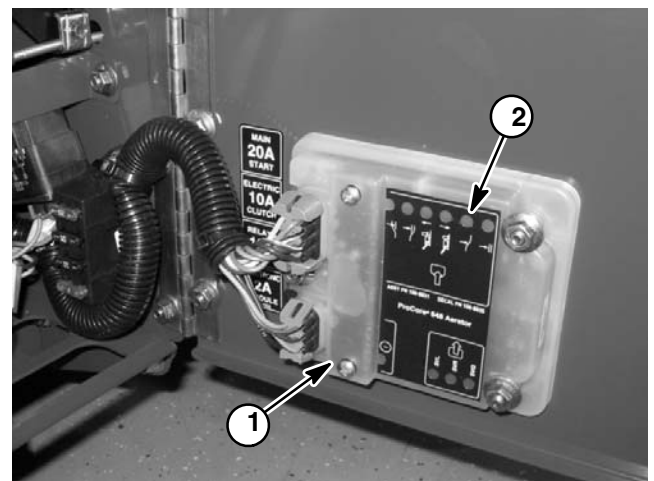


Figure 20

1. Control module
2. Ground follow LED

## Lift Reset Switch

The lift reset switch is located on the control panel (Fig. 21). This momentary rocker switch raises the coring head in instances when the coring head has been stranded in the aerating (lowered) position (e.g. engine runs out of gas, coring head stuck). By depressing the lift reset switch, the coring head lift system will reset, the coring head will raise fully and normal coring head operation can resume.

The switch terminals are marked as shown in Figure 19. The circuitry of the lift reset switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
NORMAL	2 + 3	5 + 6
MOMENTARY ON (RESET)	1 + 2	4 + 5

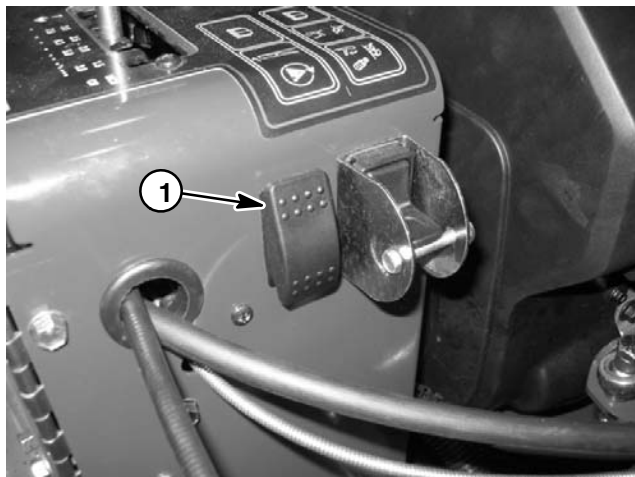


Figure 21

### 1. Lift reset switch

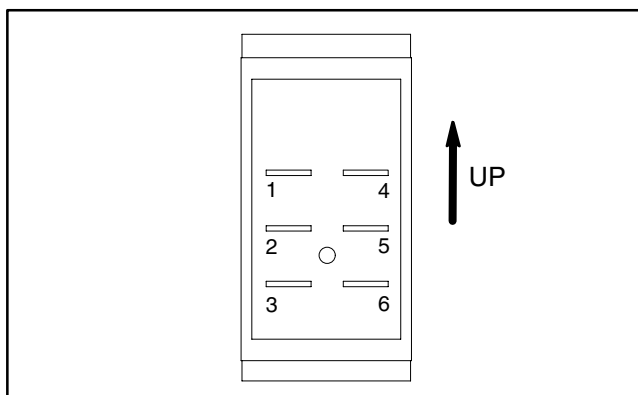


Figure 22

## Solenoid Valve Coil

The hydraulic system on the ProCore 648 uses three (3) solenoid valve coils on the hydraulic lift control manifold (Fig. 23). The aerator control module provides current to the solenoid valve coils based on the position of several inputs. A LED on the aerator control module will be illuminated when the solenoid valve coils are energized (Fig. 24).

**NOTE:** The solenoid does not have to be removed from the cartridge valve for testing.

1. Make sure ignition switch is in the OFF position. Unplug solenoid valve electrical connector.
2. Apply 12VDC source directly to the solenoid. Listen for solenoid to switch on.
3. Remove 12VDC source from the solenoid. Listen for solenoid to switch off.

**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.

4. Measure resistance between the two coil connector terminals. Resistance of the solenoid coil should be approximately 8.7 ohms.
5. Reconnect electrical connector to the solenoid.
6. If solenoid coil needs replacement, see Solenoid Valve Coil in the Service and Repairs section of this chapter.

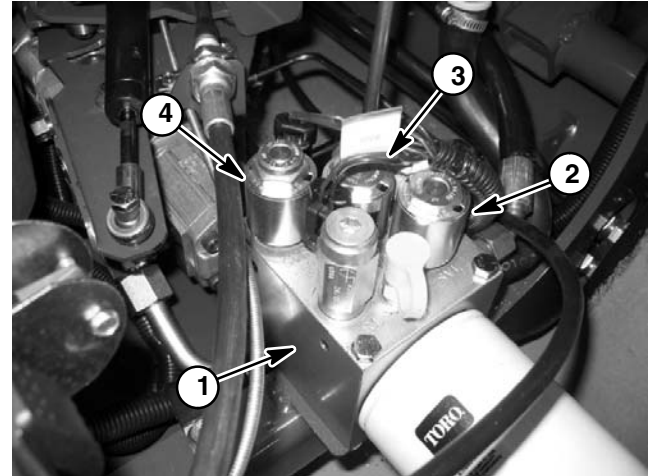


Figure 23

- |                          |                      |
|--------------------------|----------------------|
| 1. Lift control manifold | 3. SVQ solenoid coil |
| 2. SVL solenoid coil     | 4. SVR solenoid coil |

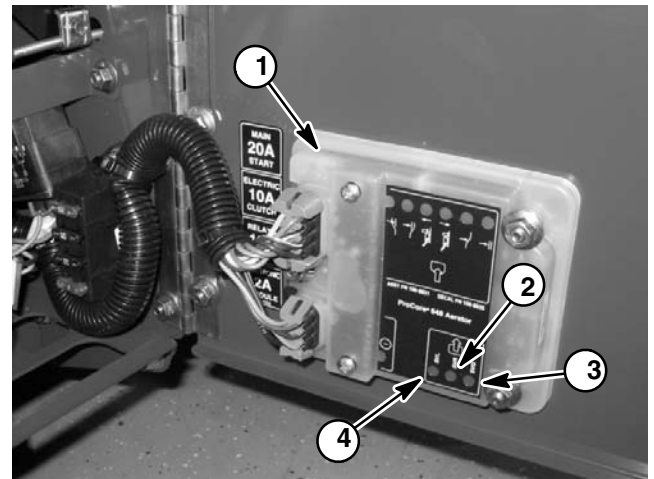


Figure 24

- |                     |                     |
|---------------------|---------------------|
| 1. Control module   | 3. SVQ solenoid LED |
| 2. SVR solenoid LED | 4. SVL solenoid LED |

## Head Low and Head High Limit Switches

The head low and head high limit switches are attached to the coring depth control housing (Fig. 25). These switches are normally open and close when the switch actuator in the housing is rotated past the switch. The head low and head high limit switches provide inputs for the True Core™ ground following system on the ProCore 648.

The Aerator Control Module monitors the operation of the head low and head high limit switches. With the coring head raised and the ignition switch in the ON position (engine not running), the Module head high input LED should be illuminated and the head low input LED should not be illuminated. By slowly raising the outer turf guard, the head high input LED should go out. If the outer turf guard continues to be raised, the head low input LED will illuminate slightly later.

While aerating with the ProCore, the turf guards follow surface undulations. With the True Core™ ground following system on, the Aerator Control Module receives an input if the turf guards move enough to close either the head high or head low limit switch. The Control Module uses that input to allow a current output to the appropriate hydraulic solenoid (SVR or SVL) to raise or lower the coring head slightly.

### Head Low and Head High Switch Test

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Locate switch on depth control housing. Disconnect the switch electrical connector.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

A. The head high switch should be closed (continuity) with the coring head raised and the turf guards extended. The switch should open (no continuity) if the turf guards are manually raised.

B. The head low switch should be open (no continuity) with the coring head raised and the turf guards extended. The switch should close (continuity) if the turf guards are manually raised.

4. Reconnect the switch electrical connector.

5. If switch replacement is necessary, apply small amount of grease onto the switch ball before installing switch in depth control housing.

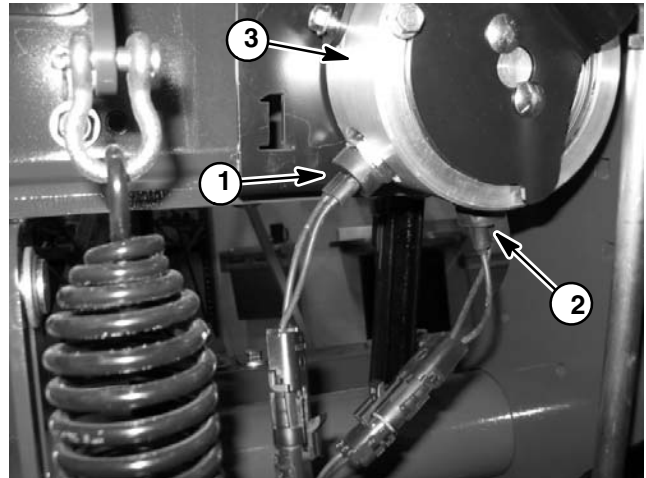


Figure 25

- 1. Head high switch
- 2. Head low switch
- 3. Depth control housing

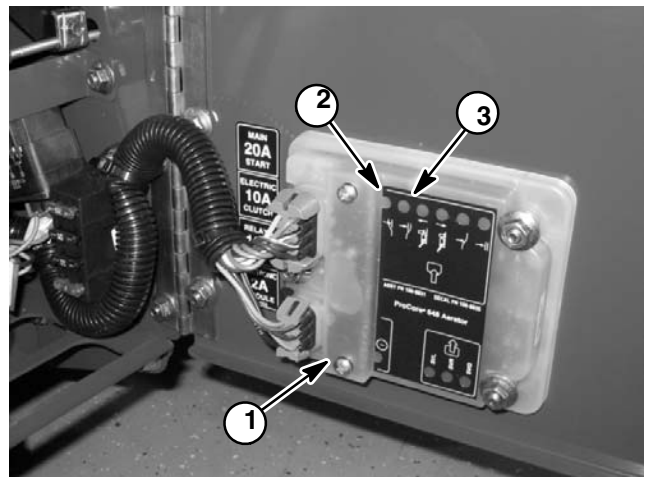


Figure 26

- 1. Control module
- 2. Head low LED
- 3. Head high LED

## Fuses

The fuse block is located behind the console cover (Fig. 27).

### Identification, Function, and Wiring

The fuses are held in the fuse block. Use Figure 28 to identify each individual fuse and its correct amperage. Each fuse holder has the following functions:

Fuse 1 (20 Amp): Supplies power to ignition switch terminal B.

Fuse 2 (10 Amp): Supplies power to electric clutch.

Fuse 3 (10 Amp): Supplies power from ignition switch terminal S.

Fuse 4 (2 Amp): Supplies power to aerator control module.

### Testing

Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

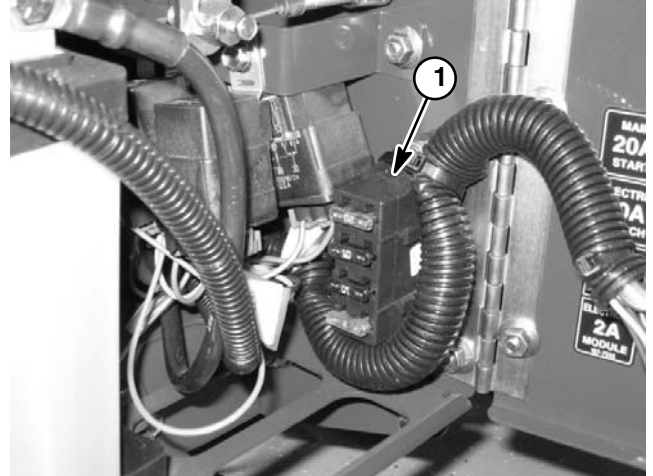


Figure 27

1. Fuse block

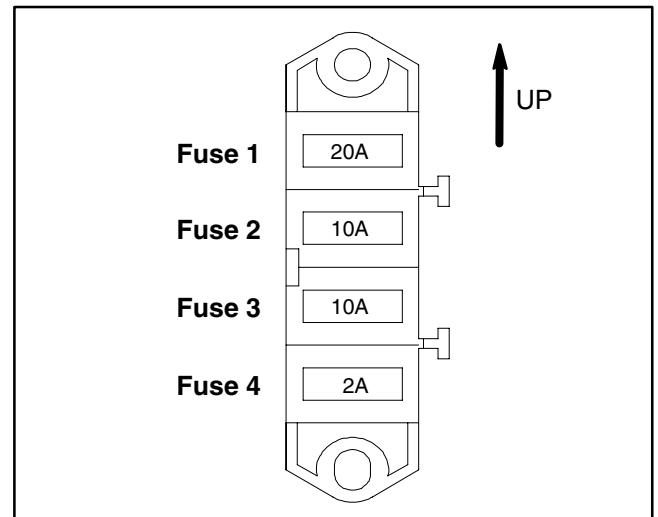


Figure 28

## Proximity Switches

The ProCore 648 uses six (6) identical proximity switches. These switches are normally open switches that close when a sensing plate is positioned near the target end of the switch (Fig. 32).

The reverse and neutral proximity switches are mounted on the control handle under the handle console (Fig. 29). They use sensing plates pinned to the traction lever.

The transport limit #1 (top) and #2 switches and aeration #3 and #4 (bottom) switches are mounted on a mounting bracket attached to the right rear frame (Fig. 30). The sensing plate for these switches is welded to the coring head H-frame.

The neutral proximity switch is used in the starting circuit to make sure that the traction lever is in the neutral position when starting the engine. This switch is closed when the traction bail is in the neutral position and opens when the bail is moved to either the forward or reverse direction.

The reverse proximity switch is one of the components used in the "OK to lower" circuit that acts as an input for the aerator control module. This proximity switch is closed when the traction lever is in either the neutral or reverse position. When the traction lever is moved to the forward direction, the reverse proximity switch opens.

The transport limit #1 proximity switch is closed when the coring head is fully raised and opens almost immediately as the coring head begins to lower. This switch is used as an input for the aerator control module to indicate that the coring head is in the transport (raised) position. Transport limit #1 switch operation can be monitored using the control module transport #1 input LED.

The transport limit #2 proximity switch is closed when the coring head is fully raised and opens as the coring head is being lowered. This switch is one of the components in the lockout circuit used to provide current for the raise and lower solenoids.

The aeration #3 proximity switch is closed as the coring head is lowering to allow the electric clutch to be energized. The switch opens as the coring head is raising.

The aeration #4 proximity switch is closed when the coring head is fully lowered and opens as the coring head begins to raise. This switch is used as an input for the aerator control module to identify when the coring head is in the aerate position. Aeration #4 switch operation can be monitored using the control module aerate #4 input LED.

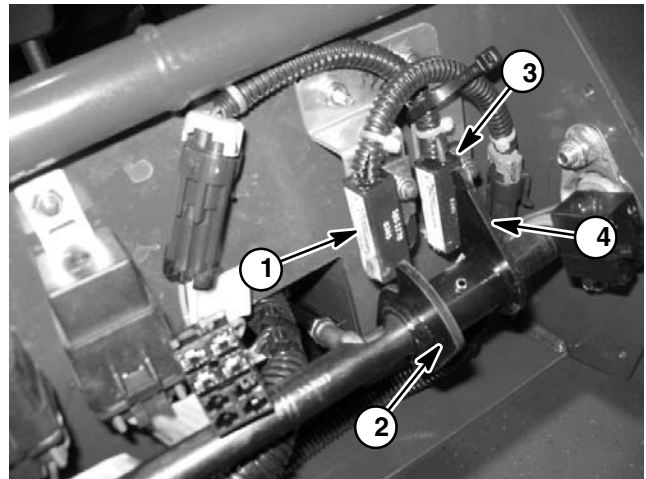


Figure 29

- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Reverse proximity switch | 3. Neutral proximity switch |
| 2. Reverse sensing plate    | 4. Neutral sensing plate    |

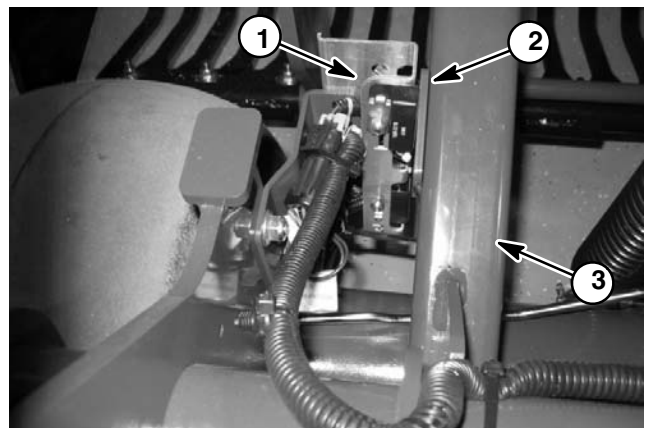


Figure 30

- |                         |                        |
|-------------------------|------------------------|
| 1. Switch mount bracket | 3. Coring head H-frame |
| 2. Sensing plate        |                        |

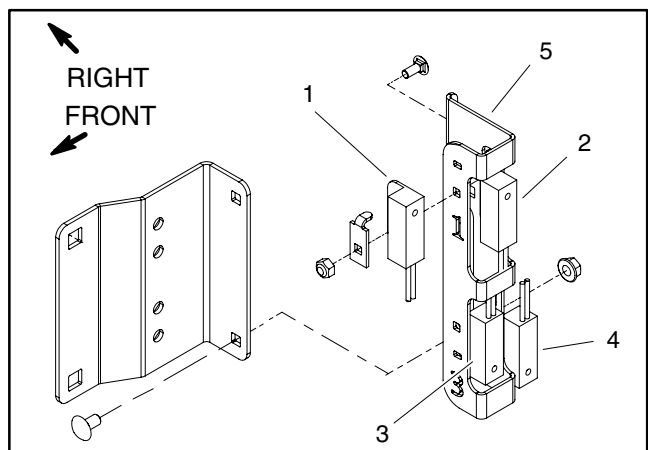


Figure 31

- |                       |                         |
|-----------------------|-------------------------|
| 1. Transport limit #1 | 4. Aeration #4          |
| 2. Transport limit #2 | 5. Switch mount bracket |
| 3. Aeration #3        |                         |

## Proximity Switch Test

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Locate proximity switch to be tested. Disconnect proximity switch from machine wiring harness.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

**NOTE:** Before checking switch continuity, clean target end of switch to make sure that there is no metallic debris on the switch that could prevent correct switch operation.

4. With the sensing plate positioned near the target end of the switch, there should be continuity across the switch terminals.

5. When the sensing plate is positioned away from the target end of the switch, there should be no continuity across the switch terminals.

6. Replace proximity switch as needed. Reconnect switch to machine wiring harness.

## Proximity Switch Installation

When installing a proximity switch to the machine, place tab on switch plate into switch mounting hole nearest target end of switch (Fig. 32). Secure proximity switch and switch plate to switch mount with carriage screw and lock nut.

The switch mounting bracket that retains the transport limit and aeration proximity switches (Fig. 30) should be mounted to allow from .030" to .090" (.8 to 2.3 mm) clearance between the switch targets and sensing plate on the coring head H-frame.

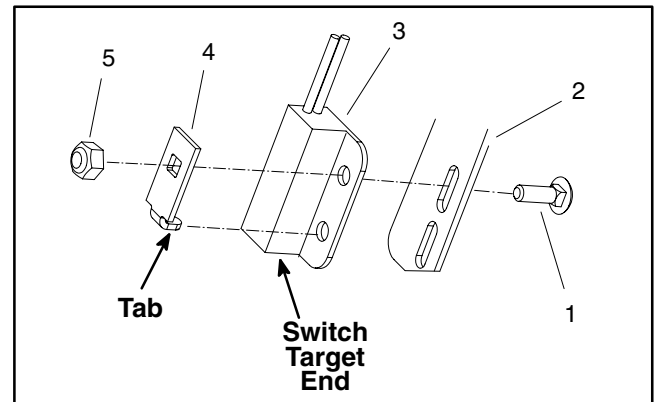


Figure 32

- |                     |                 |
|---------------------|-----------------|
| 1. Carriage screw   | 4. Switch plate |
| 2. Switch mount     | 5. Lock nut     |
| 3. Proximity switch |                 |

## Aerator Control Module

The ProCore 648 is equipped with an Aerator Control Module to monitor and control electrical components required for safe operation. This Module is located on the inside of the console cover (Fig. 33).

Inputs from the start (ignition), head low limit, head high limit, transport limit #1 proximity switch, aeration #4 proximity switch and ground follow switches are monitored by the Module. The condition (open or closed) of the "OK to lower" circuit is also monitored by the Module. Output to the three hydraulic solenoid valves (lower SVL, raise SVR and quick raise SVQ) are controlled based on the inputs received by the Module.

The Aerator Control Module does not connect to an external computer or hand held device, can not be re-programmed and does not record intermittent fault data.

The Aerator Control Module can be used to check operation of machine switches by monitoring the LED's of the module. If a module LED does not illuminate (e.g. the ground follow LED does not illuminate when the ground follow switch is in the ON position), testing of the switch and circuit wiring would be required.

### Control Module Inputs

The power input LED should be illuminated when the ignition switch is in the ON position.

The head low input LED should be illuminated when the head low limit switch is closed.

The head high input LED should be illuminated when the head high limit switch is closed.

The transport #1 input LED should be illuminated when the transport limit #1 proximity switch is closed (coring head raised).

The aerate #4 input LED should be illuminated when the aeration #4 proximity switch is closed (coring head lowered).

The ground follow ON LED should be illuminated when the ground follow switch is in the ON position.

The "OK to lower" input LED should be illuminated when the "OK to lower" circuit is closed (see OK to Lower Circuit in the Circuit Operation section of this chapter).

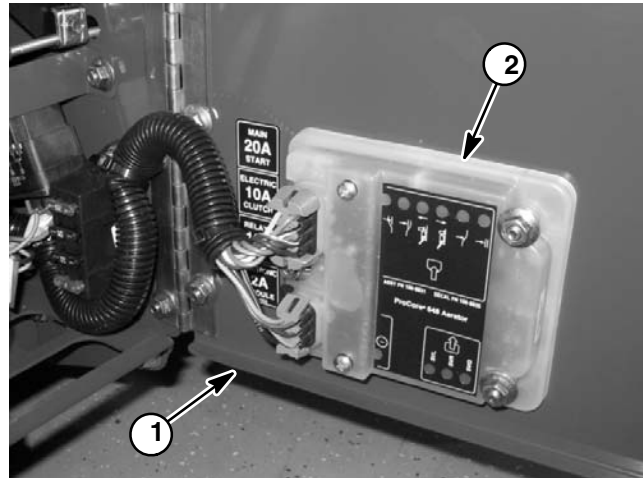


Figure 33

1. Console cover                      2. Control module

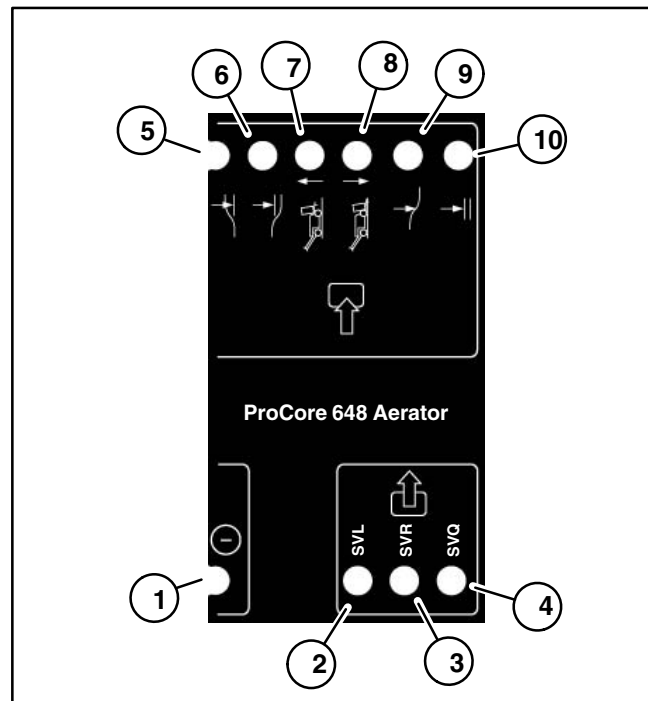


Figure 34

- |                       |                             |
|-----------------------|-----------------------------|
| 1. Power input LED    | 6. Head high input LED      |
| 2. SVL output LED     | 7. Transport #1 input LED   |
| 3. SVR output LED     | 8. Aerate #4 input LED      |
| 4. SVQ output LED     | 9. Ground follow ON LED     |
| 5. Head low input LED | 10. "OK to lower" input LED |



## Control Module Outputs

1. The SVQ output LED will be illuminated in two situations:

- A. Both "OK to lower" and transport #1 LED's **are not** illuminated.
- B. "OK to lower" LED **is** illuminated and aerate #4 LED **is not** illuminated.

