PART NO. 03112SL (Rev. C)

Service Manual

(Serial Number Below 290999999)

Multi Pro® 1200/1250

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 Multi Pro 1200 and Multi Pro 1250 sprayers with a serial number below 290999999.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manual and Parts Catalog for your machine. Replacement Operator's Manuals and Parts Catalogs are available on the internet at 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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Chapter 1

Safety

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Safety Instructions

The Multi Pro 1200 and Multi Pro 1250 Turf Sprayers are designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

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

Before Operating

1. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. A replacement Operator's Manual is available on the Internet at 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 range selector is in NEUTRAL.

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.

While Operating

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

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure range selector is in NEUTRAL and the pump switch is OFF.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. 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.

5. Before getting off the seat:

   A. Ensure that range selector is in neutral.

   B. Set parking brake.

   C. Turn pump switch OFF.

   D. Stop engine and remove key from ignition switch.

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

6. Follow chemical manufacturer's recommendations for handling precautions, necessary protective equipment, mixing proportions, and clean up procedures.

Maintenance and Service

1. Before servicing or making adjustments, turn spray pump off, put range selector in neutral, stop engine, set parking brake, and remove key from the switch.

2. Prior to servicing sprayer components, determine what chemical(s) have been used in the sprayer. Follow precautions and recommendations printed on chemical container labels or Material Safety Data Sheets when servicing sprayer components. Use appropriate protective equipment: protective clothing, chemical resistant gloves, and eye protection.

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

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

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

6. 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. 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.

7. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved. To relieve system pressure, rotate steering wheel in both directions after the key switch has been turned off.

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

9. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

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

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

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

13. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive cable first and negative 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. To assure optimum performance and continued safety 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 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 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 both rear tires to prevent the machine from moving.

2. Position jack securely under the A–arms, just to the inside of the front tire (Fig. 1).

3. Jack front of machine off the ground.

4. Position jack stands or hardwood blocks under the A–arms as close to the wheel as possible to support the machine.

Jacking the Rear End

1. Set parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely under the rear most frame supports between the angle welds (Fig. 2).

3. Jack rear of machine off the ground.

4. Position jack stands or hardwood blocks under the frame to support the machine.

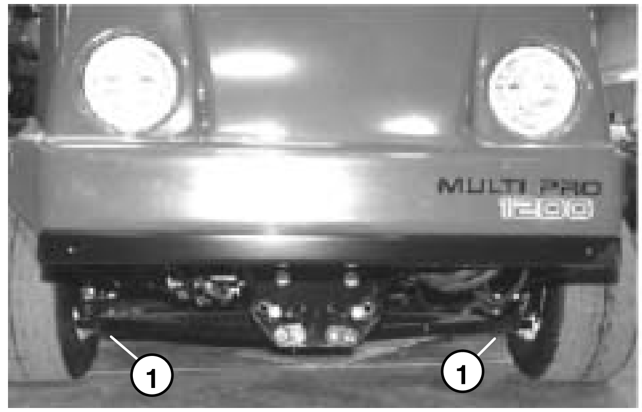

Figure 1

1. **Front jacking points**

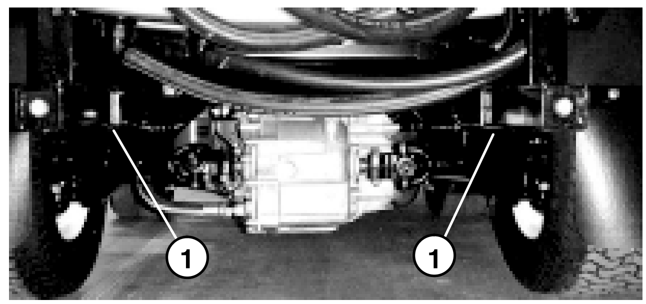

Figure 2

1. **Rear jacking points**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Multi Pro 1200 and Multi Pro 1250. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Multi Pro 1200/1250 at the end of this Chapter. Refer to Operator's Manual for recommended maintenance intervals. Additionally, insert Installation Instructions, Operator's Manuals, and Parts Catalogs for any accessories that have been installed on your Multi Pro at the end of this Chapter.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

U.S.to Metric Conversions

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

Torque Specifications

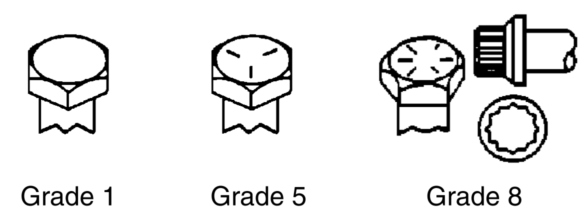
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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.

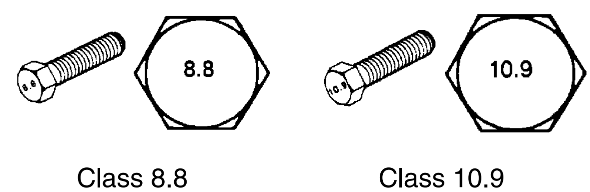
The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws

Figure 1



Metric Bolts and Screws

Figure 2

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

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 and finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

Conversion Factors

in–lb X 11.2985 = N–cm
ft–lb X 1.3558 = N–m

N–cm X 0.08851 = in–lb
N–m X 0.7376 = ft–lb

Maintenance

Maintenance procedures and recommended service intervals for the Multi Pro 1200 and Multi Pro 1250 are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance. Several maintenance procedures have break–in intervals identified in the Operator's Manual. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

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Chapter 3

Kohler Gasoline Engine

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Introduction

This Chapter gives information about specifications and repair of the Kohler engine used in the Multi Pro 1200 and 1250.

General 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 Distributor.

Specifications

Item	Description
Make / Designation	Kohler, CH20S, 4–stroke, V–Twin Air Cooled, OHV
Number of Cylinders	2
Bore x Stroke	77 mm x 67 mm (3.03” x 2.64”)
Total Displacement	624 cc (38 cu. in.)
Compression Ratio	8.5:1
Dry Weight (approximate)	41 kg (90 lb.)
Fuel	Unleaded, Regular Gasoline (Minimum 87 Octane)
Fuel Tank Capacity	18.9 liters (5 U.S. gal.)
Governor	Mechanical
Idle Speed (no load)	1000 ± 100 RPM
High Idle (no load)	3375 ± 25 RPM
Engine Oil	API SF or SG (see Operator’s Manual for viscosity)
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity	1.9 liters (2 U.S. qt.) with filter
Starter	12 VDC
Alternator/Regulator	12 VDC 30 AMP

Adjustments

Adjust Engine Speed

1. Allow engine to reach operating temperature before checking or adjusting engine speed. Park machine on a level surface, shift range selector to neutral, and engage parking brake.

2. Tip seat to gain access to engine speed control (Fig. 1).

3. With engine running, move accelerator pedal to **FAST** position.

4. Using a tachometer, check that engine is operating at **3375 ± 25 RPM**.

5. If high idle speed is incorrect, adjust high speed screw on control bracket (Fig. 2).

   A. Loosen jam nut on high speed screw.

   B. Adjust high speed screw to obtain **3375 ± 25 RPM**.

   C. Tighten lock nut. Recheck high speed.

6. Allow accelerator pedal to return to **SLOW** position.

7. Using a tachometer, check that engine is operating at **1000 ± 100 RPM**.

8. If low speed is incorrect, adjust low speed screw (Fig. 2).

   A. Loosen jam nut on slow speed screw.

   B. Adjust slow speed screw to obtain **1000 ± 100 RPM**.

   C. Tighten jam nut. Recheck low speed.

   NOTE: When the engine returns to idle speed, the drive clutch should fully disengage. Idle speed may have to be reduced to ensure complete clutch disengagement.

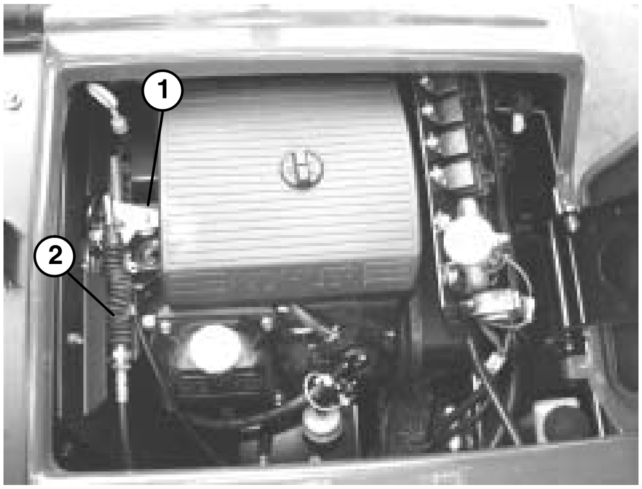

Figure 1

1. **Engine speed control**
2. **Accelerator cable**

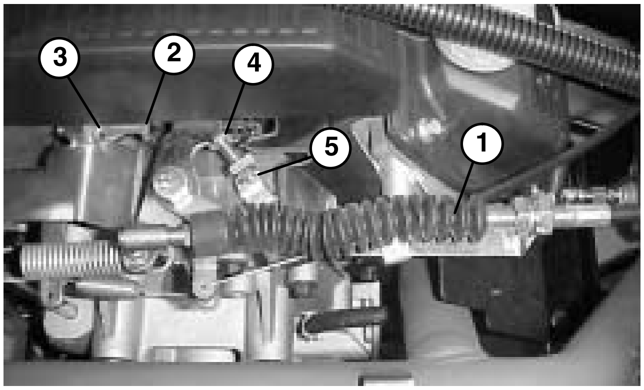

Figure 2

1. **Accelerator cable**
2. **High speed screw**
3. **Jam nut**
4. **Low speed screw**
5. **Jam nut**

Kohler Gasoline Engine

Adjust Choke Cable

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

2. Remove air cleaner cover and air filter from engine (see Operator's Manual).

3. Move choke control on control panel while watching choke plate in carburetor.

   A. Choke plate should be fully open when choke control is pushed in.

   B. Choke plate should be fully closed when choke control is pulled out.

4. If cable adjustment is needed, loosen cap screw and nut that secure choke cable clamp. Reposition cable to allow correct choke operation. Secure choke cable clamp.

5. Reassemble air cleaner.

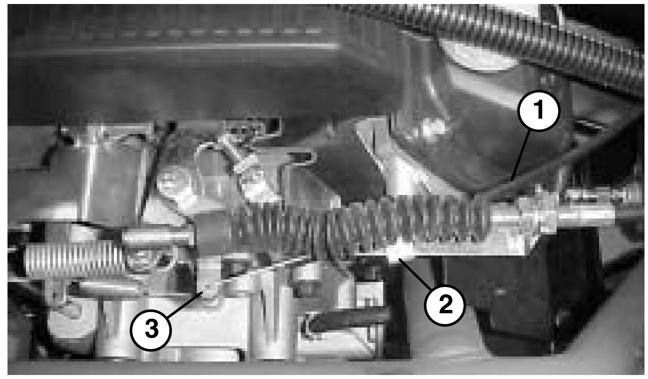

Figure 3

1. **Choke cable**
2. **Cable clamp**
3. **Choke lever**

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 Multi Pro 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, stop engine, engage parking brake, 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). Remove screen and housing if necessary.

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

4. Make sure grass screen and blower housing are reinstalled to the engine if removed.

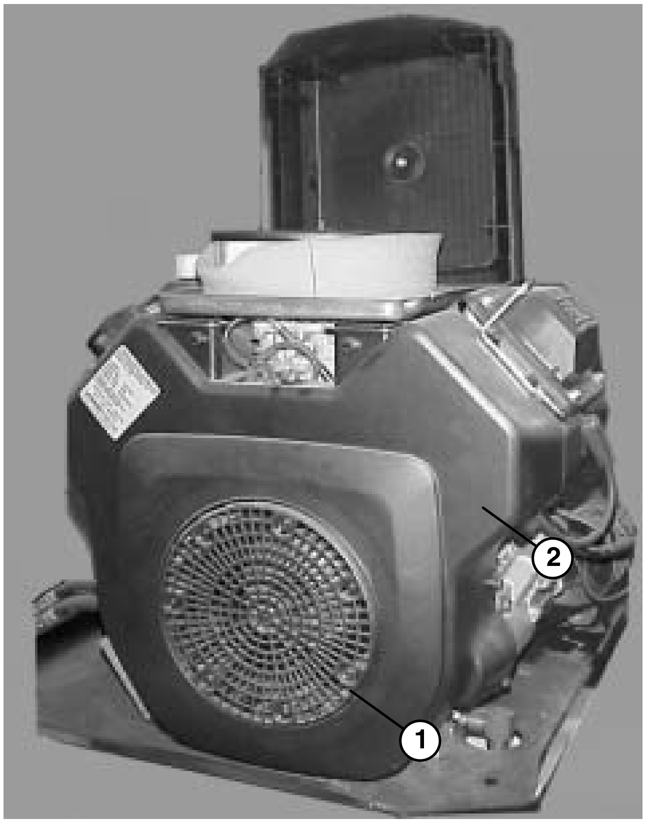

Figure 4

1. **Grass screen**
2. **Blower housing**

Fuel System

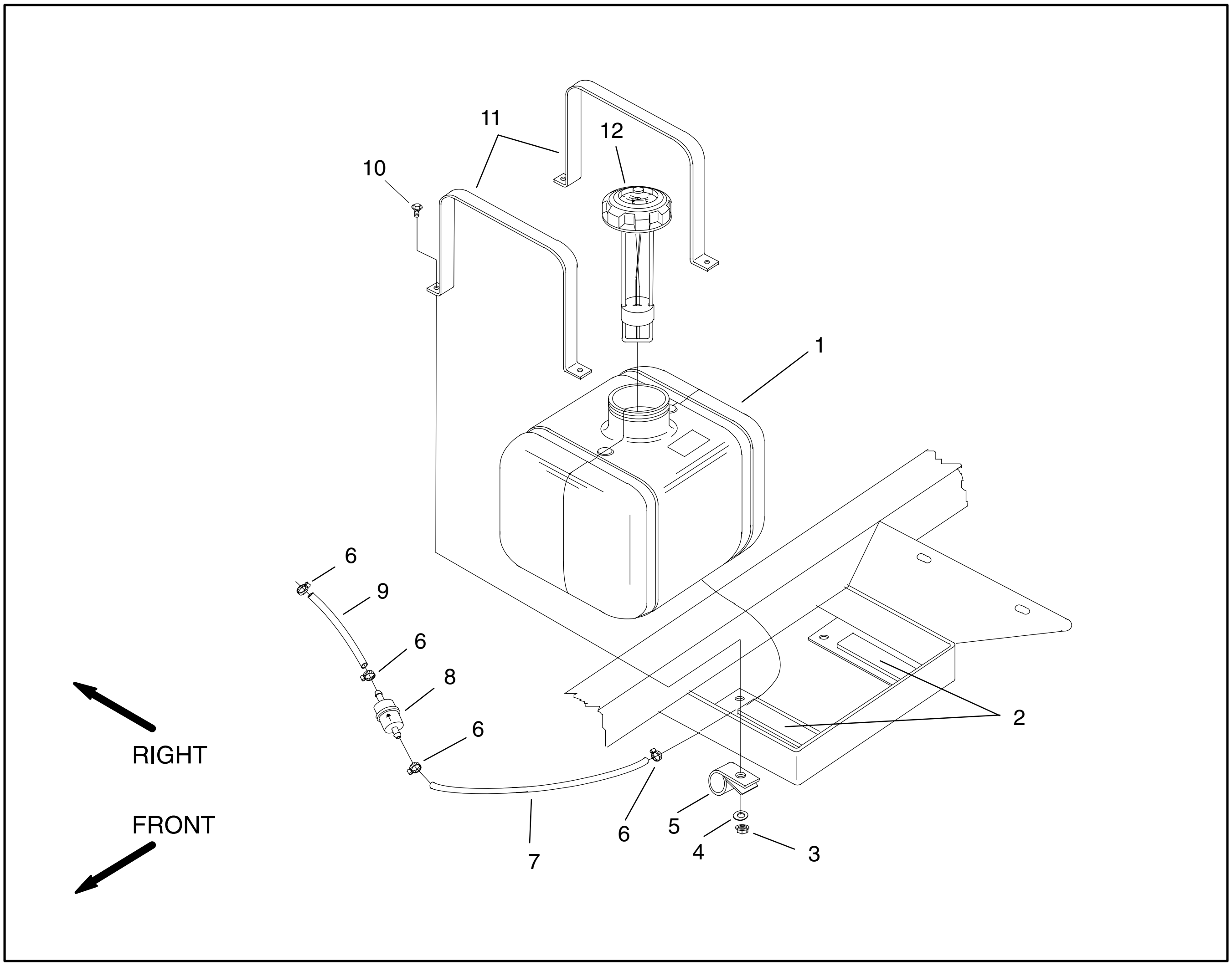

Figure 5

1. **Fuel tank**
2. **Foam strip**
3. **Nut (4 used)**
4. **Flat washer**
5. **R–clamp**
6. **Hose clamp**
7. **Fuel hose**
8. **Fuel filter**
9. **Fuel hose**
10. **Cap screw (4 used)**
11. **Fuel tank strap**
12. **Fuel cap**

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 lines for deterioration, damage, leaking, or loose connections. Replace hoses, clamps, and connections as necessary.

Drain and Clean Fuel Tank

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 contaminates and debris.

Fuel Tank Removal

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

2. Clamp fuel line before the fuel filter to prevent leakage. Disconnect fuel hose from the fuel filter.

3. Lower fuel line into a suitable container, unclamp fuel line, and drain fuel tank.

4. Remove fuel tank using Figure 5 as a guide.

Fuel Tank Installation

1. Install fuel tank to frame using Figure 5 as a guide.

2. Connect fuel hose to the fuel filter.

3. Fill fuel tank (see Operator's Manual).

Exhaust System

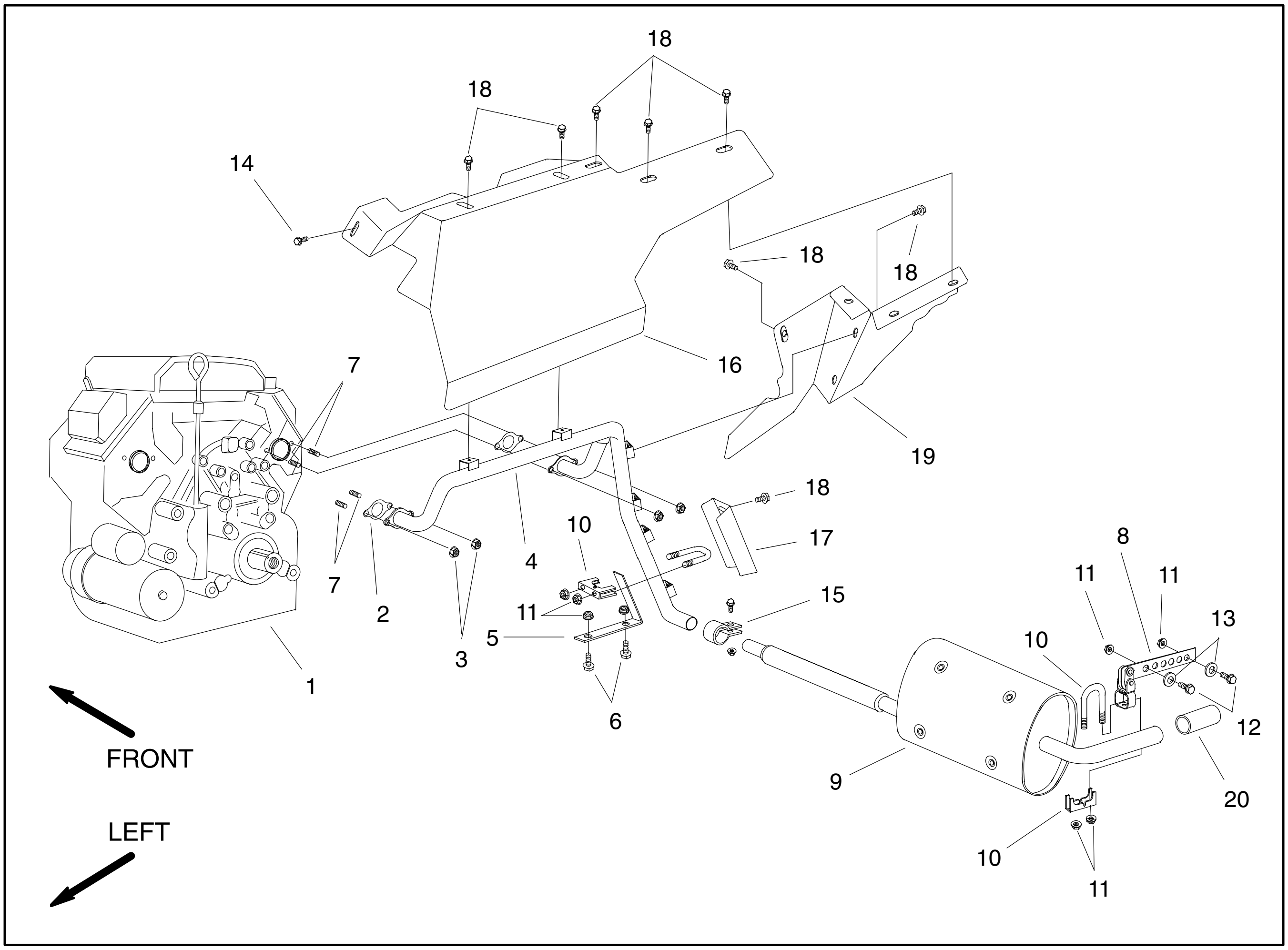

Figure 6

1. Engine
2. Exhaust gasket
3. Flange nut
4. Header pipe
5. Header support
6. Flange head screw
7. Exhaust stud
8. Muffler hanger
9. Muffler/tailpipe
10. Muffler clamp
11. Flange nut
12. Cap screw
13. Flat washer
14. Flange head screw
15. Muffler clamp
16. Upper exhaust shield
17. Lower exhaust shield
18. Cap screw
19. Muffler heat shield
20. Spark arrester (optional)

Removal (Fig. 6)

CAUTION

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

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

2. Gaining access from below machine, remove the muffler/tailpipe section of the exhaust system:

   A. Loosen muffler clamp (item 15) that secures muffler/tailpipe to header pipe.

   B. Remove two (2) flange nuts and clamp that secure the muffler/tailpipe to muffler hanger.

   C. Slide muffler/tailpipe from header pipe and lower muffler/tailpipe from machine.

3. Remove cap screws to allow removal of upper exhaust shield (item 16), muffler heat shield (item 19), and lower exhaust shield (item 17).

4. Remove two (2) flange nuts and clamp that secure the header pipe to the header support.

5. Remove four (4) flange nuts from the exhaust studs on engine. Remove header pipe from the engine.

6. Remove exhaust gaskets from engine. Replace gaskets if damaged or torn.

Installation (Fig. 6)

NOTE: Make sure engine and exhaust header sealing surfaces are free of debris or damage that may prevent a tight seal.

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

1. Place exhaust gaskets on the exhaust studs on engine. Position header pipe to the engine and install four (4) flange nuts.

2. Position header pipe to header support with clamp and two (2) flange nuts.

3. Tighten fasteners to secure header pipe:

   A. Four (4) flange nuts to secure header pipe to engine.

   B. Two (2) flange nuts on clamp to secure header pipe to header support.

4. Install lower exhaust shield (item 17), muffler heat shield (item 19), and upper exhaust shield (item 16). Secure shields with cap screws.

5. Install the muffler/tailpipe section of the exhaust system:

   A. Place muffler clamp (item 15) on muffler/tailpipe and slide muffler/tailpipe onto header pipe.

   B. Position muffler/tailpipe to muffler hanger with muffler clamp and two (2) flange nuts.

   C. Tighten muffler clamps to secure muffler/tailpipe.

Engine Mounting Plate Assembly

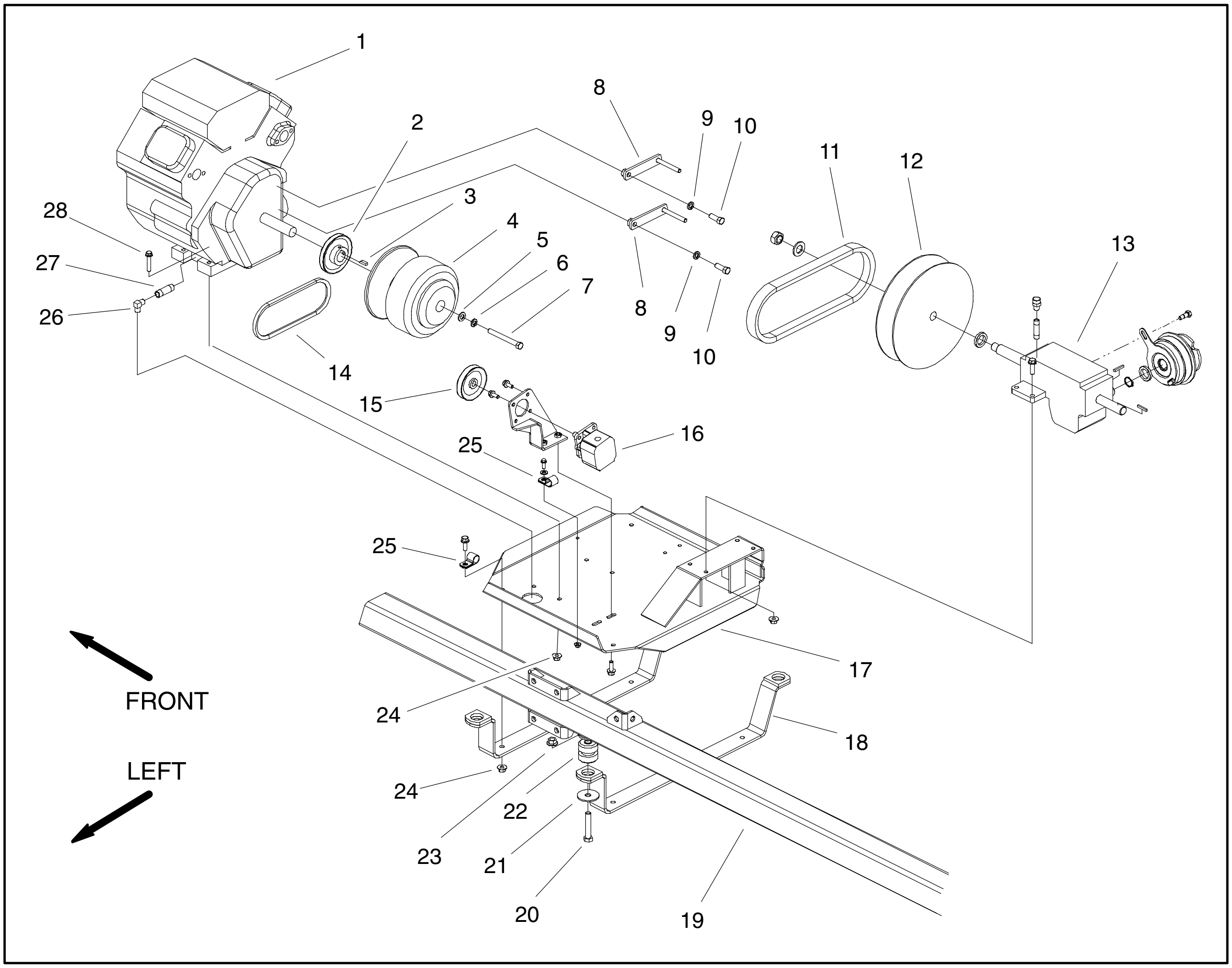

Figure 7

1. **Engine**
2. **Pump pulley**
3. **Key**
4. **Drive clutch**
5. **Flat washer**
6. **Lock washer**
7. **Cap screw**
8. **CVT belt guide**
9. **Lock washer**
10. **Cap screw**
11. **CVT drive belt**
12. **Driven clutch**
13. **Pump drive gearbox**
14. **Steering pump drive belt**
15. **Steering pump pulley**
16. **Hydraulic steering pump**
17. **Engine mounting plate**
18. **Engine support strap**
19. **Machine frame**
20. **Cap screw (4 used)**
21. **Washer (4 used)**
22. **Engine mount (4 used)**
23. **Flange nut (4 used)**
24. **Flange nut**
25. **R–clamp (3 used)**
26. **Oil drain elbow**
27. **Oil drain nipple**
28. **Flange head screw (4 used)**

NOTE: For easiest service access to the drive clutch, driven clutch, or pump drive gearbox, the engine mounting plate can be lowered from the machine. The hydraulic hoses to the steering pump and the fuel hose do not need to be disconnected unless the mounting plate is to be completely removed from the machine.

Removal (Fig. 7)

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

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

3. Remove muffler/tailpipe section of the exhaust system (see Exhaust System Removal).

4. Remove accelerator cable from engine (Fig. 8 and 9).

A. Slide the sleeve back on the cable ball joint and lift accelerator cable from the ball stud.

B. Loosen one of the two cable jam nuts that secures accelerator cable to control bracket.

C. Remove accelerator cable from the engine speed control bracket and position away from the engine.

5. Remove choke cable from the engine speed control bracket (Fig. 8 and 9).

6. Gaining access from under operator seat, loosen two (2) flange head screws and flange nuts that secure oil filter adapter to right hand frame rail (Fig. 10). Slide adapter with oil filter away from frame.

7. Disconnect engine electrical connections. Position unplugged wires away from engine.

A. Unplug engine wire harness from machine harness.

B. Remove nut on starter solenoid stud. Remove two red wires and positive (+) battery cable from solenoid stud.

C. Remove flange head screw and nut under starter motor that secures engine and negative (–) cable to engine mounting plate (Fig. 11).

8. Remove transaxle drive shaft from pump drive gearbox (see Pump Drive Gearbox in the Service and Repairs Section of Chapter 7 – Drive Train). Locate and retrieve key.

9. Disconnect spray pump coupler from pump drive electric clutch. Unplug clutch wiring connector from machine harness (see Pump Drive Electric Clutch in the Service and Repairs Section of Chapter 6 – Spray System).

10. If the mounting plate is being removed from machine, clamp fuel line at the fuel tank outlet to prevent fuel leakage. Disconnect fuel hose from fuel pump on engine and pull fuel line from R–clamps on mount plate. Position disconnected fuel line away from engine.

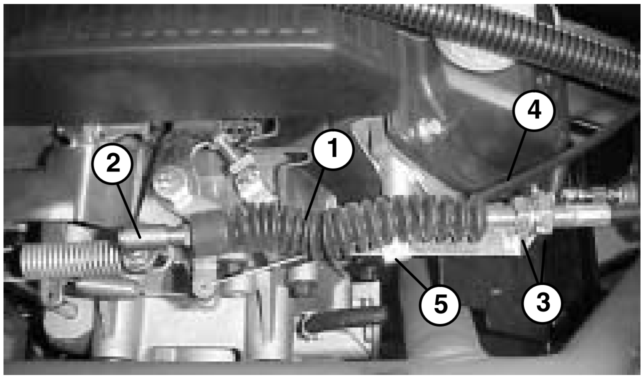

Figure 8

1. **Accelerator cable**
2. **Cable ball joint**
3. **Cable jam nut**
4. **Choke cable**
5. **Choke cable clamp**

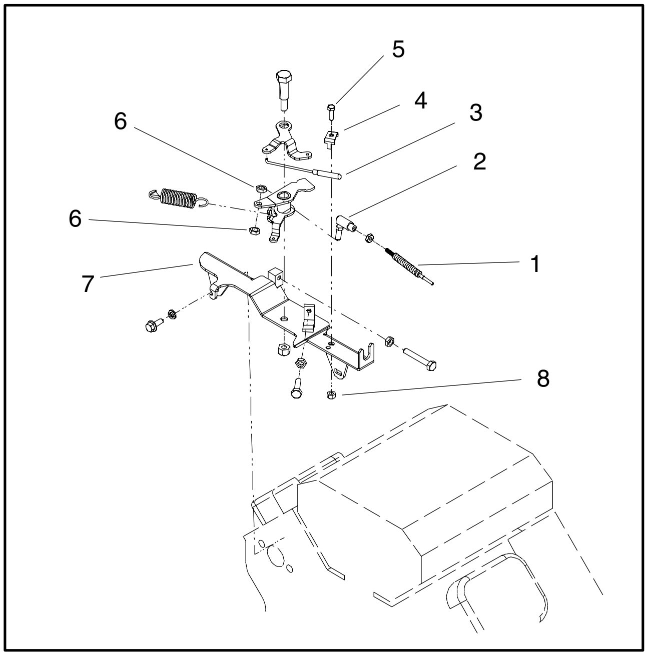

Figure 9

1. **Accelerator cable**
2. **Cable ball joint**
3. **Choke cable**
4. **Choke cable clamp**
5. **Cap screw**
6. **Ball joint jam nut**
7. **Speed control bracket**
8. **Hex nut**

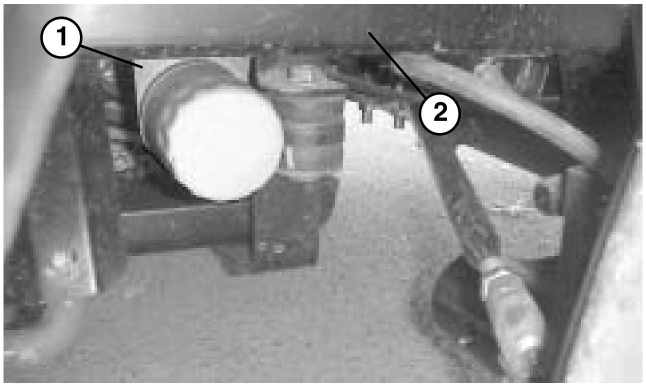

Figure 10

1. **Oil filter adapter**
2. **RH frame rail**

⚠ CAUTION

Rotate steering wheel to relieve hydraulic system pressure and avoid injury from pressurized hydraulic oil.

11. If the mounting plate assembly is being removed from machine, label all hydraulic connections for reassembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses. Remove hydraulic hoses from steering pump.

12. Remove engine mounting plate assembly from machine (Fig. 7 and 11):

A. Support the engine mounting plate assembly from below to prevent it from falling.

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

IMPORTANT: Make sure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while lowering the engine mounting plate assembly.

C. Carefully lower engine mounting plate assembly from machine.

Installation (Fig. 7)

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

2. Reinstall engine mounting plate assembly to machine (Fig. 7 and 11):

A. Make sure that engine mounts are assembled to mounting straps correctly (Fig. 12). Position engine mounting plate assembly under machine.

IMPORTANT: Make sure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while raising the engine mounting plate assembly.

B. Carefully raise engine mounting plate assembly to machine frame.

C. Secure engine mounting plate assembly to frame with four (4) cap screws and flange nuts.

3. Position key in pump drive gearbox shaft. Install transaxle drive shaft to pump drive gearbox (see Pump Drive Gearbox in the Service and Repairs Section of Chapter 7 – Drive Train).

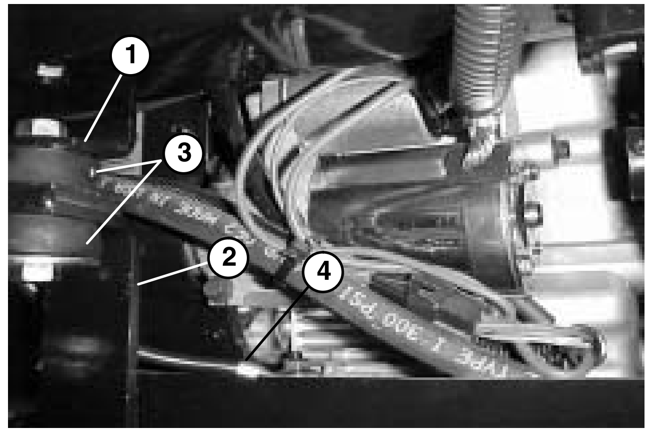

Figure 11

1. **Frame**
2. **Engine support strap**
3. **Engine mount**
4. **Negative battery cable**

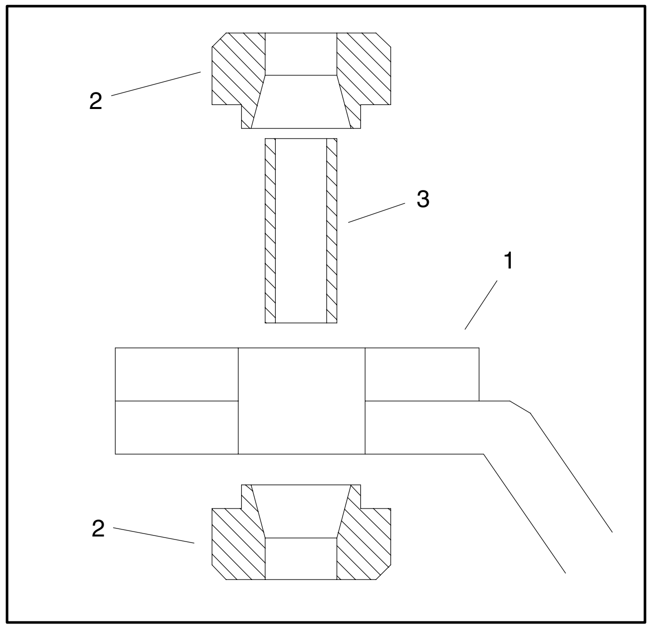

Figure 12

1. **Engine support strap**
2. **Engine mount cushion**
3. **Engine mount tube**

4. Connect spray pump coupler to pump drive electric clutch. Plug clutch wiring connector into machine harness (see Pump Drive Electric Clutch in the Service and Repairs Section of Chapter 6 – Spray System).

5. Reconnect engine electrical connections.

A. Pull wiring harness into position keeping harness away from any moving components.

B. Secure two (2) red wires and positive (+) battery cable to starter solenoid stud with nut.

C. Connect engine wire harness to main wire harness.

D. From below, install flange head screw and nut under starter motor that secures engine and negative (–) cable (Fig. 11).

6. Install choke cable to engine and secure with cable clamp (Fig. 8 and 9). Check choke cable adjustment (see Adjust Choke Cable in the Adjustments Section of this Chapter).

7. Reconnect accelerator cable to engine (Fig. 8 and 9).

A. Position accelerator cable to the engine speed control bracket.

B. Slide the sleeve back on the cable ball joint and place cable ball joint on ball stud. Release the sleeve so it slides over the stud to secure cable.

C. Tighten cable jam nuts that secure accelerator cable to control bracket.

8. If fuel line was removed, route fuel line through R–clamps on mounting plate. Connect fuel line to the fuel pump.

9. Position oil filter adapter with oil filter to the right hand frame rail. Install two (2) flange head screws and flange nuts and secure oil filter adapter to machine (Fig. 10).

10. Reinstall the muffler/tailpipe section of the exhaust system (see Exhaust System Installation).

11. If hydraulic hoses were disconnected, make sure hydraulic hoses and pump ports are clean. Install hydraulic hoses to steering pump.

12. Check engine oil level and transaxle/hydraulic fluid level (see Operator’s Manual).

13. Connect positive (+) and then negative (–) battery cables to the battery.

14. Check engine speed (see Adjust Engine Speed in the Adjustments Section of this Chapter).

Engine

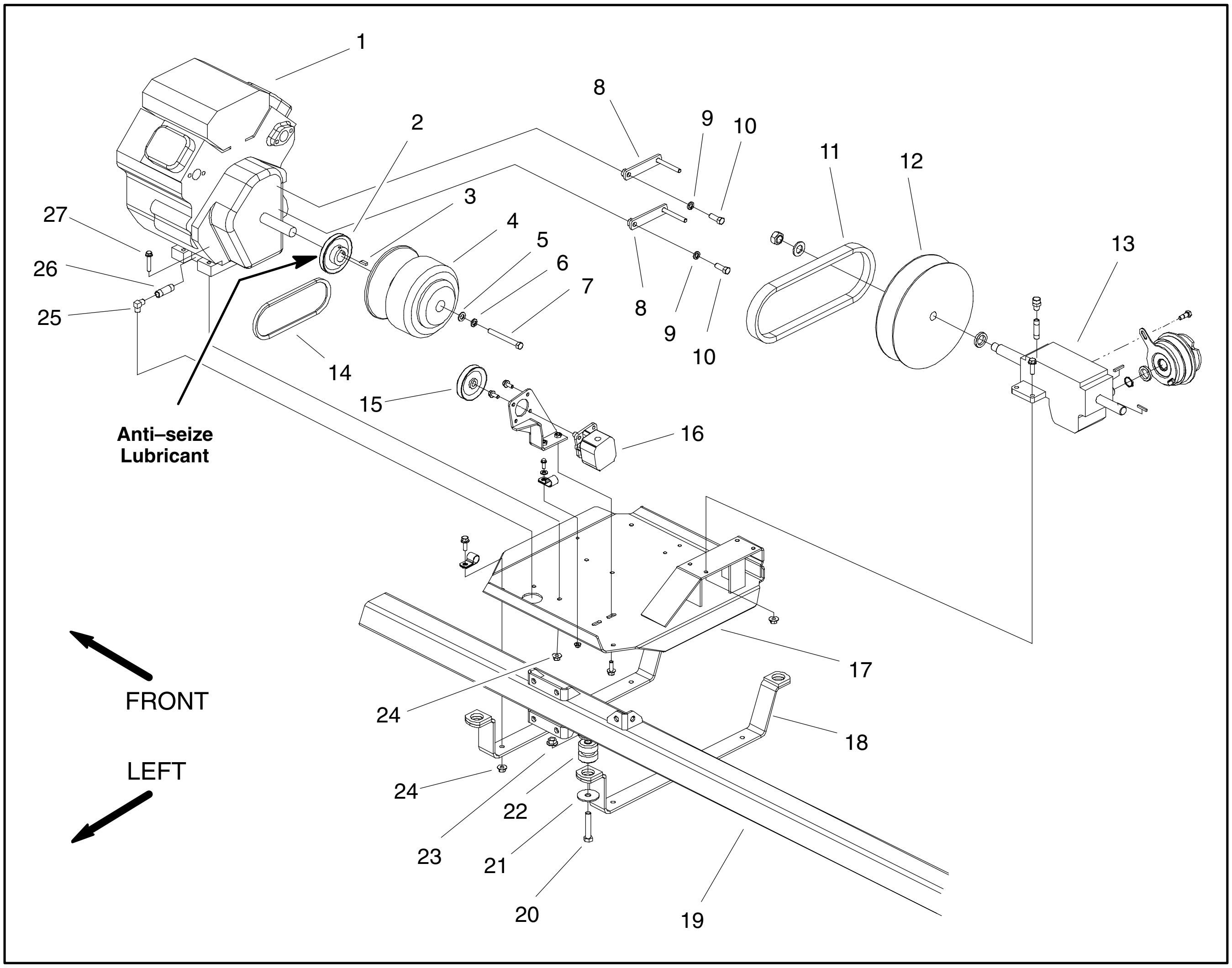

Figure 13

1. Engine
2. Pump pulley
3. Key
4. Drive clutch
5. Flat washer
6. Lock washer
7. Cap screw
8. CVT belt guide
9. Lock washer
10. Cap screw
11. CVT drive belt
12. Driven clutch
13. Pump drive gearbox
14. Steering pump drive belt
15. Steering pump pulley
16. Hydraulic steering pump
17. Engine mounting plate
18. Engine support strap
19. Machine frame
20. Cap screw (4 used)
21. Washer (4 used)
22. Engine mount (4 used)
23. Flange nut (4 used)
24. Flange nut
25. Oil drain elbow
26. Oil drain nipple
27. Flange head screw

Engine Removal (Fig. 13)

1. Remove engine mounting plate assembly from machine (see Engine Mounting Plate Removal in this section).

2. Loosen CVT drive belt guides. Rotate driven clutch and route drive belt over the driven clutch. Remove belt from the drive clutch (see Drive Belt Service in Service and Repairs Section of Chapter 7 – Drive Train).

3. Loosen hydraulic steering pump and remove pump drive belt from pulleys.

4. Loosen and remove three (3) remaining flange head screws and flange nuts that secure engine to engine mounting plate. Remove engine from mounting plate.

5. If needed, remove drive clutch from engine crankshaft (see Drive Clutch in the Service and Repairs Section of Chapter 7 – Drive Train).

6. If needed, loosen set screws and remove steering pump pulley from engine crankshaft. Locate and retrieve key.

Engine Installation (Fig. 13)

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

2. If steering pump pulley was removed from engine, position key into keyway of engine shaft. Apply anti–seize lubricant to shaft and key. Assemble pump pulley over key and shaft with hub on pulley away from engine.

3. If drive clutch was removed from engine, reinstall clutch to engine (see Drive Clutch in the Service and Repairs Section of Chapter 7 – Drive Train).

4. Secure engine to the mounting plate with three (3) flange head screws and flange nuts. The flange head screw position under the starter motor should not be used because it is used to secure the negative (–) cable to the engine.

5. Install steering pump drive belt to pump pulleys. Position pump pulley on engine so pulleys are aligned. Apply Loctite #242 (or equivalent) to pulley set screws and secure pump pulley to engine crankshaft with set screws. Adjust pump drive belt tension (see Operator's Manual).

6. Place CVT drive belt around drive clutch. Rotate driven clutch while routing the belt onto the driven clutch. Adjust belt guides (see Drive Belt Service in Service and Repairs Section of Chapter 7 – Drive Train).

7. Install engine mounting plate to machine (see Engine Mounting Plate Installation in this section).

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Chapter 4

Hydraulic System

Table of Contents

Specifications

Item	Description
Gear Pump Steering Relief Pressure	Positive displacement, gear type pump 1000 PSI (69.0 bar)
Hydraulic Filter	10 Micron spin–on cartridge type
Hydraulic Reservoir	In transaxle

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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. Stop engine and rotate the steering wheel.

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 $\pm$ 0.25
6 (3/8 in.)	0.75 $\pm$ 0.25
8 (1/2 in.)	0.75 $\pm$ 0.25
10 (5/8 in.)	1.00 $\pm$ 0.25
12 (3/4 in.)	0.75 $\pm$ 0.25
16 (1 in.)	0.75 $\pm$ 0.25

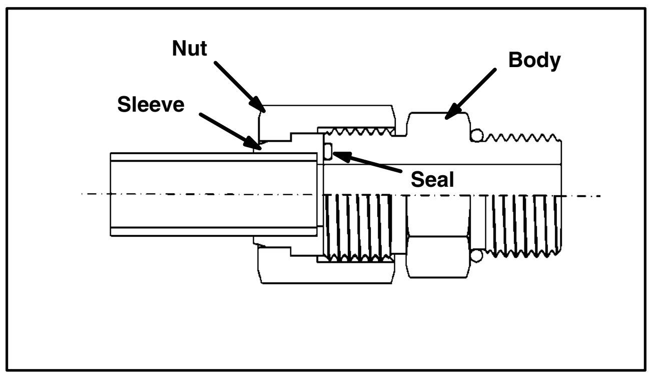


Figure 1

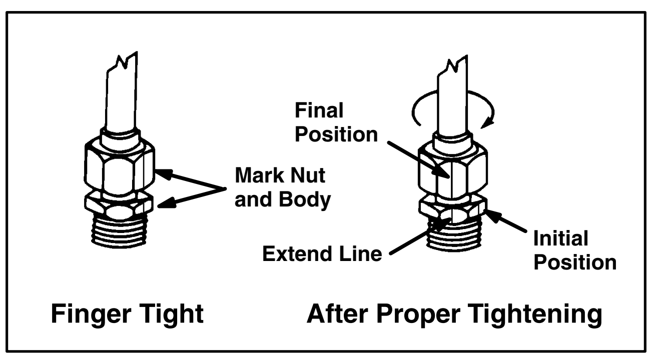


Figure 2

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

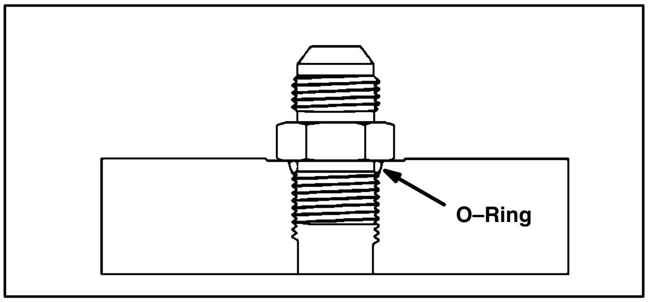


Figure 3

SAE Straight Thread O–Ring Port – Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O–ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O–ring with a light coating of oil.

4. Turn back the jam nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1).

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct Flats From Finger Tight (F.F.F.T.) (Step 4).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 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

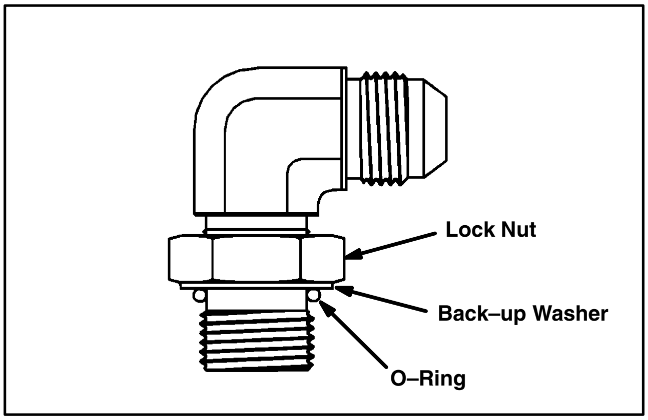


Figure 4

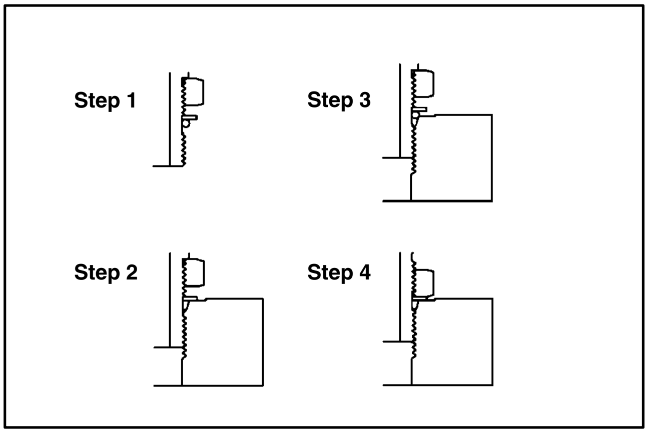
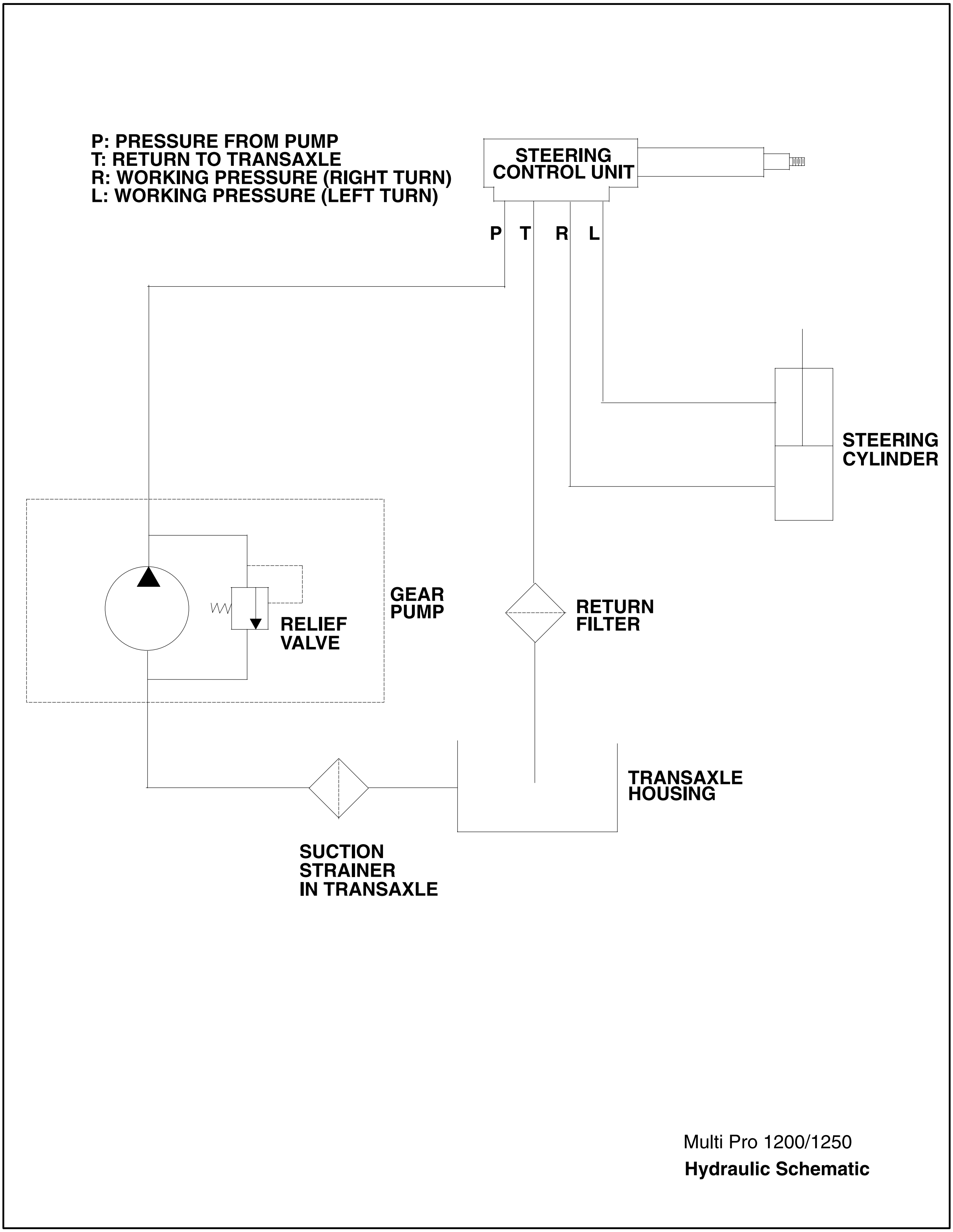


Figure 5

Hydraulic Schematic



Hydraulic Flow Diagrams

Steering Circuit

A single section, belt driven gear pump supplies hydraulic flow to the steering control valve and steering cylinder. The gear pump takes its suction from the transaxle. Steering circuit pressure is limited by a relief valve located in the gear pump.

Hydraulic flow and pressure to the steering control valve can be monitored at the outlet of the gear pump.

With the steering wheel in the neutral position and the engine running, flow enters the steering control valve and goes through the steering control spool valve, by–passing the rotary meter (V1) and steering cylinder. Flow leaves the control valve, to the oil filter, and returns to the transaxle.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve from the pump goes through the spool, to the rotary meter (V1), and out the L port. Pressure contracts the steering cylinder piston for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the steering control spool valve, then to the oil filter, and returns to the transaxle.

The steering control valve returns to the neutral position when turning is completed.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve from the pump goes through the spool, to the rotary meter (V1), and out the R port. Pressure extends the steering cylinder piston for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the steering control spool valve, then to the oil filter, and returns to the transaxle.

The steering control valve returns to the neutral position when turning is completed.

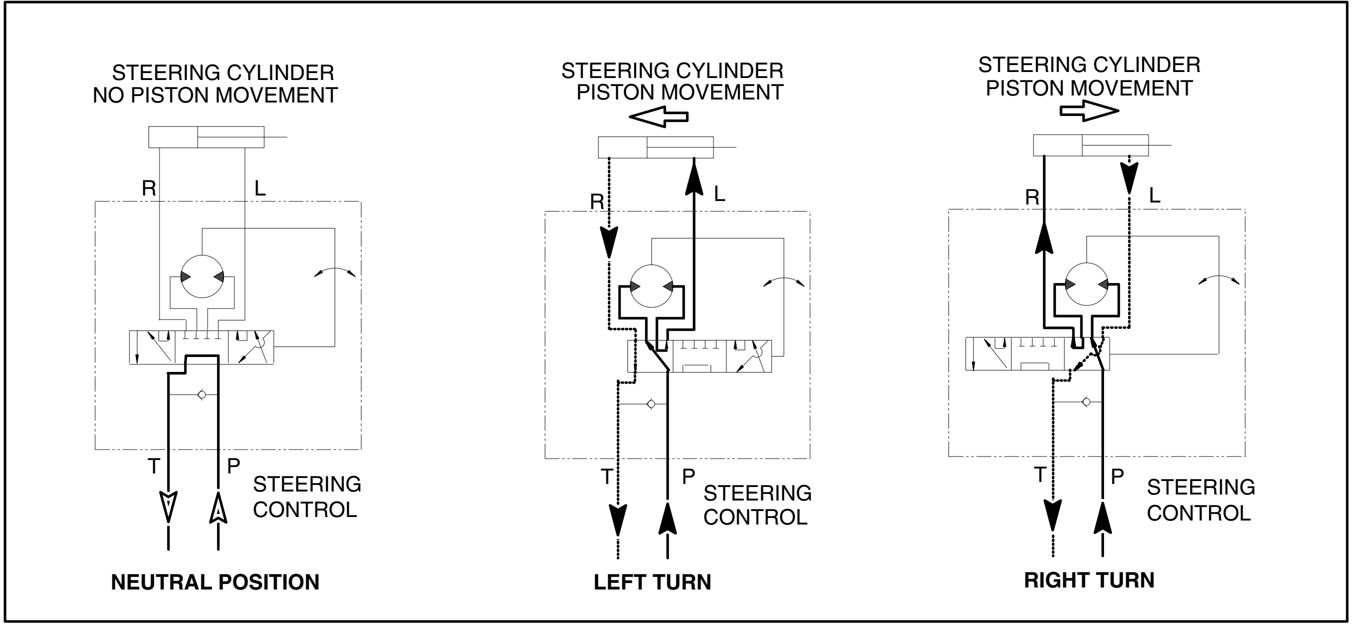


Figure 6

Special Tools

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

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 7

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 TOR4079 on next page).

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 5000 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.

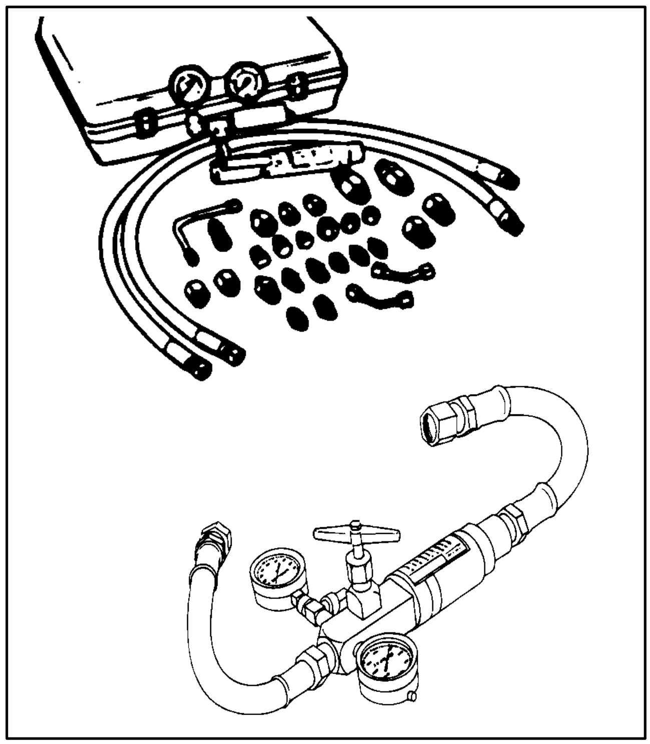


Figure 8

Hydraulic Test Fitting Kit

Toro Part Number: **TOR4079**

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

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

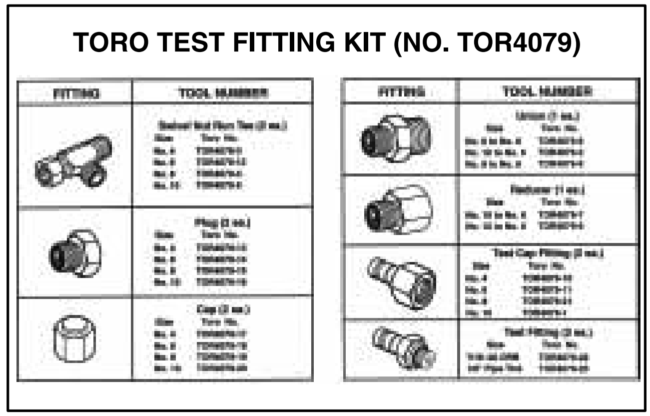


Figure 9

Troubleshooting

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

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

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

The chart that follows contains 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 transaxle is incorrect. Hydraulic system has wrong kind of oil. Hydraulic oil is contaminated. The steering pump suction line has an air leak.
Hydraulic system operates hot	Oil level in transaxle is incorrect. Suction screen in transaxle is loose or clogged. Hydraulic hose is kinked. Hydraulic oil is contaminated or incorrect viscosity. Oil constantly forced over relief. Steering pump is worn or damaged. Transaxle or drive train problem (see Drive Train – Chapter 7).
Steering inoperative or sluggish	Engine speed is too low. Pump pulley drive belt is loose. Steering cylinder is binding. Transaxle oil level is low. Steering relief valve is stuck open. Steering control valve is worn or damaged. Pulley key (either on engine or pump) is sheared. Steering cylinder leaks internally. Steering pump is worn or damaged.

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.)

CAUTION

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

Before Performing Hydraulic Tests

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

Precautions For Hydraulic Testing

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by stopping the engine and rotating the steering wheel in both directions.

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

1. Thoroughly clean the machine before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of 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 the tester readings.

4. Because the hydraulic pump is belt driven, check for proper pump belt adjustment before performing any hydraulic test.

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 pressure and flow capabilities).

6. To minimize the possibility of damaging components, completely open load valve in hydraulic tester (when using tester with pressure and flow capabilities).

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

8. Position the tester hoses so that rotating machine parts will not make contact with them and result in hose or tester damage.

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

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

11. After testing is completed, check and adjust the oil level in the transaxle before returning the machine to service.

TEST NO. 1: Steering Pump Flow and Relief Pressure (Using Tester With Pressure Gauges and Flow Meter)

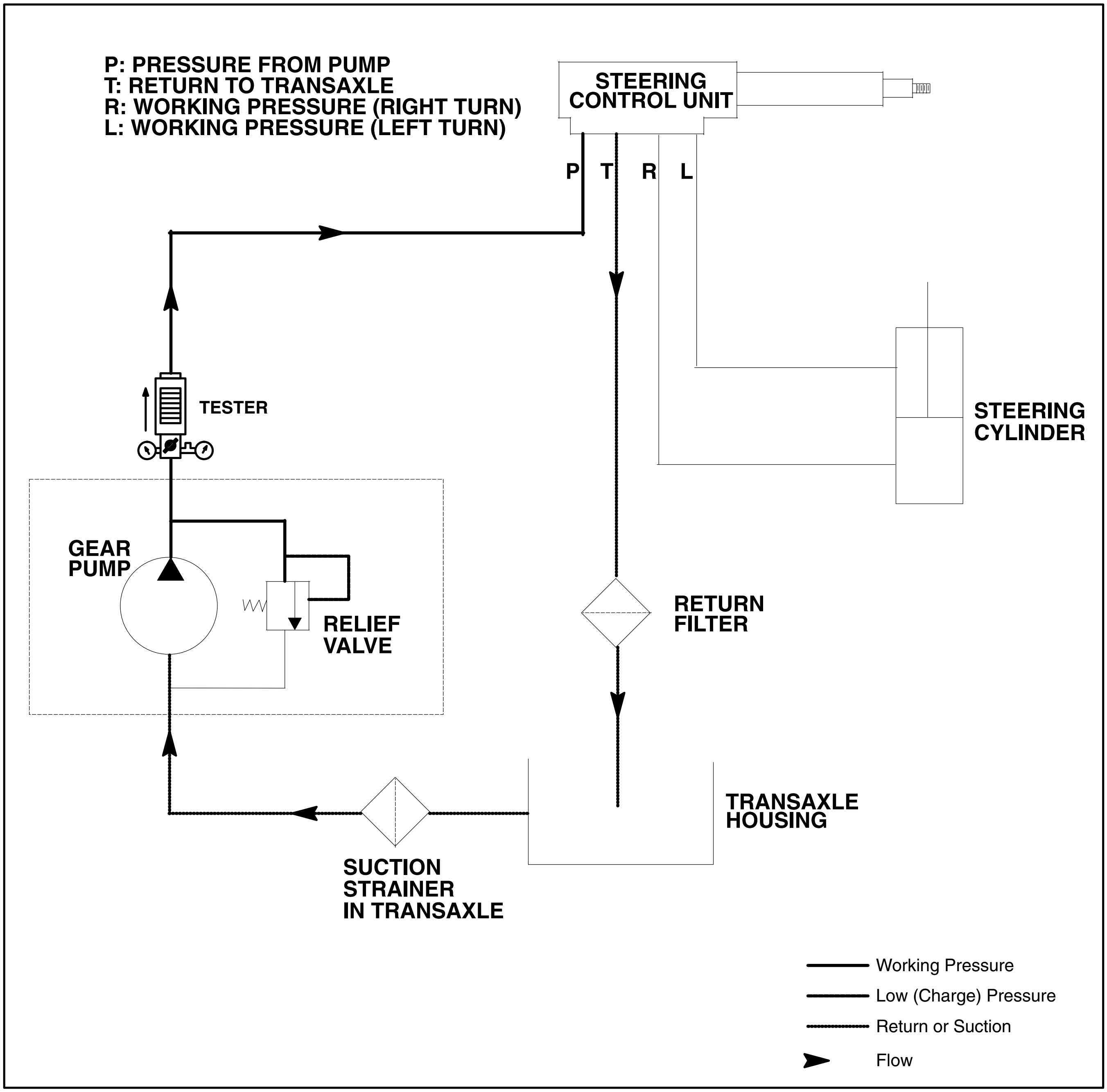


Figure 10

Procedure for Steering Pump Flow and Relief 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 spray system off. Apply parking brake and make sure range selector is in the neutral position.

3. Read Precautions For Hydraulic Testing.

4. Make sure that steering pump drive belt is adjusted properly. (see Operator's Manual).

CAUTION

Rotate steering wheel with engine off to relieve system pressure and avoid injury from pressurized hydraulic oil.

5. Clean hose fitting and disconnect pressure hose from the top of the steering pump (Fig. 11).

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

6. Install flow tester with pressure gauges in series with the pump and the disconnected hose. Make sure flow control valve on tester is fully open.

7. To test steering pump flow:

A. Start engine and adjust engine speed with accelerator pedal so pump speed is **3450 RPM** (engine speed approximately 3000 RPM). Verify pump speed with a phototac.

B. Close flow control valve on tester until pressure gauge reads **800 PSI**. Observe flow gauge.

TESTER READING: Flow approximately **2.7 GPM**.

C. Release accelerator pedal and turn off machine. Record test result.

8. If pump flow specification is not met, inspect for:

A. Slipping pump drive belt.

B. Worn, stuck, or out of adjustment relief valve.

C. Pump suction line restriction.

D. Steering pump needs to be repaired or replaced.

9. To test steering pump relief pressure:

A. Make sure flow control valve on tester is fully open.

B. Start engine and depress accelerator pedal so engine is running at high idle (**3375 ± 25 RPM**).

IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading. Holding the steering wheel against the stop for an extended period will damage the steering motor.

C. Watch pressure gauge carefully while turning the steering wheel completely in one direction (full steering lock) and holding.

D. System pressure should be approximately **1000 PSI** as the relief valve lifts. Return steering wheel to the center position.

E. Release accelerator pedal and turn off machine. Record test results.

10. If relief pressure is incorrect, inspect for:

A. Slipping pump drive belt.

B. Worn, stuck, or out of adjustment relief valve.

11. Disconnect tester from steering pump and hose. Reconnect hose to the pump.

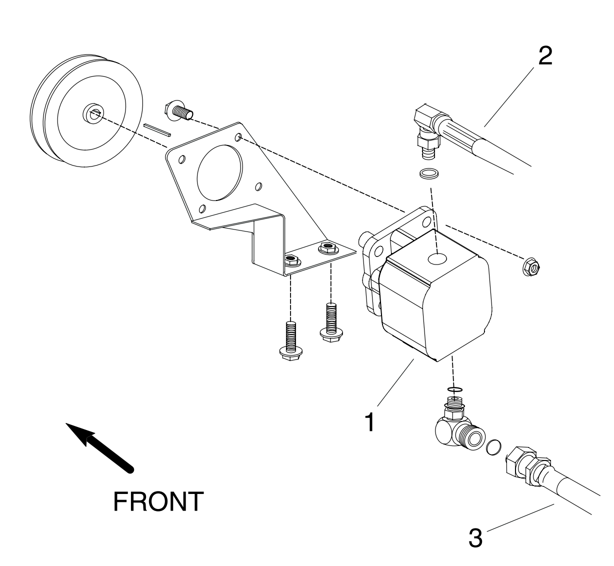


Figure 11

1. **Steering pump**
2. **Pressure hose**
3. **Suction hose**

TEST NO. 2: Steering Control Valve and Steering Cylinder

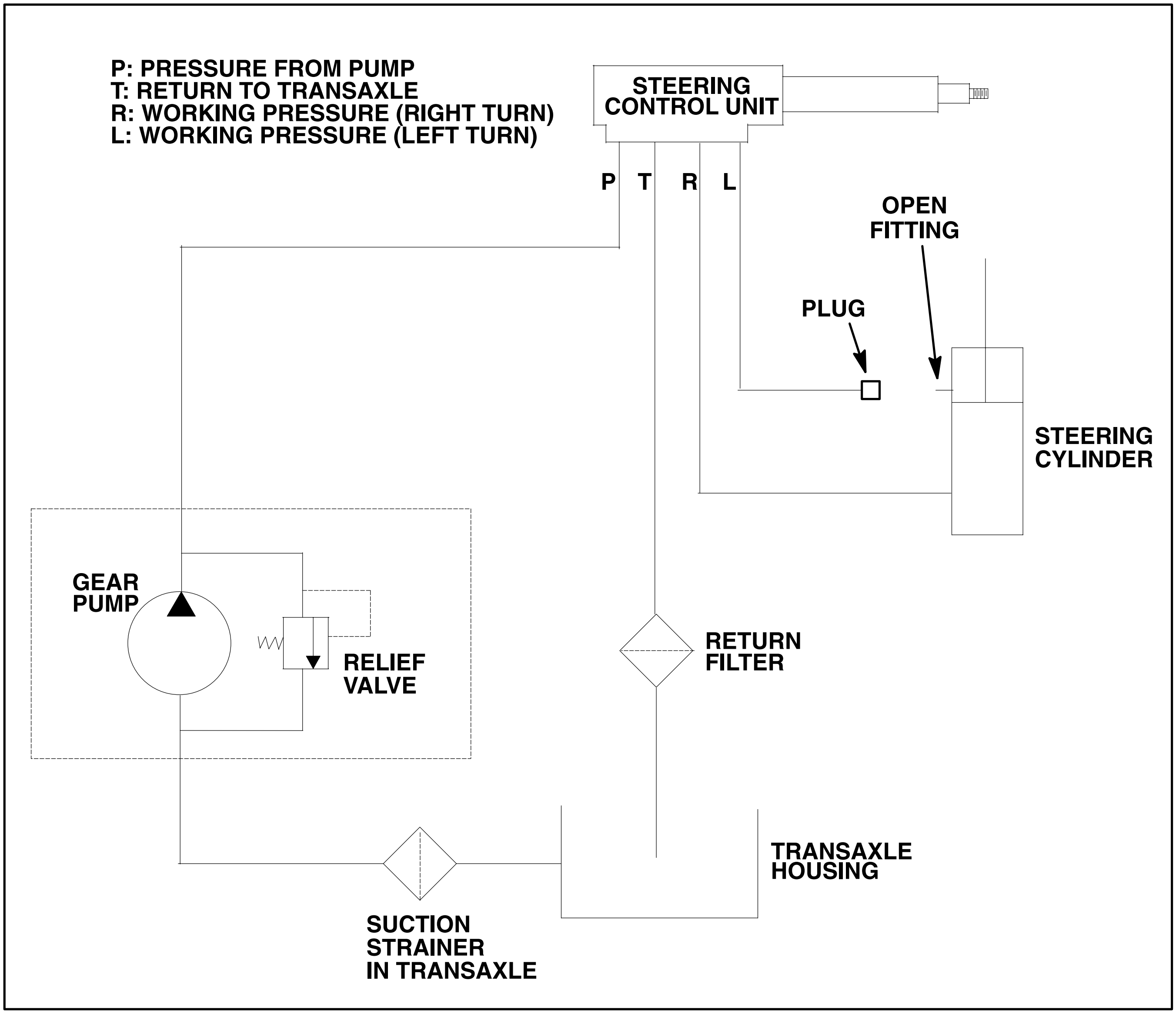


Figure 12

Procedure for Steering Control Valve and Steering Cylinder Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Perform the Steering Pump Relief Pressure and Steering Pump Flow tests to make sure that pump and relief valve are functioning correctly.

NOTE: This steering test procedure will be affected by incorrect tire pressure, binding of the hydraulic steering cylinder, excessive weight on the vehicle, and/or binding of the steering assembly (e.g. wheel spindles, tie rods, steering pivot). Make sure that these items are checked before proceeding with any hydraulic testing procedure.

3. Drive machine slowly in a figure eight on a flat level surface.

A. There should be no shaking or vibration in the steering wheel or front wheels.

B. Steering wheel movements should be followed **immediately** by a corresponding front wheel movement **without** the steering wheel continuing to turn.

4. Stop machine with the engine running. Turn steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.

A. The steering must immediately return to the neutral position.

B. The steering wheel or front wheels should **not** continue to turn.

5. If either of these performance tests indicate a steering problem, determine if the steering cylinder is faulty using the following procedure.

A. Park machine on a level surface with the spray system turned off.

B. Turn the steering wheel all the way to the right (clockwise) so the steering cylinder rod is fully extended.

C. Turn engine off and engage the parking brake.

D. Read Precautions for Hydraulic Testing.

E. Remove hydraulic hose from the fitting on the rod end of the steering cylinder. Plug the end of the hose.

WARNING

Keep body and hands away from disconnected hose and fitting that might 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.

IMPORTANT: Do not turn steering wheel to the left (counterclockwise) as system damage may occur.

F. With the engine off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If oil comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and must be repaired or replaced.

G. Remove plug from the hydraulic hose. Reconnect hose to the steering cylinder.

6. If steering problem exists and the steering cylinder tested acceptably, steering control valve requires service (see Steering Control Valve and Steering Control Valve Service).

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, engage parking brake, and stop engine. Remove key from the ignition switch.

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

Rotate steering wheel to relieve system pressure and avoid injury from pressurized hydraulic oil. Steering wheel must be rotated when the engine is not running. Remove key from the ignition switch.

3. Put caps or plugs on any hydraulic lines, hydraulic fittings, and components left open or exposed to prevent 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 transaxle and add correct oil if necessary. Drain and refill transaxle 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).

5. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Hydraulic System Start Up).

6. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in transaxle 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 chemical deterioration. Make all necessary repairs before operating.

Flush Hydraulic System

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

1. Park machine on a level surface. Stop engine, apply parking brake, and remove key from ignition switch.

2. Clean area around filter mounting area (Fig. 13). Remove filter and drain filter into a suitable container. Discard filter.

3. Remove drain plug from transaxle (Fig. 14) and drain transaxle into a suitable container.

4. Drain hydraulic system. Drain all hoses and components while the system is warm.

5. Make sure filter mounting surface is clean. Apply Dexron III ATF to gasket on new filter. Screw filter on until gasket contacts mounting plate, then tighten filter one half turn further.

6. Reinstall all hoses and components.

NOTE: Use only hydraulic fluid specified in Operator's Manual. Other fluid could cause system damage.

7. Fill transaxle with new hydraulic fluid (see Operator's Manual).

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

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

10. Reconnect spark plug wires.

11. Start engine and run at idle speed for a minimum of two (2) minutes.

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

13. Turn steering wheel in both directions several times.

14. Shut off engine and check for oil leaks. Check oil level in transaxle and add correct oil if necessary.

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 repeat steps 1 through 12 again.

17. Resume normal operation and follow recommended maintenance intervals.

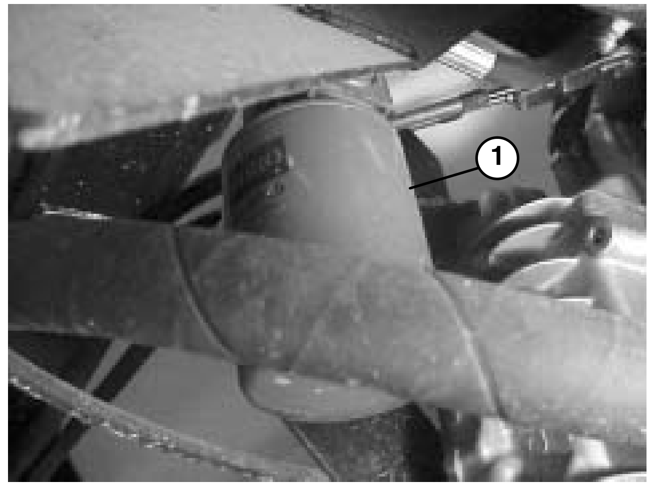


Figure 13

1. Hydraulic filter

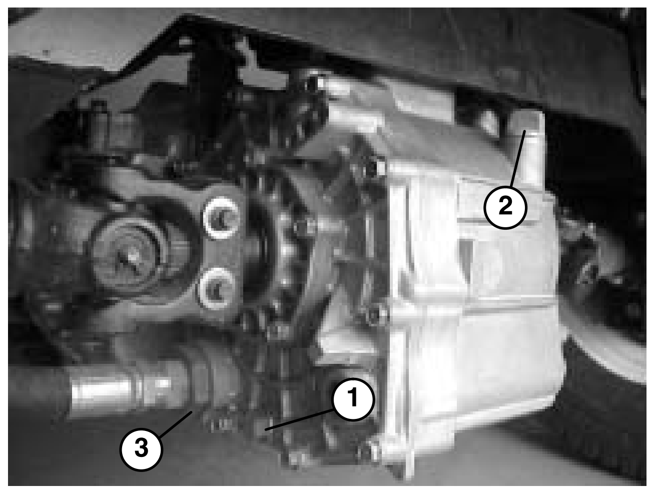


Figure 14

1. Transaxle drain plug
2. Dipstick/filler
3. Strainer

Hydraulic System

Steering Pump Drive Belt

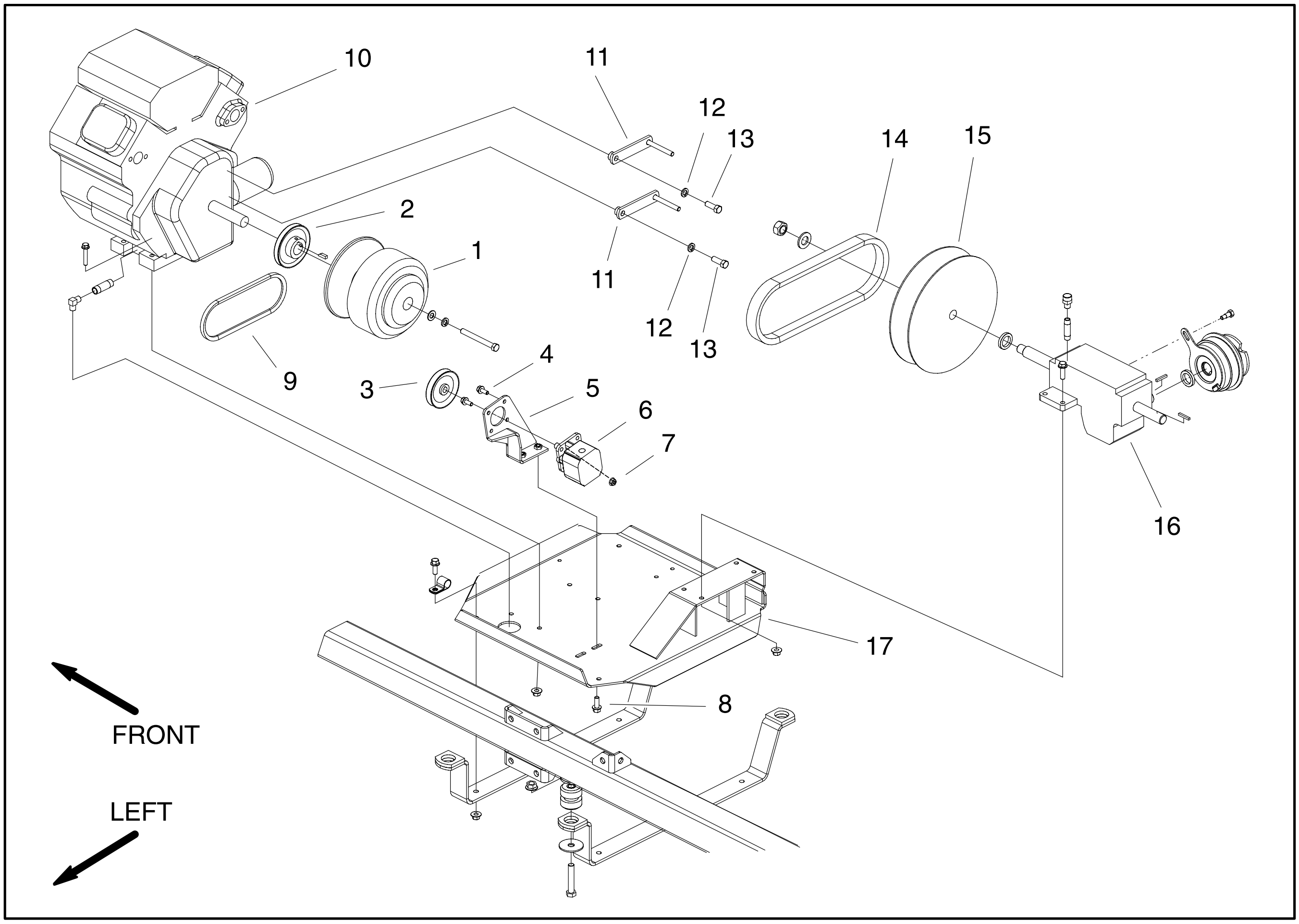


Figure 15

1. **Drive clutch**
2. **Pump drive pulley**
3. **Pump pulley**
4. **Flange head screw (4 used)**
5. **Steering pump bracket**
6. **Steering pump**
7. **Flange nut (4 used)**
8. **Flange head screw (2 used)**
9. **Steering pump drive belt**
10. **Engine**
11. **CVT belt guide**
12. **Lock washer**
13. **Cap screw**
14. **CVT drive belt**
15. **Driven clutch**
16. **Pump drive gearbox**
17. **Engine mounting plate**

Steering Pump Drive Belt Removal (Fig. 15)

1. Park the machine on a level surface, apply parking brake, and stop engine. Remove key from the ignition switch.

2. Remove CVT drive belt (see Drive Belt Service in Service and Repairs Section of Chapter 7 – Drive Train).

3. From under left side of machine, locate and loosen two (2) flange head screws that secure steering pump bracket to engine mounting plate.