2. The SVL output LED will be illuminated in three situations:

- A. "OK to lower" LED **is** illuminated and ground follow LED **is not** illuminated.
- B. Both "OK to lower" and ground follow LED's **are** illuminated and aerate #4 LED **is not** illuminated.
- C. "OK to lower", ground follow, aerate #4 and head high limit LED's **are** all illuminated.

3. The SVR output LED will be illuminated in two situations:

- A. Both "OK to lower" and transport #1 LED's **are not** illuminated.
- B. "OK to lower", ground follow, aerate #4 and head low limit LED's **are** all illuminated.

## Electric Clutch

An electric clutch is used to engage the coring head on the ProCore 648. The electric clutch is mounted on the engine crankshaft and engages when current is applied to the clutch. The clutch also incorporates a magnetic brake to stop clutch rotation when the clutch is de-energized.

When the "OK to lower" latching circuit is closed and the coring head is lowered enough to close the aeration #3 proximity switch, the clutch relay will be energized. This energized relay provides a current path to energize and engage the clutch. See Electric Clutch Circuit in the Circuit Operation section of this chapter for additional electric clutch information.

### Testing

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

1. Remove pump belt cover from machine (see Operator's Manual).

2. Remove exhaust system shield (see Exhaust System Removal in the Service and Repairs section of Chapter 3 – Kohler Engine).

3. Locate electric clutch on engine crankshaft (Fig. 35). Unplug machine wire harness connector from clutch.

4. For accurate resistance measuring, clutch should be at approximately 68°F (20°C) when coil resistance is measured.

**NOTE:** Prior to taking small resistance readings with a digital multimeter, short the meter 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.

5. Using a multimeter (ohms setting), verify clutch coil resistance between the two terminals of the clutch wire connector. Coil resistance should be 1.75 to 1.93 ohms.

6. If coil resistance is incorrect, replace clutch.

7. Measure gap between clutch rotor and armature (Fig. 36). Gap should be less than .125" (3.18 mm). This gap is not adjustable and increases as clutch components wear. If gap exceeds .125" (3.18 mm), replace clutch.

8. As an additional test, apply 12 volts to the terminals of the clutch. The clutch should engage. If clutch does not engage when voltage is applied, replace clutch.

9. If clutch removal is necessary, see Electric Clutch in the Service and Repairs section of this chapter.

10. Install exhaust system shield (see Exhaust System Installation in the Service and Repairs section of Chapter 3 – Kohler Engine).

11. Install pump belt cover to machine (see Operator's Manual).

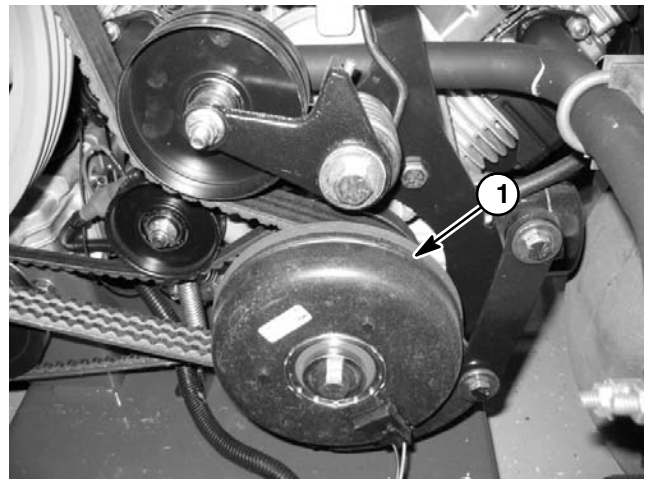


Figure 35

1. Electric clutch

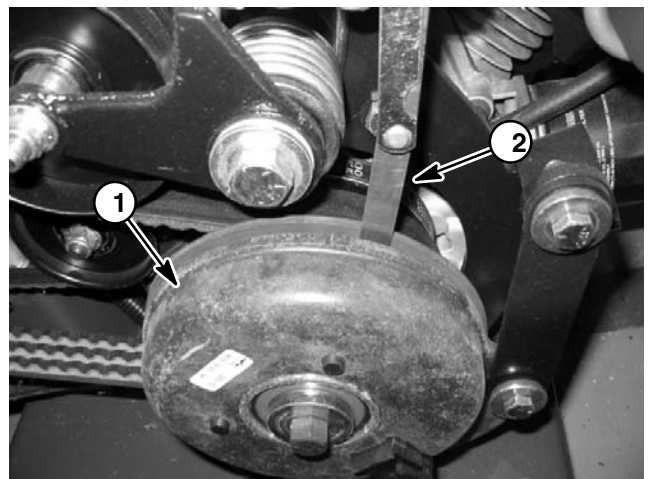


Figure 36

1. Electric clutch

2. Feeler gauge

## Diode Assemblies

Diodes D1, D2 and D3 provide logic for the latch relays used in the ProCore 648. Diode D4 is used for circuit protection from voltage spikes when the electric clutch is de-energized. The diodes plug into the wiring harness at various locations (see Wire Harness Drawings in Chapter 8 – Electrical Diagrams).

### Diode Test

The diodes (Fig. 37) can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

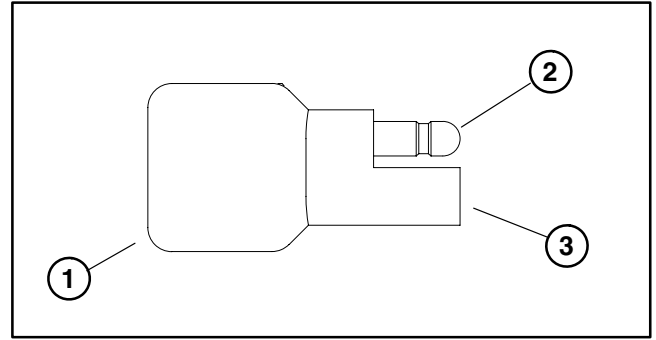


Figure 37

- 1. Diode
- 2. Male terminal
- 3. Female terminal

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

# Service and Repairs

**NOTE:** See the Kohler Engine Service Manual for engine component repair information.

## Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the battery and charge it fully (see Battery Service).
2. Either store battery on a shelf or on the machine.
3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged before storing the battery/machine (see Battery Service).

## Battery Care

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

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



### WARNING

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



### WARNING

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

**IMPORTANT: Do not remove battery filler caps while cleaning battery.**

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

B. Spray battery terminals with Battery Terminal Protector (Toro Part No. 107-0392) to prevent cable and terminal corrosion. Petroleum jelly can be used as well.

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107-0392) or petroleum jelly to prevent corrosion.

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

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

## Battery Service

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

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

### Battery Specifications

BCI Group Size U1  
300 CCA at 0° F (-18° C)  
Reserve Capacity of 28 minutes at 80°F (27°C)

### Dimensions (including terminal posts and handle)

Length 7.7 inches (19.6 cm)  
Width 5.2 inches (13.2 cm)  
Height 7.2 inches (18.3 cm)

### Electrolyte Specific Gravity

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

## Removal and Installation (Fig. 38)

1. Loosen and remove negative (-) cable from battery. After negative cable is removed, loosen and remove positive (+) cable.
2. Remove wing nuts and washers that secure battery hold down rod. Slide hold down rod away from battery.
3. Carefully remove battery from machine.
4. Install battery in reverse order making sure to connect positive (+) cable to battery before connecting negative (-) cable.

**NOTE:** Before connecting the negative (ground) cable, 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 machine's electrical system should be tested and repaired.

5. After battery cables have been connected to battery, make sure that speed selector lever does not come within 1 inch (25.4 mm) of either battery cable when moved through its entire range of motion. Also check that battery cables do not contact rotating screen on engine.

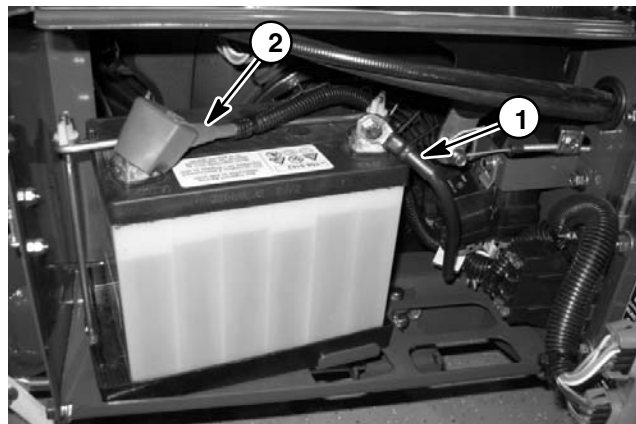


Figure 38

1. Negative battery cable
2. Positive battery cable

## Inspection and Maintenance

1. Check for cracks in battery case. Replace battery if cracked or leaking.
2. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

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

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.
4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.
5. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled water** between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

## Testing

1. To properly test a battery, perform a high-discharge test using 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.

 <span style="font-size: 24pt; font-weight: bold; margin-left: 10px;">CAUTION</span>
<p><b>Follow the manufacturer's instructions when using a battery load tester.</b></p>

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

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

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

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

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

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

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

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	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.

2. If a battery load tester is not available, the battery can be tested by conducting a hydrometer test of the battery electrolyte.

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

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

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

Example: Cell Temperature	100°F
Cell Gravity	1.245
100°F minus 80°F equals 20°F	
(37.7°C minus 26.7°C equals 11.0°C)	
20°F multiply by 0.004/10°F equals 0.008	
(11°C multiply by 0.004/5.5°C equals 0.008)	
ADD (conversion above)	<u>0.008</u>
Correction to 80°F (26.7°C)	1.253

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

## 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 charger.

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

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

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

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

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



## 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.

# Electric Clutch

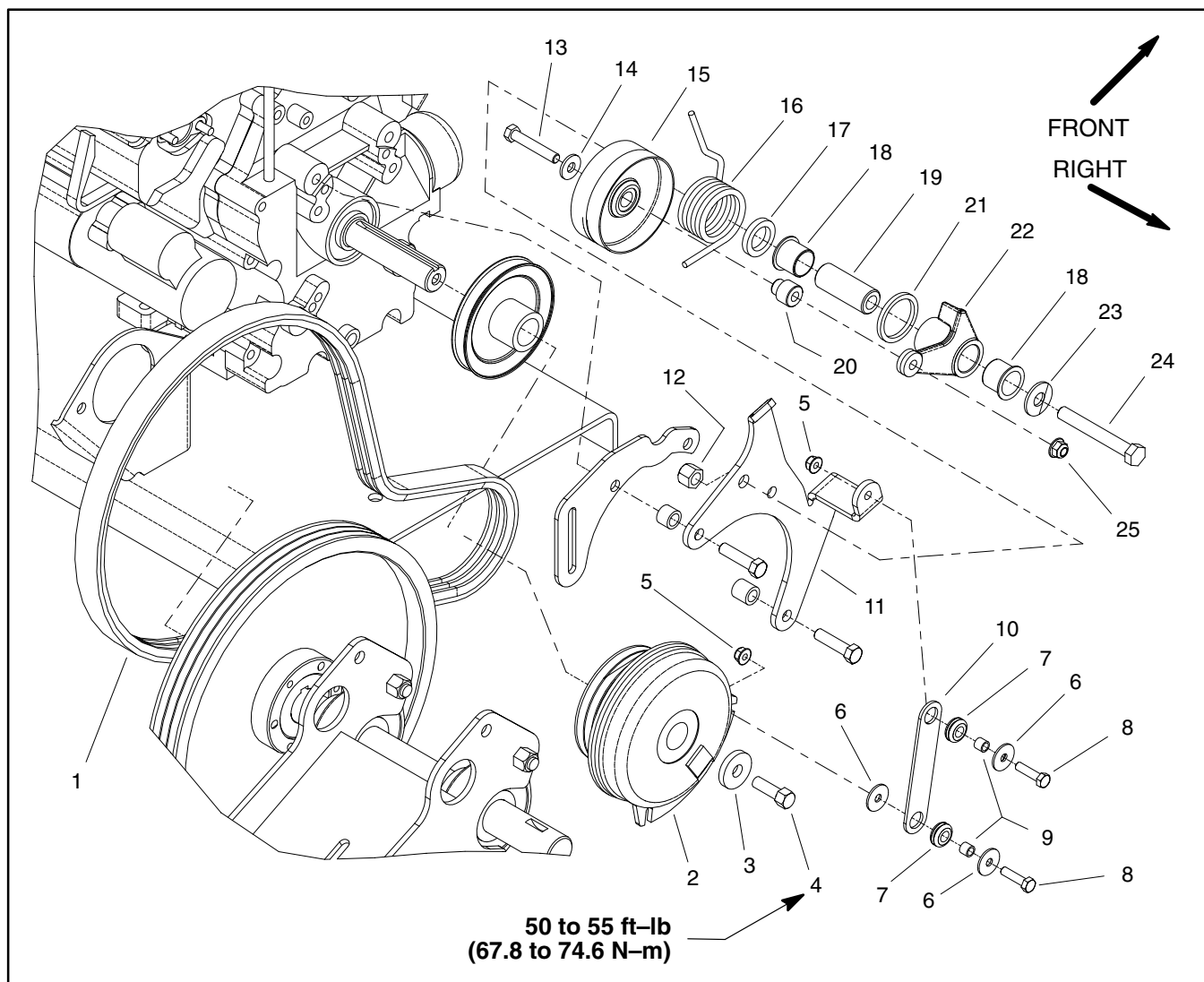


Figure 39

- 1. Drive belt
- 2. Electric clutch
- 3. Hardened washer
- 4. Cap screw
- 5. Flange nut
- 6. Flat washer
- 7. Brake grommet
- 8. Cap screw
- 9. Spacer

- 10. Clutch strap
- 11. Idler mounting bracket
- 12. Lock nut
- 13. Cap screw
- 14. Hardened washer
- 15. Idler pulley
- 16. Torsion spring
- 17. Spacer

- 18. Flange bushing
- 19. Pivot sleeve
- 20. Idler spacer
- 21. Washer
- 22. Idler arm
- 23. Flat washer
- 24. Cap screw
- 25. Flange nut



### Removal (Fig. 39)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove pump belt cover from machine (see Operator's Manual).
3. Remove muffler heat shield (see Exhaust System in the Service and Repairs section of Chapter 3 – Kohler Engine).
4. Unplug wiring harness connector from clutch.
5. Remove primary drive belt (coring head) (see Primary Drive Belt in the Service and Repairs section of Chapter 7 – Coring Head).
6. Hold hardened washer with pliers to prevent engine crankshaft from turning. Remove cap screw and hardened washer that secure clutch to engine crankshaft.
7. Slide clutch from engine crankshaft.

### Installation (Fig. 39)

1. Apply antisieze lubricant to engine crankshaft. Align clutch hub with engine crankshaft keyway and slide clutch onto crankshaft.
2. Secure clutch to crankshaft with hardened washer and cap screw. Hold hardened washer with pliers to prevent crankshaft from turning and torque cap screw from 50 to 55 ft-lb (67.8 to 74.6 N-m).
3. Install primary drive belt (coring head) (see Primary Drive Belt in the Service and Repairs section of Chapter 7 – Coring Head).
4. Plug wiring harness connector into clutch. Make sure to secure wire harness away from rotating machine components.
5. Install muffler heat shield (see Exhaust System in the Service and Repairs section of Chapter 3 – Kohler Engine).
6. Install pump belt cover to machine (see Operator's Manual).

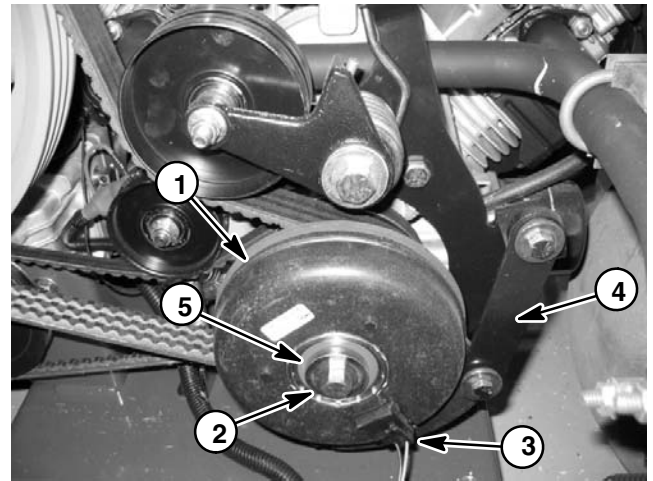


Figure 40

- |                      |                    |
|----------------------|--------------------|
| 1. Electric clutch   | 4. Clutch strap    |
| 2. Cap screw         | 5. Hardened washer |
| 3. Harness connector |                    |

## Solenoid Valve Coil

A solenoid valve coil on the hydraulic lift control manifold (Fig. 41) can be replaced without opening the hydraulic system.

### Removal

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Disconnect the wiring harness electrical connector from the solenoid coil to be replaced.
3. Remove the nut from the spool assembly.
4. Slide the coil assembly from the spool assembly. Discard the coil assembly.
5. Clean any corrosion or dirt from the spool assembly.

### Installation

1. Slide new coil assembly onto the spool assembly.
2. Install the nut onto the spool assembly and torque nut 5 ft-lb (6.8 N-m) (do not over tighten).
3. Connect the solenoid coil to the machine wiring harness.

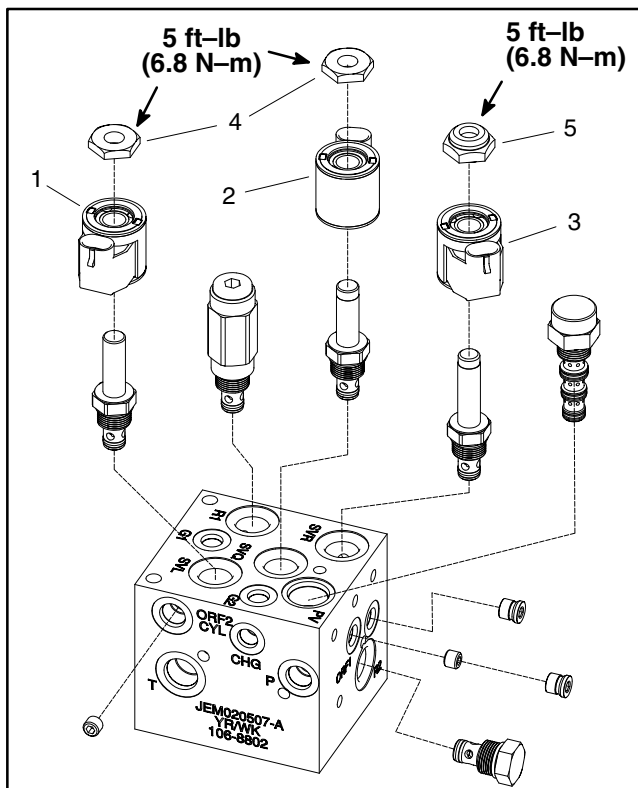


Figure 41

- |                              |        |
|------------------------------|--------|
| 1. Solenoid valve coil (SVL) | 4. Nut |
| 2. Solenoid valve coil (SVQ) | 5. Nut |
| 3. Solenoid valve coil (SVR) |        |



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# Specifications

Item	Description
Front and Rear Tires Size Pressure	19 x 10.5 – 8, 2 Ply, Tubeless 12 PSI (.83 Bar)
Wheel lug nut torque	45 to 55 ft–lb (61 to 75 N–m)
Wheel hub nut torque	190 to 230 ft–lb (258 to 312 N–m)

# Special Tools

Order special tools from your Toro Distributor.

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## Wheel Hub Puller

Part Number: **TOR4097**

The wheel hub puller allows safe removal of the wheel hub from the shaft of wheel motors.



Figure 1

# Service and Repairs

## Wheels

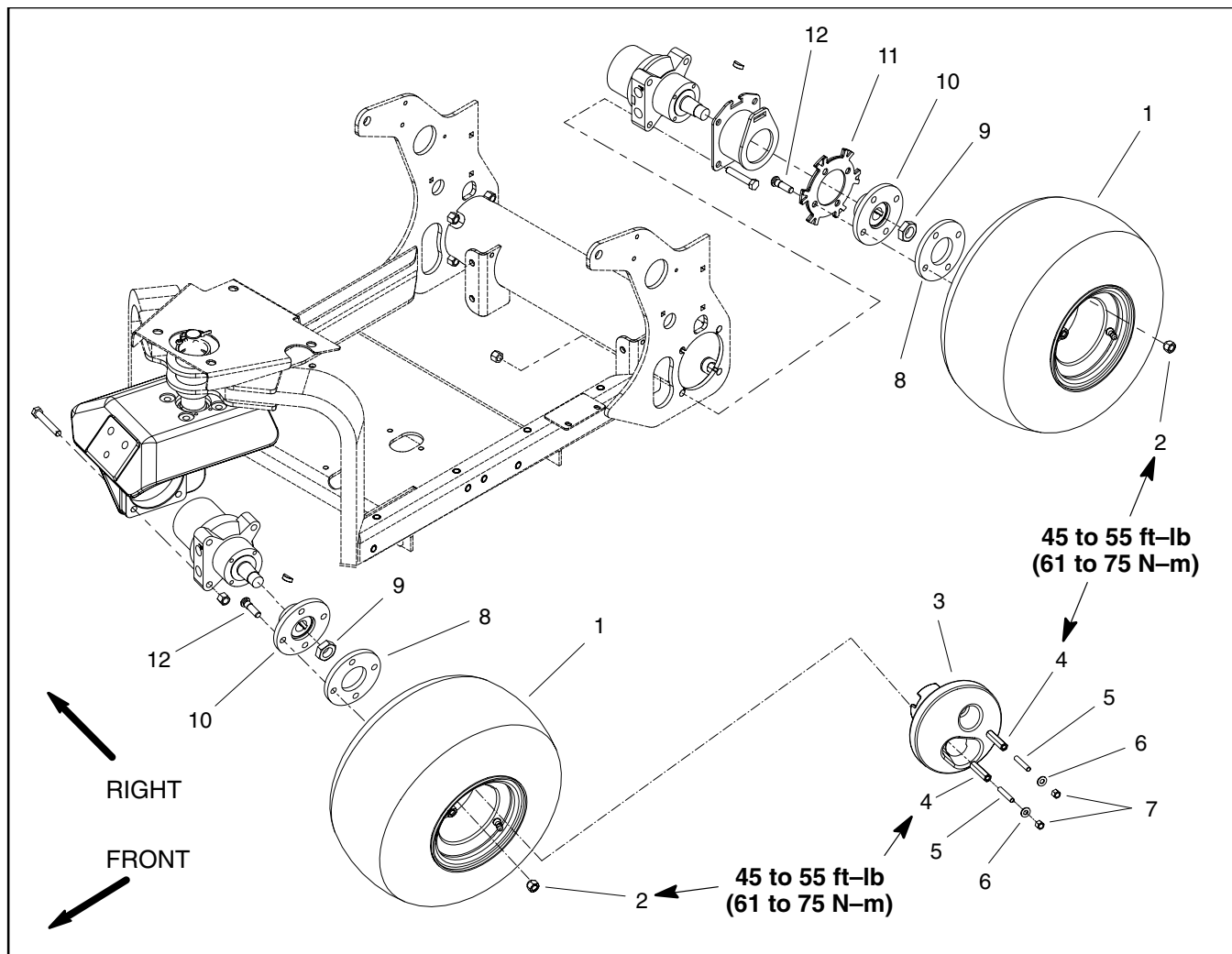


Figure 2

- 1. Tire and wheel assembly
- 2. Lug nut
- 3. Front wheel weight
- 4. Wheel weight adapter

- 5. Weight stud
- 6. Thrust washer
- 7. Lock nut
- 8. Bearing plate

- 9. Lock nut
- 10. Wheel hub
- 11. Parking latch disc
- 12. Wheel stud

## Wheel Removal (Fig. 2)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Jack machine from ground and support machine with blocking or jack stands (see Operator's Manual and Jacking Instructions in Chapter 1 – Safety).

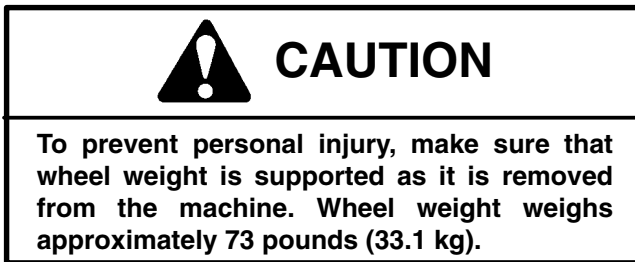
3. If rear wheel is to be removed:

A. Loosen and remove four (4) lug nuts from wheel to be removed.

B. Pull wheel from machine.

4. If front wheel is to be removed:

A. Remove two (2) lock nuts and thrust washers that secure wheel weight to wheel.



B. Carefully slide wheel weight from weight studs.

C. Loosen and remove two (2) lug nuts and two (2) wheel weight adapters with weight studs.

D. Pull wheel from machine.

## Wheel Installation (Fig. 2)

1. If rear wheel was removed:

A. Position rear wheel to wheel hub.

B. Secure wheel to machine with four (4) lug nuts. Torque lug nuts from 45 to 55 ft-lb (61 to 75 N-m).

2. If front wheel was removed:

A. If weight studs were removed from wheel weight adapters, thread studs fully into the correct end of the adapter (Fig. 3).

B. Position front wheel to wheel hub.

C. Secure wheel to machine with two (2) lug nuts and two (2) wheel weight adapters. Torque wheel fasteners from 45 to 55 ft-lb (61 to 75 N-m).



D. Carefully slide wheel weight to wheel.

E. Secure wheel weight with two (2) thrust washers and lock nuts.

3. Lower machine to ground. Remove service latch from coring head before machine use.

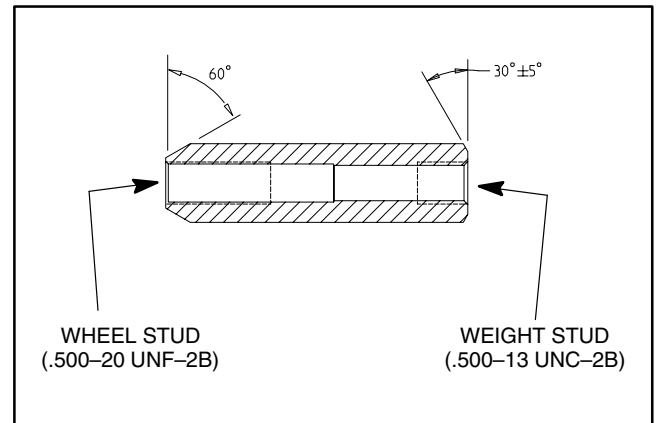


Figure 3

# Parking Brake

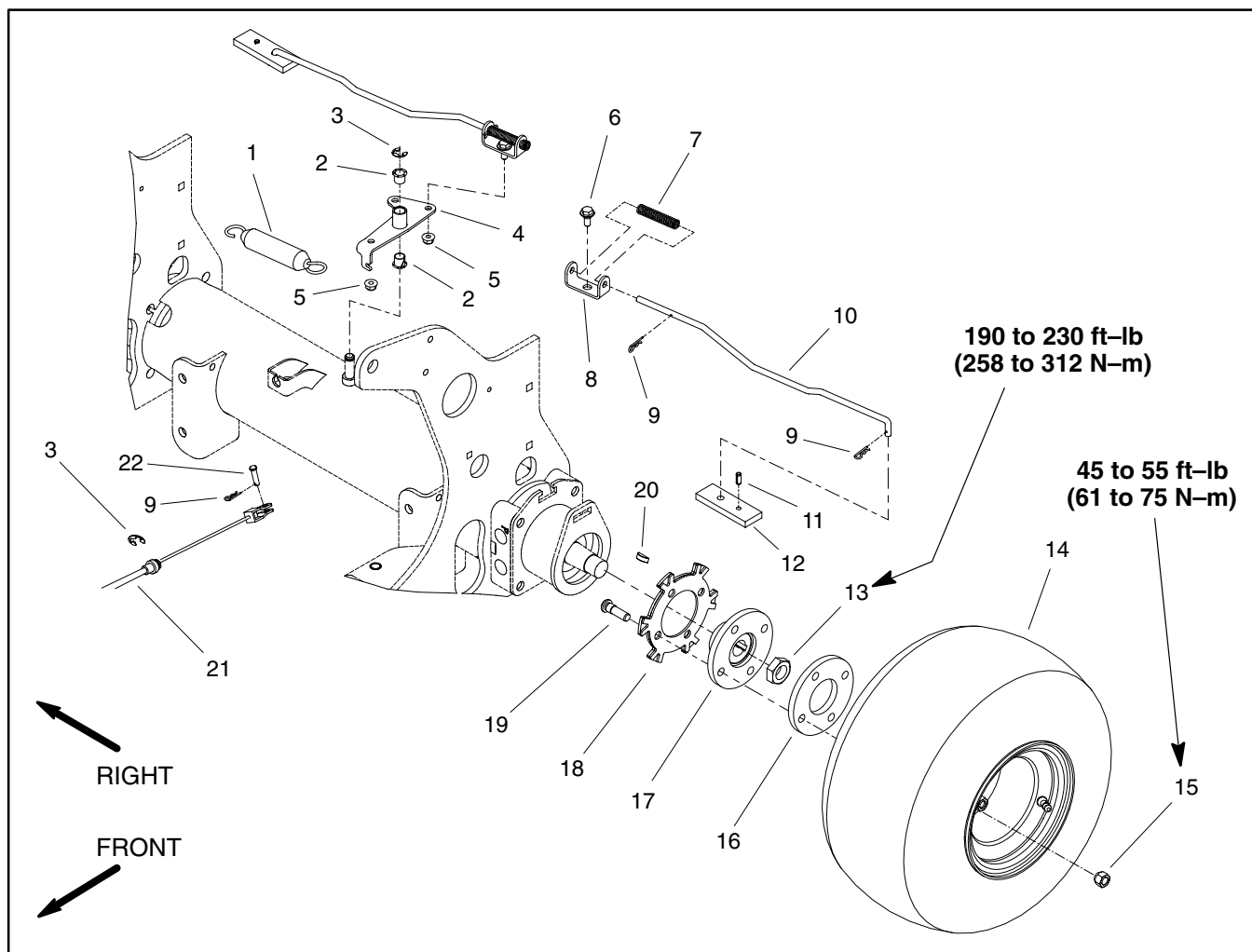


Figure 4

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"> <li>1. Extension spring</li> <li>2. Bushing</li> <li>3. Retaining ring</li> <li>4. Parking latch pivot</li> <li>5. Flange nut</li> <li>6. Shoulder bolt</li> <li>7. Compression spring</li> <li>8. Parking latch clevis</li> </ul> | <ul style="list-style-type: none"> <li>9. Hair pin</li> <li>10. Parking latch link</li> <li>11. Roll pin</li> <li>12. Parking latch bar</li> <li>13. Lock nut</li> <li>14. Tire and wheel assembly</li> <li>15. Lug nut (4 used per wheel)</li> </ul> | <ul style="list-style-type: none"> <li>16. Bearing plate</li> <li>17. Wheel hub</li> <li>18. Parking latch disc</li> <li>19. Drive stud (4 used per wheel)</li> <li>20. Woodruff key</li> <li>21. Parking brake cable</li> <li>22. Clevis pin</li> </ul> |
|---|---|--|



## Removal (Fig. 4)

1. Park machine on a level surface, fully raise coring head, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Make sure parking brake is disengaged.
3. Block front wheel. Jack or hoist rear of machine from ground and support machine with blocking or jack stands (see Operator's Manual and Jacking Instructions in Chapter 1 – Safety).
4. Remove rear wheel assembly (see Wheel Removal in this section).



5. Remove parking brake components as needed using Figure 4 as a guide.
6. If parking latch disc requires removal:
  - A. Loosen, but do not remove, nut that secures wheel hub to wheel motor shaft.

**IMPORTANT: To prevent damage to hydraulic motor, DO NOT hit wheel hub or motor with a hammer during wheel hub removal or installation.**

- B. Loosen wheel hub assembly from motor shaft using wheel hub puller (see Special Tools). Once wheel hub is loose on shaft, remove nut and wheel hub from motor shaft. Locate and retrieve woodruff key from motor shaft.
  - C. Remove wheel studs to allow separation of parking latch disc, wheel hub and bearing plate.
7. Clean all parts. Inspect parking latch bar and parking latch disc for excessive wear or damage. Replace any damaged parts.

## Installation (Fig. 4)



1. Install removed parking brake components using Figure 4 as a guide.
2. If wheel hub assembly was removed:
  - A. Make sure that wheel studs are installed through parking latch disc, wheel hub and bearing plate.
  - B. Make sure that wheel motor shaft and wheel hub taper are thoroughly cleaned.
  - C. Position woodruff key into wheel motor shaft.
  - D. Install wheel hub assembly to wheel motor shaft and secure with nut. Torque nut from 190 to 230 ft-lb (258 to 312 N-m).
3. Install wheel assembly (see Wheel Installation in this section).
4. Lower machine to ground. Remove service latch from coring head before machine use.

# Parking Brake Cable

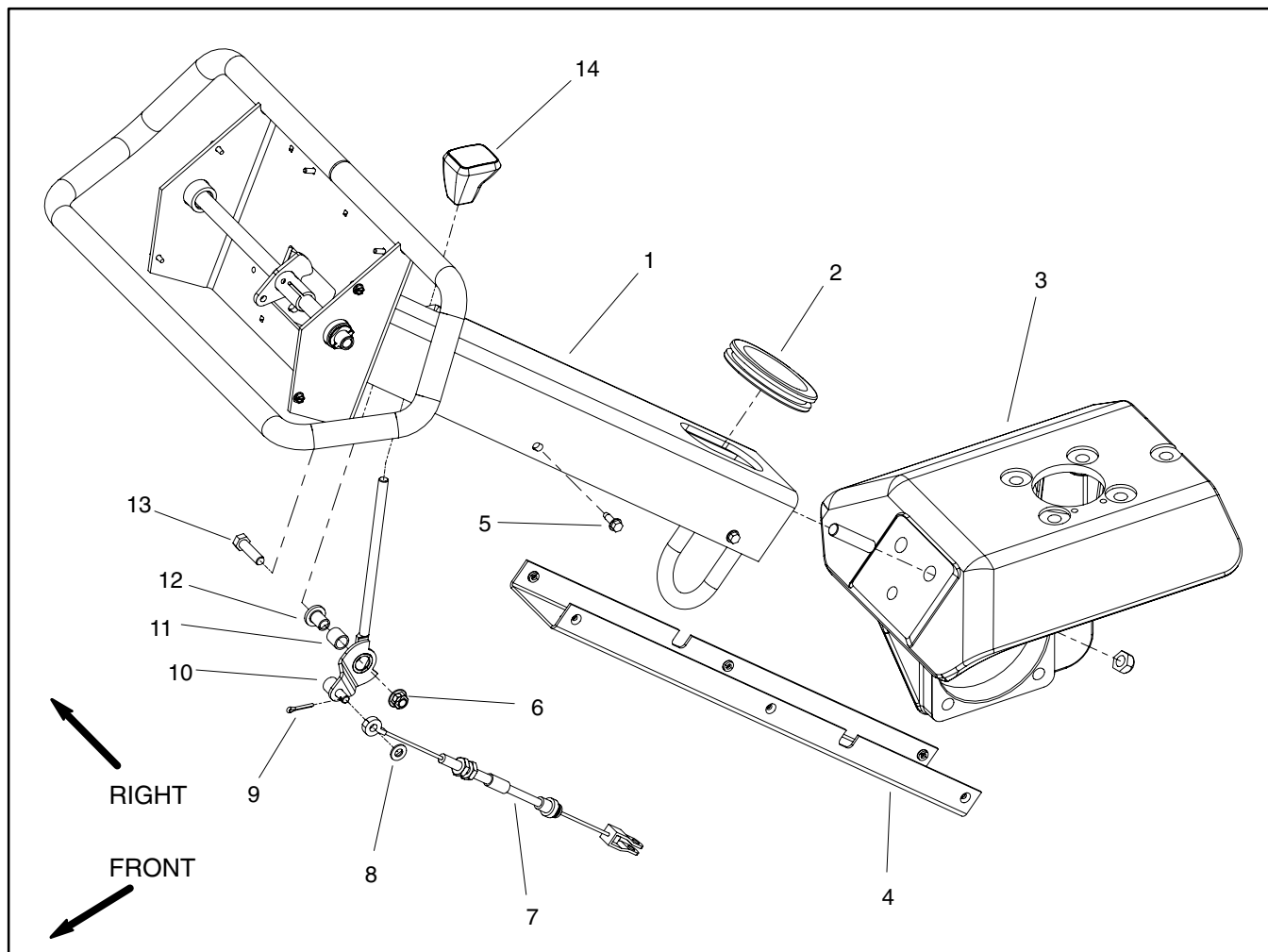


Figure 5

- 1. Control handle
- 2. Grommet
- 3. Steering arm
- 4. Lower handle cover
- 5. Washer head screw (6 used)

- 6. Flange nut
- 7. Brake cable
- 8. Flat washer
- 9. Cotter pin
- 10. Brake lever

- 11. Bushing
- 12. Brake spacer
- 13. Cap screw
- 14. Knob

### Removal (Fig. 3)

1. Park machine on a level surface, fully raise coring head, stop engine and remove key from the ignition switch. Secure coring head with service latch. Make sure that parking brake is not engaged.

2. Remove six (6) washer head screws that secure lower handle cover to control handle. Remove lower handle cover.

3. Loosen jam nut that secures parking brake cable to underside of control handle.

4. Remove cotter pin and flat washer that retain brake cable to brake lever. Slide brake cable from brake lever.

5. Remove brake cable from parking latch pivot on rear cross tube of frame (Fig. 6):

A. Remove hairpin and clevis pin that secure parking brake cable clevis to parking latch pivot.

B. Remove retaining ring that secures brake cable to rear cross tube of frame.

6. Note routing of parking brake cable. Remove parking brake cable from machine.

### Installation (Fig. 3)

1. Position new parking brake cable to machine noting original routing.

2. Secure brake cable to parking latch pivot on rear cross tube of frame (Fig. 6):

A. Position parking brake cable clevis to parking latch pivot and secure with clevis pin and hairpin.

B. Secure brake cable to rear cross tube of frame with retaining ring.

3. Position brake cable end to parking brake lever. Secure cable to lever with flat washer and cotter pin.

4. Secure parking brake cable to underside of control handle with jam nuts.

5. Position lower handle cover to control handle and secure with six (6) washer head screws.

6. Make sure that steering components do not contact cables or wire harness.

7. Remove service latch from coring head before machine use.

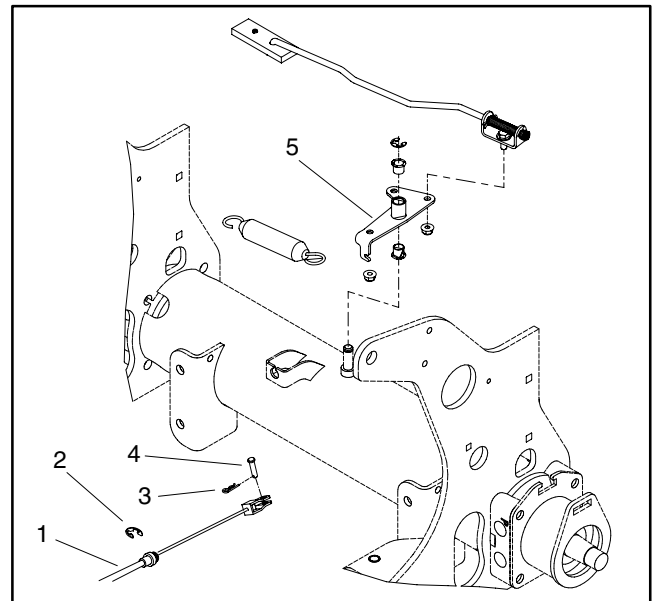


Figure 6

- |                   |                        |
|-------------------|------------------------|
| 1. Brake cable    | 4. Clevis pin          |
| 2. Retaining ring | 5. Parking latch pivot |
| 3. Hairpin        |                        |

# Steering Assembly

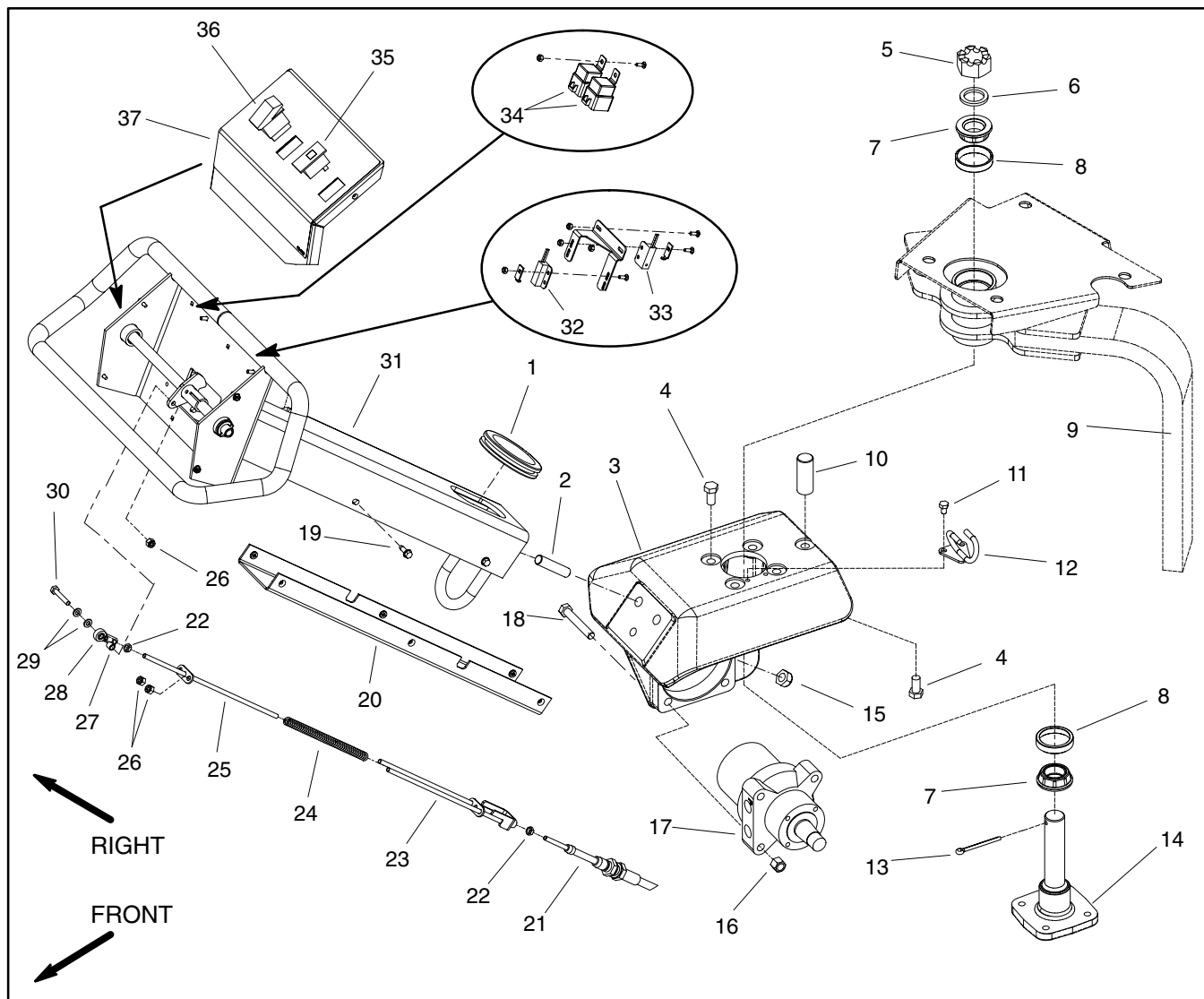


Figure 7

- |                        |                                |                                  |
|------------------------|--------------------------------|----------------------------------|
| 1. Grommet             | 14. Steering spindle           | 26. Lock nut                     |
| 2. Stud (3 used)       | 15. Lock nut (3 used)          | 27. Spacer                       |
| 3. Steering arm        | 16. Lock nut (4 used)          | 28. Ball joint                   |
| 4. Cap screw (5 used)  | 17. Wheel motor                | 29. Flat washer                  |
| 5. Slotted hex nut     | 18. Cap screw (4 used)         | 30. Cap screw                    |
| 6. Washer              | 19. Washer head screw (6 used) | 31. Control handle               |
| 7. Bearing cone        | 20. Lower handle cover         | 32. Neutral proximity switch     |
| 8. Bearing cup         | 21. Traction control cable     | 33. Reverse proximity switch     |
| 9. Frame               | 22. Jam nut                    | 34. Relay (neutral and latching) |
| 10. Steering stop      | 23. Spring retainer            | 35. Cap screw                    |
| 11. Cap screw (2 used) | 24. Compression spring         | 36. Raise/lower switch           |
| 12. Cable guide        | 25. Override rod               | 37. Handle control cover         |
| 13. Cotter pin         |                                |                                  |

## Disassembly (Fig. 7)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Block rear wheels. Jack front of machine from ground and support machine with blocking or jack stands (see Operator's Manual and Jacking Instructions in Chapter 1 – Safety).
3. Remove front wheel assembly (see Wheel Removal in this section).
4. Remove front wheel motor (see Wheel Motor Removal in Service and Repairs section of Chapter 4 – Hydraulic System).
5. Remove fuel tank from machine (see Fuel Tank Removal in Service and Repairs section of Chapter 3 – Kohler Engine).
6. Remove two (2) cap screws that secure cable guide to steering arm. Position cables and wire harness away from steering arm.
7. Support control handle. Remove three (3) lock nuts that secure control handle to steering arm. Slide control handle from steering arm taking care to not damage control cables or wiring harness that will stay attached to machine. Position handle away from steering arm.
8. Support steering arm. Remove cotter pin and slotted hex nut from upper end of steering spindle. Lower steering arm from frame.
9. If necessary, remove steering spindle from steering arm.
10. If necessary, remove control handle from machine:
  - A. Remove six (6) washer head screws that secure lower handle cover to control handle. Remove lower handle cover.
  - B. Remove four (4) screws that secure handle control cover to control handle. Unplug harness connectors from low oil pressure light and raise lower switch on cover.
  - C. Unplug harness connectors from neutral relay, latching relay, neutral proximity switch and reverse proximity switch on control handle.
  - D. Disconnect parking brake cable from brake lever (see Parking Brake Cable Removal in this section).