4. Slide pump and pump bracket toward engine crankshaft to allow steering pump drive belt to be removed from pulleys.

Steering Pump Drive Belt Installation (Fig. 15)

1. Install steering pump drive belt to pulleys.

2. Adjust steering pump belt tension (see Operator's Manual)

3. Install CVT drive belt (see Drive Belt Service in Service and Repairs Section of Chapter 7 – Drive Train).

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Steering Pump

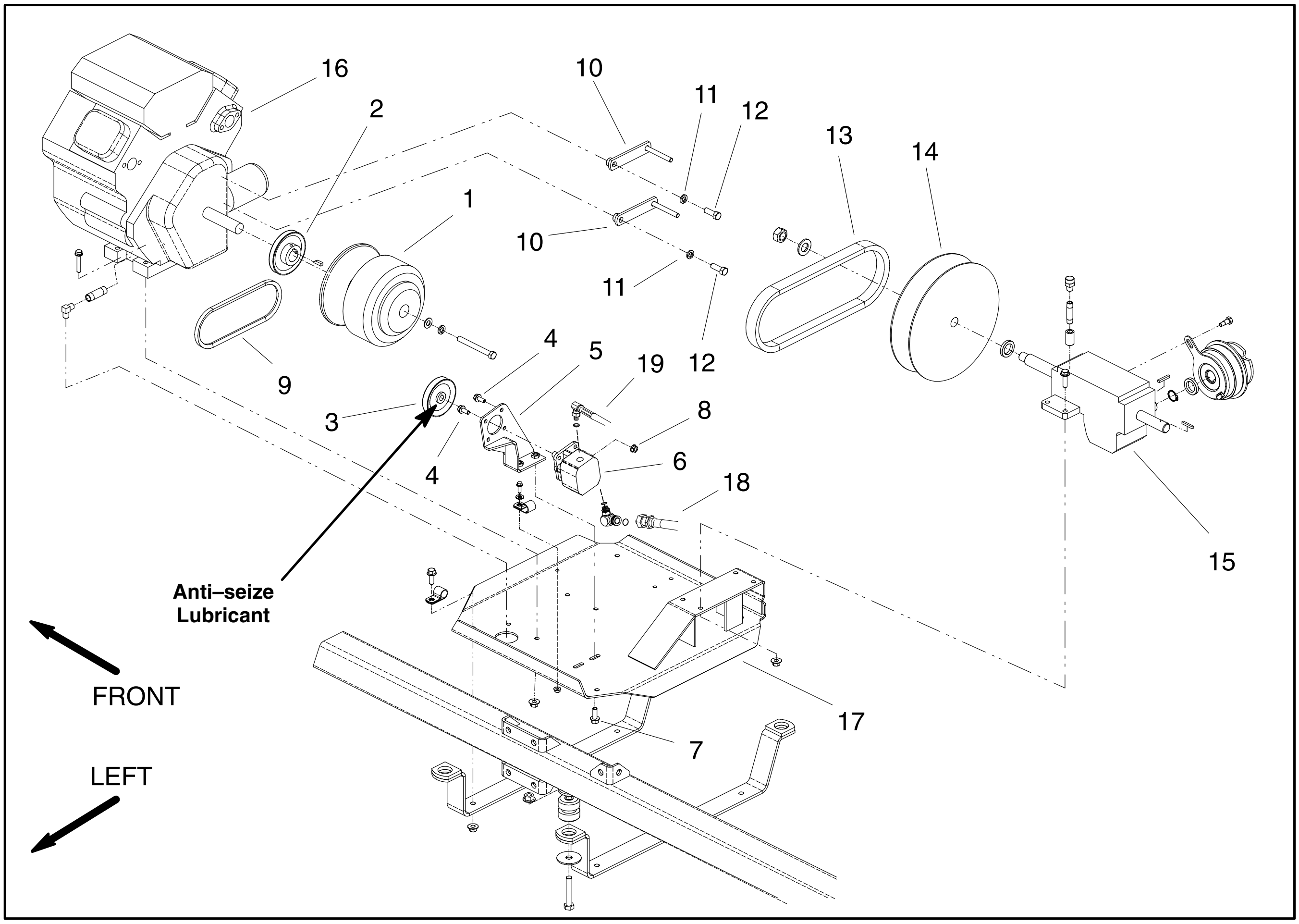

Figure 16

1. Drive clutch
2. Pump drive pulley
3. Pump pulley
4. Flange head screw (4 used)
5. Steering pump bracket
6. Steering pump
7. Flange head screw (2 used)
8. Flange nut (4 used)
9. Steering pump belt
10. CVT belt guide
11. Lock washer
12. Cap screw
13. Drive belt
14. Driven clutch
15. Pump drive gearbox
16. Engine
17. Engine mounting plate
18. Suction hose
19. Pressure hose

Removal (Fig. 16 and 17)

1. Park the machine on a level surface, engage parking brake, and stop engine. Remove key from the ignition switch.

CAUTION

Rotate steering wheel to relieve hydraulic system pressure and avoid injury from pressurized hydraulic oil.

2. Label all hydraulic connections for reassembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses.

3. From under left side of machine, disconnect hydraulic hoses connected to the hydraulic pump. Allow hoses to drain into a suitable container. Cap or plug openings of pump and hoses to prevent contamination.

4. Loosen two (2) flange head screws that secure steering pump bracket to engine mounting plate.

5. Remove steering pump drive belt from the pump pulley.

6. Remove two (2) flange head screws from the steering pump bracket. Pull hydraulic pump with pulley and bracket from the machine.

7. Loosen and remove two (2) set screws in pulley and remove pulley from the pump shaft. Locate and remove key from pump shaft.

8. Loosen and remove four (4) flange head screws and flange nuts that secure pump to pump bracket. Remove pump from bracket.

Installation (Fig. 16 and 17)

1. Position steering pump to pump bracket. Install four (4) flange head screws and flange nuts to secure pump to bracket.

2. Make sure the pulley bore and pump shaft are clean. Apply anti–seize lubricant to both the pump shaft and the bore of the pulley. Position key to pump shaft.

3. Slide pulley onto shaft with the hub side of the pulley away from the pump. Align pulley with the end of the pump shaft.

4. Apply Loctite #242 to two (2) set screws. Secure pulley on the pump shaft with set screws.

5. Position hydraulic pump with pulley and bracket to the engine mounting plate. Install two (2) flange head screws through engine mounting plate into pump bracket.

6. Install drive belt to the pump pulley.

7. Adjust belt tension (see Operator's Manual).

8. Remove any plugs or caps that were placed during disassembly. Connect hydraulic hoses to pump.

9. Check fluid level in transaxle and adjust as required (see Operator's Manual).

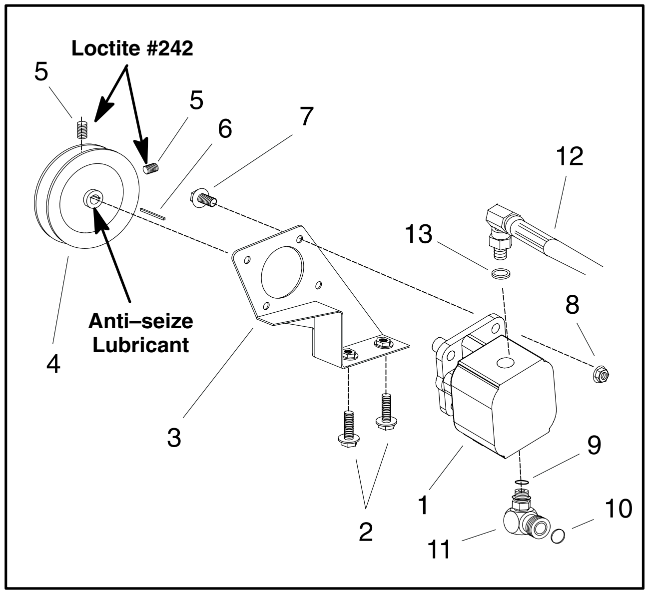

Figure 17

1. **Steering pump**
2. **Flange head screw**
3. **Pump bracket**
4. **Pulley**
5. **Set screw**
6. **Key**
7. **Flange head screw**
8. **Flange nut**
9. **O–ring**
10. **O–ring**
11. **Suction fitting**
12. **Pressure hose**
13. **O–ring**

Hydraulic System

Steering Pump Service

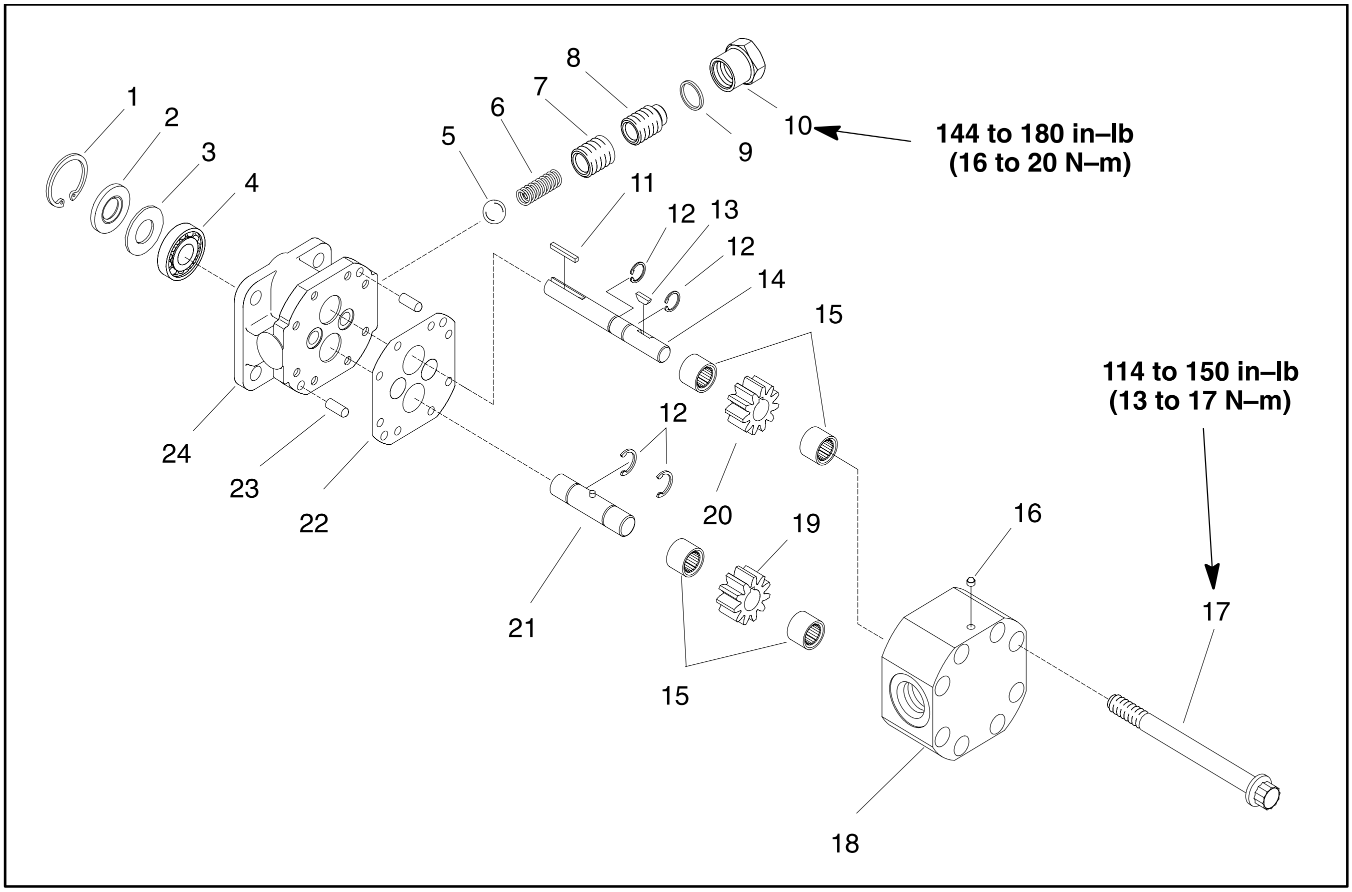

Figure 18

1. **Snap ring**
2. **Seal**
3. **Spacer**
4. **Ball bearing**
5. **Check ball**
6. **Spring**
7. **Spring**
8. **Adjusting screw**
9. **Gasket**
10. **Cap**
11. **Key**
12. **Crescent ring (4 used)**
13. **Woodruff key**
14. **Drive shaft**
15. **Needle bearing (4 used)**
16. **Plug**
17. **Screw (8 used)**
18. **Gear housing**
19. **Idler gear**
20. **Drive gear**
21. **Idler shaft**
22. **Gasket**
23. **Dowel pin**
24. **Stator**

Relief Valve Service (Fig. 18)

1. Remove cap (Item 10). Remove and discard gasket (Item 9) from cap.

NOTE: Count number of turns it takes to unthread adjusting screw so it can be reinstalled for the same approximate relief pressure setting.

2. Remove adjusting screw (Item 8), springs (Item 6 and 7), and check ball (Item 5).

3. Inspect check ball for burrs or roughness. Inspect relief valve bore and seat inside pump stator (Item 24). Inspect springs for damage. Replace any worn or damaged parts.

4. Clean and dry relief valve parts. Apply clean Dexron III ATF to valve parts.

NOTE: Install adjusting screw same number of turns as counted during removal for the same approximate relief pressure setting.

5. Install check ball (Item 5), springs (Item 6 and 7), and adjusting screw (Item 8). Position small end of springs against check ball.

6. Install cap (Item 10) and new gasket (Item 9). Torque cap from 144 to 180 in–lb (16 to 20 N–m).

7. Check pump relief pressure (see TEST NO.1 – Steering Pump Flow and Relief Pressure). If adjustment is needed, tighten adjusting screw to increase relief pressure or loosen adjusting screw to reduce pressure.

Disassembly (Fig. 18)

1. Remove shaft seal (see Shaft Seal Replacement).

2. Remove relief valve (see Relief Valve Service).

3. Matchmark the gear housing with the stator for proper orientation of these parts during reassembly.

IMPORTANT: Use caution when using a vise to avoid distorting any pump components.

4. Secure flange end of pump in a vise with drive shaft facing down.

5. Remove eight (8) screws.

6. Support gear housing (Item 18) and gently tap housing with a soft face hammer to loosen from stator (Item 24). Separate gear housing from stator. Be careful not to drop any parts or disengage gear mesh.

7. Before removing gears (Items 19 and 20), apply marking dye to mating teeth to retain "timing" and location for reassembly purposes.

8. Remove drive gear (Item 20) and woodruff key (Item 13) from drive shaft.

9. Remove idler shaft assembly (Items 12, 19, and 21) from stator. Remove crescent rings and then idler gear (Item 19) from idler shaft.

10. Locate and remove dowel pins (Item 23) from stator or gear housing.

IMPORTANT: When removing gasket (Item 22) from pump, note gasket color. Use new gasket of same color for reassembly.

11. Remove gasket from between gear housing and stator.

12. Remove retaining ring (Item 1) from stator.

IMPORTANT: Do not try to pry seal out of stator. This can damage the shaft seal bore.

13. Press drive shaft and bearing assembly (Items 2, 3, 14, 12, and 4) out of stator. Remove and discard seal (Item 2). Remove spacer (Item 3) from drive shaft.

IMPORTANT: When removing bearing and crescent rings from drive shaft, do not slide bearing or crescent rings over seal area of drive shaft.

14. Remove inner crescent ring, then remove bearing and second ring from drive shaft.

Inspection

1. Wash all parts in cleaning solvent.

2. Check all parts for burrs, scoring, nicks, etc.

3. Clean seal bore and drive shaft of pump so they are free of any foreign material.

4. Check needle bearings in stator and gear housing for excessive wear or damage. If gears (Items 19 and 20), needle bearings (Item 15), gear housing, or stator are excessively worn, scored, or damaged, replace pump.

5. Check bearing (Item 4) for smooth operation. Replace bearing if loose on shaft or noisy when rotated.

6. Inspect woodruff key (Item 11) and keyway in shaft for wear or damage and replace parts as necessary.

Reassembly (Fig. 18)

IMPORTANT: When installing bearing and crescent rings on drive shaft, do not slide bearing or crescent rings over seal area of drive shaft.

1. Install outer crescent ring on drive shaft (Item 14), then install bearing (Item 4) and second crescent ring. Slide drive shaft and bearing assembly into stator.

2. Install spacer (Item 3) on drive shaft.

3. Use a seal sleeve or tape on drive shaft to protect seal during installation. Position new seal (Item 2) onto shaft with part number facing out.

4. Use a seal installation tool to install new seal. Make sure seal is installed square with seal bore and that seal is pressed just below retaining ring groove.

5. Install retaining ring (Item 1).

6. Install woodruff key (Item 13), then apply clean Dexron III ATF to drive gear (Item 20), and install to drive shaft.

7. Install one crescent ring to idler shaft (Item 21), then install idler gear (Item 19) and second crescent ring. Apply clean Dexron III ATF to gear and idler shaft assembly, then install into stator maintaining the original timing and locations.

8. Install new gasket (Item 22) onto stator. Use same color gasket as the removed gasket.

9. Install dowel pins (Item 23). Assemble gear housing to stator using the matchmark made during disassembly. Install screws and tighten in a crossing pattern from 114 to 150 in–lb (13 to 17 N–m).

10. Install relief valve (see Relief Valve Service).

11. Place a small amount of Dexron III ATF in pump inlet and rotate pump one revolution. If binding is noted, disassemble pump and check for assembly problems.

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Steering Control Valve

Removal (Fig. 19)

1. Park the machine on a level surface, engage parking brake, and stop engine. Remove key from the ignition switch.

CAUTION

Rotate steering wheel to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Label all hydraulic connections for reassembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses.

3. Remove fasteners that secure dash panel to front hood (Fig. 20). Top of panel is secured with five (5) screws. Sides of panel are fastened with four (4) screws, flat washers, and lock nuts. Carefully slide dash panel up steering column to allow access to steering control valve.

4. Disconnect hydraulic hoses connected to the steering control valve. Allow hoses to drain into a suitable container. Cap or plug openings of control valve and hoses to prevent contamination.

5. Support steering control valve to prevent it from falling during removal.

6. Loosen and remove four (4) cap screws that secure steering column and steering control valve to machine frame.

7. Slide steering column from control valve. Remove control valve from machine.

Installation (Fig. 19)

1. Position steering control valve to frame. Slide steering column to control valve. Secure steering column and control valve to frame with four (4) cap screws.

2. Remove caps and plugs from disconnected hoses and fittings.

3. Connect hydraulic hoses to steering control valve (Fig. 19). Tighten hose connections.

4. Position dash panel to front hood and secure with fasteners (Fig. 20).

5. Check fluid level in transaxle and adjust as required (see Operator's Manual).

6. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

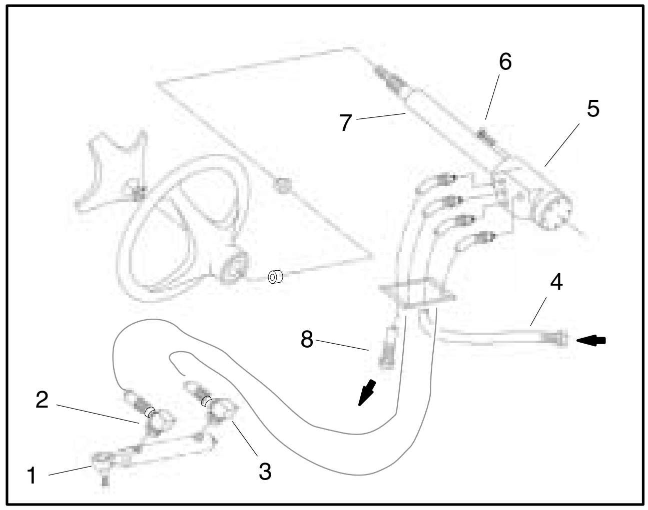

Figure 19

1. **Steering cylinder**
2. **Hyd hose (Left turn)**
3. **Hyd hose (Right turn)**
4. **Hyd hose (from pump)**
5. **Steering control valve**
6. **Cap screw (4 used)**
7. **Steering column**
8. **Hyd hose (to filter)**

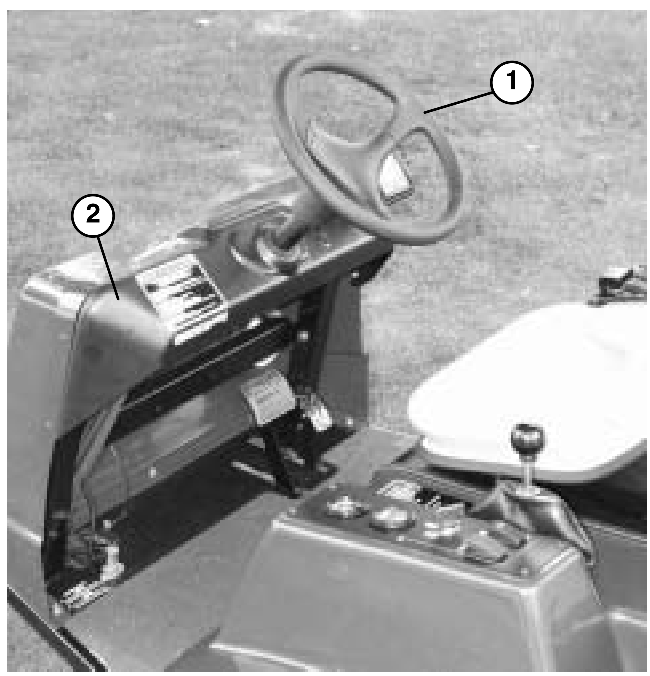

Figure 20

1. **Steering wheel**
2. **Dash panel**

Hydraulic System

Steering Control Valve Service

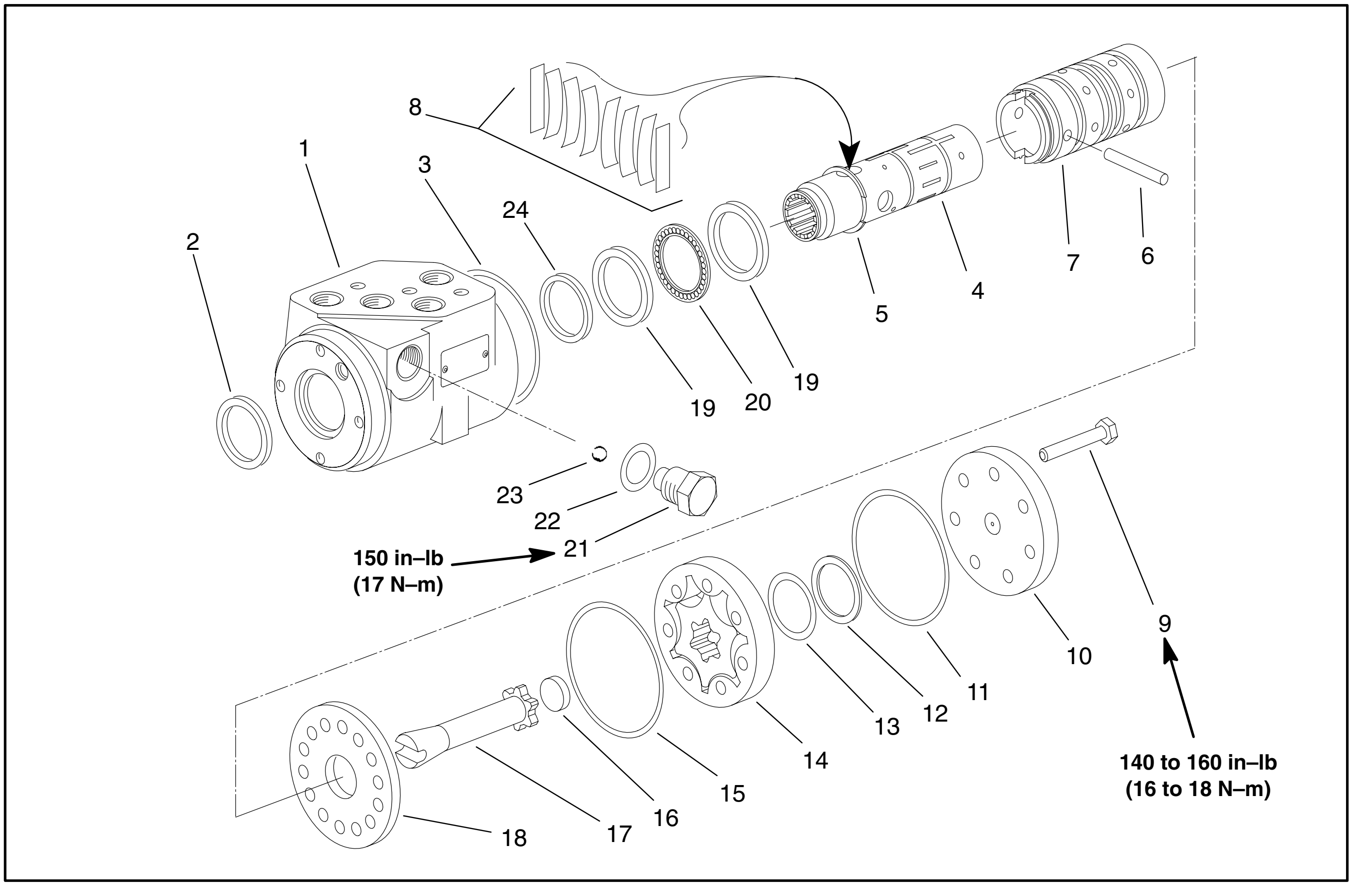

Figure 21

1. Steering valve housing	**9. Cap screw (7 used)**	**17. Geroter drive**
2. Dust seal	**10. End cap**	**18. Wear plate**
3. O–ring	**11. O–ring**	**19. Bearing race**
4. Spool	**12. Seal ring**	**20. Thrust bearing**
5. Spring retaining ring	**13. O–ring**	**21. Plug**
6. Pin	**14. Geroter**	**22. O–ring**
7. Sleeve	**15. O–ring**	**23. Check ball**
8. Centering springs/spacers	**16. Spacer**	**24. Quad seal**

Disassembly (Fig. 21)

NOTE: Cleanliness is extremely important when repairing hydraulic components. Work in a clean area. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior. During repairs, always protect machined surfaces.

1. Remove the seven cap screws from the steering valve assembly.

2. Remove end cap, geroter, spacer, geroter drive, wear plate, seal ring, and o–rings (Items 11, 13, and 15) from housing (Fig. 21).

3. Remove the plug, o–ring, and check ball from the housing.

4. Slide the spool and sleeve assembly from the housing.

5. Remove the thrust bearing and bearing races (2).

6. Remove the quad seal.

7. Use a small blade screwdriver to carefully pry the dust seal from the housing. Be careful to not damage the dust seal seat in the housing.

8. Remove the pin (Item 6) that holds the spool and sleeve together.

9. Carefully slide the spool out of the sleeve. The centering springs and spring retaining ring will stay with the spool as it is removed.

CAUTION

The centering springs are under tension. Remove the retaining ring carefully.

10. Remove the spring retaining ring and centering springs from the spool.

Reassembly (Fig. 21)

Check all mating surfaces. Replace any parts with scratches or burrs that could cause leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

NOTE: Always use new seals and o–rings when reassembling the steering control valve.

IMPORTANT: During reassembly, lubricate the new seals with petroleum jelly. Also, lubricate machined surfaces and bearings with clean Dexron III ATF.

1. Install the quad seal:

   A. Put one of the bearing races and sleeve into the housing.

   B. Together, the housing and bearing race create a groove into which the quad seal will be installed.

   C. Hold the bearing race tightly against the input end of the housing by pushing on the gerotor end of the sleeve.

   D. Fit the quad seal into its seat through the input end of the housing. Be sure the seal is not twisted.

   E. Remove the sleeve and bearing race.

2. Lubricate and install the dust seal.

3. Install the centering springs in the spool. It is best to install the two flat pieces first. Next, install the curved pieces, three at a time.

4. Fit the retaining ring over the centering springs.

5. Apply a light coating of clean Dexron III ATF to the spool and slide it into the sleeve. Be sure the centering springs fit into the notches in the sleeve.

6. Install the pin.

7. Apply a light coating of petroleum jelly to the inner edge of the dust and quad seals.

8. Put the thrust bearing and bearing races into the housing. The thrust bearing goes between the two bearing races (Fig. 22).

IMPORTANT: Do not damage the dust or quad seals when installing the spool and sleeve assembly.

9. Apply a light coating of clean Dexron III ATF to the spool and sleeve assembly. Carefully slide the assembly into the housing.

10. Clamp the housing in a vise. Use only enough clamping force to hold the housing securely.

11. Lubricate and install a new o-ring (Item 3) in the groove in the housing.

12. Install the wear plate and align screw holes in the wear plate with threaded holes in the housing.

NOTE: The holes in the wear plate are symmetrical.

13. Install the geroter drive, making sure the slot in the drive engages the pin.

14. Lubricate and install new o-ring in wear plate groove.

15. Install the gerotor and align the screw holes.

16. Lubricate and install new o-ring in gerotor ring groove.

17. Lubricate and install new o-ring and seal ring in gerotor star groove.

18. Install the spacer.

19. Install the end cap and seven (7) cap screws. Tighten the cap screws, in a crossing pattern, from 140 to 160 in-lb (16 to 18 N–m).

20. Remove the steering control unit from the vise.

21. Install the check ball and plug with o–ring. Tighten the plug to 150 in-lb (17 N–m).

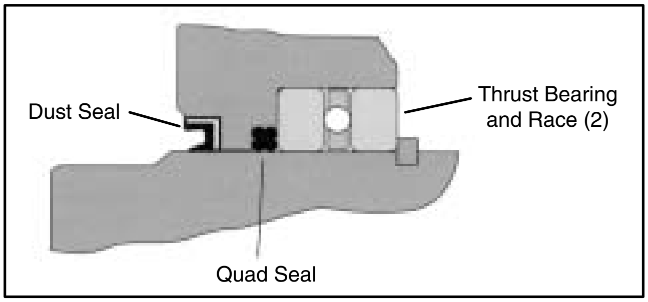

Figure 22

Hydraulic System

Steering Cylinder

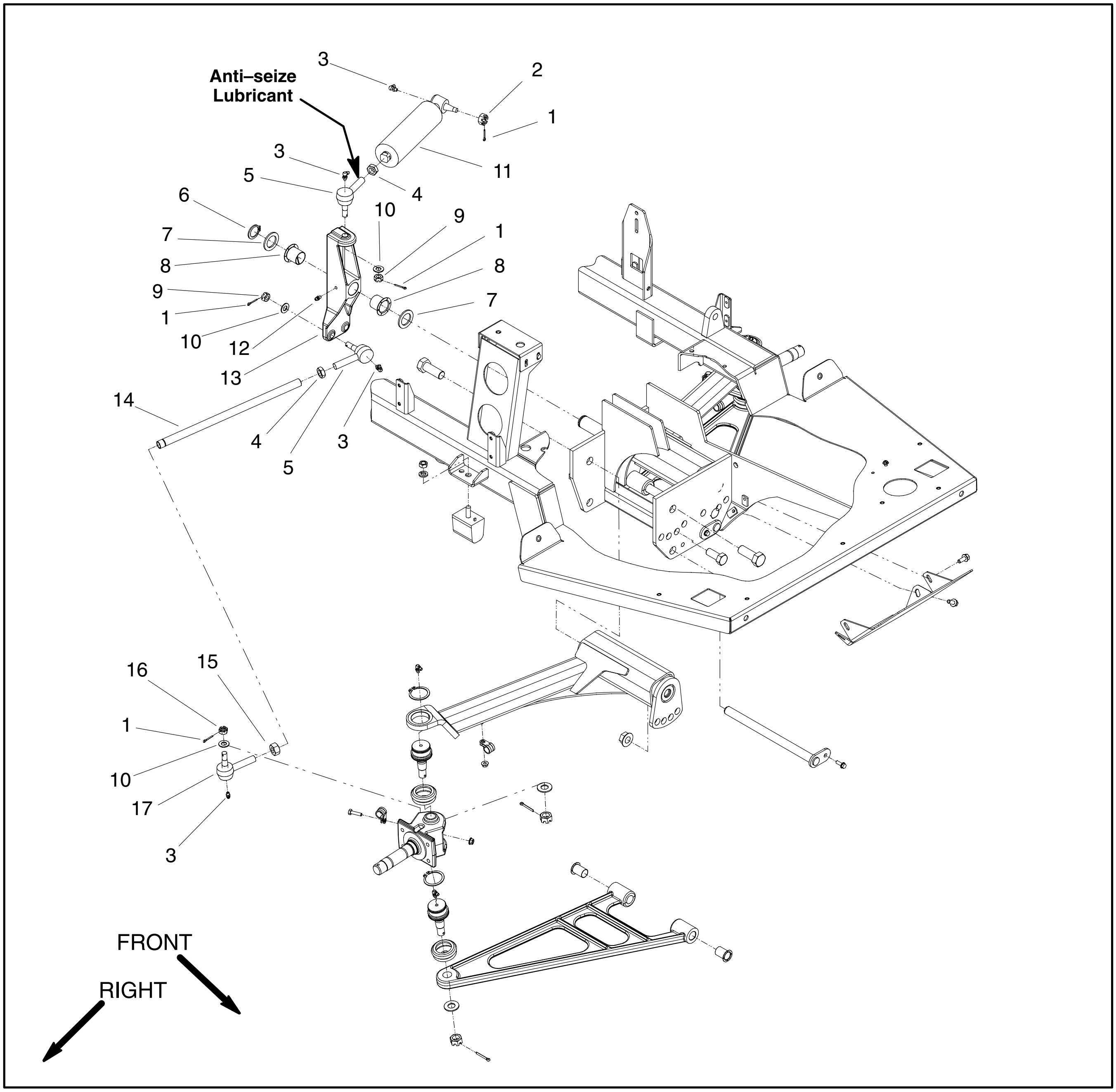

Figure 23

1. Cotter pin
2. Slotted hex nut
3. Grease fitting
4. Jam nut
5. Tie rod end
6. Retaining ring
7. Thrust washer
8. Bearing
9. Slotted hex nut
10. Flat washer
11. Steering cylinder
12. Grease fitting
13. Steering pivot
14. Tie rod (RH shown)
15. Jam nut (LH thread)
16. Slotted hex nut
17. Tie rod end (LH thread)

Removal (Fig. 23)

1. Park the machine on a level surface, engage the parking brake, and stop the engine. Remove the key from the ignition switch.

2. Lower the engine mounting plate assembly from machine (see Engine Mounting Plate Assembly Removal in Service and Repairs Section of Chapter 3 – Kohler Gasoline Engine).

3. Label all hydraulic connections for reassembly. Clean hydraulic hose ends prior to disconnecting the hoses.

CAUTION

Rotate steering wheel to relieve hydraulic system pressure and avoid injury from pressurized hydraulic oil.

4. Disconnect hydraulic hoses from steering cylinder (Fig. 24). Allow hoses to drain into a suitable container.

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

6. Remove cotter pin and hex slotted nut that secure the barrel end of the steering cylinder to the frame.

7. Remove cotter pin, flat washer, and hex slotted nut that secure the shaft end of the steering cylinder to the steering pivot.

8. Remove steering cylinder from machine.

9. If rod end is removed from cylinder shaft, count number of revolutions it takes to remove from shaft so rod end can be re–installed without affecting steering.

Installation (Fig. 23)

1. If rod end was removed from cylinder shaft, apply anti–seize lubricant to threads of rod end. Install rod end onto shaft the same number of revolutions needed to remove rod end. Secure rod end with jam nut.

2. Position shaft end of cylinder to the steering pivot. Install flat washer and slotted hex nut finger tight to rod end.

3. Position barrel end of cylinder to the frame. Install slotted hex nut finger tight to barrel rod end.

4. Tighten slotted hex nuts to secure cylinder rod ends. Install cotter pins.

5. Remove caps and plugs from disconnected hoses and fittings.

6. Connect hydraulic hoses to steering cylinder (Fig. 24). Tighten hose connections.

7. Check fluid level in transaxle and adjust as required (see Operator's Manual).

8. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

9. Raise the engine mounting plate assembly to machine (see Engine Mounting Plate Assembly Installation in Service and Repairs Section of Chapter 3 – Kohler Gasoline Engine).

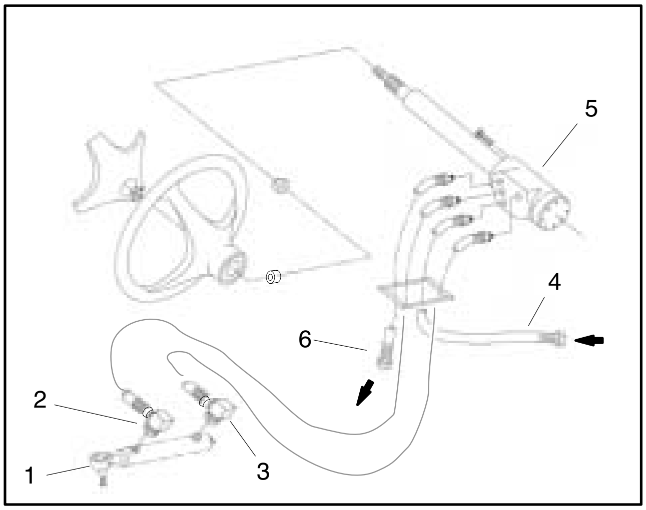

Figure 24

1. Steering cylinder
2. Hyd hose (Left turn)
3. Hyd hose (Right turn)
4. Hyd hose (from pump)
5. Steering control valve
6. Hyd hose (to filter)

Hydraulic System

Steering Cylinder Service

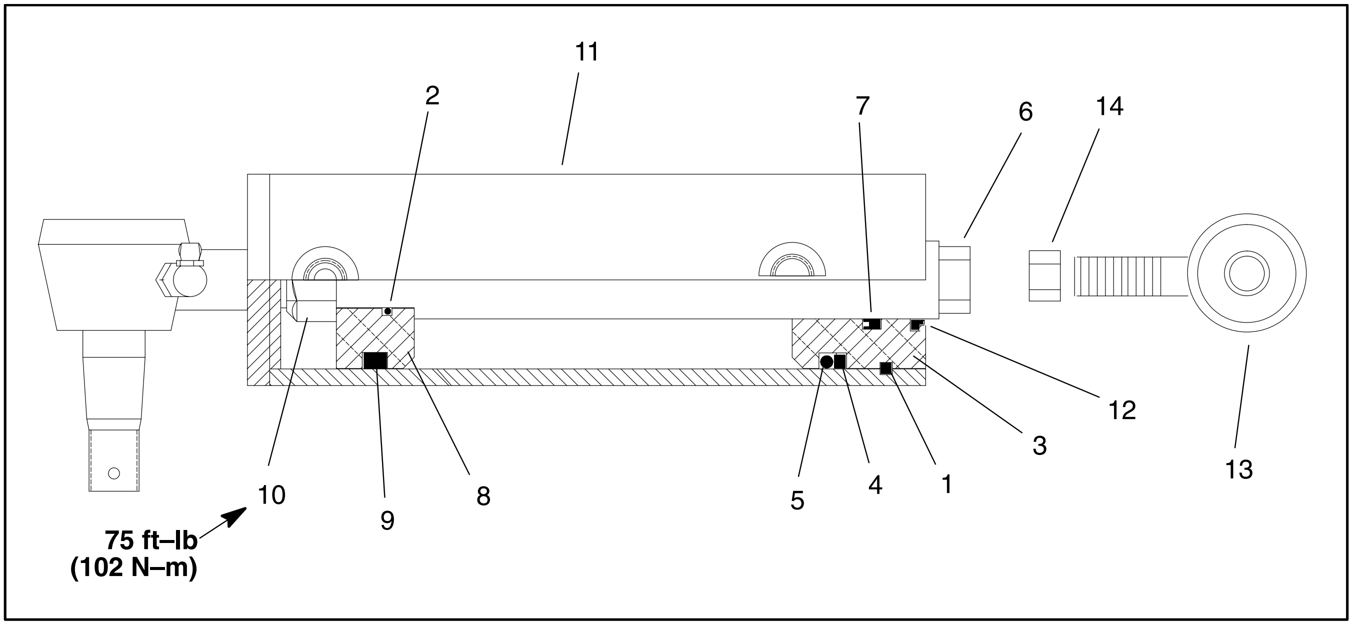

Figure 25

1. **Retaining ring**
2. **O–ring**
3. **Head**
4. **Backup ring**
5. **O–ring**
6. **Shaft**
7. **Rod seal**
8. **Piston**
9. **Uni–ring**
10. **Lock nut**
11. **Barrel**
12. **Dust seal**
13. **Ball joint**
14. **Jam nut**

Disassembly (Fig. 25)

1. Remove oil from the steering cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

2. Mount end of steering cylinder in a vise. Remove retaining ring.

3. Remove plugs from ports. Extract shaft, head, and piston by carefully twisting and pulling on the shaft.

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

4. Mount shaft securely in a vise by clamping on the end of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

5. Remove Uni–ring and o–ring from the piston.

6. Remove o–ring, back–up ring, rod seal, and dust seal from the head.

Reassembly (Fig. 25)

1. Make sure all parts are clean before reassembly.

2. Coat new o–rings, Uni–ring, rod seal, and back–up ring with with clean Dexron III ATF.

A. Install Uni–ring and o–ring to the piston.

B. Install o–ring, back–up ring, rod seal, and dust seal to the head.

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

3. Mount shaft securely in a vise by clamping on the end of the shaft.

A. Coat shaft with a light coat of clean Dexron III ATF.

B. Slide head assembly onto the shaft. Install piston and lock nut onto the shaft. Torque lock nut to 75 ft–lb (102 N–m).

C. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

4. Mount end of the barrel in a vise.

5. Coat all internal parts with a light coat of clean Dexron III ATF. Slide piston, shaft, and head assembly into the barrel being careful not to damage the seals.

6. Secure head into the barrel with retaining ring.

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Chapter 5

Electrical System

Table of Contents

Electrical Schematics and Electrical Harness and Connector Drawings

The electrical schematics and other electrical drawings for the Multi Pro 1200 and Multi Pro 1250 are located in Chapter 9 – Electrical Diagrams.

Special Tools

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

Multimeter

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

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

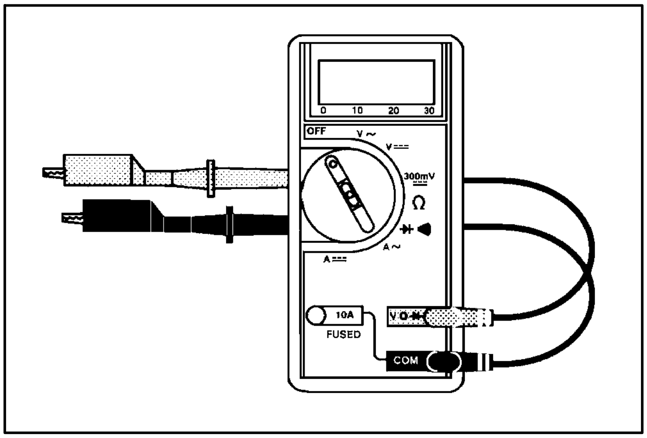


Figure 1

Skin–Over Grease

Special non–conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: 505–165

Figure 2

Electrical System

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 9 – Electrical Diagrams).

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

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid. Starter is faulty.
Nothing happens when start attempt is made.	Range selector lever is not in the neutral position. Battery cables are loose or corroded. Battery ground cable to frame is loose or corroded. Battery is dead. Main fuse (30 amp) is open. Wiring to start circuit components is loose, corroded, or damaged (see Chapter 9 – Electrical Diagrams). Neutral interlock switch is out of adjustment or faulty. Ignition switch is faulty. Fuse block is faulty. Starter solenoid is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Ignition switch is faulty. Circuit wiring to engine magneto is grounded (see Chapter 9 – Electrical Diagrams). Circuit wiring to carburetor solenoid is loose, corroded, or damaged (see Chapter 9 – Electrical Diagrams). Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Gasoline Engine). Engine may be too cold.
Engine cranks (but should not) with the range selector lever out of the neutral position.	Neutral interlock switch is out of adjustment or faulty. Neutral interlock switch wiring is faulty (see Chapter 9 – Electrical Diagrams).

General Run Problems

Problem	Possible Causes
Battery does not charge.	Wiring to the charging circuit components is loose, corroded, or damaged (see Chapter 9 – Electrical Diagrams). Alternator is faulty. Battery is dead.
Engine kills during operation.	Ignition switch is faulty. Circuit wiring to engine magneto is damaged (see Chapter 9 – Electrical Diagrams). Circuit wiring to carburetor solenoid is loose, corroded, or damaged (see Chapter 9 – Electrical Diagrams). Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Gasoline Engine).

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 a charging system is functioning. It will tell you if a charging system has an output, but not its capacity.

Tool required: Digital multimeter set to DC volts.

Test instructions: Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then 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 high idle (3375 ± 25 RPM). Allow the battery to charge for at least 3 minutes. Record the battery voltage.

Test results should be **at least 0.50 volt over initial battery voltage.** Example:

Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 13.60 v
Difference	= +1.30 v

NOTE: Typical battery voltage while the engine is running during this test should be 13.5 to 14.5 volts.

Check Operation of Neutral Interlock Switch

CAUTION

Do not disconnect neutral interlock switch. It is for the operator's protection. Check operation of the switch daily to make sure the interlock system is operating correctly. If a switch is not operating properly, replace it before operating the machine.

Neutral interlock switch operation is described in the Multi Pro 1200 and 1250 Operator's Manual. Testing of this interlock switch is included in the Component Testing section of this Chapter.

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 on the ignition switch).

NOTE: See the **Kohler Engine Repair Manual** for more component testing information.

CAUTION

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

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN, and START) (Fig. 3). The terminals are marked as shown in Figure 4.

Testing

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

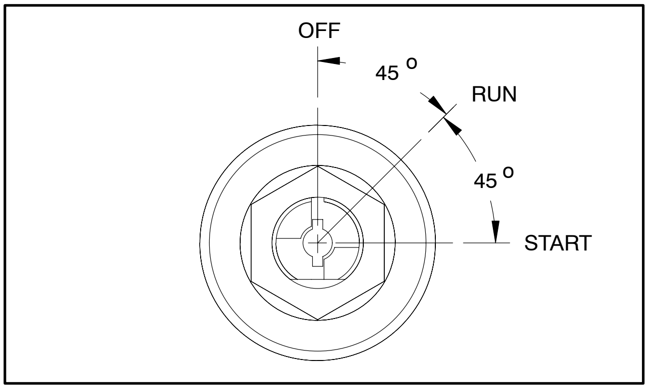


Figure 3

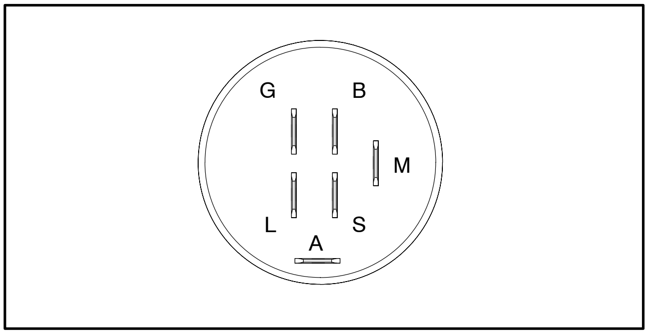


Figure 4

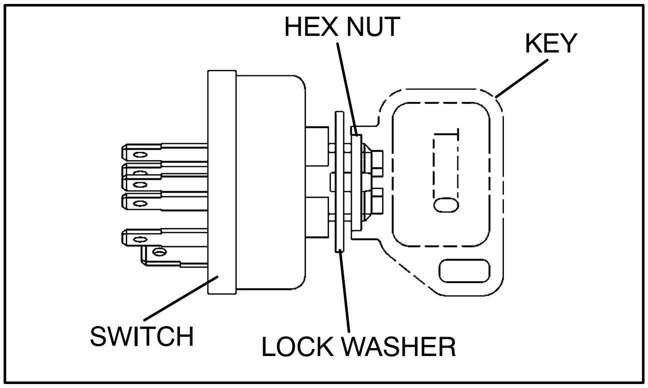


Figure 5

Electrical System

Start, Neutral Engine Speed Control, Spray Pump and Spray Valve Relays

The start and neutral engine speed control relays are used on both the Multi Pro 1200 and Multi Pro 1250. The Multi Pro 1250 uses an additional three (3) relays for the spray valve system. All relays are located under the operator seat (Fig. 6).

During the 2003 model year, an additional relay was added to both the Multi Pro 1200 and Multi Pro 1250. This additional relay is used to energize the spray pump clutch.

Two styles of relays have been used on Multi Pro sprayers. Later production machines (after serial number 240000400) have a different terminal arrangement than earlier machines (Fig. 7). Relay operation is identical regardless of terminal layout.

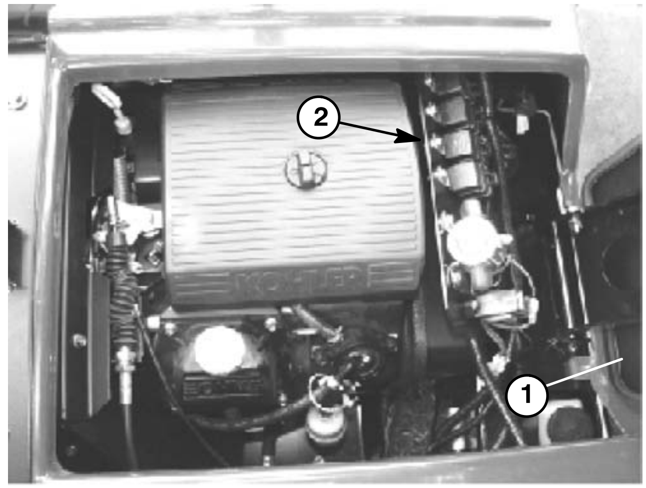


Figure 6

1. **Operator seat (raised)** 2. **Relay location**

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 from the measured value of the component you are testing.

1. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be from 70 to 95 ohms.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

3. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

4. Connect multimeter (ohms setting) 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.

5. Disconnect voltage and multimeter leads from the relay terminals.

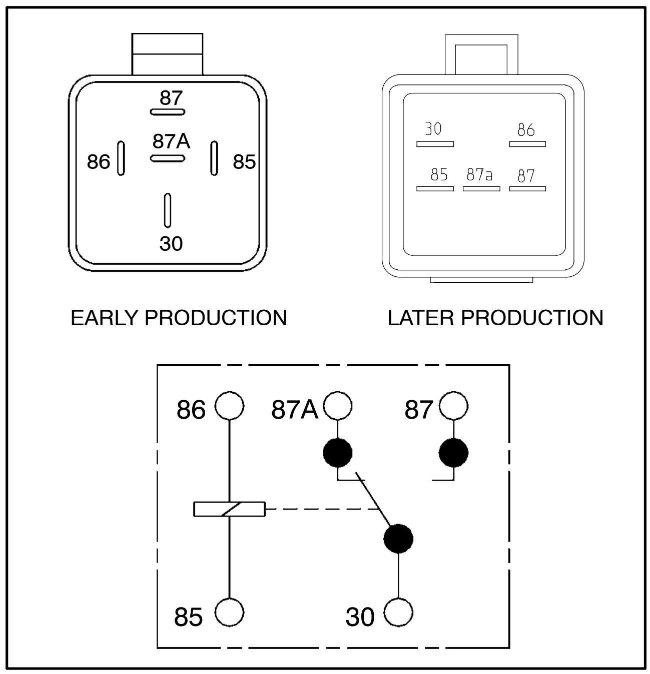


Figure 7

Neutral Interlock Switch

The neutral interlock switch is attached to the shift lever assembly (Fig. 8). The switch is closed when the shift lever is in the neutral position and allows engine cranking/ starting only when the machine is in neutral.

Two types of neutral interlock switches have been used on Multi Pro 1200 and 1250 sprayers:

On machines with serial numbers below 250000000, the neutral interlock switch is a ball type switch (Fig. 9).

On machines with serial numbers above 250000000, the neutral interlock switch is a proximity switch (Fig. 10).

Testing

1. Locate neutral interlock switch on the shift lever assembly. If needed, remove air cleaner cover to ease access to switch. Disconnect the wire harness connector from the switch.

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

3. With the shift lever in the neutral position, the neutral interlock switch should be closed (continuity).

NOTE: On machines with serial numbers below 250000000, the ignition switch should be rotated to RUN to allow the shift lever to be moved.

4. Depress the brake pedal to allow the shift lever to move. While watching the multimeter, move the shift lever out of the neutral position. Continuity of the neutral interlock switch should be broken as the lever is moved and the interlock switch opens.

5. To adjust the neutral interlock switch on machines with serial numbers below 250000000, loosen jam nut and rotate switch. Repeat steps 3 and 4 until switch operation is correct. Tighten jam nut to secure switch and test switch operation.

6. Reconnect the harness connector to the switch.

7. If removed, reinstall air cleaner cover.

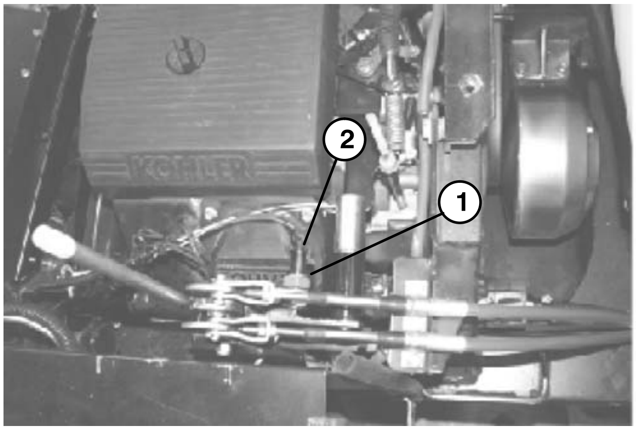


Figure 8

1. **Neutral interlock switch** 2. **Connector**

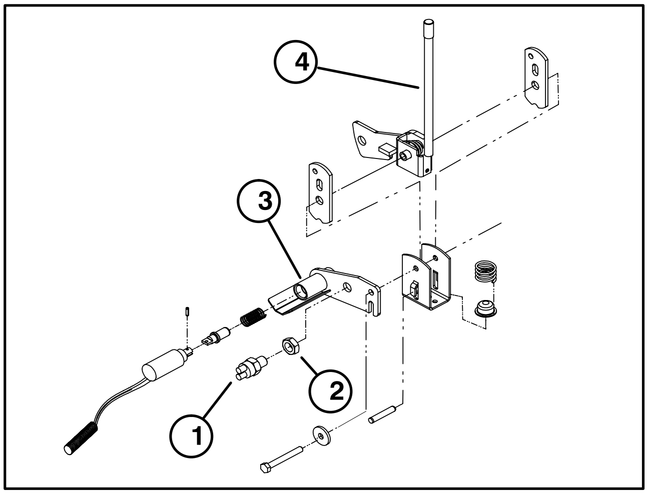


Figure 9

1. **Neutral interlock switch**
2. **Jam nut**
3. **Mount**
4. **Shift lever**

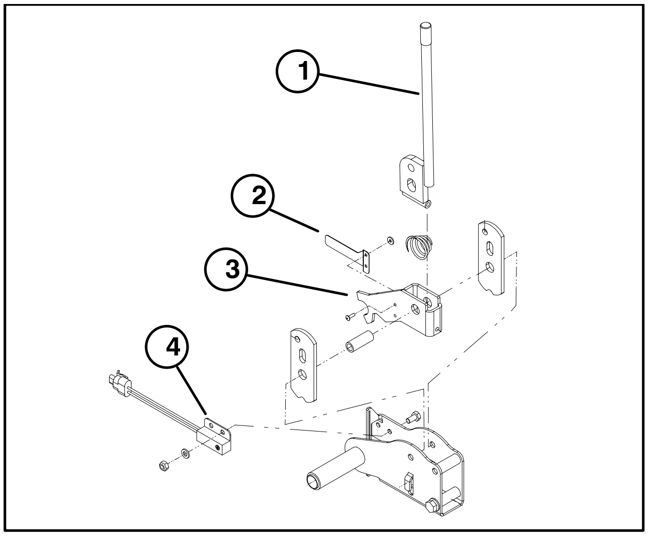


Figure 10

1. **Shift lever**
2. **Sensing tab**
3. **Shifter bracket**
4. **Neutral interlock switch**

Hour Meter

The hour meter is located on the control console next to the operator seat.

Testing

1. Remove console panel. Disconnect the harness electrical connectors from the terminals on the hour meter.

2. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

3. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

4. The hour meter should move a 1/10 of an hour in six minutes.

5. Disconnect voltage source from the hour meter.

6. Reconnect yellow/red harness wire to the positive (+) terminal of the hour meter and black harness wire to the other meter terminal. Install console panel.

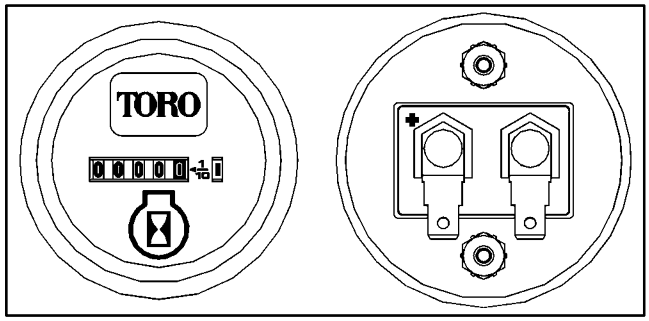


Figure 11

Headlight Switch

The headlight switch is located on the control console (Fig. 12).

Testing

1. Locate headlight switch, remove console panel, and unplug wire harness connectors from switch.

2. The switch terminals are marked as shown in Figure 13. In the ON position, continuity should exist between the two terminals. In the OFF position, there should be no continuity between the switch terminals.

3. Reconnect the harness connectors to the switch after testing. Install console panel to machine.

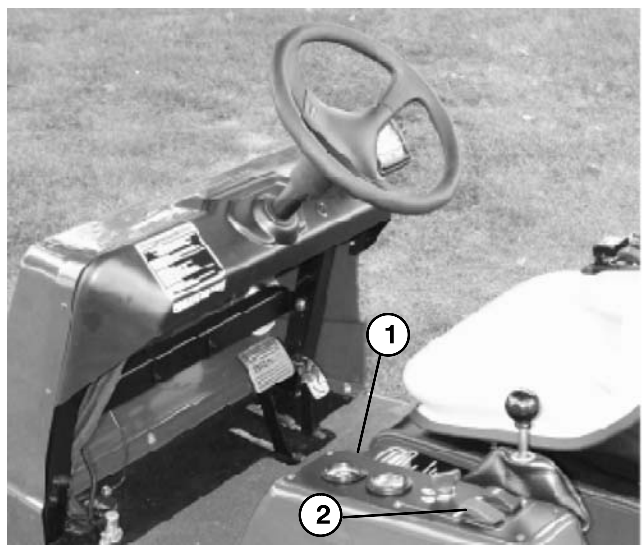
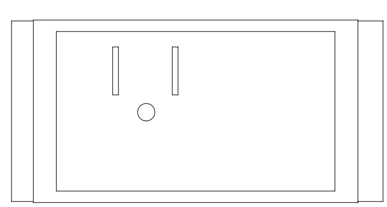


Figure 12

1. **Control console** 2. **Headlight switch**



BACK OF SWITCH

Figure 13

Pump Control and Neutral Engine Speed Control Switches

The pump control and neutral engine speed control switches are identical switches. The pump control switch is located on the sprayer (right side) console (Fig. 14). The neutral engine speed control switch is positioned on the control console (Fig. 15).

Testing

1. Locate switch, remove console panel, and unplug machine wire harness connector from switch.

2. The switch terminals are marked as shown in Figure 16. In the ON position, continuity should exist between terminals 2 and 3. In the momentary SET position, continuity should exist between terminals 5 and 6. In the OFF position, there should be no continuity between any switch terminals.

3. Terminals 7 (–) and 8 (+) are used for the indicator light in the switch. The light should be illuminated when the switch is in the ON position.

4. Reconnect the harness connector to the switch after testing. Install console panel to machine.

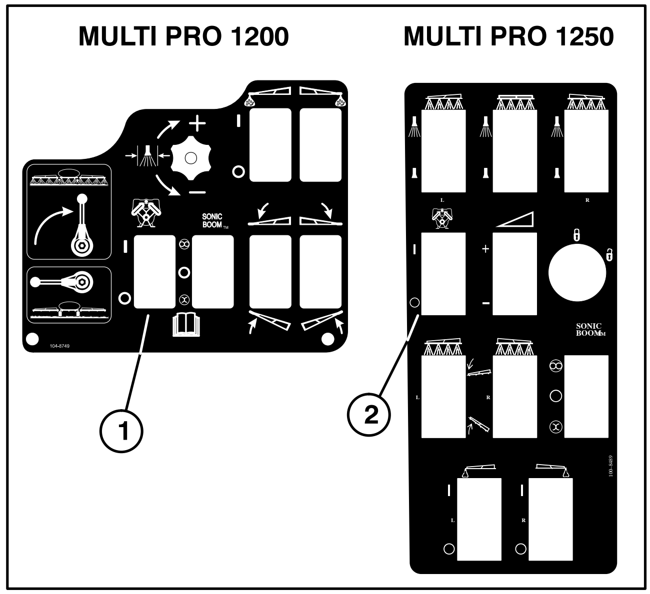


Figure 14

1. **Pump switch (MP 1200)**
2. **Pump switch (MP 1250)**

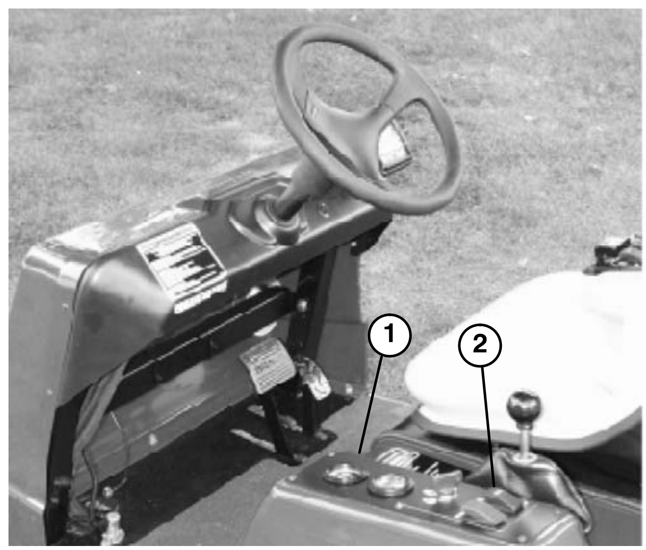
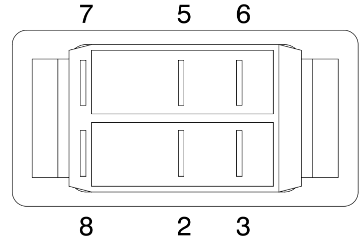


Figure 15

1. **Control console**
2. **Engine speed switch**



BACK OF SWITCH

Figure 16

Traction Speed Sensor

The traction speed sensor is attached to the upper transaxle cover (Fig. 17). It uses a magnetically based, Hall Effect integrated circuit. As the differential in the transaxle turns, the sensor accurately senses the movement of the differential ring gear teeth passing by the sensor. The red striped connector wire is the positive lead, the black wire is the ground lead, and the gray striped wire is the signal output.

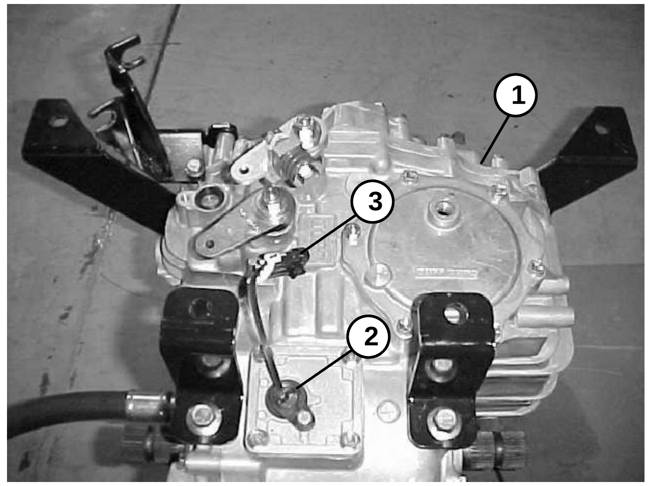


Figure 17

1. **Transaxle**
2. **Traction speed sensor**
3. **Sensor connector**

Testing

1. Locate traction speed sensor on the transaxle assembly. Disconnect the wire harness connector from the traction speed sensor.

2. Remove flange head screw that secures speed sensor to transaxle. Remove speed sensor from transaxle.

IMPORTANT: Incorrect jumper wire connections during testing can damage the sensor.

3. Using a +12 VDC battery, a multimeter, a 1K ohm resistor and appropriate jumper wires, connect the battery and multimeter to the speed sensor using Figure 18 as a guide.

4. Set multimeter to DC volts setting.

5. The multimeter should display very low voltage when a metal object is held near the sensor tip. The multimeter should display battery voltage when the metal object is moved away from the sensor tip.

6. After testing is complete, remove jumper wires, resistor and multimeter leads from sensor connector.

7. Replace speed sensor if necessary.

8. Install speed sensor into transaxle and secure with flange head screw. Reconnect speed sensor to wire harness.

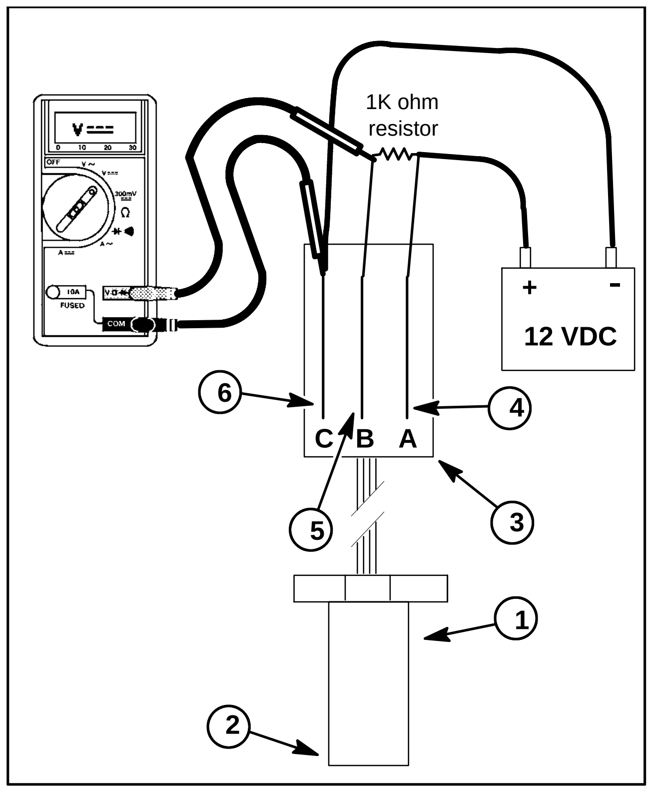


Figure 18

1. **Speed sensor**
2. **Sensor tip**
3. **Sensor connector**
4. **Red striped wire**
5. **Gray striped wire**
6. **Black wire**

Shifter Solenoid (Machines With Serial Number Below 250000000)

The shifter solenoid is attached to the shift lever assembly (Fig. 19). The solenoid is energized when the brake pedal is depressed. When the solenoid is energized, the solenoid plunger retracts to allow shifting.

Testing

1. Park machine, stop engine, and engage parking brake. Make sure that range selector is in neutral.

2. Locate shifter solenoid on the shift lever assembly. Remove air cleaner cover to ease access to solenoid.

3. With the ignition switch in the RUN position, check shifter solenoid operation:

   A. Depress the brake pedal. The shifter solenoid should click and the solenoid pin should retract.

   B. Release the brake pedal. The shifter solenoid should click and the solenoid pin should extend.

4. If necessary, test solenoid coil:

   A. Make sure that ignition switch is in the OFF position.

   B. Unplug solenoid electrical connector from machine wire harness.

   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 from the measured value of the component you are testing.

   C. Using a multimeter (ohms setting), verify shifter solenoid coil resistance between the two terminals of the electrical connector. Resistance should be approximately 19 ohms.

   D. Reconnect the solenoid connector to the harness after testing.

5. If solenoid does not retract the pin when voltage is applied or if coil resistance is incorrect, replace shifter solenoid.

6. If removed, reinstall air cleaner cover.

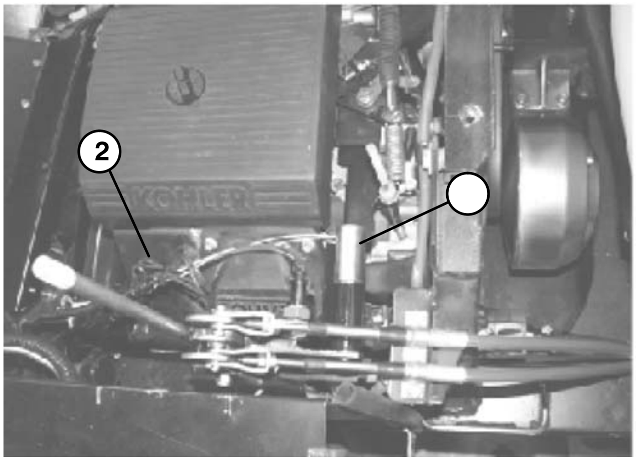


Figure 19

1. **Shifter solenoid**
2. **Connector**

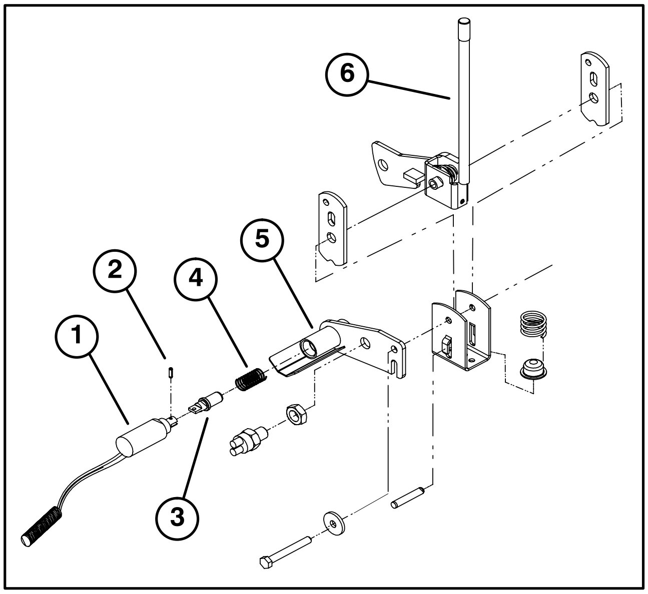


Figure 20

1. **Shifter solenoid**
2. **Spring pin**
3. **Pin**
4. **Compression spring**
5. **Mount**
6. **Shift lever**

Electrical System

Pump Drive Electric Clutch

An electric clutch is used to engage and drive the sprayer pump on the Multi Pro. Clutch operation is controlled by the pump control switch located on the spray console. The electric clutch is mounted on the pump drive gearbox output shaft and is coupled to the spray pump. The clutch engages when current is applied to the clutch.

Testing

1. Locate clutch on pump drive gearbox shaft. Unplug clutch connector from machine wire harness (Fig. 21).

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 from the measured value of the component you are testing.

2. Using a multimeter (ohms setting), verify clutch coil resistance between the two terminals of the connector. Resistance should be 2.45 ohms.

3. If clutch does not engage when voltage is applied or coil resistance is incorrect, replace clutch.

4. See Pump Drive Electric Clutch in the Service and Repairs section of Chapter 6 – Spray System if clutch removal is necessary.

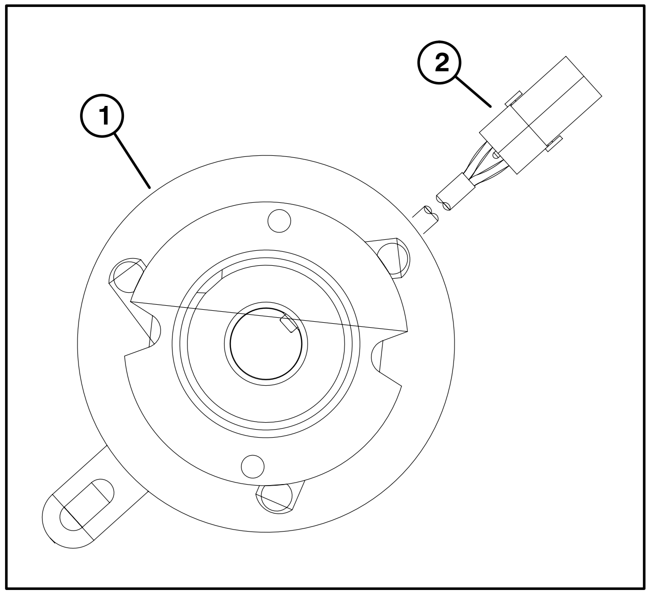


Figure 21

1. Electric clutch **2. Clutch connector**

Neutral Engine Speed Control Coil

The neutral engine speed control coil is energized by the speed control switch and cruise module. The energized coil becomes a magnet to hold the accelerator lever in position and maintains engine speed for sprayer operation when the machine is stationary.

Testing

1. Locate control coil next to accelerator lever under the floorboard. Unplug coil connector from machine wire harness (Fig. 22).

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 from the measured value of the component you are testing.

2. Using a multimeter (ohms setting), verify control coil resistance between the two terminals of the connector. Resistance should be from 10.2 to 11.2 ohms.

3. If coil does not engage when voltage is applied or coil resistance is incorrect, replace control coil.

4. Reconnect the coil connector to the machine harness after testing.

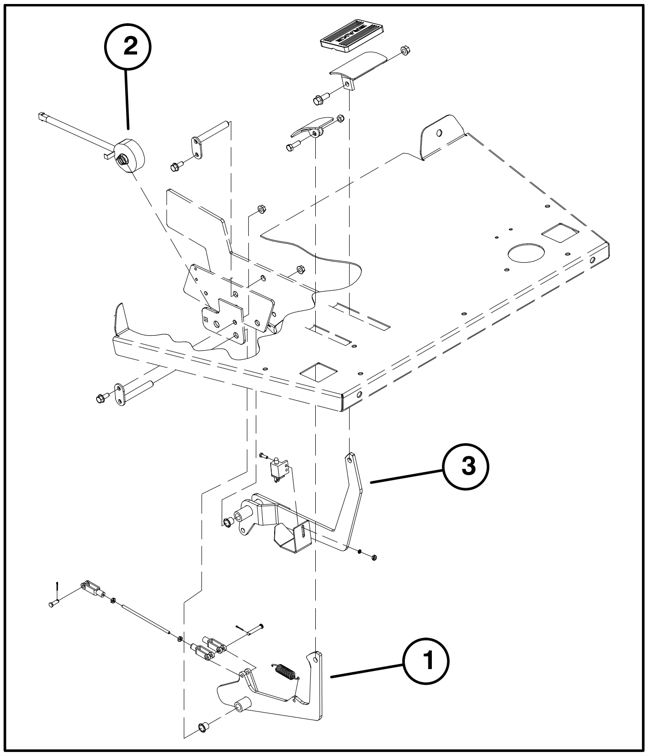


Figure 22

1. **Accelerator lever**
2. **Control coil**
3. **Brake lever**

Electrical System

Accessory Solenoid

The accessory solenoid provides a current supply to the spray system and optional accessories (electric boom lifts and foam markers). The solenoid is energized when the ignition key switch is in the RUN position. The accessory solenoid is located under the operator seat (Fig. 23).

Testing

1. Make sure engine is off. Disconnect battery.

2. Raise operator seat and locate accessory solenoid. Put labels on wires for proper installation after repairs are completed. Disconnect machine harness wires from solenoid.

3. Apply 12 VDC (+) to the solenoid coil post and ground the solenoid mount with a jumper wire. The solenoid should click. Using a multimeter (ohms setting), make sure resistance across the main contact posts is less than 1 ohm.

4. Remove voltage from solenoid coil post. The solenoid should click. Make sure resistance across the main contact posts is infinite ohms (no continuity).

5. Replace accessory solenoid if necessary.

6. Reconnect electrical connections to solenoid: red wire to engine starter and red wire to main fuse on one main contact post, red/white wire to spray system and accessory fuses on the other main contact post, and yellow/red wire on coil post. Reconnect battery.

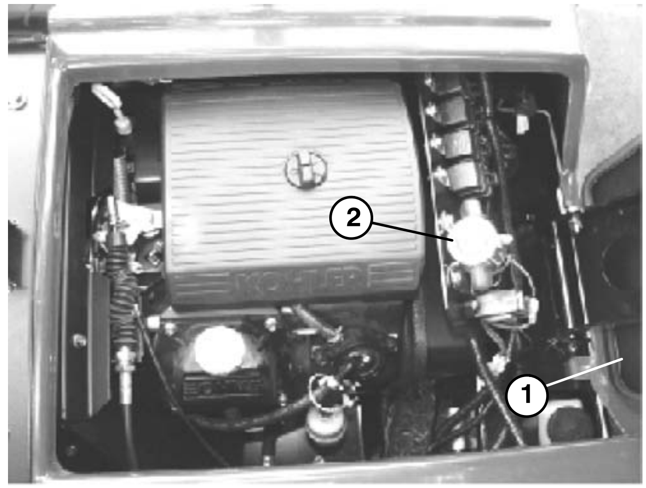


Figure 23

1. **Operator seat (raised)**
2. **Accessory solenoid**

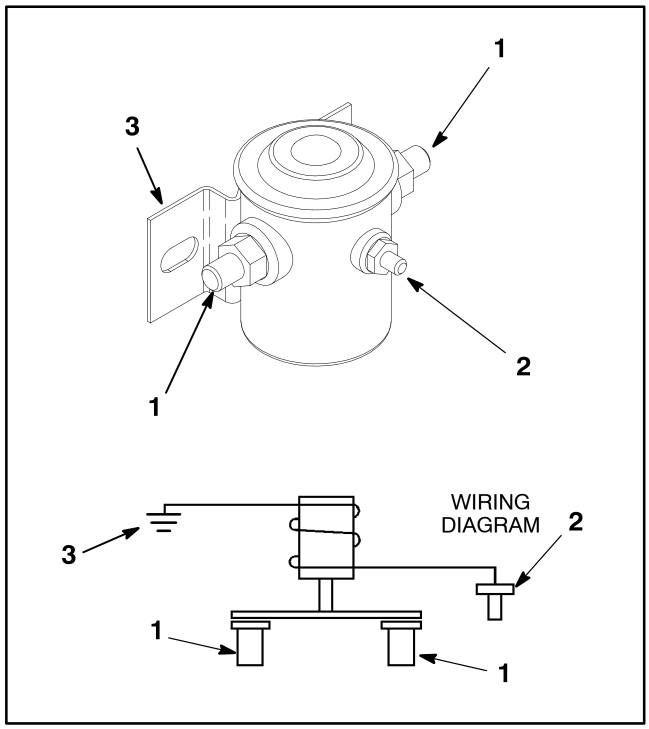


Figure 24

1. **Main contact post**
2. **Solenoid coil post**
3. **Solenoid mount**

Brake Pedal Switch (Machines With Serial Number Below 250000000)

The brake pedal switch is located on the brake lever under the floorboard (Fig. 25). The brake pedal switch allows the shifter solenoid to be energized when the brake pedal is pushed.

Testing

1. Locate switch and unplug wire harness connector from switch.

2. When the switch plunger is pressed (brake pedal depressed), there should be continuity (closed) between the switch terminals. When the switch plunger is extended (brake pedal released), there should be no continuity (open) between the switch terminals.

3. Reconnect the harness connector to the switch after testing.

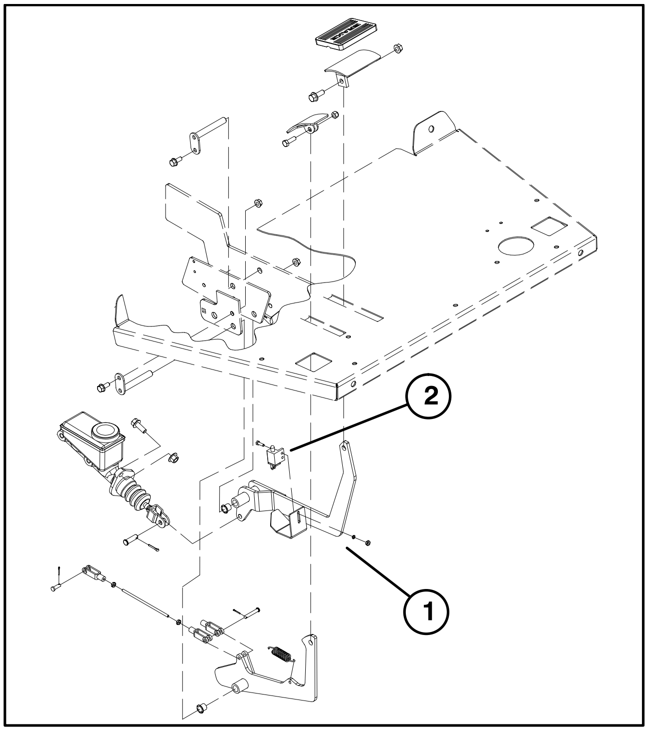


Figure 25

1. Brake lever **2. Brake pedal switch**

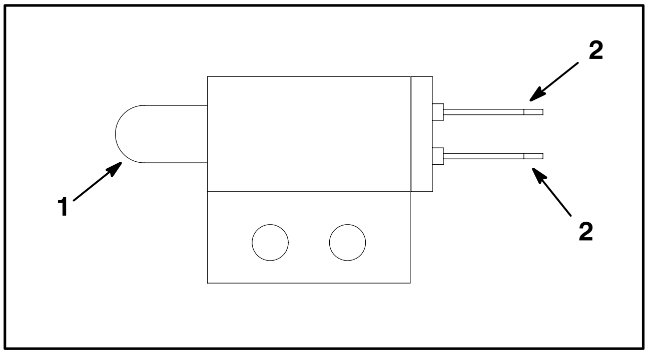


Figure 26

1. Switch plunger **2. Switch terminal**

Electrical System

Spray Pro Monitor

The Multi Pro 1200 and 1250 are equipped with a spray monitor to provide the machine operator with spray system information. Operation, calibration, and troubleshooting information for the Spray Pro Monitor is included in the Operator's Manual.

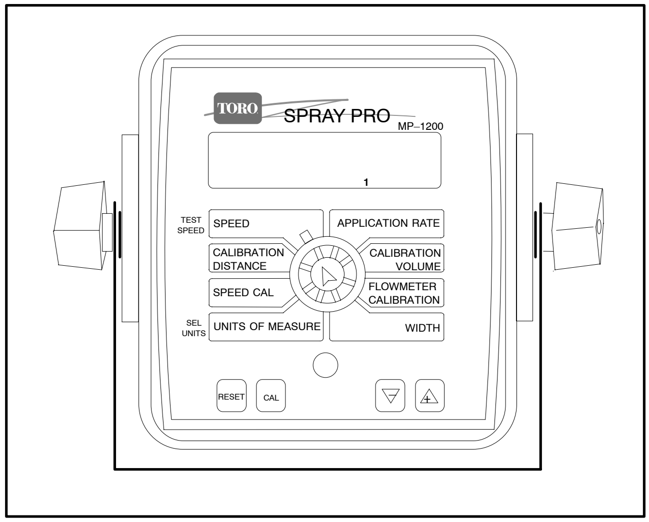


Figure 27

Pressure Increase/Decrease (Multi Pro 1250 only) and Boom Actuator (Optional) Switches

The pressure increase/decrease switch is located on the spray control console (Fig. 28).

On machines equipped with the optional electric boom lift kit, this same switch is used to operate the boom actuators.

Testing

1. Locate switch, remove console panel, and unplug wire harness connector from switch.

2. The switch terminals are marked as shown in Figure 29. In the INCREASE or boom raise position, continuity should exist between terminals 2 and 3 and also between terminals 5 and 6. In the neutral, center position, there should be no continuity between any switch terminals. In the DECREASE or boom lower position, continuity should exist between terminals 2 and 1 and also between terminals 5 and 4.

3. Reconnect the harness connector to the switch after testing. Install console panel to machine.

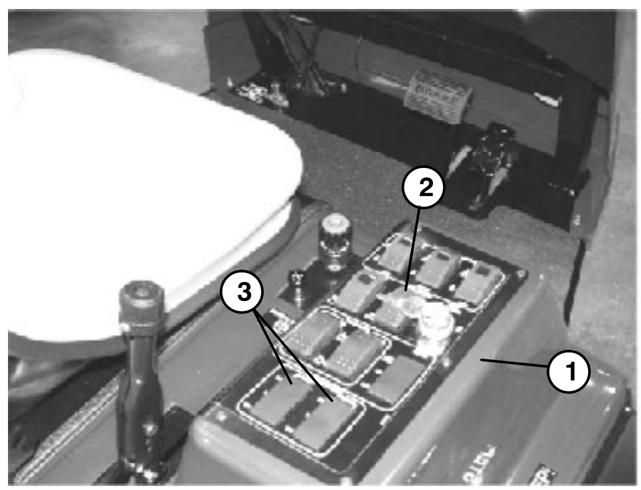


Figure 28

1. **Spray control console**
2. **Pressure +/– switch**
3. **Boom switch location**

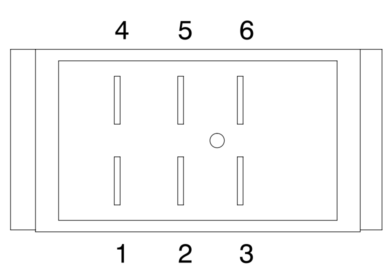


Figure 29

Rate Lockout Key Switch (Multi Pro 1250 only)

The rate lockout key switch is located on the spray control console (Fig. 30).

Testing

1. Locate switch, remove console panel, and remove wire harness connectors from switch.

2. The switch terminals are shown in Figure 31. When the key is in the ON position, continuity should exist between the two terminals. In the OFF position, there should be no continuity between the switch terminals.