E. Remove lock nut and cap screw that secure traction control cable to control lever. Locate and retrieve two (2) flat washers. Loosen jam nut that secures parking brake cable to underside of control handle.

11. Inspect bearing cups and cones for wear or damage. Replace worn or damaged components.

## Assembly (Fig. 7)

1. If removed, secure steering spindle to steering arm with four (4) cap screws.
2. If bearing cups were removed from frame, install new cups to frame.
3. Install steering arm to frame:
  - A. Pack bearing cones with grease. Position lower bearing on steering spindle shaft.
  - B. Slide steering shaft up through frame. Position upper bearing and washer on steering spindle shaft.
  - C. Install slotted hex nut onto steering spindle, tighten completely and then back nut off slightly. Retighten nut until drag is felt while rotating steering arm. Back-off nut to align spindle shaft hole with slotted hex nut. Make sure that steering arm rotates freely after slotted hex nut has been tightened.
  - D. Insert cotter pin through slotted hex nut and steering spindle shaft.
4. Assemble steering components in the reverse order of disassembly using Figure 7 as a guide.
5. Lower machine to ground. Remove service latch from coring head before machine use.
6. Make sure that steering components do not contact cables or wire harness.

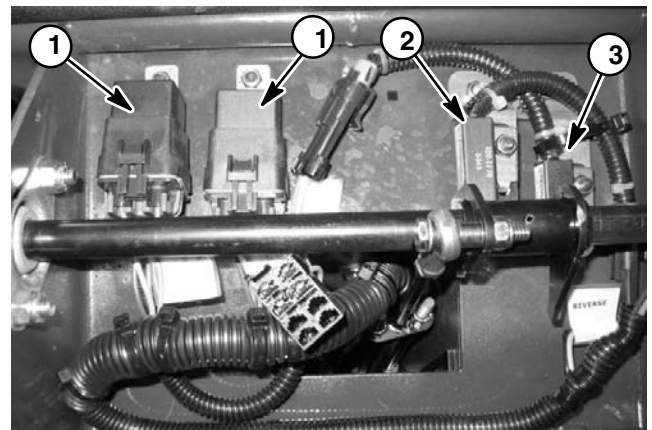


Figure 8

1. Relay
2. Reverse prox switch
3. Neutral prox switch

## Traction Control Cable

### Removal

1. Remove traction control cable from hydraulic pump control (Fig. 10) and traction lever on handle and (Fig. 11).
2. Remove traction control cable from machine noting routing of cable to aid in correct installation.
3. Disassemble traction control cable using Figure 9 as a guide.

### Installation

1. Assemble traction control cable using Figure 9 as a guide. Tighten lock nuts (item 6) so that compression spring (item 4) has a length from 6.750" to 6.880" (17.2 to 17.4 cm).
2. Route traction control cable from traction lever on handle to pump control noting original routing.
3. After assembly, make sure that steering components do not contact traction cable.
4. Check and adjust traction drive for neutral (see Operator's Manual).

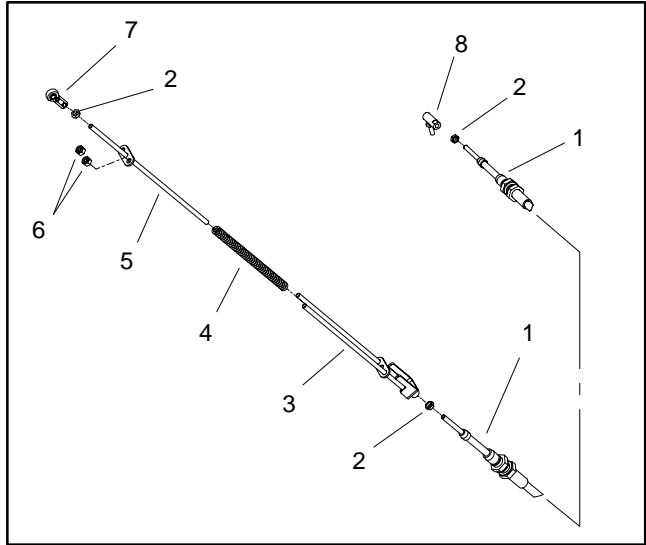


Figure 9

- |                           |                                |
|---------------------------|--------------------------------|
| 1. Traction control cable | 5. Override rod                |
| 2. Jam nut                | 6. Lock nut                    |
| 3. Spring retainer        | 7. Ball joint (traction lever) |
| 4. Compression spring     | 8. Ball joint (pump lever)     |

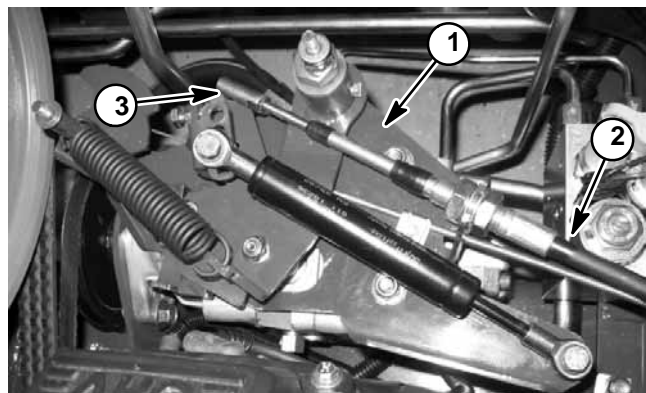


Figure 10

- |                           |                     |
|---------------------------|---------------------|
| 1. Pump control           | 3. Cable ball joint |
| 2. Traction control cable |                     |

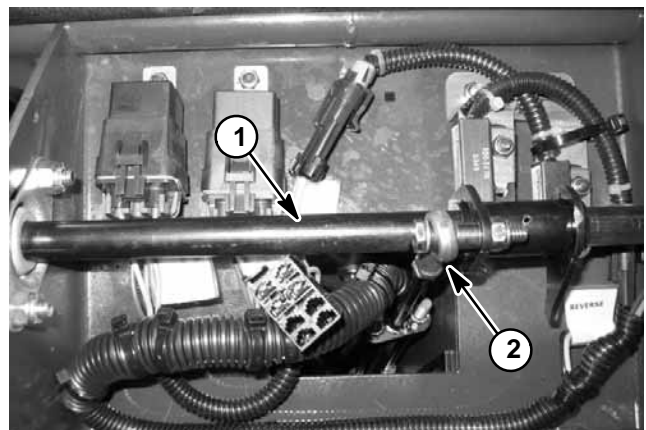


Figure 11

- |                   |                     |
|-------------------|---------------------|
| 1. Traction lever | 2. Cable ball joint |
|-------------------|---------------------|



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# General Information

## Coring Head Operation

The coring head of the Procore 648 consists of a frame that pivots for aerating depth control, a coring crankshaft, stomper arms with rotolinks to provide vertical tine motion, turf holders, tine holders and aerating tines.

Drive for the coring head comes from the engine mounted electric clutch through a primary and secondary drive belt. The primary drive belt drives a jackshaft which in turn drives the coring crankshaft with the secondary drive belt. Each of these drive belts is tensioned by a spring loaded idler pulley.

The coring crankshaft is composed of multiple crankarms, bearings, bearing housings and couplings. For assembly purposes, proper component position is identified by alignment marks on bearing housings and numbers cast into crankarms. Crankshaft journals are timed to ensure minimal vibration.

Aerating depth control is based on tine choice and handled automatically by the TrueCore™ ground following system. Manual depth control aeration can be performed by turning the TrueCore™ System off and adjusting the coring head manual spacers to obtain the desired aerating depth (1/2" increments).

Turf holders are used to prevent damage to the turf as the tines are lifted from the ground. Turf holders also provide inputs for the TrueCore™ ground following system.

A variety of tines, tine heads and turf holders are available for use on the ProCore 648. See the Operator's Manual for available options.



Figure 1

## Coring Crankshaft

The coring crankshaft assembly is composed of six (6) crankarms. One of the crankarms is incorporated into the crankshaft pulley. The crankarms need to be timed for proper aerating operation. For assembly purposes, crankshaft positions are identified as #1 through #6. The #1 position is on the right (pulley) side of the crankshaft (Fig. 2). The crankshaft position is cast into the crankarms to assist in correct crankshaft assembly.

The crankshaft assembly is supported with three identical bearing housing assemblies. The six stomper arms and rotolink dampers used on the ProCore 648 are the same for all positions.

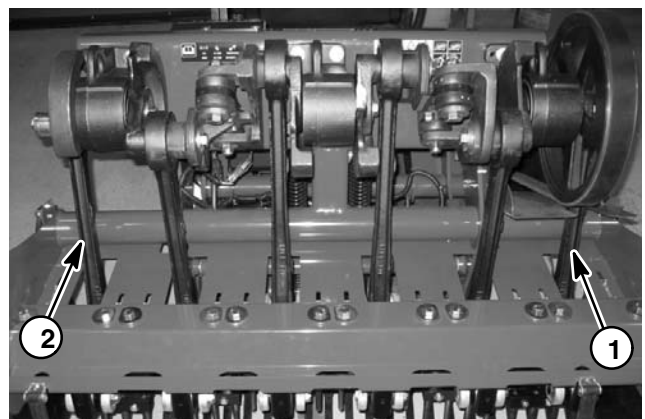


Figure 2

- 1. #1 position
- 2. #6 position



---

## Coring Head Service Latch

Whenever service is to be performed on coring head components, fully raise coring head and install service latch (Fig. 3).

Before using machine, remove service latch from coring head.

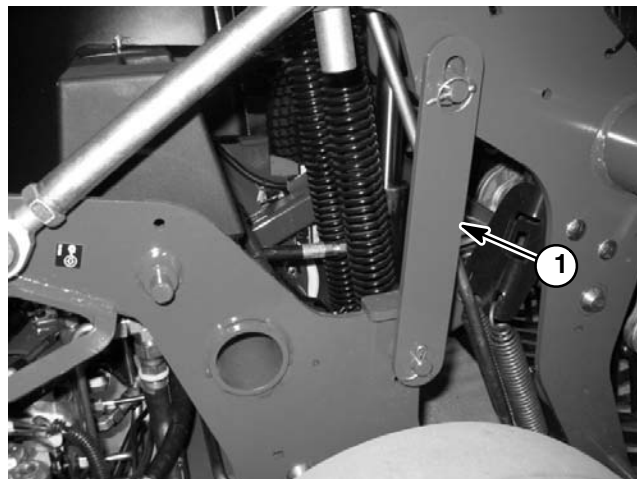


Figure 3

1. Service latch (in raised, locked position)

---

## Coring Head Adjustments

See Operator's Manual for adjustment procedures for the coring head on the ProCore 648.



### CAUTION

Never work on the coring head with the engine running. Always fully raise coring head, stop engine, remove key from the ignition switch and install the coring head service latch before performing any service to coring head components.

# Service and Repairs

## Rotolink Dampers

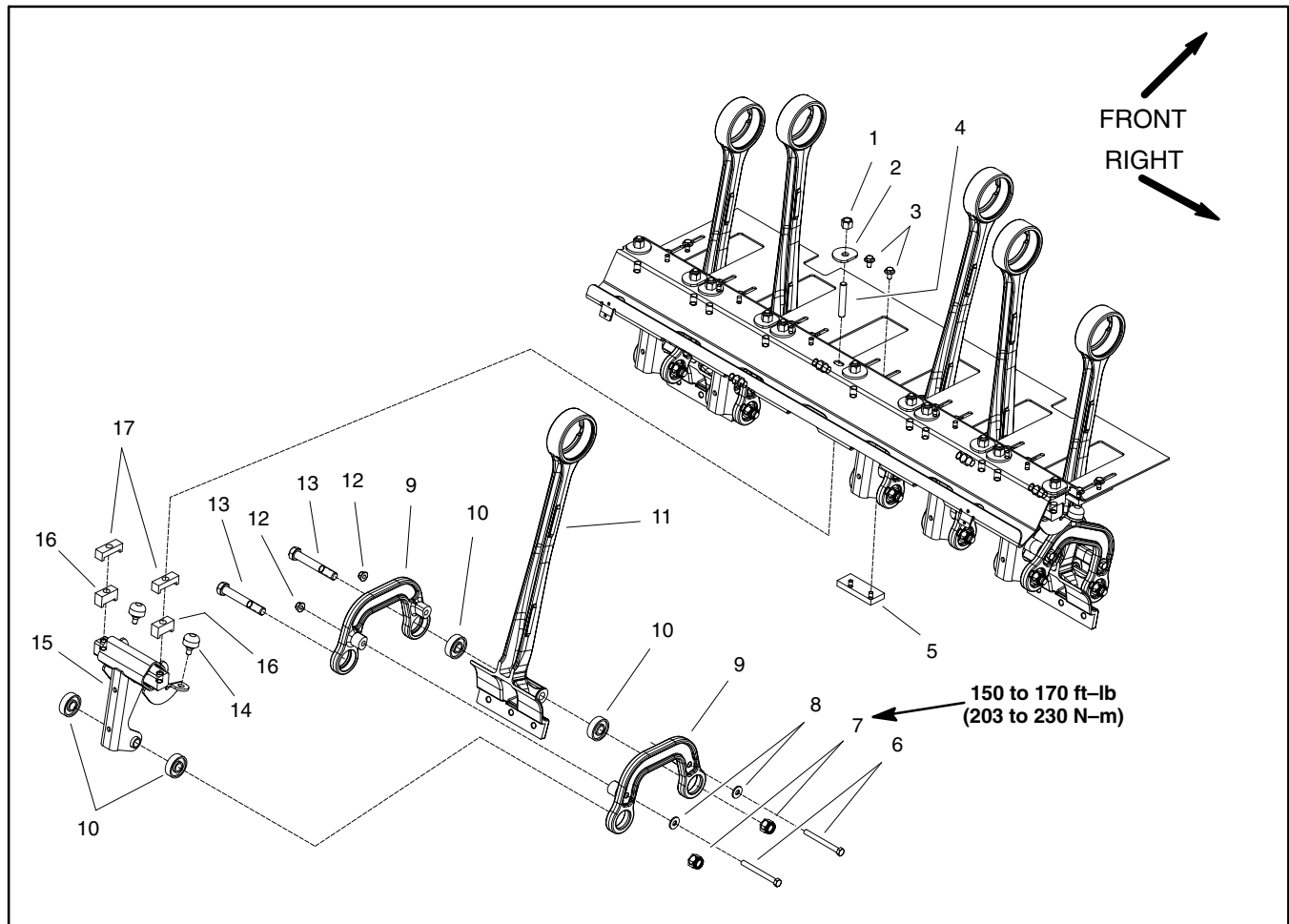


Figure 4

- |                      |                    |                       |
|----------------------|--------------------|-----------------------|
| 1. Lock nut          | 7. Lock nut        | 13. Cap screw         |
| 2. Hardened D washer | 8. Hardened washer | 14. Rubber bumper     |
| 3. Flange head screw | 9. Damper link     | 15. Rotolink damper   |
| 4. Stud              | 10. Bearing        | 16. Damper standoff   |
| 5. Bumper plate      | 11. Stomper arm    | 17. Damper top spacer |
| 6. Cap screw         | 12. Flange nut     |                       |

**NOTE:** The rotolink damper assemblies for all stomper arms used on the ProCore 648 are identical.

### Disassembly (Fig. 4)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove rotolink components as needed using Figure 4 as a guide.

### Assembly (Fig. 4)

1. If studs (item 4) were removed from damper (item 15), thread stud fully into damper.
2. If bearings were removed from damper links, press new bearings into links.
3. Assemble all components before fully tightening any fasteners so there is no preload on rotolink damper components. Tighten fasteners in the following order:
  - A. Secure damper links (item 9) to stomper arm (item 11) and damper (item 15). Torque lock nuts (item 7) from 150 to 170 ft-lb (203 to 230 N-m).
  - B. Tighten two (2) flange nuts (item 12) that secure damper links.
  - C. Tighten two (2) lock nuts (item 1) that secure damper to frame.
4. After assembly, rotate coring crankshaft by hand to make sure that no binding occurs.

**NOTE:** If using longer, solid tines, damper top spacer (item 17) might not be installed (see Operator's Manual).

5. If damper standoff (item 16) and top spacer (item 16) are both installed on rotolink damper, rubber bumpers (item 16) should contact bumper plates (item 5). If only damper standoff (item 16) is used, rubber bumpers should contact frame (bumper plates moved forward).
6. Remove service latch from coring head before using machine.

# Stomper Arms

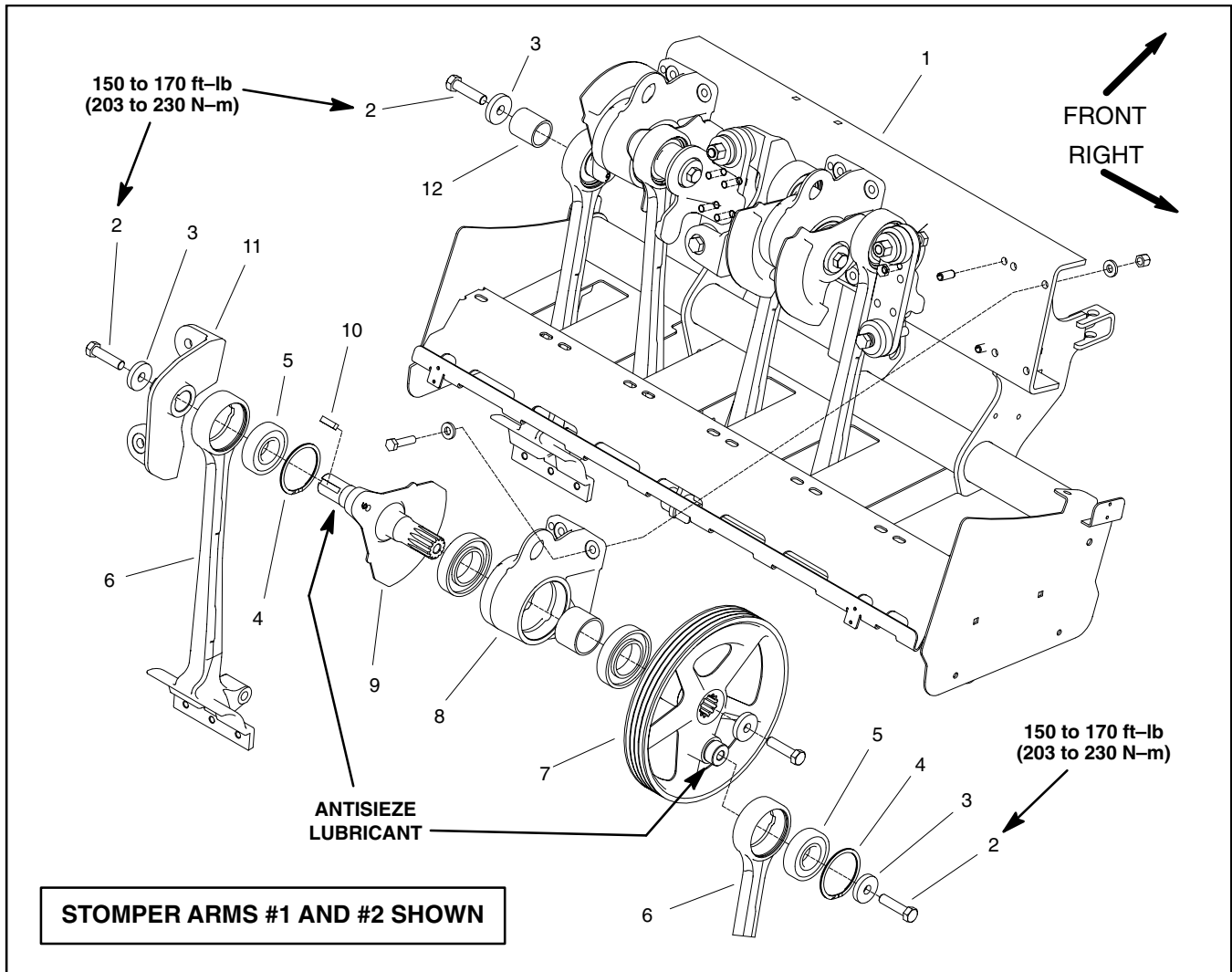


Figure 5

- |                   |                    |                 |
|-------------------|--------------------|-----------------|
| 1. Coring frame   | 5. Ball bearing    | 9. Crankarm     |
| 2. Cap screw      | 6. Stomper arm     | 10. Square key  |
| 3. Flat washer    | 7. Pulley          | 11. Coupling    |
| 4. Retaining ring | 8. Bearing housing | 12. Spacer tube |

**NOTE:** The six (6) stomper arms used on the ProCore 648 are identical. Coring crankshaft positions are identified as #1 through #6. The #1 position is on the right (pulley) side of the coring crankshaft (Fig. 6).

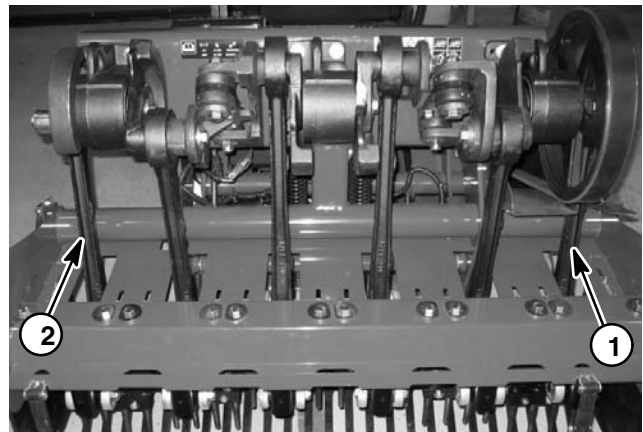


Figure 6

- |                |                |
|----------------|----------------|
| 1. #1 position | 2. #6 position |
|----------------|----------------|

## Removal (Fig. 5)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove rear hood (see Operator's Manual).
3. Remove two (2) lock nuts and hardened D washers that secure rotolink damper to coring head frame (see Rotolink Dampers in this section).
4. If outside stomper arm (#1 or #6) is to be removed:
  - A. If #1 stomper arm is being removed, remove secondary coring head drive belt (see Secondary Drive Belt Removal in this section).
  - B. Remove cap screw and flat washer that retain stomper arm to coring crankshaft.
  - C. If #6 stomper arm is being removed, remove spacer tube (item 12) from coring crankshaft.
  - D. Support stomper arm assembly to prevent it from falling during removal. Slide stomper arm from coring crankshaft. Carefully, lower stomper arm assembly from frame.
5. If inside stomper arm (#2, #3, #4 or #5) is to be removed:
  - A. Remove fasteners that secure coupling plate to coupling on stomper to be removed (Fig. 7).
  - B. Remove cap screw and flat washer that secures coupling and stomper arm to coring crankshaft.
  - C. Slide coupling from coring crankshaft. Locate and retrieve square key.
  - D. Support stomper arm assembly to prevent it from falling during removal. Slide stomper arm from coring crankshaft. Carefully, lower stomper arm assembly from frame.
6. If necessary, remove retaining ring and ball bearing from stomper arm.
7. If necessary, remove tines and tine holders from stomper arm (see Operator's Manual).
8. Remove rotolink damper components as needed (see Rotolink Dampers in this section).