3. Reconnect the harness connectors to the switch after testing. Install console panel to machine.

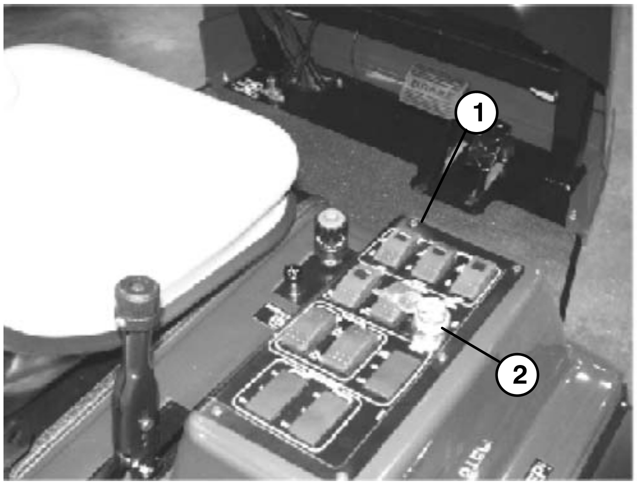


Figure 30

1. **Spray control console** 2. **Rate lockout key switch**

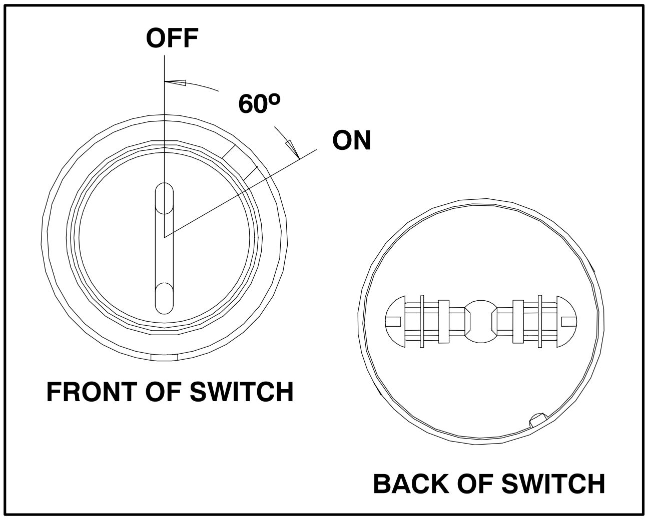


Figure 31

Electrical System

Master Boom (Foot) Switch (Multi Pro 1250 only)

The master boom switch is located on the floorboard of the machine (Fig. 32).

Testing

1. Locate switch and unplug wire harness connectors from switch. Note wire connector location on switch.

2. The switch terminals are shown in Figure 33. Continuity should exist between the common terminal and only one of the side terminals. When the switch is depressed, continuity should exist between the common terminal and the other side terminal. Regardless of switch position, there should never be continuity between the two side terminals.

3. Reconnect the harness connectors to the switch after testing.

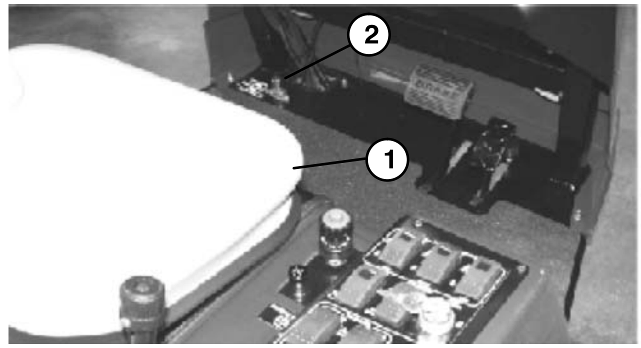


Figure 32

1. **Operator seat**
2. **Master boom switch**

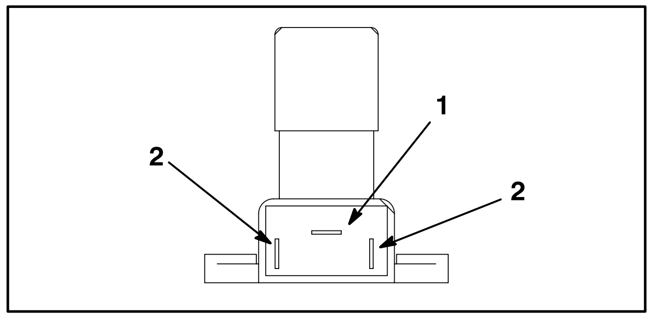


Figure 33

1. **Common terminal**
2. **Side terminal**

Spray Valve Switch (Multi Pro 1250 only)

The three spray valve switches for the Multi Pro 1250 are located on the spray control console (Fig. 34).

Testing

1. Locate spray valve switch, remove console panel, and unplug machine wire harness connector from switch.

2. The switch terminals are marked as shown in Figure 35. In the ON position, continuity should exist between terminals 2 and 3 and also between terminals 5 and 6. In the OFF position, continuity should exist between terminals 1 and 2 and also between terminals 4 and 5.

3. Terminals 7 (–) and 8 (+) are used for the indicator light in the switch. The light should be illuminated when the switch is in the ON position.

4. Reconnect the harness connector to the switch after testing. Install console panel to machine.

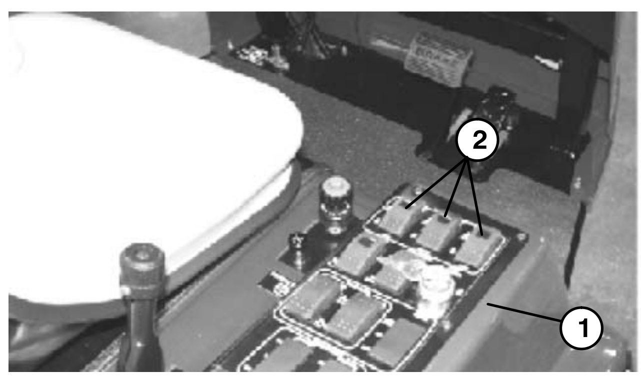


Figure 34

1. **Spray control console**
2. **Spray valve switch**

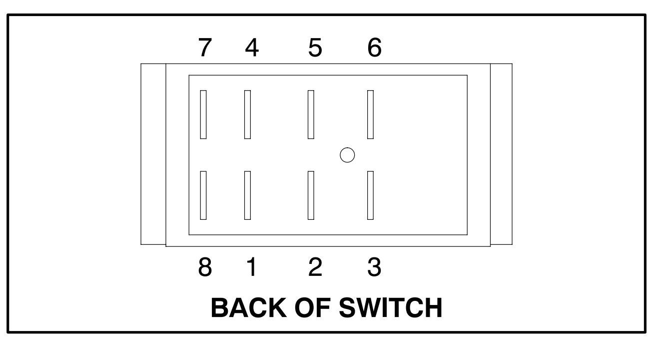


Figure 35

Service and Repairs

NOTE: See the Kohler Engine Repair Manual for more component repair information.

Headlights

Removal and Installation (Fig. 36)

1. Set parking brake, turn ignition off, and remove key.

2. Reach beneath dash and push headlight out of the hood.

3. Remove screws attaching the wire harness to the headlight.

4. Remove rubber seal from around the headlight. Discard headlight.

5. Align notch on the inside of the seal with the notch on the new headlight. Slide seal onto the headlight until the seal is firmly in place.

6. Attach headlight to the wire harness using the previously removed screws.

NOTE: Applying soapy water to the outside of the seal may aid in sliding the seal into the hood. Make sure to thoroughly dry headlights before turning lights on.

7. Align notch on the outside of the seal with the notch in the hood. Push headlight and seal into the hood until it is firmly in place.

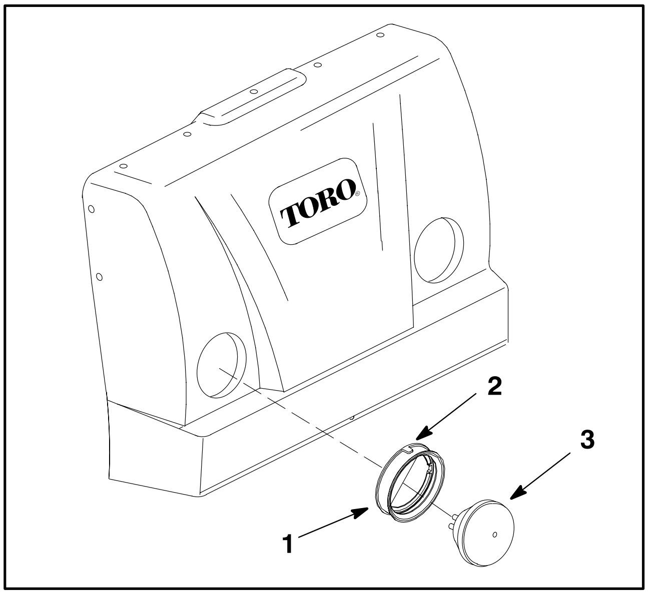


Figure 36

1. **Rubber seal**
2. **Outside notch**
3. **Headlight**

Electrical System

Battery Storage

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

1. Remove the battery and charge it fully (see Battery Service).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

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

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

Battery Care

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

WARNING

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

IMPORTANT: Do not remove battery fill caps while cleaning.

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. Coat battery posts and cable connectors with skin–over grease (Toro Part No. 505-47) or petroleum jelly to prevent corrosion.

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

WARNING

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

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (–) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with skin–over grease (Toro Part No. 505-47) 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 level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

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

> **CAUTION**
>
> **When working with batteries, use extreme caution to avoid 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.**

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

Battery Specifications
BCI Group Size 70
360 CCA at 0° F (–18° C)
Reserve Capacity of 130 minutes at 80°F (27°C)

Dimensions (including terminal posts)

Length	10.2 inches (25.9 cm)
Width	6.9 inches (17.5 cm)
Height	8.6 inches (21.8 cm)

Removal and Installation (Fig. 37)

See Operator's Manual for battery removal and installation information.

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 0 amps. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Replace battery if cracked or leaking.

   B. 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.

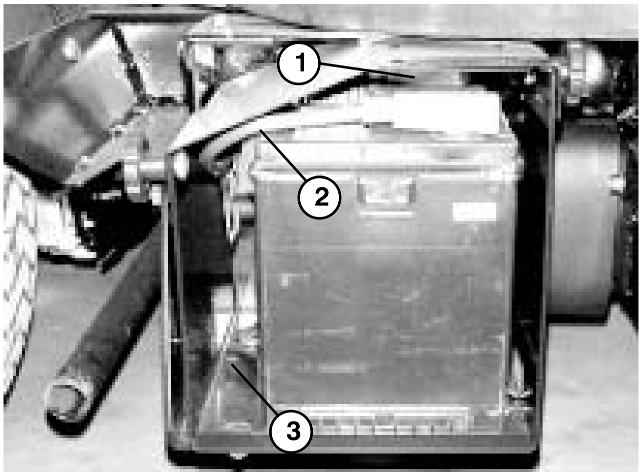


Figure 37

1. Negative battery cable
2. Positive battery cable
3. Battery retainer

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

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

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

2. Conduct a hydrometer test of the battery electrolyte.

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

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

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

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

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

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

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

CAUTION

Follow the manufacturer's instructions when using a battery tester.

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.

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.

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Spray System

Table of Contents

Spray System

Specifications

Item	Description
Spray Pump	Diaphragm Pump, 30 GPM @ 220 PSI
Spray Pressure Relief Valve	Poppet Style, 220 PSI Maximum
Sprayer Tank	160 Gallon, Polyethylene
Suction Strainer	50 Mesh, Stainless Steel, Tank Mounted (30 Mesh and 80 Mesh Optional)

General Information

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil, or other property. To eliminate environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection, and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals, and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Stop the vehicle and set the parking brake.

2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses, and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure line pressure is relieved before loosening any system component.

O–Ring Seal Kit

The O–Ring Seal Kit (Part Number 106–4846) includes an assortment of o–rings used for sealing hose couplings on the spray tank. It is recommended that o–rings be replaced every two (2) years or whenever a fitting is loosened.

Spray System Operation

The Multi Pro 1200 and 1250 spray systems use a positive displacement diaphragm pump to move spray solution from the spray tank to the boom nozzles. The spray pump is self–priming and has a dry crankcase. The pump is driven by the pump drive gearbox output shaft at a speed that is proportional to the ground speed of the vehicle. The pump is engaged with an electric clutch.

The downward stroke of the pumps' connecting rods and diaphragms create suction to allow fluid to be drawn from the spray tank to the pump through the suction tube, suction strainer, hoses, and connectors. A suction dampener placed in the suction line dampens suction pulses to smooth suction flow. Suction valves positioned in the pump valve chamber prevent fluid from being pumped back into the suction line when the connecting rods change direction. Leaks in the suction line will cause system problems and often will be indicated by erratic suction line jumping and pump noise.

Once to the pump, the fluid is pushed by the upward stroke of the pumps' connecting rods and diaphragms to the pressure side of the spray system through hoses, connectors, control valves, and spray nozzles. A pressure dampener at the pump outlet smooths system pressure pulsation. Pressure valves positioned in the pump head prevent fluid from being drawn back into the pump. Maximum pressure in the system is limited by a pressure relief valve located in the tank. A pressure gauge indicates system pressure.

The spray control system on the Multi Pro 1200 consists of a main on/off valve, a pressure control valve, and three boom control valves. An adjustable boom bypass valve exists in each of the boom control valves to prevent system pressure changes when a boom section is shut off. Flow in excess of control valve settings is directed back to the spray tank or used for tank agitation.

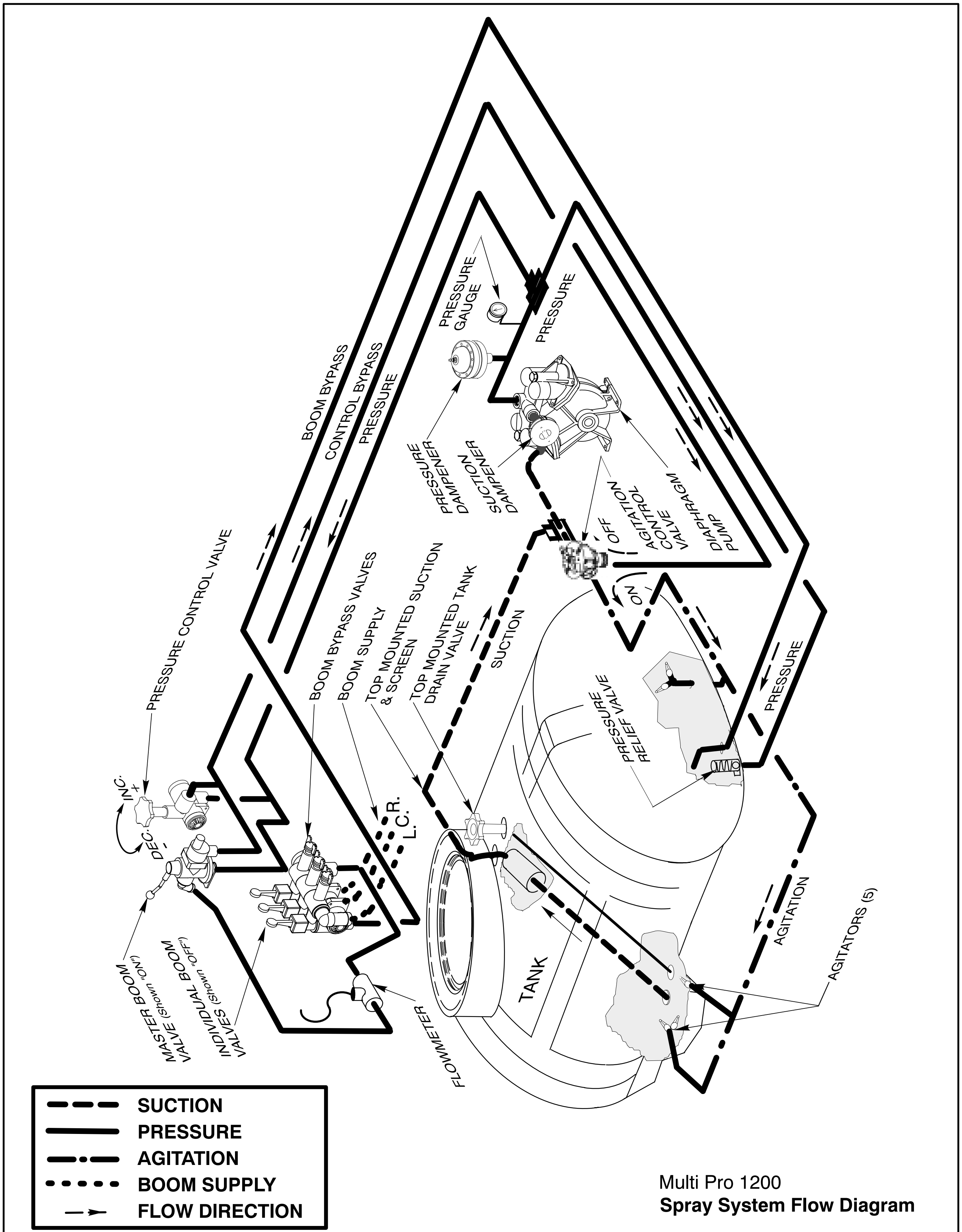
The spray system on the Multi Pro 1250 is controlled electrically and consists of a main control valve and three boom control valves. An adjustable boom bypass valve exists in each of the boom control valves to prevent system pressure changes when a boom section is shut off. Flow in excess of control valve settings is directed back to the spray tank or used for tank agitation.

An inline flowmeter in the pressure side of the system directly before the boom control valves measures flow to the spray booms. The Spray Pro Monitor displays information regarding application rate based on input from the flowmeter and the ground speed sensor.

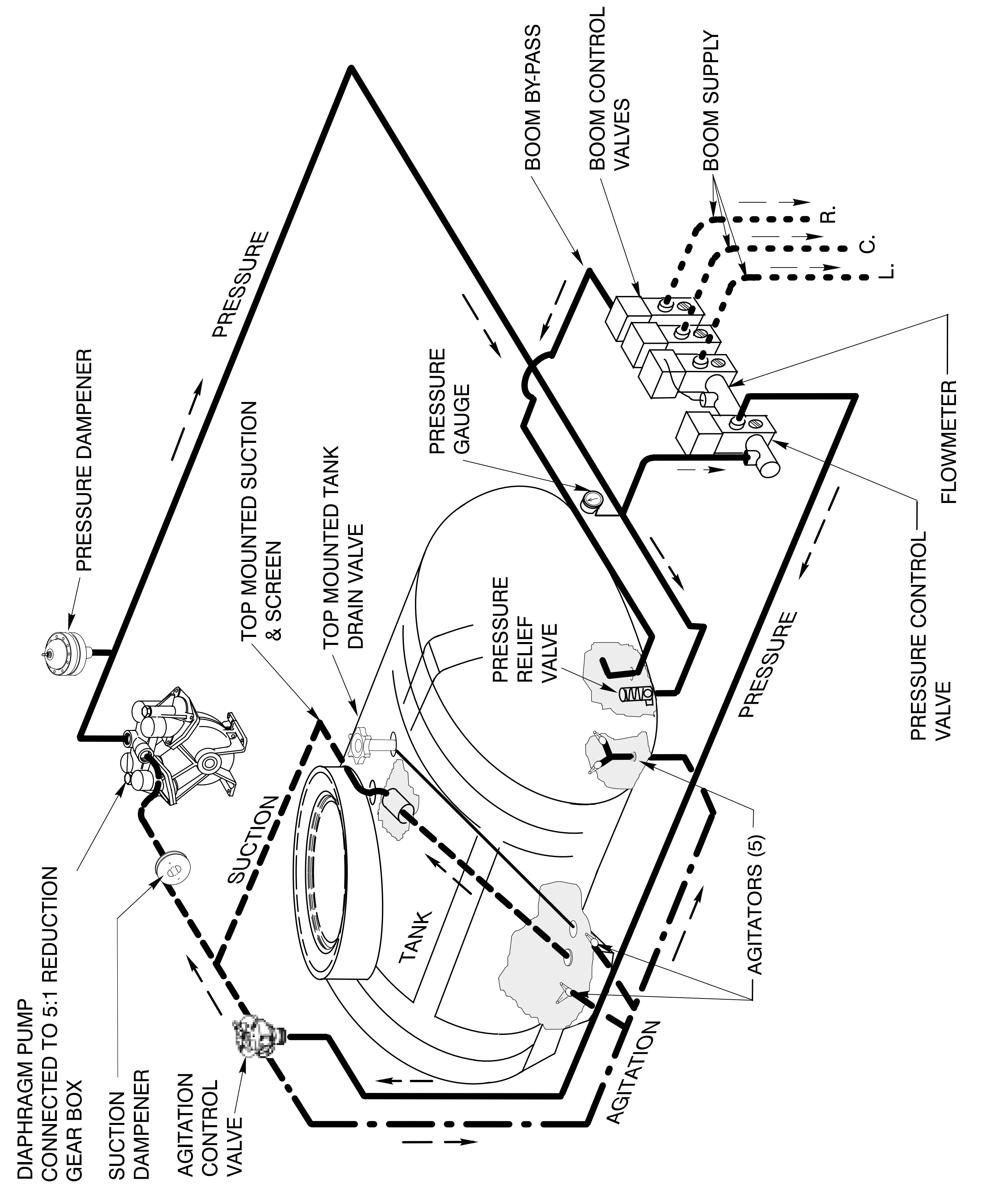
Flow for tank agitation on both the Multi Pro 1200 and 1250 comes from flow that is bypassed by the pressure control valve. A manual agitation control valve directs flow to five agitation nozzles in the spray tank.

Battery current for spray system fuses, switches, relays, and other components is provided by the accessory solenoid when the machine ignition switch is in the RUN position. For spray system electrical component information and test procedures, see Chapter 5 – Electrical System.

Spray System Flow Diagrams



Multi Pro 1200
Spray System Flow Diagram



SUCTION
PRESSURE
AGITATION
BOOM SUPPLY
FLOW DIRECTION

Multi Pro 1250
Spray System Flow Diagram

Spray System

Troubleshooting

Problem	Possible Cause
Spray system leaks fluid.	Fitting(s), hose(s), or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged.
Fluid leaking from bottom of spray pump.	Faulty diaphragm(s) in spray pump.
Excessive suction hose vibration.	Suction screen in tank is plugged. Spray pump suction line has an air leak. Suction tube in spray tank has air leak. Suction line is restricted. Suction dampener diaphragm is damaged.
Spray pressure is low.	Suction line is restricted. Suction screen in tank is plugged. Spray nozzles worn or damaged. Pressure line or component is loose or leaking. Engine speed is low. Pressure relief valve in tank is stuck. Pressure control valve damaged or incorrectly adjusted (Multi Pro 1200) Drive belt is slipping (Ground speed also affected: see Drive Train – Chapter 7). Spray pump is damaged.
Nozzles on one spray boom leak when boom is switched off.	Diaphragm in turret body is leaking or damaged. Distribution valve for affected boom not seating (Multi Pro 1200). Boom valve motor for affected boom not seating (Multi Pro 1250).
All spray boom nozzles leak when boom is turned off.	Master boom valve not seating (Multi Pro 1200). Rate control motor not seating (Multi Pro 1250). All distribution valves not seating (Multi Pro 1200). All boom valve motors not seating (Multi Pro 1250).

Spray pump doesn't rotate.	Spray pump switch off or damaged. Foot switch off or damaged (Multi Pro 1250). Key on spray pump shaft or gearbox shaft is sheared. Spray pump coupler is damaged. Pump drive electric clutch not engaged or is damaged (see Chapter 5 – Electrical System).
Erratic spray operation from booms.	Clogged strainer. Damaged suction dampener. Damaged pressure dampener. Boom bypass valve on distribution valve is damaged (Multi Pro 1200). Master boom valve damaged (Multi Pro 1200). Console boom switch(es) dirty, corroded, or damaged (Multi Pro 1250). Rate control motor worn or sticking (Multi Pro 1250). Boom valve motor seat loose or damaged (Multi Pro 1250). Boom valve motor actuating cam worn or sticking (Multi Pro 1250).
No spray output from one spray boom.	Hoses on boom are pinched or kinked. Distribution valve for affected boom not open (Multi Pro 1200). Boom valve motor for affected boom not opening (Multi Pro 1250). Console boom switch dirty, corroded, or damaged (Multi Pro 1250). Check for 12 volts at affected boom valve motor (Multi Pro 1250).
Low spray rate from one nozzle.	Clogged or damaged spray nozzle(s). Spray nozzles are different sizes. Distribution valve for affected boom not seating (Multi Pro 1200). Boom valve motor for affected boom not seating (Multi Pro 1250).

Pump Drive Electric Clutch

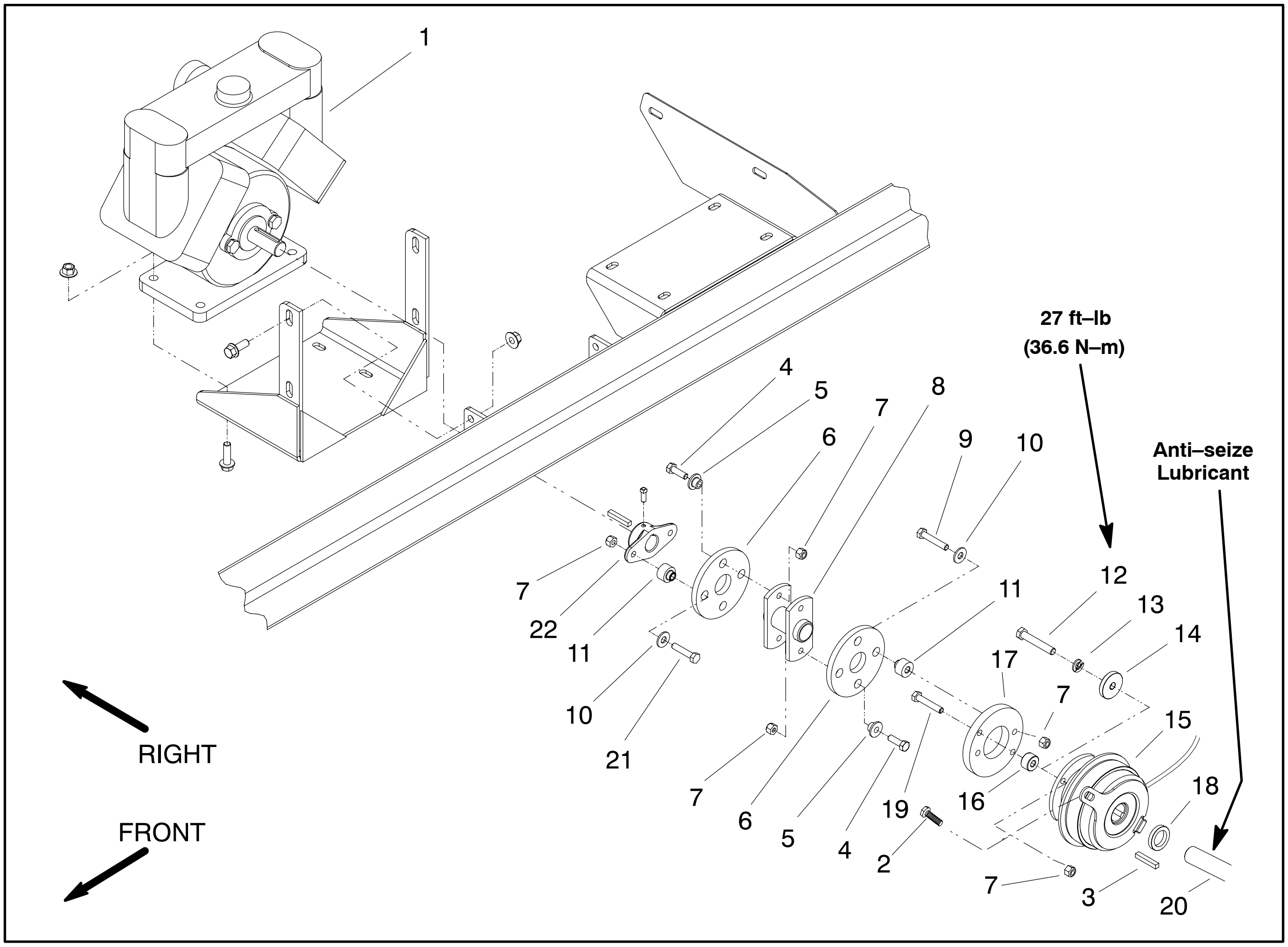


Figure 1

1. Spray pump
2. Shoulder bolt
3. Key
4. Cap screw (4 used)
5. Coupling spacer (4 used)
6. Rubber coupling
7. Lock nut
8. Drive coupler
9. Cap screw (2 used)
10. Flat washer (2 used)
11. Spacer (4 used)
12. Cap screw
13. Lock washer
14. Clutch retainer
15. Electric clutch
16. Spacer (2 used)
17. Clutch adapter
18. Spacer
19. Cap screw (2 used)
20. Pump drive gearbox shaft
21. Cap screw (2 used)
22. Pump hub

Removal (Fig. 1)

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

2. Remove cap screws, flat washers, lock nuts, and spacers that secure rubber coupling to pump hub (item 23).

3. Remove lock nuts that secure clutch adapter (item 17) to electric clutch.

4. Slide drive coupler, both rubber couplings, and clutch adapter from machine as an assembly. Locate and retrieve two (2) spacers from between clutch adapter and electric clutch.

5. Unplug clutch wire connector from machine wiring harness.

6. Remove cap screw, lock washer, and clutch retainer from pump gearbox shaft.

7. Remove shoulder bolt that secures clutch leg to gearbox.

8. Pull electric clutch from pump gearbox. Locate and remove key and spacer from gearbox shaft.

Installation (Fig. 1)

1. Apply anti–seize lubricant to pump drive gearbox shaft. Place key and spacer onto shaft.

2. Align key slot in clutch with key in gearbox shaft and align mounting leg of clutch to threaded hole in gearbox. Slide clutch onto gearbox shaft.

3. Install shoulder bolt through leg of clutch and into gearbox. Tighten shoulder bolt. After shoulder bolt is tightened, make sure that leg of clutch does not bind on bolt.

4. Install cap screw, lock washer, and clutch retainer to secure clutch to gearbox shaft. Torque bolt 27 ft–lb (36.6 N–m).

5. Connect clutch wires to machine wiring harness.

6. Position drive coupler assembly (with both rubber couplings and clutch adapter) between pump hub and electric clutch.

7. Install two (2) spacers between clutch adapter (item 17) and electric clutch. Secure clutch adapter to clutch with two (2) lock nuts.

8. Secure rubber coupling to pump hub (item 23) with spacers, flat washers, cap screws,and lock nuts. Make sure that cap screw threads extend through lock nut.

Pump Drive Electric Clutch Service

NOTE: For clutch electrical testing information, see Pump Drive Electric Clutch in the Service and Repair section of Chapter 5 – Electrical System.

The pump drive electric clutch used on the Multi Pro has sealed, non–serviceable bearings. If bearing failure occurs, clutch replacement is necessary.

Suction Dampener

The suction dampener is mounted to the suction line at the spray pump (Fig. 2) and is used to dampen suction pulses and smooth suction flow. During pump operation, the suction dampener diaphragm will move.

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

A damaged suction dampener diaphragm will allow a suction leak and will cause improper pump operation. If the diaphragm is damaged, remove diaphragm from dampener housing and replace it (Fig. 3).

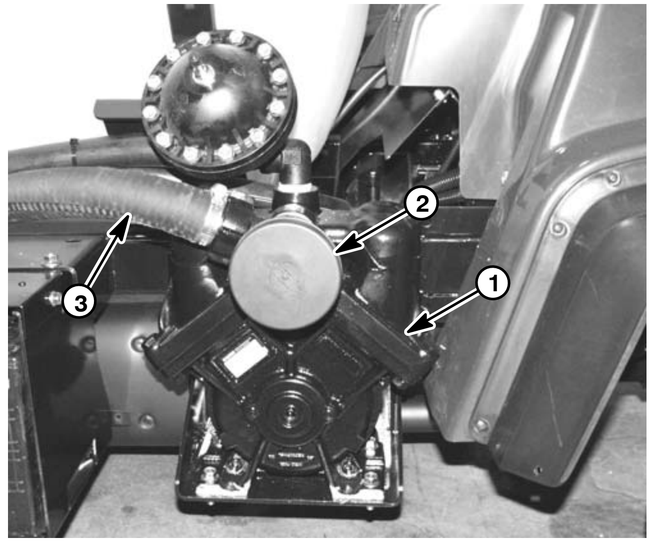


Figure 2

1. **Spray pump**
2. **Suction dampener**
3. **Suction hose**

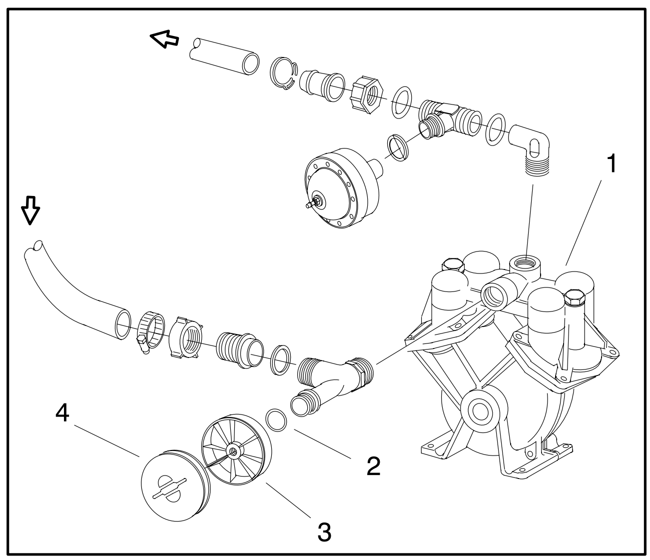


Figure 3

1. **Spray pump**
2. **O–ring**
3. **Dampener housing**
4. **Diaphragm**

Pressure Dampener

The pressure dampener is mounted to the pressure line at the spray pump (Fig. 4) and is used to smooth system pressure pulsation. Adjust air pressure on the pressure dampener to approximately 14 PSI (.97 bar). If fluid is present when pressure in the dampener is checked, the diaphragm in the pressure dampener is damaged and should be replaced.

Dampener Service (Fig. 5)

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

1. Loosen and remove cap screws and nuts that secure diaphragm between housings.

2. Remove diaphragm from dampener.

3. Replace diaphragm and reassemble dampener.

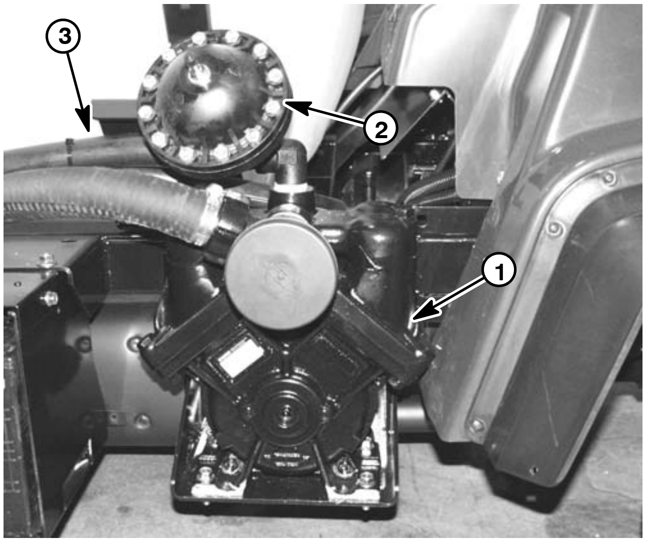


Figure 4

1. **Spray pump**
2. **Pressure dampener**
3. **Pressure hose (1”)**

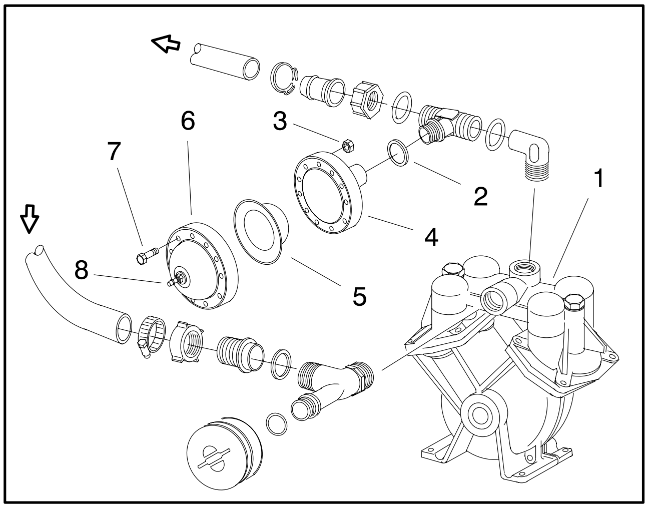


Figure 5

1. **Spray pump**
2. **O–ring**
3. **Hex nut (12 used)**
4. **Rear housing**
5. **Diaphragm**
6. **Front housing**
7. **Cap screw (12 used)**
8. **Air valve**

Spray System

Spray Pump

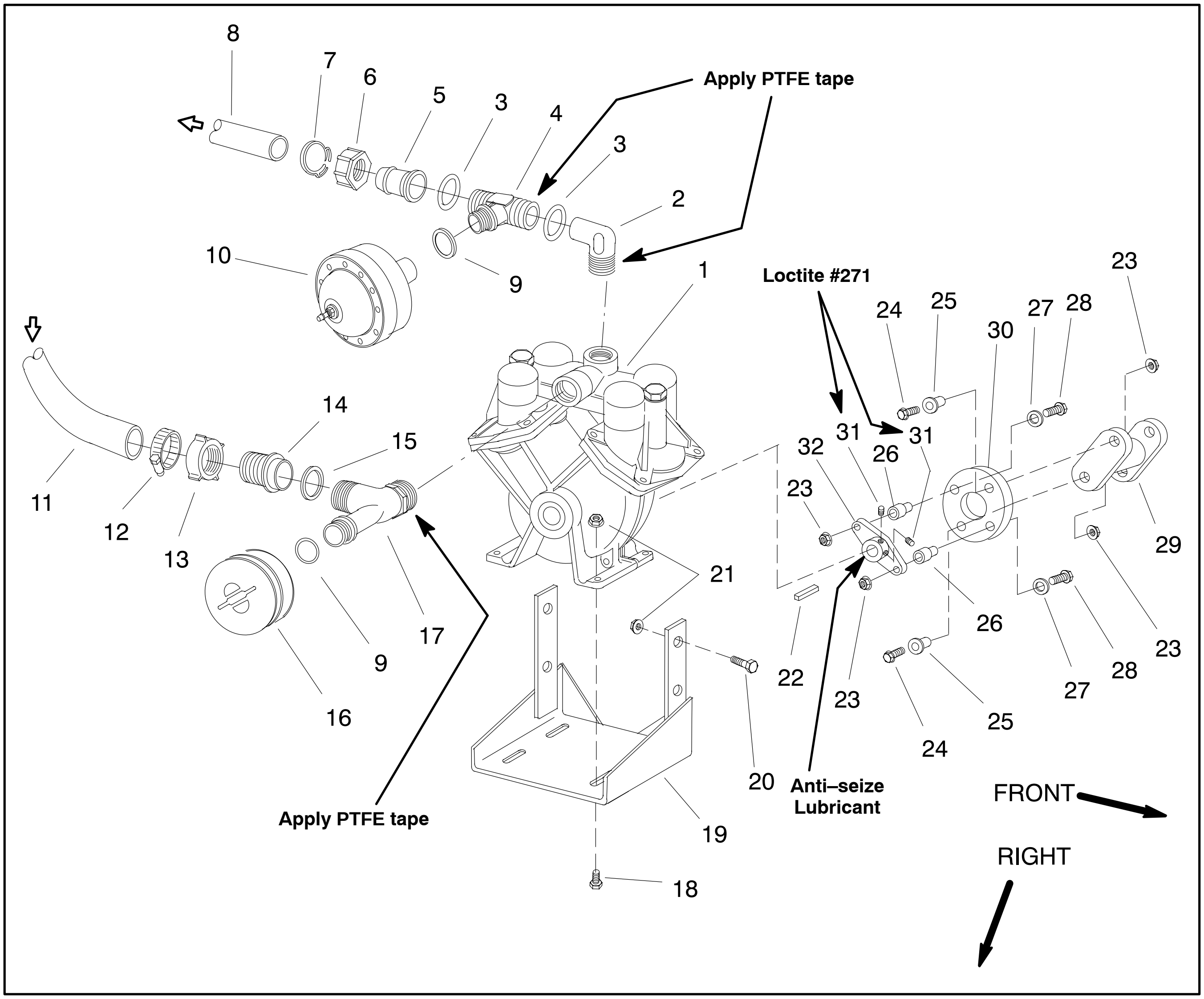


Figure 6

1. **Spray pump assembly**
2. **Elbow (pressure)**
3. **O–ring**
4. **Tee (pressure)**
5. **Hose barb**
6. **Nut**
7. **Hose clamp**
8. **Pressure hose (1”)**
9. **O–ring**
10. **Pressure dampener**
11. **Suction hose (1 1/2”)**
12. **Hose clamp**
13. **Nut**
14. **Hose barb**
15. **Seal**
16. **Suction dampener**
17. **Tee (suction)**
18. **Flange head screw (4 used)**
19. **Pump mount bracket**
20. **Flange head screw (4 used)**
21. **Flange nut**
22. **Square key**
23. **Lock nut**
24. **Cap screw**
25. **Coupling spacer**
26. **Coupling spacer**
27. **Flat washer**
28. **Cap screw**
29. **Drive coupler**
30. **Rubber coupling**
31. **Set screw**
32. **Pump hub**

Removal (Fig. 6)

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

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

2. Loosen hose clamp that secures suction hose (item 11) to hose barb (item 14). Pull suction hose from hose barb.

3. Loosen hose clamp that secures pressure hose (item 8) to hose barb (item 5). Pull pressure hose from hose barb.

4. Remove lock nuts, flat washers, cap screws, and spacers that secure rubber coupling to pump hub.

5. Remove cap screws and flange nuts that secure pump to pump mount bracket.

6. Remove pump from machine.

7. Loosen set screws in pump hub. Pull hub from pump shaft. Locate and remove key from pump shaft.

8. Remove pressure dampener, tee (pressure), and elbow (pressure) from pump outlet.

9. Remove suction dampener and tee (suction) from pump inlet.

Installation (Fig. 6)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Apply PTFE tape to threads of tee (pressure), elbow (pressure), and tee (suction). Position new o–rings and gaskets on suction and pressure fittings that were removed during disassembly.

2. Install tee (suction) and suction dampener to pump inlet. Orientate tee toward rear of machine (Fig. 7).

3. Install elbow (pressure), tee (pressure), and pressure dampener to pump outlet. Orientate elbow toward rear of machine (Fig. 7).

4. Remove set screws from pump hub. Clean threads of set screws and hub.

5. Apply anti–seize lubricant to pump shaft. Install key in shaft and slide pump hub onto shaft.

6. Position pump on pump mounting bracket. Install cap screws and flange nuts to pump and mounting bracket. Leave fasteners loose.

7. Place coupling spacers into rubber coupling. Install cap screws, flat washers, and lock nuts to secure rubber coupling to pump hub. Make sure that cap screw threads extend through lock nut.

8. Secure pump to mounting bracket by tightening cap screws and flange nuts.

9. Apply Loctite #242 (or equivalent) to threads of pump hub set screws. Install set screws into pump hub to secure hub to pump shaft.

10. Install pressure and suction hoses to correct barb fittings. Secure hoses with hose clamps.

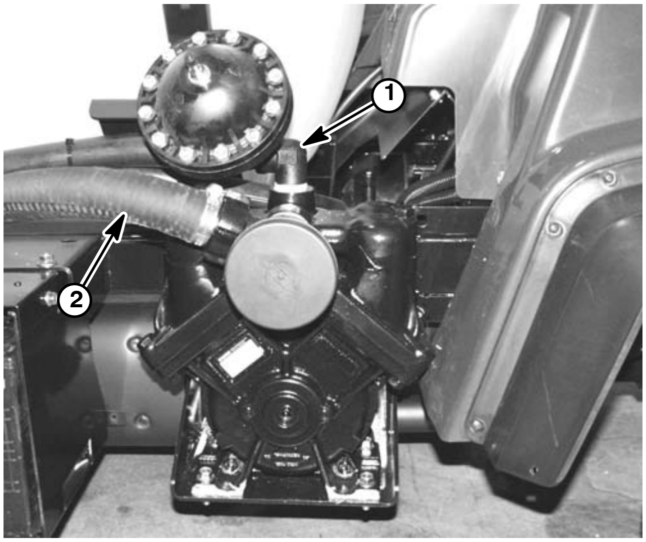


Figure 7

1. **Elbow (pressure)**
2. **Suction hose**

Spray System

Spray Pump Service

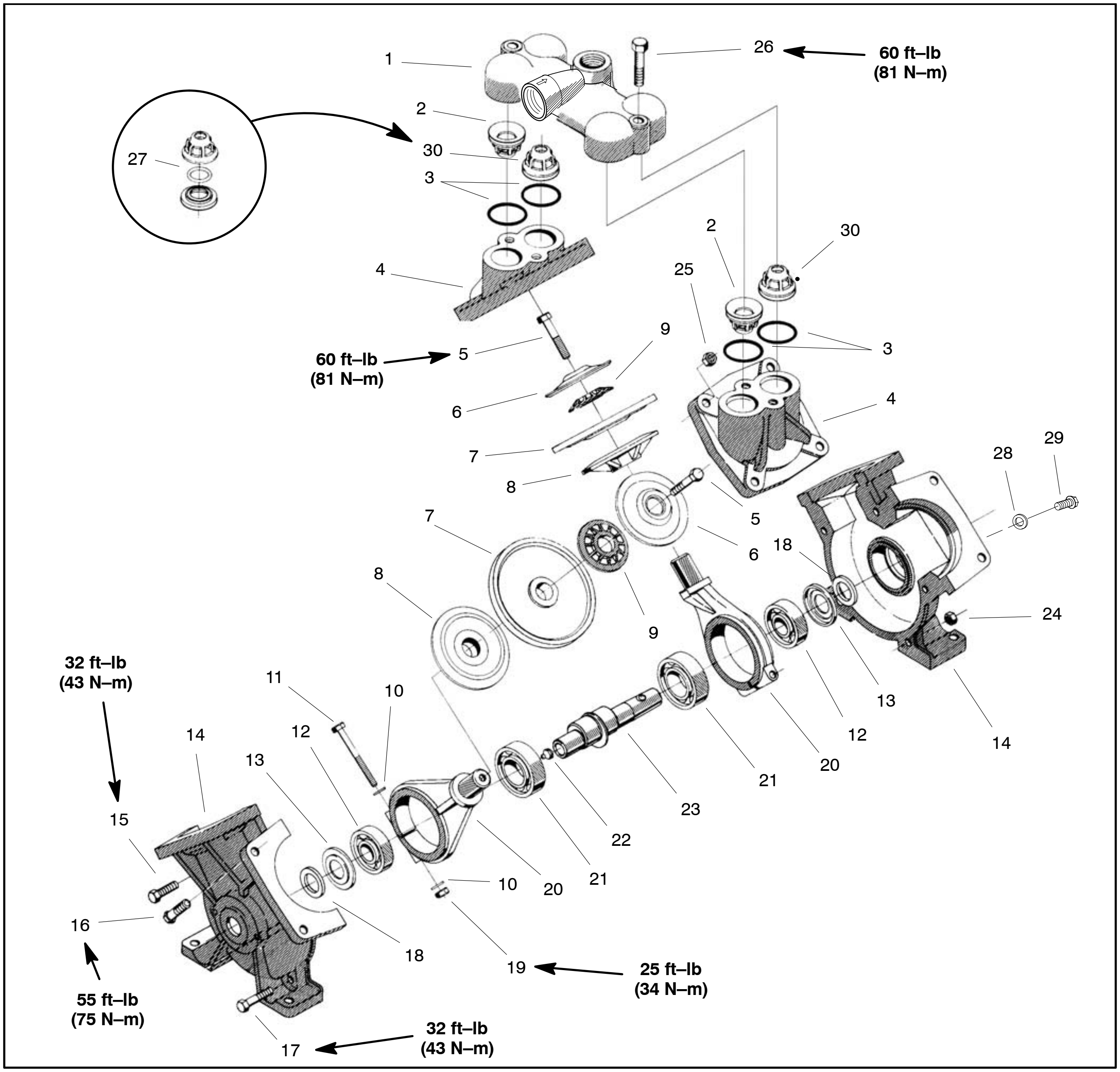


Figure 8

1. Valve chamber
2. Valve (inlet position)
3. O–ring
4. Diaphragm cover
5. Hex bolt
6. Washer
7. Diaphragm
8. Diaphragm back disc
9. Nylon washer
10. Lock washer
11. Hex bolt (M8)
12. Ball bearing (crankshaft)
13. Dust plate
14. Pump casing
15. Hex bolt (30 mm long) (3 used)
16. Hex bolt (M12) (4 used per cover)
17. Hex bolt (55 mm long) (2 used)
18. Felt seal
19. Hex nut (M8)
20. Connecting rod
21. Ball bearing (connecting rod)
22. Grease fitting
23. Crankshaft
24. Hex nut (5 used)
25. Hex nut (M12) (4 used per cover)
26. Hex bolt (2 used)
27. Poly o–ring
28. Lock washer
29. Hex bolt
30. Valve (outlet position)

IMPORTANT: The spray pump used on the Multi Pro may have SAE, metric, and Whitworth fasteners. To prevent component damage, take special care to identify correct location of all fasteners.

Disassembly (Fig. 8)

IMPORTANT: Make sure to remove and neutralize chemicals from pump before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during pump repair.

1. Remove two (2) hex bolts that retain valve chamber to pump. Separate valve chamber from pump.

2. Remove inlet and outlet valves and o–rings from each diaphragm cover. Note orientation of valves. Discard valves and o–rings. Clean valve and o–ring seats in the valve chambers and diaphragm covers.

3. Remove hex bolts and nuts that secure diaphragm covers to pump. Remove diaphragm covers. Note: Some pumps may use bolts that thread into the pump casings to secure diaphragm covers.

4. Remove hex bolt, washer, nylon washer, diaphragm, and diaphragm back disc from each connecting rod. Discard diaphragms.

5. Remove five (5) hex bolts and nuts that secure pump casing halves together. Note location of two (2) longer hex bolts. Carefully separate pump casing halves.

6. Clean grease from bottom of housing and check condition of bearings on crankshaft. If bearings require replacement, remove and disassemble crankshaft:

    A. Remove crankshaft assembly from pump casing.

    B. Slide felt seal and dust plate from both ends of crankshaft.

    C. Loosen bolt and hex nut that secure connecting rods to crankshaft. Slide connecting rods from crankshaft.

    D. Press ball bearings from crankshaft.

Assembly (Fig. 8)

1. If disassembled, reassemble crankshaft.

    A. Hand pack new bearings with #2 general purpose lithium base grease.

    B. Pressing on bearing inner race, install two connecting rod and two crankshaft ball bearings onto crankshaft.

    C. Slide connecting rods onto rod bearings. Offsets of the connecting rods should face each other. Install hex bolt, flat washers, and hex nut to connecting rod. Torque hex nuts to 25 ft–lb (34 N–m) to secure connecting rod to crankshaft.

    D. Position dust plate and felt seal on both ends of crankshaft.

    IMPORTANT: If connecting rod position is incorrect, pump will not operate properly.

    E. Slide crankshaft assembly into pump casing. The rear connecting rod should be positioned to the left side and the connecting rod closest to you to the right side (Fig. 9).

2. Place second pump casing onto assembly. Pump casing surfaces should mate together.

3. Install three (3) shorter (30 mm) and two (2) longer (55 mm) bolts into pump casing assembly (Fig. 10). Thread hex nuts onto bolts but do not fully tighten. Check that crankshaft turns freely.

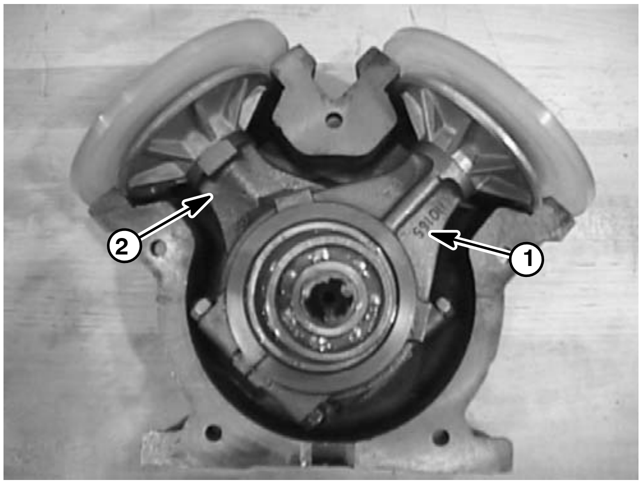


Figure 9

1. **Closest connecting rod (to right side)**
2. **Rear connecting rod (to left side)**

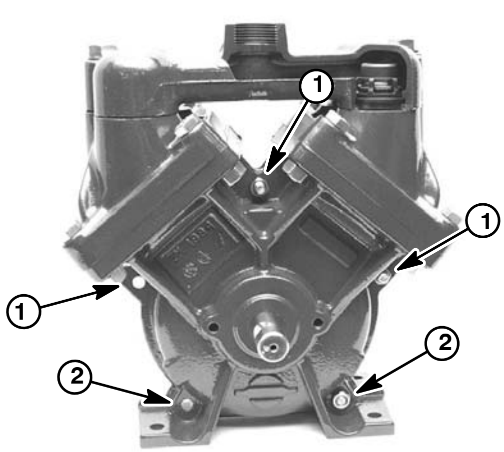


Figure 10

1. **Hex bolt (30 mm long)**
2. **Hex bolt (55 mm long)**

Spray System

4. Place diaphragm back disc and new diaphragm onto each connecting rod. The connecting rods should extend above the diaphragms when correctly installed (Fig. 11). Position nylon washer and washer on each connecting rod and then thread hex bolt into connecting rod. Torque bolt to 60 ft–lb (81 N–m).

5. Make sure that pump casings align and then secure pump casing assembly by torquing five (5) bolts to 32 ft–lb (43 N–m).

6. Install diaphragm covers to pump using hex bolts and nuts (4 per cover). Torque nuts to 55 ft–lb (75 N–m). Note: Some pumps may use hex bolts that thread into the pump casing to secure diaphragm covers.

7. Place new o–rings and valves into diaphragm cover openings (Fig. 12). Inlet valves should be installed with the spring down into the cover. Outlet valves should be installed in with the spring up and away from cover.

8. Place valve chamber over valves noting orientation of chamber inlet and outlet. Secure valve chamber with two (2) hex bolts. Torque bolts 60 ft–lb (81 N–m).

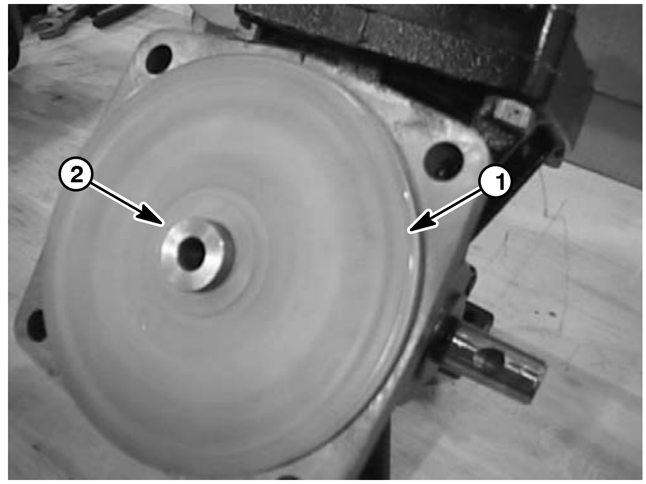


Figure 11

1. **Diaphragm**
2. **Connecting rod**

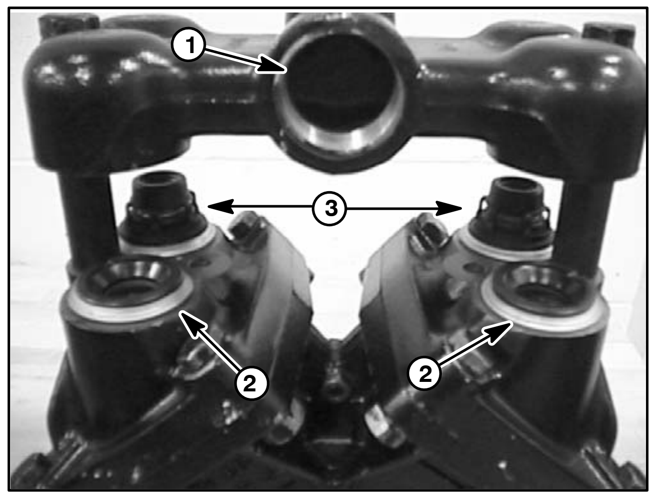


Figure 12

1. **Inlet (suction)**
2. **Inlet valve**
3. **Outlet valve**

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Spray System

Agitation Control Valve

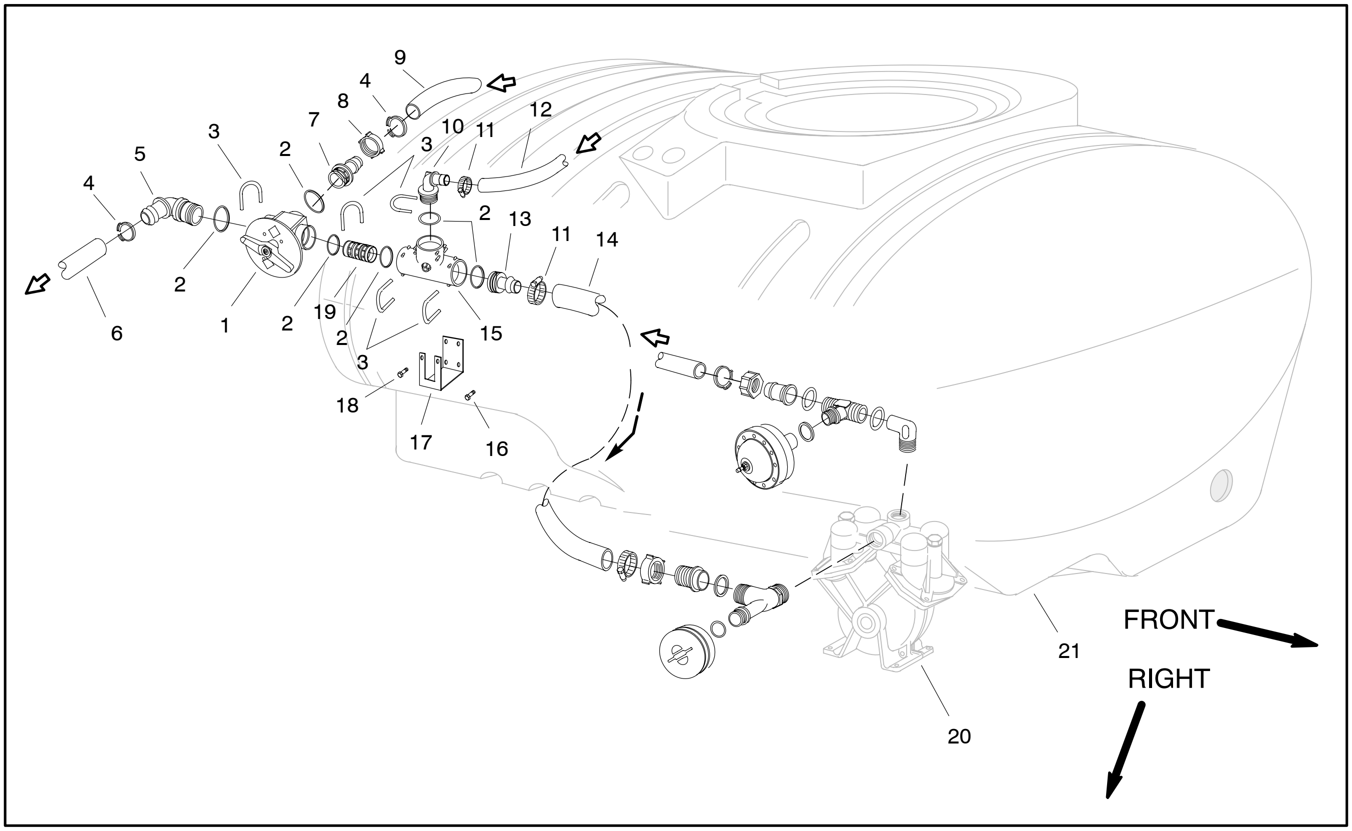

Figure 13

1. Agitation control valve
2. O–ring
3. Fork
4. Hose clamp
5. Hosebarb
6. Hose: agitation supply(1”)
7. Hosebarb
8. Nut
9. Hose: control bypass (1”)
10. Hosebarb
11. Hose clamp
12. Hose: tank suction (1 1/2”)
13. Hosebarb
14. Suction hose (1 1/2”)
15. Tee
16. Cap screw
17. Tee bracket
18. Phillips head screw
19. Connector
20. Spray pump
21. Spray tank

Removal (Fig. 13)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Label disconnected hoses for proper installation after repairs are completed.

3. Remove agitation control valve using Figures 13 and 14 as guides.

4. Disassemble agitation valve as required (Fig 15).

Installation (Fig. 13)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble agitation control valve (Fig 15). Align arrow on valve handle with large hole in valve ball during assembly (Fig. 16).

2. Install agitation valve using Figures 13 and 14 as guides.

3. Check spray system for leaks.

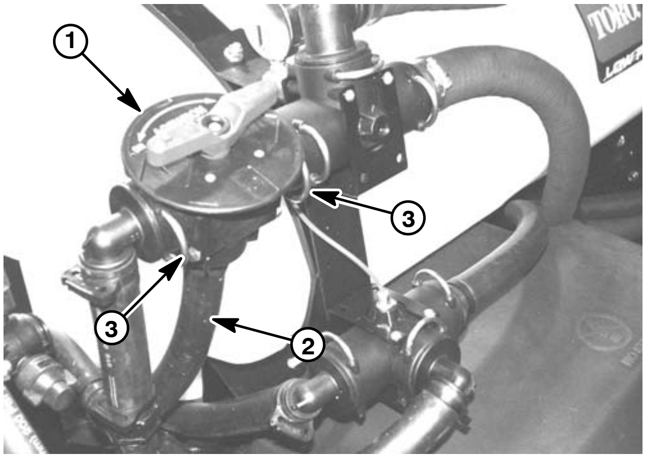

Figure 14

1. **Agitation control valve**
2. **Control bypass hose**
3. **Fork**

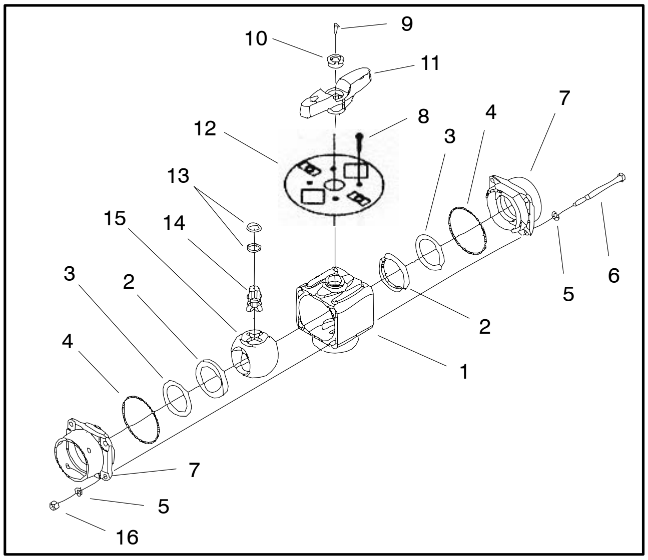

Figure 15

1. **Valve housing**
2. **Ball seat**
3. **O–ring**
4. **O–ring**
5. **Washer (8 used)**
6. **Cap screw (4 used)**
7. **End cover**
8. **Screw (4 used)**
9. **Screw**
10. **Button**
11. **Valve handle**
12. **Disc**
13. **O–ring**
14. **Spindle**
15. **Valve ball**
16. **Lock nut (4 used)**

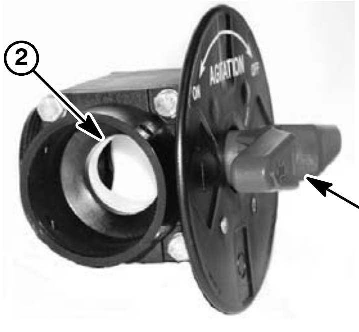

Figure 16

1. **Valve handle arrow**
2. **Valve ball large hole**

Spray System

Agitation Nozzles (Tank mounted)

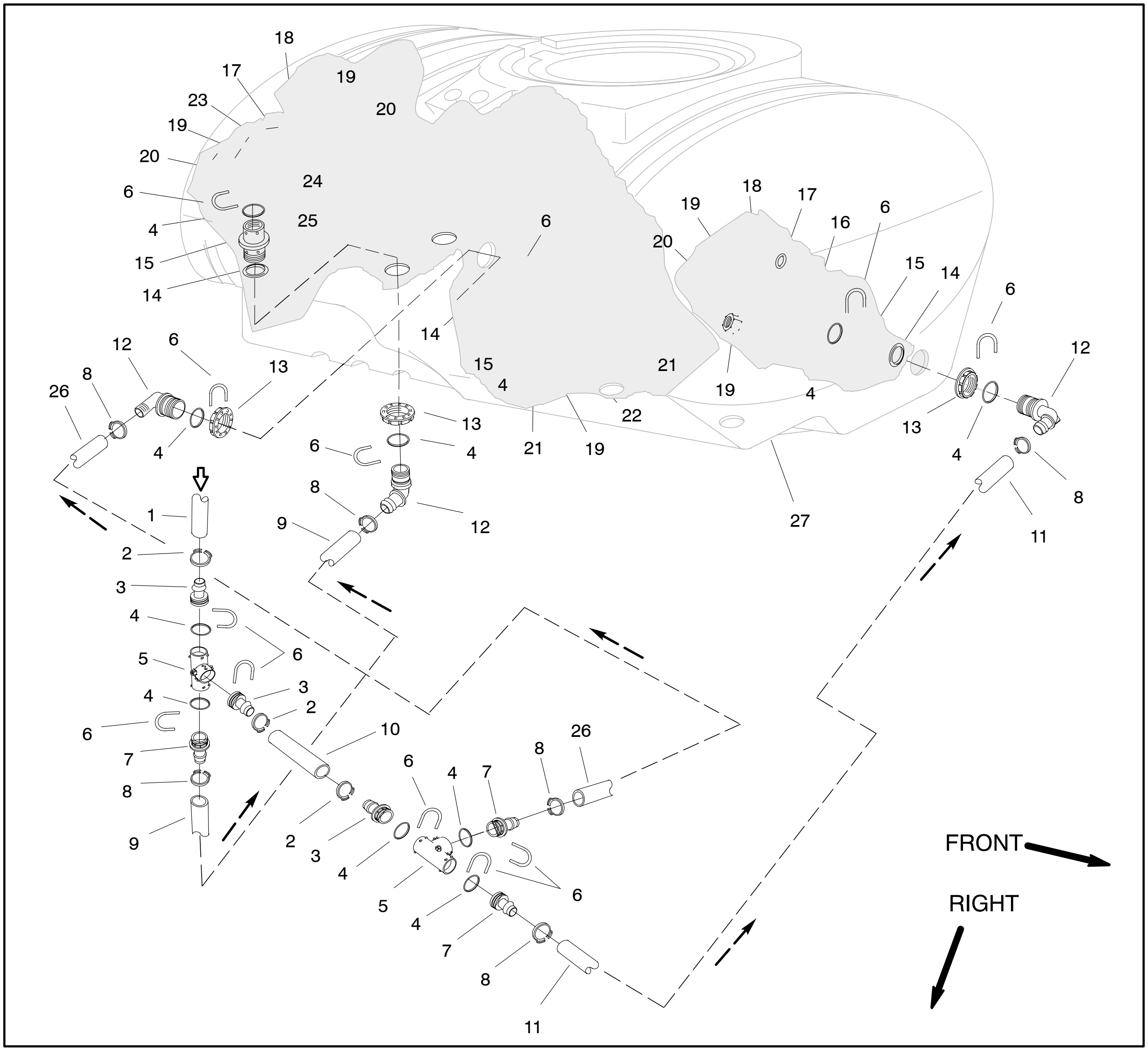

Figure 17

1. Hose: agitation supply (1”)
2. Hose clamp
3. Hosebarb
4. O–ring
5. Tee
6. Fork
7. Hosebarb
8. Hose clamp
9. Hose (3/4”)
10. Hose (1”)
11. Hose (3/4”)
12. Hosebarb
13. Nut
14. Bulkhead gasket
15. Bulkhead
16. Tee
17. O–ring
18. Elbow
19. Nut
20. Nozzle
21. Nozzle
22. Elbow
23. Tee
24. Nipple
25. Adapter
26. Hose (3/4”)
27. Spray tank

Disassembly (Fig. 17)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Drain spray tank (see Operator's Manual).

3. Label disconnected hoses for proper installation after repairs are completed.

4. Remove agitation nozzles as required using Figure 17 as a guide. Discard all removed o–rings and gaskets.

Assembly (Fig. 17)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install agitation nozzles using Figure 17 as a guide. Replace all removed o–rings and gaskets.

2. Check spray system for leaks.

Pressure Relief Valve (Tank Mounted)

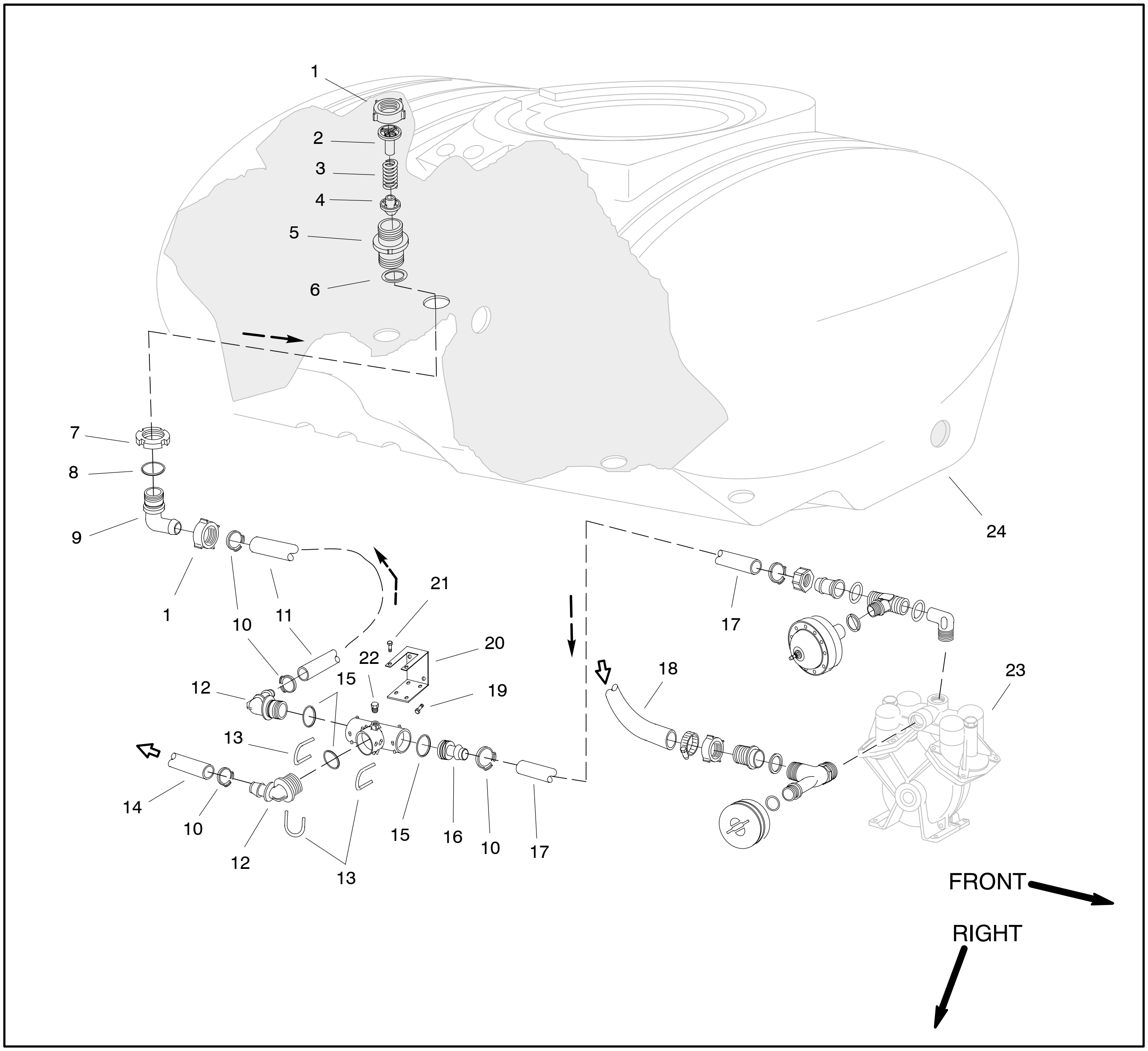

Figure 18

1. **Nut**
2. **Valve seat**
3. **Spring**
4. **Valve cone**
5. **Relief valve housing**
6. **Gasket**
7. **Ringnut**
8. **O–ring**
9. **Hosebarb**
10. **Hose clamp**
11. **Hose: pressure relief valve (1”)**
12. **Hosebarb**
13. **Fork**
14. **Hose: control supply (1”)**
15. **O–ring**
16. **Hosebarb**
17. **Pressure supply hose (1”)**
18. **Suction hose (1 1/2”)**
19. **Cap screw (2 used)**
20. **Tee bracket**
21. **Phillips head screw (4 used)**
22. **Coupler (pressure gauge)**
23. **Spray pump**
24. **Spray tank**

Removal (Fig. 18)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Drain spray tank (see Operator's Manual).

3. Label disconnected hoses for proper installation after repairs are completed.

4. Remove pressure relief valve from spray tank using Figure 18 and 19 as guides. Discard all removed o–rings and gaskets.

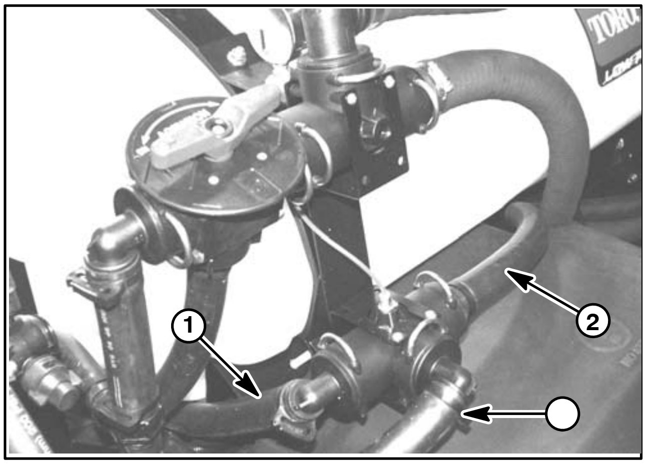

Figure 19

1. **Hose to pressure relief**
2. **Hose from spray pump**
3. **Control supply hose**

Assembly (Fig. 18)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install pressure relief valve using Figure 18 and 19 as guides. Replace all removed o–rings and gaskets.

2. Check spray system for leaks.

Spray System

Spray Control (Multi Pro 1200)

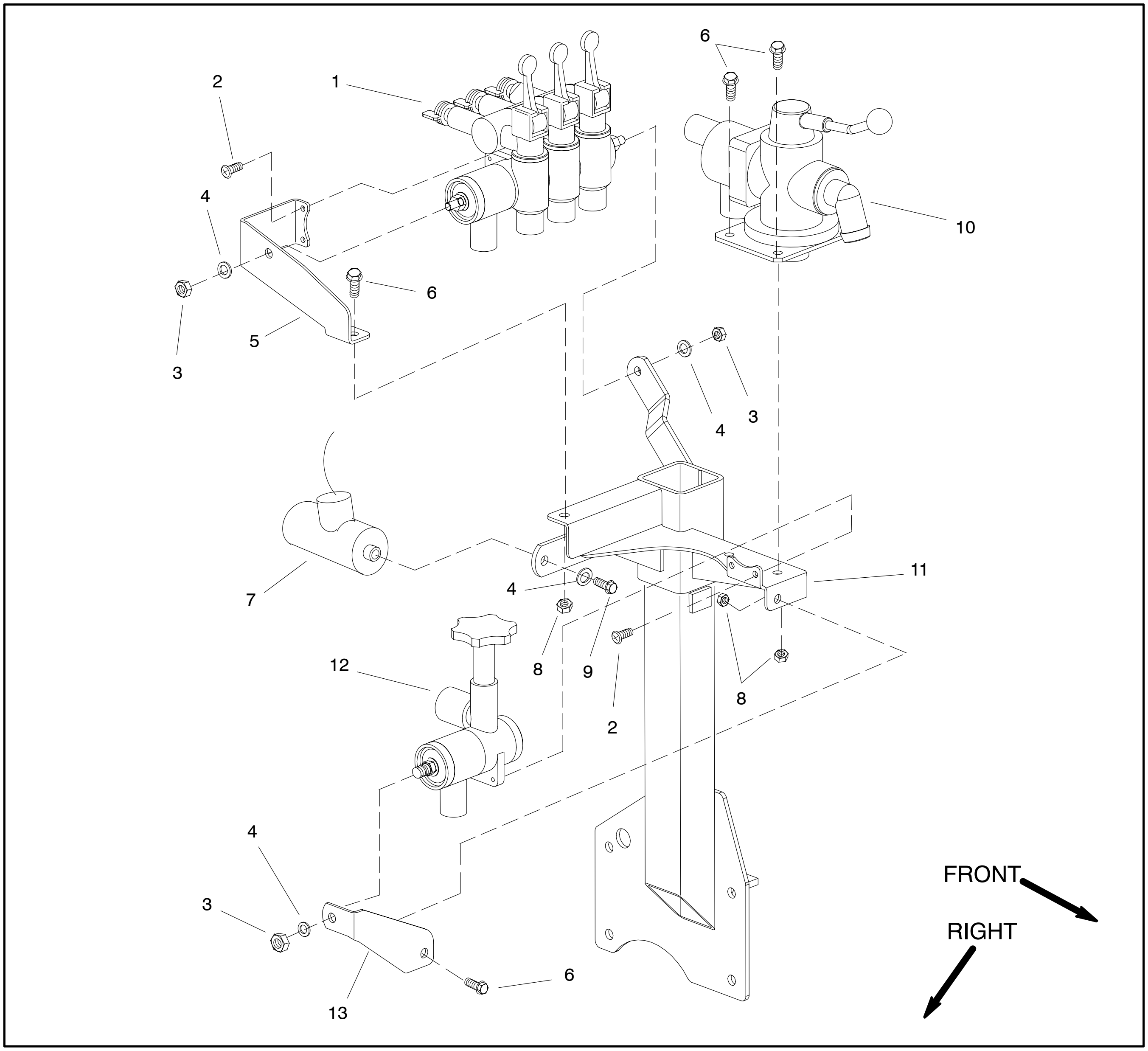

Figure 20

1. **Boom distribution valves**
2. **Screw**
3. **Hex nut**
4. **Washer**
5. **Bracket**
6. **Flange head screw**
7. **Flowmeter**
8. **Hex nut**
9. **Hex bolt**
10. **Master boom valve**
11. **Valve mount**
12. **Pressure control valve**
13. **Pressure control valve bracket**

Removal (Fig. 20)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Remove master boom valve handle, spray console panel, and spray console from machine (Fig. 21).

3. Label hoses for proper installation after repairs are completed.

4. Remove spray control components as required using Figure 20 and 22 as guides.

Assembly (Fig. 20)

1. Install spray control components using Figures 20 and 22 as guides.

2. Operate spray system and check for leaks.

3. Install spray console, spray control panel, and master boom valve handle to machine (Fig. 21).

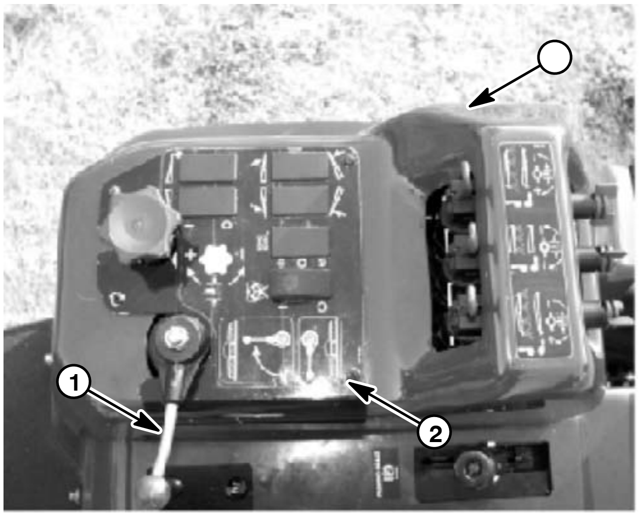

Figure 21

1. **Boom valve handle**
2. **Spray console panel**
3. **Spray console**

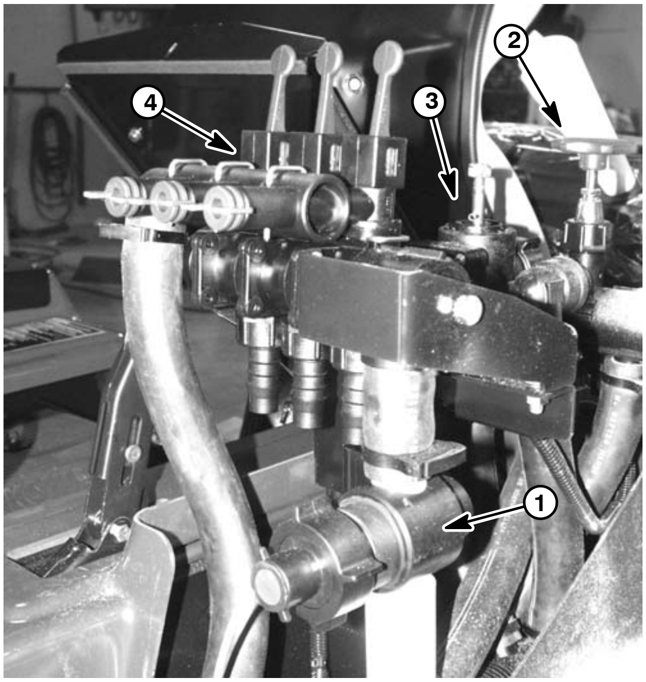

Figure 22

1. **Flowmeter**
2. **Pressure control valve**
3. **Master boom valve**
4. **Boom distribution valves**

Spray System

Flowmeter (Multi Pro 1200)

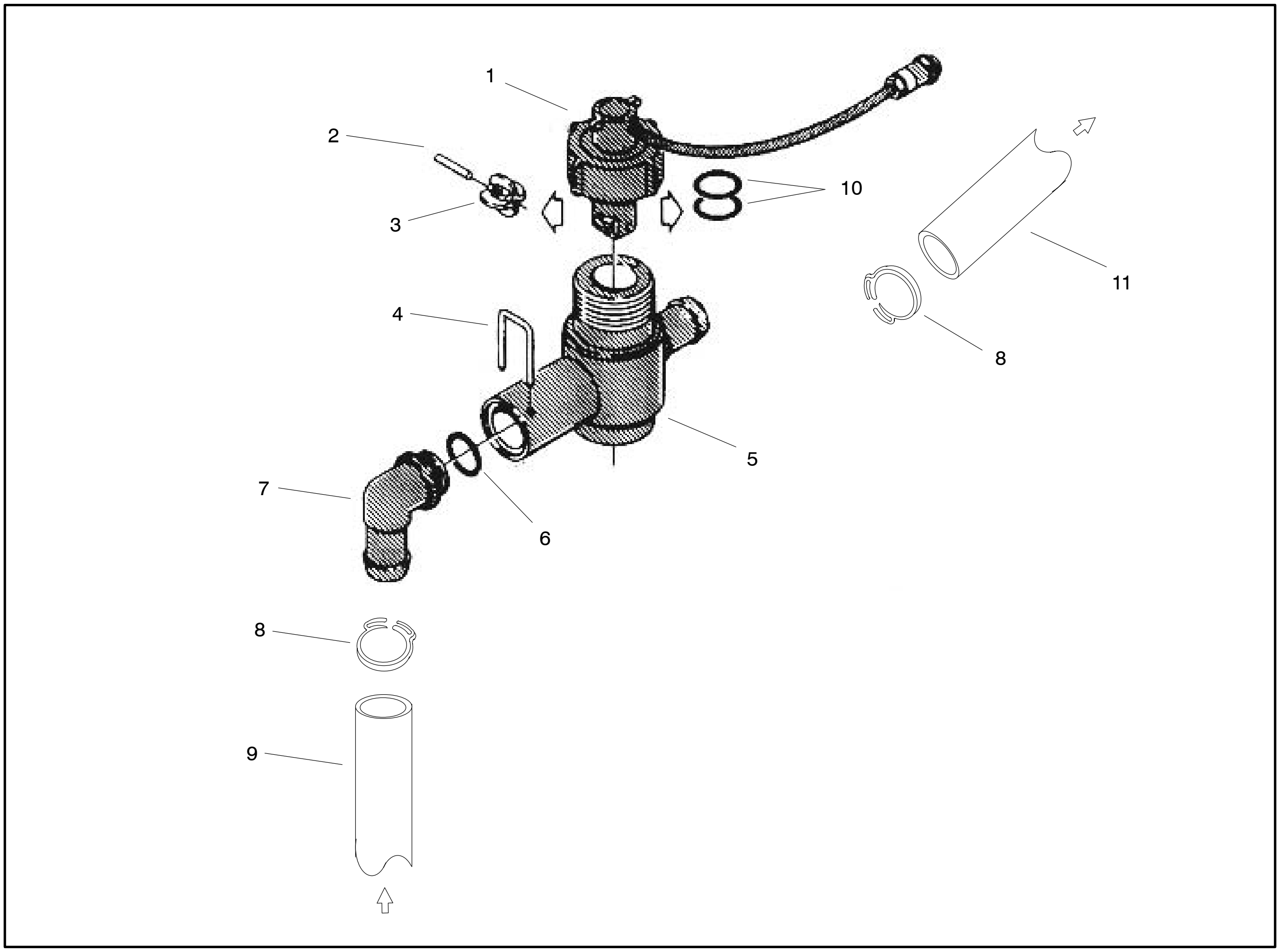

Figure 23

1. **Flow sensor with nut**
2. **Flowmeter rotor shaft**
3. **Flowmeter rotor**
4. **Fork**
5. **Flowmeter housing**
6. **O–ring**
7. **Hosebarb**
8. **Hose clamp**
9. **Hose: from master boom valve (1”)**
10. **O–ring**
11. **Hose: to distribution valves (1”)**

Removal and Inspection (Fig. 23)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Remove master boom valve handle, spray control panel, and spray console from machine (Fig. 24).

3. Loosen and remove nut that secures flow sensor to housing (Fig. 25). Carefully remove flow sensor from flowmeter housing.

4. Clean rotor, rotor shaft, and flowmeter sensor if required (see Operator's Manual).

5. With the flow sensor harness connected to the machine and the ignition key in the ON position, slowly spin the flowmeter rotor. The LED on the flowmeter should illuminate as a rotor magnet passes the flow sensor and should go out as the next rotor magnet passes the sensor.

NOTE: When using a magnet to check the flowmeter, make sure to alternately use both north and south poles of the magnet.

6. If the flowmeter LED does not flash, remove rotor and rotor shaft from sensor. With the flowmeter harness connected to the machine and the ignition key in the ON position, slowly pass alternate poles of a magnet past the flow sensor. If the flowmeter LED flashes as the magnet poles pass the sensor, replace the rotor and rotor shaft. If the flowmeter LED does not flash as the magnet poles pass the sensor, replace the flow sensor.

7. If necessary, remove flowmeter housing using Figures 23 and 25 as guides (also see Spray Control (Multi Pro 1200) in this section). Discard all removed o–rings and gaskets.

Assembly (Fig. 23)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

NOTE: When installing flow sensor into housing, make sure to align locating pin on sensor with hole in housing.

1. Reassemble flowmeter using Figures 23 and 25 as guides. Replace all removed o–rings and gaskets.

2. Operate spray system and check for leaks.

3. Install spray console, spray control panel, and master boom valve handle to machine (Fig. 24).

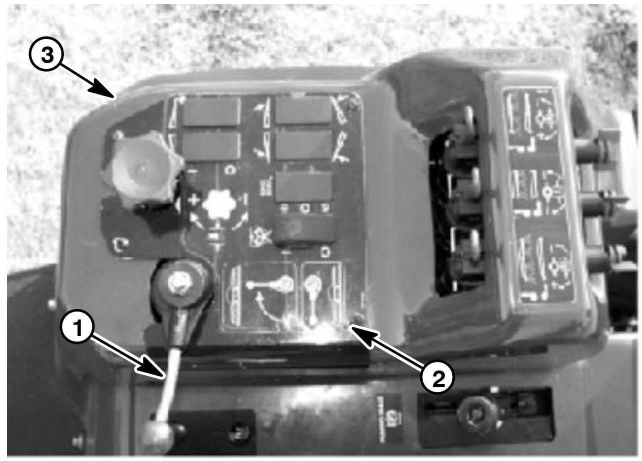

Figure 24

1. **Boom valve handle**
2. **Spray console panel**
3. **Spray console**

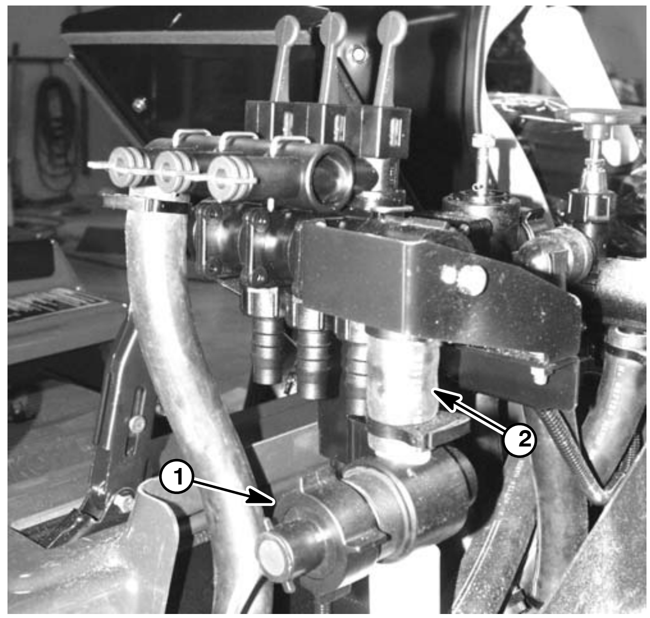

Figure 25

1. **Flowmeter**
2. **Hose to boom valves**

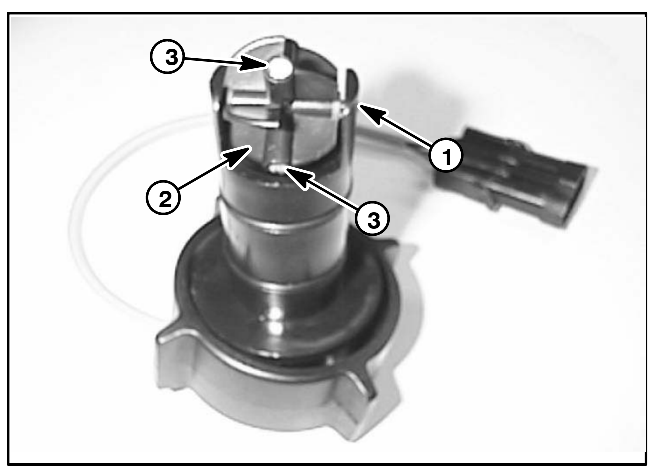

Figure 26

1. **Rotor shaft**
2. **Rotor**
3. **Rotor magnet**

Master Boom Valve (Multi Pro 1200)

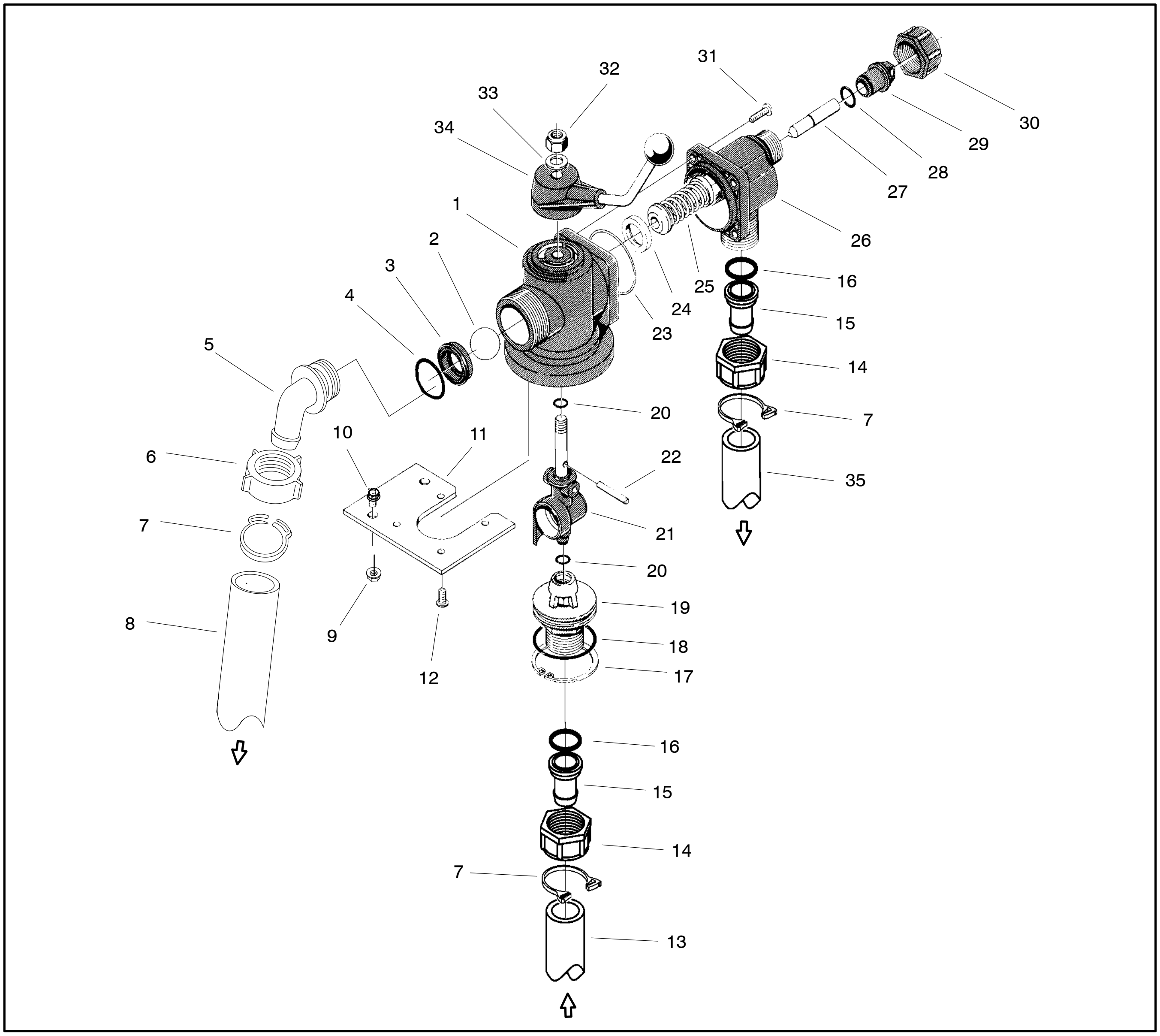

Figure 27

1. Housing
2. Ball
3. Seat
4. O–ring
5. Hosebarb
6. Nut
7. Hose clamp
8. Hose: to flowmeter (1")
9. Nut (2 used)
10. Flange head screw (2 used)
11. Plate
12. Screw (4 used)
13. Hose: pressure supply (1")
14. Nut
15. Hose barb
16. Seal
17. Retaining ring
18. O–ring
19. Adapter
20. O–ring
21. Stem
22. Roll pin
23. O–ring
24. Seat
25. Valve assembly
26. Pressure valve housing
27. Pin
28. O–ring
29. Fitting
30. Nut
31. Screw (4 used)
32. Hex nut
33. Washer
34. Handle
35. Hose: control bypass (1")

Disassembly (Fig. 27)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

1. Remove master boom valve from machine (see Spray Control (Multi Pro 1200) in this section).

2. Disassemble master boom valve using Figure 27 as a guide. Discard all removed o–rings.

Assembly (Fig. 27)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Reassemble master boom valve using Figure 27 as a guide. Replace all removed o–rings.

2. Install master boom valve to machine (see Spray Control (Multi Pro 1200) in this section).

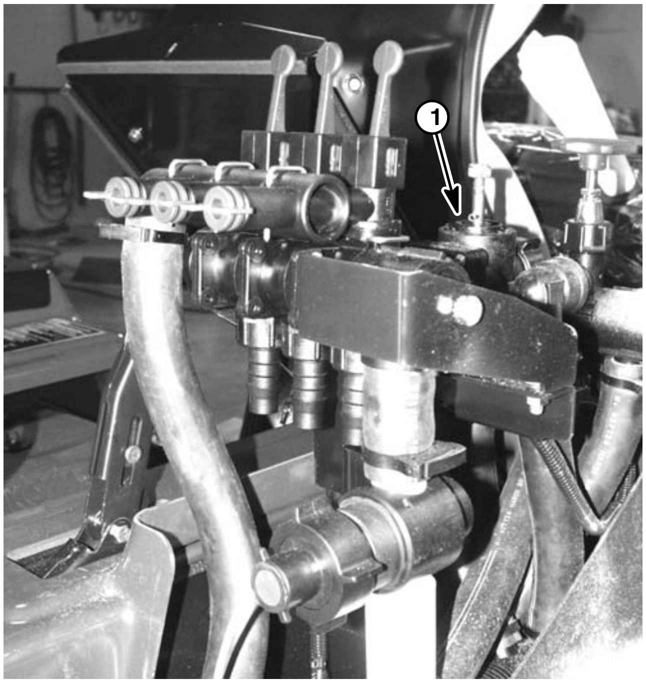

Figure 28

1. **Master boom valve (shown without handle)**

Spray System

Pressure Control Valve (Multi Pro 1200)

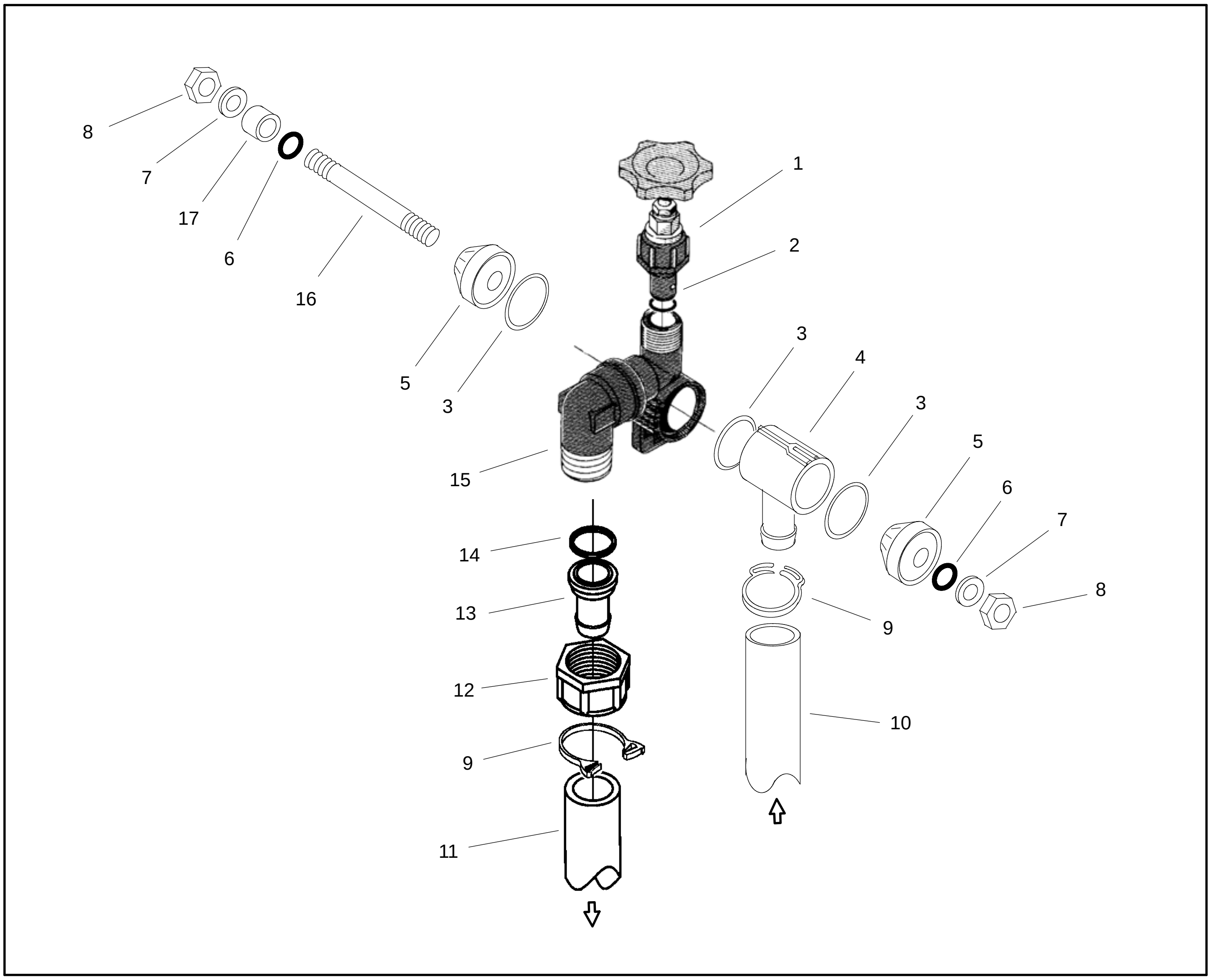

Figure 29

1. **Pressure control valve**
2. **O–ring**
3. **O–ring**
4. **Tee piece**
5. **Cap**
6. **O–ring**
7. **Washer**
8. **Hex nut**
9. **Hose clamp**
10. **Hose: pressure supply (1”)**
11. **Hose: control bypass (1”)**
12. **Nut**
13. **Hosebarb**
14. **Seal**
15. **Pressure control housing**
16. **Threaded rod**
17. **Bushing**

Disassembly (Fig. 29)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

1. Remove pressure control valve from machine (see Spray Control (Multi Pro 1200) in this section).

2. Disassemble pressure control valve using Figure 29 as a guide. Discard all removed o–rings.

Assembly (Fig. 29)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Reassemble pressure control valve using Figure 29 as a guide. Replace all removed o–rings.

2. Install pressure control valve to machine (see Spray Control (Multi Pro 1200) in this section).

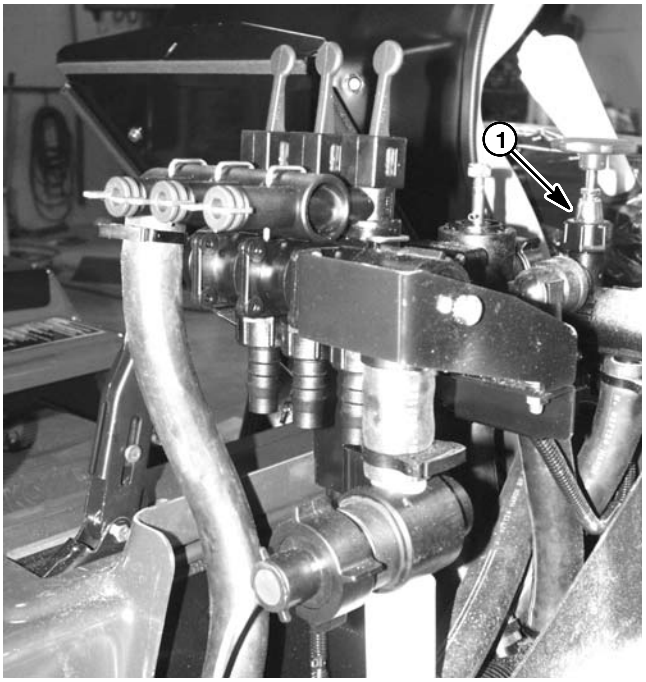

Figure 30

1. **Pressure control valve**

Spray System

Boom Distribution Valves (Multi Pro 1200)

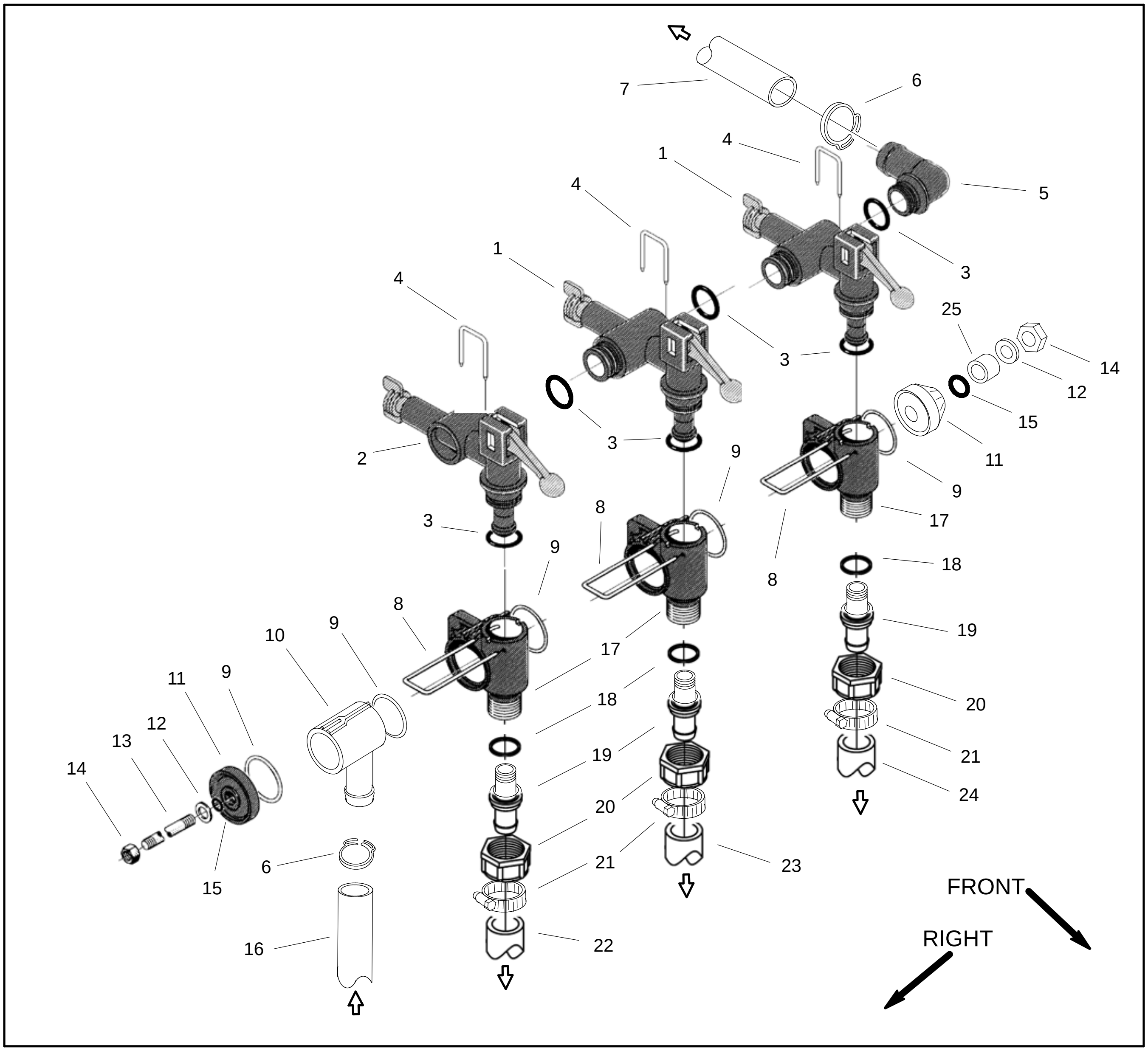

Figure 31

1. Distribution valve (center/LH boom)
2. Distribution valve (RH boom)
3. O-ring
4. Fork
5. Elbow
6. Hose clamp
7. Hose: boom bypass (1")
8. Fork
9. O-ring
10. Tee fitting
11. Cover
12. Washer
13. Threaded rod
14. Hex nut
15. O-ring
16. Hose: from flowmeter (1")
17. Housing
18. Seal
19. Hosebarb
20. Nut
21. Hose clamp
22. Hose: RH boom (3/4")
23. Hose: Center boom (3/4")
24. Hose: LH boom (3/4")
25. Bushing

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

Disassembly (Fig. 31)

1. Remove boom distribution valve assembly (see Spray Control (Multi Pro 1200) in this section).

2. Separate boom distribution valves:

   A. Remove forks (item 4) that secure distribution valves together.

   B. Remove hex nut from one end of threaded rod.

   C. Pull threaded rod from assembly and separate components.

3. Remove fork (item 8) to separate individual distribution valves from housings.

4. Remove and discard o–rings and seals.

Distribution Valve Service (Fig. 33 and 34)

1. Remove cap screw and washer to allow seat assemblies to be removed from shaft. Each seat assembly includes two (2) o–rings.

2. The seat assemblies allow the spindle to shut off flow to the spray boom. If boom nozzles leak when the boom is shut off, the seat and seat o–rings should be inspected carefully. The seats should be free of nicks or worn spots.

3. Press pin from handle to remove handle from shaft.

4. Take note of washer, spring, retaining ring (not pictured), and o–ring locations as shaft is removed from housing.

5. Assemble valve in reverse order of disassembly. Torque cap screw to 70 in–lb (8 N–m).

Assembly (Fig. 31)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Replace o–rings and seals that were removed during disassembly.

2. Secure distribution valves to housings with fork (item 8).

3. Position distribution valves, tee fitting, o–rings, and covers together. Slide threaded rod with o–rings, bushing, and washers through distribution valves and secure with hex nuts.

4. Install forks (item 4) to secure distribution valves together.

5. Install boom distribution valve assembly to machine (see Spray Control (Multi Pro 1200) in this section).

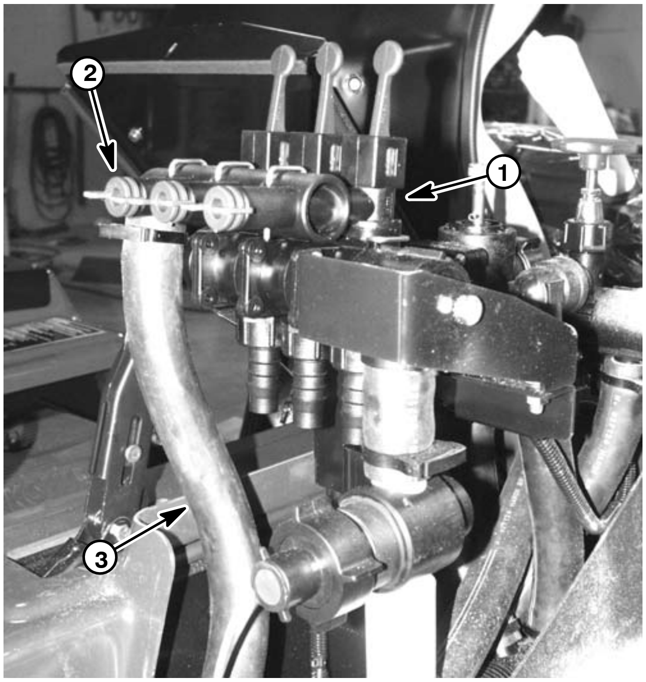

Figure 32

1. **Boom distribution valves**
2. **Boom bypass valve**
3. **Boom bypass hose**

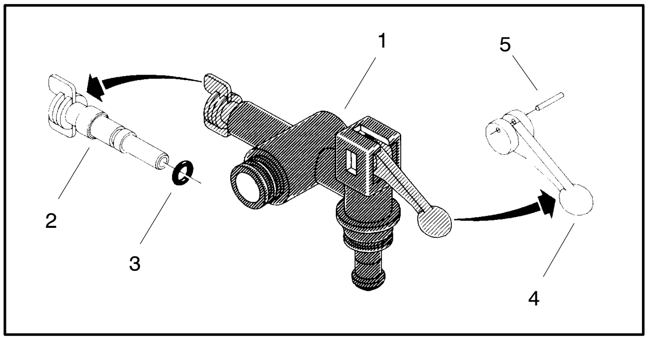

Figure 33

1. **Distribution valve**
2. **Bypass valve**
3. **O–ring**
4. **Handle**
5. **Pin**

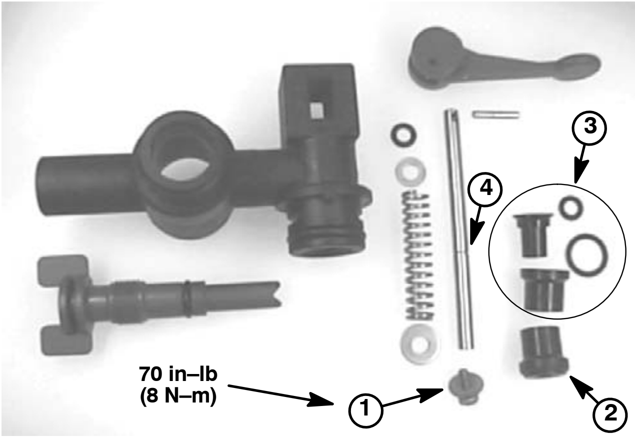

Figure 34

1. **Cap screw and washer**
2. **Seat assembly (2 used)**
3. **Seat components**
4. **Retaining ring location**

Spray System

Spray Control (Multi Pro 1250)

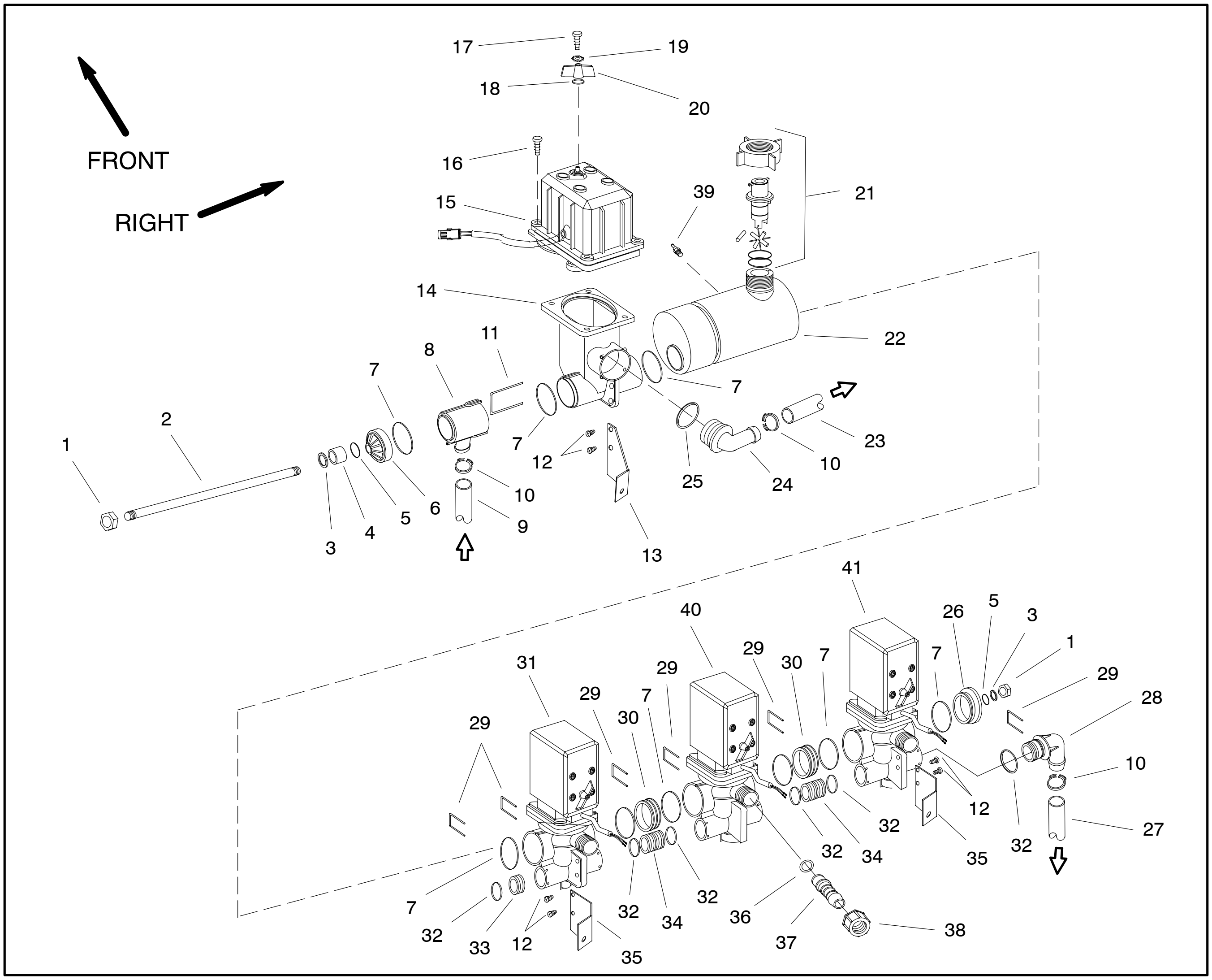

Figure 35

1. **Nut**
2. **Threaded rod**
3. **Washer**
4. **Bushing**
5. **O–ring**
6. **Cap**
7. **O–ring**
8. **Tee piece**
9. **Hose: control supply (1”)**
10. **Hose clamp**
11. **Fork**
12. **Screw**
13. **Control valve bracket**
14. **Rate control valve housing**
15. **Rate control motor**
16. **Screw (4 used)**
17. **Screw**
18. **O–ring**
19. **Lock washer**
20. **Handgrip**
21. **Flowmeter assembly**
22. **Flowmeter housing**
23. **Hose: control bypass (1”)**
24. **Hosebarb**
25. **O–ring**
26. **End cap**
27. **Hose: boom bypass (1”)**
28. **Hosebarb**
29. **Fork**
30. **Joiner**
31. **LH boom valve motor/manifold**
32. **O–ring**
33. **End cap**
34. **Joiner**
35. **Boom valve bracket**
36. **O–ring (3 used)**
37. **Hosebarb: boom supply (3 used)**
38. **Nut (3 used)**
39. **Coupler (pressure gauge)**
40. **Center boom valve motor/manifold**
41. **RH boom valve motor/manifold**

IMPORTANT: Rate control and boom valve motors may have a fuse for circuit protection. Make sure that correct fuse is installed in the in–line fuse holder located in the motor harness.

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

Removal

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

2. Label hoses for proper installation after repairs are completed. Loosen hose clamps and disconnect hoses from spray control.

3. Unplug electrical connectors from rate control motor, flowmeter, and three (3) boom valve motors from machine electrical harness.

4. Remove pressure gauge tube from coupler on back of flowmeter housing (Fig. 37).

5. Remove three (3) flange head screws that secure spray control assembly to valve mounting bar. Remove spray control assembly from machine.

6. Remove spray control components as required using Figure 35 as a guide. Discard all removed o–rings and gaskets.

Assembly

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install spray control components using Figure 35 as a guide. Replace all removed o–rings and gaskets.

2. Position spray control assembly to valve mounting bar and secure with three (3) flange head screws.

3. Install hoses to correct locations on spray control assembly. Secure hoses with hose clamps.

4. Install pressure gauge tube to coupler on back of flowmeter housing (Fig. 37).

5. Plug electrical connectors from rate control motor, flowmeter, and three (3) boom valve motors to machine electrical harness.

6. Operate spray system and check for leaks.

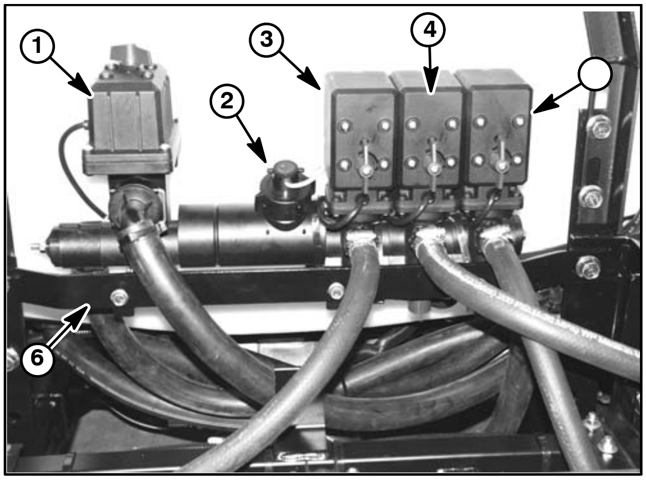

Figure 36

1. **Rate control motor**
2. **Flowmeter**
3. **LH boom valve motor**
4. **Center boom valve motor**
5. **RH boom valve motor**
6. **Valve mounting bar**

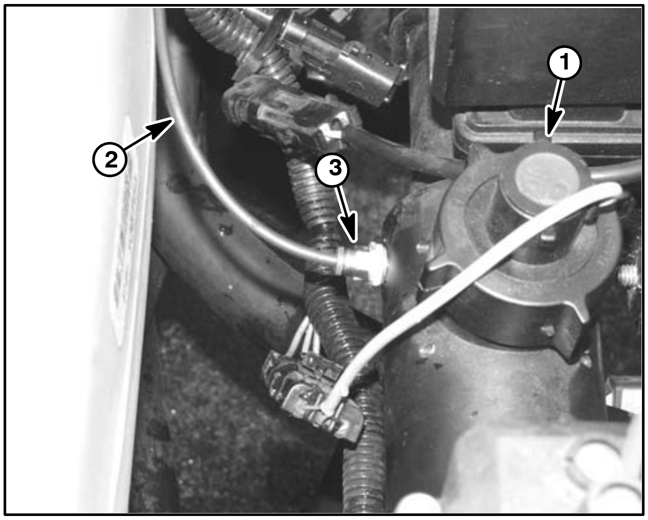

Figure 37

1. **Flowmeter**
2. **Pressure gauge tube**
3. **Coupler**

Spray System

Flowmeter (Multi Pro 1250)

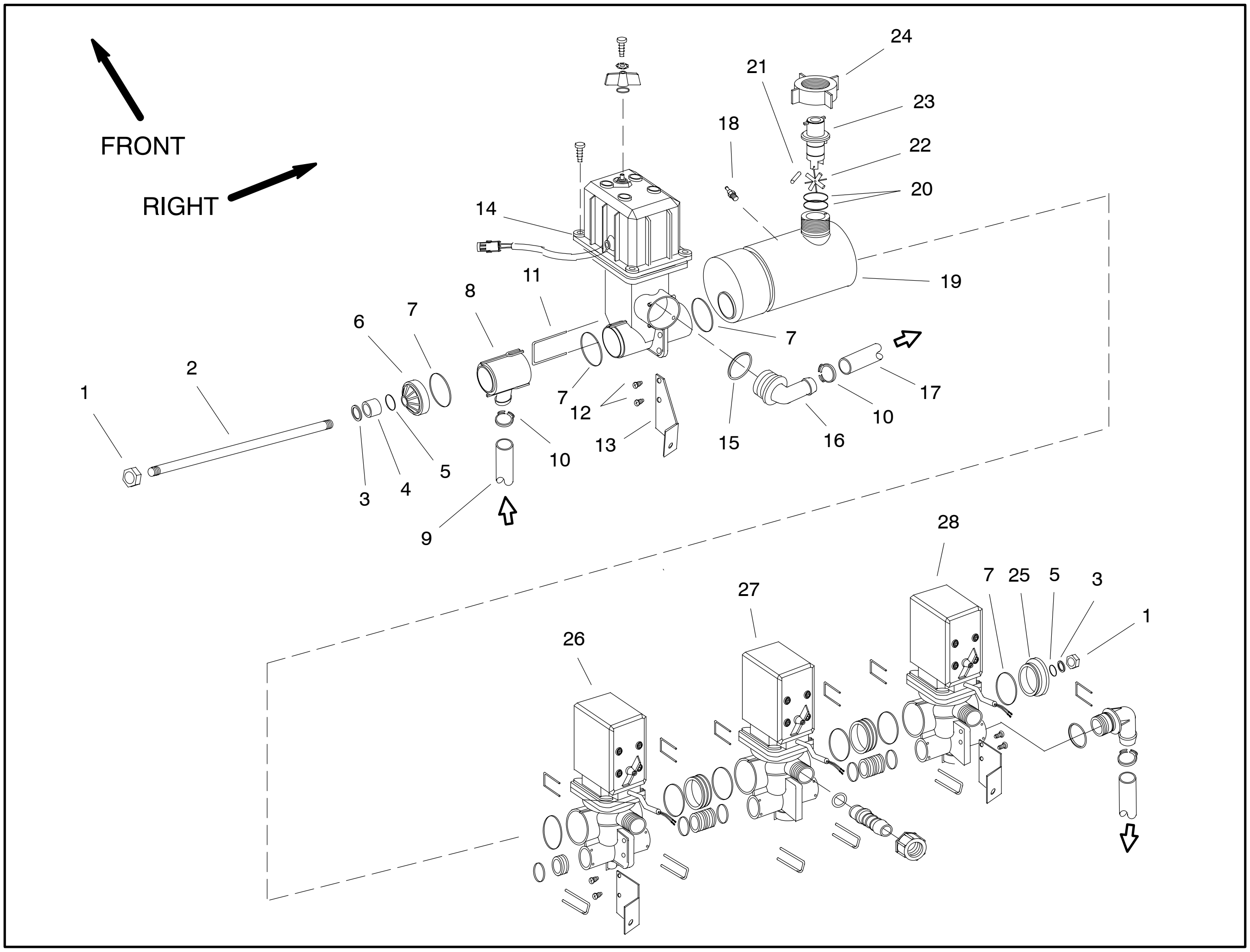

Figure 38

1. **Nut**
2. **Threaded rod**
3. **Washer**
4. **Bushing**
5. **O–ring**
6. **Cover**
7. **O–ring**
8. **Tee piece**
9. **Hose: control supply (1")**
10. **Hose clamp**
11. **Fork**
12. **Screw**
13. **Control valve bracket**
14. **Rate control motor/housing**
15. **O–ring**
16. **Hosebarb**
17. **Hose: control bypass (1")**
18. **Coupler (pressure gauge)**
19. **Flowmeter housing**
20. **O–ring**
21. **Flowmeter rotor shaft**
22. **Flowmeter rotor**
23. **Flow sensor**
24. **Nut**
25. **End cap**
26. **LH boom control motor**
27. **Center boom control motor**
28. **RH boom control motor**

Removal and Inspection (Fig. 38)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Loosen and remove nut that secures flow sensor to flowmeter housing. Carefully remove flow sensor from housing.

3. Clean rotor, rotor shaft, and flowmeter sensor if required (see Operator's Manual).

4. With the flow sensor harness connected to the machine and the ignition key in the ON position, slowly spin the flowmeter rotor. The flowmeter LED should illuminate as a rotor magnet passes the flow sensor and should go out as the next magnet passes the sensor.

NOTE: When using a magnet to check the flowmeter, make sure to alternately use both north and south poles of the magnet.

5. If the flowmeter LED does not flash, remove rotor and rotor shaft from sensor. With the flowmeter harness connected to the machine and the ignition key in the ON position, slowly pass alternate poles of a magnet past the flow sensor. If the flowmeter LED flashes as the magnet poles pass the sensor, replace the rotor and rotor shaft. If the flowmeter LED does not flash as the magnet poles pass the sensor, replace the flow sensor.

6. If necessary, remove flowmeter housing using Figures 38 and 40 as guides (also see Spray Control (Multi Pro 1250) in this section). Discard all removed o–rings and gaskets.

Assembly (Fig. 38)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

NOTE: When installing flow sensor into housing, make sure to align locating pin on sensor flange with hole in housing.

1. Reassemble flowmeter using Figures 38 and 40 as guides. Replace all removed o–rings and gaskets.

2. Operate spray system and check for leaks.

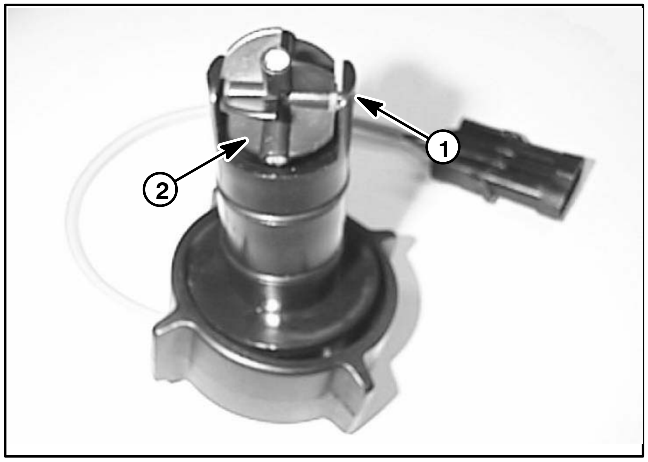

Figure 39

1. **Rotor shaft**
2. **Rotor**

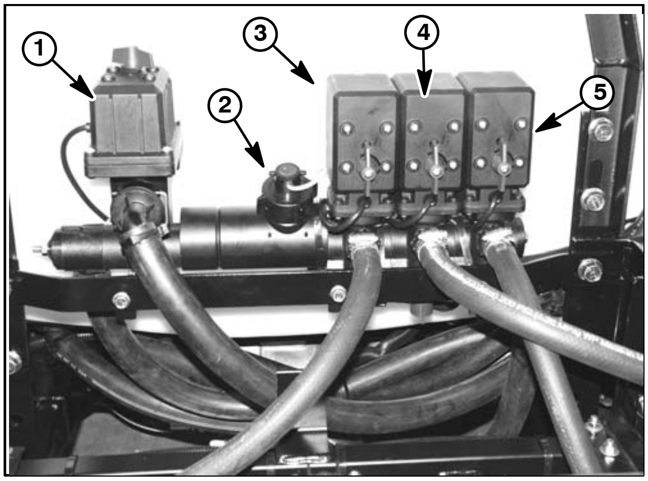

Figure 40

1. **Rate control motor**
2. **Flowmeter**
3. **LH boom valve motor**
4. **Center boom valve motor**
5. **RH boom valve motor**

Spray System

Rate Control Motor (Multi Pro 1250)

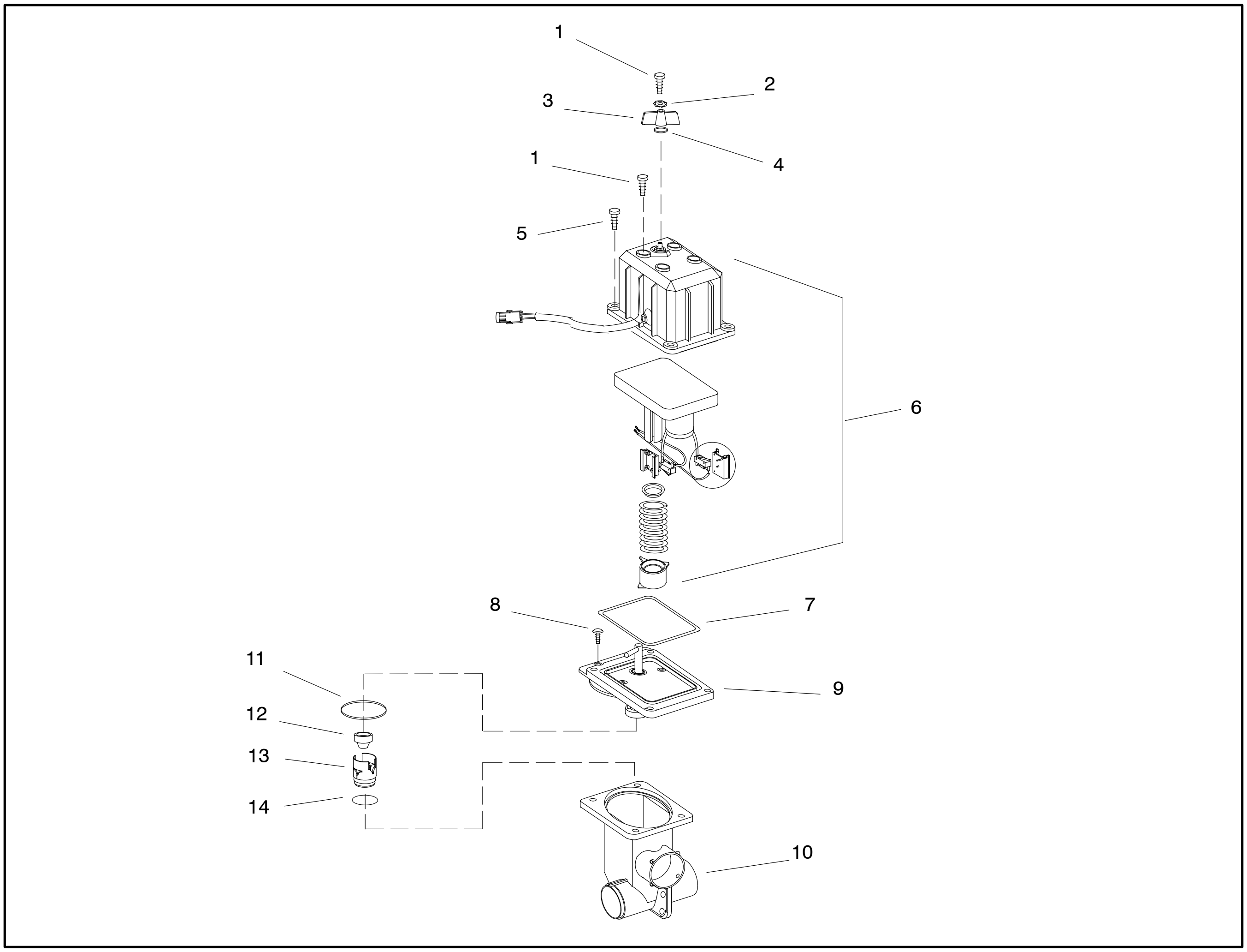

Figure 41

1. **Phillips head screw (5 used)**
2. **Lock washer**
3. **Hand grip**
4. **O–ring**
5. **Phillips head screw (4 used)**
6. **Rate control motor assembly**
7. **Gasket**
8. **Phillips head screw (4 used)**
9. **Rate valve spindle section**
10. **Rate control valve housing**
11. **O–ring**
12. **Cone**
13. **Control valve**
14. **Seal**

The rate control motor allows the operator to vary the spray application rate. The pressure increase/decrease switch on the spray console energizes the rate control motor which adjusts the valve opening and allows some flow to bypass the spray booms.

NOTE: The rate control motor affects flow to all spray booms. Therefore, a problem with the rate control motor will affect all booms and nozzles.

Disassembly and Inspection (Fig. 41)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

1. To remove the rate control motor:

   A. Unplug rate control motor electrical connector from machine electrical harness.

   B. Adjust the rate control to maximum to allow the motor spring to relax. This can be done with either the increase/decrease switch on the spray console or by using the hand grip on the motor.

   C. Loosen four (4) phillips head screws (item 5) evenly to allow removal of the rate control motor.

   D. The inside of motor housing should be free of excessive moisture, corrosion, and dirt.

2. Remove four (4) phillips head screws (item 8) that secure spindle section to housing. Remove spindle section.

3. Locate, remove, and discard o–ring (item 11) and seal (item 14).

4. Remove valve (item 13) and inspect for wear and/or damage. Replace if needed.

5. If needed, the spindle shaft can be removed by removing lock nut that secures cone (item 12) to shaft.

NOTE: Many individual components for the rate control motor and spindle section are not available separately. If individual components are worn or damaged, assemblies must be replaced. Refer to Parts Catalog.

6. If necessary, remove rate control valve housing from machine (see Spray Control (Multi Pro 1250) in this section).

Assembly (Fig. 41)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. If removed, install rate control valve housing to machine (see Spray Control (Multi Pro 1250) in this section).

2. If spindle shaft was removed, assemble by reversing disassembly process. Make sure that spindle shaft support aligns with notches in housing during assembly. Secure spindle assembly with lock nut.

3. Align control valve with tabs in spindle section and install control valve. Rotate spindle to fully retract control valve.

4. Install new o–ring (item 11) and seal (item 14) to spindle section.

5. Position spindle section to rate control valve housing. Secure spindle section with four (4) phillips head screws (item 8).

6. To ease assembly of the motor, rotate spindle shaft so the post is about 1/2” (13 mm) from the spindle section housing. Align slot in motor with post in spindle and install motor.

7. Secure motor to assembly by evenly tightening four (4) phillips head screws (item 5).

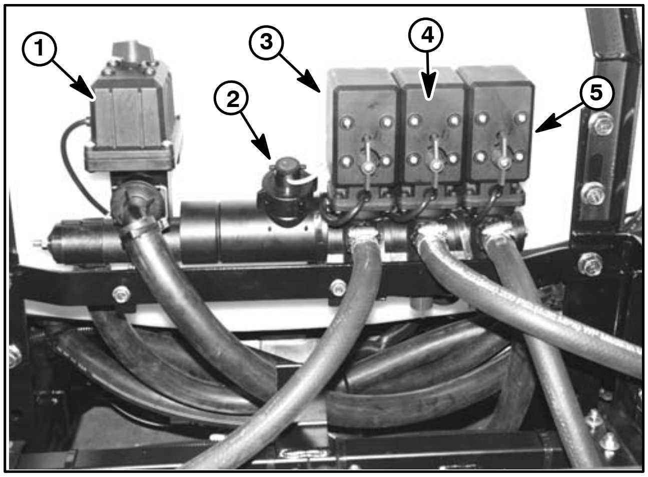

Figure 42

1. **Rate control motor**
2. **Flowmeter**
3. **LH boom valve motor**
4. **Center boom valve motor**
5. **RH boom valve motor**

Boom Valve Motor (Multi Pro 1250)

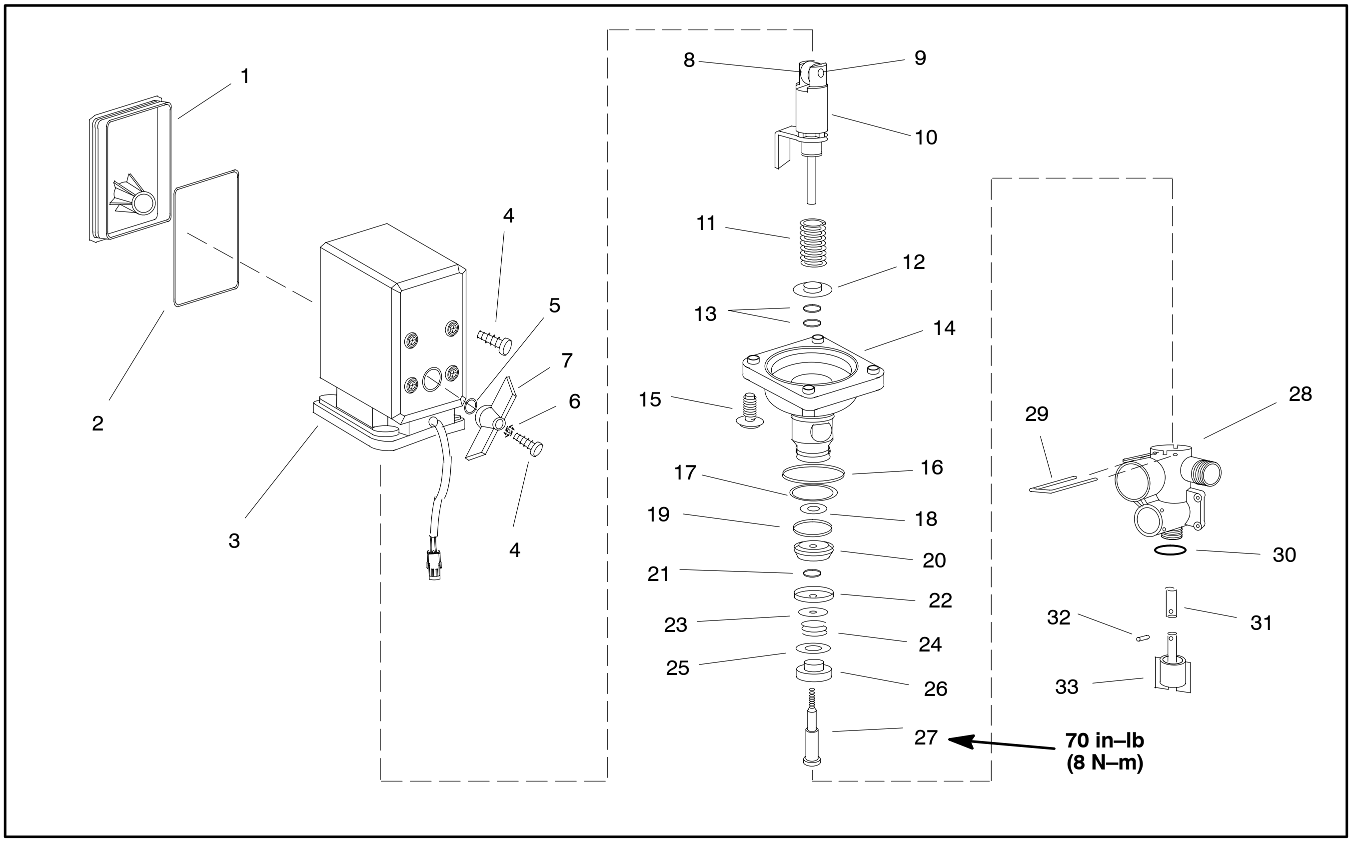

Figure 43

1. Housing cover	**12. Spring seat**	**23. Flat washer**
2. Cover seal	**13. O–ring**	**24. Spring**
3. Boom valve motor	**14. Spindle housing**	**25. Flat washer**
4. Phillips head screw (5 used)	**15. Phillips head screw (4 used)**	**26. Cone**
5. O–ring	**16. O–ring**	**27. Screw**
6. Lock washer	**17. O–ring**	**28. Boom valve manifold housing**
7. Hand grip	**18. Flat washer**	**29. Fork**
8. Roller	**19. Seat outer o–ring**	**30. O–ring**
9. Roller pin	**20. Seat**	**31. Balancing valve**
10. Spindle	**21. Seat inner o–ring**	**32. Roll pin**
11. Spring	**22. Seat base**	**33. Balancing valve knob**

The Multi Pro 1250 uses three boom valve motor assemblies to control the spray booms. Each boom valve motor assembly includes a motor section, a spindle section, and a manifold assembly.

Disassembly and Inspection (Fig. 43)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

1. Remove spray control from machine. Separate spray control components to allow boom valve motor disassembly (see Spray Control (Multi Pro 1250) in this section).

2. To remove the motor and spindle section assembly from the manifold assembly:

   A. Remove the fork (item 29) that secures the motor and spindle sections to the manifold assembly.

   B. Lift the motor and spindle section assembly from the manifold.

3. To allow easier separation of the motor and spindle sections, make sure that boom valve motor is in the closed position (green indicator is recessed into the spindle housing). Remove four phillips head screws (item 15) and separate spindle section from motor section.

4. Remove rear housing cover from boom valve motor to inspect motor components.

A. Cam should be tight on shaft. Cam surface should be free of wear and/or scoring.

B. The inside of motor housing should be free of excessive moisture, corrosion, and dirt.

C. The cam bearing surface in the housing cover should be inspected for excessive wear.

5. Inspect and disassemble spindle section (Fig. 45).

A. Inspect spindle roller surface for wear or scoring. Check that spindle roller rotates freely on roller pin. Replace roller and/or pin as required.

B. The spindle can be disassembled by removing the screw at the bottom of the spindle shaft. Take note of washer, spring, seat, and o–ring locations as spindle is removed.

C. Inspect the cone located at the bottom of the spindle. The cone should be free of nicks or worn spots. A damaged cone will allow flow to the boom bypass rather than to the spray boom.

D. The seat o–rings allow the spindle to shut off flow to the spray boom. If boom nozzles leak when the boom is shut off, the seat and seat o–rings should be inspected carefully.

6. If leakage occurs from balancing valve knob at bottom of boom valve manifold (Fig. 46):

A. Carefully remove roll pin that secures balancing valve to knob.

B. Remove knob from manifold. Remove and discard o–ring.

Assembly (Fig. 43)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Replace all removed o–rings.

2. If boom valve manifold was disassembled (Fig. 46):

A. Install o–ring, balancing valve, and knob to manifold.

B. Secure balancing valve to knob by carefully installing roll pin.

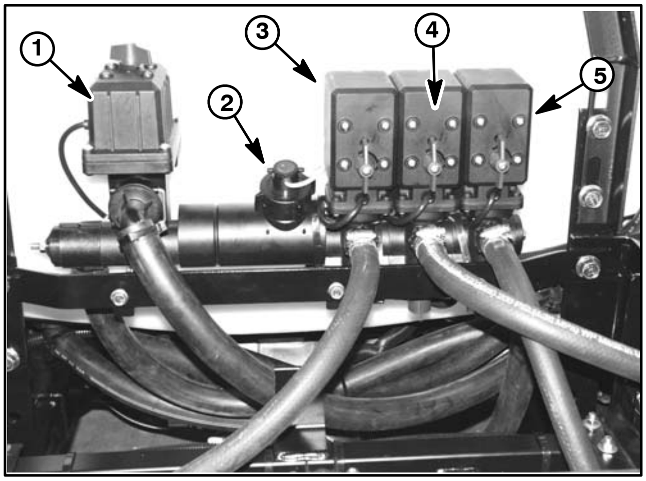

Figure 44

1. **Rate control motor**
2. **Flowmeter**
3. **LH boom valve motor**
4. **Center boom valve motor**
5. **RH boom valve motor**

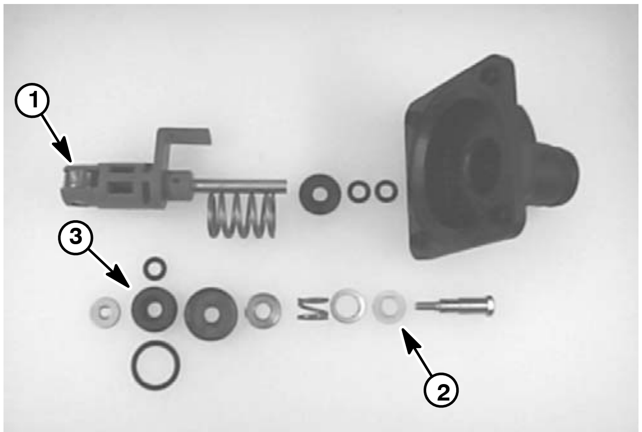

Figure 45

1. **Spindle roller**
2. **Cone**
3. **Seat**

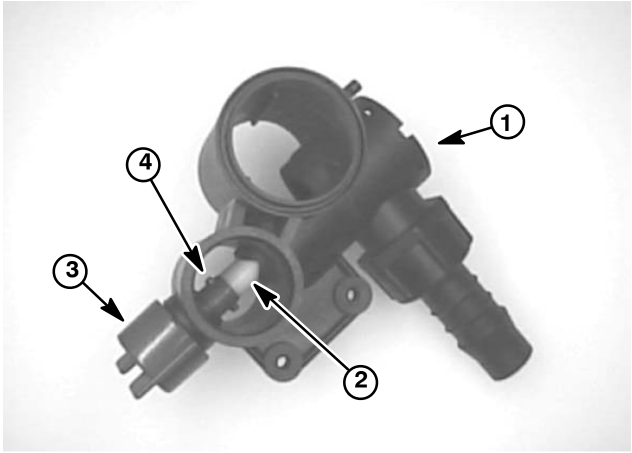

Figure 46

1. **Boom valve manifold**
2. **Balancing valve**
3. **Balancing valve knob**
4. **Roll pin**

Spray System

3. Assemble spindle section by reversing disassembly process. Align green indicator tab on spindle to slot in spindle housing. Install screw into bottom of spindle to secure assembly. Torque screw 70 in–lb (8 N–m).

4. Position spindle section on motor section so that green indicator on spindle section is opposite the motor hand grip. Secure spindle section to motor section with four phillips head screws (item 15).

5. Replace rear housing to boom valve motor.

6. Position the motor and spindle section assembly to the manifold assembly. The motor hand grip and boom supply hosebarb on manifold should be on the same side of the assembly. Install the fork (item 29) to secure the motor and spindle sections to the manifold.

7. Assemble spray control assembly. Install spray control to machine (see Spray Control (Multi Pro 1250) in this section).

8. Operate spray system and check for leaks.

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Boom Bypass

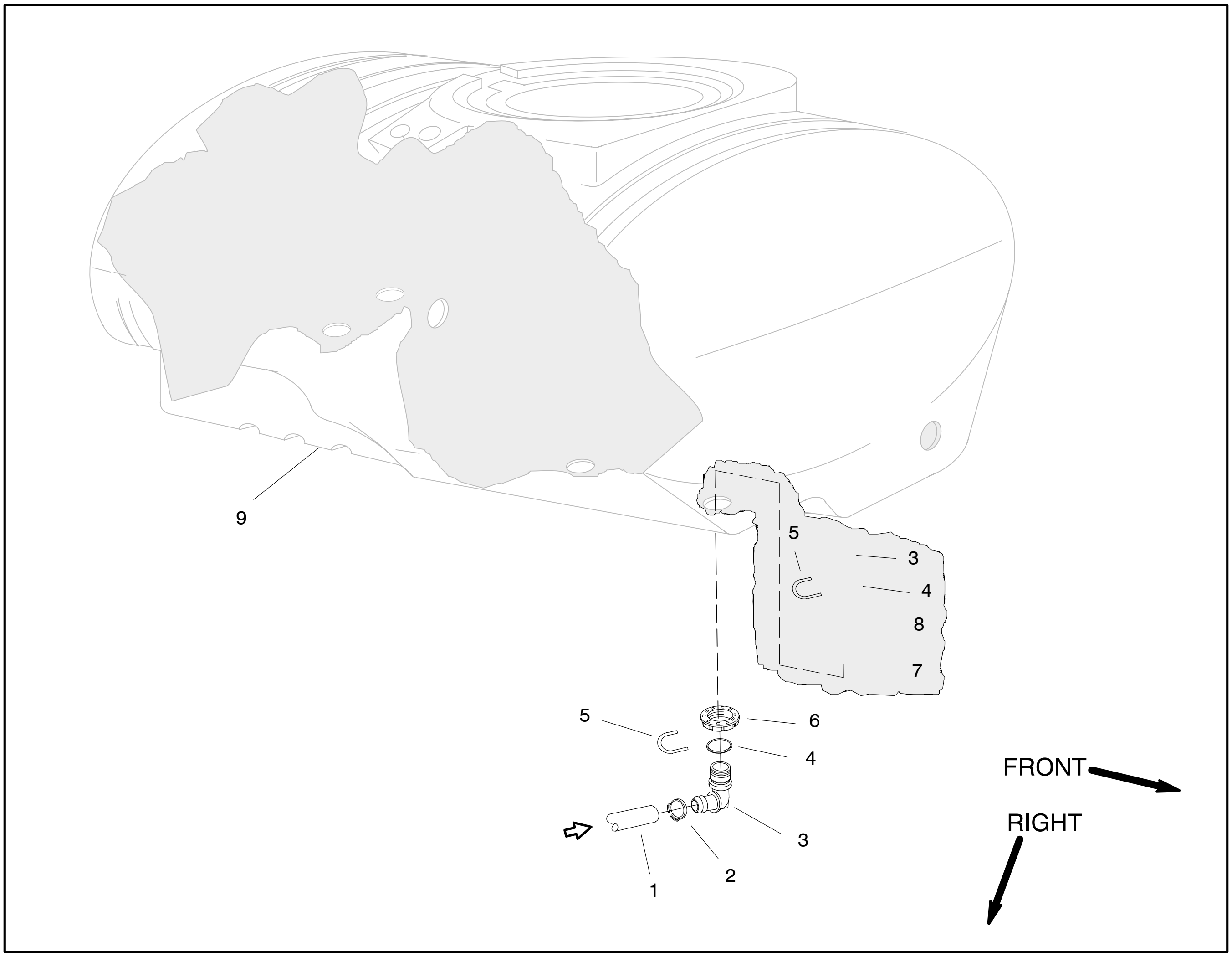

Figure 47

1. **Hose: boom bypass (1”)**
2. **Hose clamp**
3. **Hosebarb**
4. **O–ring/gasket**
5. **Fork**
6. **Nut**
7. **Bulkhead gasket**
8. **Bulkhead**
9. **Spray tank**

Disassembly (Fig. 47)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Drain spray tank (see Operator’s Manual).

NOTE: The boom bypass hose on the Multi Pro 1200 (item 1) is routed between the spray tank hosebarb (item 3) and the boom distribution valves. On the Multi Pro 1250, the boom bypass hose (item 3) is routed between the spray tank hosebarb and the spray control assembly.

3. Disassemble boom bypass using Figure 47 as a guide. Discard all removed o–rings and gaskets.

Assembly (Fig. 47)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble boom bypass using Figure 47 as a guide. Replace all removed o–rings and gaskets.

2. Check spray tank for leaks.

Tank Suction

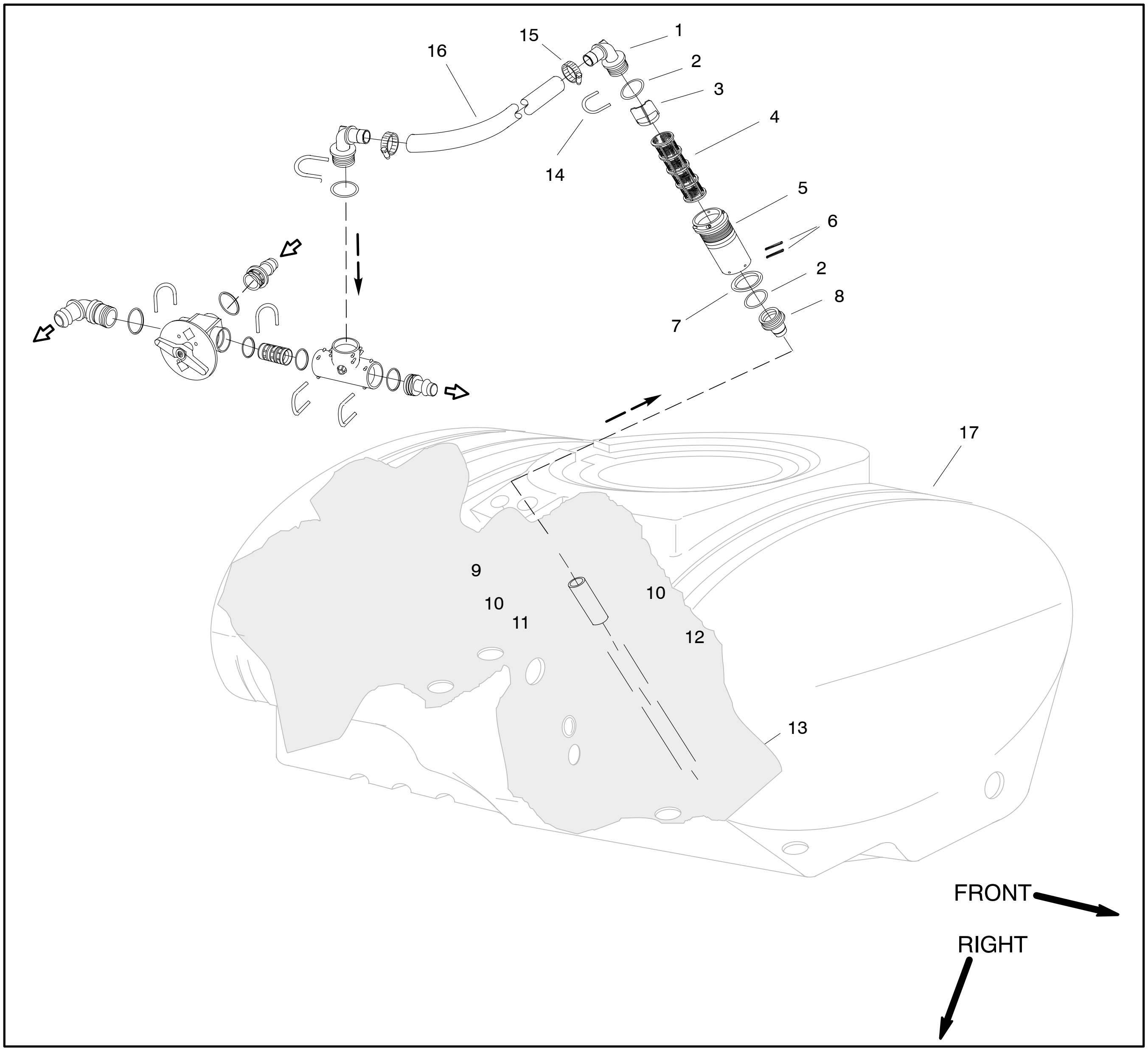

Figure 48

1. Suction hosebarb
2. O–ring
3. Screen vane
4. Suction screen
5. Filter housing
6. Expansion pin
7. Bulkhead gasket
8. Hosebarb
9. Nut
10. Hose clamp
11. Suction hose (2”)
12. Suction tube
13. Suction tube foot
14. Fork
15. Hose clamp
16. Suction hose (1 1/2”)
17. Spray tank

NOTE: If suction tube in tank develops an air leak, spray performance will diminish when tank level reaches the leak.

Removal (Fig. 48)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Remove suction strainer from spray tank (see Operator's Manual).

3. Raise tank lid and remove strainer basket to gain access to suction tube inside spray tank (Fig. 49).

4. Remove suction tube assembly from spray tank and disassemble tube using Figure 48 as a guide. Discard all removed o–rings and gaskets.

Assembly (Fig. 48)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble and install suction tube assembly using Figure 48 as a guide. Replace all removed o–rings and gaskets.

2. Check spray tank for leaks.

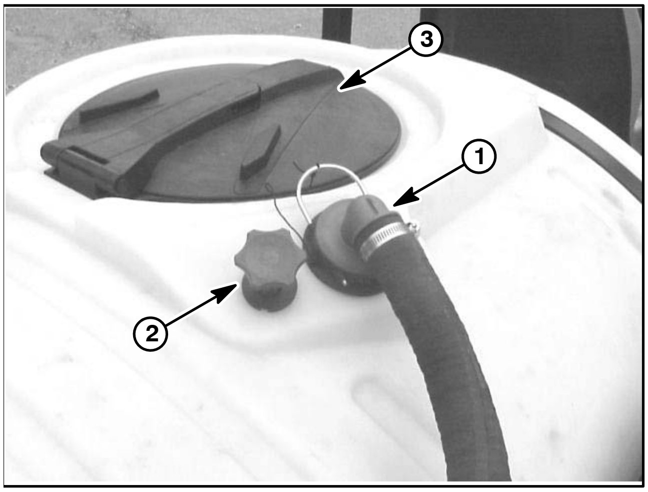

Figure 49

1. **Suction strainer**
2. **Tank drain knob**
3. **Tank lid**

Spray System

Tank Drain Valve

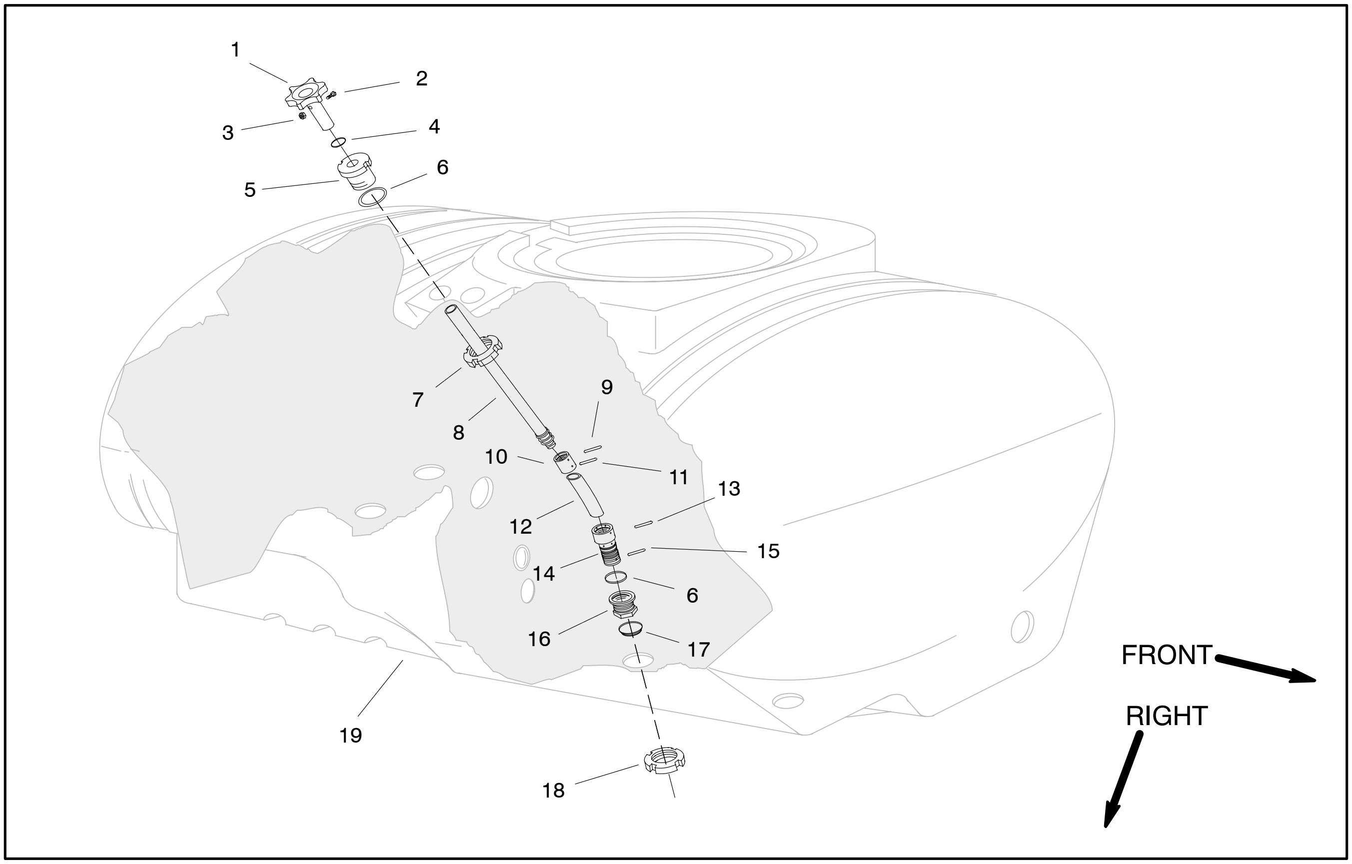

Figure 50

1. **Tank drain knob**
2. **Bolt**
3. **Lock nut**
4. **O–ring**
5. **Bulkhead**
6. **O–ring**
7. **Ringnut**
8. **Drain tube**
9. **Pin**
10. **Connector**
11. **Pin**
12. **Flex tube**
13. **Pin**
14. **Drain screw**
15. **Pin**
16. **Bulkhead fitting**
17. **Bulkhead gasket**
18. **Ringnut**
19. **Spray tank**

Disassembly (Fig. 50)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Drain spray tank (see Operator's Manual).

3. Remove bolt and locknut that secure tank drain knob to drain tube. Slide knob from tube.

4. Raise tank lid and remove strainer basket to gain access to ringnut (item 7) that secures bulkhead (item 5) to tank. Loosen and remove ringnut from bulkhead. Slide bulkhead from drain tube.

5. Loosen and remove ringnut (item 18) that secures bulkhead fitting (item 16) to bottom of tank.

6. Lift drain tube until bulkhead fitting (item 16) clears bottom of tank. Lower drain tube assembly into tank and remove tube assembly through tank lid opening.

7. Disassemble drain tube using Figure 50 as a guide. Discard all removed o–rings and gaskets.

Assembly (Fig. 50)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble drain tube using Figure 50 as a guide. Replace all removed o–rings and gaskets.

2. Check spray tank for leaks.

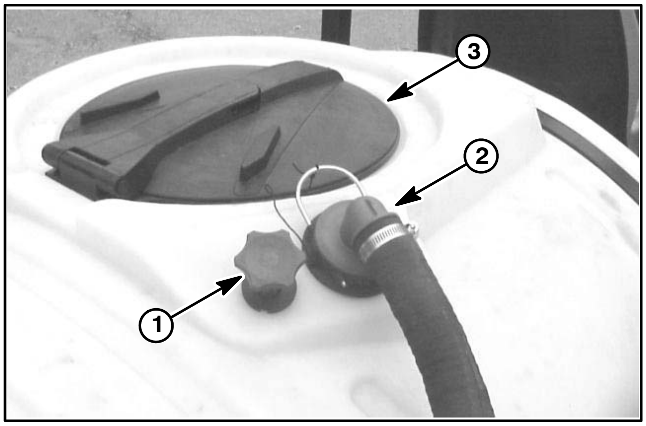

Figure 51

1. **Tank drain knob**
2. **Suction strainer**
3. **Tank lid**

Spray System

Turret Bodies

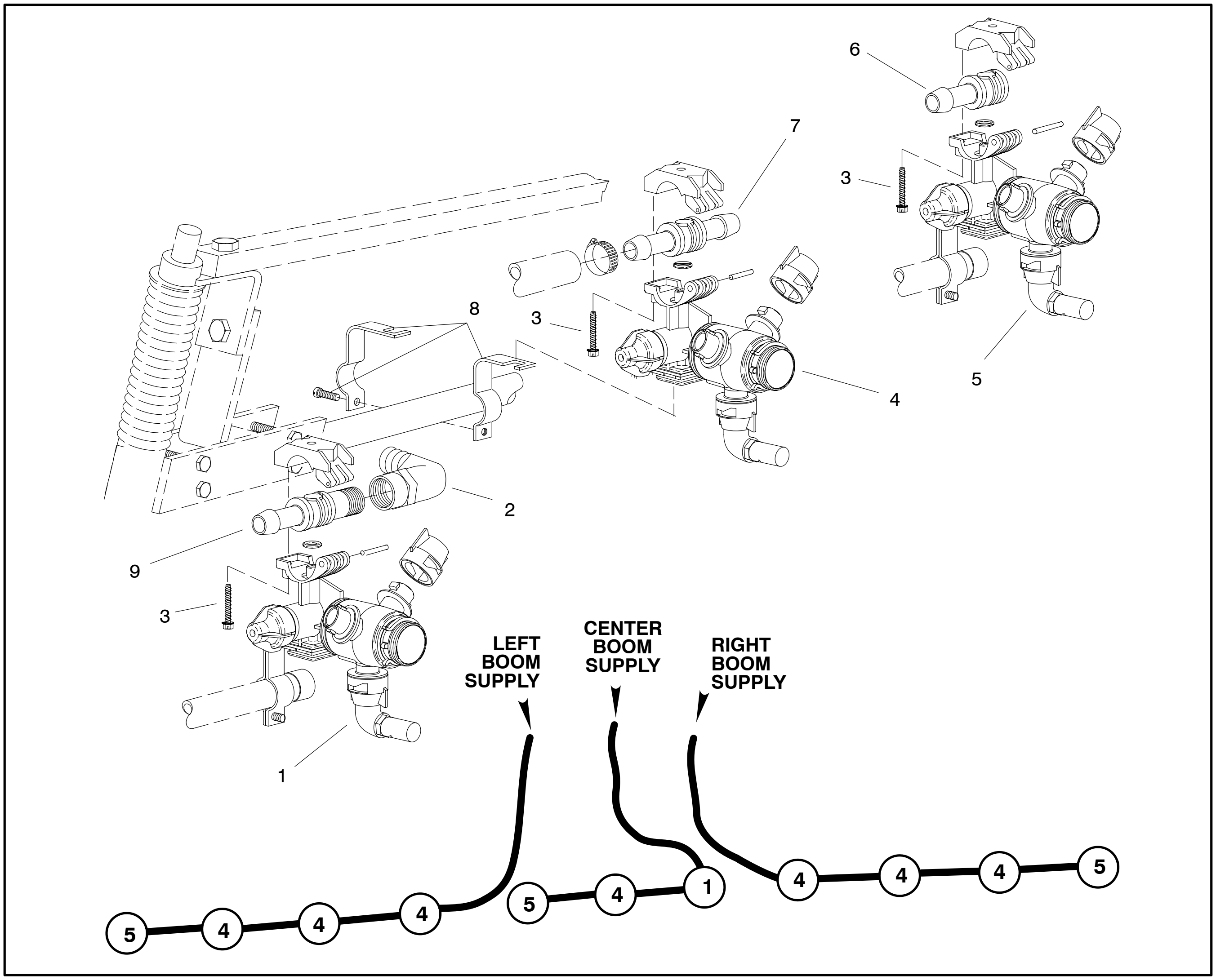

Figure 52

1. **Turret body (w/90° elbow)**
2. **90° elbow (1 used)**
3. **Screw**
4. **Turret body (w/double hose barb)**
5. **Turret body (w/single hose barb)**
6. **Single hose barb (3 used)**
7. **Double hose barb (7 used)**
8. **Turret body clamp**
9. **Hose barb (for 90° elbow)**

Removal (Fig. 52)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

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

2. Loosen hose clamp(s) and remove supply hose(s) from turret body.

3. Remove screw that secures turret body clamp to spray boom. Separate clamp halves and remove turret body from machine.

Installation (Fig. 52)

NOTE: The type of hose barb on turret body determines turret location on spray boom. Refer to Figure 52 for turret position on booms.

1. Position turret body clamp halves to spray boom and turret body. Slide clamp halves together. Level turret and tighten clamp screw to secure turret body.

2. Install supply hose(s) to turret body. Tighten hose clamp(s).

Turret Body Service

Disassembly (Fig. 53)

1. Pull e–clip from body and slide plug with o–ring from body.

2. Disassemble turret body using Figure 53 as a guide.

3. Discard all removed seals, gaskets, o–rings, and diaphragms.

Assembly (Fig. 53)

NOTE: Coat all o–rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Replace all removed seals, gaskets, o–rings, and diaphragms.