## Installation (Fig. 5 and 7)

1. If removed, install ball bearing into upper end of stomper arm and secure with retaining ring.
2. Install any rotolink damper components that were removed during disassembly (see Rotolink Dampers in this section).
3. Thoroughly apply antisieze lubricant to stomper arm shaft surface on coring crankshaft.
4. Raise stomper arm assembly up through frame. Slide stomper arm bearing onto coring crankshaft.
5. Secure stomper arm to coring crankshaft in the reverse order of disassembly.
  - A. Torque 5/8" cap screws from 150 to 170 ft-lb (203 to 230 N-m).
  - B. Torque 1/2" cap screws from 70 to 80 ft-lb (95 to 108 N-m).
6. Secure rotolink damper to coring head frame with lock nut and hardened D washer (see Rotolink Dampers in this section).
7. After assembly, rotate coring crankshaft by hand to make sure that no binding occurs.
8. If removed, install tine holders and tines to stomper arm (see Operator's Manual).
9. If removed, install secondary coring head drive belt (see Secondary Drive Belt Installation in this section).
10. Install rear hood (see Operator's Manual). Disengage service latch before machine use.

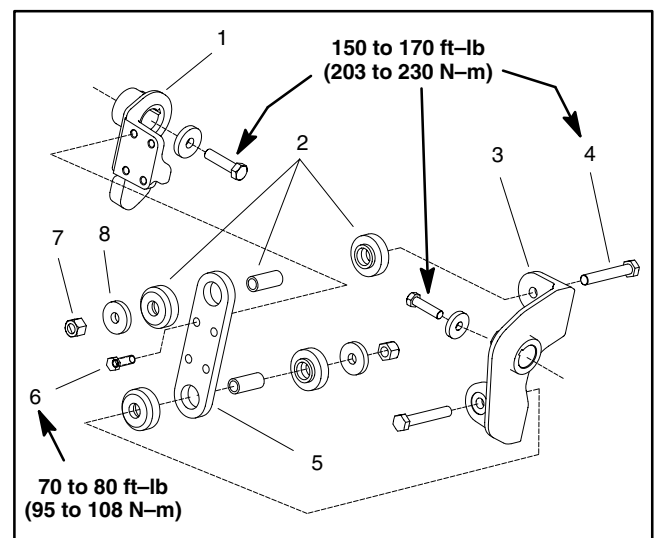


Figure 7

- |                        |                         |
|------------------------|-------------------------|
| 1. Coupling (#3 shown) | 5. Coupling plate       |
| 2. Iso mount (2 used)  | 6. Cap screw (4 used)   |
| 3. Coupling (#2 shown) | 7. Lock nut (2 used)    |
| 4. Cap screw (2 used)  | 8. Flat washer (2 used) |

## Coring Crankshaft Bearing Housings

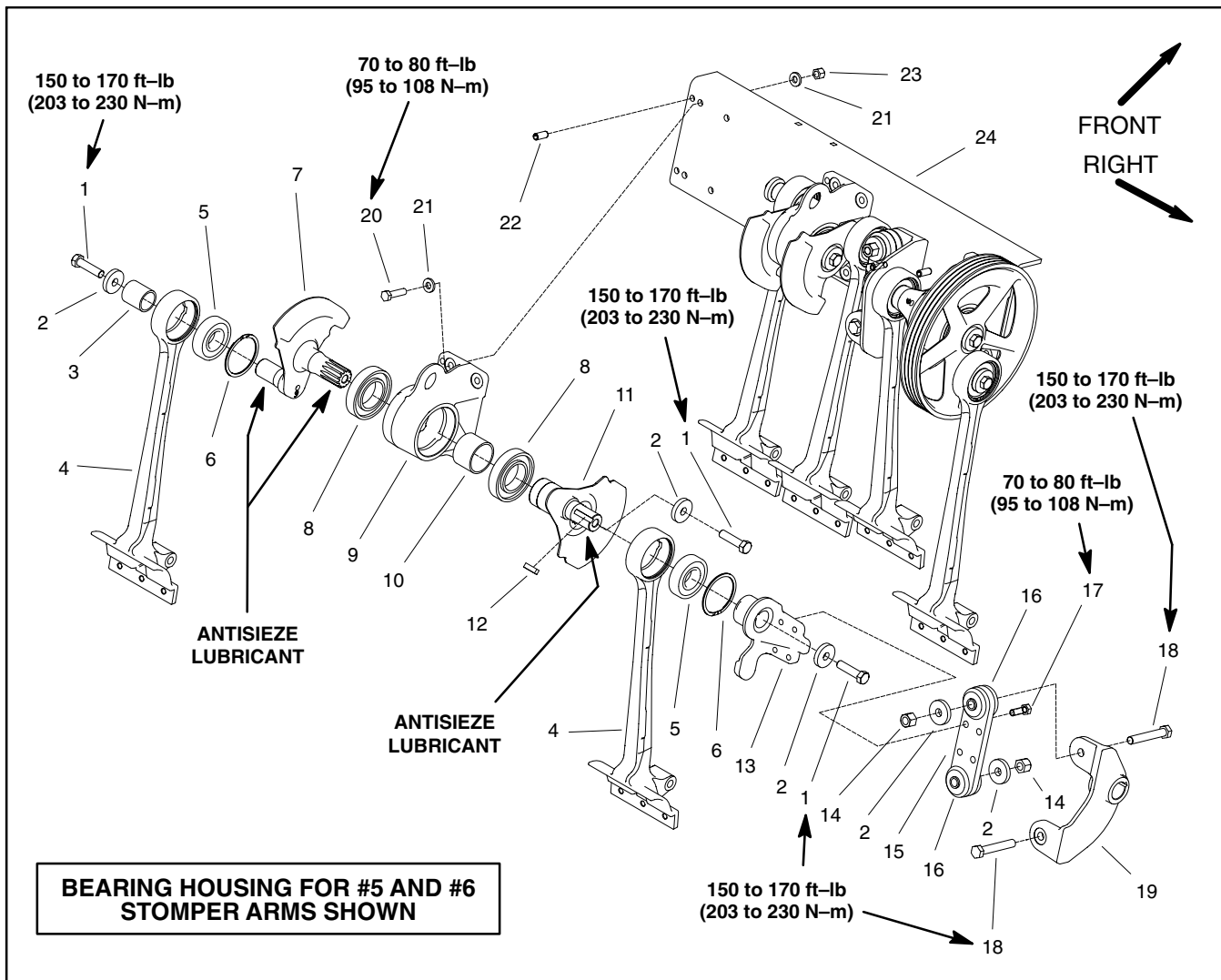


Figure 8

- |                   |                         |                                     |
|-------------------|-------------------------|-------------------------------------|
| 1. Cap screw      | 9. Bearing housing      | 17. Cap screw (4 used per plate)    |
| 2. Flat washer    | 10. Spacer              | 18. Cap screw                       |
| 3. Spacer tube    | 11. Crankarm            | 19. Coupling                        |
| 4. Stomper arm    | 12. Square key          | 20. Cap screw (4 used per housing)  |
| 5. Ball bearing   | 13. Coupling (#5 shown) | 21. Hardened washer                 |
| 6. Retaining ring | 14. Lock nut            | 22. Spring pin (2 used per housing) |
| 7. Crankarm       | 15. Coupling plate      | 23. Lock nut                        |
| 8. Ball bearing   | 16. Iso mount           | 24. Coring head frame               |

**NOTE:** The three (3) bearing housings used on the ProCore 648 are identical. Coring crankshaft positions are identified as #1 through #6. The #1 position is on the right (pulley) side of the coring crankshaft.

### Removal (Fig. 8)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove rear hood (see Operator's Manual).

3. If bearing housing for #1 and #2 stomper arms is to be removed, remove secondary coring head drive belt (see Secondary Drive Belt Removal in this section).

4. Remove stomper arms on either side of bearing housing that is to be removed (see Stomper Arm Removal in this section).

5. Drive Spring pins from bearing housing and coring head frame.

6. Support bearing housing to prevent it from falling. Remove fasteners that secure bearing housing assembly to coring head frame. Remove bearing housing assembly.

7. Disassemble bearing housing assembly:

A. Remove cap screw (item 1) and flat washer (item 2) that fasten crankarms together. Take note of alignment of identification number on crankarm with timing mark on bearing housing (Fig. 9).

B. Slide crankarms from bearing housing.

C. If necessary, remove bearings and spacer from bearing housing.

**Installation (Fig. 8)**

1. Install new bearings if they were removed from housing:

A. Install new bearing in one side of housing by pressing on outer race of bearing.

B. Position spacer into bearing housing.

C. Install second new bearing by pressing on outer race of bearing. Make sure that spacer is centered between bearings.

2. Thoroughly apply antisieze lubricant to splines of crankarms.

3. Install crankarms into bearing housing. Make sure that correct identification number on crankarm is aligned with timing mark on bearing housing (Fig. 9).

4. Install cap screw (item 1) and flat washer (item 2) to retain crankarms. Do not fully tighten cap screw.

5. Drive new spring pins into coring head frame holes.

6. Position bearing housing assembly to coring head frame and secure with four (4) cap screws, eight (8) hardened washers and four (4) lock nuts. Torque fasteners from 70 to 80 ft-lb (95 to 108 N-m).

7. Install stomper arms to crankarms on either side of bearing housing (see Stomper Arm Installation in this section). Do not fully tighten fasteners.

**NOTE:** With #1 crankarm aligned with cast mark on bearing housing, all subsequent crankarm cast timing numbers must be in line from 1 to 6.

8. Once all components have been installed, fully tighten fasteners in the following order. Tighten fasteners to the torque specifications identified in Figures 8 and 10:

- A. Cap screws that fasten crankarms.
- B. Cap screws that secure top and bottom of stomper arms.
- C. Cap screws that secure coupling plates (Fig. 10).

D. Lock nuts that secure rotolink dampers to frame (see Rotolink Damper Installation in this section).

9. After assembly, rotate coring crankshaft by hand to make sure that no binding occurs.

10. If removed, install secondary coring head drive belt (see Secondary Drive Belt Installation in this section).

11. Install rear hood (see Operator's Manual). Disengage service latch before machine use.

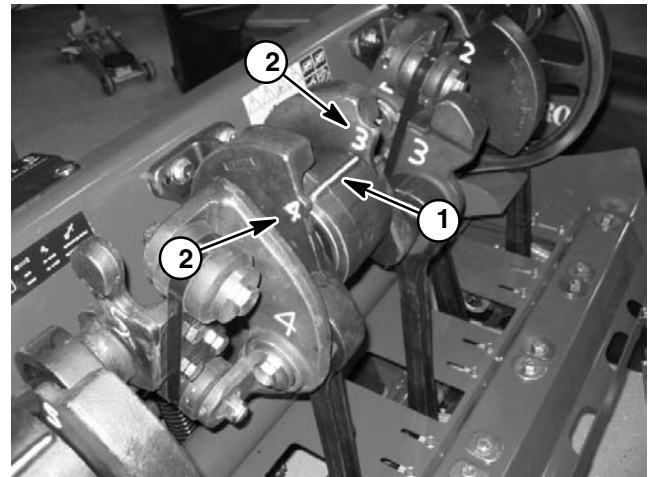


Figure 9

- 1. Housing timing mark
- 2. Crankarm position

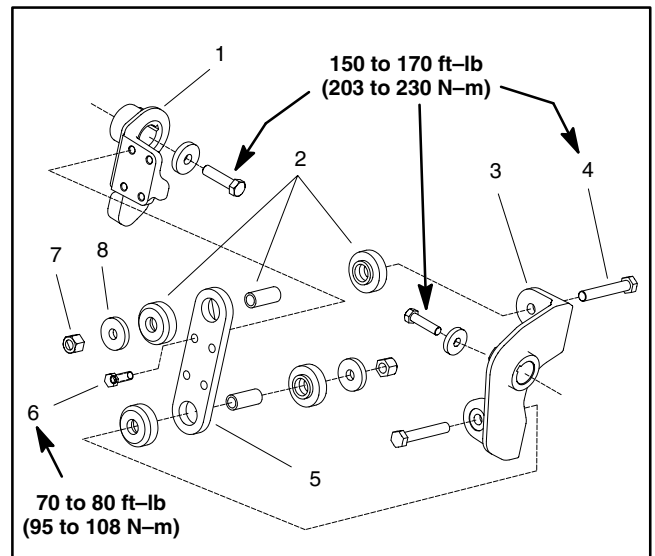


Figure 10

- 1. Coupling (#3 shown)
- 2. Iso mount (2 used)
- 3. Coupling (#2 shown)
- 4. Cap screw (2 used)
- 5. Coupling plate
- 6. Cap screw (4 used)
- 7. Lock nut (2 used)
- 8. Flat washer (2 used)

# Primary Drive Belt

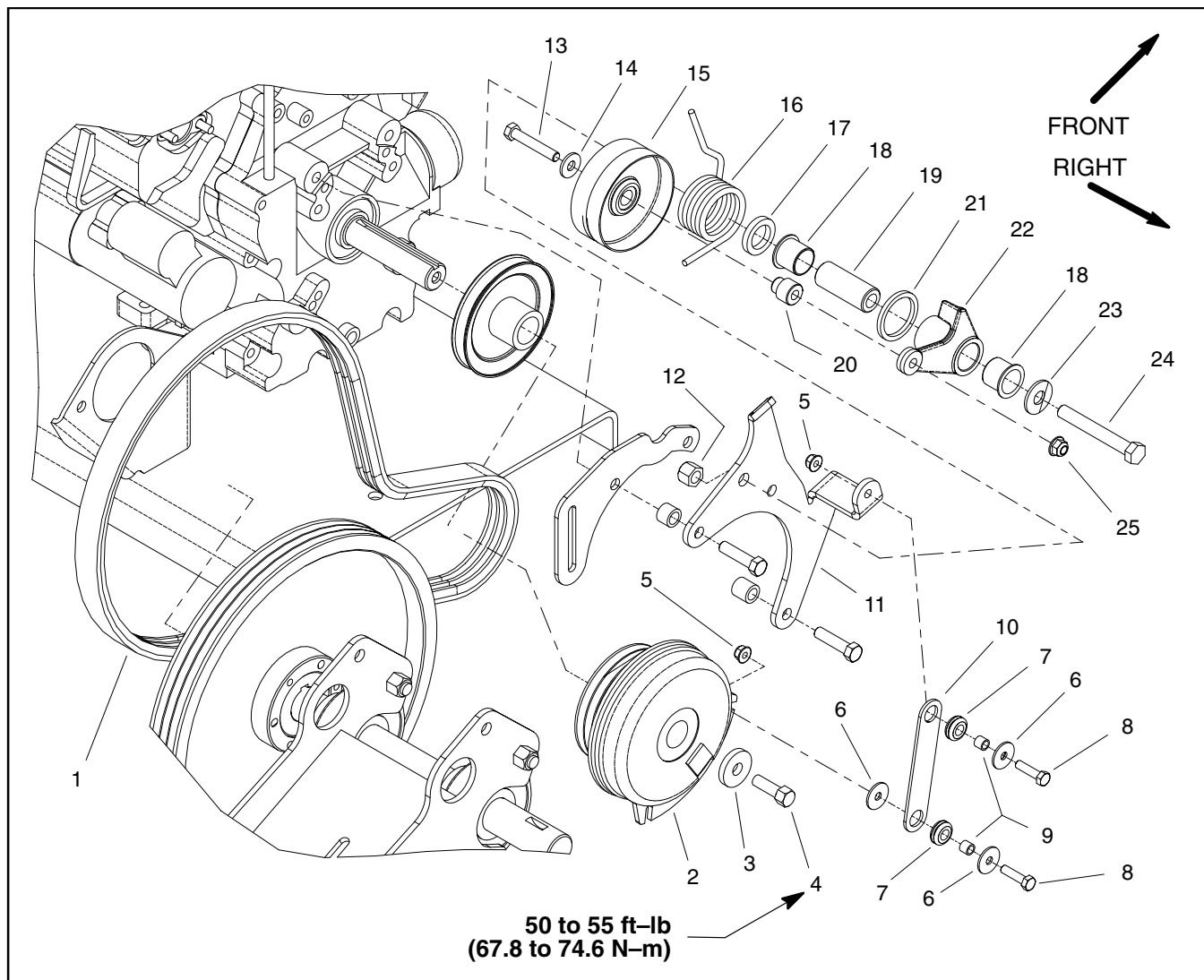


Figure 11

- 1. Primary drive belt
- 2. Electric clutch
- 3. Hardened washer
- 4. Cap screw
- 5. Flange nut
- 6. Flat washer
- 7. Brake grommet
- 8. Cap screw
- 9. Spacer

- 10. Clutch strap
- 11. Idler mounting bracket
- 12. Lock nut
- 13. Cap screw
- 14. Hardened washer
- 15. Idler pulley
- 16. Torsion spring
- 17. Spacer

- 18. Flange bushing
- 19. Pivot sleeve
- 20. Idler spacer
- 21. Washer
- 22. Idler arm
- 23. Flat washer
- 24. Cap screw
- 25. Flange nut



## Removal (Fig. 11)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove belt cover (see Operator's Manual).
3. Remove exhaust system shield (see Exhaust System Removal in the Service and Repairs section of Chapter 3 – Kohler Engine).
4. Insert nut driver or small piece of pipe onto the end of the torsion spring (item 16) of the idler pulley.



5. Push down on the spring end and unhook the spring from the idler mounting bracket.
6. Loosen and remove cap screw (item 8), flat washers (item 6) and flange nut (item 5) that secure clutch strap (item 10) to clutch. Position clutch strap away from clutch.
7. Unplug machine wire harness connector from clutch.
8. Remove primary drive belt from pulleys and machine.

## Installation (Fig. 11)

1. Position drive belt to machine pulleys. Make sure that belt is routed under idler pulley.
2. Position clutch strap (item 10) to clutch and secure with cap screw (item 8), flat washers (item 6) and flange nut (item 5).
3. Plug machine wire harness connector into clutch.



4. Insert nut driver or small piece of pipe onto the end of the torsion spring (item 16) of the idler pulley. Push down on the spring end and hook the spring on the idler mounting bracket to tension the idler pulley.
5. Install exhaust system shield (see Exhaust System Installation in the Service and Repairs section of Chapter 3 – Kohler Engine).
6. Install belt cover (see Operator's Manual).
7. Remove service latch from coring head before using machine.

## Secondary Drive Belt

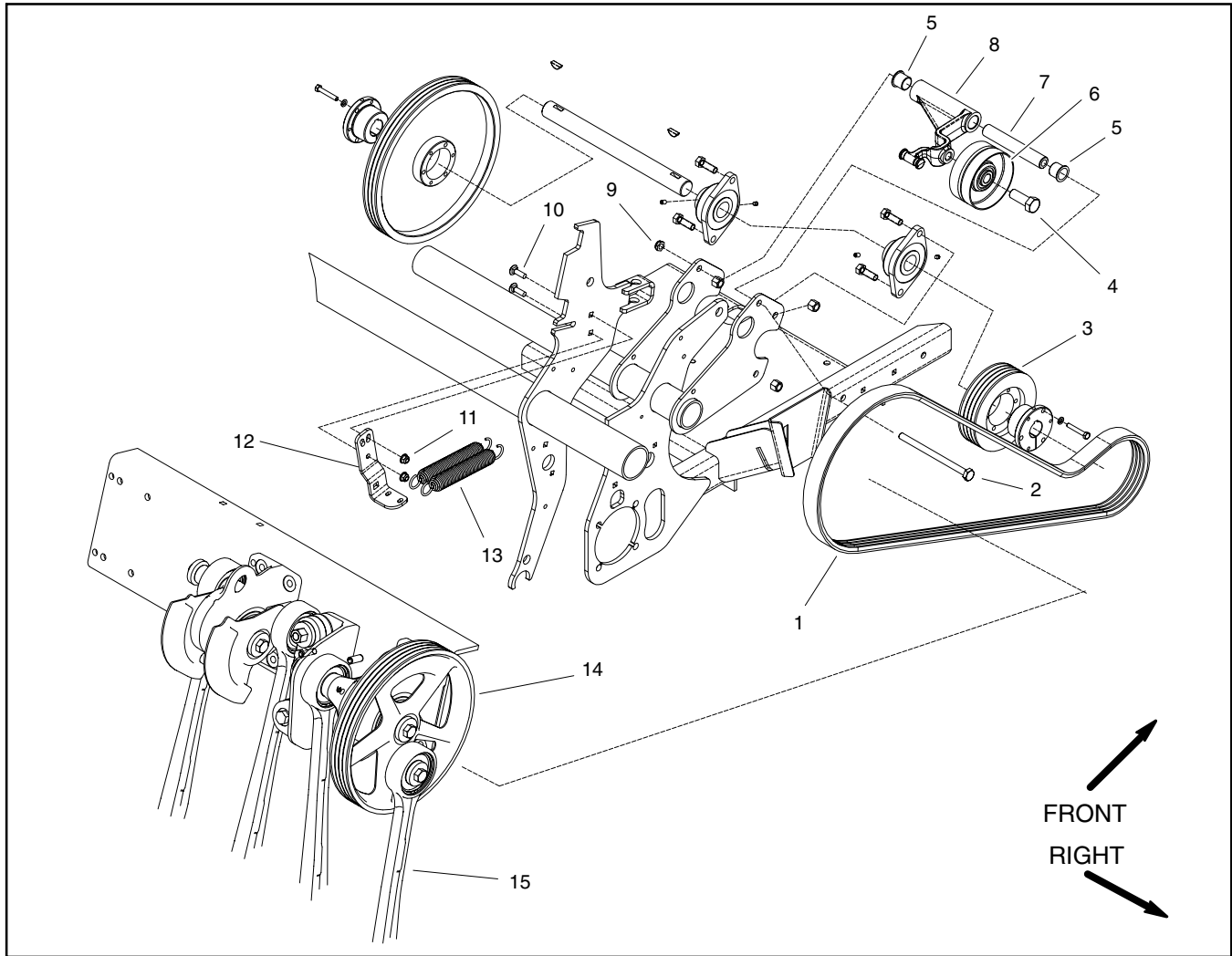


Figure 12

- |                         |                             |                               |
|-------------------------|-----------------------------|-------------------------------|
| 1. Secondary drive belt | 6. Idler pulley             | 11. Flange nut (2 used)       |
| 2. Cap screw            | 7. Idler pivot tube         | 12. Idler spring arm          |
| 3. Secondary pulley     | 8. Idler arm                | 13. Extension spring (2 used) |
| 4. Cap screw            | 9. Lock nut                 | 14. Coring crankshaft pulley  |
| 5. Flange bushing       | 10. Carriage screw (2 used) | 15. #1 stomper arm            |

### Removal (Fig. 12)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Remove belt cover and rear hood from machine (see Operator's Manual).

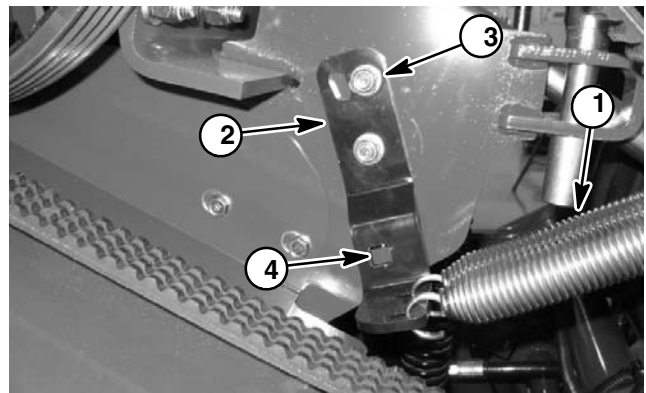


Figure 13

- |                      |                     |
|----------------------|---------------------|
| 1. Extension springs | 3. Upper flange nut |
| 2. Spring arm        | 4. 1/2" drive hole  |



## CAUTION

Be careful when lifting the idler pulley. The idler pulley is spring loaded and may cause personal injury.

**NOTE:** If desired, extension spring tension can be removed from idler pulley by loosening two (2) flange nuts that secure spring arm to frame. Use 1/2" drive breaker bar inserted into spring arm to hold arm, remove upper carriage screw and flange nut and rotate spring arm to relax spring (Fig. 13).

3. Lift idler pulley to release tension on secondary drive belt (Fig. 14). While holding idler away from belt, remove belt from secondary drive pulley. Carefully lower idler pulley.

4. Loosen and remove two (2) lock nuts and hardened D washers that secure rotolink damper for #1 stomper arm (see Rotolink Damper Removal in this section). Lower rotolink damper from coring head frame.