2. Assemble turret body using Figure 53 as a guide.

   A. The turret (item 8) end with slightly larger bore and detent grooves needs to be orientated toward detent posts on body (item 4) (Fig. 54).

   B. Make sure to align notch on plug (item 10) with groove in body (item 4) as plug is installed.

   C. Install e–clip (item 5) into body to secure assembly.

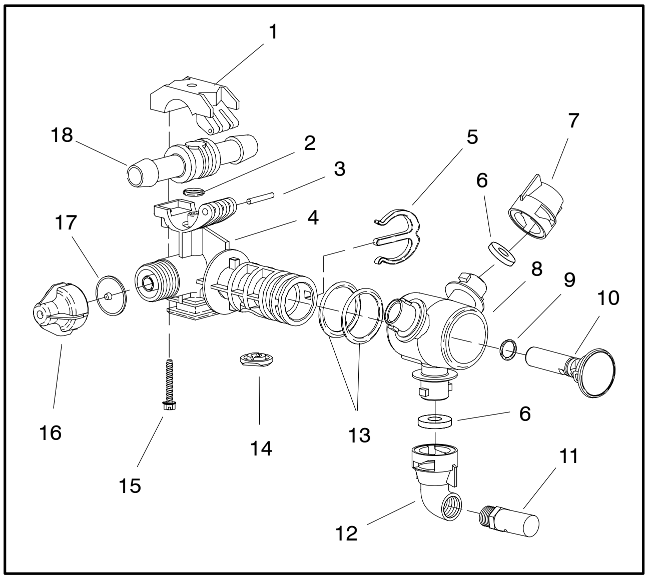

Figure 53

1. **Upper clamp**
2. **O–ring**
3. **Pivot pin**
4. **Body**
5. **E–clip**
6. **Gasket (3 used)**
7. **Dust cap (2 used)**
8. **Turret**
9. **O–ring**
10. **Plug**
11. **Nozzle**
12. **Nozzle cap**
13. **O–ring**
14. **Seal**
15. **Screw**
16. **End cap**
17. **Diaphragm**
18. **Hose barb**

Figure 54

1. **Body**
2. **Detent post**
3. **Detent groove**

Boom Frame Breakaway Pivot Assembly (Machines with Serial Numbers Below 260000000)

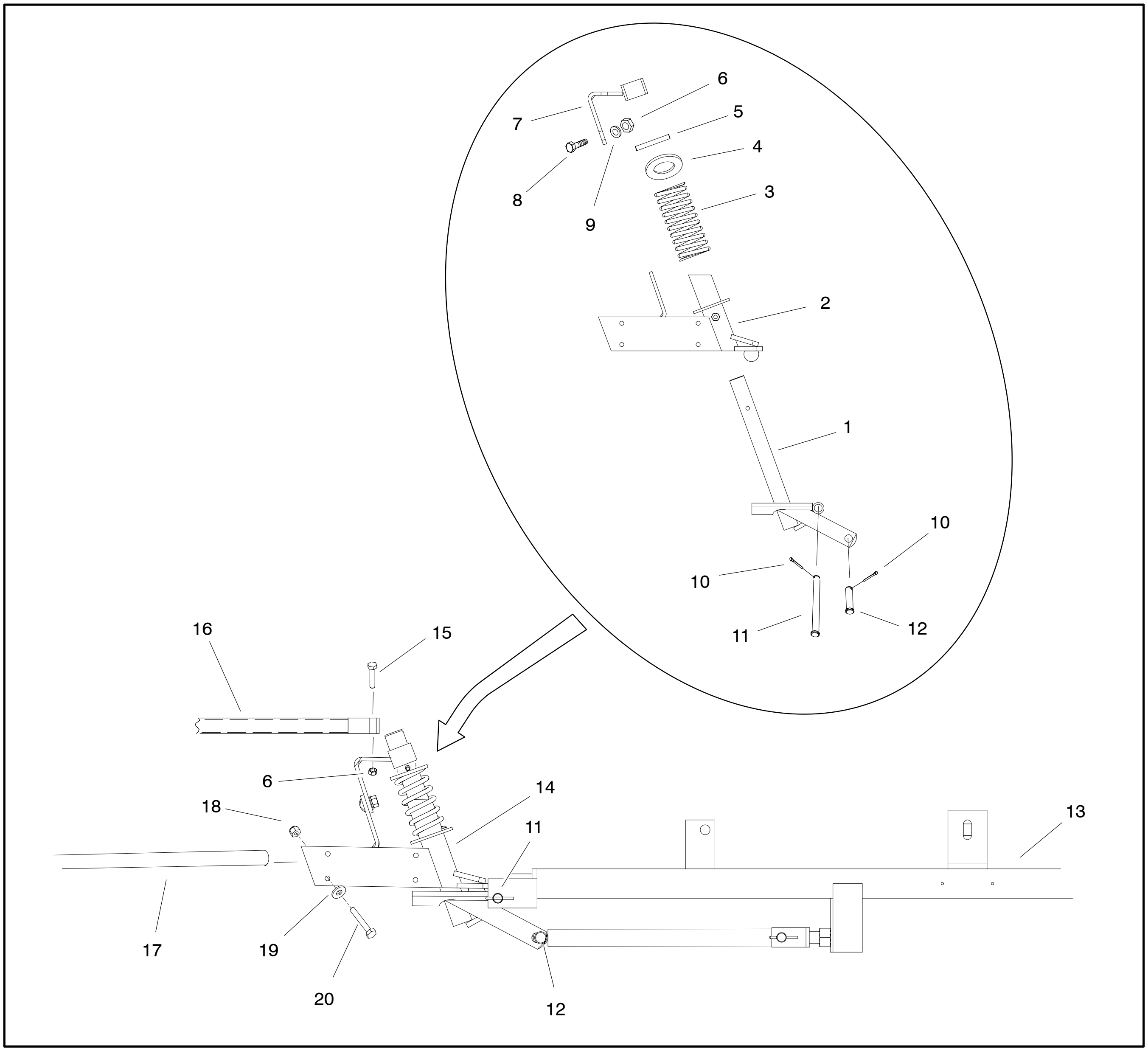

Figure 55

1. Hinge
2. Breakaway pivot
3. Spring
4. Washer
5. Roll pin
6. Hex nut
7. Support bracket
8. Carriage screw
9. Flat washer
10. Cotter pin
11. Clevis pin
12. Clevis pin
13. Main boom frame
14. Breakaway pivot assembly
15. Cap screw
16. Boom support
17. Boom extension pipe
18. Lock nut (4 used per side)
19. Flat washer (4 used per side)
20. Cap screw (4 used per side)

Disassembly (Fig. 55)

1. Park machine on a level surface, lower booms, stop engine, engage parking brake, and remove key from the ignition switch.

2. Support boom to prevent it from falling. Remove cap screw and hex nut that secure boom support to breakaway assembly.

3. Remove hex nut, flat washer, and carriage screw that secure support bracket to breakaway pivot. Slide support bracket from breakaway assembly.

CAUTION

Spring in breakaway pivot is under tension. To prevent possible personal injury, compress spring before removing roll pin. Wear eye protection when removing roll pin.

4. Compress spring in breakaway assembly slightly. Drive roll pin from hinge (Fig. 57). Remove flat washer and spring from assembly.

5. Complete disassembly as required using Figures 55 and 56 as guides.

Assembly (Fig. 55)

1. Assemble breakaway pivot using Figures 55 and 56 as guides.

2. Lubricate grease fitting on breakaway pivot after assembly is complete (see Operator's Manual).

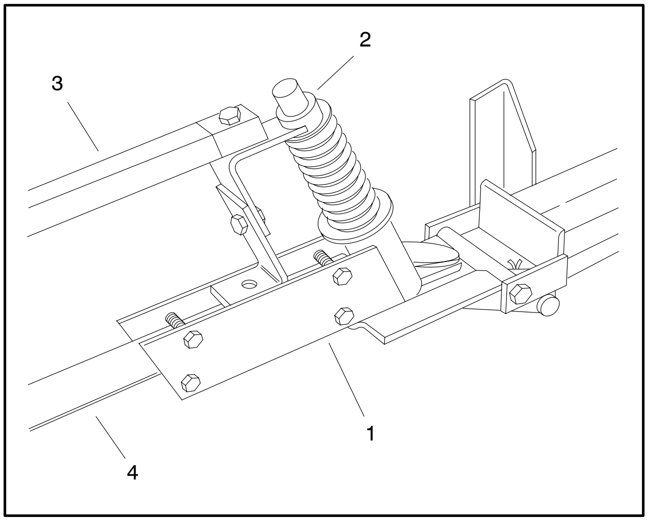

Figure 56

1. **Breakaway pivot**
2. **Support bracket**
3. **Boom support**
4. **Boom extension pipe**

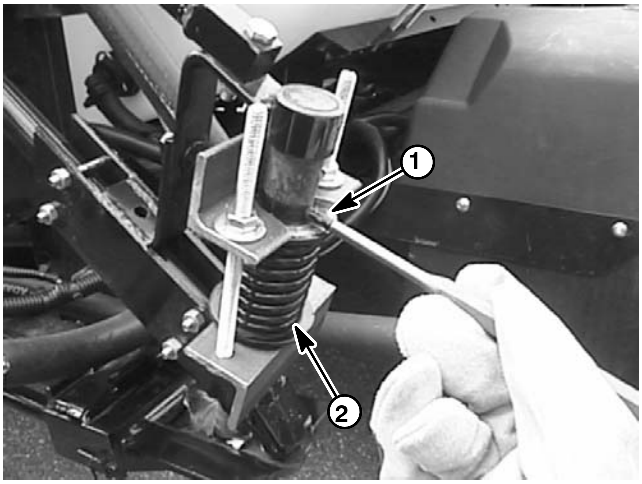

Figure 57

1. **Roll pin**
2. **Spring**

Spray System

Boom Hinge (Machines with Serial Numbers Above 260000000)

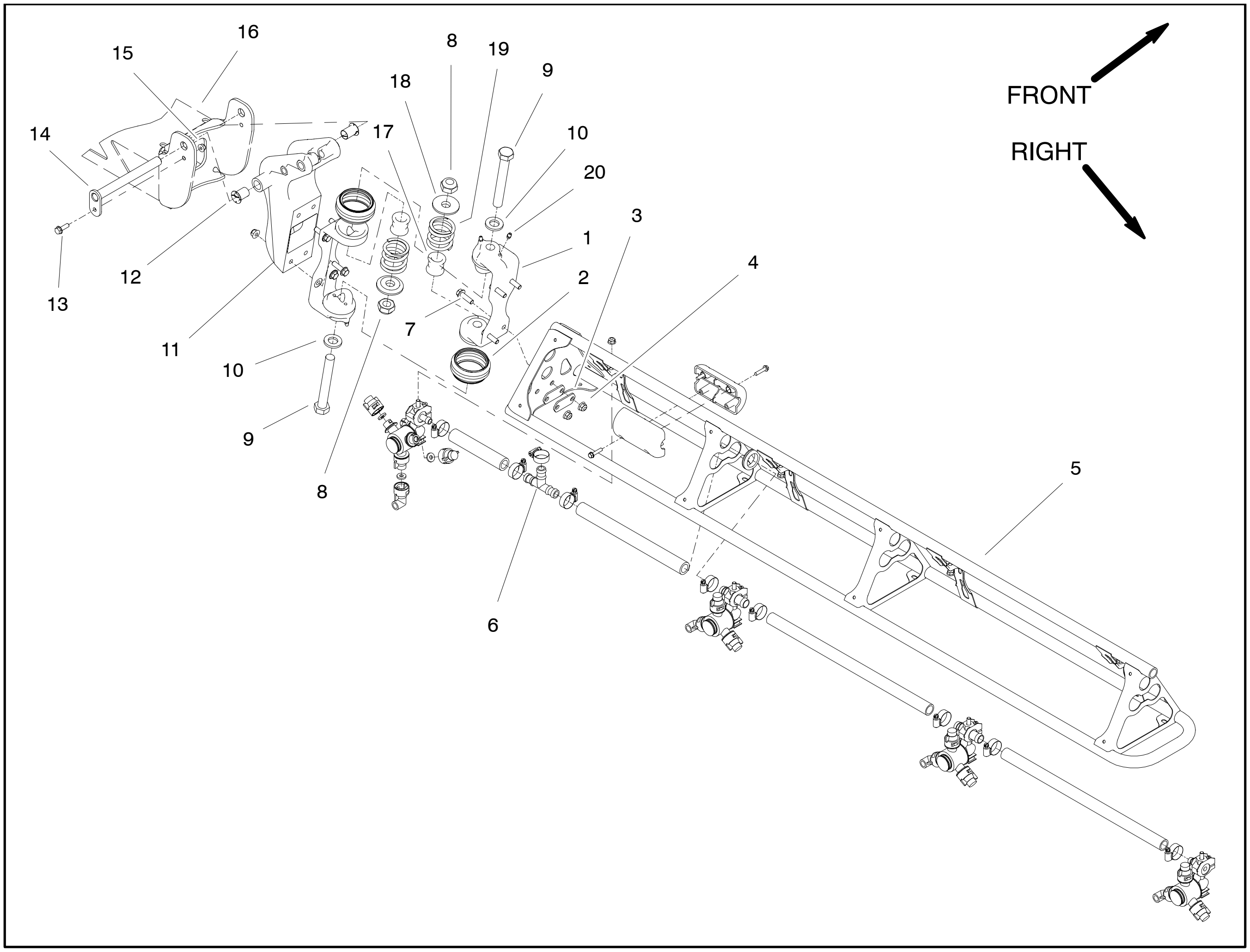

Figure 58

1. **Hinge (2 used per boom)**
2. **Rubber boot (2 used per hinge)**
3. **Backing plate (4 used per hinge)**
4. **Flange nut (4 used per hinge)**
5. **Boom (RH shown)**
6. **Tee fitting**
7. **Flange hd screw (4 used per hinge)**
8. **Lock nut**
9. **Cap screw**
10. **Flat washer**
11. **Pivot bracket**
12. **Bushing (2 used per pivot bracket)**
13. **Flange head screw**
14. **Pivot pin**
15. **Flange nut**
16. **Boom frame**
17. **Tube (2 used per boom)**
18. **Spring retainer (2 used per boom)**
19. **Breakaway spring (2 used per boom)**
20. **Grease fitting (2 used per hinge)**

Disassembly (Fig. 58)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

1. Park machine on a level surface, lower spray booms, stop engine, engage parking brake and remove key from the ignition switch.

2. Loosen hose clamp and remove supply hose from tee fitting (item 6) on spray boom.

3. Support spray boom to prevent it from falling.

4. Loosen two (2) cap screws (item 9) and lock nuts (item 8) to allow breakaway springs (item 18) to fully extend.

5. Complete disassembly as required using Figure 58 as a guide. If pivot bracket (item 11) is to be removed from machine, disconnect boom actuator (not shown) from pivot bracket (see Boom Actuator Removal (Machines with Serial Numbers Above 260000000) in this section).

6. Clean all removed components. If pivot bracket was removed, inspect bushings and pivot pin for damage or wear.

Assembly (Fig. 58)

1. If pivot bracket (item 11) was removed from machine, lightly lubricate bushings (item 12) with motor oil before assembly. Connect boom actuator (not shown) to pivot bracket (see Boom Actuator Installation (Machines with Serial Numbers Above 260000000) in this section).

2. Make sure that hinges (item 1) are securely fastened to pivot bracket (item 11) and boom (item 5). The boom hinge uses four (4) backing plates between the boom and flange nuts.

3. Position boom hinge to pivot bracket hinge. Make sure that rubber boots (item 2) are placed at hinge junctions and that rib on boots are toward the top of the boom (Fig. 59).

4. Insert two (2) cap screws (item 9) through flat washers (item 10) and hinges. Place tube (item 17), breakaway spring (item 19), spring retainer (item 18) and lock nut (item 8) on each cap screw. Make sure that shoulder on spring retainer fits into breakaway spring.

5. Tighten lock nuts so there is 1.560" (39.6 mm) between the face of the spring retainer and the hinge casting (Fig. 60).

6. Connect supply hose to tee fitting on spray boom and secure with hose clamp.

7. Lubricate grease fittings on boom hinge (see Operator's Manual).

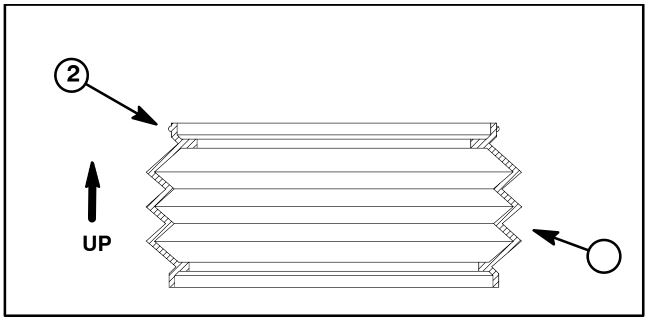

Figure 59

1. Rubber boot
2. Rib

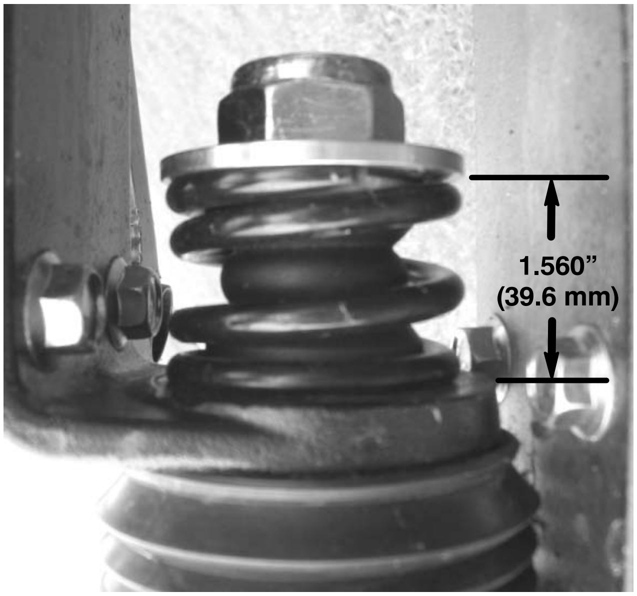

Figure 60

Spray System

Boom Actuator (Optional) (Machines with Serial Numbers Below 260000000)

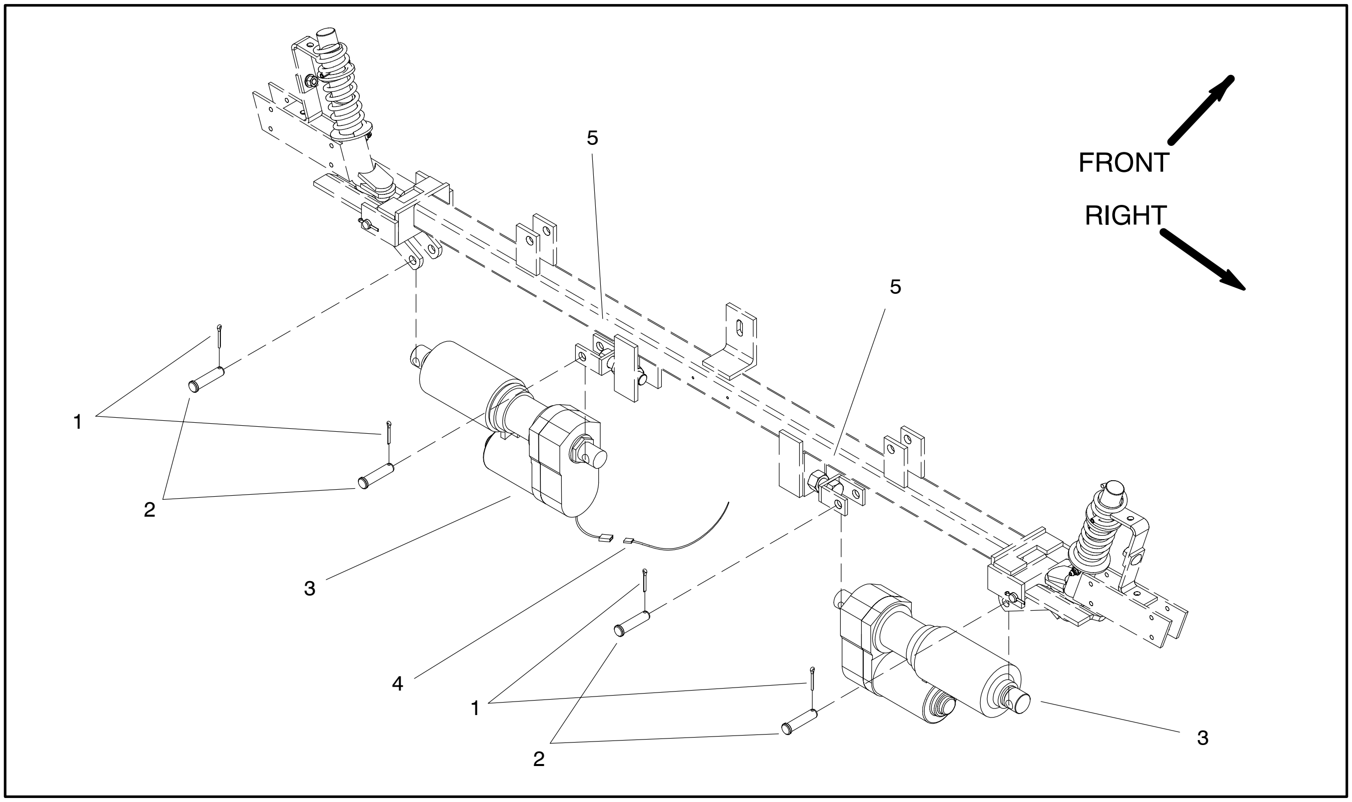

Figure 61

1. **Cotter pin**
2. **Clevis pin**
3. **Boom actuator**
4. **Wire harness**
5. **Adjustable clevis**

Removal (Fig. 61)

1. Park machine on a level surface, lower booms, stop engine, engage parking brake, and remove key from the ignition switch.

2. Unplug boom actuator connector wires from machine harness.

3. Support boom to prevent it from falling. Remove cotter pins and clevis pins that attach boom actuator to center and side boom.

4. Pull boom actuator from machine.

Installation (Fig. 61)

1. Position boom actuator to clevis attachment points on center and side booms.

2. Install clevis pins and cotter pins to secure actuator to boom assembly.

3. Plug actuator connector wires into machine harness.

Adjustment

1. Loosen end nut that secures adjustable clevis to boom frame (Fig. 62). Position jam nut as close as possible to adjustable clevis. Tighten end nut to secure clevis.

2. Fully raise side boom with the boom actuator. The boom actuator should fully extend and ratchet.

3. With the boom actuator at full extension, the breakaway pivot gusset should just touch the center boom frame slot (Fig. 63).

4. If needed, loosen end nut that secures adjustable clevis and readjust jam nut on clevis to allow correct boom actuator extension. Tighten end nut to secure clevis adjustment.

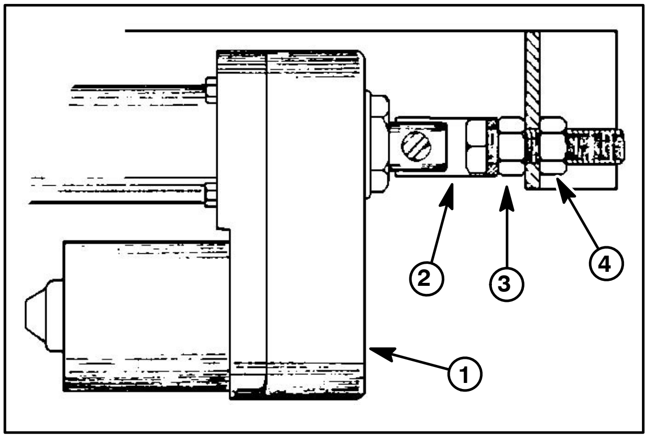

Figure 62

1. **Boom actuator**
2. **Adjustable clevis**
3. **Jam nut**
4. **End nut**

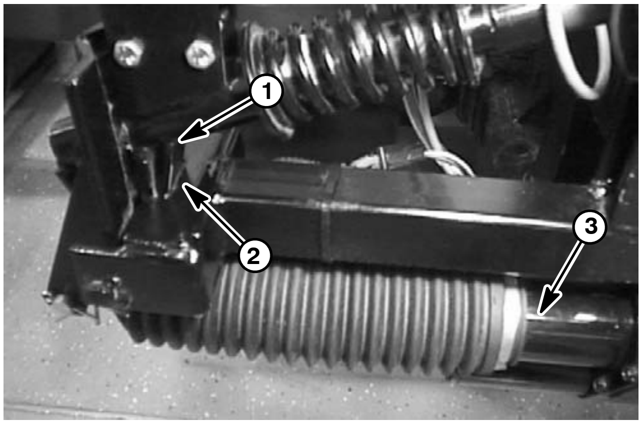

Figure 63

1. **Breakaway pivot gusset**
2. **Boom frame slot**
3. **Boom actuator**

Boom Actuator Service (Machines with Serial Numbers Below 260000000)

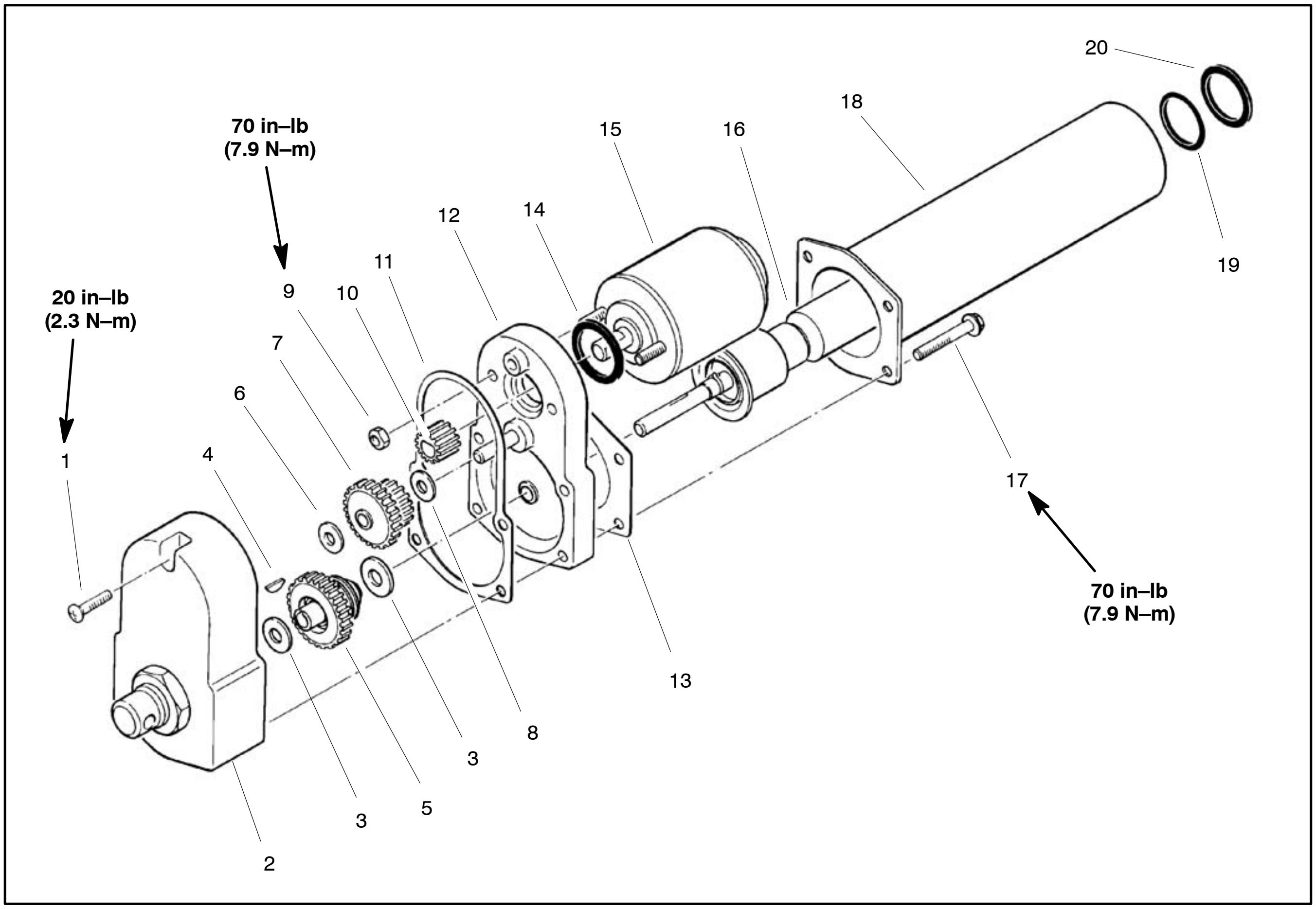

Figure 64

1. Screw
2. Rear housing
3. Washer
4. Woodruff key
5. Clutch
6. Thin washer
7. Intermediate gear
8. Thick washer
9. Hex nut (2 used)
10. Motor gear
11. Housing gasket
12. Front housing
13. Cover tube gasket
14. Motor seal
15. Motor assembly
16. Ball screw and brake assembly
17. Washer head screw (4 used)
18. Cover tube
19. O–ring
20. O–ring

Disassembly (Fig. 64)

1. Remove four (4) washer head screws that secure cover tube. Remove one (1) screw (item 1) that retains rear housing. Slide rear housing and housing gasket from assembly.

2. Slide thin washer, intermediate gear, and thick washer from front housing support pin.

3. In order, remove washer, clutch, woodruff key, and second washer from ball screw shaft.

4. Pull cover tube from front housing. Remove cover tube gasket.

5. Loosen and remove two (2) hex nuts that secure motor to front housing. Slide motor, motor gear, and motor seal from front housing.

6. Remove ball screw and brake assembly from front housing.

7. Clean actuator components. Replace worn or damaged parts.

8. Discard and replace all removed gaskets and o–rings.

Assembly (Fig. 64)

1. Position ball screw and brake assembly to front housing. Take care to not disturb brake components.

2. Slide motor, motor gear, and motor seal to front housing. Secure motor with two (2) hex nuts. Torque nuts to 70 in–lb (7.9 N–m).

3. Install new o–rings into rear of cover tube. Slide cover tube gasket and cover tube over ball screw.

4. Place washer on ball screw shaft. Position woodruff key and then slide clutch and second washer onto shaft.

5. Place thick washer, intermediate gear, and thin washer onto front housing support pin. Make sure that intermediate gear engages both motor gear and clutch.

6. Position housing gasket to front housing. Slide rear housing over gears.

7. Secure rear housing:

   A. Thread one (1) screw (item 1) through rear housing and into front housing.

   B. Install four (4) washer head screws through cover tube.

   C. Torque screw (item 1) to 20 in–lb (2.3 N–m). Torque four washer head screws to 70 in–lb (7.9 N–m).

Boom Actuator (Machines with Serial Numbers Above 260000000)

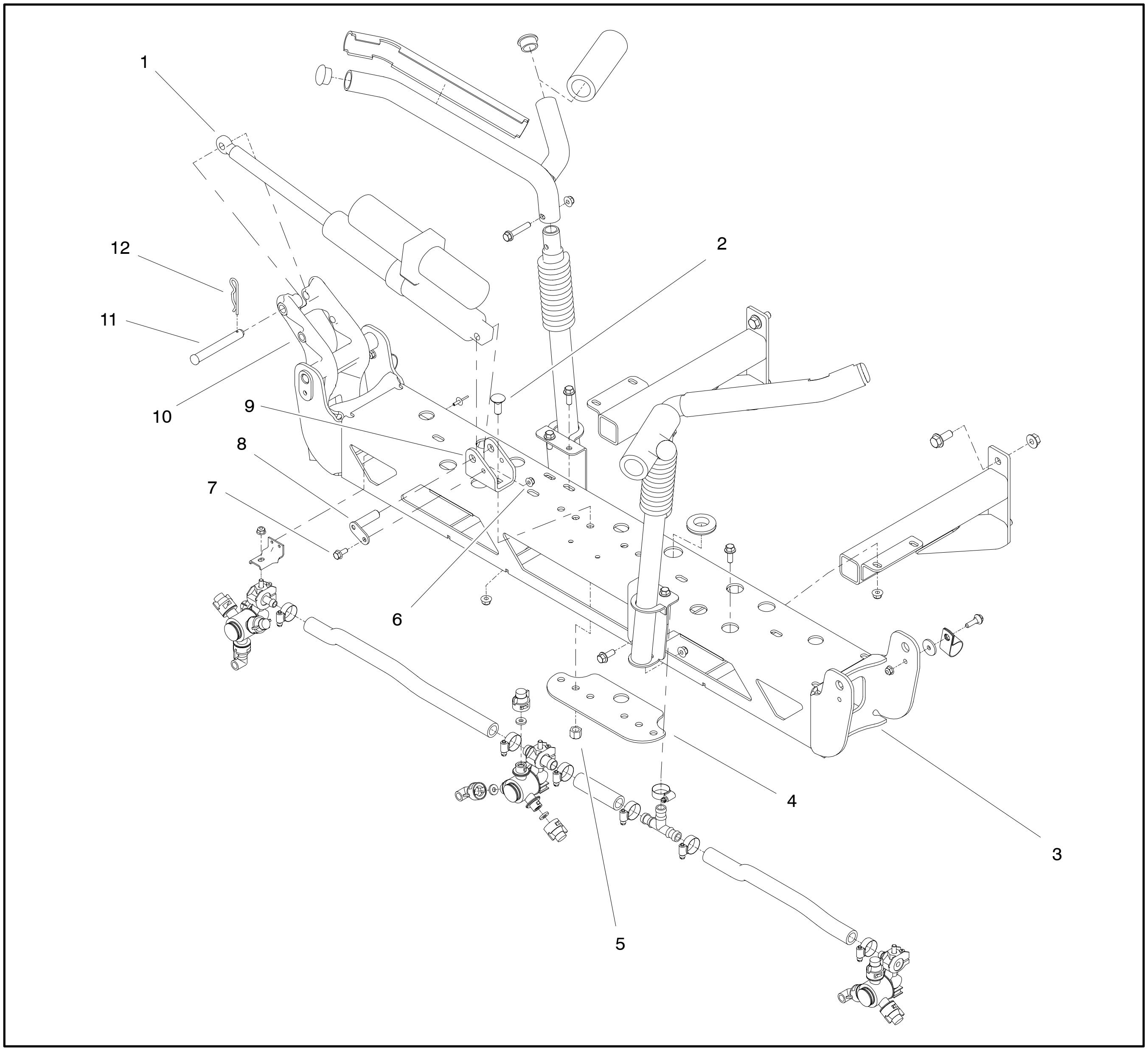

Figure 65

1. **Boom actuator (2 used)**
2. **Carriage screw (4 used)**
3. **Boom frame**
4. **Washer plate**
5. **Lock nut (4 used)**
6. **Flange nut (2 used)**
7. **Flange head screw (2 used)**
8. **Pivot pin (2 used)**
9. **Clevis strap (2 used)**
10. **Boom pivot bracket**
11. **Clevis pin (2 used)**
12. **Cotter pin (2 used)**

Removal (Fig. 65)

1. Park machine on a level surface, place spray booms in the transport (raised) position, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect boom actuator from machine wire harness.

3. Remove pivot pin (item 8) that secures actuator to clevis strap (item 9) on boom frame.

4. Remove cotter pin (item 11) from clevis pin (item 12). Support boom actuator and slide clevis pin from boom pivot bracket. Remove actuator from machine.

Installation (Fig. 65)

1. Position boom actuator to boom frame and boom pivot bracket.

2. Secure actuator to boom pivot bracket with clevis pin and cotter pin.

3. Secure actuator to clevis strap on boom frame with pivot pin.

4. Connect boom actuator to machine wire harness.

Boom Actuator Service (Machines with Serial Numbers Above 260000000)

IMPORTANT: Do not dismantle, repair or modify the boom actuator. Internal components are not available for the actuator. If an actuator is damaged or worn, replace actuator.

CAUTION

During and after operation, the actuator may be very hot. To avoid possible burns, allow the actuator to cool before working on it.

Actuator Circuit Protection

Each boom actuator is protected internally by a thermal circuit breaker. In case of actuator overheating, the thermal breaker will trip, causing the actuator to cease functioning. Once the actuator cools to appropriate operating temperature, the actuator thermal breaker will reset to allow actuator operation to resume.

A separate 30 amp thermal breaker also protects each boom actuator circuit. These thermal breakers are located at the machine fuse panel and will prevent circuit operation if overloaded. The thermal breakers reset automatically.

Actuator Freeplay Inspection

Over time, actuator operation may be affected by air captured in the reservoir oil. An excessive amount of air in the actuator oil will allow excessive actuator freeplay. Excessive freeplay will allow spray boom bouncing when driving over severe terrain.

Measure actuator freeplay using the following procedure:

1. Move the vehicle to an open area and lower the spray booms to the spray position.

2. Lift up on the boom at the last triangular gusset with a 25 pound (11.4 kg) force. Support boom in that position.

3. Using a non–permanent felt tipped marker, mark the cylinder rod at the outside of the cylinder seal.

4. Release the spray boom and allow it to return to the spray (fully lowered) position.

5. Determine the actuator freeplay by measuring the distance from the mark on the cylinder rod to the cylinder seal. The freeplay should be less than 0.100" (2.5 mm). If excessive freeplay is found, bleed air from actuator.

Actuator Air Bleeding

If actuator freeplay is excessive, air bleeding of the actuator should be performed using the following procedure:

1. Make sure that the exterior of the actuator is thoroughly clean to prevent contaminates from entering the actuator.

2. Make sure that the actuator cylinder is fully retracted.

IMPORTANT: To prevent actuator damage, use vise with protective jaws when clamping actuator.

3. Place the actuator in a vise making sure that actuator is clamped in the area identified in Figure 66. Use just enough clamping force to hold the housing securely. Make sure that the reservoir plug is orientated up.

CAUTION

The actuator reservoir is pressurized. If the reservoir plug is removed too quickly, oil under pressure can be ejected from the actuator.

4. Slowly loosen and remove the reservoir plug at the top of the reservoir.

5. Using a light through the plug hole, confirm that the reservoir oil is clear. If the oil appears milky, air is entrained in the reservoir oil. Keep the actuator vertical with the plug removed for approximately 15 minutes to allow the air to separate from the oil.

6. When oil appears clear, use a 12 volt DC power supply to power the actuator and extend the cylinder completely.

IMPORTANT: To ensure proper reservoir pressure, make sure that cylinder is extended before installing reservoir plug.

7. Install the reservoir plug and torque from 45 to 60 in–lb (5.1 to 6.8 N–m).

8. If reservoir oil was milky, use power supply to contract and extend the actuator cylinder 3 times. Repeat steps 2 through 7 until oil is clear.

9. When actuator oil is clear and plug has been installed, use power supply to fully contract the actuator cylinder. Remove actuator from vise and install on machine.

Actuator Oil Level

Under normal conditions, actuator oil level should remain constant. If any oil is spilled from the reservoir during air bleeding, the oil level in the actuator should be checked and adjusted.

1. Make sure that the exterior of actuator is thoroughly clean to prevent contaminates from entering the actuator.

2. Make sure that the actuator cylinder is fully retracted.

IMPORTANT: To prevent actuator damage, use vise with protective jaws when clamping actuator.

3. Place the actuator in a vise making sure that actuator is clamped in the area identified in Figure 66. Use just enough clamping force to hold the housing securely. Make sure that the reservoir plug is orientated up.

CAUTION

The actuator reservoir is pressurized. If the reservoir plug is removed too quickly, oil under pressure can be ejected from the actuator.

4. Slowly loosen and remove the reservoir plug at the top of the reservoir.

5. Using a light through the plug hole, confirm that the reservoir oil is clear. If the oil appears milky, perform actuator air bleeding procedure.

6. Use a clean rod to identify the level of oil in reservoir. Distance from plug fitting to oil level should be .984” (25 mm). If necessary, add ISO VG 32 mineral oil to actuator reservoir to adjust oil level.

7. When oil level is correct, use a 12 volt DC power supply to power the actuator and extend the cylinder completely.

IMPORTANT: To ensure proper reservoir pressure, make sure that cylinder is extended before installing reservoir plug.

8. Install the reservoir plug and torque from 45 to 60 in–lb (5.1 to 6.8 N–m).

Actuator Disposal

If actuator disposal is necessary, remove hydraulic oil from actuator before disposal.

1. Open actuator reservoir (see Steps 1 through 4 in Actuator Air Bleeding).

2. Drain oil from actuator.

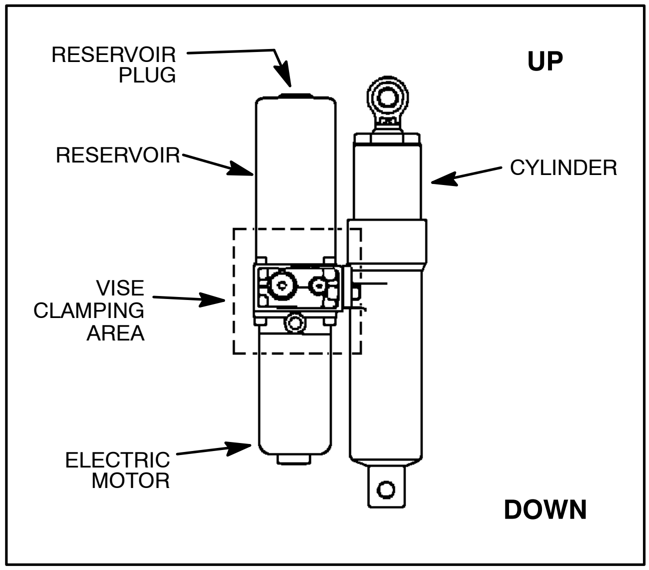

Figure 66

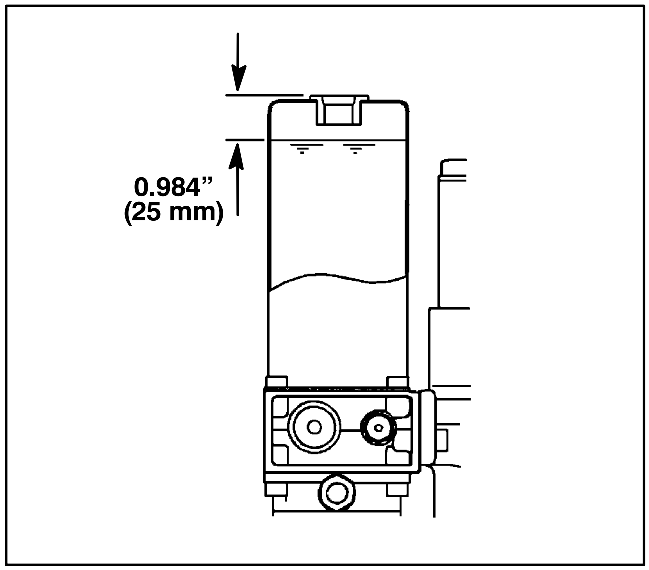

Figure 67

Spray System

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Chapter 7

Drive Train

Table of Contents

Specifications

Item	Description
Transmission Fluid Capacity Fluid Type	Integrated Transaxle with 3 Forward Speed Ranges and Reverse 7.5 quarts (7.1 liters) Dexron III ATF
Clutch System Drive Clutch Driven Clutch	Centrifugally Engaged Variable Belt Drive Speed Sensing With Mechanical Fly-Weights Torque Sensing With Spring Loaded Cam
Pump Drive Gearbox Fluid Capacity Fluid Type	Reducing Worm Gear for Pump Drive (through shaft for Transaxle) .5 quarts (.47 liters) Mobil SHC 634 Synthetic Lubricant (Toro Part No. 104-8772)

Special Tools

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

Clutch Removal Tool

This tool is required to remove the drive clutch from the tapered crankshaft of the engine. It is placed in the threaded hole of the fixed clutch sheave after the clutch retaining cap screw has been removed.

Toro Part Number: **TOR4094**

IMPORTANT: The chamfered end of the clutch removal tool can damage the engine crankshaft threads. When using the clutch removal tool on the Multi Pro sprayer, position a thick washer or spacer on the end of the engine crankshaft before installing the removal tool into the clutch.

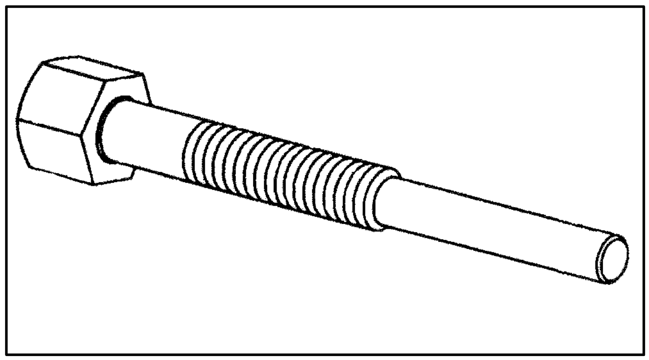

Figure 1

Clutch Service Tool Kit

This kit is required to remove the drive clutch spider from the post of the fixed sheave. Tool kit includes spanner and clutch holding bar.

Toro Part Number: **TOR4098**

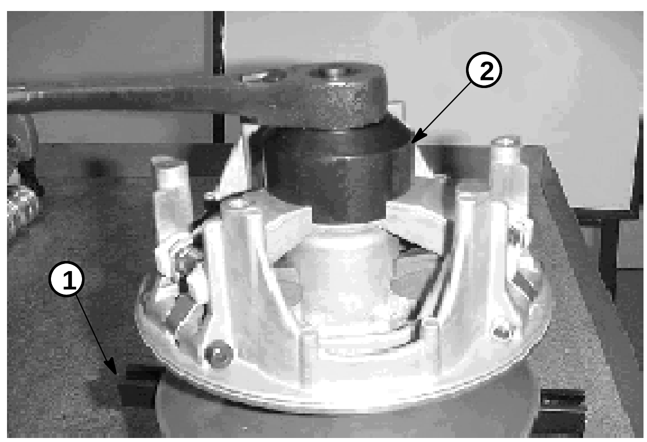

Figure 2

1. **Clutch holding bar**
2. **Spanner**

Clutch System Operation

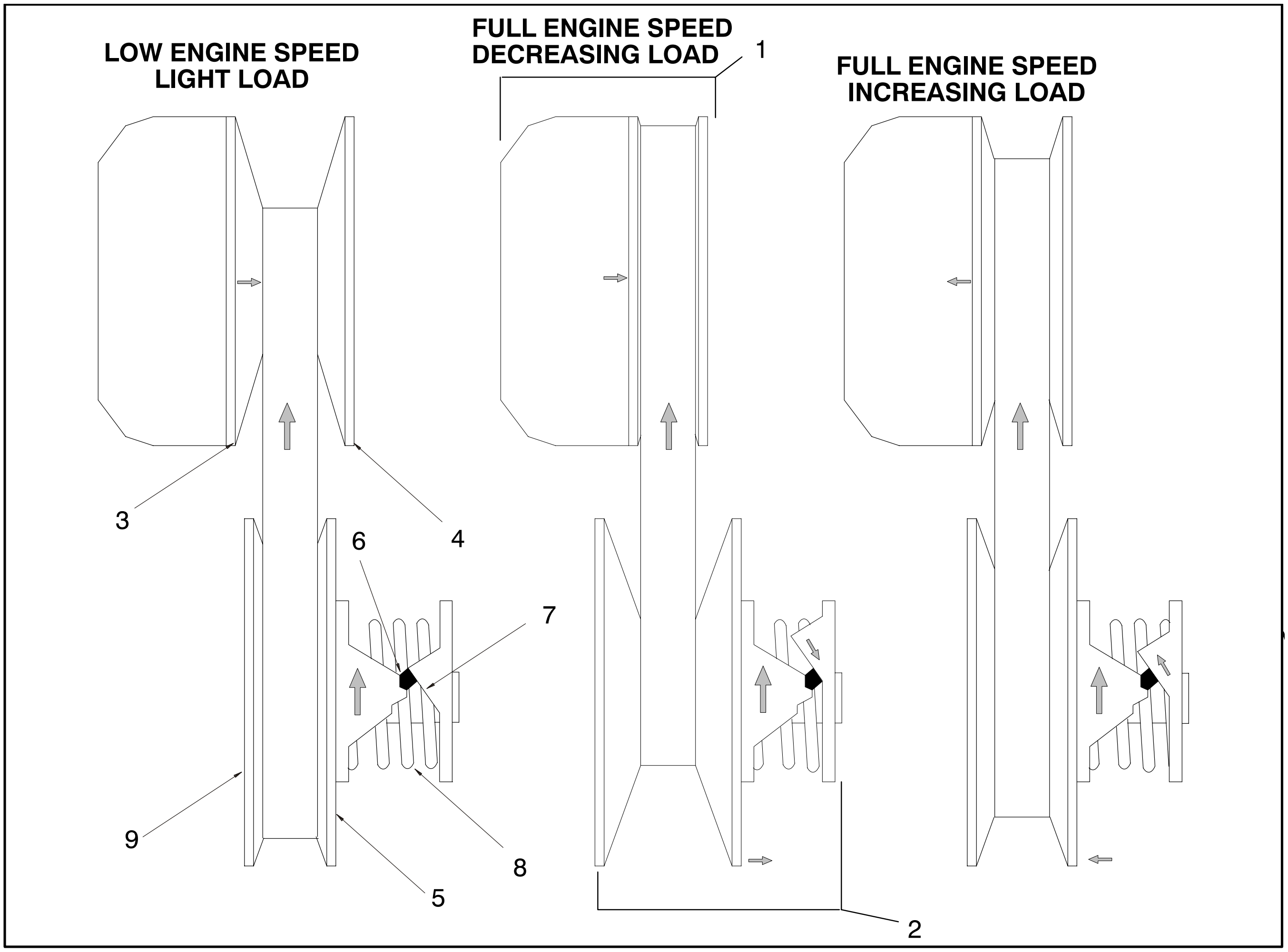

Figure 3

1. **Drive clutch**
2. **Driven clutch**
3. **Moveable sheave (drive clutch)**
4. **Fixed sheave (drive clutch)**
5. **Moveable sheave (driven clutch)**
6. **Button**
7. **Ramp (fixed cam)**
8. **Spring**
9. **Fixed sheave (driven clutch)**

Two Clutch System (Fig. 3)

Power is transferred from the engine to the transaxle and spray pump by a variable clutch system that consists of two clutches connected by a drive belt. The drive clutch responds to engine speed, and is mounted to the engine driveshaft. The driven clutch responds to changes in load from the transaxle and spray pump, and is mounted to the gearbox input shaft.

Both clutches work together as a matched unit. The units automatically up–shift and back–shift with changes in load and speed. This shifting changes the turning ratio between the drive and driven clutches and allows the engine to operate at optimum efficiency.

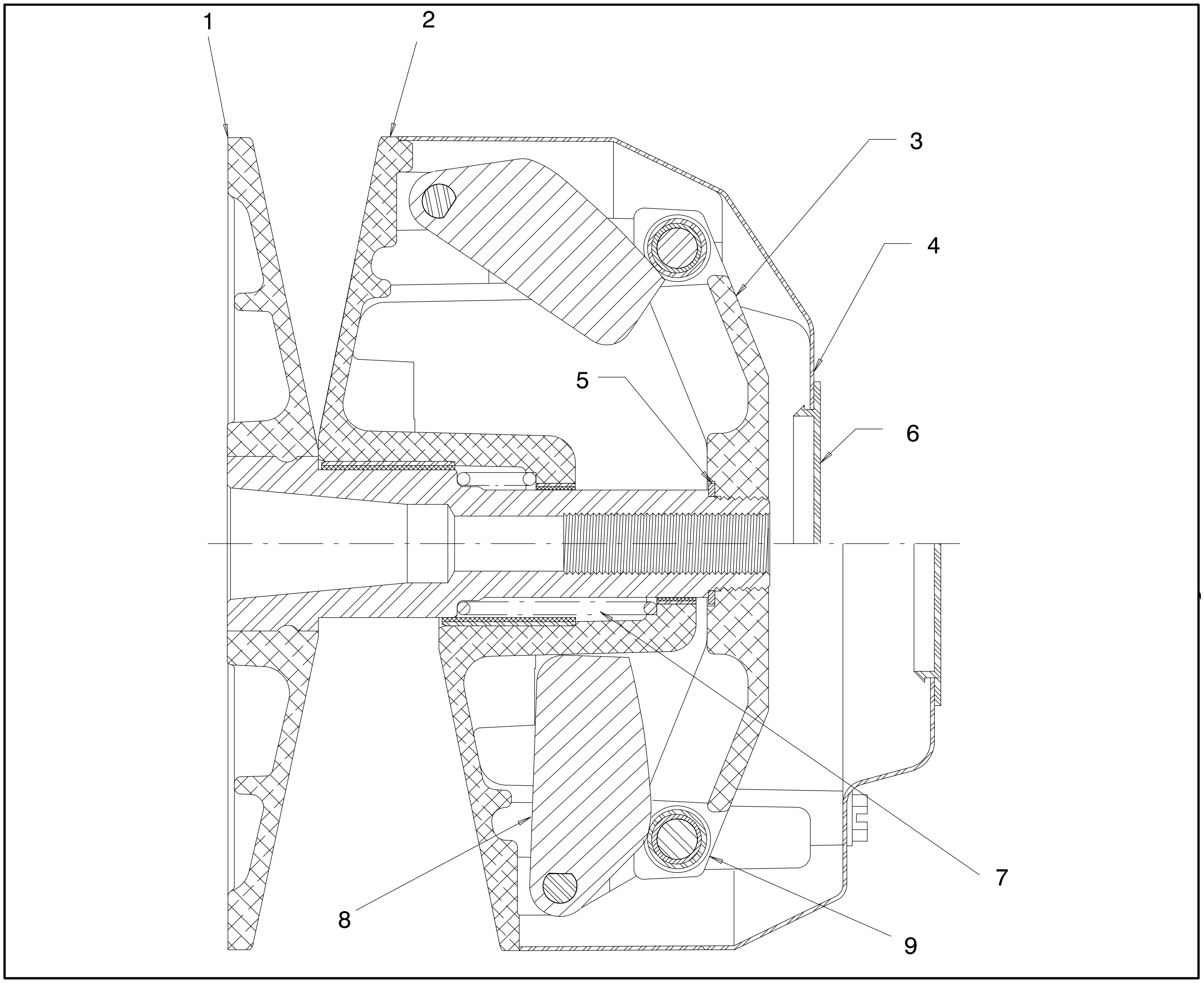

Figure 4

1. **Fixed sheave**
2. **Moveable sheave**
3. **Spider assembly**
4. **Cover**
5. **Washer**
6. **Plastic cap**
7. **Spring**
8. **Cam weight**
9. **Roller**

Principles of Operation (Fig. 4)

The operation of the drive clutch is affected by engine shaft speed. With the engine not turning, the drive belt rests low within the drive clutch sheaves as the pressure of the spring holds the sheaves apart. As the engine increases in speed, the cams attached to the moveable sheave move outward as they spin about the engine driveshaft. The outward movement of the cams presses against the rollers and overcomes spring pressure through the spider assembly, which forces the moveable sheave closer to the fixed sheave. This inward movement of the sheave engages the drive belt to drive the driven clutch.

With increasing engine speed, the moveable sheave continues to move inward, which forces the drive belt to ride towards the outer diameter of the clutch sheaves.

When engine speed is decreased, the cams exert less force on the rollers and thus the spring. The spring pressure overcomes the force of the cams, and shifts the moveable sheave away from the fixed sheave. The drive belt disengages from the clutch sheaves at a point where the force of the spring is greater than that of the weights.

Driven Clutch

Principles of Operation (Fig. 5)

The operation of the driven clutch is affected by load. When the vehicle is stopped, the drive belt is held at the outer diameter of the driven clutch sheaves from the pressure of the spring pushing the moveable sheave against the fixed sheave and away from the fixed cam. Three sets of buttons on the moveable sheave provide a low friction surface on which the sheave can slide on the ramp of the fixed cam.

Once the drive clutch (engine mounted) starts rotating, the drive belt also starts to rotate. With increasing speed of the drive clutch, the belt begins to climb to the outer diameter of the drive clutch sheaves. This increases the tension on the drive belt, and forces the driven clutch moveable sheave to move away from the fixed sheave against the pressure of the spring. As the belt tightens and the driven clutch sheaves open up, the drive belt rides lower in the driven clutch sheaves.

With increased load from the transaxle and/or spray pump, the cam resists forward movement relative to the moveable sheave and drive belt. Torque from the drive belt and spring pressure moves the movable sheave up the ramp of the fixed cam. The drive belt becomes positioned closer to the outer diameter of the driven clutch sheaves to respond to the load increase.

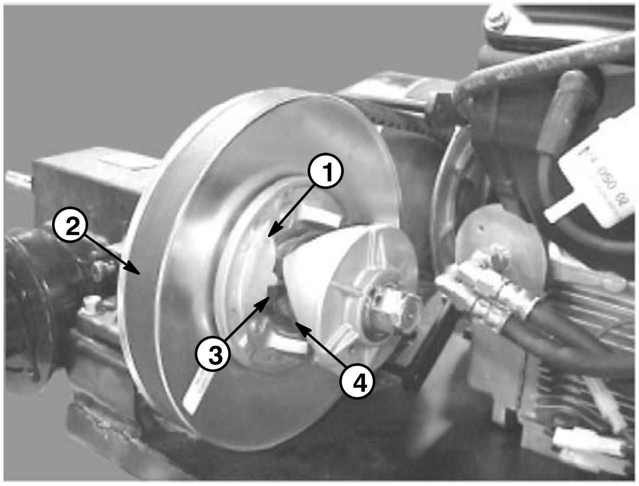

Figure 5

1. **Moveable sheave**
2. **Drive belt**
3. **Button**
4. **Ramp (fixed sheave)**

Drive Train

Troubleshooting

Transaxle

Symptom	Possible Causes
Noisy operation.	Low oil level in transaxle. Damaged or worn transaxle bearings. Gears worn, scuffed, or broken. Excessive end play in countershaft. Gears loose on transaxle shaft. Excessive wear of differential side gear liners and pinion liners. Excessive wear of splined slider on axle drive joints.
Difficult shifting.	Shift cable out of adjustment. Shift cable damaged. Shifter capscrew loose (at operator station). Loose shift lever on transaxle. Cable clamp securing cables near shifter is loose. Sliding gear tight on shaft or splines. Synchronizing unit damaged. Sliding gear teeth damaged. Synchro keys damaged.

Transaxle (continued)

Symptom	Possible Causes
Gears make clashing noise when shifting.	Shifting too fast. Excessive wear of synchro rings. Excessive wear of differential side gear thrust washers and/or pinion gear washers. Damaged synchro springs and/or keys. Main gear needle bearings worn or damaged. Excessive wear of driveshaft(s).
Transaxle sticks in gear.	Shift fork detent ball stuck. Shift linkage damaged, loose, or out of adjustment. Sliding gears tight on shaft splines. Synchro shift keys damaged.
Transaxle slips out of gear.	Shift linkage out of adjustment. Gear loose on shaft. Gear teeth worn. Excessive end play in gears. Lack of spring pressure on shift fork detent ball. Badly worn bearings.
Overheating of transaxle.	Oil level too high. Excessive hydraulic load. See Chapter 8 – Hydraulic System.

Adjustments

Shift Cable Adjustment (Fig. 6)

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch. Place the shift lever in the neutral position.

2. Remove cotter pins and clevis pins that secure cable clevis to shift levers.

3. Check that the threads of the shift cables are centered in the mounting brackets. If needed, readjust shift cable jam nuts.

4. Adjust cable clevis with clevis jam nuts so that forward and backward free play of clevis is equal relative to the hole in the transaxle shift lever. Tighten clevis jam nuts.

5. Secure cable clevis to shift levers with clevis pins and cotter pins.

6. Check shift lever for proper operation.

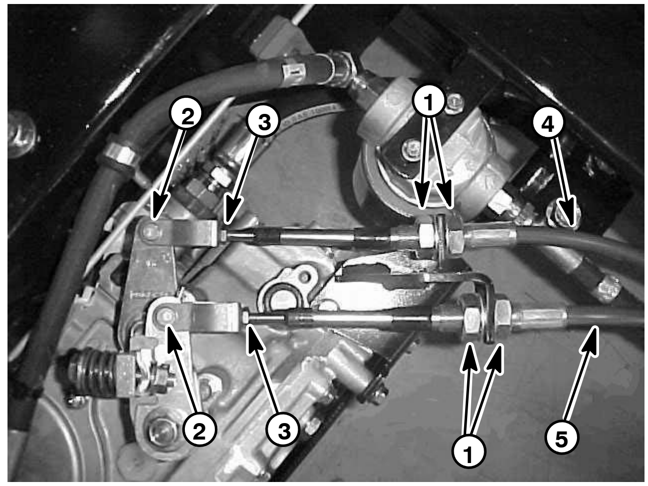

Figure 6

1. **Shift cable jam nut**
2. **Clevis pin**
3. **Clevis jam nut**
4. **Shift cable (1/reverse)**
5. **Shift cable (2/3)**

Service and Repairs

Drive Belt Service

Inspection

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

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

2. Put vehicle transmission in neutral.

3. Rotate and inspect drive belt for excessive wear or damage. Replace belt as necessary.

Replacement (Fig. 7)

1. If machine is equipped with drive belt guides, loosen belt guides and rotate them away from belt.

2. Rotate and route belt over the driven clutch. Remove belt from the drive clutch.

3. Place new belt around drive clutch. Position belt to driven clutch. Rotate driven clutch while routing the belt into position.

NOTE: The current drive belt used on Multi Pro 1200 and Multi Pro 1250 sprayers is double cogged. If machine has belt guides and a double cogged drive belt, belt guides should be secured away from drive belt or removed from machine.

4. If sprayer is equipped with belt guides and belt has a flat outer surface (not double cogged), position belt guides to allow 1/8" to 3/16" (3.2 to 4.8 mm) clearance between drive pulley and belt guide. Secure guides in place after adjustment.

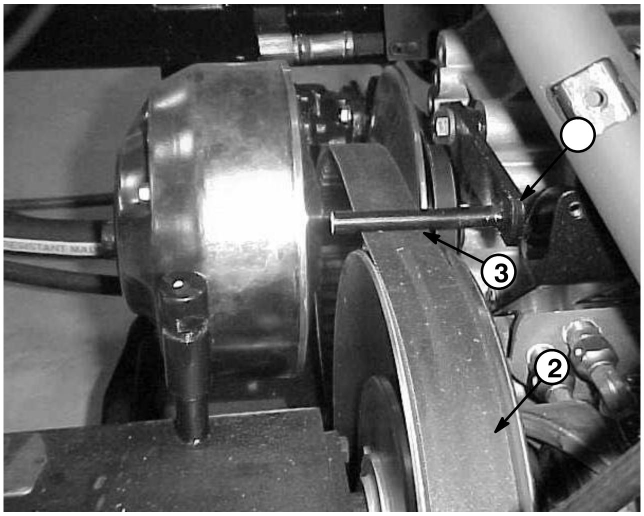

Figure 7

1. **Belt guide**
2. **Drive belt**
3. **Clearance location**

Drive Train

Drive Clutch

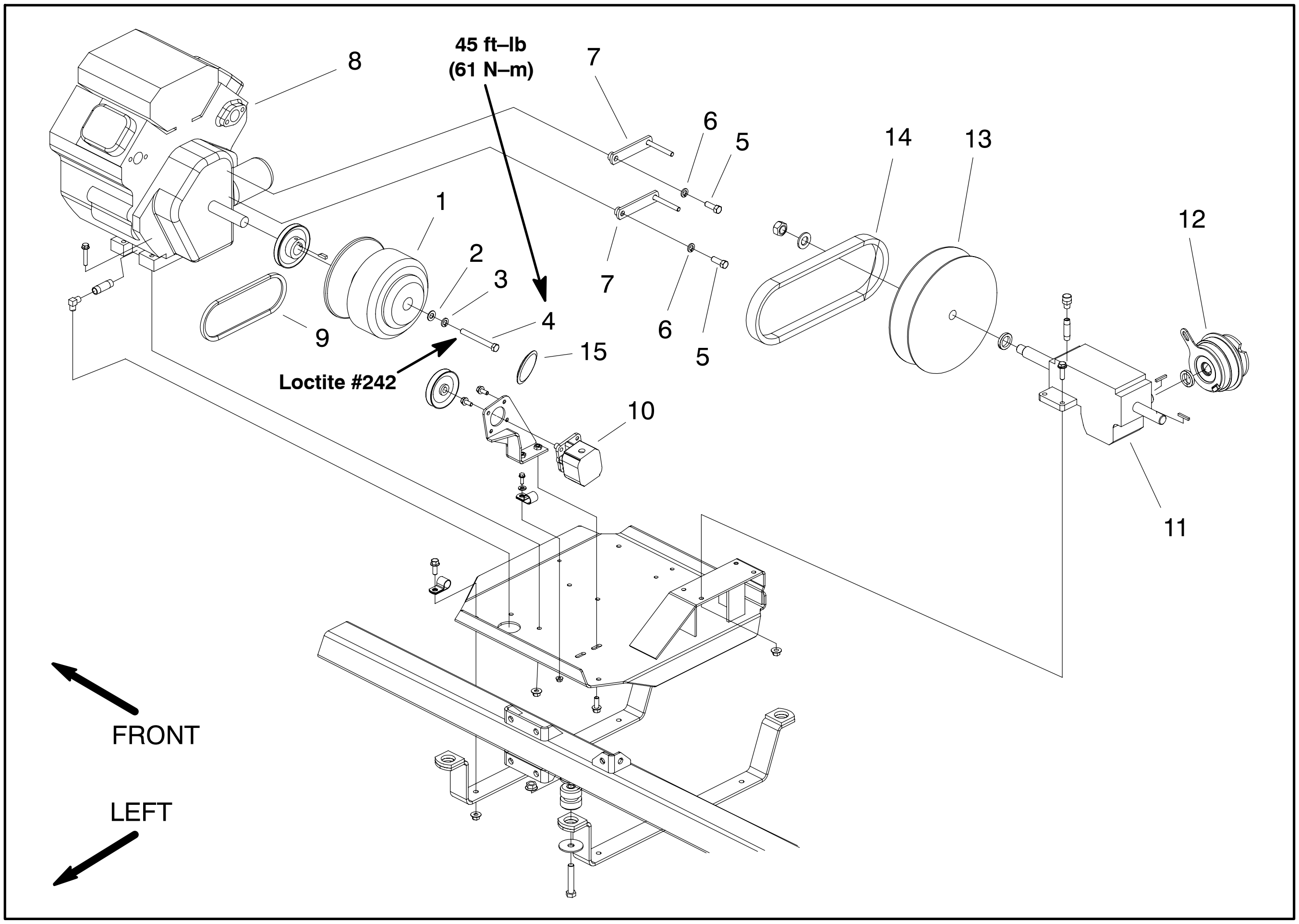

Figure 8

1. Drive clutch
2. Flat washer
3. Lock washer
4. Cap screw
5. Cap screw
6. Lock washer
7. Belt guide
8. Engine
9. Steering pump belt
10. Steering pump
11. Pump drive gearbox
12. Pump drive electric clutch
13. Driven clutch
14. Drive belt
15. Clutch cap

Removal (Fig. 8)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. To ease drive clutch removal, lower engine mounting plate from machine (see Engine Mounting Plate Assembly Removal in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

3. Remove drive belt from the drive clutch (see Drive Belt Service).

4. Carefully remove plastic clutch cap from the drive clutch.

5. Remove cap screw, lock washer, and flat washer securing the drive clutch to the engine tapered crankshaft.

IMPORTANT: Grease end of clutch removal tool lightly to prevent damage to removal tool. Prevent damage to clutch threads; thread tool only enough to remove the clutch.

IMPORTANT: The chamfered end of the clutch removal tool can damage the engine crankshaft threads. When using the clutch removal tool on the Multi Pro sprayer, position a thick washer or spacer on the end of the engine crankshaft before installing the removal tool into the clutch.

6. Use clutch removal tool (see Special Tools) to remove drive clutch from the engine tapered shaft.

Installation (Fig. 8)

1. Slide drive clutch onto engine shaft.

2. Apply Loctite #242 (or equivalent) to the threads of the cap screw used to secure clutch to crankshaft. Install cap screw, lock washer, and flat washer to crankshaft. Torque cap screw 45 ft–lb (61 N–m) to secure drive clutch.

3. Carefully install plastic cap to the drive clutch.

4. Install drive belt to the drive clutch (see Drive Belt Service).

5. Raise engine mounting plate assembly to machine (see Engine Mounting Plate Installation in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

Drive Clutch Service

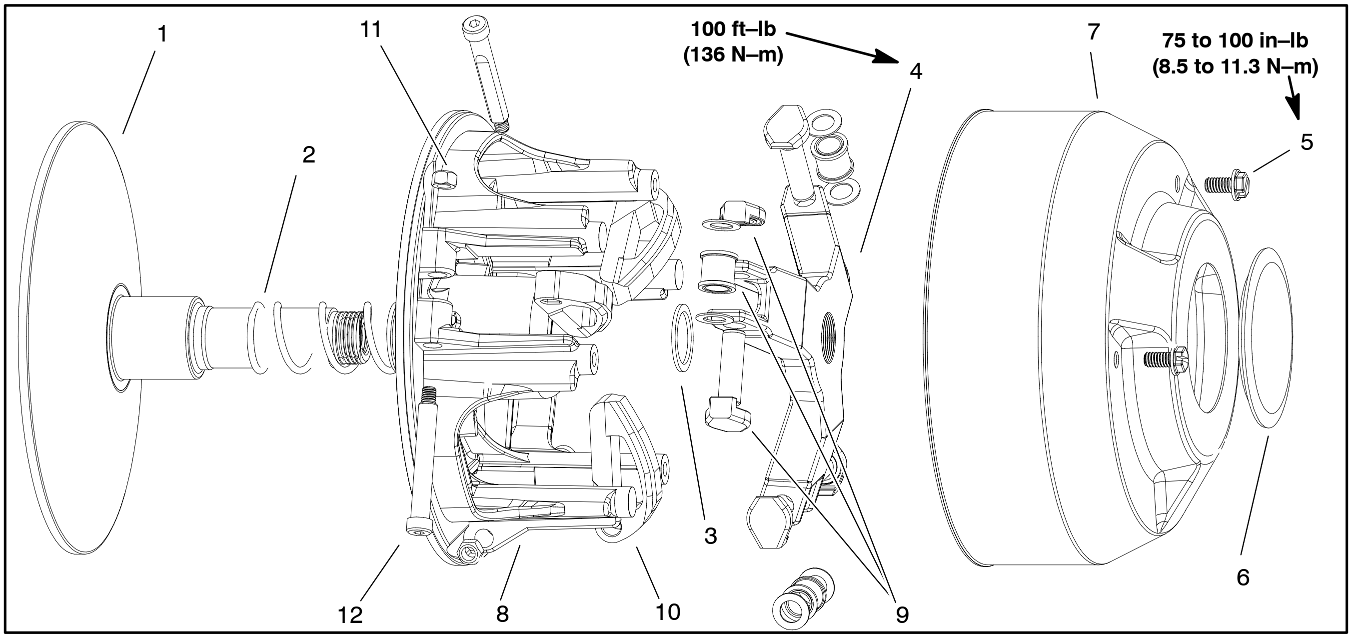

Figure 9

1. Fixed sheave
2. Spring
3. Washer
4. Spider assembly
5. Cap screw (3 used)
6. Plastic cap
7. Cover
8. Moveable sheave
9. Roller kit (3 used)
10. Cam weight (3 used)
11. Lock nut (3 used)
12. Pilot bolt (3 used)

Disassembly (Fig. 9)

IMPORTANT: Do not pry off cover, damage may result. Cover should pop off.

1. Remove cap screws securing the cover to the movable sheave. Pull cover from clutch.

2. Use two 1/4–20 X 1" cap screws to secure the clutch holding bar (see Special Tools) to the drive clutch (Fig. 10).

3. Place clutch with attached clutch holding bar into vise.

4. Matchmark position of spider and moveable sheave for reassembly.

IMPORTANT: Use clutch service tool kit to remove spider. Unequal pressure on the cam towers may damage them.

CAUTION

Remove spider from fixed sheave slowly. The moveable sheave is under pressure from the spring.

5. Using spider removal spanner tool (see Special Tools), remove spider from the fixed sheave post (Fig. 10).

6. Disassemble clutch as needed using Figure 9 as a guide.

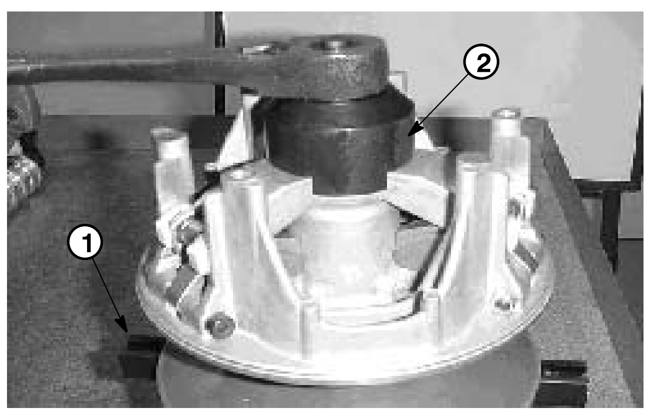

Figure 10

1. Clutch holding bar
2. Spanner

Inspection

1. Inspect the tapered ends of the crankshaft and primary fixed sheave for scratches. If either is severely scratched, replace component. If scratches are minor, burnish the component with emery cloth.

2. Check the contact surface of the cam weights. If worn, replace all cam weights as a set (Fig. 11).

3. Check the rollers. If binding or uneven wear is found, replace all rollers as a set (Fig. 12).

4. Clean pilot bolts and roller pins with 800 – 1000 grit abrasive paper. If the chrome–plated surface of the bolts or pins is scaled off, replace the damaged components.

5. Check the contact surface of the movable sheave for wear and/or fraying. If surface is worn/frayed, replace component.

6. Inspect the clutch spring and replace if damaged or fatigued.

Assembly (Fig. 9)

1. If removed, install rollers, washers, and roller pins to spider. Roller pins should be lubricated with Comet Clutch Lube GP–730 A or equivalent.

2. Lubricate cam weights with Comet Clutch Lube GP–730–A or equivalent. Make sure lubricant penetrates to pilot bolts by rotating and sliding the weights side to side, or remove weights if needed to lubricate properly. Assemble cam weights to moveable sheave as follows:

A. Make sure the threads of the pilot bolts are clean and dry. Apply Loctite #271 (or equivalent) to the threads of each bolt.

IMPORTANT: To maintain the balance of the clutch, all pilot bolts must be installed with their threads pointing in a clockwise direction (Fig. 13).

B. Immediately install new lock nuts on the pilot bolts. Tighten nuts until they just touch the sheave casting. Never reuse lock nuts.

3. Apply Loctite #271 (or equivalent) to the threads of the fixed sheave post.

4. Install spider to the fixed sheave post using clutch service tool kit (see Special Tools). Make sure to align matchmark.

5. Torque spider to 100 ft–lb (136 N–m).

6. Position cover to clutch. Secure cover to the movable sheave with cap screws. Torque cap screws from 75 to 100 in–lb (8.5 to 11.3 N–m).

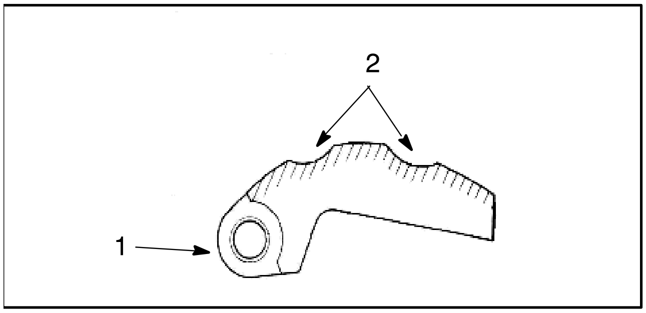

Figure 11

1. **Cam weight**
2. **Worn contact surface**

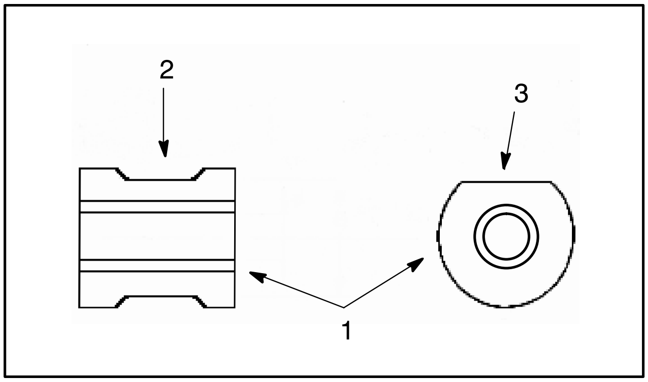

Figure 12

1. **Roller**
2. **Weight contact surface**
3. **Roller uneven wear**

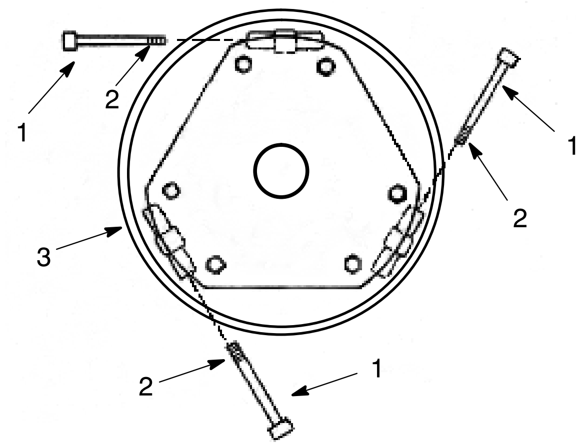

Figure 13

1. **Pilot bolt**
2. **Pilot bolt threads**
3. **Moveable sheave**

Drive Train

Driven Clutch

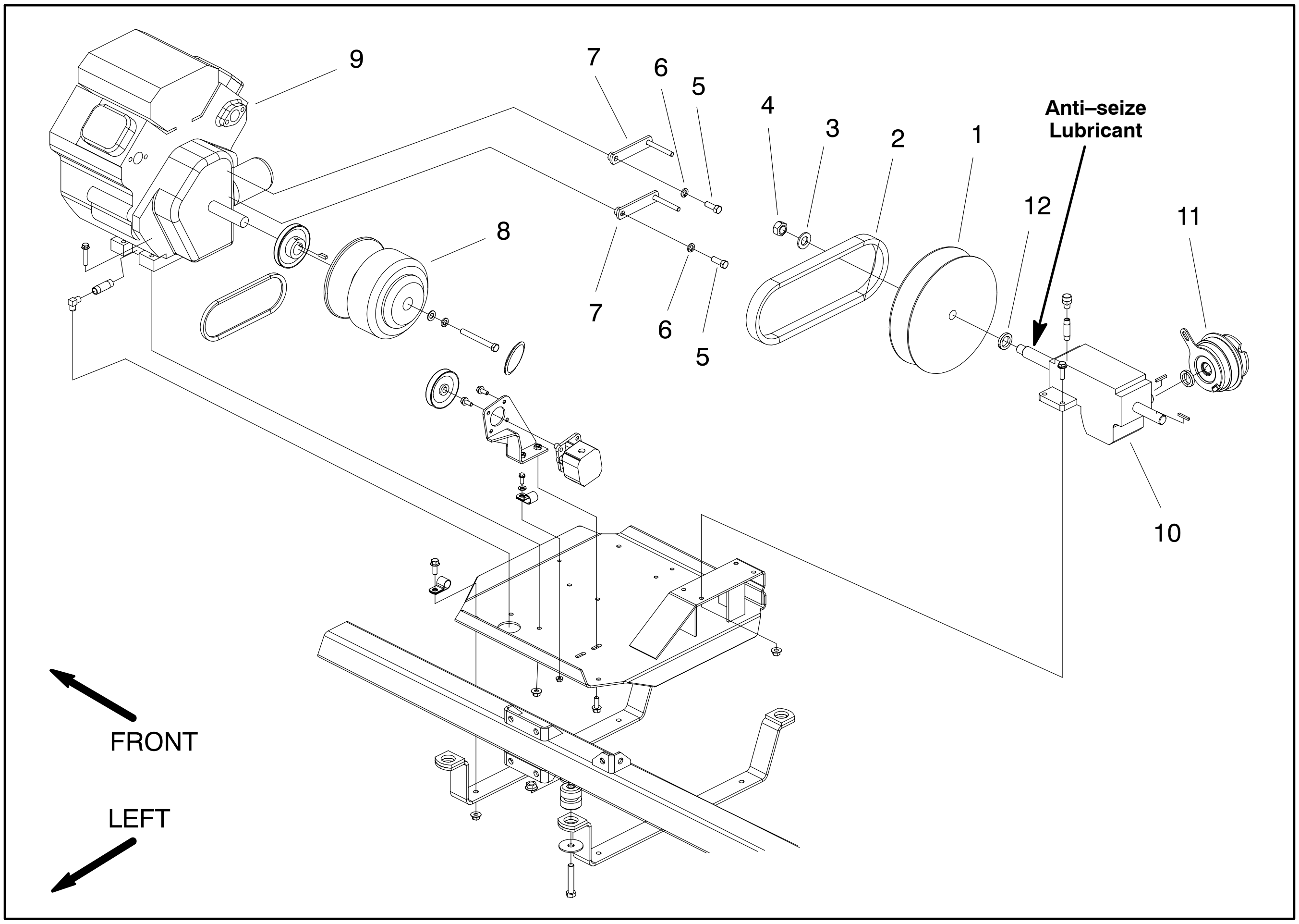

Figure 14

1. **Driven clutch**
2. **Drive belt**
3. **Flat washer**
4. **Lock nut (LH thread)**
5. **Cap screw**
6. **Lock washer**
7. **Belt guide**
8. **Drive clutch**
9. **Engine**
10. **Pump drive gearbox**
11. **Pump drive electric clutch**
12. **Spacer**

Removal (Fig. 14)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. To ease driven clutch removal, lower engine mounting plate from machine (see Engine Mounting Plate Assembly Removal in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

3. Remove drive belt from the driven clutch (see Drive Belt Service).

IMPORTANT: The gearbox input shaft and lock nut that secures the driven clutch have left hand threads.

4. Remove lock nut and flat washer securing the driven clutch to the input shaft of the pump drive gearbox.

5. Pull driven clutch from the input shaft.

Installation (Fig. 14)

1. Apply anti–seize lubricant to gearbox input shaft.

2. Position driven clutch to the gearbox input shaft. Make sure pulley side of the clutch faces away from the gearbox case.

IMPORTANT: The gearbox input shaft and locknut that secures the driven clutch have left hand threads.

3. Secure driven clutch to the input shaft with lock nut and flat washer.

4. Install drive belt to the driven clutch (see Drive Belt Service).

5. Raise engine mounting plate to machine (see Engine Mounting Plate Assembly Installation in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

Ramp Button Replacement (Fig. 15)

1. Remove drive belt from the driven clutch (see Drive Belt Service).

2. Turn fixed and moveable sheaves in opposite directions so buttons are separated sufficiently enough from the ramp to allow removal.

3. Place small block of wood between the outer ramps to keep the ramps apart.

CAUTION

To prevent burns when heating, hold allen wrench with locking pliers.

4. Clamp long end of a 2 mm allen wrench with locking pliers. Heat short end of the allen wrench until it is red hot.

5. Insert hot end of the allen wrench into the button so the button melts around the end of the wrench. Hold wrench in place until the button hardens.

6. Pull and twist on the allen wrench to remove the button from the ramp.

NOTE: If the new button is difficult to install, sand its mounting tab as necessary. If the button is loose, apply Loctite #242 (or equivalent) on its mounting tab.

7. Install new button to ramp. Push button in straight with a screw driver by prying against the ramp.

8. Remove and install remaining buttons.

9. Install drive belt to the driven clutch (see Drive Belt Service).

Check Driven Clutch Spring Torsion (Fig. 15)

1. Place transaxle in gear to prevent the fixed sheave from moving.

2. Remove drive belt from the driven clutch (see Drive Belt Service).

IMPORTANT: Use protective strips of soft metal when clamping the moveable sheave with locking pliers to prevent damage to the sheave.

3. Clamp moveable sheave with locking pliers.

4. Measure spring torsion.

   A. Pull spring tension scale tangentially to the outer diameter of the moveable sheave.

   B. When the button on the ramp of the moveable sheave is 0.125” (3.18 mm) from the ramp of the fixed sheave, read the scale.

   C. The reading should be 16 to 20 lbf (71 to 89 N).

5. If the above specification is not met, replace the driven clutch.

6. Install drive belt to the driven clutch (see Drive Belt Service).

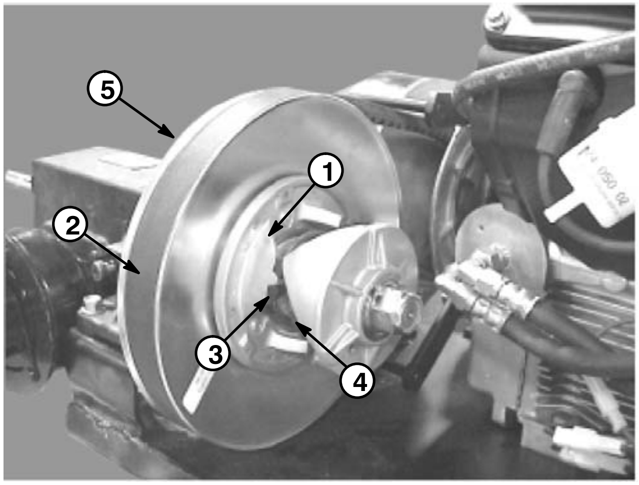

Figure 15

1. **Moveable sheave**
2. **Drive belt**
3. **Button**
4. **Ramp (fixed sheave)**
5. **Fixed sheave**

Drive Train

Pump Drive Gearbox

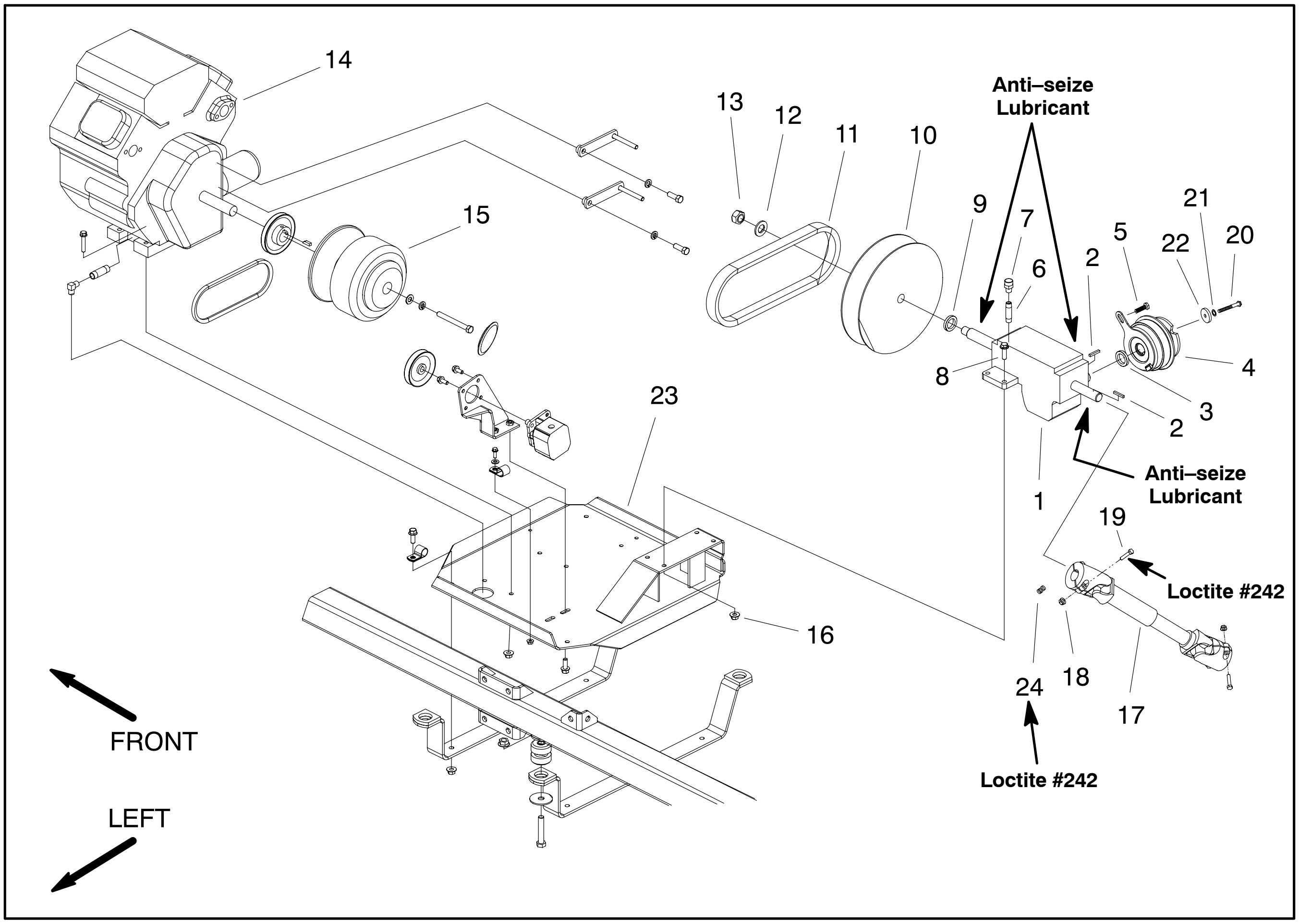

Figure 16

1. Pump drive gearbox
2. Key
3. Spacer
4. Pump drive electric clutch
5. Shoulder bolt
6. Coupler/nipple
7. Breather
8. Flange head screw (4 used)
9. Spacer
10. Driven clutch
11. Drive belt
12. Flat washer
13. Lock nut (LH thread)
14. Engine
15. Drive clutch
16. Lock nut (4 used)
17. Transaxle driveshaft
18. Flange nut (2 used)
19. Cap screw (2 used)
20. Cap screw
21. Lock washer
22. Clutch retainer
23. Engine mounting plate
24. Set screw

Removal (Fig. 16)

1. Park vehicle on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. To ease gearbox removal, lower engine mounting plate assembly from machine (see Engine Mounting Plate Assembly Removal in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

3. Remove driven clutch from pump drive gearbox (see Driven Clutch). Locate and remove spacer from gearbox input shaft.

4. Remove electric clutch from pump drive gearbox (see Electric Clutch (Pump Drive) in the Service and Repairs Section of Chapter 6 – Spray System). Locate and remove key and spacer from gearbox pump driveshaft.

5. Remove four flange head screws and lock nuts that secure gearbox to engine mounting plate. Remove gearbox from machine.

Installation (Fig. 16)

1. Position gearbox to engine mounting plate. Secure gearbox to mounting plate with four flange head screws and lock nuts.

2. Install electric clutch to gearbox shaft (see Electric Clutch (Pump Drive) in the Service and Repairs Section of Chapter 6 – Spray System).

3. Install driven clutch to gearbox (see Driven Clutch).

4. Raise and install engine mounting plate assembly to machine (see Engine Mounting Plate Assembly Installation in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

5. Check and adjust gearbox lubricant level (see Operator's Manual).

Pump Drive Gearbox Service

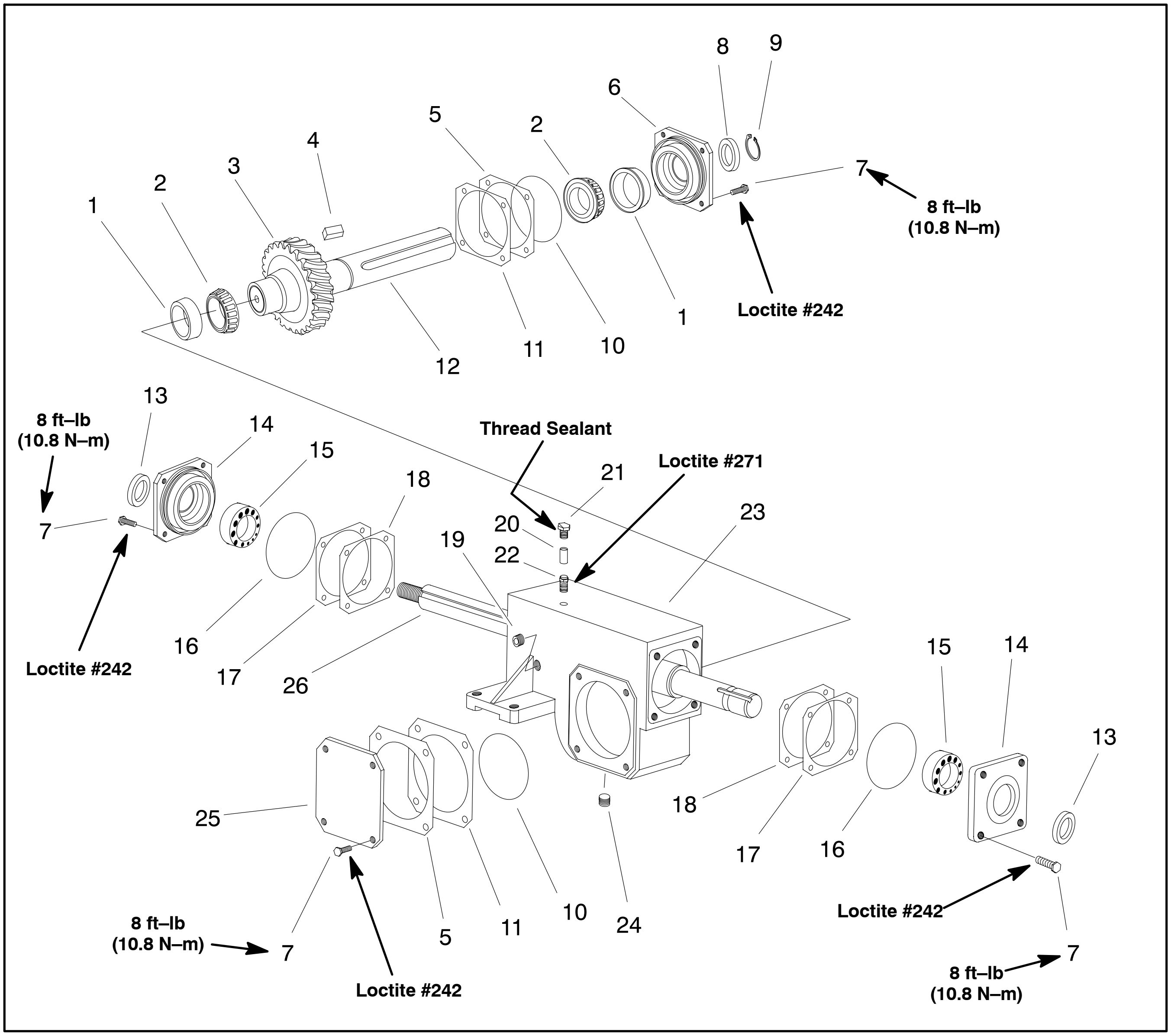

Figure 17

1. **Bearing cup**
2. **Bearing cone**
3. **Worm gear**
4. **Key**
5. **Red shim (.002")**
6. **Open output cap**
7. **Cap screw (4 per cap)**
8. **Output shaft seal**
9. **Retaining ring**
10. **O–ring**
11. **Blue shim (.005")**
12. **Output shaft**
13. **Input shaft seal**
14. **Open input cap**
15. **Ball bearing**
16. **O–ring**
17. **Red shim (.002")**
18. **Blue shim (.005")**
19. **Oil level plug**
20. **Coupling**
21. **Breather**
22. **Nipple**
23. **Gearbox housing**
24. **Drain plug**
25. **Closed output cap**
26. **Worm (input) shaft**

Disassembly (Fig. 17)

1. Drain lubricant from gearbox.

2. Remove retaining ring (item 9) from output shaft.

3. Loosen and remove cap screws that secure output caps (item 6 and 25) to gearbox housing. Remove caps with bearing cups and o–rings. Remove shims.

4. Carefully remove output shaft (item 12) with worm gear and bearing cones from housing.

5. Loosen and remove cap screws that secure both open input caps (item 14) to gearbox housing. Remove caps and o–rings from housing. Remove shims.

6. Carefully pull worm (input) shaft (item 26) with bearings from housing.

7. Remove seals from open caps taking care not to damage seal bores. Clean seal bore in caps. Remove and discard o–rings from caps.

8. If required, press bearings from input shaft (item 26).

9. If necessary, remove bearing cups from output caps. Make sure to remove bearing cups evenly to prevent damage to output caps.

IMPORTANT: Do not attempt to remove both bearing cones and gear from output shaft at the same time. The key (item 4) will cause severe damage to gear, shaft, and bearings.

10. If worm gear (item 3) and bearing cones (item 2) are to be removed from output shaft, support bottom side of gear and press shaft down through one bearing cone and gear (Fig. 18). Remove key from shaft. Second bearing cone can then be pressed from shaft.

11. Thoroughly clean all gearbox components and inspect for evidence of wear or damage. Replace internal components as needed.

Assembly (Fig. 17)

1. If removed, install bearings onto worm (input) shaft. Press on the inner bearing race until the bearing is tight against the shaft shoulder.

2. If removed, press bearing cups evenly into output caps.

3. If worm gear and bearing cones were removed from output shaft, fit key into output shaft and position gear to shaft. Press gear onto shaft until the gear is centered on the key (Fig. 19). Pressing on the inner bearing race, install bearing cones until they are tight against the gear.

4. Slide worm (input) shaft with bearings into housing noting correct orientation of shaft ends.

5. Adjust worm (input) shaft end play.

A. Position new shims to gearbox housing.

B. Install both open caps (item 14) (o–ring and seal not installed on cap) to gearbox housing. Torque cap screws 8 ft–lb (10.8 N–m) while checking for binding of shaft. If shaft binds as screws are tightened, add additional shims.

C. After both input caps are installed, check end play of worm (input) shaft. Shaft end play should be .001” to .003” (.025 to .076 mm). End play can be adjusted by adding or removing shims from between input caps and gearbox housing. Total shim thickness at one input cap should be within .005” (.13 mm) of the total shim thickness of the other cap.

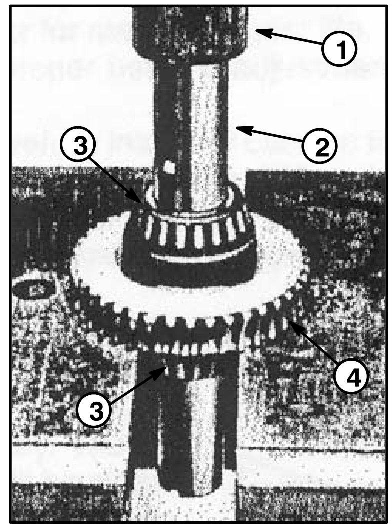

Figure 18

1. Press
2. Output shaft
3. Bearing cone
4. Worm gear

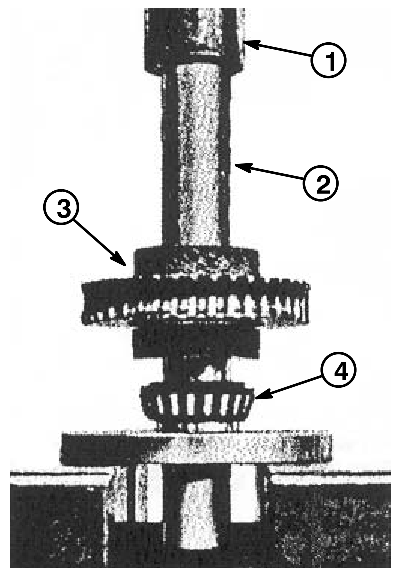

Figure 19

1. Press
2. Output shaft
3. Worm gear
4. Bearing cone

6. Once correct quantity of shims has been determined, make final assembly of input caps to gearbox housing.

A. Remove open input caps from housing.

B. Install new o–ring into groove of input cap. Apply light coat of grease on o–ring and gearbox housing bore.

C. Taking care not to damage o–ring or shims, install input cap over input shaft and into housing.

D. Apply Loctite #242 to cap screw threads. Install and torque cap screws 8 ft–lb (10.8 N–m).

7. Slide output shaft with worm gear and bearing cones into housing. Align output shaft worm gear with input shaft gear.

8. Adjust output shaft end play.

A. Position one red (.002”) and one blue (.005”) shim to both openings of gearbox housing.

B. Install both output caps (items 6 and 25) (o–rings and seals not installed on caps) to gearbox housing. Torque cap screws 8 ft–lb (10.8 N–m) while checking for binding of shaft. If shaft binds as screws are tightened, add additional shims.

C. After both output caps are installed, check end play of output shaft. Shaft end play should be .001” to .003” (.025 to .076 mm). End play can be adjusted by adding or removing shims from between output caps and gearbox housing. Total shim thickness at one output cap should be within .005” (.13 mm) of the total shim thickness of the other cap.

D. Check gear contact by applying blueing compound to worm gear (item 3) teeth. Turn worm (input) shaft while putting a slight load on output shaft. Inspect contact on gear by viewing through drain plug opening in gear housing. Worm contact should be centered on both sides of the gear (Fig. 20). To adjust gear contact while maintaining shaft end play, move shim(s) from one side of the gear housing to the other.

9. Once correct quantity of shims has been determined and gear contact has been adjusted, make final assembly of output caps to gearbox housing.

A. Remove output caps from gearbox housing.

B. Install new o–rings into groove of output caps. Apply light coat of grease on o–rings and gearbox housing bores.

C. Taking care not to damage o–rings or shims, install caps over output shaft and into housing.

D. Apply Loctite #242 to cap screw threads. Install and torque cap screws 8 ft–lb (10.8 N–m).

10. Install seals into input and output caps.

A. Apply a light coat of Permatex to outside diameter of new shaft seal.

B. To prevent seal damage, cover shaft keyway with seal protector, cellophane tape, or other thin material. Apply light coat of grease on seal lip and place seal on the shaft with the seal lip facing in.

C. Press seal evenly into cap bore until seal is flush to the cap face.

11. Install retaining ring to output shaft.

12. If breather assembly was removed from gearbox, apply Loctite #271 (or equivalent) to threads on each end of nipple. Install nipple into gearbox housing and then thread coupling onto nipple. Apply thread sealant onto threads of breather and install breather onto coupling.

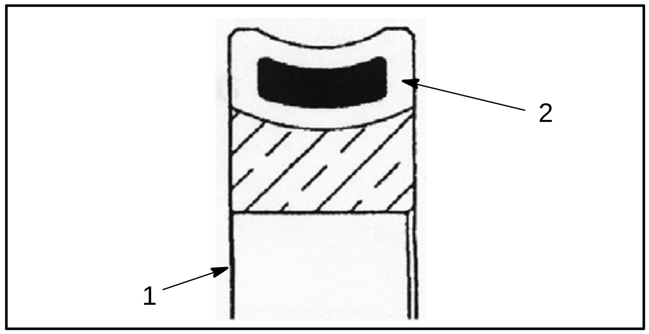

Figure 20

1. Worm gear (output shaft) **2. Gear pattern**

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Drive Train

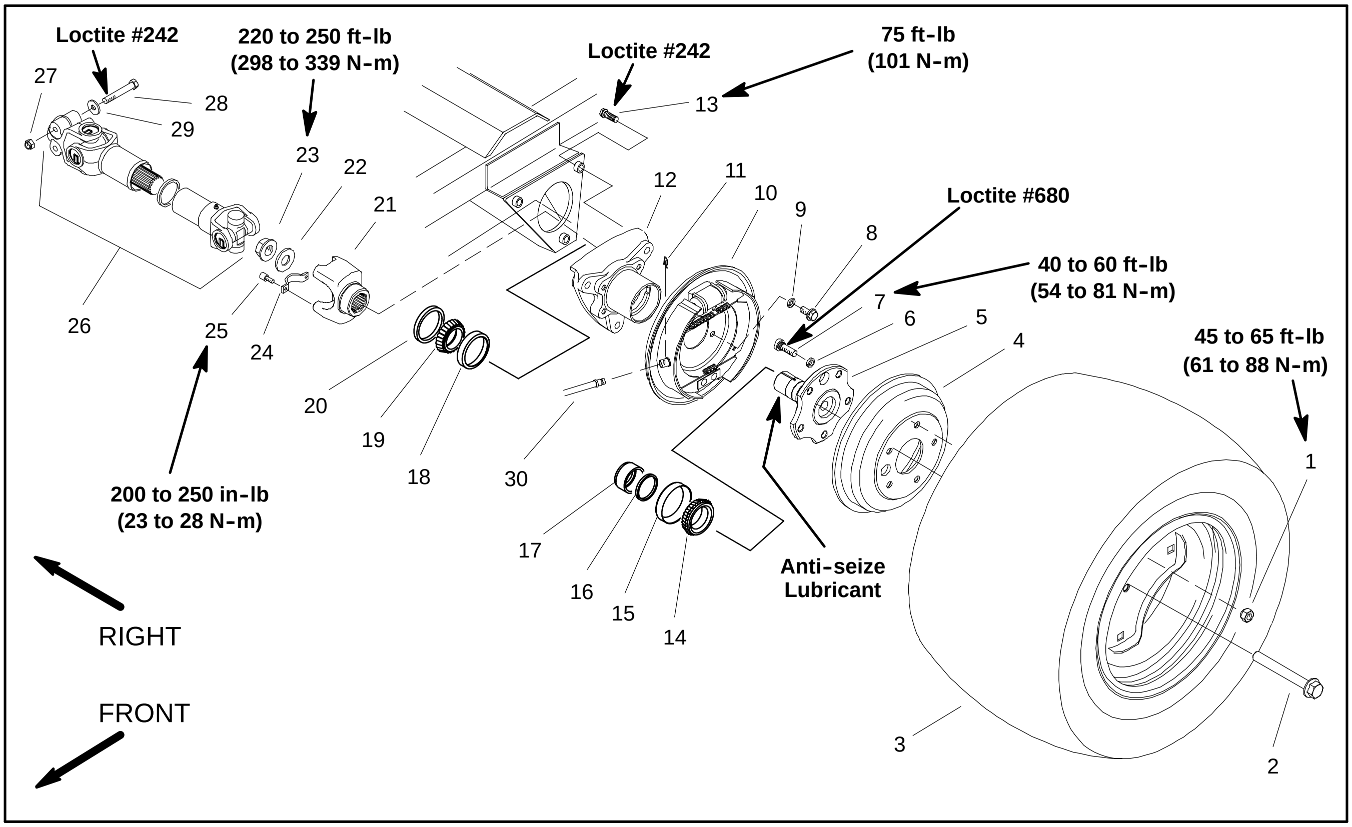

Figure 21

1. Lug nut (5 used per wheel)
2. Flange head screw
3. Wheel assembly
4. Brake drum
5. Stub axle
6. Lock washer (5 used per wheel)
7. Drive stud (5 used per wheel)
8. Cap screw (4 used per wheel)
9. Lock washer (4 used per wheel)
10. Brake assembly
11. Brake cable clip
12. Axle housing
13. Flange head screw (3 used per wheel)
14. Outer bearing cone
15. Outer bearing cup
16. Spacer
17. Bearing spacer
18. Inner bearing cup
19. Inner bearing cone
20. Bearing seal
21. End yoke
22. Flat washer
23. Flange lock nut
24. Yoke strap (2 used per yoke)
25. Bolt (4 used per yoke)
26. Driveshaft assembly
27. Lock nut (2 used per driveshaft)
28. Cap screw (2 used per driveshaft)
29. Hardened washer (2 per driveshaft)
30. Parking brake cable

Removal (Fig. 21)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Chock front wheels. Raise rear wheel using a jack or hoist (see Jacking Instructions in Operator's Manual). Block rear of machine.

3. Loosen and remove lug nuts. Remove rear wheel. Remove brake drum (see Rear Wheels and Brakes in Service and Repairs Section of Chapter 8 – Chassis).

NOTE: Loosening driveshaft at transaxle will allow easier driveshaft removal from end yoke.

4. Remove the straps securing driveshaft bearing cross to the end yoke, then disconnect driveshaft from the end yoke.

5. Loosen flange lock nut that secures end yoke to stub axle. Remove flange lock nut, flat washer, and flange head screw. Pull end yoke from stub axle.

6. Carefully slide stub axle from axle housing.

7. To remove driveshaft from transaxle, loosen and remove lock nuts, cap screws, and hardened washers securing driveshaft to splined axle shaft of transaxle. Slide driveshaft outward and remove from transaxle.

8. To remove axle housing from machine:

A. Remove brake assembly from axle housing (see Rear Wheels and Brakes in Service and Repairs Section of Chapter 8 – Chassis).

B. Remove three (3) flange head screws that secure axle housing to machine frame. Remove axle housing.

Bearing Service (Fig. 21)

1. Inspect bearings and replace if necessary. If outer bearing is removed from stub axle, bearing set must be replaced.

IMPORTANT: Bearings, with bearing cups and thin spacer, are a MATCHED SET. Use one bearing set for each axle housing. Bearing set components are NOT INTERCHANGEABLE.

2. Remove bearing seal from back of axle housing.

3. Remove inner bearing cone. Slide spacers from axle housing.

4. Press inner and outer bearing cups from housing. Press outer bearing cone from stub axle.

5. Clean all parts thoroughly before reassembly.

6. Position inner and outer bearing cups to axle housing. Press bearing cups into housing until they seat against the housing shoulder.

7. Pack bearings with lithium based grease.

8. Position larger bearing cone (Item 7), wide end first, onto stub axle. Press bearing onto stub axle putting pressure on inner race of bearing. Slide thin spacer onto stub axle.

9. Insert stub axle with bearing and thin spacer into axle housing.

10. Insert large spacer onto stub axle inside housing.

11. Insert smaller, greased bearing, small end first, onto stub axle inside housing.

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

12. Install new seal over shaft and into housing. Be careful not to damage the seal during installation.

Installation (Fig. 21)

1. If removed, install axle housing to frame:

   A. Apply Loctite #242 (or equivalent) to the threads of three (3) flange head screws that mount axle housing to machine.

   B. Position axle housing to frame and install three flange head screws to secure axle housing to machine frame. Torque fasteners 75 ft–lb (101 N–m).

   C. Install brake assembly to axle housing (see Rear Wheels and Brakes in Service and Repairs Section of Chapter 8 – Chassis).

2. If driveshaft was removed from transaxle:

   A. Apply anti–seize lubricant to transaxle shaft. Slide driveshaft clamp end onto splined transaxle shaft.

   B. Apply Loctite #242 (or equivalent) to threads of cap screws that secure driveshaft to transaxle shaft.

   C. Align mounting holes in driveshaft with relief in transaxle shaft.

   D. Install cap screws, hardened washers, and lock nuts to secure driveshaft to transaxle shaft.

3. If wheel studs were removed from stub axle, apply Loctite #680 (or equivalent) to threads near head of stud. Install stud with lock washer into stub axle and torque from 40 to 60 ft–lb (54 to 81 N–m).

4. Insert stub axle with greased bearing and thin spacer into axle housing. Be careful not to damage the bearing seal during installation.

5. Apply anti–seize lubricant to splines of stub axle.

6. Slide end yoke onto stub axle shaft.

7. Insert cap screw through stub axle and end yoke. Install flat washer and flange nut onto cap screw. Torque flange nut from 220 to 250 ft–lb (298 to 339 N–m).

8. Position driveshaft cross to the end yoke. Install the straps to secure driveshaft bearing cross to the end yoke. Torque bolts from 200 to 250 in–lb (23 to 28 N–m).

9. Lubricate driveshaft grease fittings (see Operator's Manual).

10. Install brake drum and wheel. Tighten wheel nuts to a torque of 45 to 65 ft–lb (61 to 88 N–m) (see Rear Wheels and Brakes in Service and Repairs Section of Chapter 8 – Chassis).

11. Lower machine to ground.

Driveshaft Universal Joint Service

1. Remove driveshaft from machine:

   A. For transaxle driveshaft (Fig. 22) removal, see Pump Drive Gearbox Removal in this section.

   B. For rear axle driveshaft (Fig. 23) removal, see Stub Axle and Driveshaft Removal in this section.

2. Remove snap rings that secure bearings.

IMPORTANT: Yokes must be supported when removing and installing bearings to prevent damage.

3. Use a press to remove cross and bearings from yokes.

4. To install new cross and bearings:

   A. Apply a coating of grease to all bearing bores.

   B. Press one bearing partially into yoke.

   C. Insert cross into yoke and bearing.

   D. Hold cross in alignment and press bearing in until it hits the yoke.

   E. Install snap ring into yoke groove to secure installed bearing.

   F. Place second bearing into yoke bore and onto cross shaft. Press bearing into yoke and secure with snap ring.

   G. Repeat procedure for other yoke.

   H. Grease cross until grease comes out of all four (4) cups.

5. Reinstall driveshaft to machine:

   A. For transaxle driveshaft installation, see Pump Drive Gearbox Installation in this section.

   B. For rear axle driveshaft installation, see Stub Axle and Driveshaft Installation in this section.

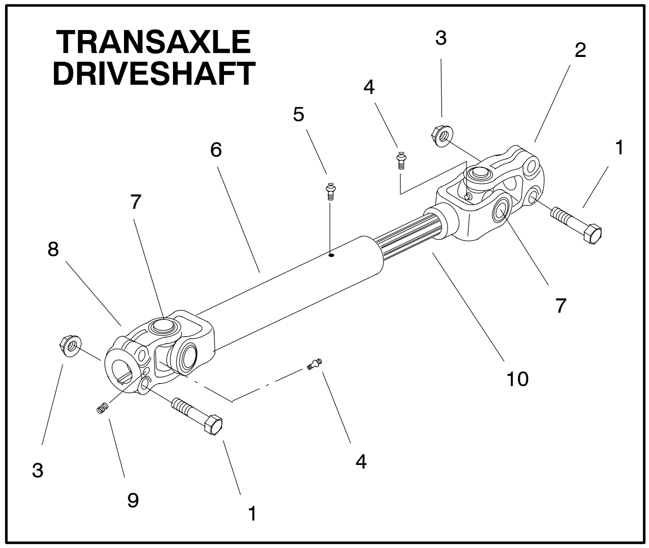

Figure 22

1. Cap screw (2 per yoke)
2. Splined yoke
3. Flange nut (2 per yoke)
4. Grease fitting
5. Grease fitting
6. Yoke and tube
7. Cross and bearing kit
8. Keyed yoke
9. Set screw
10. Yoke and shaft

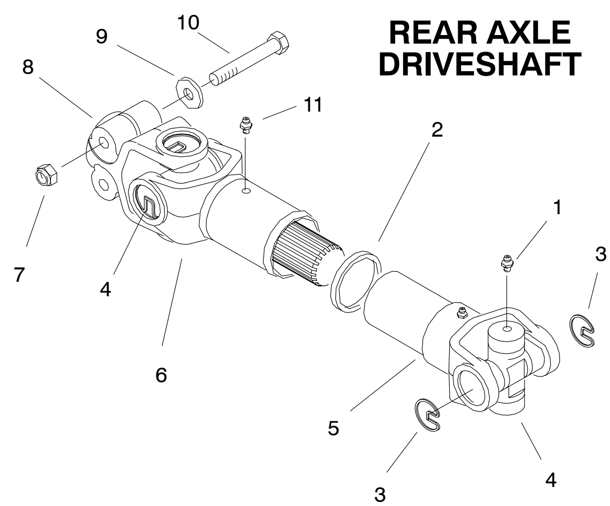

Figure 23

1. Grease fitting
2. Seal
3. Snap ring
4. Cross and bearing kit
5. Yoke and hub
6. Shaft and tube yoke
7. Lock nut (2 per yoke)
8. Clamp yoke
9. Hardened washer
10. Cap screw (2 per yoke)

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Drive Train

Transaxle

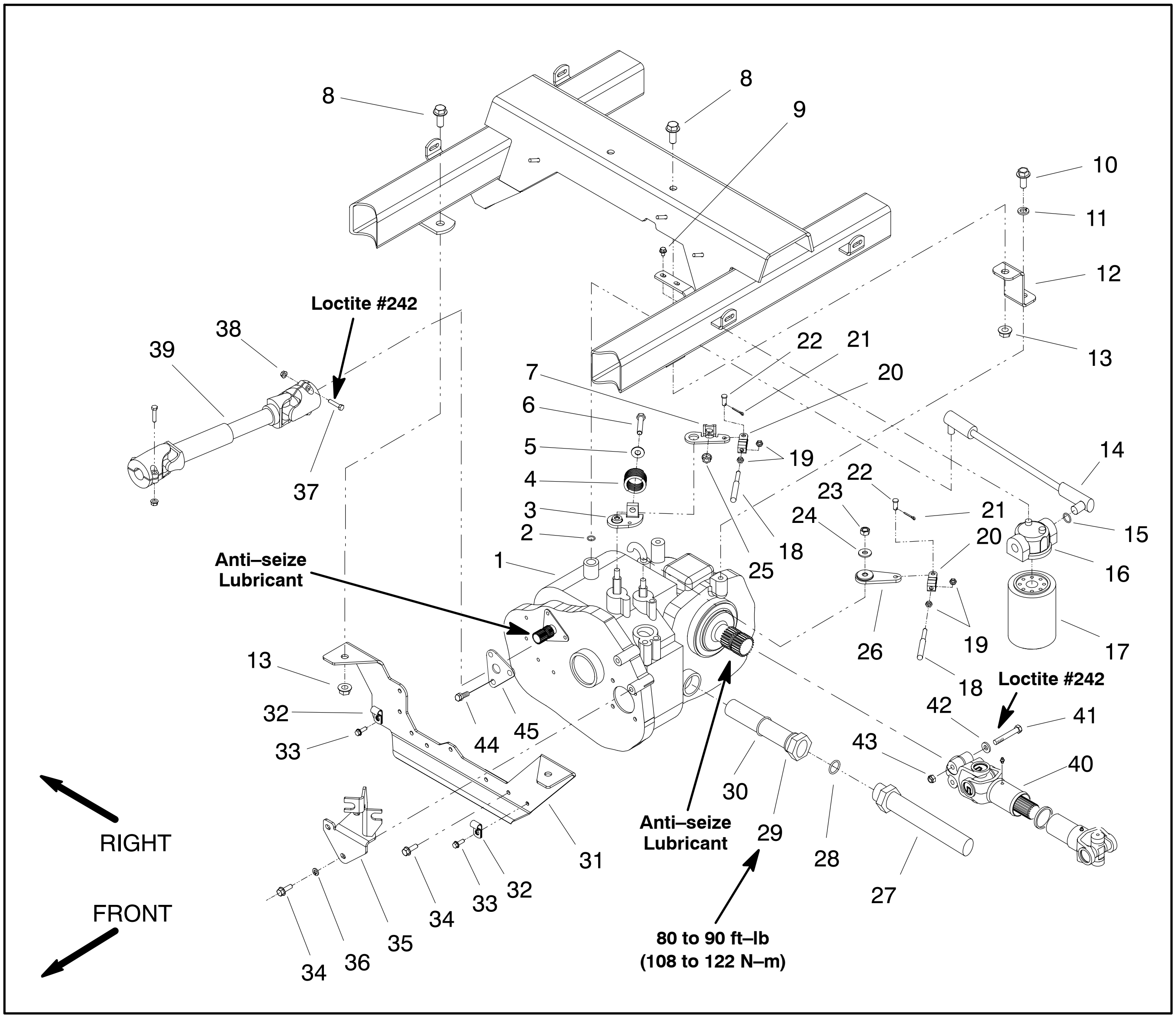

Figure 24

1. Transaxle assembly
2. O–ring
3. Shift arm
4. Compression spring
5. Flat washer
6. Cap screw
7. Shift arm plate
8. Flange head screw (4 used)
9. Flange head screw (2 used)
10. Flange head screw (2 used)
11. Lock washer (2 used)
12. Transaxle strap mount (2 used)
13. Flange nut (4 used)
14. Hydraulic return hose
15. O–ring
16. Oil filter head
17. Oil filter
18. Shift cable
19. Jam nut
20. Cable clevis
21. Cotter pin
22. Clevis pin
23. Lock nut
24. Hardened washer
25. Flange nut
26. Shift lever
27. Suction hose
28. O–ring
29. Strainer
30. O–ring
31. Front transaxle mount
32. LH brake cable R–clamp (2 used)
33. Flange head screw (2 used)
34. Flange head screw (10 used)
35. Shift cable mount
36. Lock washer
37. Cap screw (2 used)
38. Flange nut
39. Transaxle driveshaft
40. Driveshaft assembly
41. Cap screw (2 used per driveshaft)
42. Hardened washer
43. Lock nut
44. Cap screw (3 used)
45. Input shaft cover plate

Removal (Fig. 24)

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

2. Drain oil from transaxle (see Operator's Manual).

3. Disconnect negative (–) cable from battery first and then positive (+) cable.

4. Block front wheels. Jack–up rear of machine and secure machine with jack stands or blocks so transaxle can be removed by sliding out under rear of machine (see Jacking Instructions in Operator's Manual).

5. Unplug speed sensor connector from machine wire harness (Fig. 25).

6. Label shift cables to ease reassembly. Loosen shift cable jam nuts at cable mount (Fig. 26). Remove cotter pin and clevis pin that attach shift cable ends to transaxle shift arm levers. Pull shift cables free from mount.

7. Drain oil from transaxle (see Operator's Manual).

8. Disconnect hydraulic return hose from top of transaxle (Fig. 26). Locate, remove, and discard hose o–ring.

9. Disconnect suction hose from transaxle (Fig. 25). Locate, remove, and discard suction hose o–ring. Position suction hose away from transaxle.

10. Put caps or plugs on all open hoses and fittings to prevent contamination.

11. Remove two (2) R–clamps that secure LH parking brake cable to front transaxle mount.

12. Remove the straps securing driveshaft bearing cross to the end yoke at both rear wheel hubs.

13. Loosen and remove cap screws, hardened washers, and lock nuts that secure driveshafts (both right and left sides) to transaxle axle shafts (Fig. 27). Remove both driveshafts from machine.

14. Loosen and remove cap screws and flange nuts that secure universal joint of transaxle driveshaft to input shaft of transaxle (Fig. 28). Disconnect driveshaft from transaxle input shaft.

15. Support transaxle to prevent it from shifting or falling. Remove four flange nuts that secure transaxle mounts to machine frame. Lower transaxle with mounts from machine.

16. If required, remove front transaxle mount, shift cable mount, and transaxle strap mounts from transaxle.

17. Remove oil strainer from transaxle. Locate, remove, and discard strainer o–ring.

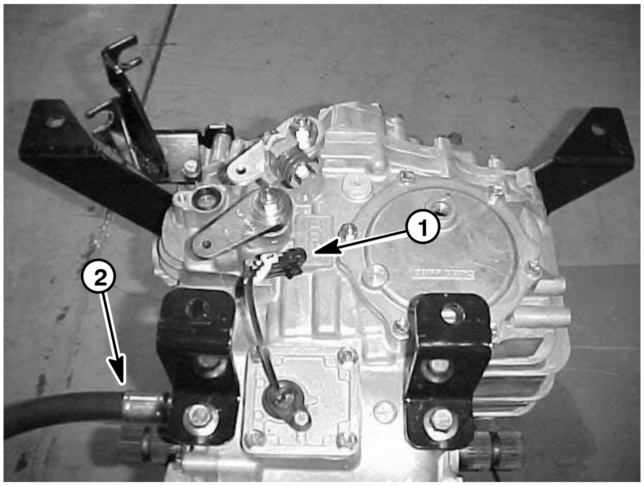

Figure 25

1. **Speed sensor connector** 2. **Suction hose**

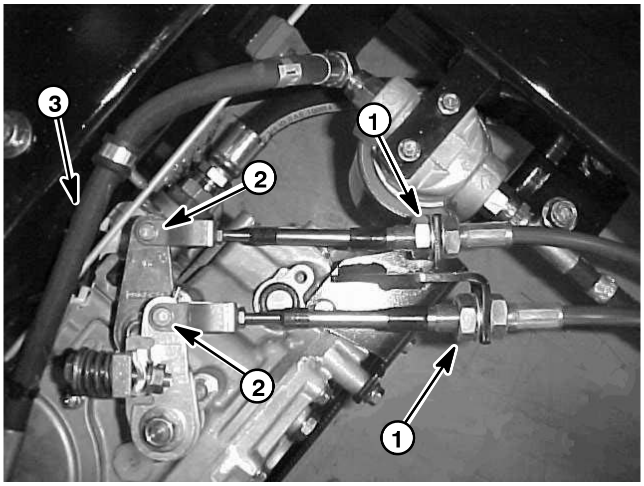

Figure 26

1. **Shift cable jam nut**
2. **Clevis pin**
3. **Hydraulic return hose**

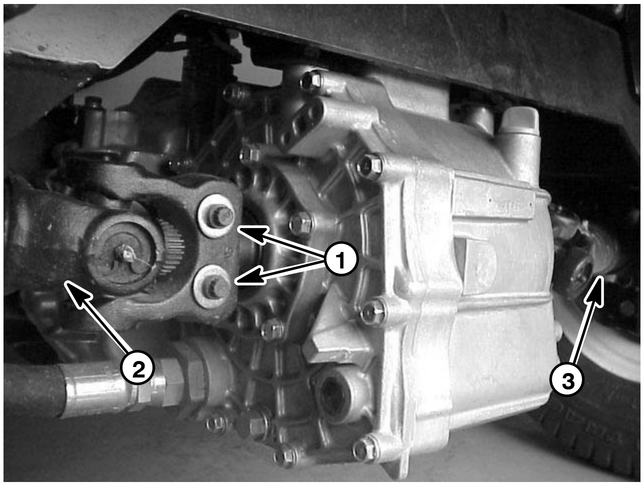

Figure 27

1. **Cap screw w/washer**
2. **Driveshaft (LH)**
3. **Driveshaft (RH)**

Drive Train

Installation (Fig. 24)

1. Lubricate new oil strainer o–ring with Dexron III ATF oil and position on strainer. Install strainer into transaxle and torque from 80 to 90 ft–lb (108 to 122 N–m).

2. If removed, install front transaxle mount, shift cable mount, and transaxle strap mounts to transaxle.

3. Apply anti–seize lubricant to transaxle shafts.

4. Position transaxle to machine. Slide universal joint of transaxle driveshaft onto input shaft of transaxle. Slide both driveshafts onto transaxle axle shafts. Position driveshaft bearing cross to the end yoke at both rear wheel hubs and loosely install straps.

5. Secure transaxle to machine by installing and tightening four flange nuts onto cap screws.

6. Secure driveshafts to transaxle:

   A. Tighten the strap bolts to secure driveshaft bearing cross to the end yoke at wheel hubs. Torque bolts from 200 to 250 ft–lb (271 to 339 N–m).

   B. Align mounting holes in driveshafts with reliefs in transaxle shafts.

   C. Apply Loctite #242 (or equivalent) to threads of cap screws used to secure driveshafts to transaxle shafts.

   D. Install cap screws and flange nuts to secure driveshaft to transaxle input shaft (Fig. 28).

   E. Install cap screws, hardened washers, and lock nuts to secure driveshafts to transaxle axle shafts (Fig. 27).

7. Secure LH parking brake cable to front transaxle mount with two (2) R–clamps.

8. Remove all caps or plugs placed on hydraulic hoses and fittings during disassembly.

9. Lubricate new suction and return hose o–rings with Dexron III ATF oil. Install suction and return hoses to transaxle.

10. Position shift cables to cable mount noting cable identification made during disassembly. Center the cable threads to the cable mounts and secure cables with jam nuts (Fig. 26).

11. Check and adjust shift cables as needed (see Shift Cable Adjustment in the Adjustments section of this Chapter).

12. Secure shift cable ends to shift arm levers of transaxle with clevis pins and cotter pins.

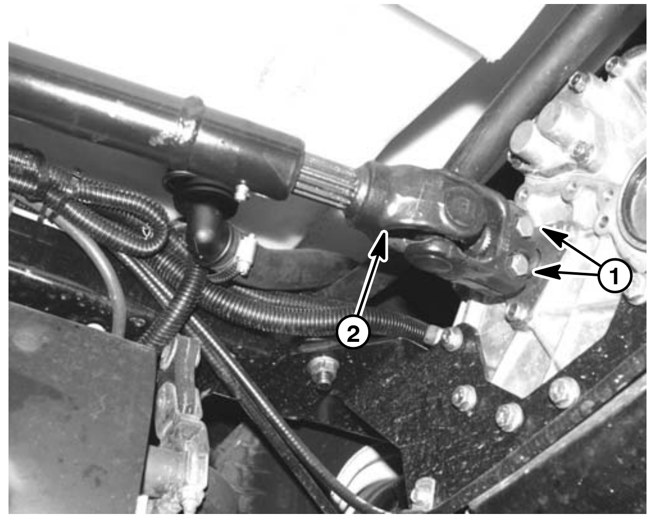

Figure 28

1. **Cap screw** 2. **Driveshaft**

13. Plug speed sensor connector into wire harness (Fig. 25).

14. Lower machine to ground.

WARNING

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

15. Connect positive (+) cable to battery first and then negative (–) cable.

16. Fill transaxle with Dexron III ATF oil (see Operator's Manual).

Transaxle Service

Transaxle Disassembly

1. Thoroughly clean outside surface of transaxle.

NOTE: Item numbers in figures are shown in order of disassembly; for example, remove Item 1 first, then Item 2, etc. Reassemble in reverse order; for example, install Item 1 last.

2. Remove three (3) cap screws that secure input shaft cover plate to transaxle. Remove cover plate.

3. Loosen four (4) cap screws (Items 1 and 2) and remove fork shaft cap (Item 3) from center plate. Note location of longer cap screw. Be careful when removing cap as steel balls inside are spring loaded.

4. Inspect fork shaft cap for cracks or damage and replace if necessary.

5. Hold hand over the area and shift R–1 and 2–3 levers to move shafts outward so two (2) balls (Item 3), two (2) springs (Item 2), and spindle lock (Item 1) can be removed from center plate.

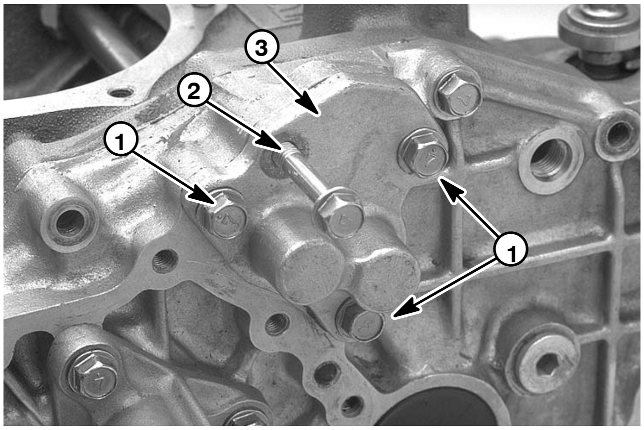

Figure 29

1. **Cap screw**
2. **Longer cap screw**
3. **Fork shaft cap**

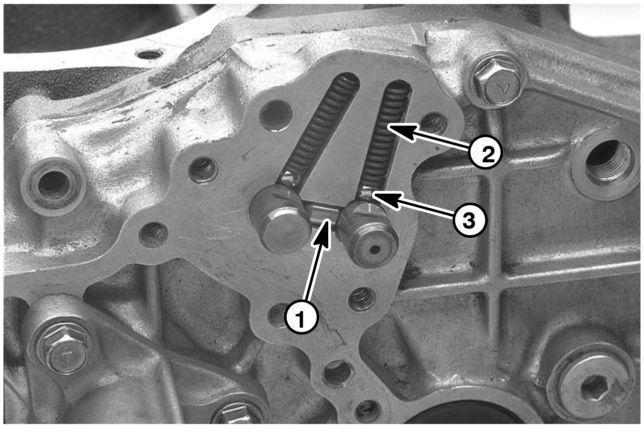

Figure 30

IMPORTANT: The center plate has one tabbed shim (Item 4) with three tabless shims (Item 2) (Fig. 31).

6. Loosen cap screws and separate center plate from transaxle case. Note dowel pin locations in transaxle case. Remove seal cap (Item 1), shims (Items 2 and 4), and snap ring (Item 3) from center plate.

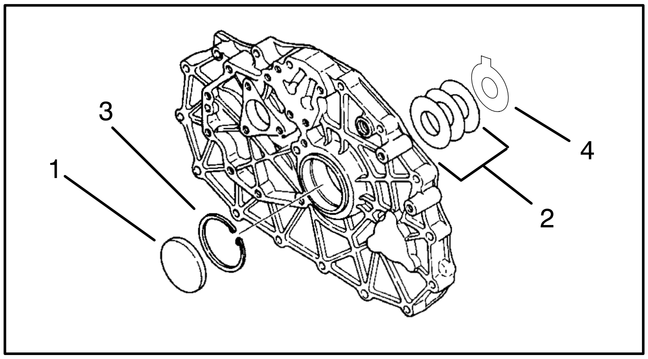

Figure 31

Drive Train

7. Remove reverse shaft (Item 1) from transaxle case.

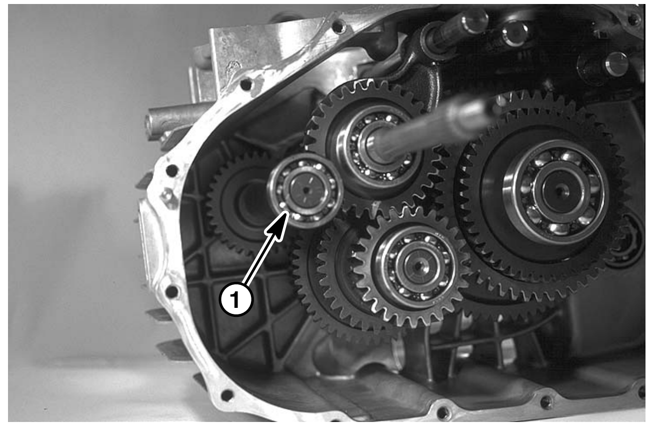

Figure 32

8. Remove main shaft assembly (Item 1) together with 2nd–3rd fork shaft assembly (Item 2) from transaxle case.

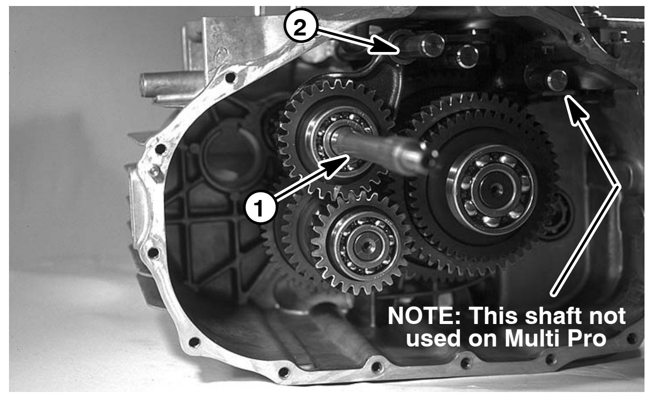

Figure 33

9. Remove, all at the same time, reduction shaft assembly (Item 1), 1st–reverse fork shaft assembly (Item 2), and countershaft assembly (Item 3)

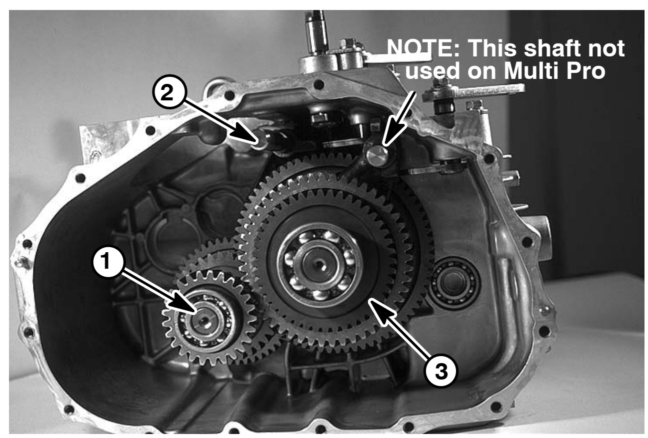

Figure 34

10. Loosen five (5) cap screws (Item 1) and remove differential carrier with L.H. axle shaft assembly (Item 2) and shims (Item 3) from side cover (Item 4).

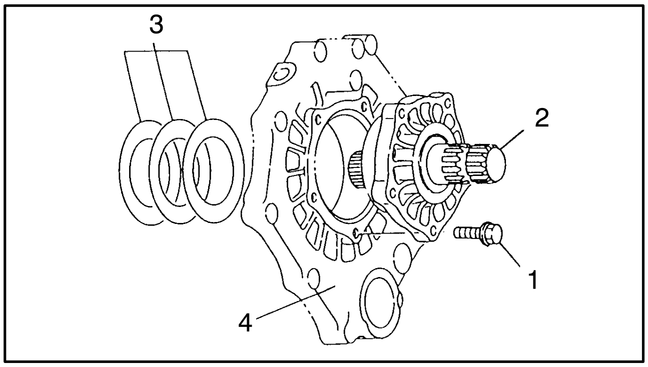

Figure 35

11. Loosen cap screws (Item 1) and remove side cover (Item 2) from transaxle case. Note locations of two dowel pins (Item 3) in transaxle case.

12. Inspect side cover for cracks or damage and replace if necessary.

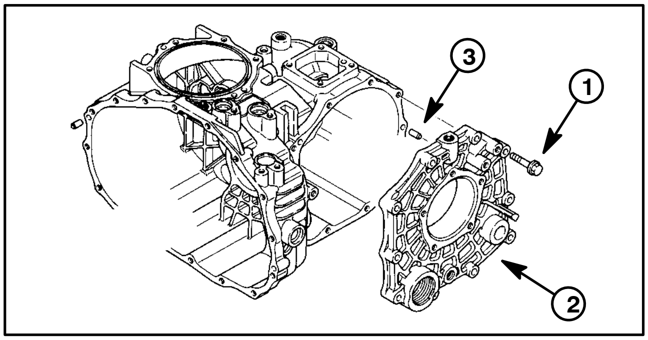

Figure 36

13. Loosen cap screws (Item 1) and remove R.H. axle shaft assembly (Item 2) from transaxle case.

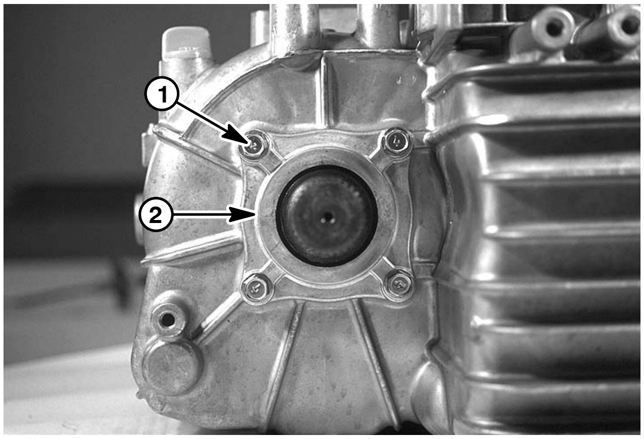

Figure 37

14. Slide differential gear assembly (Item 1) from transaxle case.

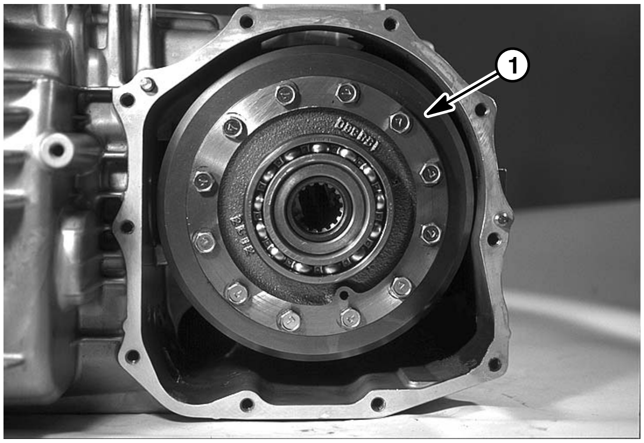

Figure 38

15. To remove shift arms:

A. Loosen and remove lock nut (Item 8) that secures 2nd–3rd shift arm (Item 1). Remove flat washer (Item 7), and 2nd–3rd shift arm together with shift arm plate (Item 6), compression spring (Item 2), lock nut (Item 5), flat washer (Item 3) and cap screw (Item 4).

B. Loosen and remove lock nut (Item 8) that secures 1st–reverse shift arm (Item 9). Remove flat washer (Item 7). Remove 1st–reverse shift arm lever.

C. Loosen and remove cap screws (Item 10). Remove lock washers (Item 11) and keeper plates (Item 12).

D. Remove oil seals (Item 13) from transaxle case.

E. Inspect shift arms and keeper plates for bending or damage and replace if necessary.

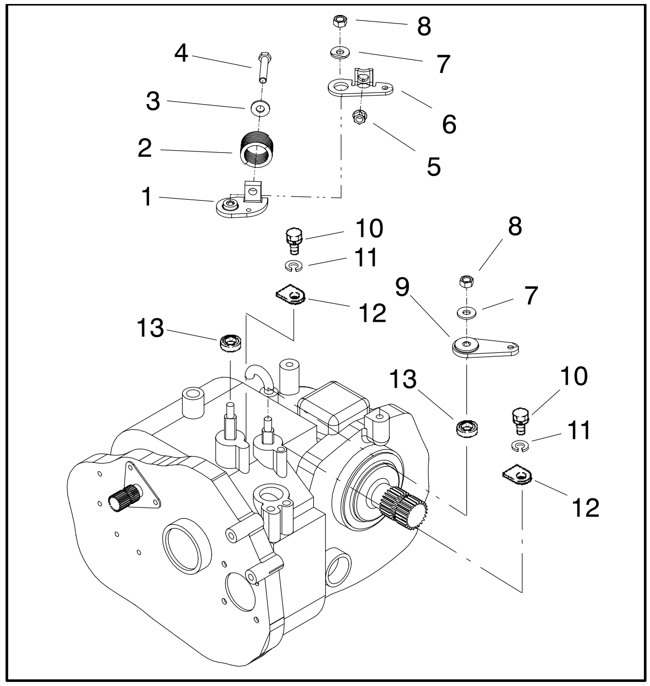

Figure 39

1. **Shift arm (2–3)**
2. **Compression spring**
3. **Flat washer**
4. **Cap screw**
5. **Lock nut**
6. **Shift arm plate**
7. **Flat washer**
8. **Lock nut**
9. **Shift arm lever (1–R)**
10. **Cap screw**
11. **Lock washer**
12. **Keeper plate**
13. **Oil seal**

16. Loosen five (5) cap screws (Item 1) and remove nut with washer (Item 2). Separate P.T.O. cover (Item 3) and O–ring from transaxle case. Inspect P.T.O. cover for cracks or damage and replace if necessary.

17. If necessary, remove oil cap (Item 4) with O–ring from transaxle case.

18. If necessary, remove air breather (Item 5) from transaxle case.

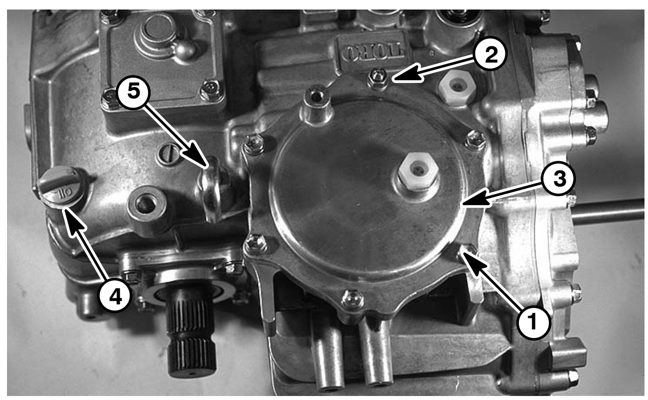

Figure 40

19. If necessary, remove cap screw with lock washer (Item 1) and slide speed sensor (Item 2) from upper cover (Item 4).

20. Loosen and remove cap screws (Item 3) that secure upper cover to transaxle case. Remove upper cover (Item 4) from case.

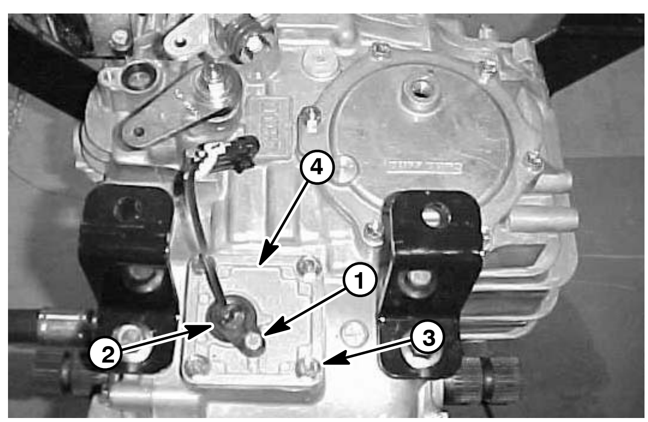

Figure 41

21. Disassemble main shaft assembly:

A. Use a bearing puller to remove bearing (Item 1) from main shaft.

B. Remove snap ring (Item 2) and thrust washer (Item 3). Measure thickness of thrust washer. Replace washer if it is less than .0709” (1.8 mm) thick.

C. Remove two (2) needle bearings (Item 5) and 36T gear (Item 4). Inspect needle bearings and replace if necessary.

D. Remove synchro ring (Item 6).

E. Remove retaining ring (Item 7).

F. Remove synchro shifter (Item 8) together with springs, hub, and three (3) keys.

G. Remove key (Item 9).

H. Remove retaining ring (Item 10).

I. Remove synchro ring (Item 6), 22T gear (Item 11), two (2) needle bearings (Item 12), and thrust washer (Item 13). Inspect needle bearings and replace if necessary.

J. Use a bearing puller to remove bearing (Item 14).

K. Remove 14T gear (Item 15), retaining ring (Item 16), 20T gear (Item 17), and 16T gear (Item 18).

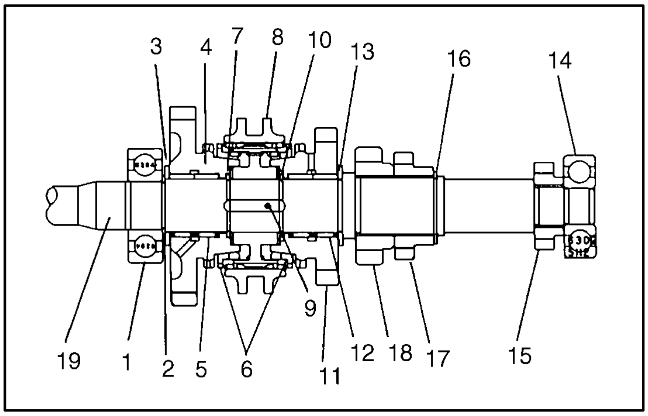

Figure 42

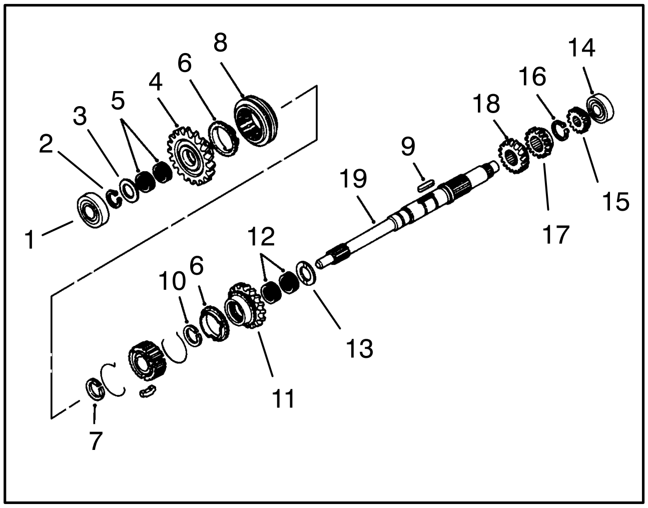

Figure 43

Drive Train

22. Disassemble reduction shaft assembly:

A. Use a bearing puller to remove bearing (Item 1) from reduction shaft.

B. Remove 25T gear (Item 2), 23T helical gear (Item 3), collar (Item 4), and 32T gear (Item 5).

C. Use a bearing puller to remove bearing (Item 6).

D. Remove thrust washer (Item 7), needle bearing (Item 9), and 40T gear (Item 8).

E. Remove retaining ring (Item 11).

F. Remove synchro shifter (Item 12) together with springs, hub, and three (3) keys.

G. Remove key (Item 13) from reduction shaft.

H. Remove synchro ring (Item 14) from 47T gear (Item 15).

I. Remove 47T gear (Item 15), needle bearings (Item 16), and thrust washer (Item 17). Inspect needle bearings and replace if necessary. Measure thickness of thrust washer. Replace thrust washer if thickness is less than .0709" (1.8 mm).

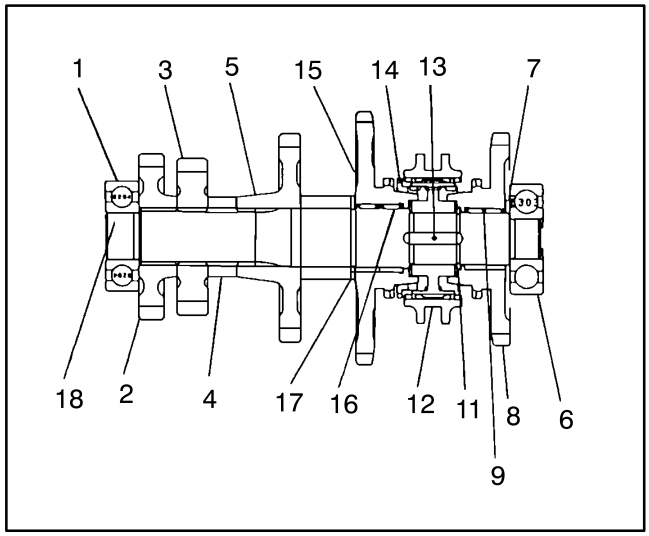

Figure 44

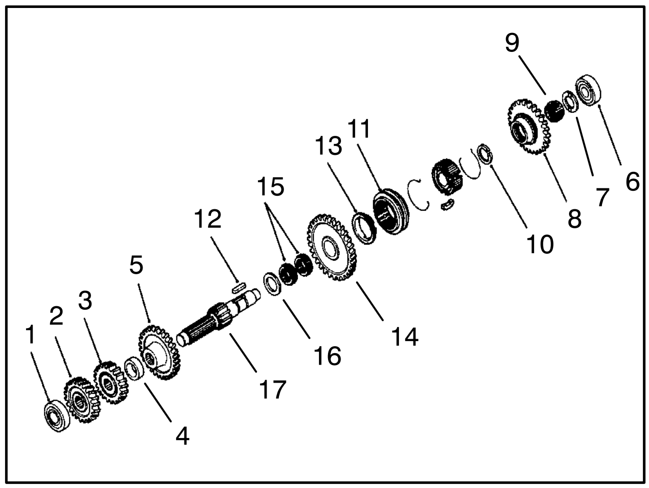

Figure 45

23. Disassemble reverse shaft assembly:

A. Use a bearing puller to remove bearing (Item 1) from reverse shaft.

B. Remove 33T gear (Item 2).

C. Use a bearing puller to remove bearing (Item 3) from reverse shaft.

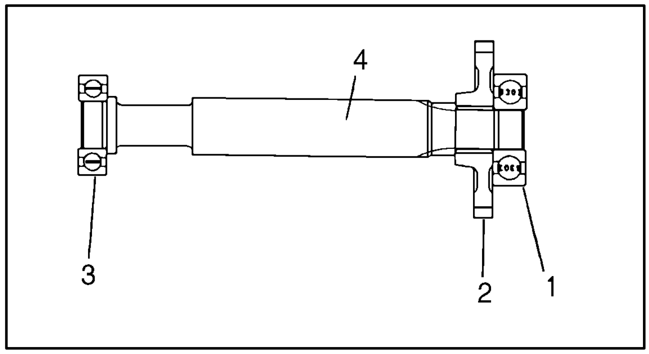

Figure 46

24. Disassemble countershaft assembly:

A. Use a bearing puller to remove bearing (Item 1) from countershaft.

B. Remove collar (Item 2) and retaining ring (Item 3).

C. Remove thrust washer (Item 4) and 49T gear (Item 5). Measure thickness of thrust washer. Replace thrust washer if thickness is less than .071" (1.8 mm).

D. Remove inner sleeve (Item 6) and thrust washer (Item 7). Inspect inner sleeve for wear and damage. Replace inner sleeve if O.D. is less than 1.258" (31.95 mm). Measure thickness of thrust washer. Replace thrust washer if thickness is less than .071" (1.8 mm).

E. Remove two (2) retaining rings (Item 8).

F. Remove shifter (Item 9) and spline collar (Item 10).

G. Remove 71T gear (Item 11). Inspect gear bushing for wear and damage. Replace gear if I.D. exceeds 1.184" (30.08 mm).

H. Remove thrust washer (Item 12), retaining ring (Item 13), and collar (Item 14). Measure thickness of thrust washer. Replace washer if thickness is less than .110" (2.8 mm).

I. Use a bearing puller to remove two (2) bearings (Item 15) from shaft.

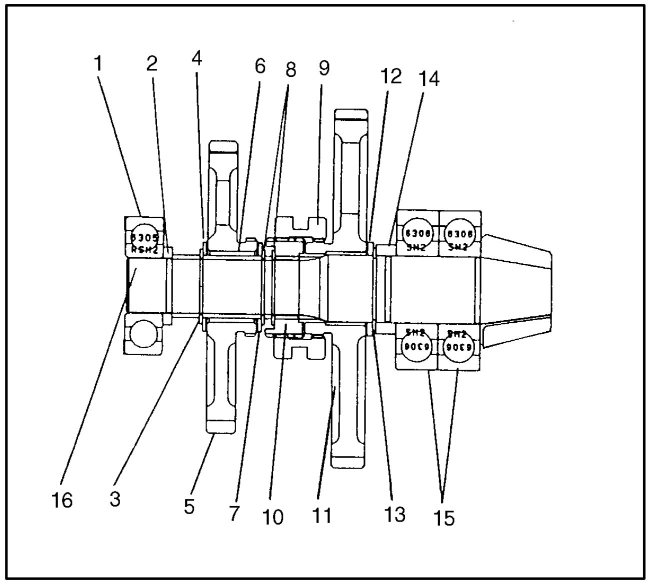

Figure 47

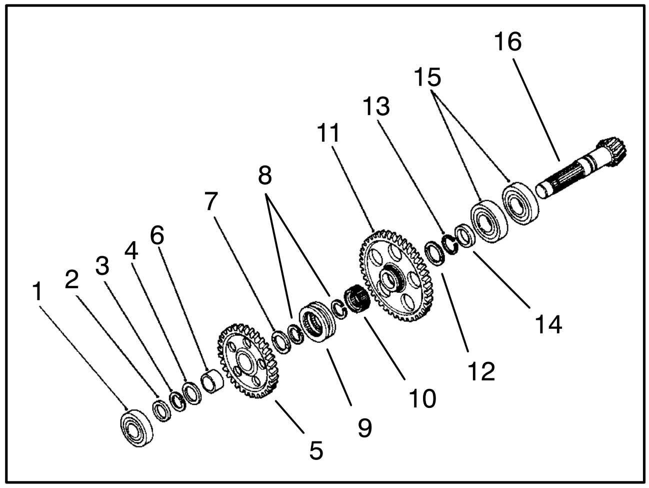

Figure 48

25. Disassemble fork shaft assemblies:

A. Remove spring pin (Item 1) from 2nd–3rd fork shaft assembly.

B. Remove shift fork (Item 2) from fork shaft (Item 3).

C. Remove spring pin (Item 4) from 1st–Reverse fork shaft assembly.

D. Remove fork (Item 5) from fork shaft (Item 5).

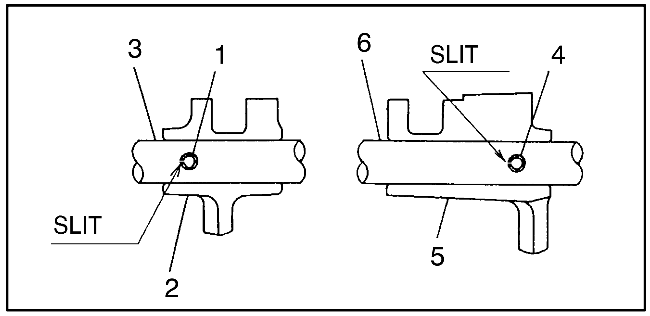

Figure 49

26. Disassemble differential gear assembly:

A. Use a bearing puller to remove bearing (Item 1) from differential case.

B. Remove retaining ring (Item 2).

C. Use a bearing puller to remove bearing (Item 3).

D. Loosen and remove twelve (12) flange head screws (Item 4) that secure ring gear (Item 5) to differential case.

E. Remove ring gear (Item 5) from differential case and remove two (2) alignment pins (Item 6).

F. Drive spring pin (Item 7) out of pinion shaft (Item 8).

G. Remove pinion shaft (Item 8) from differential case.

H. Remove two (2) differential pinion gears (Item 9) and two (2) washers (Item 10).

I. Remove L.H. side gear (Item 11), R.H. side gear (Item 12), and two (2) thrust washers (Item 13).

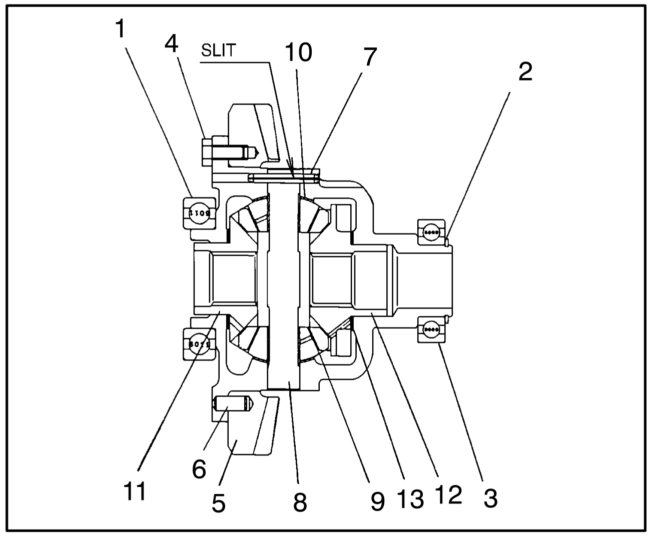

Figure 50

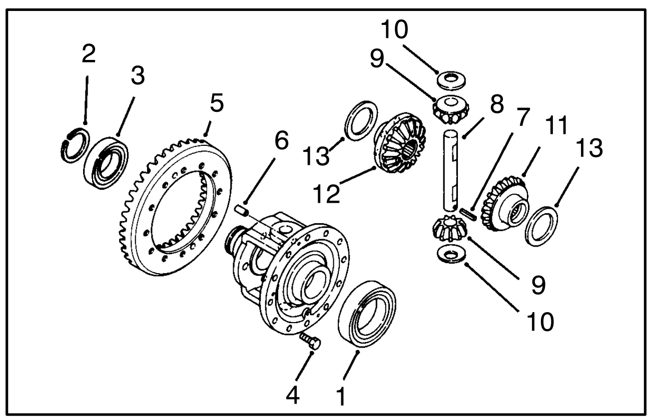

Figure 51

27. Disassemble differential carrier (L.H. axle shaft) assembly:

A. Remove O–ring (Item 1) from differential carrier.

B. Remove retaining ring (Item 2) from differential carrier.

C. Remove L.H. axle shaft assembly (Item 3) from differential carrier.

D. Remove retaining ring (Item 4) and washer (Item 5) from axle shaft.

E. Use a bearing puller to remove bearing (Item 6) from axle shaft.

F. Remove oil seal (Item 7) from differential carrier (Item 8).

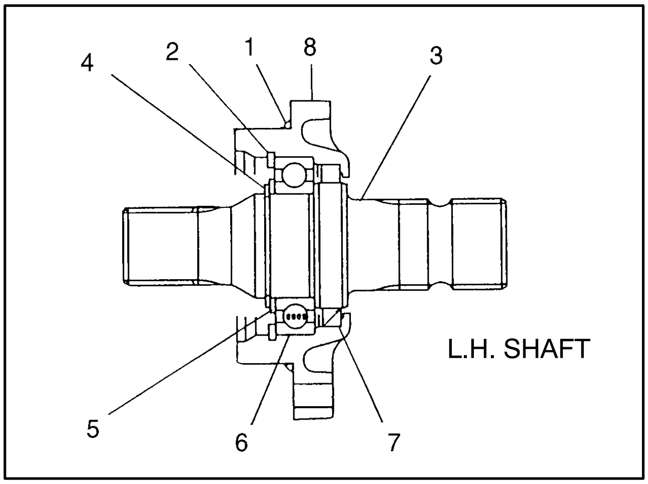

Figure 52

28. Disassemble R.H. axle shaft assembly:

A. Remove R.H. axle shaft assembly (Item 1) from seal cover.

B. Remove retaining ring (Item 2) and washer (Item 3) from axle shaft.

C. Use a bearing puller to remove bearing (Item 4) from axle shaft.

D. Remove oil seal (Item 5) from seal cover.

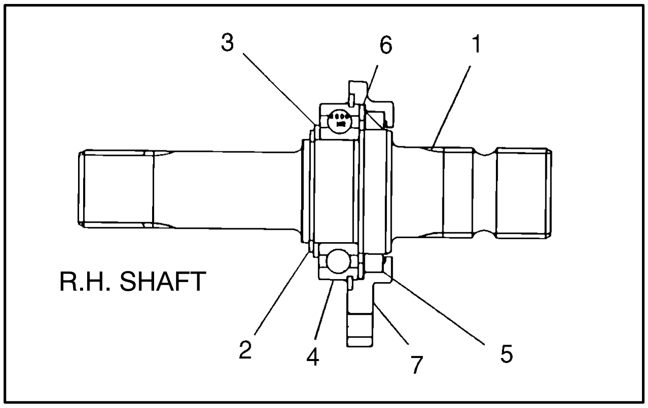

Figure 53

Drive Train

Transaxle Inspection

1. Thoroughly clean and dry all parts.

2. Use emery cloth to remove nicks and burrs from all parts.

3. Inspect synchronizer ring:

   A. Inspect the chamfer for excessive wear or damage.

   B. Inspect inner tapered area for excessive wear or damage.

   C. Measure the clearance between synchronizer ring and synchro gear in three equally spaced points. If clearance is less than .0197” (0.5 mm) replace the synchronizer ring.

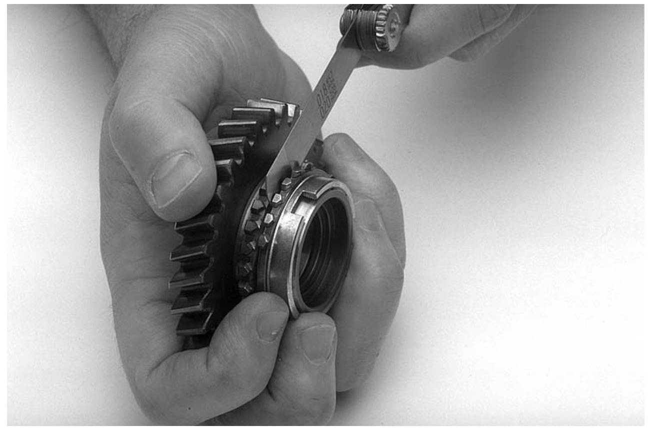

Figure 54

4. Inspect synchro gears:

   A. Inspect the cone surface for roughness, material transfer (brass color material), or damage.

   B. Inspect the spline chamfer for excessive chipping or damage.

   C. Inspect I.D. of synchro gears on main shaft for excessive wear or scoring (Fig. 55). If synchro gear has the following I.D., replace the synchro gear:

      22T I.D. exceeds 1.027” (26.08 mm)
      36T I.D. exceeds 1.027” (26.08 mm)

   D. Inspect I.D. of synchro gears on reduction shaft for excessive wear or scoring (Fig. 56). If synchro gear has the following I.D., replace the synchro gear:

      40T I.D. exceeds 1.027” (26.08 mm)
      47T I.D. exceeds 1.145” (29.08 mm)

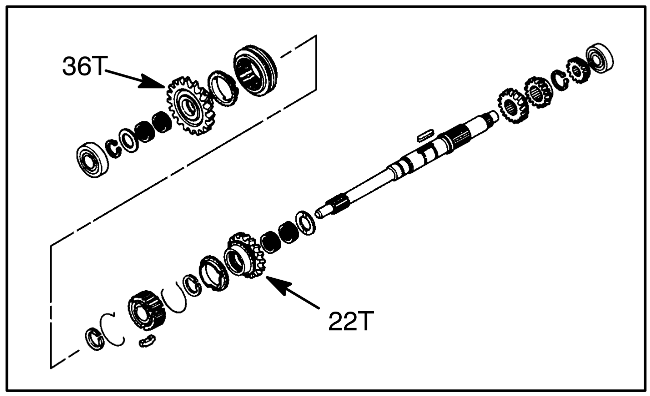

Figure 55

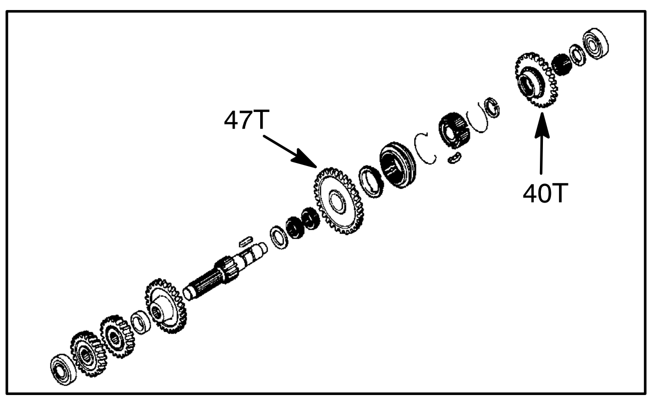

Figure 56

5. Inspect hub, shifter, synchro keys, and synchro springs:

A. Inspect hub for worn or damaged spline.

B. Inspect shifter for chipping or damaged chamfer.

C. Inspect synchro keys for wear or damage.

D. Inspect synchro springs for wear or damage.

E. The shifter should move freely on the hub.

F. Measure the clearance between shifter groove and fork. Replace shift fork if the clearance exceeds .039” (1.0 mm).

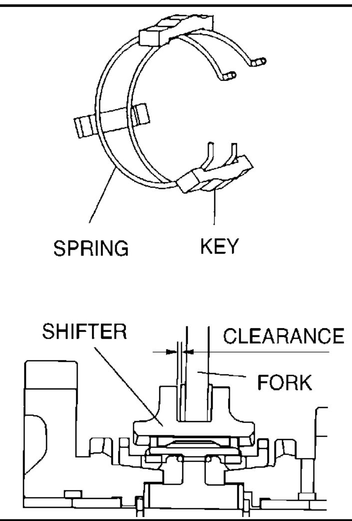

Figure 57

6. Inspect main shaft:

A. Inspect main shaft for worn or damaged surfaces. If O.D. of needle bearing surface is less than .864” (21.95 mm), replace the main shaft.

B. Inspect lip portion of oil seal for wear or damage.

C. Inspect main shaft input spline for wear or damage.

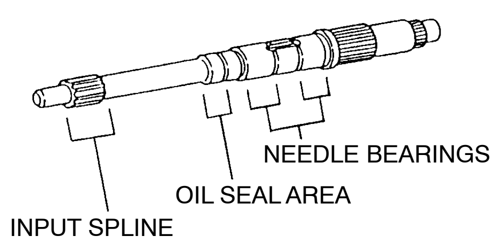

Figure 58

IMPORTANT: The center plate has one tabbed shim (Item 4) <u>with</u> three tabless shims (Item 2) (Fig. 59).

7. Inspect retaining ring (item 3) and shims (items 2 and 4) for damage (Fig. 59). Replace all parts if any component is cracked or broken.

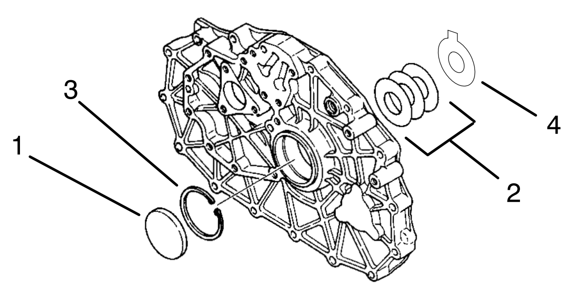

Figure 59

Drive Train

8. Inspect center plate for cracks and damage. Replace center plate if the retaining ring groove has more than 15% of its edges damaged due to nicks, rounding, cracks, or dents (Fig. 60 and 61).

Figure 60

Figure 61

9. Inspect reduction shaft:

A. Inspect reduction shaft for wear or damage. If O.D. of needle bearing area is less than .864” (21.95 mm) or .982” (24.95 mm), replace the reduction shaft.

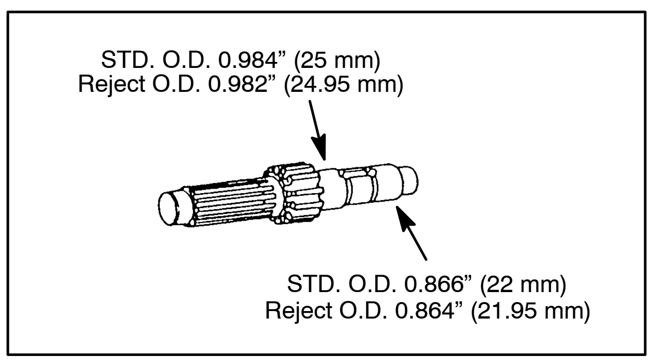

Figure 62

10. Inspect countershaft:

A. Inspect countershaft for wear or damage. If O.D. of inner portion is less than 1.100” (27.95 mm) or 71T gear portion is less than 1.179” (29.95 mm), replace the countershaft.