5. Remove secondary drive belt from coring crankshaft pulley.

6. Route drive belt down through coring head frame and around lower end of #1 stomper arm to remove secondary drive belt from machine (Fig. 15 and 16).

#### Installation (Fig. 12)

1. Route secondary drive belt around lower end of #1 stomper arm and up through coring head frame (Fig. 15 and 16).

2. Position drive belt to coring crankshaft pulley.

3. Lift idler pulley to allow installation of belt to secondary drive pulley (Fig. 14). Carefully lower idler pulley to tension drive belt.

4. Raise rotolink damper for #1 stomper arm to coring head frame. Make sure that damper standoff and top spacer are on damper studs. Secure damper to coring head frame with two (2) hardened D washers and lock nuts (see Rotolink Damper Installation in this section).

5. Install belt cover and rear hood to machine (see Operator's Manual).

6. Remove service latch from coring head before using machine.

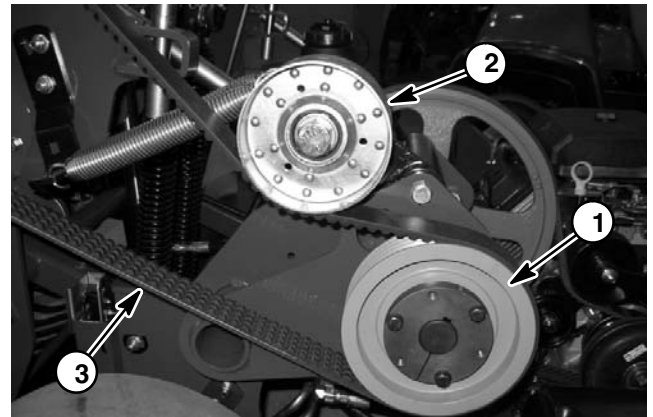


Figure 14

- 1. Secondary drive pulley
- 2. Idler pulley
- 3. Secondary drive belt

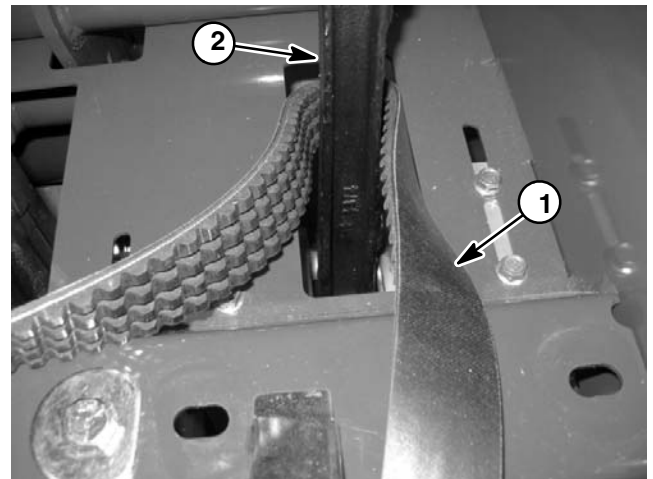


Figure 15

- 1. Secondary drive belt
- 2. #1 stomper arm

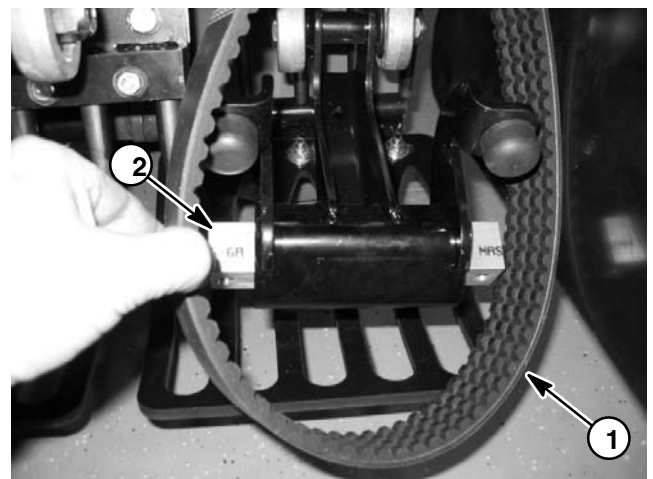


Figure 16

- 1. Secondary drive belt
- 2. #1 rotolink damper

## Coring Head Drive Jackshaft

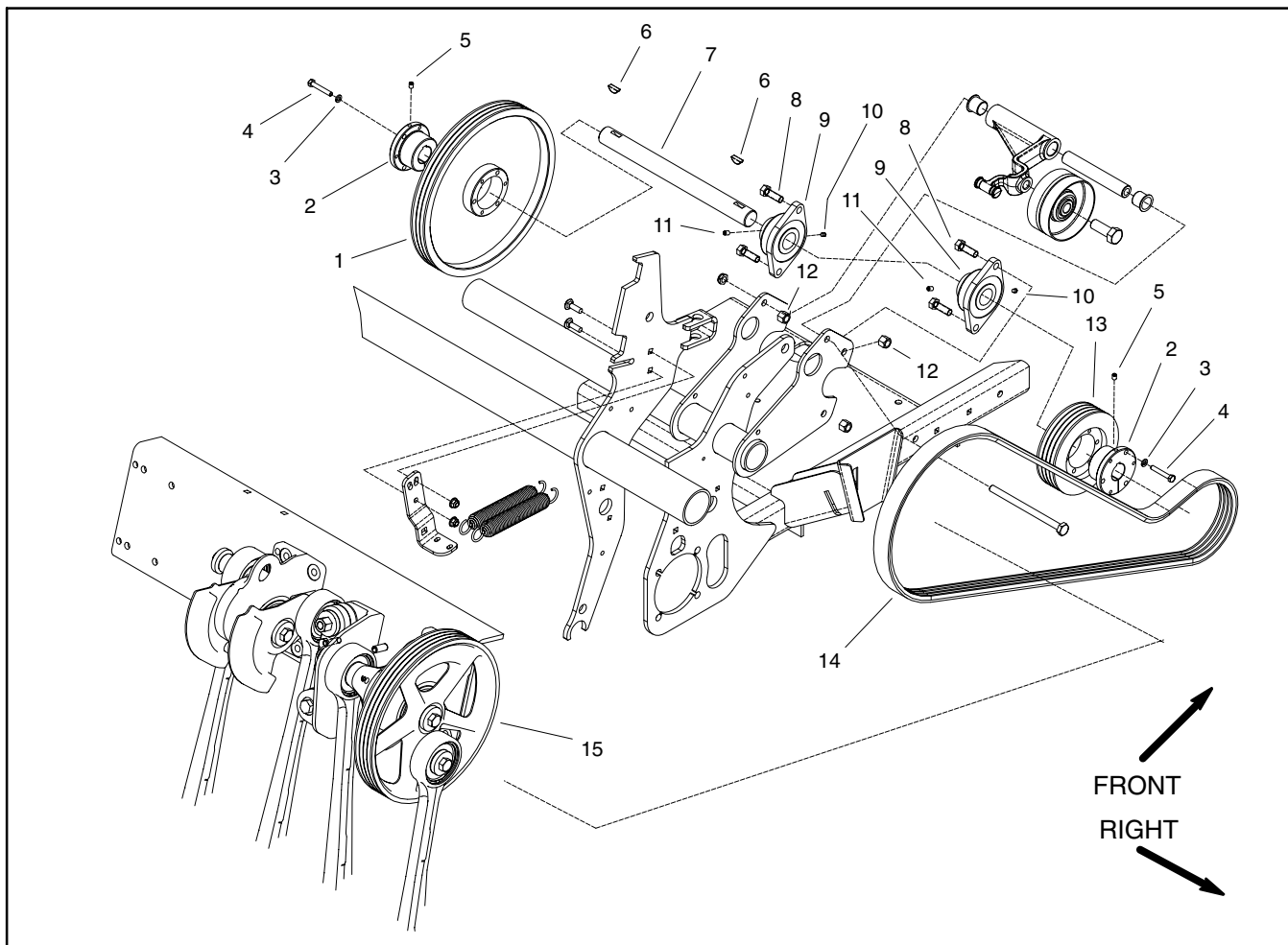


Figure 17

- |                       |                                   |                                   |
|-----------------------|-----------------------------------|-----------------------------------|
| 1. Primary pulley     | 6. Woodruff key                   | 11. Set screw                     |
| 2. Taper lock bushing | 7. Jackshaft                      | 12. Lock nut (2 used per bearing) |
| 3. Lock washer        | 8. Cap screw (2 used per bearing) | 13. Secondary pulley              |
| 4. Cap screw          | 9. Flange mount bearing           | 14. Secondary drive belt          |
| 5. Set screw          | 10. Plug                          | 15. Coring crankshaft             |

### Removal (Fig. 17)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.

2. Remove belt cover and rear hood from machine (see Operator's Manual).

3. Remove primary and secondary drive belts from jackshaft pulleys (see Primary Drive Belt Removal and Secondary Drive Belt Removal in this section).

4. Loosen cap screws and lock nuts that secure flange mount bearings to machine frame. Support jackshaft assembly, remove loosened cap screws and lock nuts and remove jackshaft assembly from machine.

5. Loosen taper lock bushings (Fig. 18):

A. Remove three (3) cap screws and lockwashers that secure taper lock bushing to pulley.

**IMPORTANT: Excessive or unequal pressure on the cap screws can break the taper lock bushing flange. When removing taper lock bushing, tighten screws progressively and evenly.**

B. Insert cap screws into threaded removal holes of the bushing. Tighten screws progressively and evenly until the pulley is loose on the bushing.

6. Loosen set screws (item 5) that secure taper lock bushings to jackshaft. Remove bushings and pulleys from the jackshaft. Locate and retrieve woodruff keys (item 6) that locate bushings on jackshaft.

**NOTE:** Jackshaft rotates counterclockwise as viewed from right side of machine (Fig. 18).

7. Loosen set screw that secures each flange mount bearing locking collar to jackshaft. Using the blind hole in bearing collar as a striking point, unlock collar from jackshaft by rotating the collar in the opposite direction of jackshaft rotation with a punch (Fig. 19).

8. Slide flange mount bearings from jackshaft.

### Installation (Fig. 17)

1. Make sure that tapered surfaces of pulleys and taper lock bushings are thoroughly clean (no oil, grease, dirt, rust, etc.).

2. Slide flange mount bearings onto jackshaft.

3. Place woodruff keys (item 6) in jackshaft. Slide pulleys and taper lock bushings onto jackshaft making sure that tapered surfaces of pulley and bushing align. Align threaded holes of pulley with non-threaded holes of bushing. Loosely install three (3) cap screws with lock washers to both bushing and pulley assemblies.

4. Position jackshaft assembly to machine frame. Secure flange mount bearings to frame with cap screws and lock nuts.

**IMPORTANT: When tightening bushing cap screws, tighten in three equal steps and in a circular pattern to prevent bushing flange damage.**

5. Align taper lock bushing in primary pulley flush with end of jackshaft and secure with set screw. Tighten three (3) cap screws to a torque from 180 to 200 in-lb (20.3 to 22.6 N-m) in three equal steps and in a circular pattern to secure primary pulley and taper lock bushing.

6. Position jackshaft to align primary pulley and electric clutch pulley on engine.

7. Using the blind hole in flange mount bearing locking collars as a striking point, lock collars to jackshaft by rotating the collars with a punch in the direction of jackshaft rotation (Fig. 20). Tighten set screw (item 11) to secure each bearing locking collar to jackshaft.

8. Position secondary pulley on jackshaft to align secondary pulley and coring head pulley. Secure in position with taper lock bushing set screw.

**IMPORTANT: When tightening bushing cap screws, tighten in three equal steps and in a circular pattern.**

9. Secure taper lock bushing by tightening three (3) cap screws to a torque from 180 to 200 in-lb (20.3 to 22.6 N-m) in three equal steps and in a circular pattern to secure secondary pulley and taper lock bushing.

10. Install primary and secondary drive belts to jackshaft pulleys (see Primary Drive Belt Installation and Secondary Drive Belt Installation in this section).

11. Check that belt alignment is still correct. If needed, readjust pulley location on jackshaft.

12. Install belt cover and rear hood to machine (see Operator's Manual). Remove service latch from coring head before using machine.

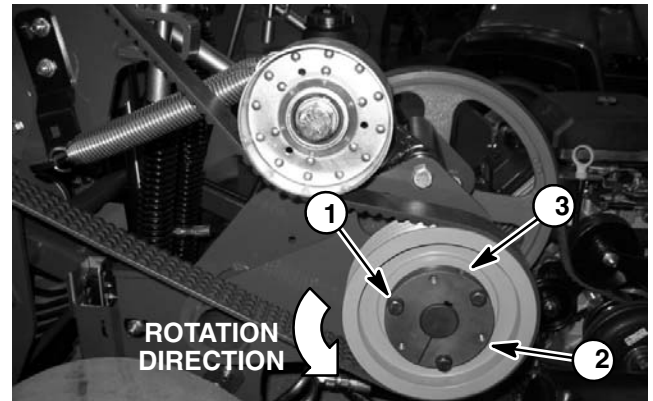


Figure 18

- 1. Cap screw/lock washer
- 2. Threaded hole
- 3. Set screw

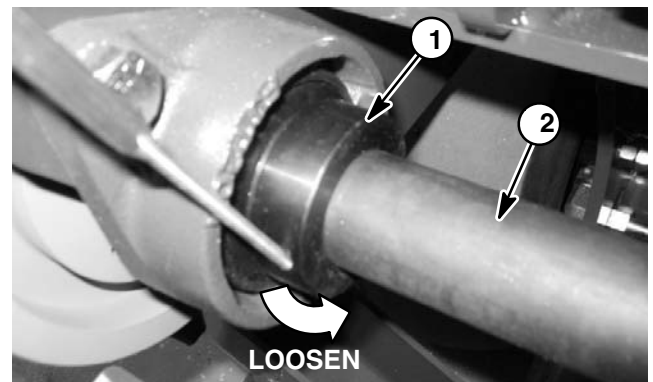


Figure 19

- 1. Flange mount bearing
- 2. Jackshaft

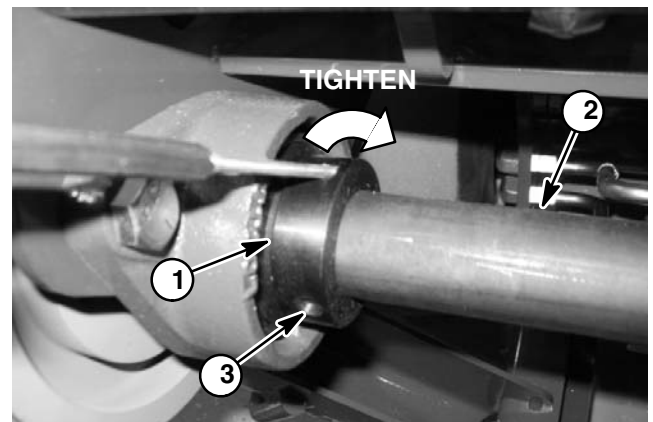


Figure 20

- 1. Flange mount bearing
- 2. Jackshaft
- 3. Set screw

# Coring Head Pivot (H-Frame)

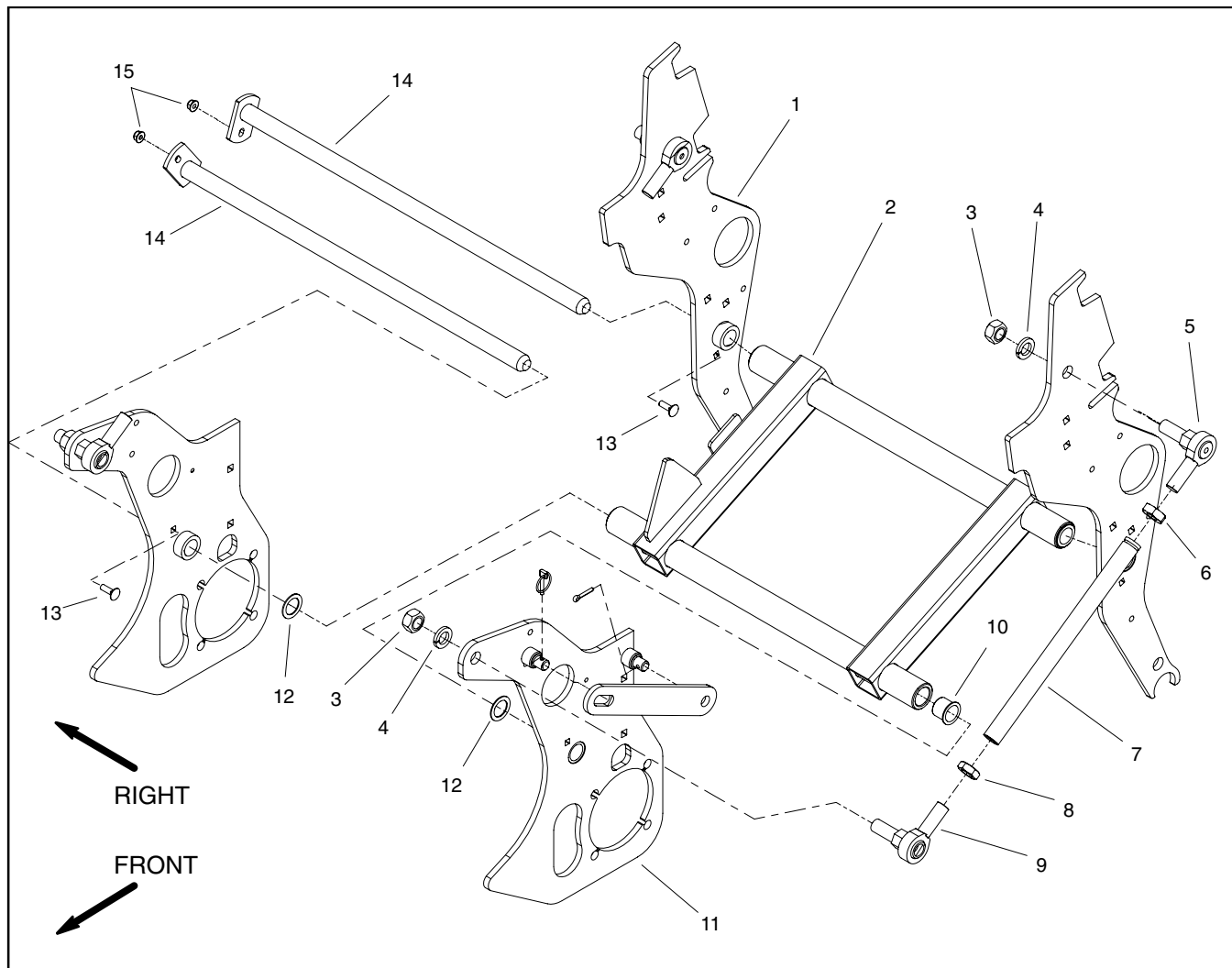


Figure 21

- |                        |                             |                    |
|------------------------|-----------------------------|--------------------|
| 1. Coring frame        | 6. Jam nut (LH thread)      | 11. Main frame     |
| 2. H-frame             | 7. Upper link               | 12. Thrust washer  |
| 3. Hex nut             | 8. Jam nut                  | 13. Carriage screw |
| 4. Lock washer         | 9. Rod end                  | 14. Pivot shaft    |
| 5. Rod end (LH thread) | 10. Flange bushing (4 used) | 15. Flange nut     |

## Disassembly (Fig. 21)

1. Park machine on a level surface, fully raise coring head, engage parking brake, stop engine and remove key from the ignition switch. Secure coring head with service latch.
2. Remove belt cover and rear hood from machine (see Operator's Manual).
3. Chock wheels to prevent the machine from moving.
4. Remove tine heads from stomper arms to allow coring head to be fully lowered.



5. Disconnect the upper end of both extension springs from spring plates on coring head frame (Fig. 22):

A. Remove service latch from coring head. Turn key switch to ON (engine not running). Move traction lever to forward direction and depress lower switch on handle to fully lower coring head.

B. Loosen, but do not remove, both flange nuts (Fig. 22 item 6) that secure the spring plates (Fig. 22 item 5) for both extension springs.

C. Using a 1/2" breaker bar, hold spring plate to prevent it from moving. Remove **upper** flange nut and carriage screw (Fig. 22 item 4) from spring plate and coring head frame.

D. Using lower carriage screw and flange nut as a pivot, carefully release tension on extension spring (Fig. 22 item 3) by rotating spring plate with breaker bar.

E. Remove hair pin (Fig. 22 item 3) and clevis pin (Fig. 22 item 2) that secure spring shackle (Fig. 22 item 1) to spring plate. Position extension spring away from coring head frame.

6. Start engine and allow coring head to fully raise. Turn engine off. Secure coring head with service latch.

7. Lower coring head onto service latch to allow lift cylinder to be disconnected from coring head. Turn key switch to ON (engine not running). Move traction lever to forward direction and depress lower switch on handle to lower coring head onto service latch. Return key switch to OFF and remove key from the ignition switch.

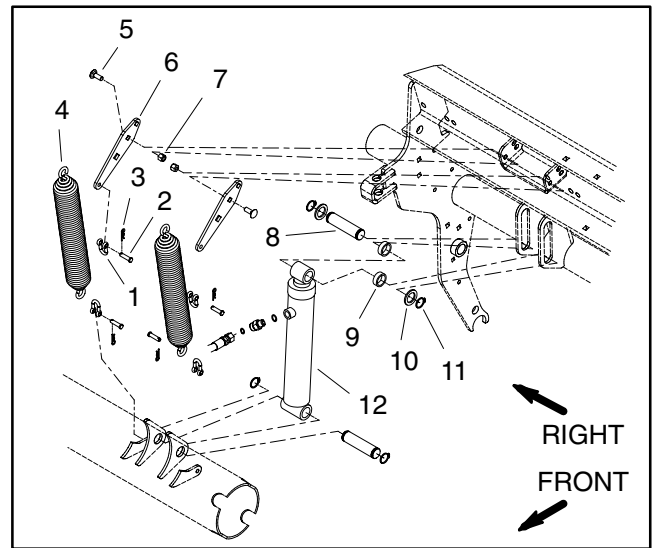


Figure 22

- |                     |                    |
|---------------------|--------------------|
| 1. Shackle          | 7. Flange nut      |
| 2. Clevis pin       | 8. Cylinder pin    |
| 3. Hair pin         | 9. Spacer          |
| 4. Extension spring | 10. Thrust washer  |
| 5. Carriage screw   | 11. Retaining ring |
| 6. Spring plate     | 12. Lift cylinder  |

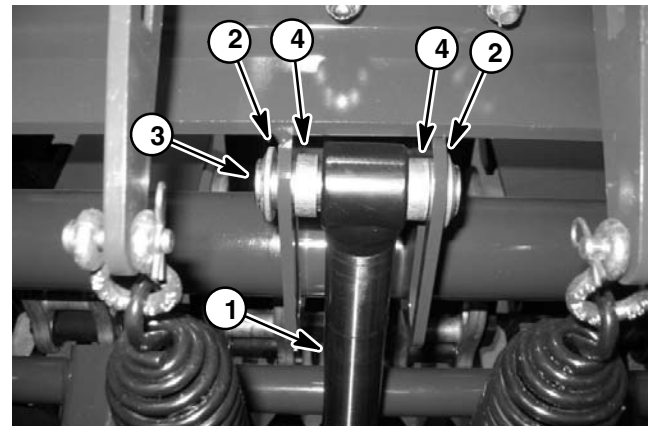


Figure 23

- |                        |                 |
|------------------------|-----------------|
| 1. Lift cylinder shaft | 3. Cylinder pin |
| 2. Thrust washer       | 4. Spacer       |

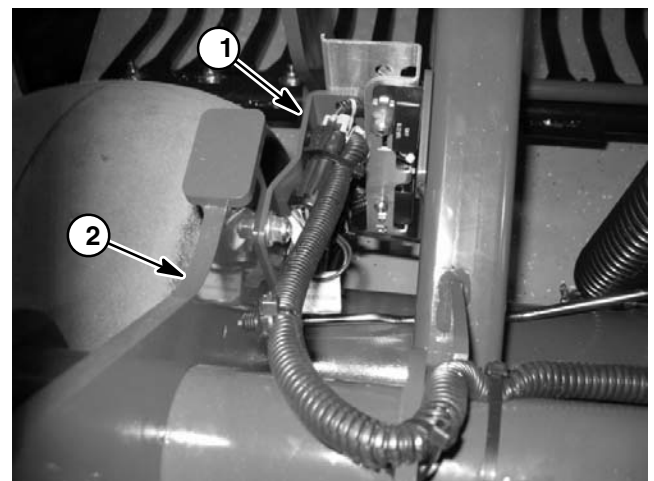


Figure 24

- |                             |                  |
|-----------------------------|------------------|
| 1. Proximity switch bracket | 2. Machine frame |
|-----------------------------|------------------|

8. Disconnect upper end of lift cylinder from coring head frame (Figs. 22 and 23):

A. Remove retaining ring from one end of cylinder pin that secures lift cylinder to coring head frame.

B. Pull cylinder pin from coring head frame and lift cylinder. Locate and retrieve two (2) thrust washers and two (2) spacers as pin is removed.