B. Inspect the gear contact condition of the bevel gear.

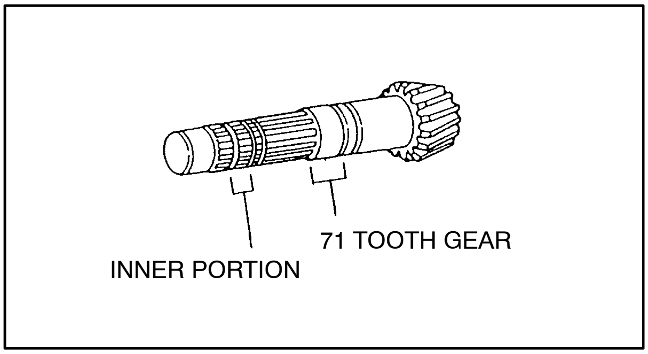

Figure 63

11. Inspect differential:

A. Inspect pinion shaft for excessive wear or damage. If O.D. is less than .707” (17.95 mm), replace the pinion shaft.

B. Measure thickness of pinion shaft washers. If thickness is less than .035” (0.9 mm), replace the washers.

C. Measure thickness of side gear thrust washers. If thickness is less than .043” (1.1 mm), replace the thrust washers.

D. Inspect the gear contact condition of the ring gear.

E. Inspect differential case for wear in side gears and pinion shaft mating area. Replace the case if machined surfaces are scored or if the pinion shaft fits loosely in the bore.

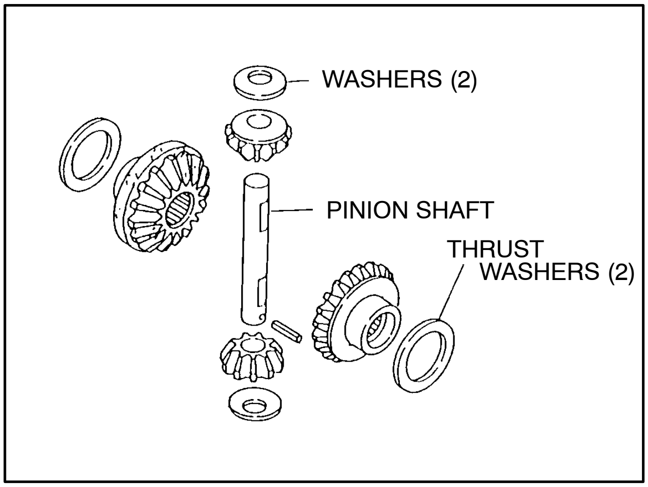

Figure 64

Drive Train

Transaxle Assembly

NOTE: Item numbers in figures are shown in reverse order of assembly; for example, when reassembling, install Item 1 last.

IMPORTANT: Be careful not to damage mating surfaces when removing gasket material.

1. Clean gasket material from all transaxle mating surfaces before reassembling. Make sure all parts are clean and free of dirt and dust.

2. Assemble differential carrier (L.H. axle shaft) assembly (Fig. 65):

   A. Apply multi–purpose grease on new oil seal (Item 7) and install seal into differential carrier.

   B. Use a press to install bearing (Item 6) onto L.H. axle shaft (Item 3).

   C. Install washer (Item 5) and retaining ring (Item 4) onto L.H. axle shaft.

   D. Install L.H. axle shaft assembly into differential carrier.

   E. Install retaining ring (Item 2).

   F. Apply multi–purpose grease onto O–ring (Item 1) and install O–ring onto carrier.

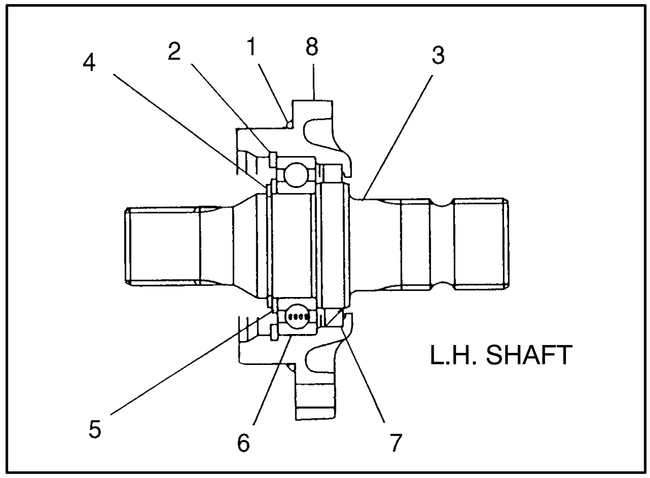

Figure 65

3. Assemble R.H. axle shaft (Fig. 65):

   A. Apply multi–purpose grease on oil seal (Item 5) and install seal into seal cover.

   B. Use a press to install bearing (Item 4) onto R.H. axle shaft.

   C. Install washer (Item 3) and retaining ring (Item 2) onto R.H. axle shaft.

   D. Insert washer (Item 6) into seal cover.

   E. Install R.H. axle shaft assembly into seal cover (Item 7).

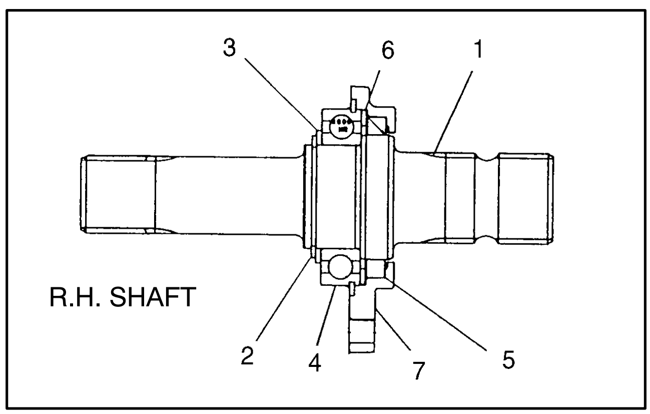

Figure 66

4. Assemble differential gears:

A. Apply moly disulfide grease on washers (Item 10), holes of pinion gears (Item 9), side gear thrust washers (Item 13), and hubs of side gears (Item 11 and 12).

B. Install side gear thrust washers (Item 13), side gears (Item 11 and 12), washers (Item 10), and differential pinion gears (Item 9) into differential case.

C. Rotate side gears until holes of pinion gears and washers line up with holes of differential case.

D. Grease the pinion shaft (Item 8) and insert it into the differential case.

E. Assemble lock pin (Item 7). Drive the pin to the approximate center location of the pinion shaft. Pay attention to direction of slit in lock pin (Fig. 69).

F. Check for smooth revolution of pinion gears and side gears.

G. Completely clean oil from fastener threads in ring gear (Item 5).

NOTE: Ring gear and countershaft are supplied in matched sets only.

H. Insert two (2) dowel pins (Item 6) onto ring gear (Item 5).

I. Completely clean oil from threads of cap screws (Item 4).

J. Clean oil from contact surface of differential case and ring gear.

K. Drive ring gear onto differential case.

NOTE: It is recommended that whenever the ring gear screws are removed that they be replaced with new screws.

L. Apply thread locking compound (e.g. Loctite) to threads of cap screws (Item 4).

M. Install cap screws into ring gear. Torque cap screws from 18 to 22 ft–lb (24.5 to 29.5 N–m).

N. Use a press to install bearing (Item 1) onto differential case.

O. Use a press to install bearing (Item 3) onto differential case.

P. Install retaining ring (Item 2) to secure bearing.

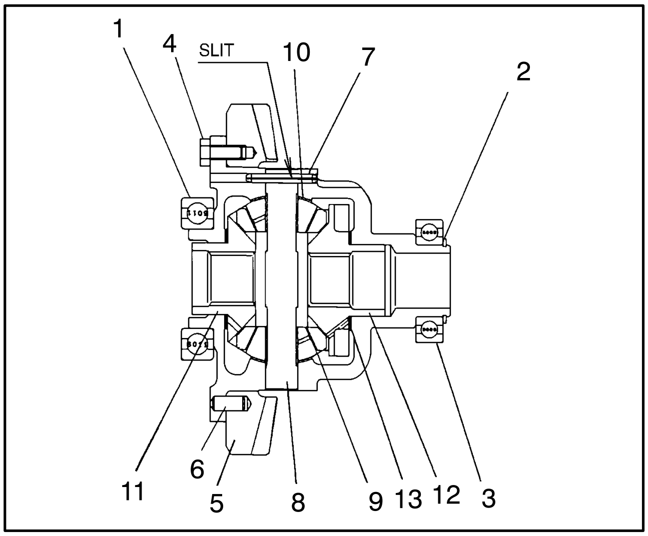

Figure 67

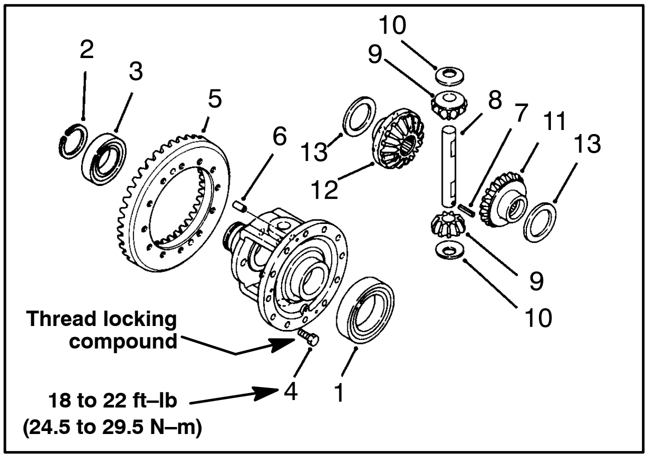

Figure 68

Figure 69

Drive Train

5. Assemble 1st–reverse and 2nd–3rd fork shaft:

   A. Insert 1st–reverse fork shaft (Item 3) into 1st–reverse fork (Item 2).

   B. Drive spring pin (Item 1) into fork and fork shaft. Pay attention to direction of slit in spring pin.

   C. Insert 2nd–3rd fork shaft (Item 6) into 2nd–3rd fork (Item 5).

   D. Drive spring pin (Item 4) into fork and fork shaft. Pay attention to direction of slit in spring pin.

6. Assemble countershaft:

   A. Use a press to install two (2) new bearings (Item 15) onto countershaft.

   B. Install collar (Item 14) and retaining ring (Item 13).

   C. Apply moly disulfide grease into bushing of countershaft gear. Install thrust washer (Item 12) and 71T gear (Item 11) onto countershaft. Oil groove on washer must face the gear.

   D. Install spline collar (Item 10) and retaining ring (Item 8).

   E. Install shifter (Item 9) onto spline collar.

   F. Install retaining ring (Item 8), thrust washer (Item 7) and inner sleeve (Item 6). Oil groove on washer must face the gear.

   G. Install 49T gear (Item 5).

   H. Install thrust washer (Item 4) and retaining ring (Item 3). Oil groove on washer must face the gear.

   I. Install collar (Item 2) and new bearing (Item 1) using a press.

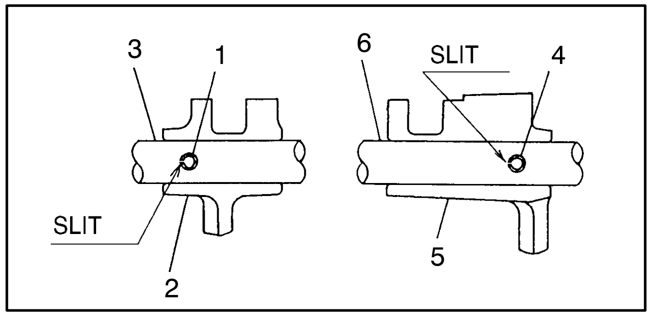

Figure 70

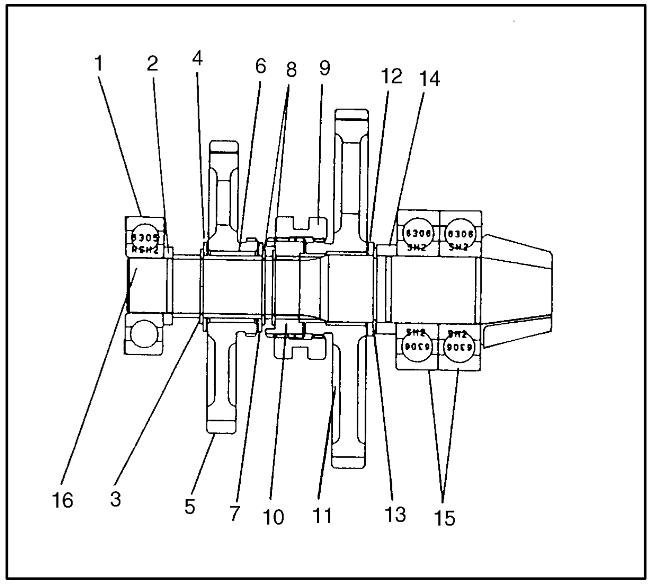

Figure 71

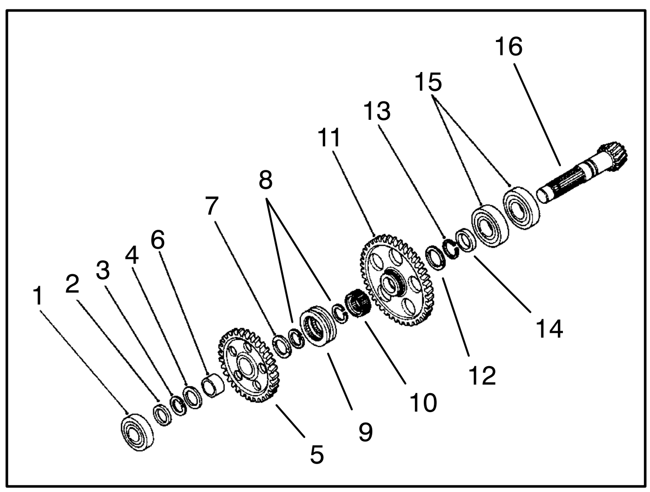

Figure 72

7. Assemble synchro hub:

A. Install three (3) keys (Item 1) into grooves of hub (Item 2).

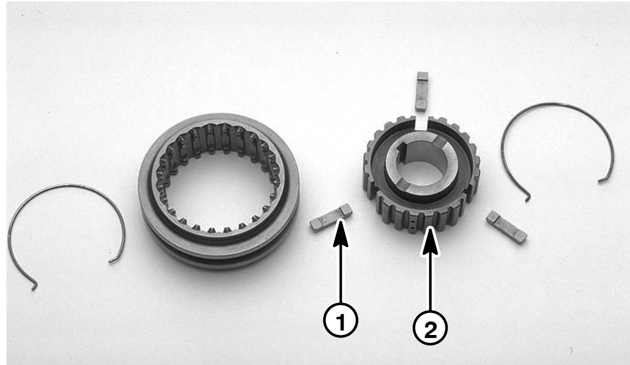

Figure 73

B. Install shifter (Item 1) onto hub assembly (Item 2).

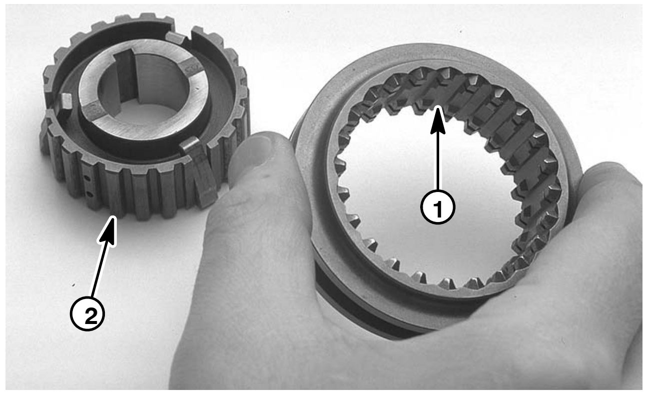

Figure 74

C. Insert two (2) springs (Item 1) into hub to secure hub assembly. Pay attention to direction of spring.

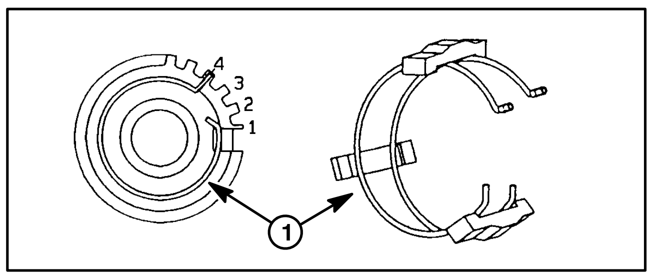

Figure 75

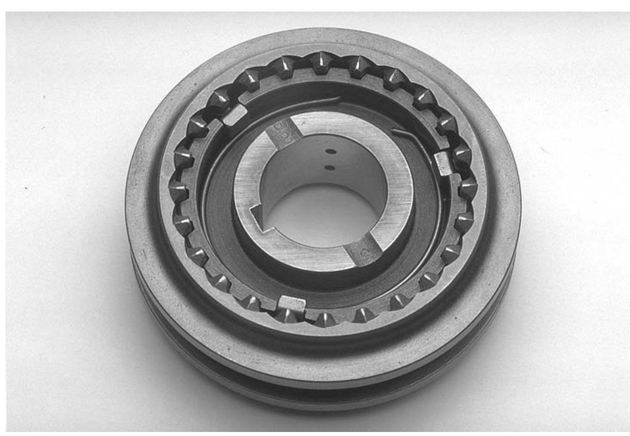

Figure 76

Drive Train

8. Assemble reduction shaft:

A. Apply moly disulfide grease to thrust washer (Item 16) and two (2) needle bearings (Item 15). Install washer, needle bearings, and 47T gear (Item 14) onto reduction shaft (Item 17). Oil groove on washer must face the gear.

B. Apply Dexron III ATF oil on cone face of gear (Item 14). Install synchro ring (Item 13) onto gear.

C. Insert key (Item 12) into reduction shaft slot.

D. Install synchro hub sub–assembly (Item 11).

E. Install retaining ring (Item 10).

F. Insert needle bearing (Item 9) into 40T gear (Item 8).

G. Install thrust washer (Item 7). Oil groove on washer must face the gear.

H. Use a press to install bearing (Item 6) onto shaft.

I. Install 32T gear (Item 5), collar (Item 4), 23T helical gear (Item 3), and 25T gear (Item 2) onto shaft.

J. Use a press to install bearing (Item 1) onto shaft.

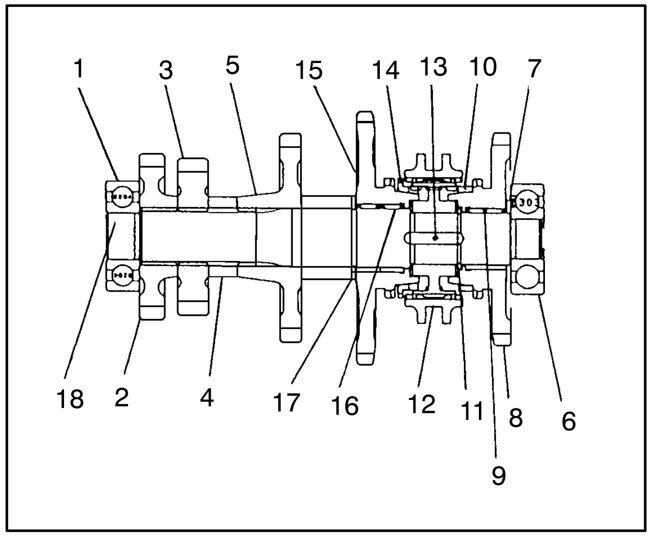

Figure 77

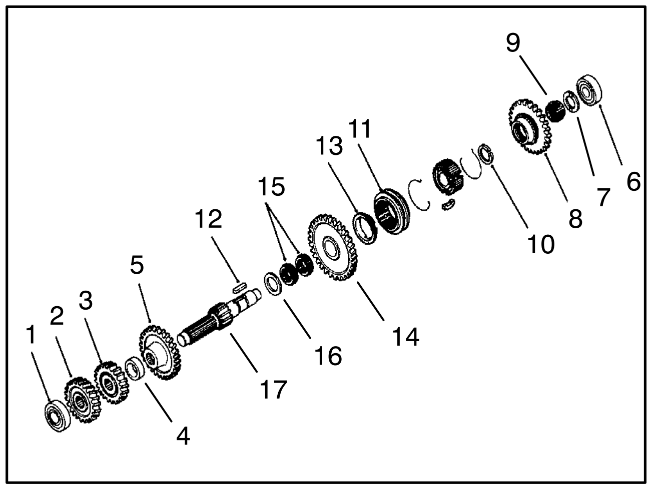

Figure 78

9. Assemble reverse shaft:

A. Install 33T gear (Item 2) onto reverse shaft (Item 4).

B. Use a press to install bearings (Item 3 and 1).

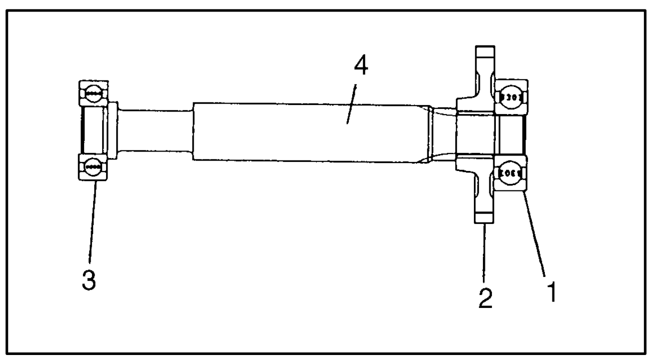

Figure 79

10. Assemble main shaft:

A. Install 16T gear (Item 18), 20T gear (Item 17) and retaining ring (Item 16).

B. Install 14T gear (Item 15).

C. Use a press to install bearing (Item 14) onto shaft.

D. Apply moly disulfide grease onto thrust washer (Item 13) and two (2) needle bearings (Item 12). Install washer and needle bearings onto main shaft. Oil groove on washer must face the gear.

E. Install 22T gear (Item 11) and retaining ring (Item 10).

F. Apply Dexron III ATF oil on cone face of gear (Item 11). Install synchro ring (Item 6) onto gear.

G. Insert key (Item 9) into main shaft slot.

H. Install synchro hub sub–assembly (Item 8).

I. Install retaining ring (Item 7).

J. Apply Dexron III ATF oil to cone face of 36T gear (Item 4). Install synchro ring (Item 6) onto gear.

K. Apply moly disulfide grease onto two (2) needle bearings (Item 5). Insert needle bearings into gear (Item 4).

L. Install gear (Item 4) with synchro ring and needle bearings onto main shaft.

M. Apply moly disulfide grease to thrust washer (Item 3). Install washer and snap ring (Item 2) to shaft. Oil groove on washer must face the gear.

N. Use a press to install bearing (Item 1) onto shaft.

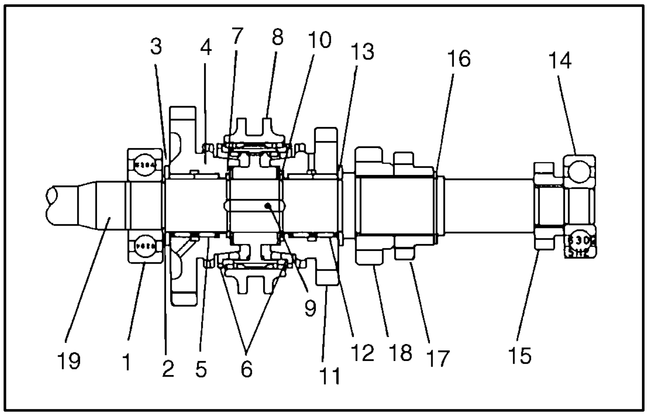

Figure 80

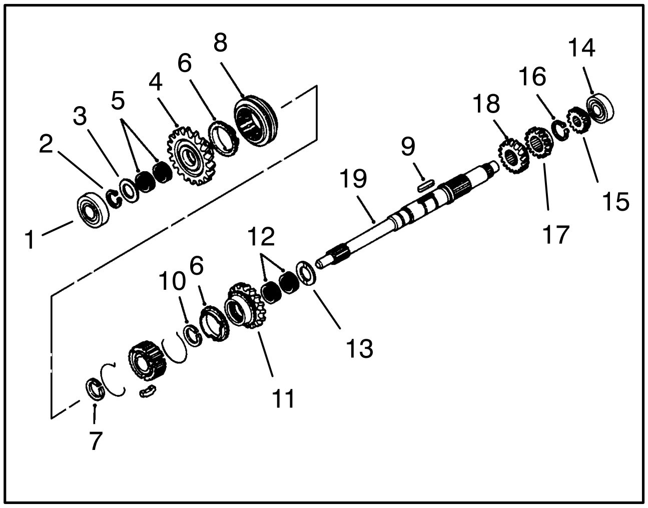

Figure 81

Drive Train

11. Assemble shift arms:

A. Apply multi–purpose grease on lips of three (3) new oil seals (Item 14). Install oil seals into transaxle case.

B. Position three (3) keeper plates (Item 13) and secure with three (3) cap screws (Item 12). Torque cap screws from 11 to 13 ft–lb (15 to 17 N–m).

C. Apply Loctite #680 (or equivalent) to threads of 2–3 shift fork arms.

D. Install 1st–reverse shift arm (Item 9).

E. Install 2nd–3rd shift arm assembly (Item 8, 7, 6, 5, 4, 3, 2,and 1). Tighten cap screw (Item 5) and lock nut (Item 5) until compression spring length is 0.080” (2 mm) (Fig. 83).

F. Install flat washers (Item 7) and lock nuts (Item 8) to secure shift arms. Torque shift arm retaining lock nuts from 18 to 22 ft–lb (24.5 to 29.5 N–m).

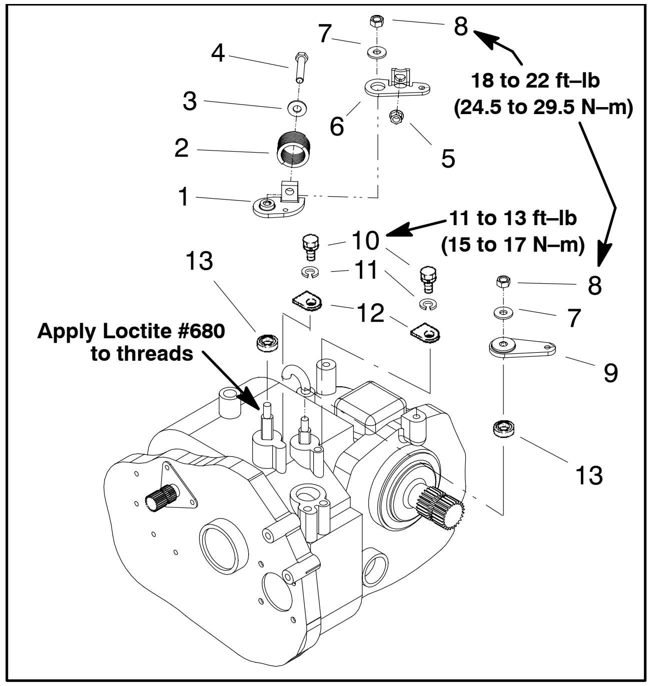

Figure 82

1. Shift arm (2–3)
2. Compression spring
3. Flat washer
4. Cap screw
5. Lock nut
6. Shift arm plate
7. Flat washer
8. Lock nut
9. Shift arm lever (1–R)
10. Cap screw
11. Lock washer
12. Keeper plate
13. Oil seal

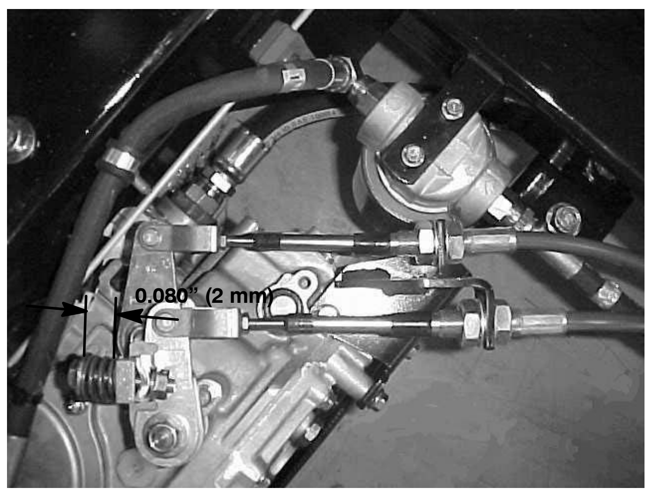

Figure 83

12. Install reduction shaft and countershaft together with 1st–reverse fork shaft. Insert head of shift arm into groove of fork (Item 1) when installing assembly.

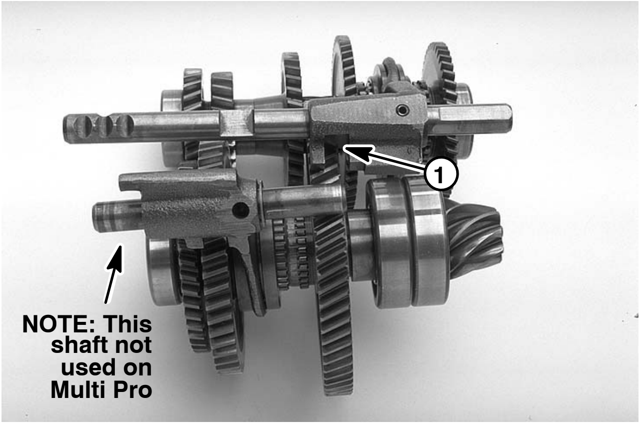

Figure 84

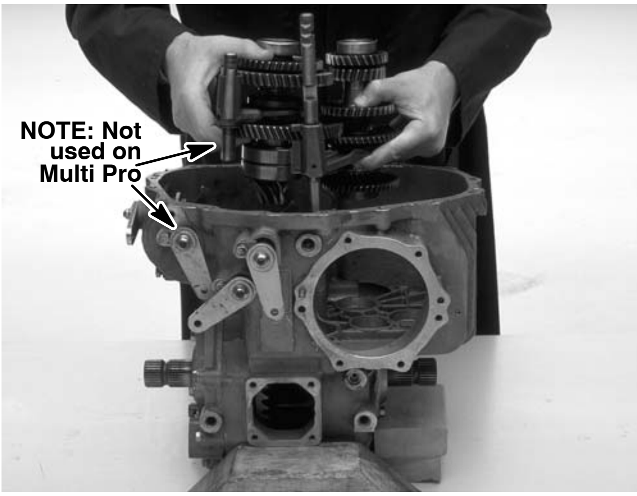

Figure 85

13. Install main shaft together with 2nd–3rd fork shaft. Insert head of shift arm into groove of fork (Item 1) while installing.

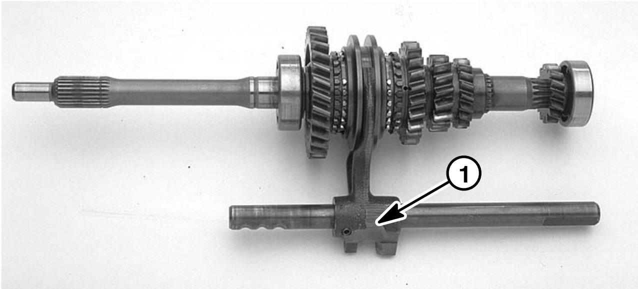

Figure 86

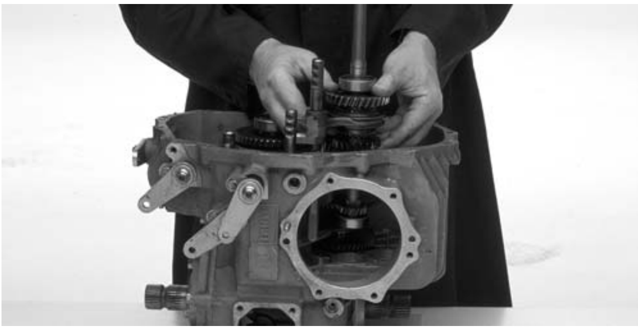

Figure 87

14. Install reverse shaft (Item 1) into transaxle case. Rotate main shaft and reverse shaft gears to mesh gears when installing.

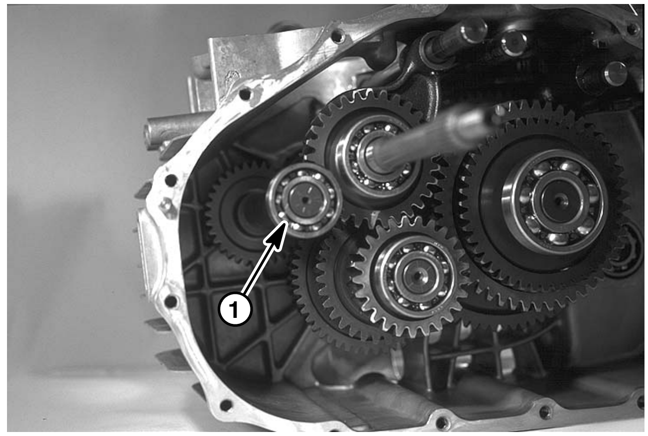

Figure 88

15. Install center plate onto transaxle:

    A. Thoroughly clean mating surfaces of transaxle case and center plate. Insert two (2) dowel pins into transaxle case.

    B. Apply silicone sealant onto mating surface of center plate. Carefully install center plate onto transaxle case.

    C. Install and tighten cap screws to a torque of 18 to 22 ft–lb (24.5 to 29.5 N–m) to secure center plate.

    D. Apply multi–purpose grease onto lips of main shaft oil seal. Insert oil seal into center plate flush with face of housing.

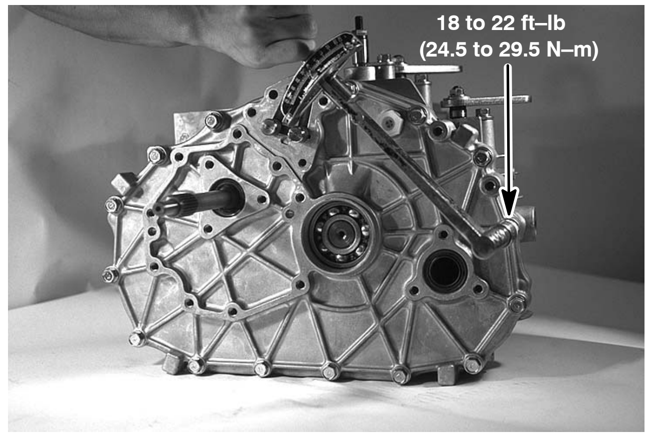

Figure 89

IMPORTANT: The center plate uses one tabbed shim (Item 4) with three tabless shims (Item 3) (Fig. 90).

NOTE: The thickest shim of the shim set (Item 3) should be positioned against the retaining ring (Fig. 90).

16. Insert tabbed shim (Item 4) against the bearing. Insert shim set (Item 3) against the tabbed shim. Use thickest shims in set possible, that will permit installation of the snap ring (Fig. 90 and 91).

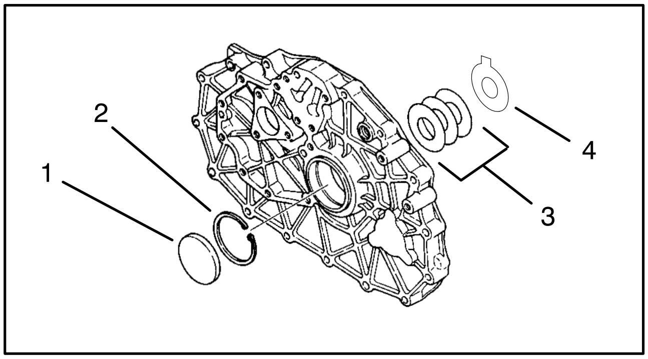

Figure 90

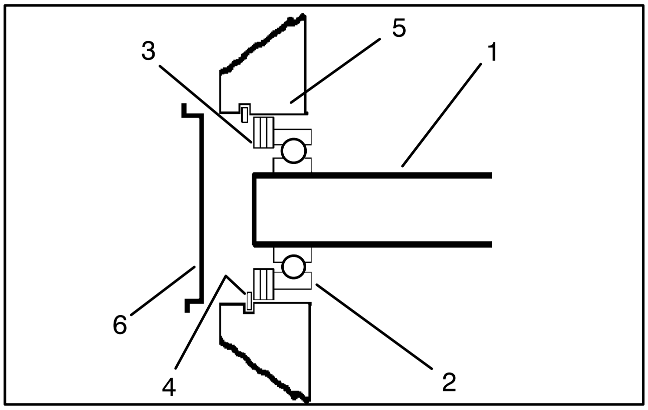

Figure 91

1. **Countershaft**
2. **Bearing**
3. **Shims**
4. **Retaining ring**
5. **Center plate**
6. **Sealing cap**

17. Install retaining ring into the groove of the center plate (Fig. 91 and 92).

Figure 92

Drive Train

18.Measure countershaft end play. Rotate one of the axle shafts back and forth to take up all back lash. Rotating the shaft in one direction will pull the shaft and bearing away from the snap ring. Rotate axle shaft in this direction, then measure space between the retaining ring and shim (set) with a feeler gauge. Make sure shim set is pressed against the bearing during the measurement. End play should be 0.000" to 0.0039" (0.0 to 0.10 mm) (Fig. 93).

IMPORTANT: If end play is too great, replace shim/ shim set (item 2) with thicker shims to allow correct end play.

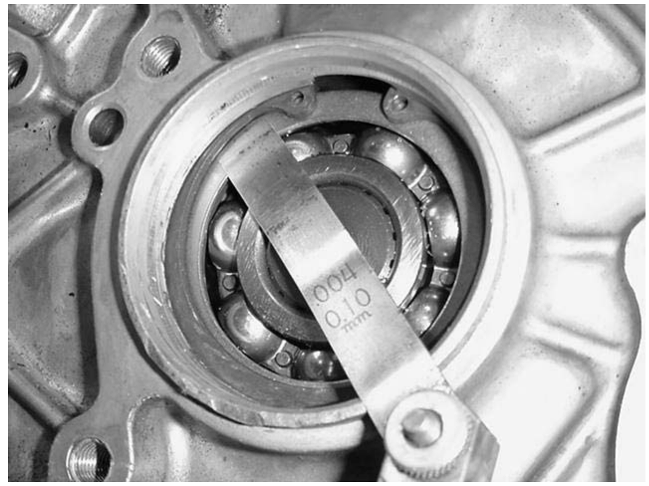

Figure 93

19.Insert sealing cap (Item 1) flush with face of center plate. Make sure not to insert sealing cap too far. Pay attention to direction of sealing cap.

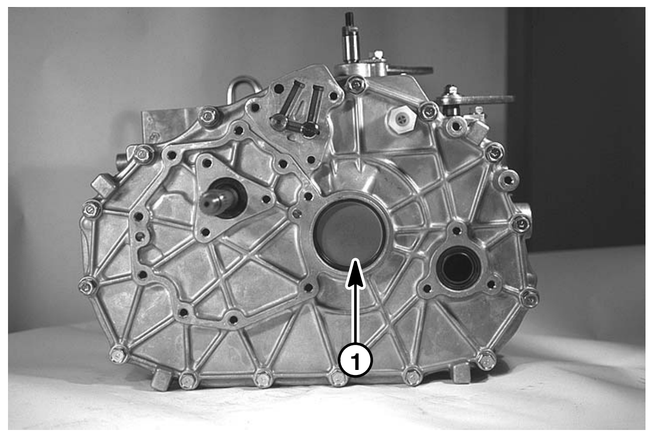

Figure 94

20. Install fork shaft case:

A. Thoroughly clean mating surface of transaxle case and fork shaft case.

B. Insert spindle lock (Item 1) between fork shafts.

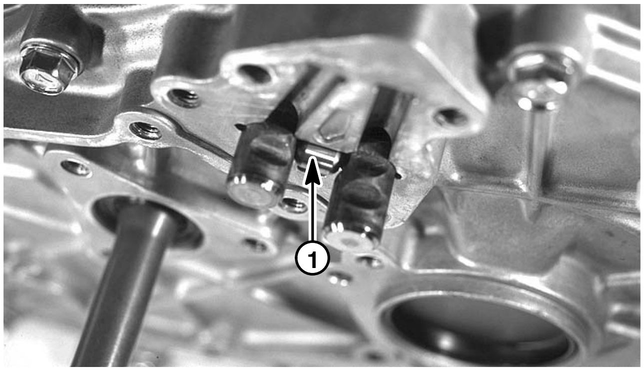

Figure 95

C. Insert two (2) steel balls (Item 2) and two (2) springs (Item 1) into the grooves of the center plate.

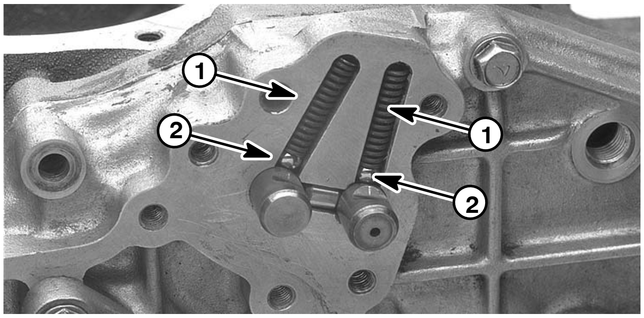

Figure 96

D. Apply silicone sealant to mating surface of fork shaft case. Install fork shaft case (Item 3). Install cap screws (Items 2 and 1) noting location of longer screw (Item 1). Tighten cap screws to a torque of 18 to 22 ft–lb (24.5 to 29.5 N–m). Check operation of shifters and detent.

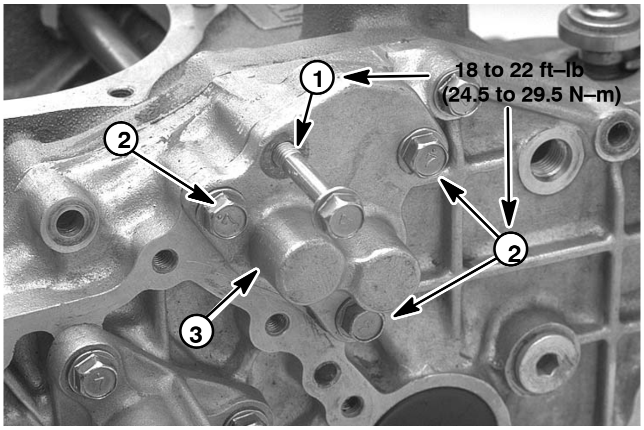

Figure 97

Drive Train

21. Install differential gear assembly (Item 2) into transaxle case.

22. Insert two (2) dowel pins (Item 1) into transaxle case.

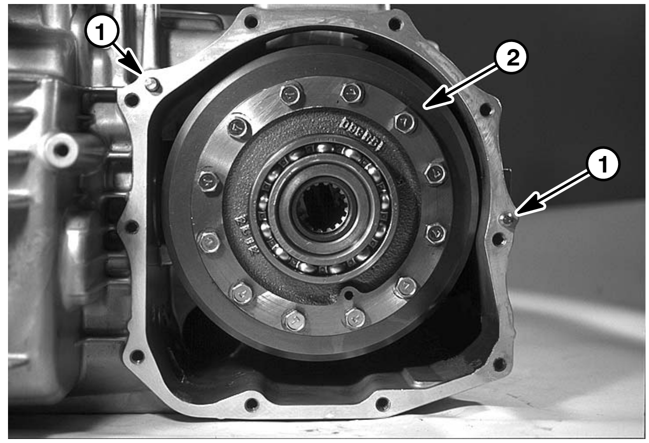

Figure 98

23. Install side cover:

A. Thoroughly clean mating surfaces of transaxle case and side cover. Apply silicone sealant onto mating surface of side cover.

B. Install side cover and secure with cap screws. Torque cap screws from 18 to 22 ft–lb (24.5 to 29.5 N–m).

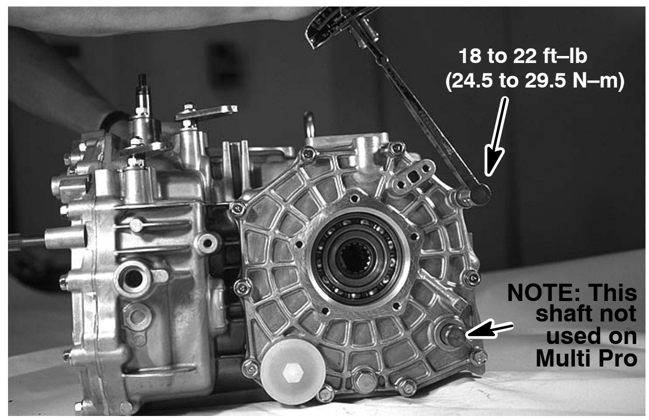

Figure 99

24. Install R.H. axle shaft assembly:

A. Thoroughly clean mating surface of transaxle case and seal cover of R.H. axle shaft assembly. Apply silicone sealant onto mating surface of seal cover.

B. Install axle shaft assembly (Item 2) and secure with cap screws. Torque cap screws (Item 1) from 18 to 22 ft–lb (24.5 to 29.5 N–m).

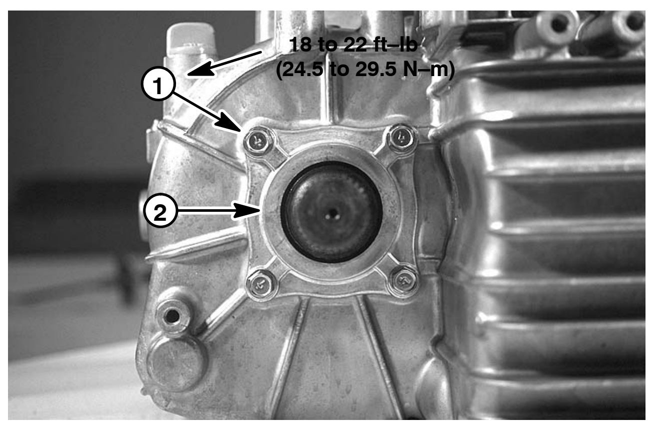

Figure 100

25. Install L.H. axle shaft assembly:

A. Thoroughly clean mating surface of differential carrier and side cover (Item 2).

B. Insert selected shims (Item 1) into housing of side cover. NOTE: The thickest shim should be inserted against the bearing.

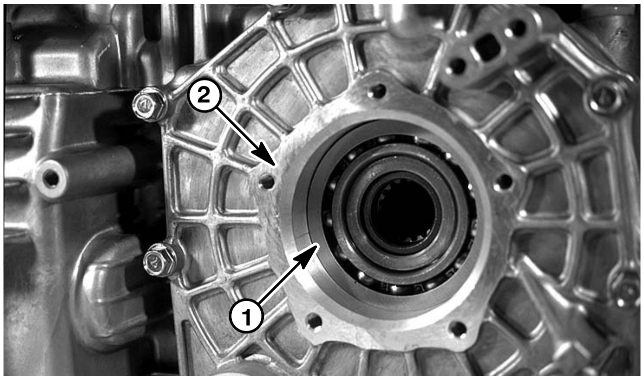

Figure 101

C. Install axle shaft assembly and secure with cap screws (Item 1). Torque cap screws from 18 to 22 ft–lb (24.5 to 29.5 N–m).

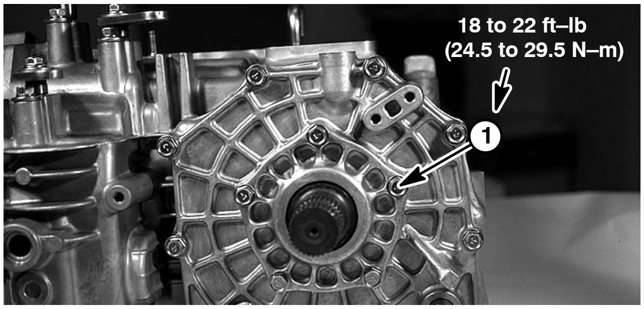

Figure 102

26. Measure backlash of ring gear through P.T.O. cover opening on top of transaxle. Using a dial indicator, check ring gear backlash in three equally spaced points. Backlash should be .0031" to .0071" (0.08 to 0.18 mm) and must not vary more than .002" (0.05 mm) at the points checked. If backlash is not in this range, replace shim set in end of differential carrier:

A. If backlash is less than target range, decrease total thickness of shim set until correct backlash is achieved.

B. If backlash exceeds the target range, increase total thickness of shim set until correct backlash is achieved.

NOTE: The thickest shim should be installed against the bearing.

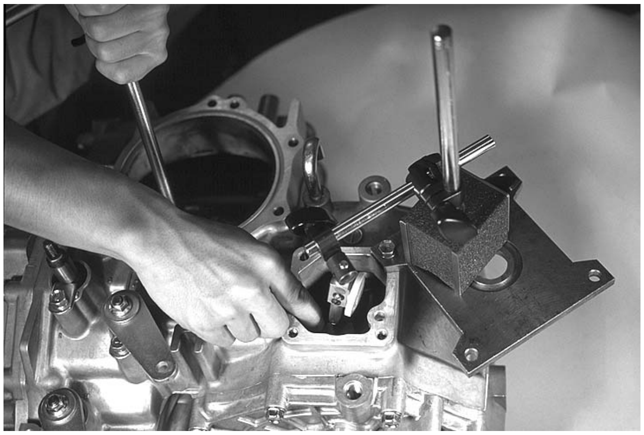
Figure 103

Drive Train

27.Apply multi–purpose grease to P.T.O. cover O–ring and insert O–ring into groove of transaxle case. Position P.T.O. cover (Item 5) to transaxle case. Install five (5) cap screws (Item 4) and nut with lock washer (Item 3). Tighten cap screws and nut to a torque of 11 to 13 ft–lb (15 to 17 N–m).

28.If removed, install oil cap (Item 2) with O–ring to transaxle case.

29.If removed, apply sealing tape to threads of air breather (Item 1) and install air breather.

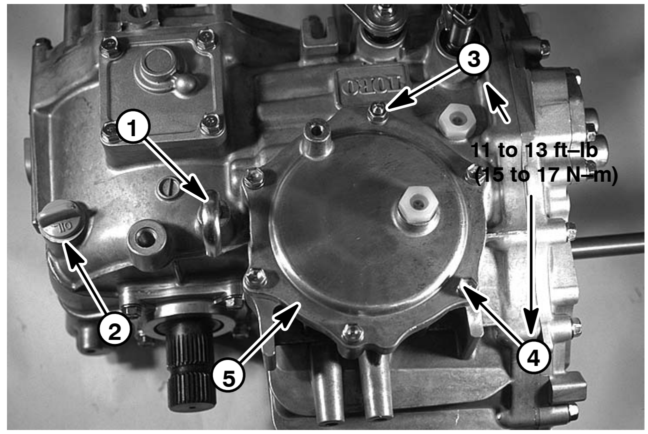

Figure 104

30.Apply silicone sealant to mating surface of upper cover (Item 4). Pay attention to direction of cover and install. Torque cap screws (Item 3) from 18 to 22 ft–lb (24.5 to 29.5 N–m).

31.If removed, slide speed sensor (Item 2) into upper cover (Item 4). Install cap screw (Item 1) with lock washer to secure sensor.

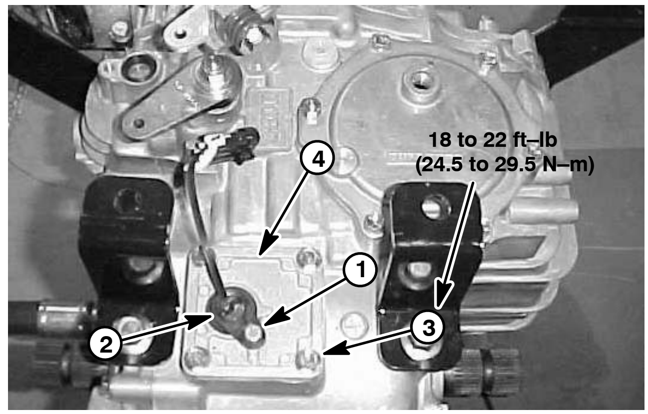

Figure 105

32.Position input shaft cover plate (Item 2) to transaxle and secure it with three (3) cap screws (Item 1).

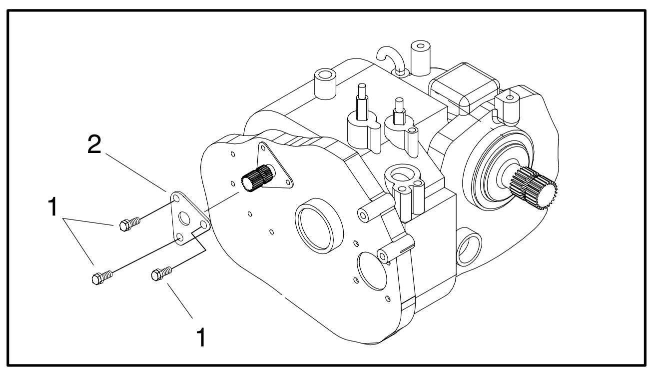

Figure 106

Chapter 8

Chassis

Table of Contents

Specifications

Item	Description
Front tire pressure (18 x 9.5 – 8, 4 ply, tubeless)	18 PSI (1.24 bar) Maximum
Rear tire pressure (24 x 13 – 12, 4 ply, tubeless)	18 PSI (1.24 bar) Maximum
Front wheel lug nut torque	55 to 65 ft–lb (75 to 88 N–m)
Rear wheel lug nut torque	45 to 65 ft–lb (61 to 88 N–m)
Front wheel Toe–in	0 to 1/8 inch (0 to 3.2 mm)

Adjustments

Front Suspension

Any time the front wheel toe–in is checked, the front suspension should be checked as well. Incorrect suspension setting can affect steering and can cause accelerated tire wear and scuffing.

IMPORTANT: When checking suspension, vehicle spray tank should be approximately half full and operator should be in seat.

IMPORTANT: Prior to checking front suspension, drive the machine straight forward at least 15 feet to allow the suspension to relax. Do not turn steering wheel.

1. Drive machine straight ahead at least 15 feet and stop on a level surface. Stop engine and remove key from ignition switch.

2. Check attitude of both right and left A–arms (Fig. 1). Both A–arms should be level and parallel to the ground.

3. If either A–arm is not level, check all suspension and steering components for wear or damage. If no component wear or damage is detected, adjust suspension:

   A. Chock rear wheels to prevent vehicle from shifting. Lift front of machine using a jack or hoist to allow front suspension to relax (see Jacking Instructions in Operator's Manual).

   B. Loosen and remove lock nut and cap screw that secure axle assembly position to the frame (Fig. 2).

   C. Rotate axle assembly to allow different cap screw position. Rotating axle toward ground increases tension on suspension.

   D. Reinstall cap screw in new position and secure with lock nut. Torque from 130 to 150 ft–lb (176 to 203 N–m).

   E. Lower machine to ground and repeat steps 1 to 3 as needed.

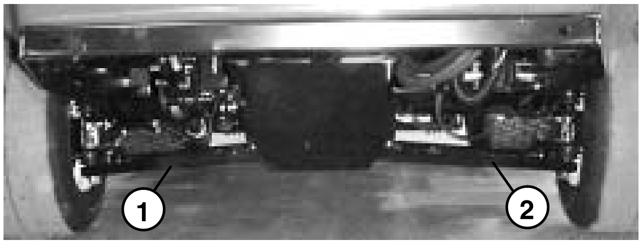

Figure 1

1. RH A–arm
2. LH A–arm

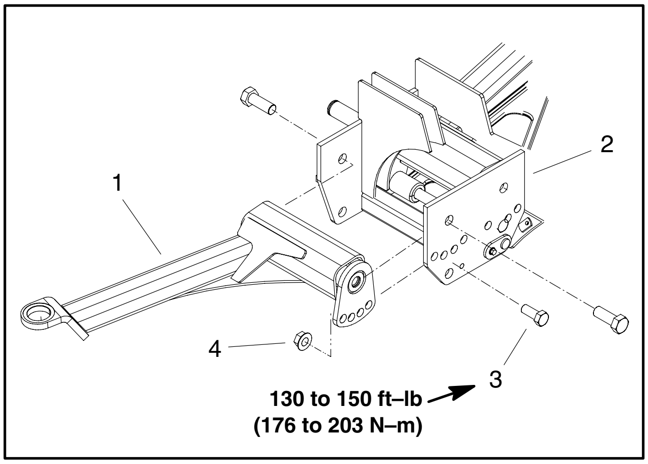

Figure 2

1. Axle assembly (RH)
2. Frame
3. Cap screw
4. Lock nut

Front Wheels and Brakes

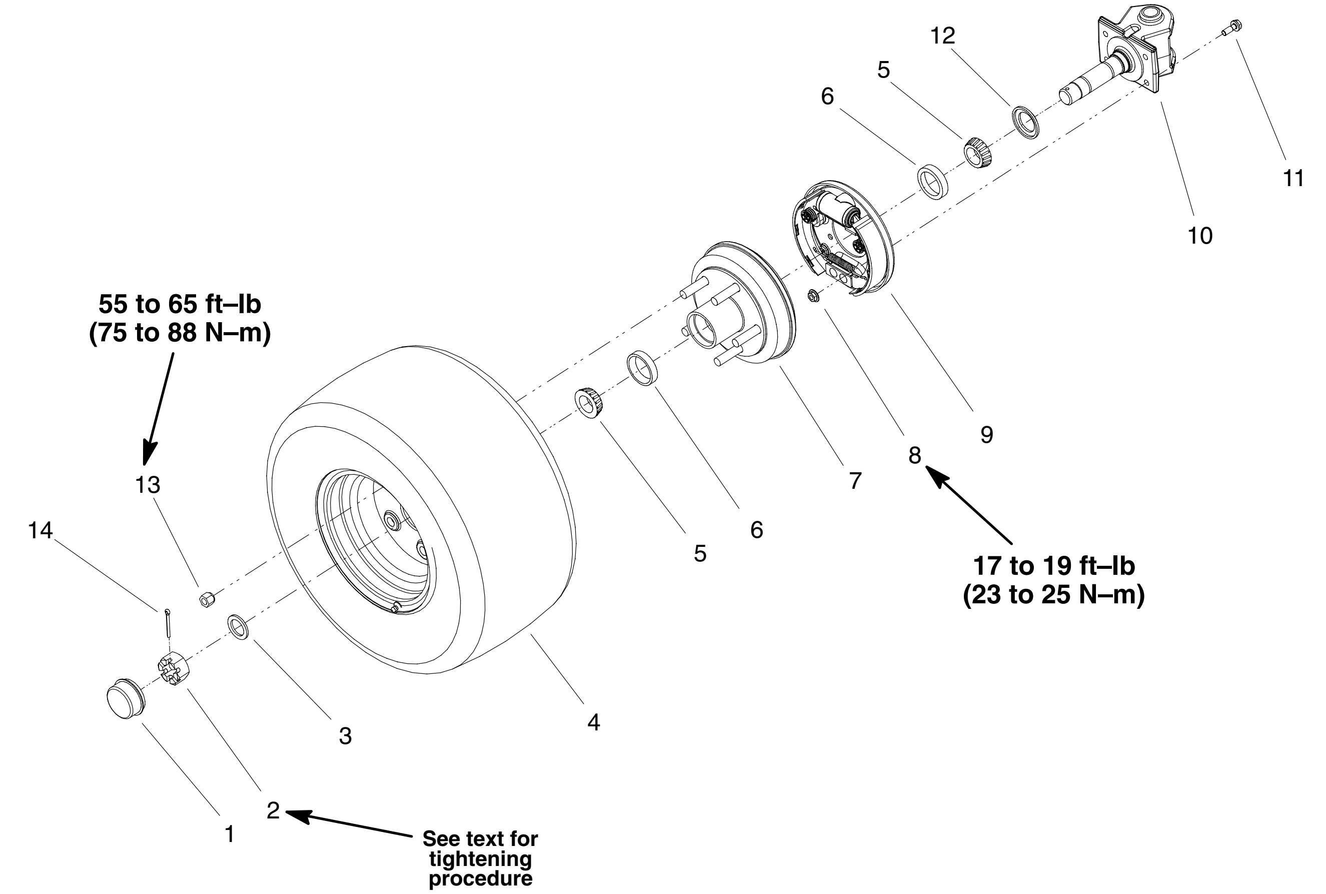

Figure 3

1. **Dust cap**
2. **Slotted hex nut**
3. **Washer**
4. **Wheel and tire assembly**
5. **Wheel bearing cone**
6. **Wheel bearing cup**
7. **Wheel hub/drum**
8. **Lock nut (4 per wheel)**
9. **Front brake assembly**
10. **Front spindle**
11. **Flange head screw (4 per wheel)**
12. **Seal**
13. **Lug nut (5 per wheel)**
14. **Cotter pin**

Removal (Fig. 3)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Jack front wheel off the ground (see Jacking Instructions in Operator's Manual). Chock front and rear of other wheels.

3. Remove lug nuts and wheel assembly.

4. Carefully pry dust cap from wheel hub.

5. Remove cotter pin from front spindle.

6. Remove slotted hex nut and washer that secures wheel hub/drum to spindle. Slide wheel hub with bearings from spindle.

7. If required, disassemble wheel hub/drum:

   A. Pull seal out of the wheel hub.

   B. Remove bearings from both sides of wheel hub. Clean bearings in solvent. Clean inside of the hub.

8. Inspection and service of front brakes can be completed with brake assembly on machine (see Front Brake Service). If required, brake assembly can be removed from machine as follows:

A. Clean hydraulic brake line area of brake assembly to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Cap brake line and position it away from brake assembly.

B. Remove four flange head screws and lock nuts that secure the brake assembly to the front spindle.

C. Remove brake assembly from spindle.

Inspection

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace front brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out–of–round, scored, heat spotted, or excessively rusted. Minor scoring in brake drum can be removed with sandpaper.

2. If removed, inspect wheel bearings. Make sure bearing cones are in good operating condition. Check the bearing cups for wear, pitting, or other noticeable damage. Replace worn or damaged parts.

Installation (Fig. 3)

1. Clean all parts thoroughly before reassembly.

2. If removed, position brake assembly to the front spindle.

A. Secure backing plate of the brake assembly to the spindle with four flange head screws and lock nuts. Torque screws from 17 to 19 ft–lb (23 to 25 N–m).

B. Install brake line to wheel cylinder.

3. If wheel bearings were removed from wheel hub/drum, assemble wheel hub:

A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

B. Pack both bearings with grease. Install greased inner bearing into the cup on inboard side of the wheel hub.

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

C. Lubricate the inside of the new lip seal and press it into the wheel hub.

4. Install the wheel hub/drum onto the spindle shaft taking care to not damage seal.

5. Install greased outer bearing cone, washer, and slotted hex nut onto spindle shaft.

6. Rotate the wheel hub/drum by hand and tighten the slotted hex nut from 75 to 100 in-lb (8.5 to 11.3 N–m) to set the bearings. Then, loosen the nut until the wheel hub has end play.

7. Rotate the wheel hub/drum by hand and re-tighten the slotted hex nut from 15 to 20 in-lb (1.7 to 2.3 N–m). If necessary, nut can be tightened slightly to align cotter pin position in spindle and nut.

8. Install cotter pin through spindle shaft hole. Install dust cap to hub.

9. Install wheel assembly with valve stem facing out and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from 55 to 65 ft–lb (75 to 88 N–m).

10. Lower machine to ground.

11. Bleed brakes (see Bleed Brake System).

12. Align steering, adjust toe–in (see Operator's Manual), and check front suspension (see Front Suspension in the Adjustments section of this Chapter).

13. Lubricate tie rod ball joints (see Operator's Manual).

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

14. Check brake operation.

Burnish Brake Shoes

Sintered metal linings may not provide maximum brake stopping distance after brake shoes are replaced. It may be necessary to burnish new brake shoe linings.

IMPORTANT: Do not drive machine with the brakes applied. The brake shoe linings will overheat.

IMPORTANT: Do not allow the brakes to lock up. Allow brakes to cool between applications.

Drive machine while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at moderate speed.

Front Brake Service

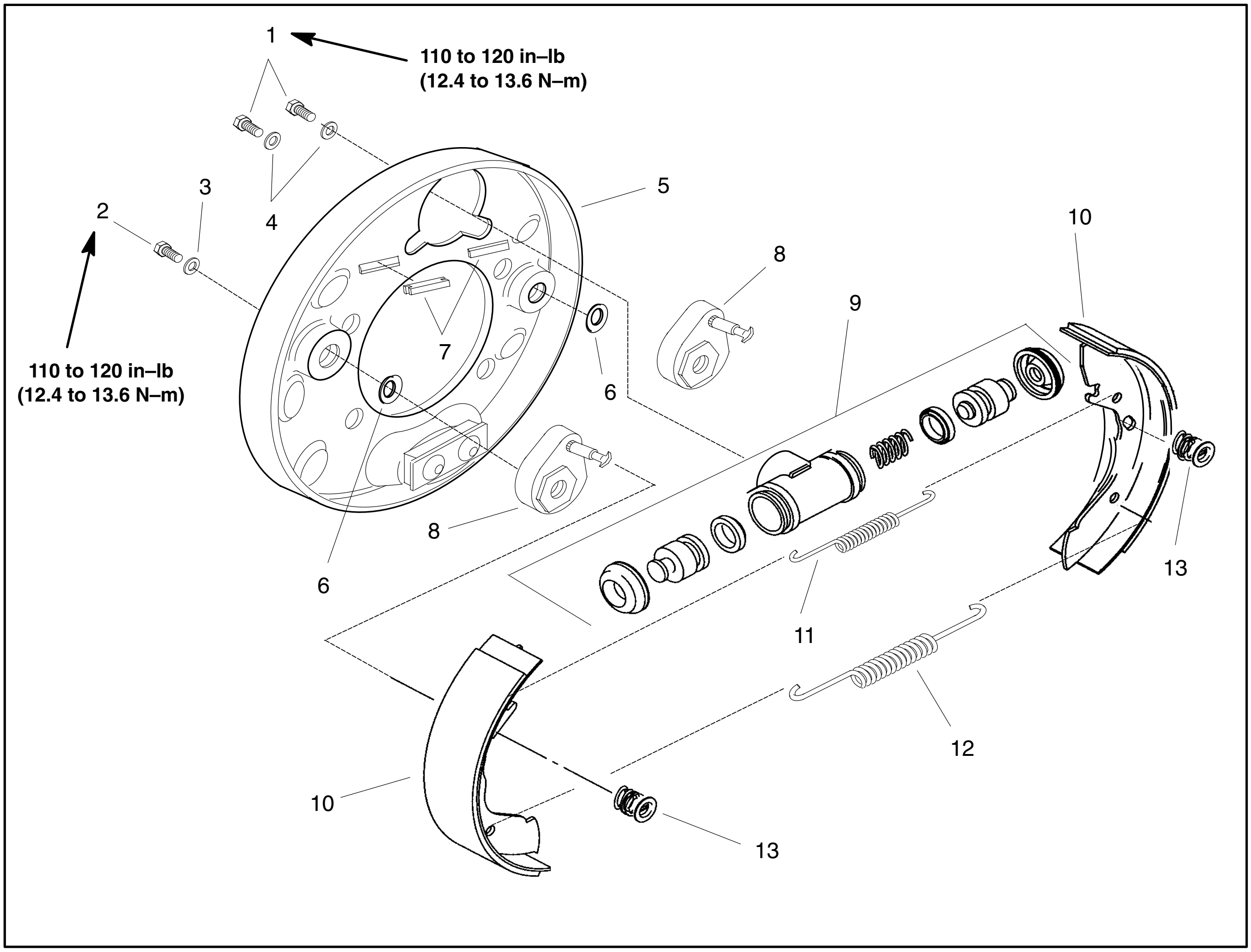

Figure 4

1. **Flange head screw**
2. **Cap screw (2 used per wheel)**
3. **Flat washer (2 used per wheel)**
4. **Lock washer**
5. **Brake backing plate**
6. **Belleville washer**
7. **Dust cover**
8. **Adjuster lever**
9. **Wheel cylinder**
10. **Brake shoe**
11. **Upper spring**
12. **Lower spring**
13. **Shoe hold down cup and spring**

Disassembly (Fig. 4)

CAUTION

Be careful when removing springs from brake shoes. The springs are under heavy tension and may cause personal injury.

1. Remove upper and lower springs from brake shoes.

2. Remove shoe hold down cups and springs that secure the brake shoes to the backing plate.

3. Remove brake shoes from backing plate.

4. If brake assembly is still on machine and wheel cylinder removal is necessary:

   A. Clean hydraulic brake line area of wheel cylinder to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Cap brake line and position it away from brake assembly.

   B. Remove two flange head screws that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

5. If necessary, remove cap screws and washers to allow adjuster levers to be separated from backing plate. Locate and remove belleville washers from between adjuster levers and backing plate.

Inspection

1. Inspect brake shoes.

IMPORTANT: Replace front brake shoes as a set (all four shoes on both wheels) to maintain equal braking forces.

A. Replace brake shoes if damaged or if lining is worn to 1/16” (1.6 mm). Replace shoes if lining is contaminated by oil, grease, or other fluids.

NOTE: Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, upper and lower springs, and shoe hold down springs for overheating and stretching. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins on adjuster levers for bends, rust, or corrosion. Replace as necessary.

2. Inspect backing plate surfaces which contact with the brake shoes for grooves that may restrict shoe movement. Replace backing plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace backing plate if cracked, warped, or excessively rusted.

3. Inspect adjuster levers. Replace levers if deformation or excessive rust is found.

Assembly (Fig. 4)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil, and other foreign matter.

1. Apply a light film of lubricant to the following:

A. Ledges on which the brake shoes rest.

B. Pin surfaces on adjuster levers.

C. Anchor block surfaces that contact shoe webs.

D. Both surfaces of belleville washers that are positioned between adjuster levers and backing plate (if removed).

2. If removed, position lubricated belleville washer between adjuster lever and backing plate. Secure adjuster to backing plate with washer and cap screw. Torque bolt from 110 to 120 in–lb (12.4 to 13.6 N–m).

3. If removed, install wheel cylinder:

A. Secure wheel cylinder to backing plate with two flange head screws. Torque screws from 110 to 120 in–lb (12.4 to 13.6 N–m).

B. If brake assembly is still on machine, connect brake line to wheel cylinder.

4. If removed from backing plate, install dust covers in backing plate.

5. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, wheel cylinder, and pin on adjuster lever. Secure shoes to adjuster levers with shoe hold down cups and springs.

CAUTION

Be careful when installing springs to brake shoes. The springs are under heavy tension and may cause personal injury.

6. Secure brake shoes with upper and lower springs.

7. Reassemble front wheel (see Front Wheels and Brakes).

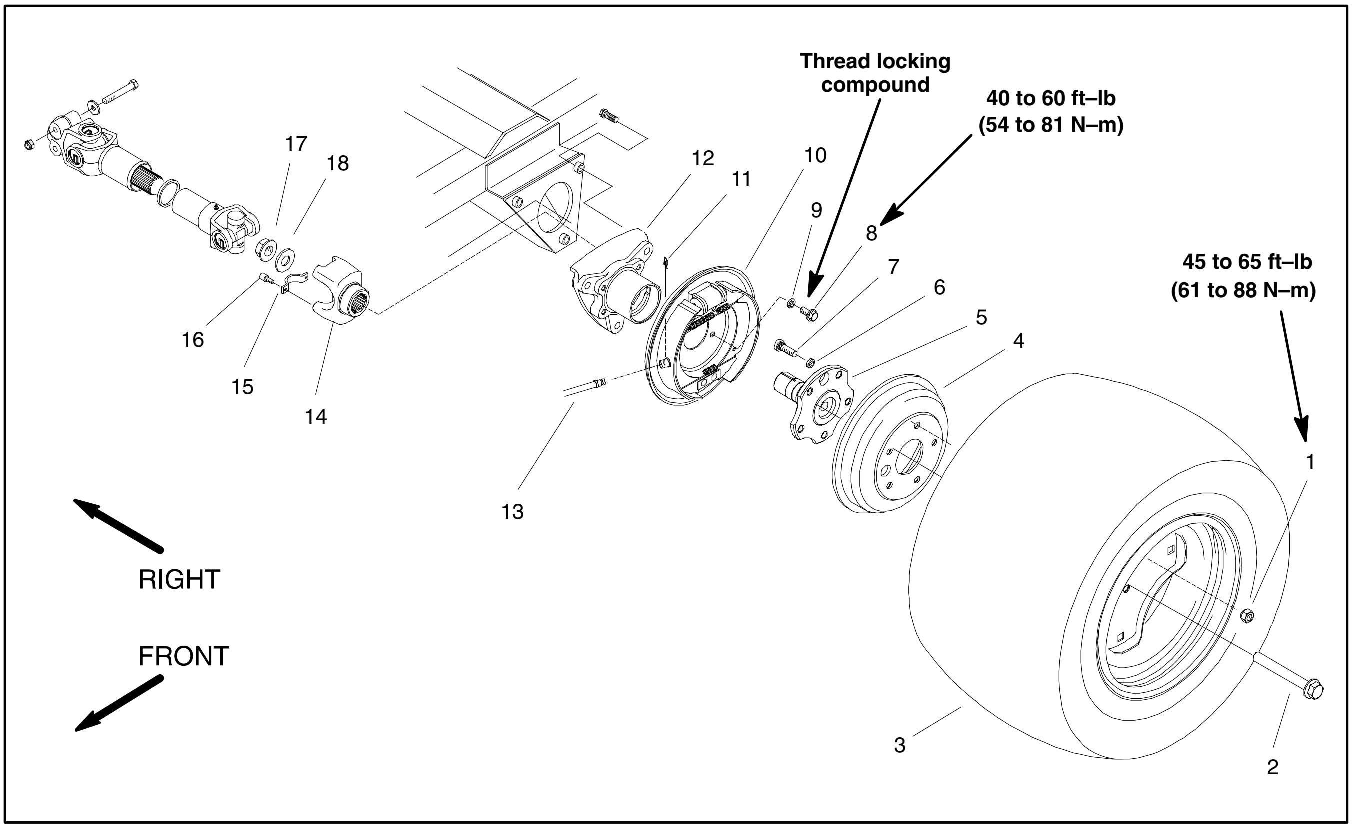

Figure 5

1. Lug nut (5 used per wheel)
2. Flange head screw
3. Wheel assembly
4. Brake drum
5. Stub axle
6. Lock washer (5 used per wheel)
7. Drive stud (5 used per wheel)
8. Cap screw (4 used per wheel)
9. Lock washer (4 used per wheel)
10. Brake assembly
11. Brake cable clip
12. Axle housing
13. Parking brake cable
14. End yoke
15. Yoke strap (2 used per yoke)
16. Bolt (4 used per yoke)
17. Flange lock nut
18. Flat washer

Removal (Fig. 5)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Chock front wheels. Raise rear wheel using a jack or hoist (see Jacking Instructions in Operator's Manual). Block rear of machine.

3. Loosen and remove lug nuts. Remove rear wheel.

4. Loosen set screw on parking brake control lever knob (Fig. 6). Turn knob on parking brake lever counterclockwise all the way to loosen brake cables.

5. To remove brake drum, it may be necessary to back off parking brake adjuster. To back off adjuster, rotate brake drum until access hole lines up with star wheel. Use a hooked piece of wire to pull pawl away from star wheel, then turn star wheel. Pull brake drum from machine.

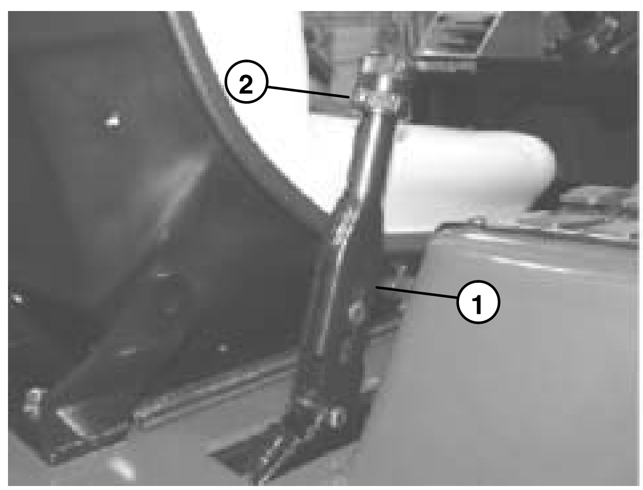

Figure 6

1. Parking brake lever
2. Set screw

6. Inspection and service of rear brakes can be completed with brake assembly on machine (see Rear Brake Service). If required, brake assembly can be removed from machine as follows:

A. Remove parking brake cable from brake assembly (see Parking Brake Cable Removal).

B. Clean hydraulic brake line area of brake assembly to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Cap brake line and position it away from brake assembly.

C. Remove stub axle from machine (see Stub Axle and Driveshaft in Chapter 7 – Drive Train).

D. Remove four cap screws and lock washers that secure the brake assembly to the axle housing.

E. Remove brake assembly from machine.

Inspection

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace rear brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 8.071" (205.0 mm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out–of–round, scored, heat spotted, or excessively rusted.

C. Minor scoring in brake drum can be removed with sandpaper.

Installation (Fig. 5)

1. Clean all parts thoroughly before reassembly.

2. If removed, position brake assembly to the machine.

A. Apply medium strength thread locking compound (e.g. Loctite #242) to four cap screws. Secure backing plate of the brake assembly to the axle housing with cap screws and lock washers. Torque screws from 40 to 60 ft–lb (54 to 81 N–m).

B. Install stub axle (see Stub Axle and Driveshaft in Chapter 7 – Drive Train).

C. Install hydraulic brake line to wheel cylinder.

D. Install parking brake cable to brake assembly (see Parking Brake Cable Installation).

3. Position brake drum so access hole in drum aligns with hole in stub axle flange. Slide brake drum onto machine.

4. Adjust brake shoes: Align access hole in brake drum with star wheel on brake adjuster assembly, then rotate star wheel to increase adjuster length until brake shoes contact brake drum, then back off star wheel until drum rotates freely.

5. Install wheel and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from 45 to 65 ft–lb (61 to 88 N–m).

6. Lower machine to ground.

7. Bleed brakes (see Bleed Brake System).

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

8. Check brake operation. To adjust the brakes, stop several times while vehicle is moving in reverse.

9. Adjust parking brake (see Operator's Manual).

Burnish Brake Shoes

Brake linings may not provide maximum brake stopping distance after brake shoes are replaced. It is necessary to burnish new brake shoe linings.

IMPORTANT: Do not drive machine with the brakes applied. The brake shoe linings will overheat.

IMPORTANT: Do not allow the brakes to lock up. Allow brakes to cool between applications.

Drive machine while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at moderate speed.

Rear Brake Service

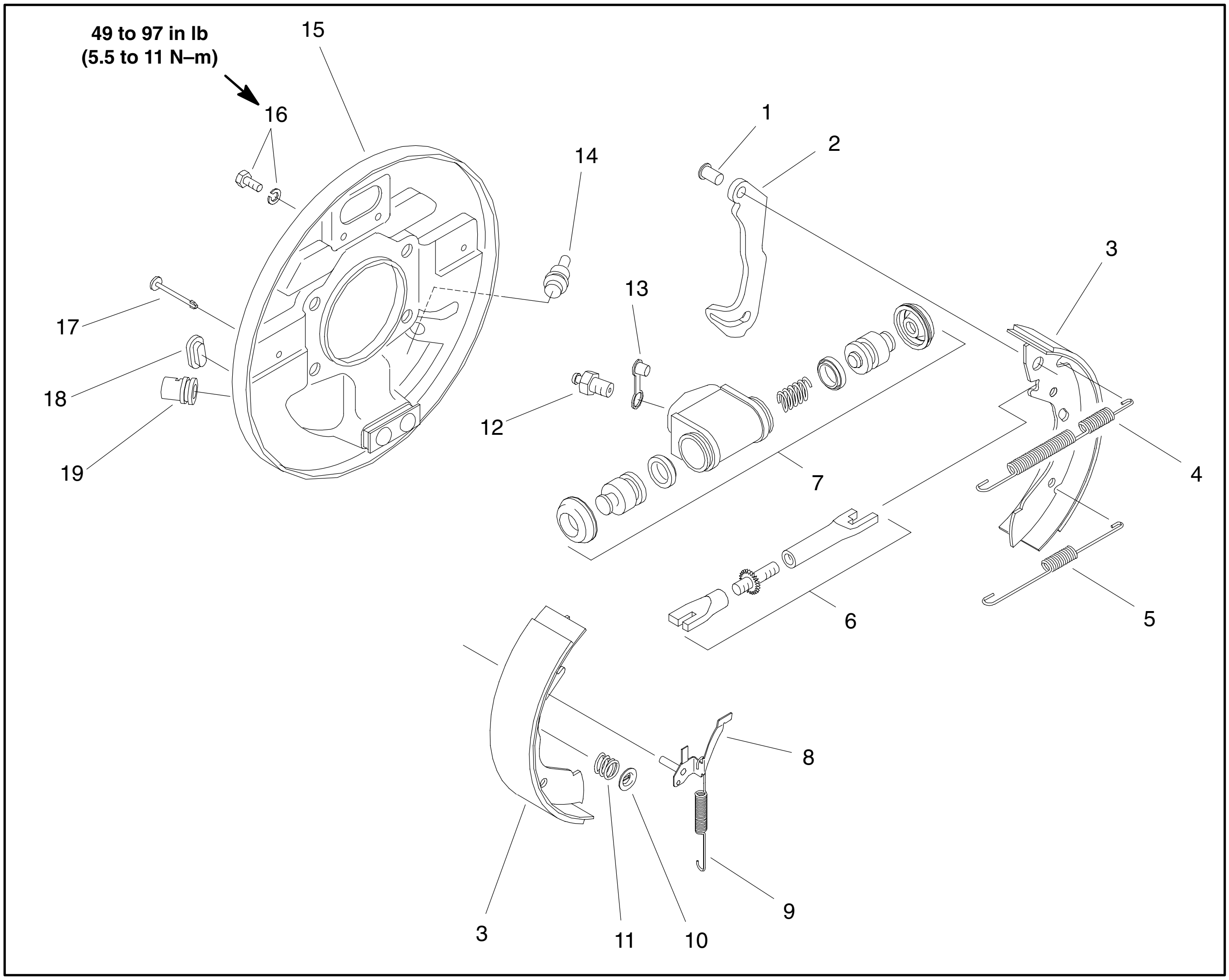

Figure 7

1. Pin
2. Parking brake lever
3. Brake shoe
4. Upper spring
5. Lower spring
6. Brake adjuster assembly
7. Brake cylinder assembly
8. Parking brake pawl with pin
9. Adjuster spring
10. Hold down washer (2 used per wheel)
11. Hold down spring (2 used per wheel)
12. Bleed screw
13. Cap
14. Plug
15. Brake back plate
16. Bolt set (2 used per wheel)
17. Hold down pin (2 used per wheel)
18. Inspection plug
19. Cable guide

Disassembly (Fig. 7)

1. If brake assembly is still on machine, remove parking brake cable (see Parking Brake Cable Removal).

CAUTION

Be careful when removing springs from brake shoes. The springs are under heavy tension and may cause personal injury.

2. Remove upper and lower springs from brake shoes.

3. Remove shoe hold down washers and springs that secure the brake shoes to the backing plate.

4. Remove brake shoes from backing plate.

5. If brake assembly is still on machine and wheel cylinder removal is necessary:

   A. Clean hydraulic brake line area of wheel cylinder to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Cap brake line and position it away from brake assembly.

   B. Remove two bolts and washers that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

Inspection

1. Inspect brake shoe linings.

   IMPORTANT: Replace rear brake shoes as a set (all four shoes) to maintain equal braking forces.

   A. Replace brake shoes if damaged or if lining is worn to 1/16” (1.6 mm). Replace if lining is contaminated by oil, grease, or other fluids.

   NOTE: Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

   B. Inspect brake shoe webbing, upper and lower springs, and shoe hold down springs for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

   C. Inspect hold down pins for damage. Replace as necessary.

2. Inspect brake adjuster, parking brake lever, and parking brake pawl for damage or wear. Replace components as necessary.

Assembly (Fig. 7)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil, and other foreign matter.

1. Apply a light film of lubricant to the following:

   A. Ledges on which the brake shoes rest.

   B. Hold down pins.

   C. Anchor block surfaces that contact shoe webs.

2. If removed, install wheel cylinder:

   A. Secure wheel cylinder to backing plate with two bolts and washers. Torque bolts from 49 to 97 in–lb (5.5 to 11 N–m).

   B. If brake assembly is still on machine, connect brake line to wheel cylinder.

3. If removed from backing plate, install dust covers in backing plate.

4. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, wheel cylinder, and hold down pin. Secure shoes to pins with hold down springs and washers.

CAUTION

Be careful when installing springs to brake shoes. The springs are under heavy tension and may cause personal injury.