C. Rotate lift cylinder toward front of machine.

9. Disconnect wire harness connectors from limit switches on depth actuator assembly.

10. Remove proximity switch bracket from machine frame (Fig. 24). Position switch bracket with proximity switches still attached away from H-frame.

11. Remove right rear wheel from machine (see Wheel Removal in Service and Repairs section of Chapter 6 – Chassis). Make sure that machine is supported well with jackstands or blocking.

2. Position H-frame to machine frame making sure that thrust washers are placed between H-frame and machine frame. Align both sides of H-frame to pivot shaft holes in machine frame. Slide pivot shaft into H-frame and machine frame.

3. Position coring head to allow alignment of both sides of H-frame to pivot shaft holes in coring head frame. Slide pivot shaft into H-frame and coring head frame.

4. Complete assembly of coring head to machine in the reverse order of disassembly.

	<b>CAUTION</b>
<b>The coring head assembly weighs approximately 650 pounds (294.8 kg). Make sure that proper lift or hoist is used to support coring head during repairs.</b>	

12. Using suitable lift or hoist, support coring head using lifting eyelets on coring crankshaft as lift points (Fig. 25). Once coring head is well supported, remove service latch from coring head.

13. Remove upper link assemblies from machine frame and coring head frame.

14. Remove flange nuts (item 15) and carriage screws (item 13) that secure end of pivot shafts to machine.

15. Carefully slide pivot shafts from H-frame. Locate and retrieve thrust washers (item 12) from between H-frame and machine frame.

16. Remove H-frame from machine.

### Assembly (Fig. 21)

1. If upper links were disassembled, install rod ends equally to make link assembly 17.720" to 17.780" (45.0 to 45.2 cm) long (rod center to rod center) (Fig. 26).

**IMPORTANT:** When installing pivot shaft to H-frame, make sure that both sides of H-frame are aligned with holes in machine frame before installing pivot shaft.

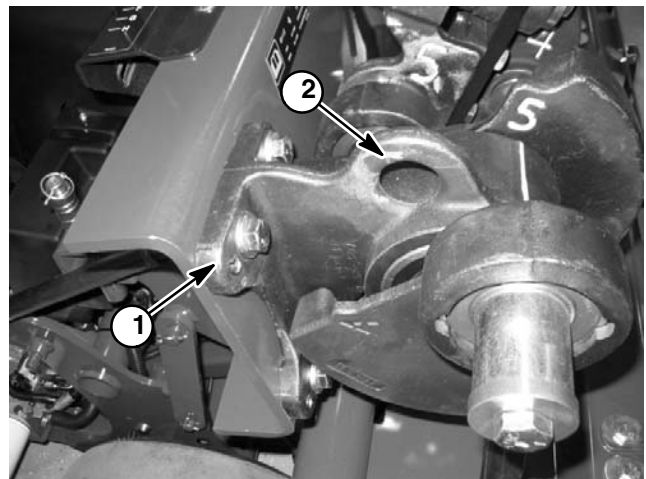


Figure 25

1. Bearing housing                      2. Lifting eyelet

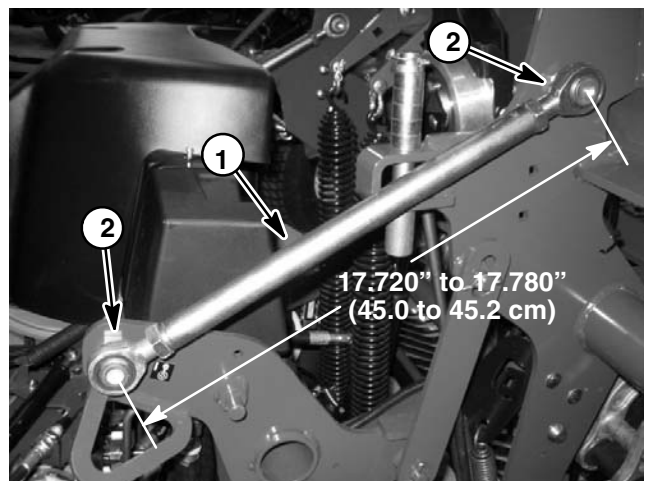


Figure 26

1. Upper link                              2. Rod end





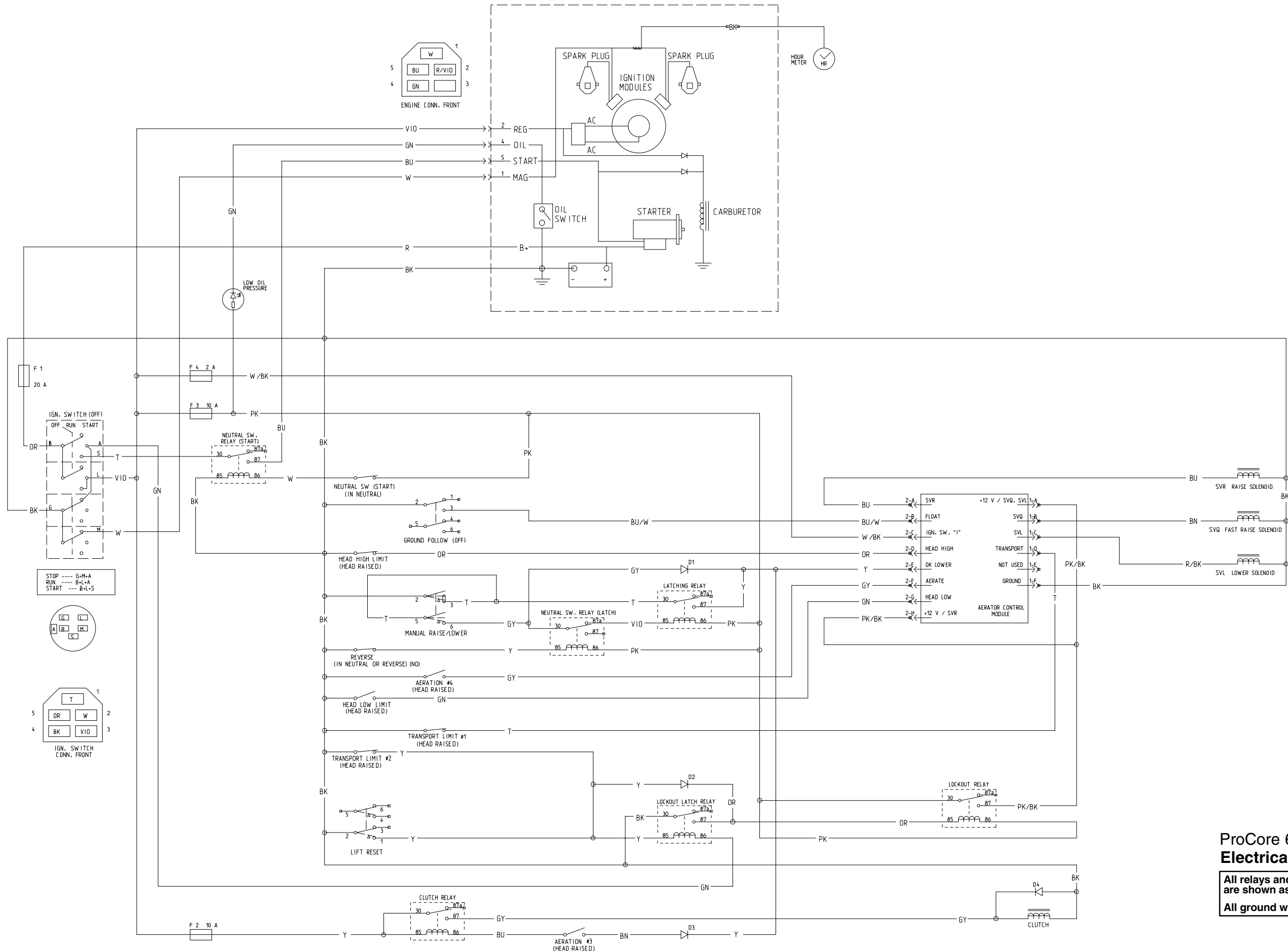
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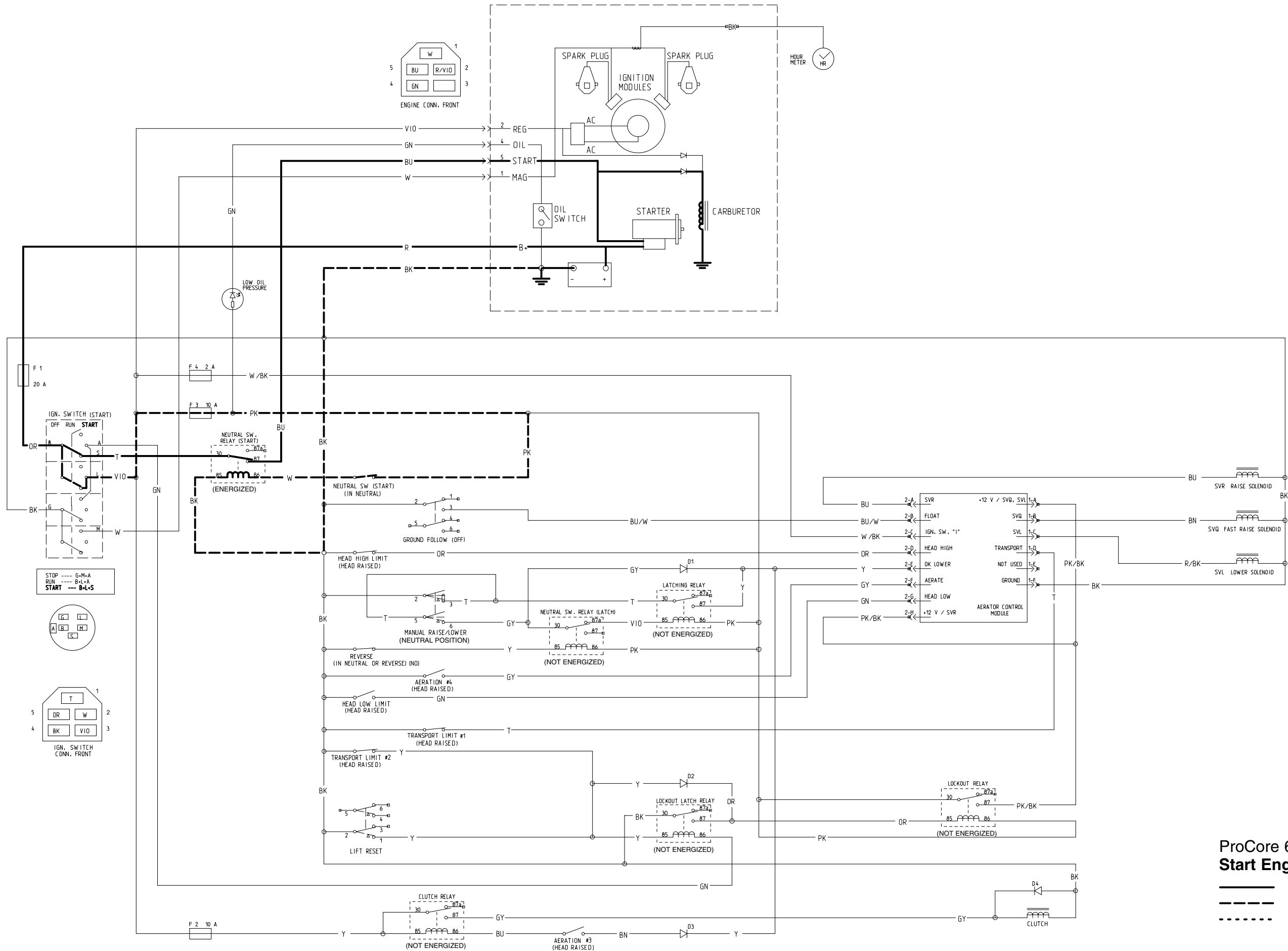
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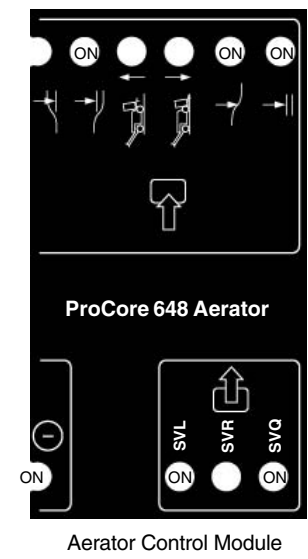
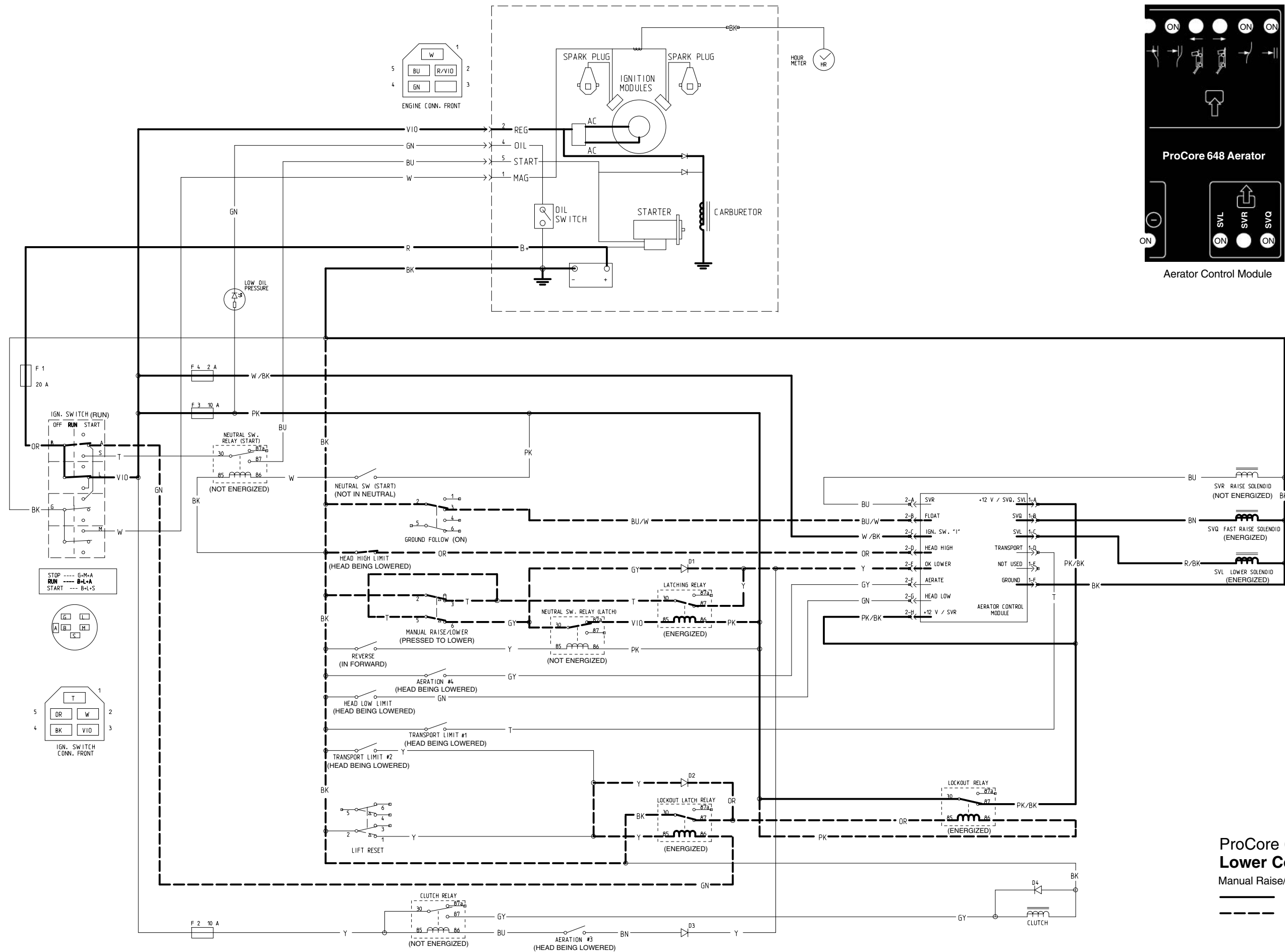
**ProCore 648  
Electrical Schematic**

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



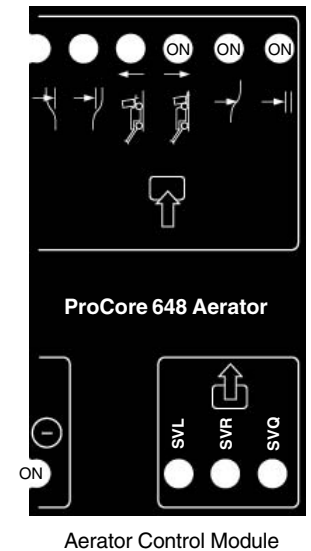
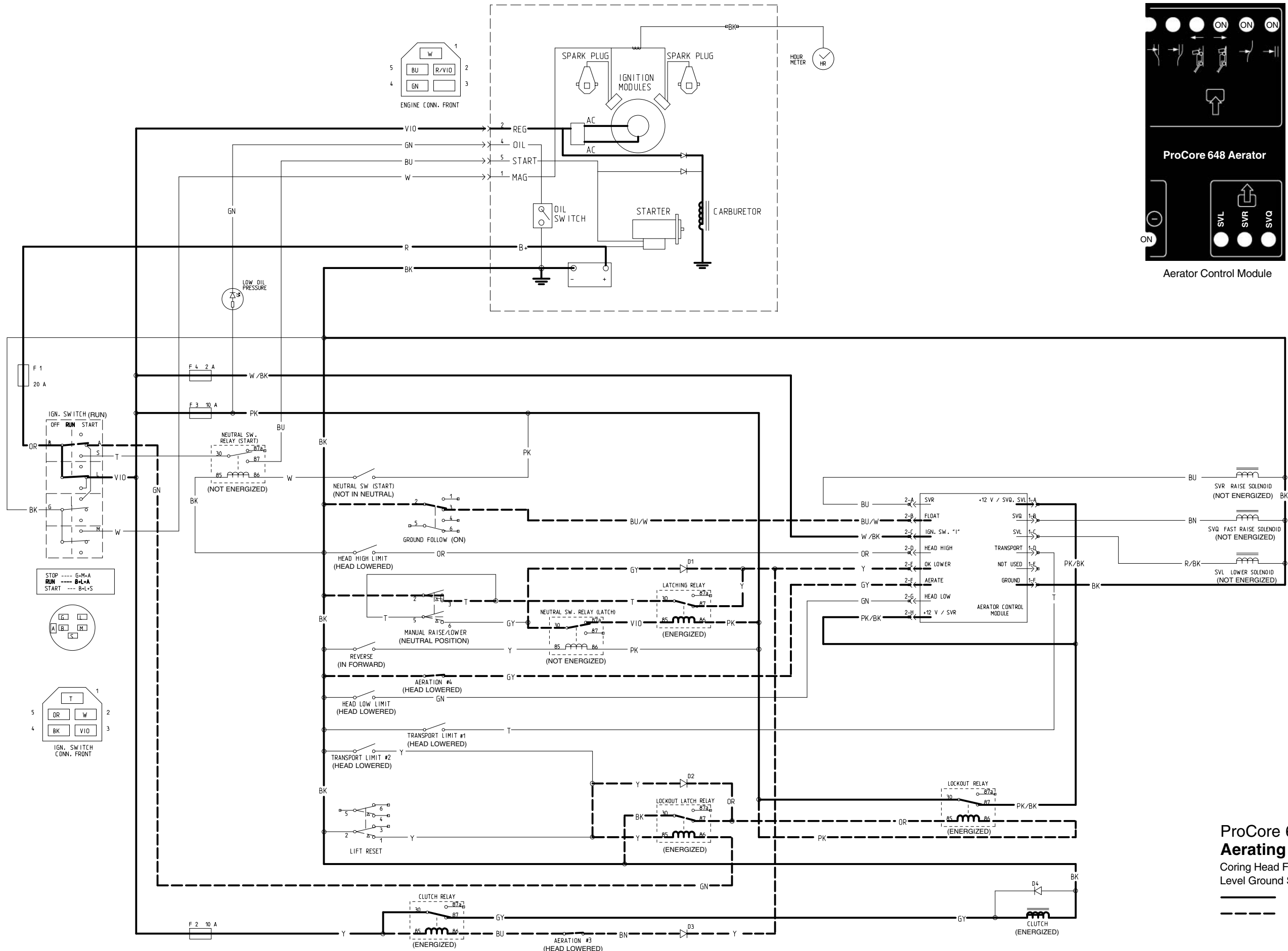
**ProCore 648  
Start Engine**

- Power Current
- Control Current
- Indication Current



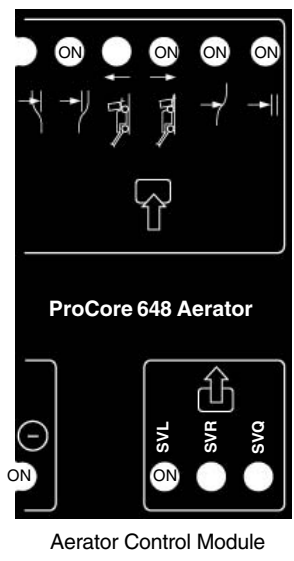
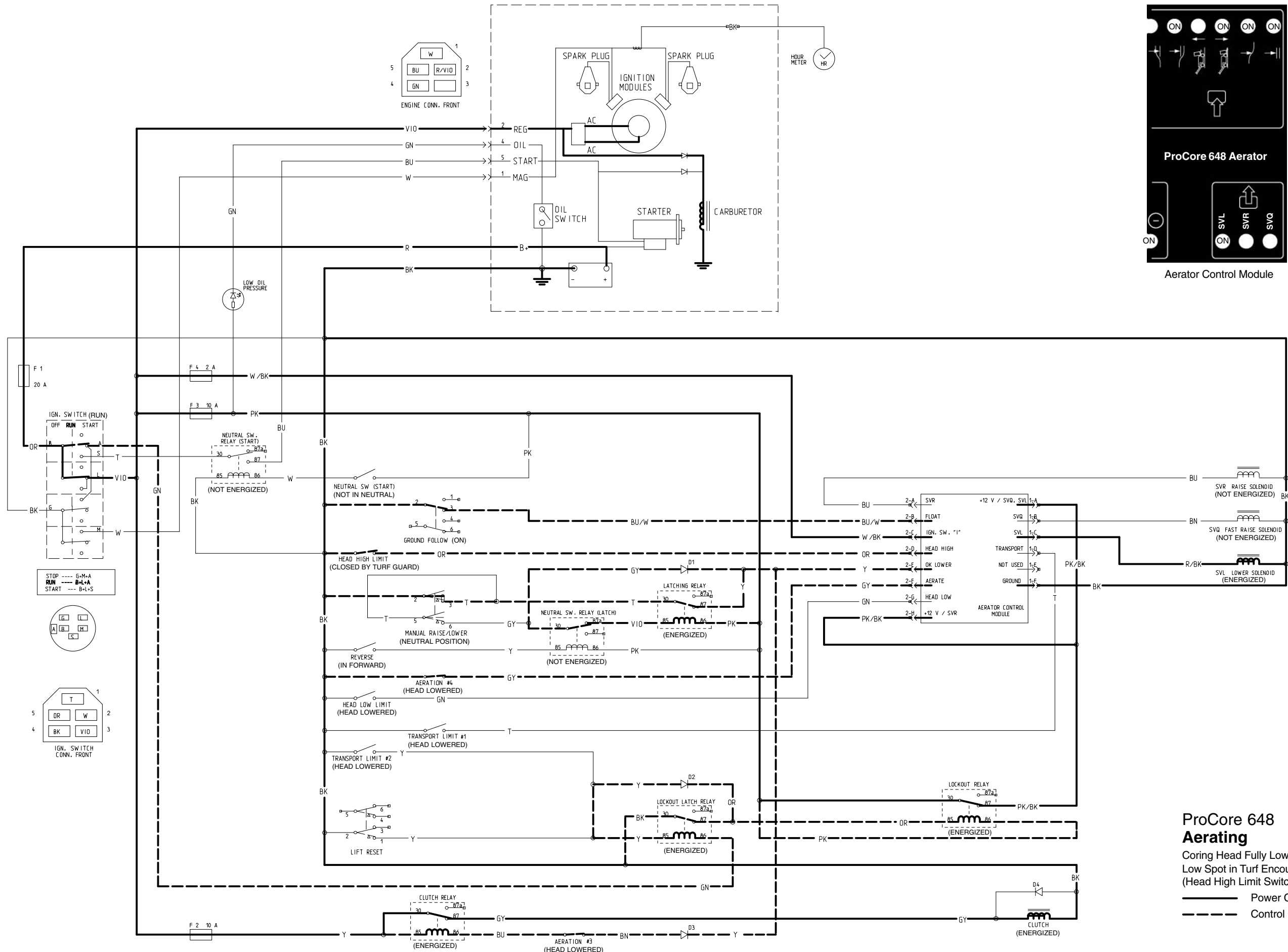
**ProCore 648  
Lower Coring Head**

Manual Raise/Lower Switch Pressed to Lower  
 ——— Power Current  
 - - - - Control Current



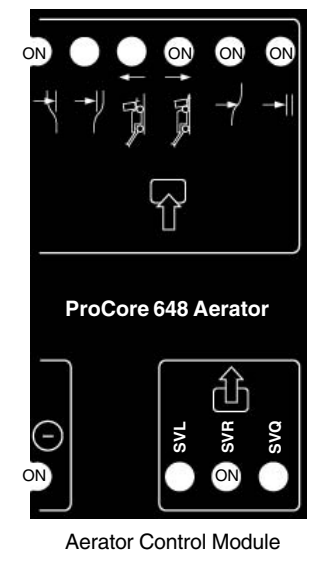
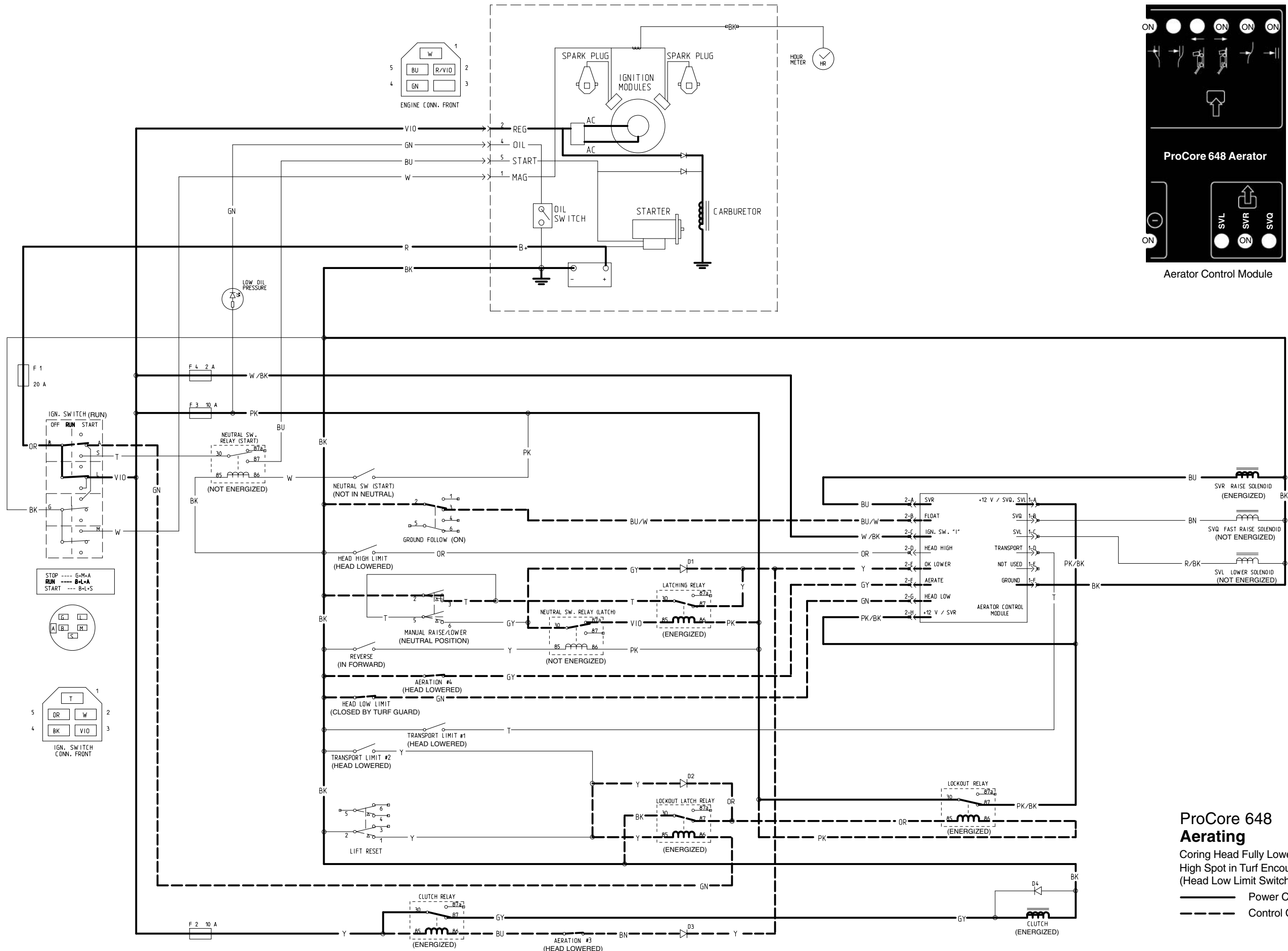
**ProCore 648  
Aerating**  
Coring Head Fully Lowered  
Level Ground Surface

— Power Current  
- - - Control Current



**ProCore 648  
Aerating**  
 Coring Head Fully Lowered  
 Low Spot in Turf Encountered  
 (Head High Limit Switch Closed by Turf Guard Movement)

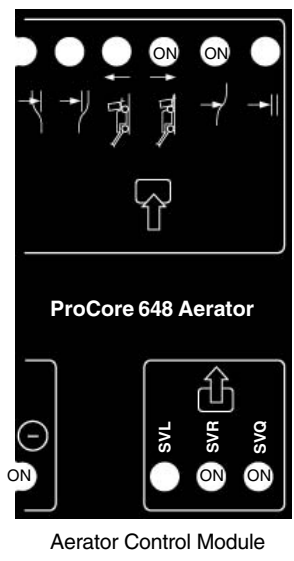
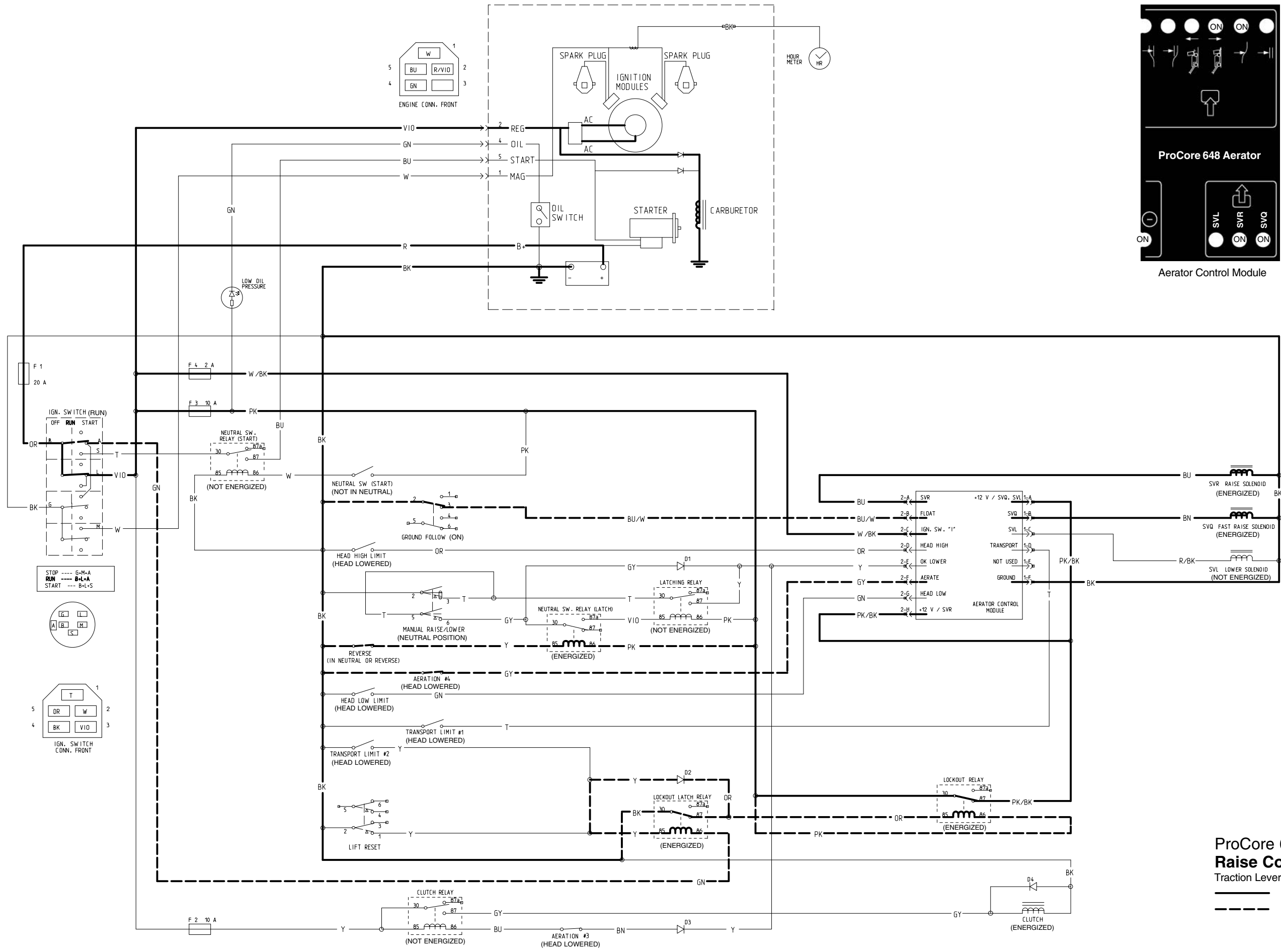
— Power Current  
 - - - Control Current



**ProCore 648  
Aerating**  
 Coring Head Fully Lowered  
 High Spot in Turf Encountered  
 (Head Low Limit Switch Closed by Turf Guard Movement)

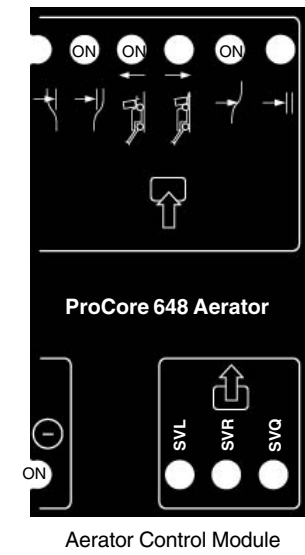
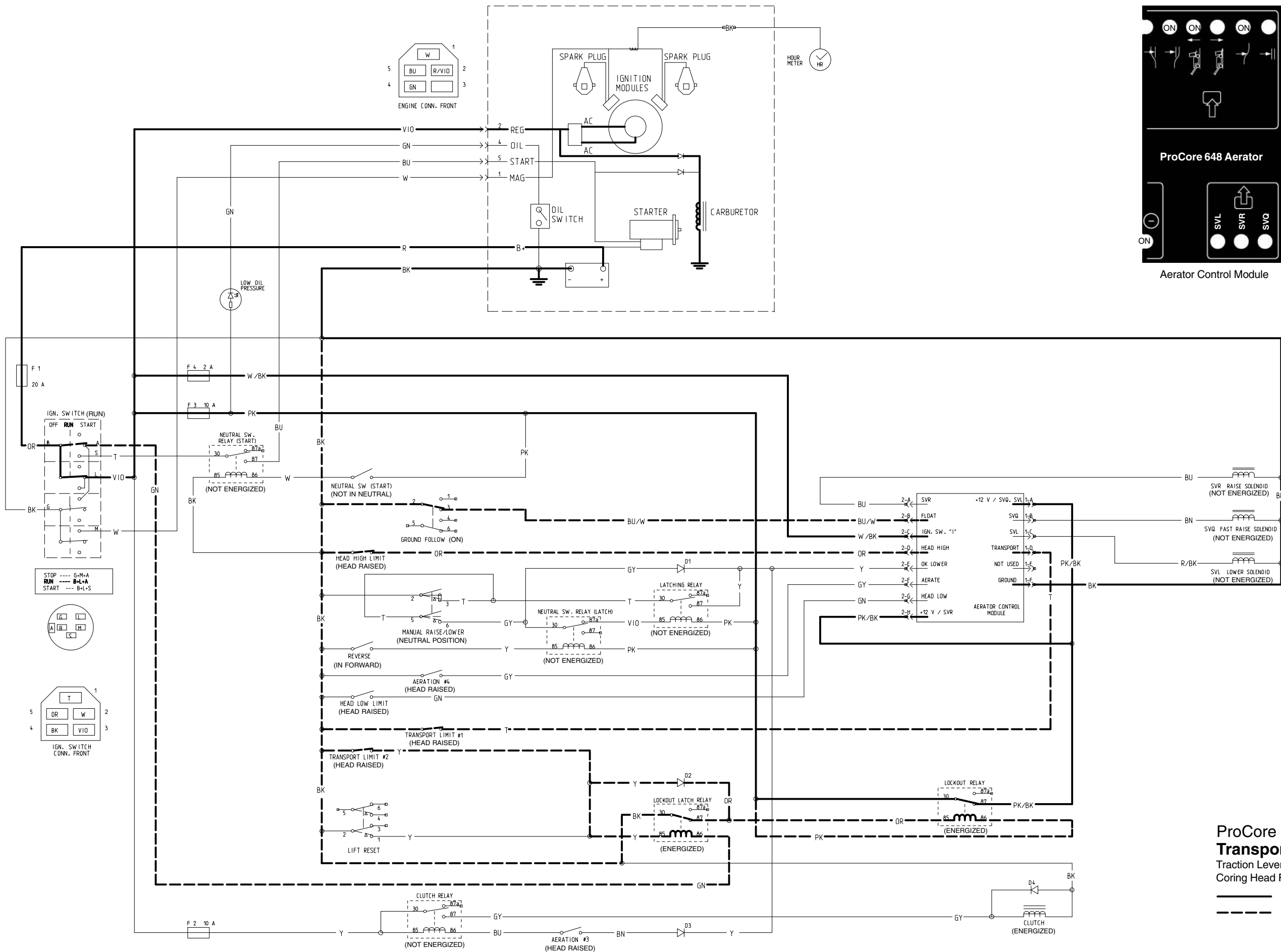
— Power Current  
 - - - Control Current





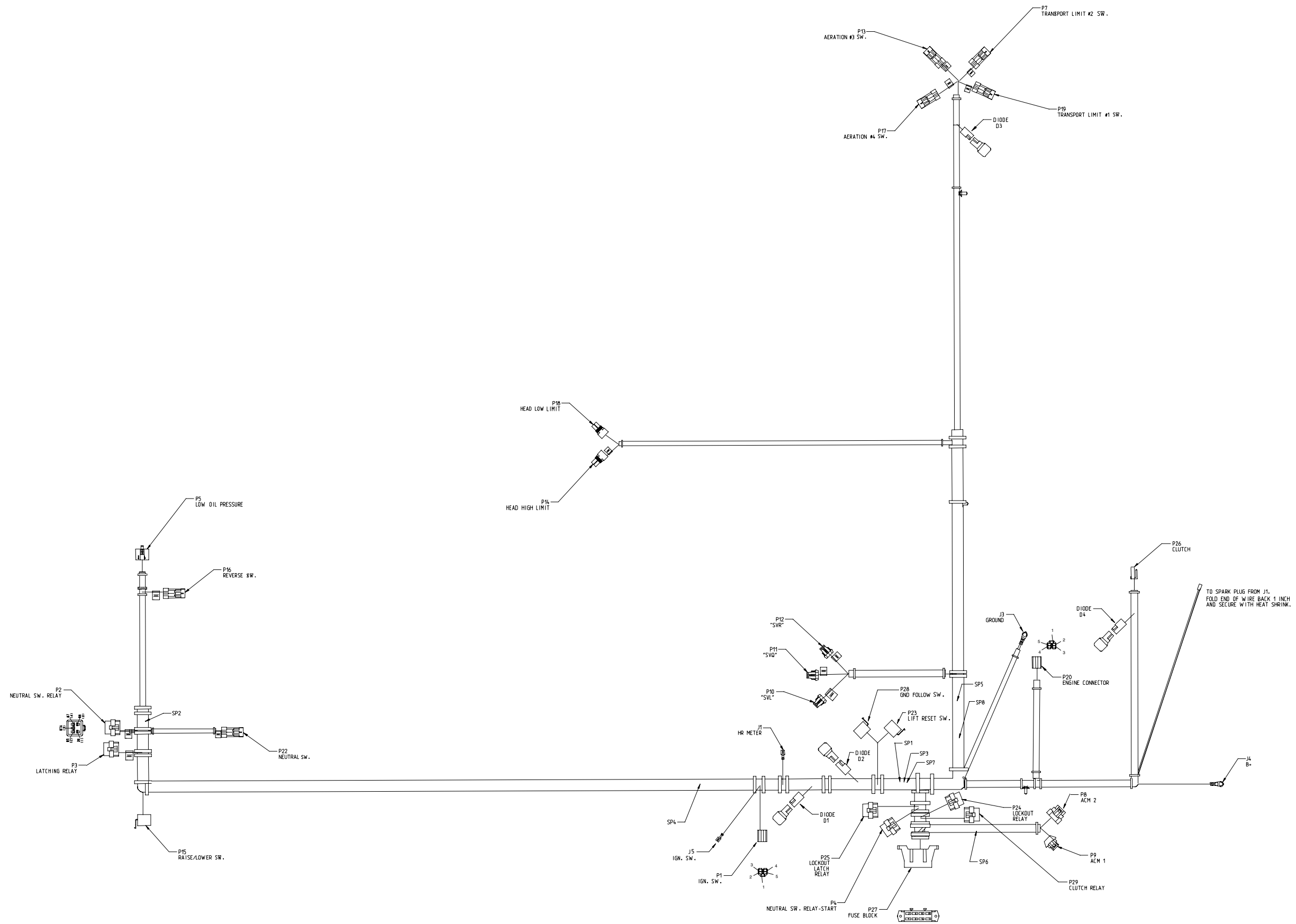
**ProCore 648**  
**Raise Coring Head**  
 Traction Lever Moved from Forward

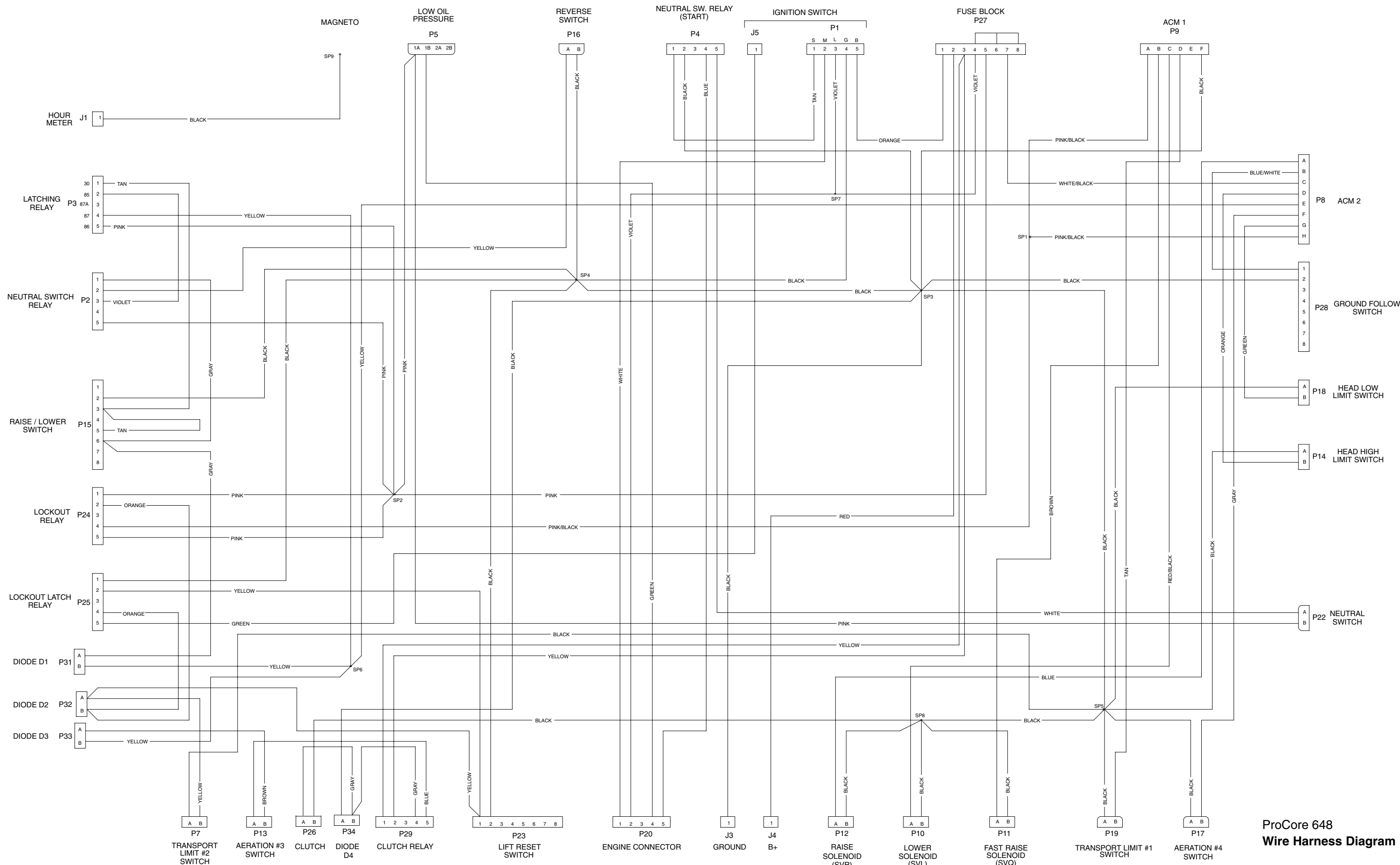
— Power Current  
 - - - Control Current



**ProCore 648 Transport**  
 Traction Lever Moved to Forward  
 Coring Head Fully Raised

— Power Current  
 - - - Control Current





ProCore 648  
Wire Harness Diagram

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