5. Install lower spring to brake shoes.

6. Install brake adjuster assembly to slots on brake shoes, then the parking brake pawl with pin. Install adjuster spring.

7. Install upper spring.

8. If brake assembly is still on machine, install parking brake cable (see Parking Brake Cable Installation).

9. Reassemble rear wheel (see Rear Wheels and Brakes Installation).

Brake Lines

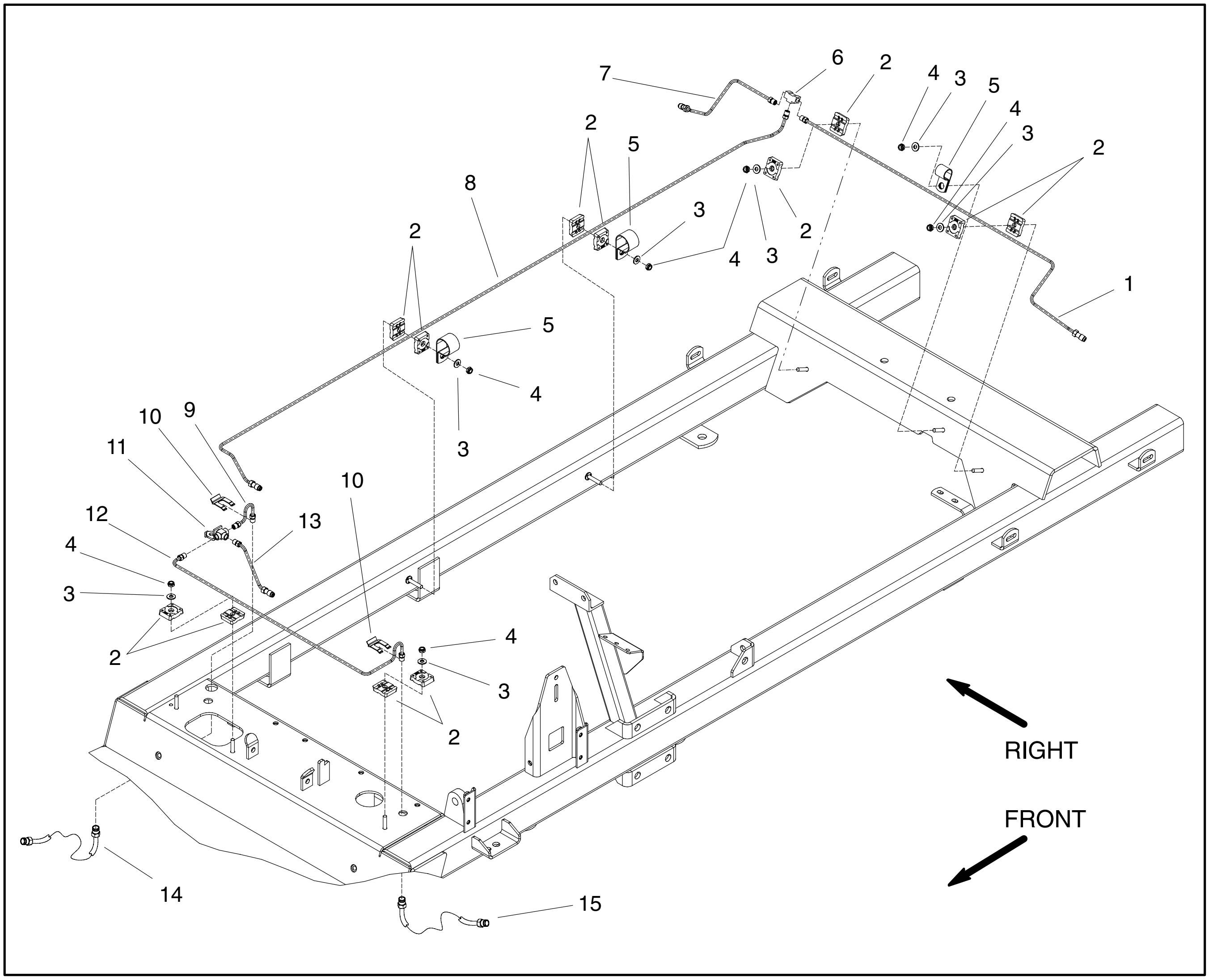

Figure 8

1. **Rear LH brake tube**
2. **Tube clamp**
3. **Flat washer**
4. **Lock nut**
5. **R–clamp**
6. **Tee fitting**
7. **Rear RH brake tube**
8. **Rear supply brake tube**
9. **Front RH brake tube**
10. **Retainer clip**
11. **Tee fitting**
12. **Front LH brake tube**
13. **Front supply brake tube**
14. **Front brake hose (RH)**
15. **Front brake hose (LH)**

When performing service work on the Multi Pro brake lines, make sure to clean brake components before disassembly. Use Figure 8 as a guide for removal and installation of hydraulic brake lines.

Parking Brake Cables

Removal

1. Loosen set screw on parking brake lever knob (Fig. 9). Turn knob on parking brake lever counterclockwise fully to loosen cable adjustment.

2. Raise seat to allow access to cable connection at parking brake lever.

3. Remove cotter pin, flat washer, and clevis pin that secure brake equalizer to parking brake lever (Fig. 10).

4. Remove retaining rings that secure brake cables to frame. Remove cable ends from equalizer plate (Fig. 10).

5. Jack up and support rear of machine (see Jacking Instructions in Operator's Manual). Remove both rear wheels and brake drums (see Rear Wheels and Brakes).

6. Remove cable clip that holds each brake cable into brake backing plate. Remove cable end from parking brake lever (Fig. 11). Pull cable from rear brake assembly.

7. Note routing of cables and location of cable ties and r–clamps before removing cables from machine.

Installation

1. Install new cables to brake equalizer. Attach equalizer to parking brake lever with clevis pin, flat washer, and cotter pin.

2. Position cables to frame and secure with retaining rings.

3. Route cables to rear brakes and secure with cable ties and r–clamps.

4. Insert cables through cable guide on appropriate rear brake. Connect cable end to parking brake lever. Install cable clip to secure cable to brake backing plate.

5. After installing cable to each rear brake, check to make sure that the bottoms of the brake shoes are seated in grooves at bottom of backing plate.

6. Install brake drums and rear wheels (see Rear Wheels and Brakes). Lower machine to ground.

7. Lower seat.

8. Adjust parking brake (see Operator's Manual). Check operation of brakes before using the machine.

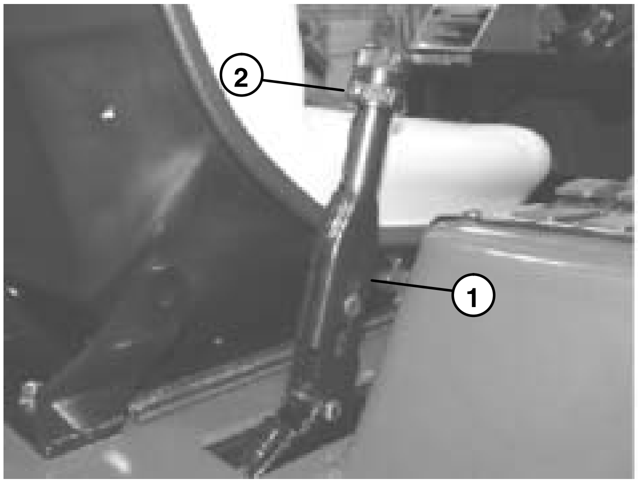

Figure 9

1. **Parking brake lever**
2. **Set screw**

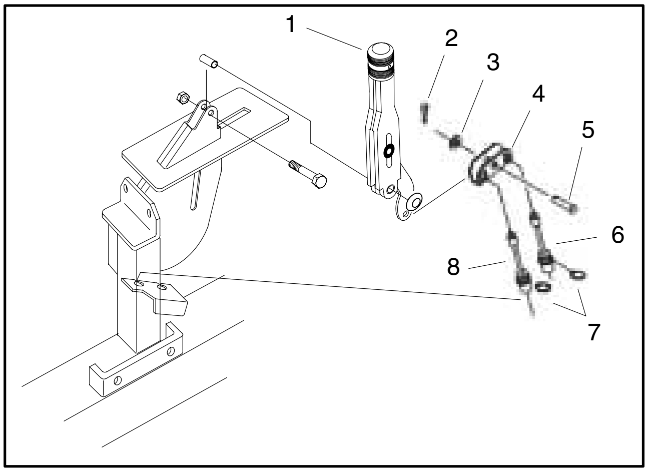

Figure 10

1. **Parking brake lever**
2. **Cotter pin**
3. **Flat washer**
4. **Equalizer plate**
5. **Clevis pin**
6. **LH brake cable**
7. **Retaining ring**
8. **RH brake cable**

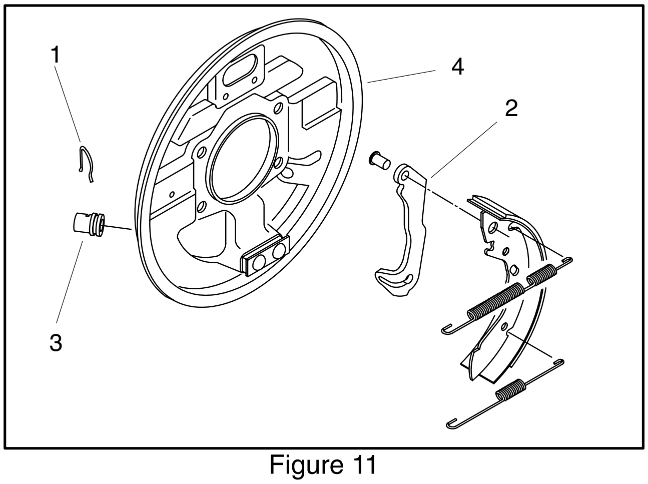

Figure 11

1. **Cable clip**
2. **Parking brake lever**
3. **Cable guide**
4. **Brake backing plate**

Chassis

Brake Master Cylinder Service

Testing

1. Insure that brake system is properly adjusted and bled.

2. Apply light pressure to brake pedal.

3. If brake pedal fades or falls away while applying light pressure to pedal, the master cylinder should be serviced.

Disassembly (Fig. 12)

1. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.

2. Disconnect lower end of the dust cover from the housing.

3. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.

4. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.

2. Check cylinder bore, pistons, and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring, or cracks are evident in cylinder bore. **Note:** Do not hone bore of brake cylinder.

Assembly (Fig. 12)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.

2. Install secondary piston assembly and primary piston assembly into cylinder.

3. Install retainer washer.

4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.

5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

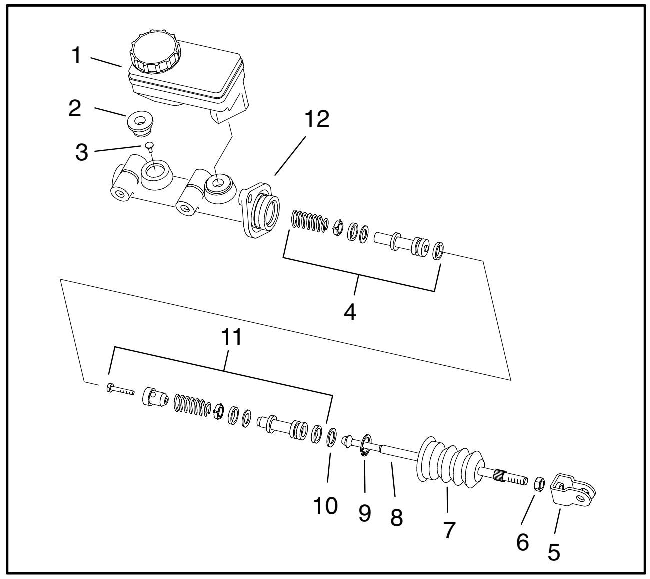

Figure 12

1. **Reservoir**
2. **Flange seal**
3. **Stop pin**
4. **Secondary piston assy**
5. **Clevis**
6. **Jam nut**
7. **Dust cover**
8. **Push rod**
9. **Circlip**
10. **Retainer washer**
11. **Primary piston assy**
12. **Cylinder housing**

Bleed Brake System

After loosening or removing any hydraulic brake component, the brake system should be bled to insure proper brake operation.

NOTE: A power/vacuum brake bleeding tool will provide faster and more effective brake bleeding than manual bleeding.

1. Connect a suitable transparent hose to bleeder valve on wheel cylinder and submerge other end of hose in a glass container partially filled with clean brake fluid.

2. Have a helper pump brake pedal several times, then hold pedal down firmly.

3. With pedal firmly depressed, open bleeder valve of wheel cylinder until pedal fades to floor. Close bleeder valve before releasing pedal.

4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times**.

5. Repeat steps 1 to 4 for other wheel cylinders.

CAUTION

After servicing the brakes, always check brake operation in a wide open, level area that is free of other persons and obstructions.

6. After bleeding of brakes is completed, test vehicle to make sure brakes are operating correctly and that brake pedal is solid.

Front Suspension

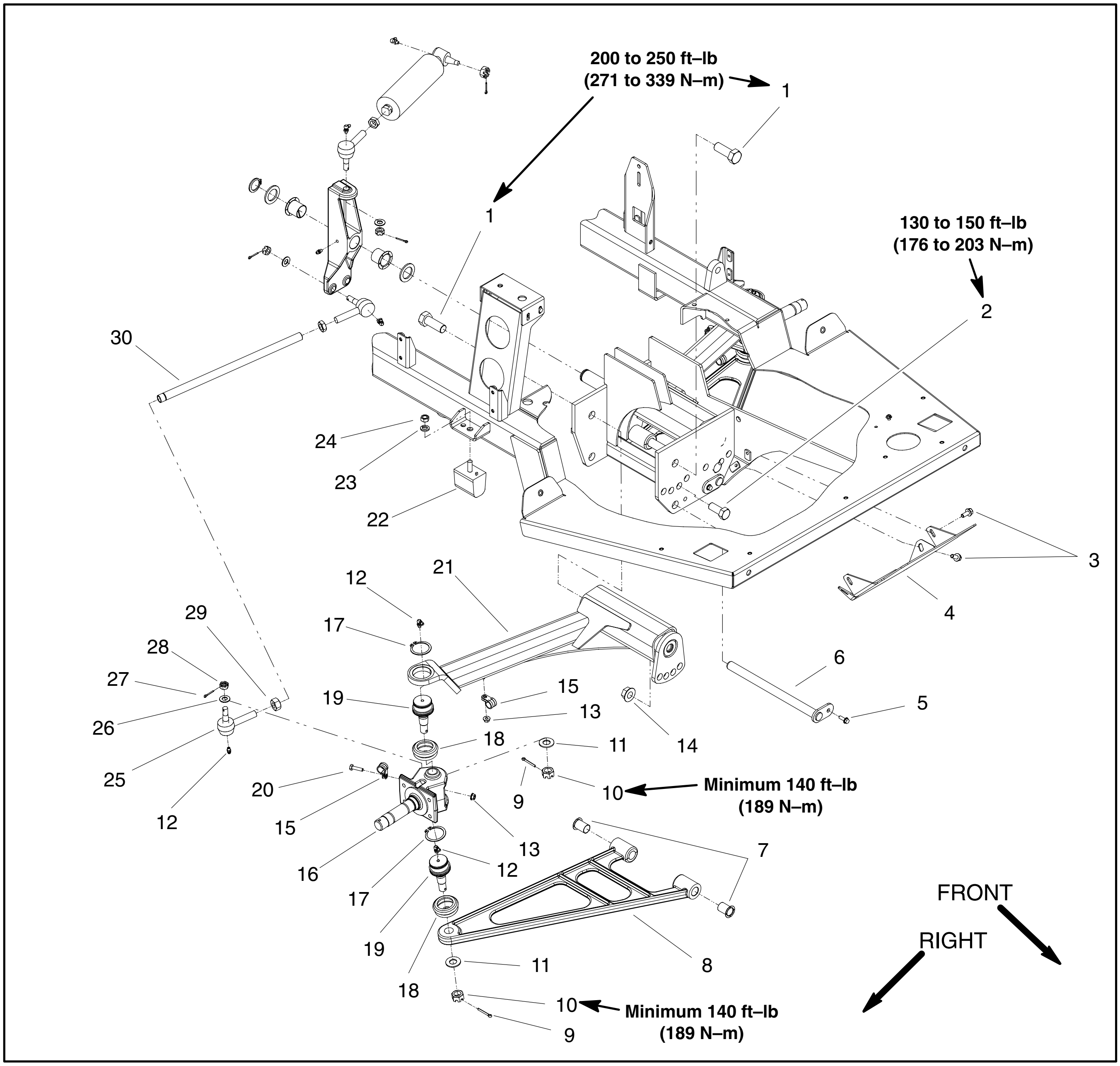

Figure 13

1. Cap screw
2. Cap screw
3. Flange head screw (4 used)
4. Skid plate
5. Flange head screw
6. Pivot pin
7. Flange bushing
8. A–arm
9. Cotter pin
10. Slotted hex nut
11. Flat washer
12. Grease fitting
13. Flange nut
14. Flange nut
15. R–clamp
16. Spindle
17. Retaining ring
18. Ball joint seal
19. Ball joint
20. Cap screw
21. Axle assembly (RH shown)
22. Axle bumper
23. Lock washer
24. Hex nut
25. Ball joint (LH thread)
26. Flat washer
27. Cotter pin
28. Slotted hex nut
29. Jam nut (LH thread)
30. Tie rod

Disassembly (Fig. 13)

1. Park machine on a level surface, stop engine, engage parking brake, and remove key.

2. Lift front of machine using a jack or hoist to allow front suspension to hang freely from machine. Chock rear wheels to prevent vehicle from shifting.

3. Remove front wheel assembly (see Front Wheels and Brakes).

4. Support brake and spindle assembly to prevent them from falling during disassembly. If necessary, remove front brake assembly from spindle (see Front Wheels and Brakes).

5. Disassemble suspension as needed using Figure 13 as a guide.

   A. During disassembly, note position of cap screw in torque arm of axle assembly for reassembly purposes (Fig. 14).

Assembly (Fig. 13)

1. Assemble suspension using Figure 13 as a guide.

   A. Loosely install cap screws (Item 1) that secure axle assembly to machine frame.

   B. Install cap screw (Item 2) in noted location of axle assembly torque arm (Fig. 14). Torque cap screw from 130 to 150 ft–lb (176 to 203 N–m).

   C. Torque cap screws (Item 1) that secure axle assembly to machine frame from 200 to 250 ft–lb (271 to 339 N–m).

   D. If ball joints were loosened or removed from spindle, tighten slotted hex nut to a minimum of 140 ft–lb (189 N–m). If necessary for cotter pin installation, tighten slotted hex nut further until cotter pin can be installed.

2. After assembly is complete, make sure that components do not contact hoses and/or wires.

3. Lubricate suspension grease fittings (see Operator's Manual).

4. Install wheel and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from 55 to 65 ft–lb (75 to 88 N–m).

5. Lower machine to ground.

NOTE: Right and left tie rods should be identical length.

6. Check and adjust front wheel toe–in (see Operator's Manual). Check front suspension (see Front Suspension in the Adjustments section of this Chapter).

IMPORTANT: If axle assembly has been replaced, front wheel toe–in should be rechecked after machine has been used for several hours.

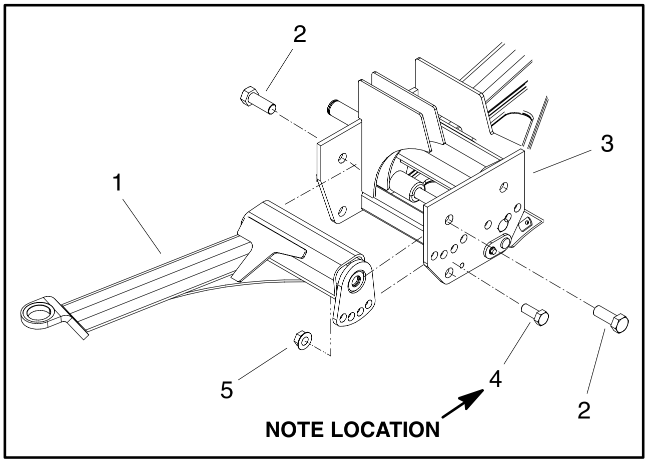

Figure 14

1. **Axle assembly (RH)**
2. **Cap screw**
3. **Frame**
4. **Cap screw**
5. **Lock nut**

Chassis

Steering Assembly

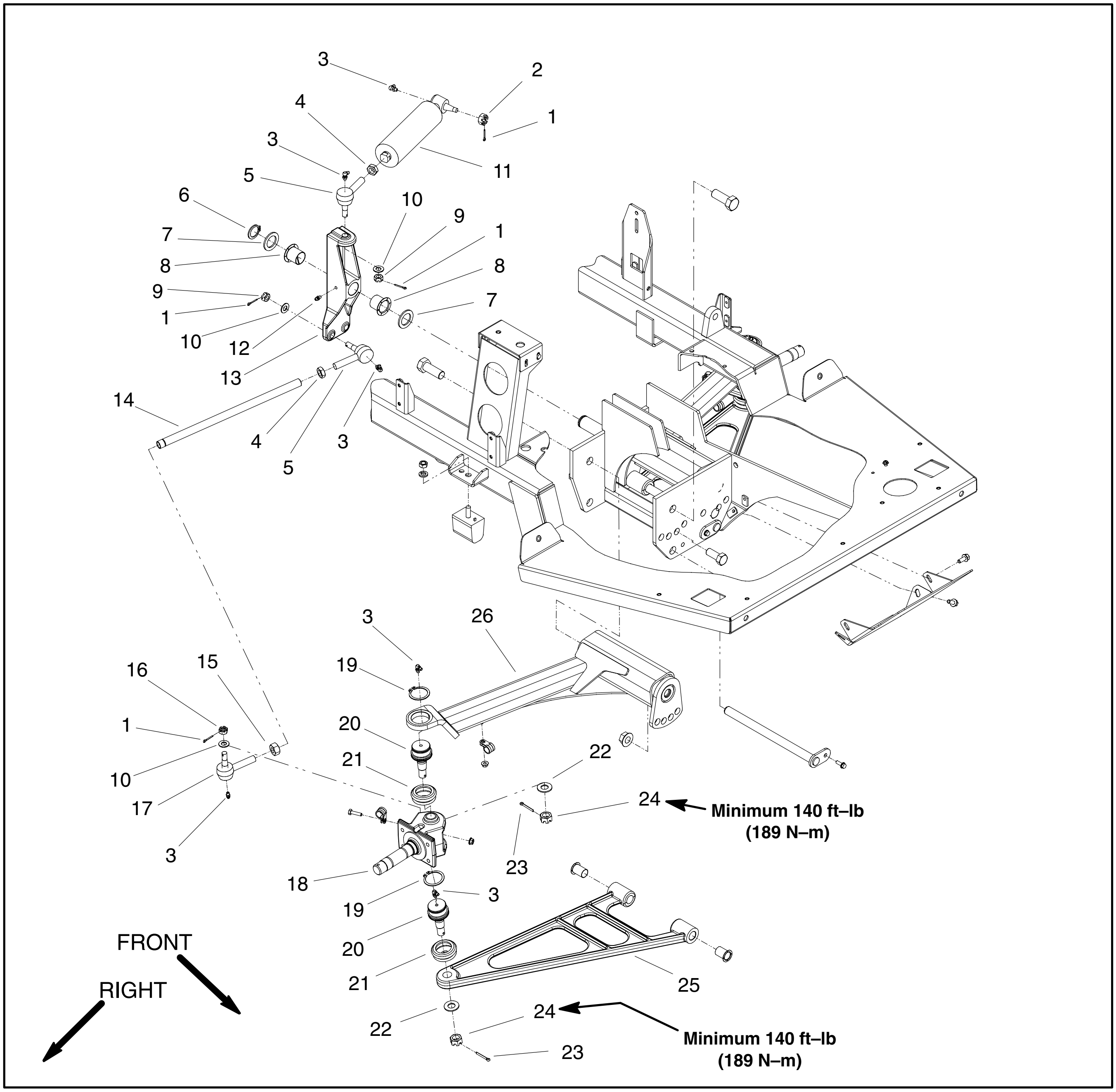

Figure 15

1. **Cotter pin**
2. **Slotted hex nut**
3. **Grease fitting**
4. **Jam nut**
5. **Tie rod end**
6. **Retaining ring**
7. **Thrust washer**
8. **Bearing**
9. **Slotted hex nut**
10. **Flat washer**
11. **Steering cylinder**
12. **Grease fitting**
13. **Steering pivot**
14. **Tie rod**
15. **Jam nut (LH thread)**
16. **Slotted hex nut**
17. **Tie rod end (LH thread)**
18. **Spindle**
19. **Retaining ring**
20. **Ball joint**
21. **Ball joint seal**
22. **Flat washer**
23. **Cotter pin**
24. **Slotted hex nut**
25. **A–arm**
26. **Axle**

Disassembly (Fig. 15)

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

2. Jack front of machine off ground (see Operator's Manual). Front of machine should be lifted enough to allow front suspension to hang freely from machine.

3. Remove front wheel assembly (see Front Wheels and Brakes).

4. Support brake and spindle assembly to prevent them from falling during disassembly. If necessary, remove front brake assembly from spindle (see Front Wheels and Brakes).

5. If steering pivot requires removal, lower engine mounting plate from machine (see Engine Mounting Plate Assembly Removal in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

6. Disassemble steering components as needed using Figure 15 as a guide.

Assembly (Fig. 15)

1. Assemble steering components using Figure 15 as a guide.

2. If engine mounting plate was lowered from machine, raise mounting plate assembly to machine (see Engine Mounting Plate Installation in the Service and Repairs section of Chapter 3 – Kohler Gasoline Engine).

3. After assembly is complete, make sure that steering components do not contact hoses and/or wires.

4. Lubricate suspension grease fittings (see Operator's Manual).

5. Install wheel and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from 55 to 65 ft–lb (75 to 88 N–m).

6. Lower machine to ground.

NOTE: Right and left tie rods should be identical length.

7. Check and adjust front wheel toe–in (see Operator's Manual). Check front suspension (see Front Suspension in the Adjustments section of this Chapter).

Tie Rod End Replacement

Removal (Fig. 16)

1. Loosen jam nut on tie rod end. Note: outside tie rod end that is attached to spindle has left hand threads.

2. Remove cotter pin and slotted hex nut from tie rod end to be removed.

3. Use a suitable puller to separate tie rod end from spindle (outside tie rod end) or steering pivot (inside tie rod end).

4. When removing tie rod end from tie rod, count the number of revolutions it takes to remove so new tie rod end can be installed without changing the front wheel toe–in.

Installation (Fig. 16)

1. Install new tie rod end to tie rod. Thread in new rod end the same number of revolutions as the old one took to remove.

2. Install grease fitting into tie rod end.

3. Insert tie rod end shaft into spindle (outside tie rod end) or steering pivot (inside tie rod end) and secure with flat washer and slotted hex nut. Install cotter pin.

4. Grease tie rod end (see Operator's Manual).

NOTE: Right and left tie rods should be identical length.

5. Check and adjust front wheel toe–in (see Operator's Manual) and front suspension (see Front Suspension in the Adjustments section of this Chapter).

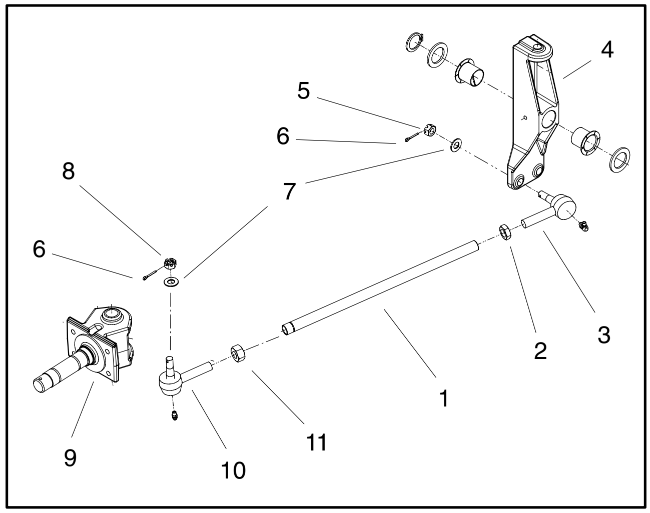

Figure 16

1. **Tie rod**
2. **Jam nut**
3. **Tie rod end**
4. **Steering pivot**
5. **Slotted hex nut**
6. **Cotter pin**
7. **Flat washer**
8. **Slotted hex nut**
9. **Spindle**
10. **Tie rod end (LH thread)**
11. **Jam nut (LH thread)**

Ball Joint Replacement

Removal (Fig. 17)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Lift front wheel off the ground using a jack (see Jacking Instructions in Operator's Manual). Block front and rear of other wheels.

3. Remove lug nuts and wheel assembly.

4. Support axle, spindle, and a–arm to prevent them from falling during disassembly.

5. Remove cotter pin from ball joint to be removed, then remove slotted hex nut and flat washer.

6. Using fork or suitable press, separate upper ball joint from spindle or lower ball joint from A–arm.

7. Remove ball joint seal.

8. Remove retaining ring that secures ball joint. Press upper ball joint from axle or lower ball joint from spindle. Note: Ball joint removal may be easier if affected A–arm or spindle is removed from machine.

Installation (Fig. 17)

1. Press new upper ball joint into axle or lower ball joint into spindle. Install retaining ring to secure ball joint. Use punch and hammer to seat retaining ring if needed.

2. If removed, install A–arm or spindle to machine.

3. Install grease fitting into ball joint. Install ball joint seal over shaft on ball joint. Edge of seal must be inserted into ball joint slot.

4. Position upper ball joint to spindle or lower ball joint to A–arm.

5. Secure ball joint with flat washer and slotted hex nut. Torque slotted hex nut at least 140 ft–lb (189 N–m) and until cotter pin can be installed. Secure with cotter pin.

6. Grease ball joint (see Operator's Manual).

7. Install wheel and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from 55 to 65 ft–lb (75 to 88 N–m).

8. Lower machine to ground.

9. Check and adjust front wheel toe–in (see Operator's Manual) and front suspension (see Front Suspension in the Adjustments section of this Chapter).

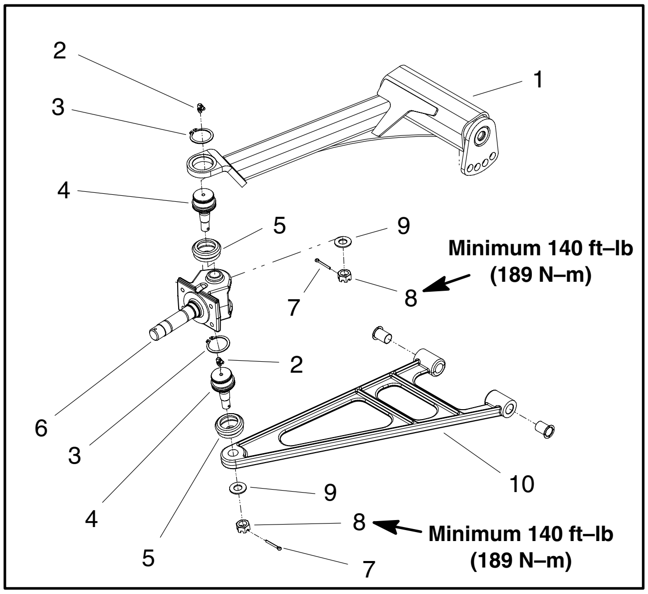

Figure 17

1. **Axle**
2. **Grease fitting**
3. **Retaining ring**
4. **Ball joint**
5. **Ball joint seal**
6. **Spindle**
7. **Cotter pin**
8. **Slotted hex nut**
9. **Flat washer**
10. **A–arm**

Chassis

Seat Base (Multi Pro 1200)

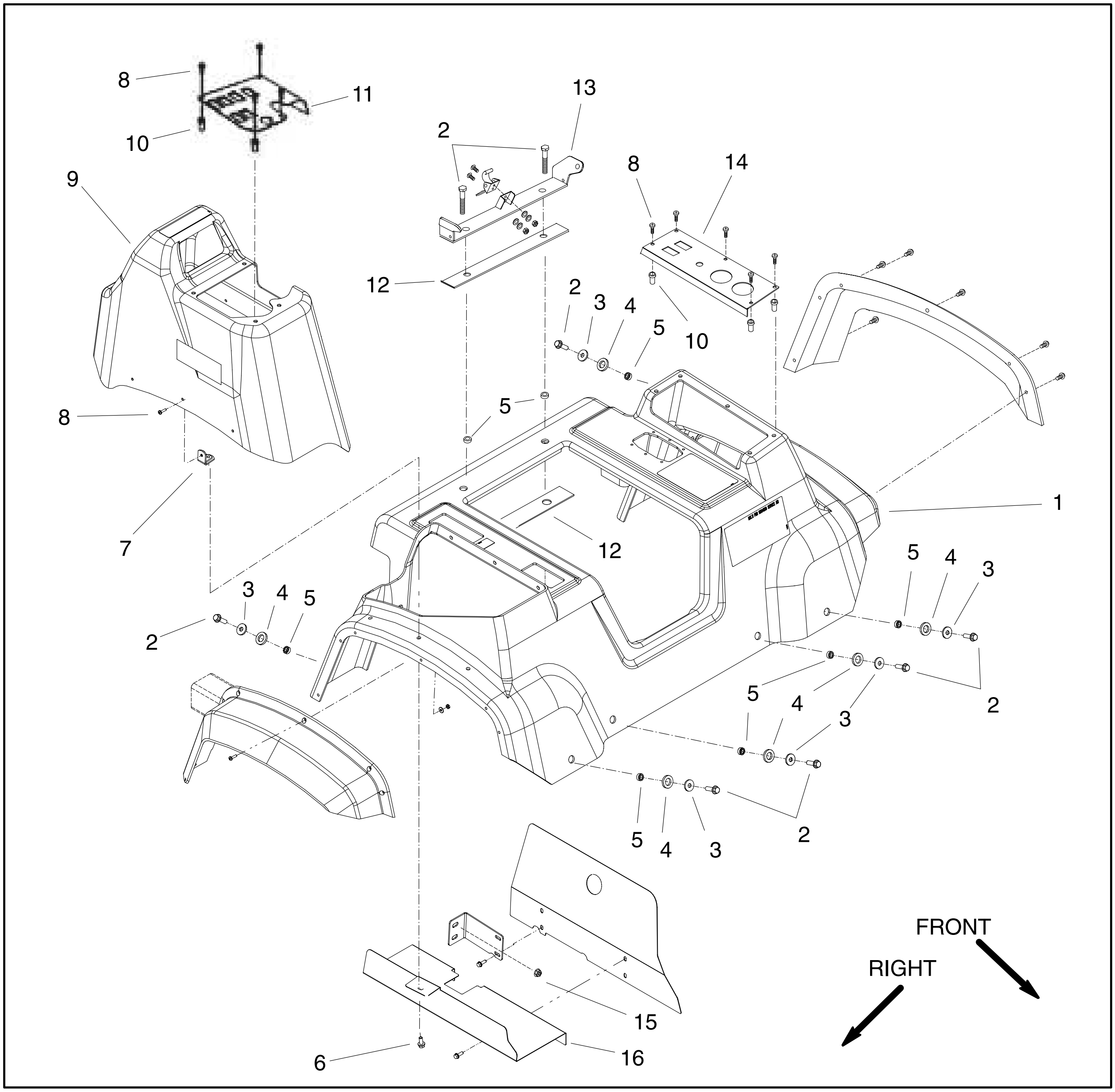

Figure 18

1. Seat base
2. Cap screw
3. Flat washer
4. Rubber washer
5. Spacer
6. Flange head screw
7. L bracket
8. Phillips head screw
9. Console
10. Well nut
11. Spray control panel
12. Seal
13. Seat belt bracket
14. Control panel
15. Flange nut
16. RH inner fender

Removal (Fig. 18)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Disconnect negative (–) cable and then positive (+) cable from battery (see Operator's Manual).

3. Remove seat assembly by tilting seat forward and removing hitch pin and clevis pin (Fig. 19).

4. Remove screws that secure control panels to seat base. Carefully place control panels into seat base openings.

5. Remove knob from shift lever.

6. Remove flange head screw (item 6) that secures right hand inner panel (item 16) to L bracket (item 7).

7. Remove eight (8) flange head screws that fasten seat base to machine. During screw removal, locate and remove washers and spacers. The two (2) screws directly behind the front wheels are secured with flange nuts (item 15).

8. Carefully lift seat base from machine.

Installation (Fig. 18)

1. Position seat base on machine.

2. Carefully pull control panels through openings in seat base.

3. Install flange head screw (item 6) to secure right hand inner panel (item 16) to L bracket (item 7).

4. Secure seat base to machine using washers, spacers, flange nuts, and eight (8) flange head screws. Install all fasteners before tightening.

5. Install knob on shift lever.

6. Secure control panels to seat base.

7. Secure seat assembly to machine with clevis pin and hitch pin.

8. Connect positive (+) cable and then negative (–) cable to battery (see Operator's Manual).

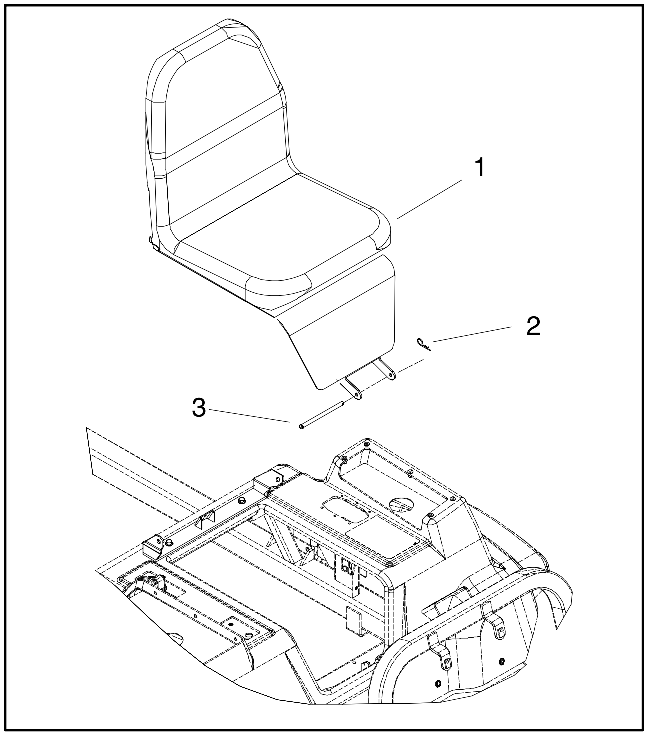

Figure 19

1. Seat assembly
2. Hitch pin
3. Clevis pin

Chassis

Seat Base (Multi Pro 1250)

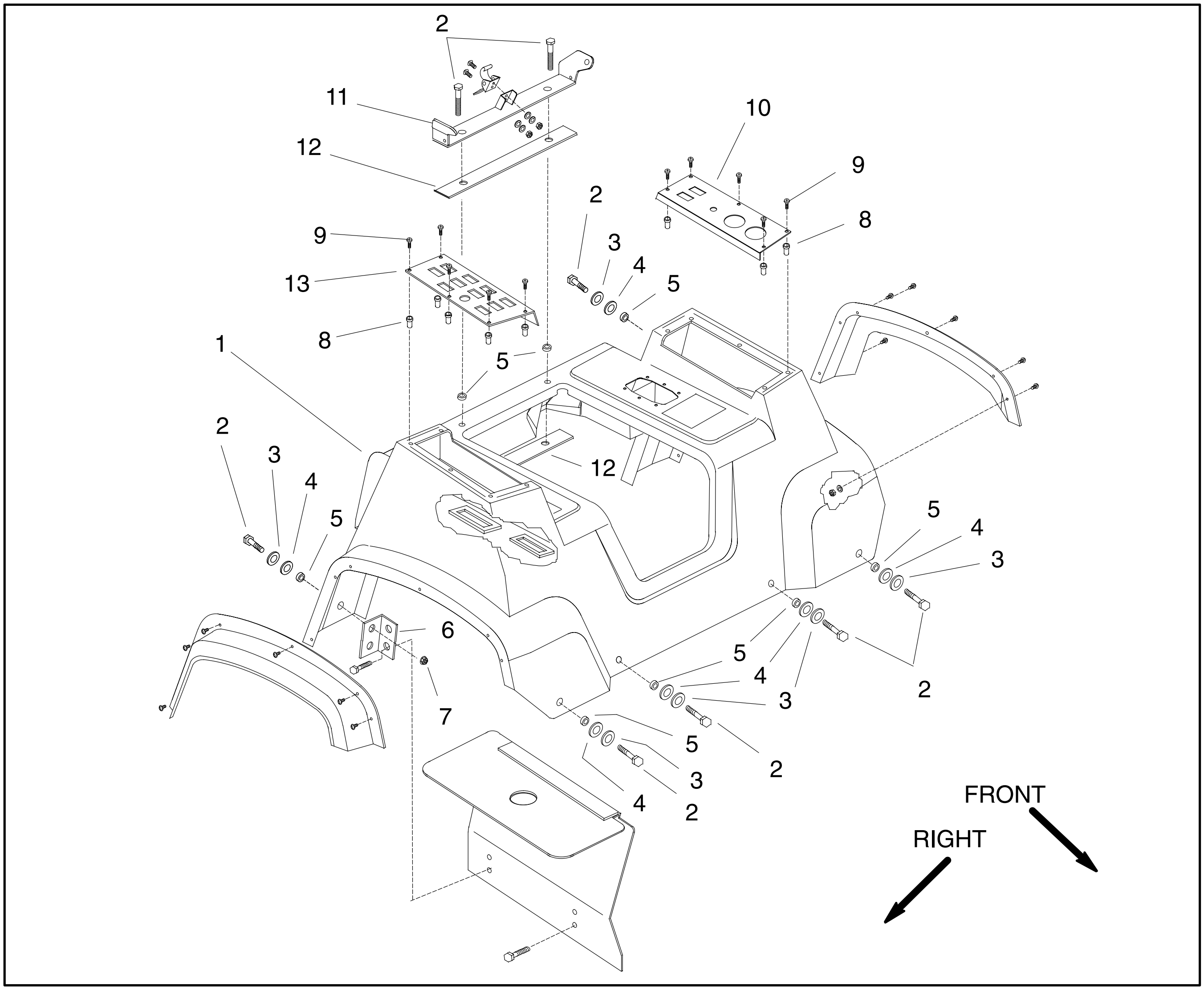

Figure 20

1. Seat Base	**6. Support bracket**	**10. Control panel**
2. Flange head screw	**7. Flange nut**	**11. Seat belt bracket**
3. Flat washer	**8. Well nut**	**12. Seal**
4. Rubber washer	**9. Phillips head screw**	**13. Spray control panel**
5. Spacer		

Removal (Fig. 20)

1. Park machine on a level surface, stop engine, and remove key from the ignition switch.

2. Disconnect negative (–) cable and then positive (+) cable from battery (see Operator's Manual).

3. Remove seat assembly by tilting seat forward and removing hitch pin and clevis pin (Fig. 21).

4. Remove screws that secure control panels to seat base. Carefully place control panels into seat base openings.

5. Remove knob from shift lever.

6. Remove eight (8) flange head screws that fasten seat base to machine. During screw removal, locate and remove washers and spacers. The two (2) screws directly behind the front wheels are secured with flange nuts (Item 7).

7. Carefully lift seat base from machine.

Installation (Fig. 20)

1. Position seat base on machine.

2. Carefully pull control panels through openings in seat base.

3. Secure seat base to machine using washers, spacers, flange nuts, and eight (8) flange head screws. Install all fasteners before tightening.

4. Install knob on shift lever.

5. Secure control panels to seat base.

6. Secure seat assembly to machine with clevis pin and hitch pin.

7. Connect positive (+) cable and then negative (–) cable to battery (see Operator's Manual).

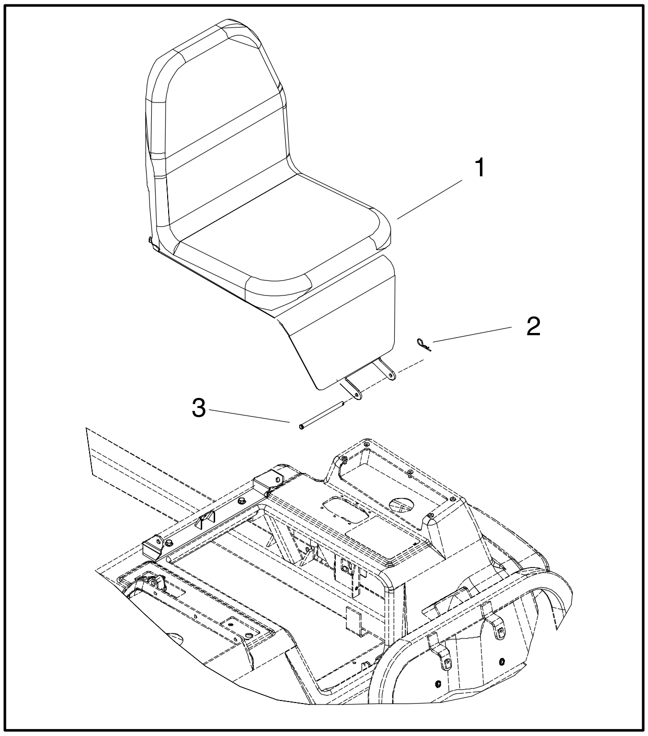

Figure 21

1. **Seat assembly**
2. **Hitch pin**
3. **Clevis pin**

Chassis

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Chapter 8.1

Sonic Boom System (Optional Kit)

Table of Contents

General Information

Installation Instructions

The Sonic Boom Kit Installation Instructions provides information regarding the installation, operation and general maintenance for your Sonic Boom System. Refer to that publication for additional information when servicing the machine.

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil and other property. To eliminate environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (refer to container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Park vehicle on a level surface and apply the parking brake.

2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure spray system pressure is relieved before loosening any system component.

Special Tools

Diagnostic Display

The Diagnostic Display (Fig. 1) can be connected to the Sonic Boom wire harness communication connector to verify correct electrical functions of the Sonic Boom System. electronic control unit (ECU) inputs and outputs for the Sonic Boom System can be checked using the Diagnostic Display.

Toro Part Number for Diagnostic Display: **85–4750**

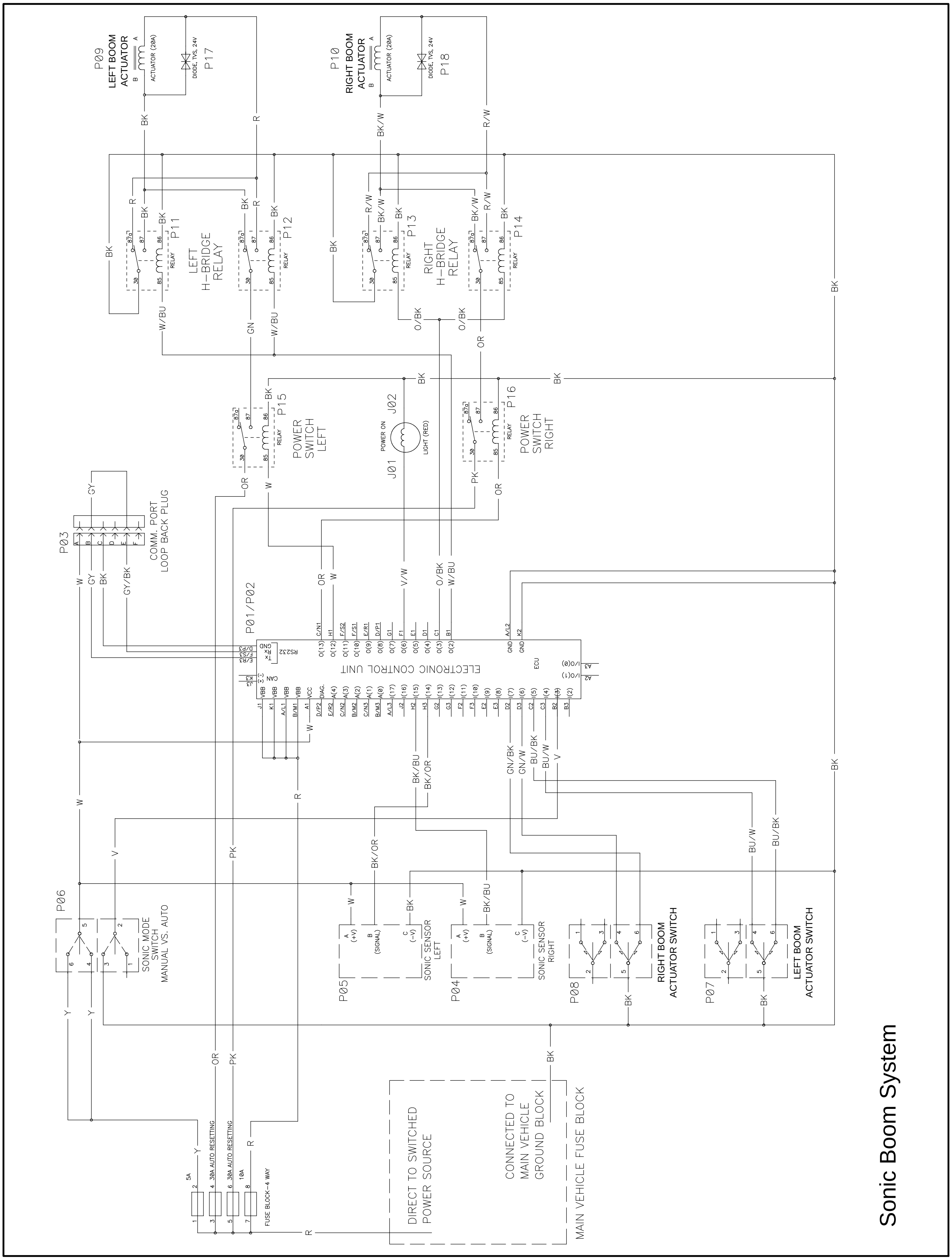
Toro Part Number for Overlay (English)**: 94–8604**

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to wire harness communication connector. Machine will not operate without loopback connector installed on wire harness. Store Diagnostic Display in a dry, secure, indoor location and not on machine.

Figure 1

Figure 2

Electrical Schematic



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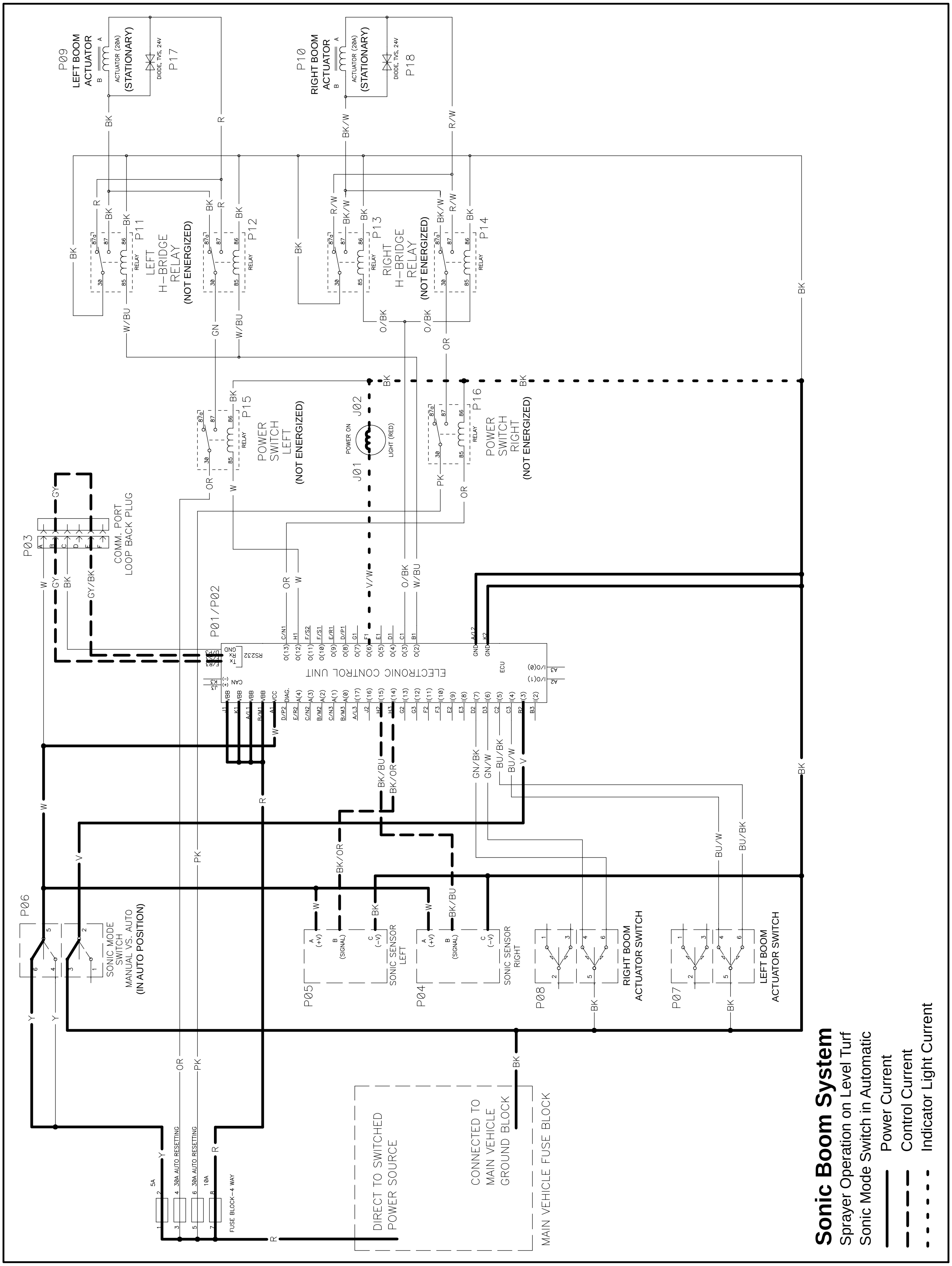
Sonic Boom System Operation



Sprayer Operation on Level Turf

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echos as the signals bounce off the turf. The electronic control unit (ECU) determines the sensor distance from the ground based on the elapsed time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom will remain at a fixed height from the ground for spraying accuracy.

On level turf, the boom sensors continually send signals and receive echoes that determine that the booms sections are at the calibrated height. Thus, there is no need to change boom height. The boom actuators will not be energized and the boom sections remain at the correct, level position.

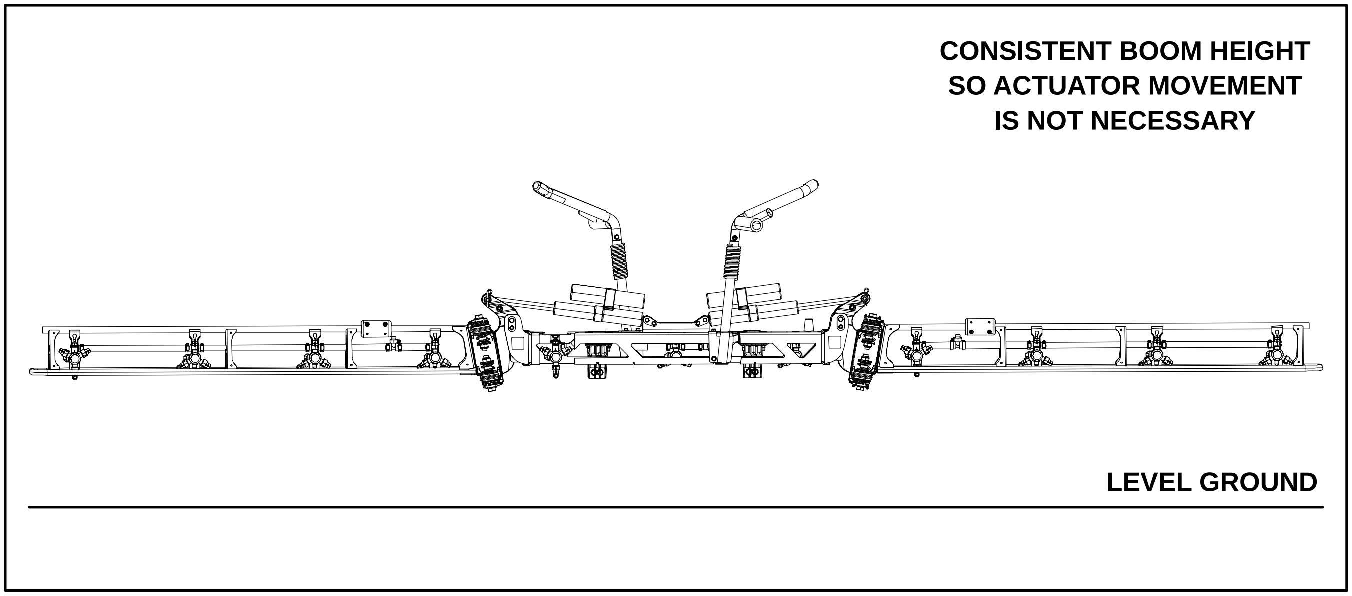
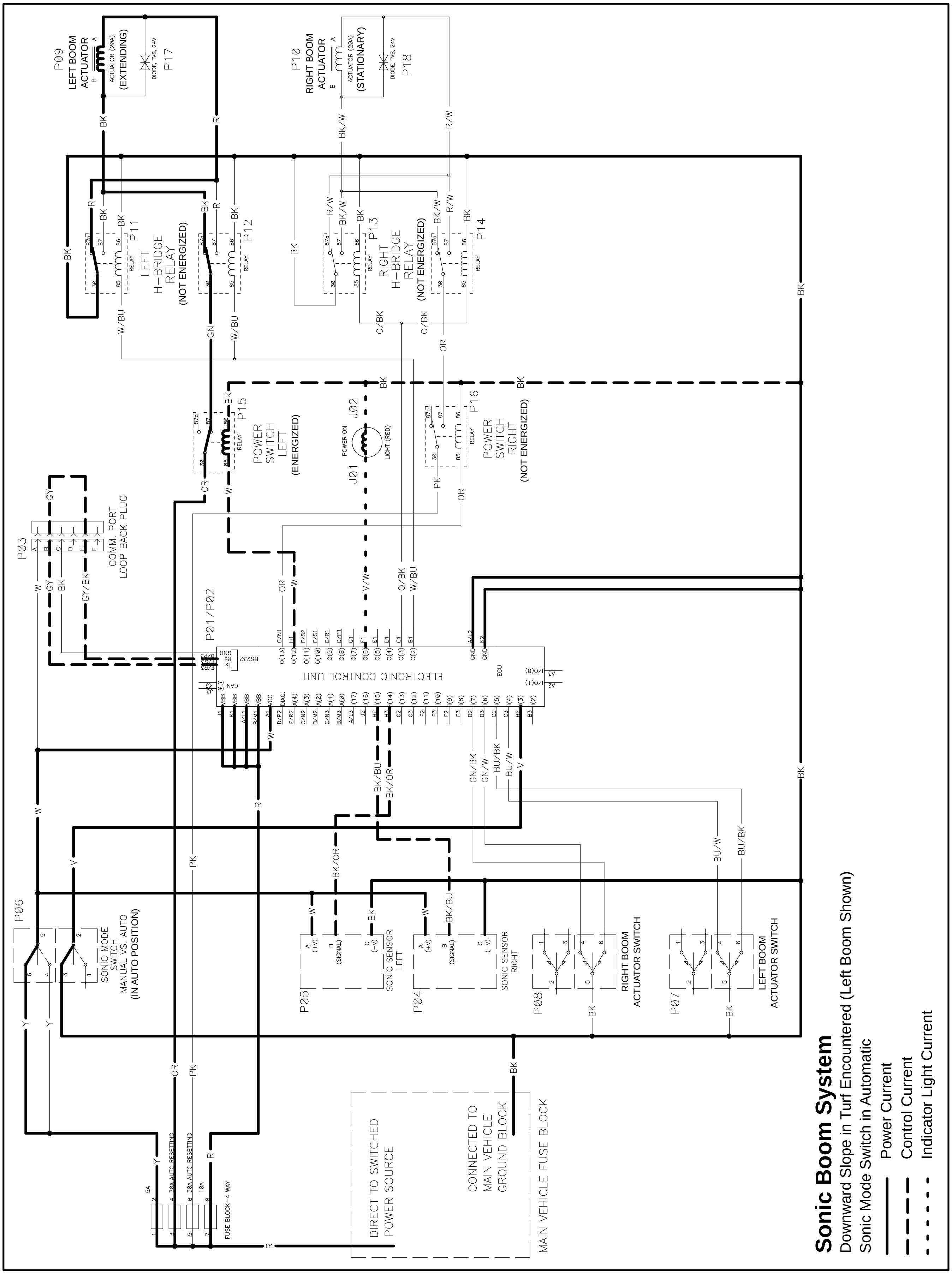


Figure 24


Sonic Boom System
Downward Slope in Turf Encountered (Left Boom Shown)
Sonic Mode Switch in Automatic
Power Current
Control Current
Indicator Light Current
P09 LEFT BOOM ACTUATOR
ACTUATOR (20A) (EXTENDING)
P17
P10 RIGHT BOOM ACTUATOR
ACTUATOR (20A) (STATIONARY)
P18
P11 LEFT H-BRIDGE RELAY (NOT ENERGIZED) P12
P13 RIGHT H-BRIDGE RELAY (NOT ENERGIZED) P14
P15 POWER SWITCH LEFT (ENERGIZED)
P16 POWER SWITCH RIGHT (NOT ENERGIZED)
J01 J02
POWER ON
LIGHT (RED)
P03 COMM. PORT LOOP BACK PLUG
P01/P02
ELECTRONIC CONTROL UNIT
P06 SONIC MODE SWITCH MANUAL VS. AUTO (IN AUTO POSITION)
P05 SONIC SENSOR LEFT
P04 SONIC SENSOR RIGHT
P08 RIGHT BOOM ACTUATOR SWITCH
P07 LEFT BOOM ACTUATOR SWITCH
FUSE BLOCK-4 WAY
5A
30A AUTO RESETTING
30A AUTO RESETTING
10A
DIRECT TO SWITCHED POWER SOURCE
CONNECTED TO MAIN VEHICLE GROUND BLOCK
MAIN VEHICLE FUSE BLOCK

Downward Slope in Turf Encountered

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echos as the signals bounce off the turf. The electronic control unit (ECU) determines the sensor distance from the ground based on the elapsed time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom section will remain at a fixed distance from the ground for spraying accuracy.

When a spray boom section encounters a downward slope in the turf, the time necessary for the sensor to receive the signal echo is longer than the calibrated timeframe. This change in time causes the ECU to energize the appropriate power switch relay. The energized relay provides a current path to the boom actuator causing the actuator to extend and the boom section to lower. This maintains the boom height at the calibrated distance from the ground. Once the boom section is lowered to the calibrated distance, the elapsed time between the sensor signal generation and the received echo returns to the correct timeframe and the boom stops lowering.

The boom sensor target distance is initiated during initial sonic boom calibration and is typically set at twenty (20) inches. When in automatic mode, the booms will not move if the target distance change is three (3) inches or less (inner dead band). Once the target distance exceeds five (5) inches (outer dead band), the ECU will energize the appropriate power switch relay. The energized relay will lead to a change in boom actuator length and ultimately a change in boom height.

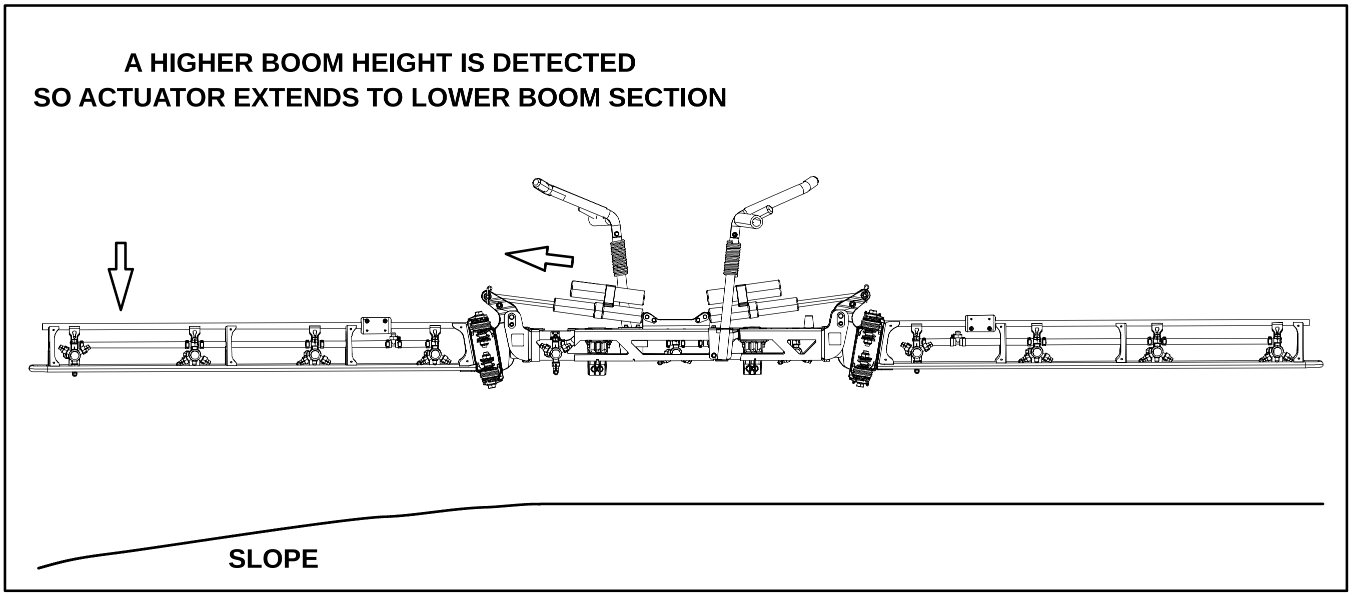
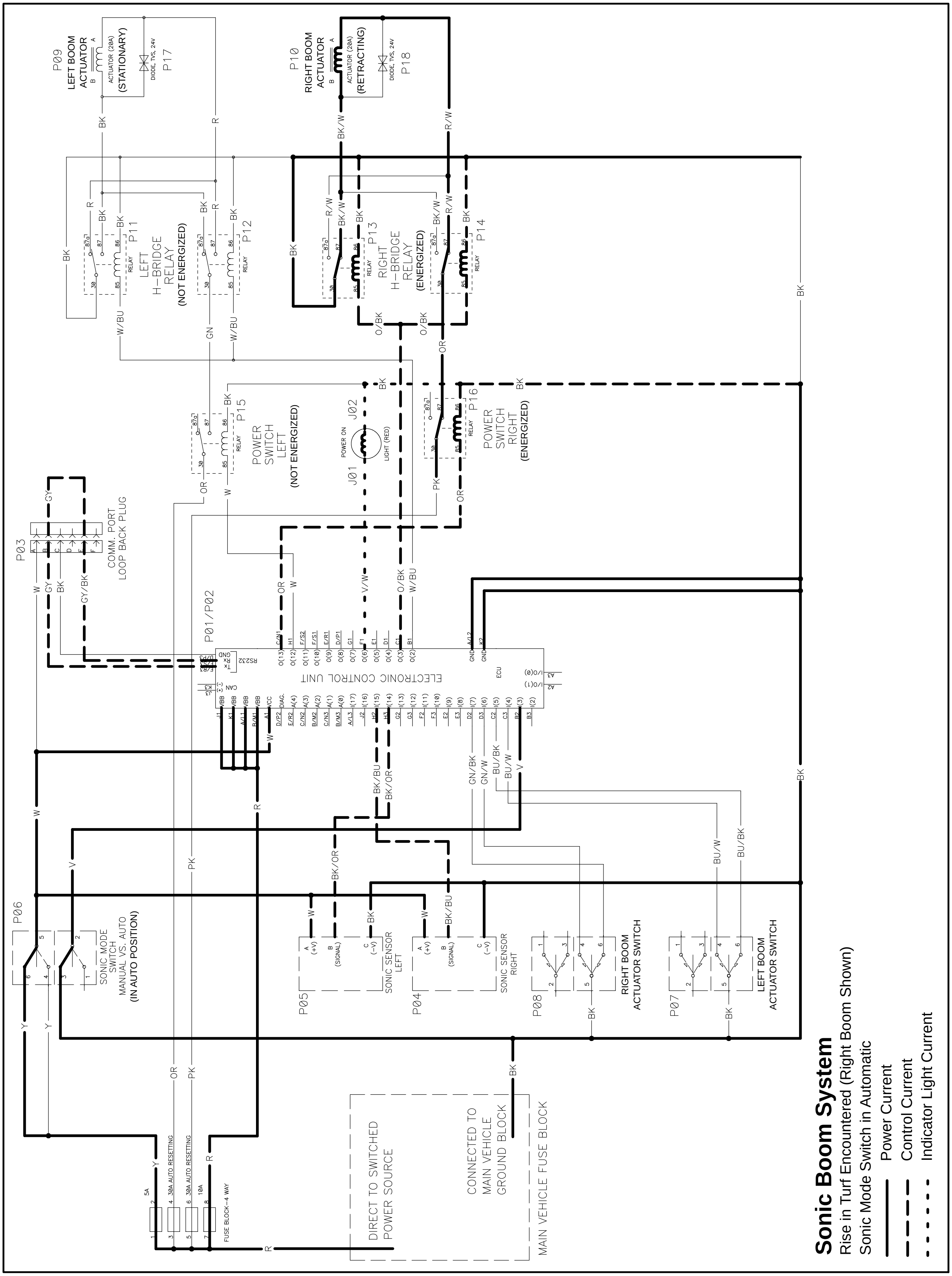


Figure 25


Sonic Boom System
Rise in Turf Encountered (Right Boom Shown)
Sonic Mode Switch in Automatic
Power Current
Control Current
Indicator Light Current
LEFT BOOM ACTUATOR
RIGHT BOOM ACTUATOR
ELECTRONIC CONTROL UNIT
SONIC SENSOR LEFT
SONIC SENSOR RIGHT
RIGHT BOOM ACTUATOR SWITCH
LEFT BOOM ACTUATOR SWITCH
SONIC MODE SWITCH MANUAL VS. AUTO (IN AUTO POSITION)
COMM. PORT LOOP BACK PLUG
DIRECT TO SWITCHED POWER SOURCE
CONNECTED TO MAIN VEHICLE GROUND BLOCK
MAIN VEHICLE FUSE BLOCK
FUSE BLOCK-4 WAY

Rise in Turf Encountered

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echos as the signals bounce off the turf. The electronic control unit (ECU) determines the sensor distance from the ground based on the time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom section will remain at a fixed distance from the ground for spraying accuracy.

When a spray boom section encounters a rise in the turf, the time necessary for the sensor to receive the signal echo is shorter than the calibrated timeframe. This change in time causes the ECU to energize the appropriate power switch relay and H–bridge relays. These energized relays provide a current path to the boom actuator causing the actuator to retract and the boom section to raise. This maintains the boom height at the calibrated distance from the ground. Once the boom section is raised to the calibrated distance, the elapsed time between the sensor signal generation and the received echo returns to the correct timeframe and the boom stops raising.

The boom sensor target distance is initiated during initial sonic boom calibration and is typically set at twenty (20) inches. When in automatic mode, the booms will not move if the target distance change is three (3) inches or less (inner dead band). Once the target distance exceeds five (5) inches (outer dead band), the ECU will energize the appropriate power switch relay. The energized relay will lead to a change in boom actuator length and ultimately a change in boom height.

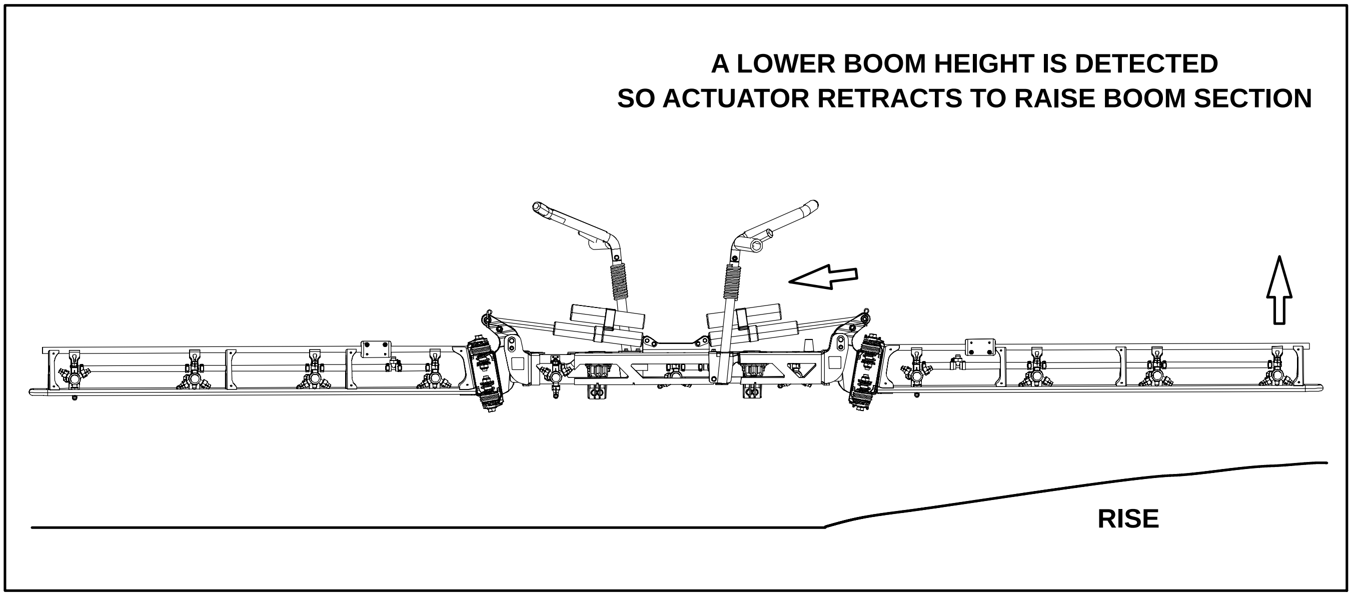
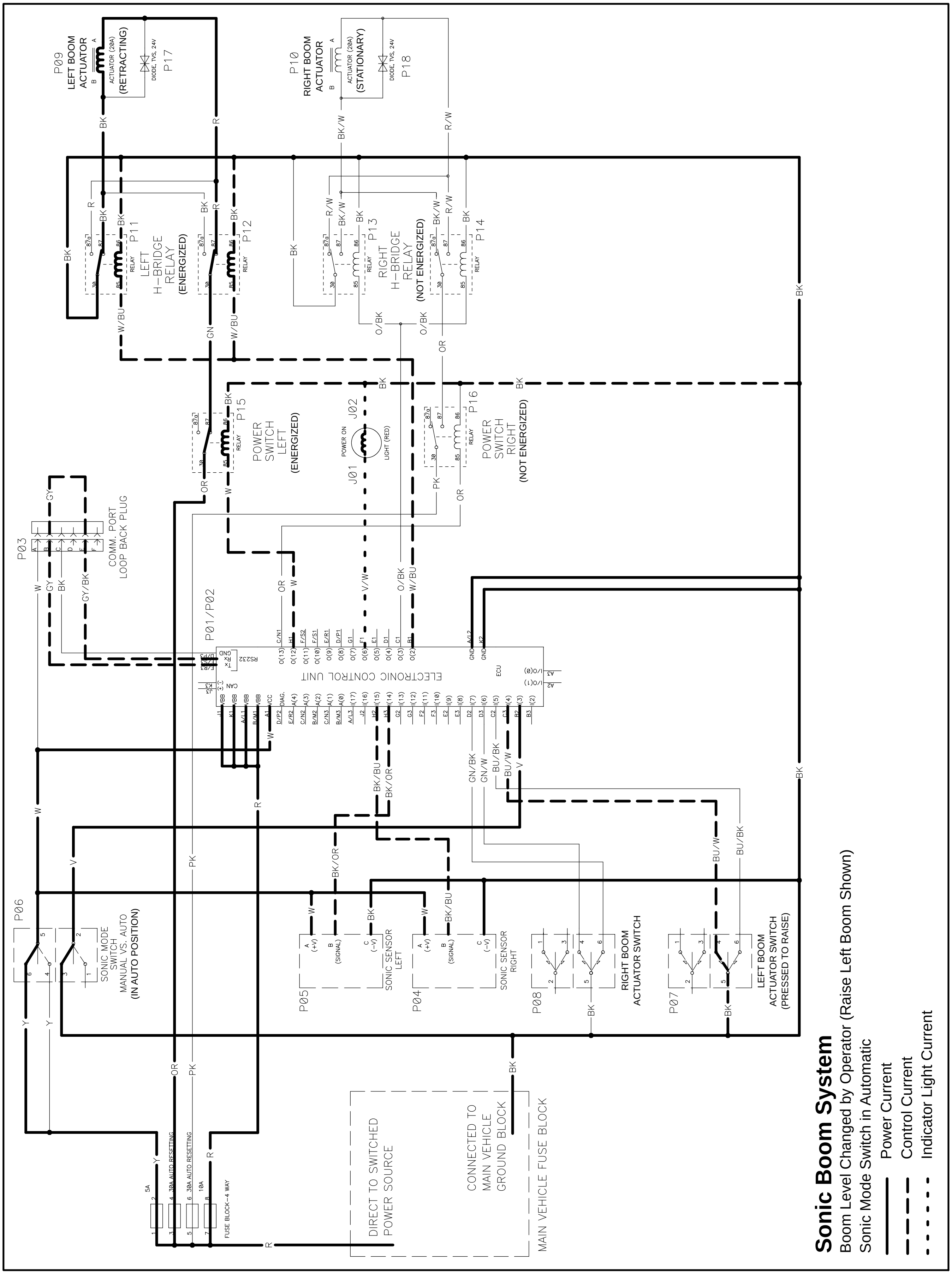


Figure 26

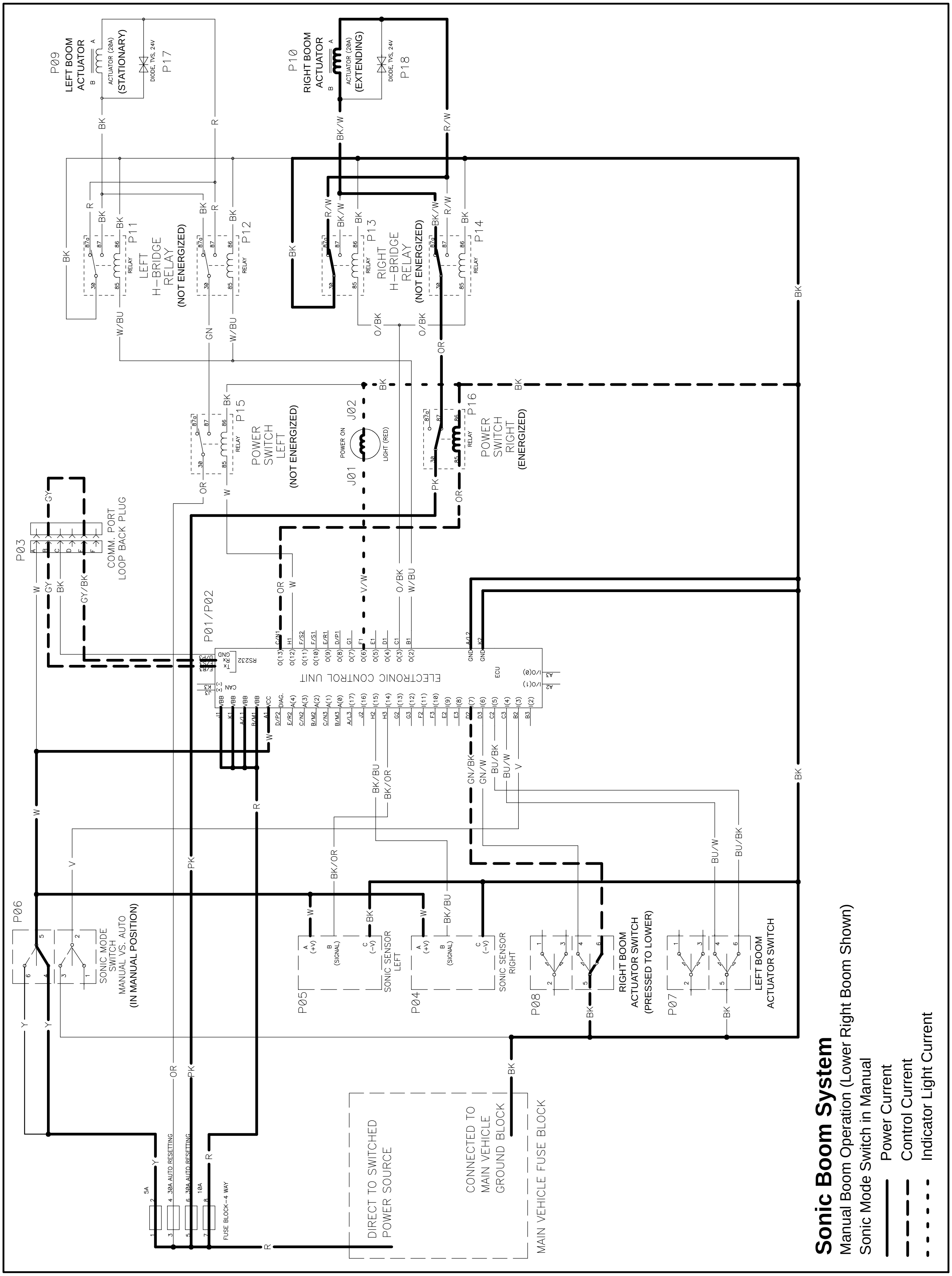

Sonic Boom System
Boom Level Changed by Operator (Raise Left Boom Shown)
Sonic Mode Switch in Automatic
Power Current
Control Current
Indicator Light Current

Boom Level Changed by Operator During Automatic Operation

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echos as the signals bounce off the turf. The electronic control unit (ECU) determines the sensor distance from the ground based on the time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom will remain at a fixed distance from the ground for spraying accuracy.

If the sprayer operator should press a boom actuator switch while in automatic operation, the ECU energizes the necessary power switch relay and H–bridge relays to raise or lower the appropriate boom. The energized relay(s) provides a current path to the requested boom actuator to raise or lower the boom. The boom actuator will stay energized as long as the operator keeps the boom actuator switch pressed. The sonic boom light will flash as long as the boom actuator switch is pressed.

If a boom is raised by the operator while the Sonic Boom System is in automatic operation, the boom will remain in the raised position until it is lowered halfway with the boom actuator switch to re–engage automatic sonic boom operation. If one boom is moved by the operator, the other boom continues to function automatically.


Sonic Boom System
Manual Boom Operation (Lower Right Boom Shown)
Sonic Mode Switch in Manual
Power Current
Control Current
Indicator Light Current
P09
LEFT BOOM ACTUATOR
ACTUATOR (20A) (STATIONARY)
DIODE, TVS, 24V
P17
P10
RIGHT BOOM ACTUATOR
ACTUATOR (20A) (EXTENDING)
P18
P11
P12
LEFT H-BRIDGE RELAY
(NOT ENERGIZED)
P13
P14
RIGHT H-BRIDGE RELAY
(NOT ENERGIZED)
P15
POWER SWITCH LEFT
(NOT ENERGIZED)
J01
J02
POWER ON
LIGHT (RED)
P16
POWER SWITCH RIGHT
(ENERGIZED)
P03
COMM. PORT LOOP BACK PLUG
P01/P02
ELECTRONIC CONTROL UNIT
ECU
RS232
CAN
P06
SONIC MODE SWITCH MANUAL VS. AUTO
(IN MANUAL POSITION)
P05
SONIC SENSOR LEFT
P04
SONIC SENSOR RIGHT
P08
RIGHT BOOM ACTUATOR SWITCH
(PRESSED TO LOWER)
P07
LEFT BOOM ACTUATOR SWITCH
5A
30A AUTO RESETTING
10A
FUSE BLOCK-4 WAY
DIRECT TO SWITCHED POWER SOURCE
CONNECTED TO MAIN VEHICLE GROUND BLOCK
MAIN VEHICLE FUSE BLOCK

Manual Boom Operation

During sprayer operation with the sonic boom switch in the manual position, the spray booms will remain in position unless the operator presses a boom actuator switch. When the sonic boom switch is in the manual position, the sonic boom light should be illuminated. The operator will control the boom position with the boom actuator switches.

Raise Boom

When a boom actuator switch is pressed to raise a boom section, the electronic control unit (ECU) energizes the power switch relay and both H–bridge relays for the requested boom section. The energized relays provide a current path to the boom actuator causing the actuator to retract which will raise the boom section. The boom will continue to rise until the operator releases the boom actuator switch.

Lower Boom

When a boom actuator switch is pressed to lower a boom section, the electronic control unit (ECU) energizes the power switch relay for the requested boom section. The energized relay provides a current path to the boom actuator causing the actuator to extend which will lower the boom section. The boom will continue to lower until the operator releases the boom actuator switch.

Troubleshooting

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on the Sonic Boom System (see Sonic Boom System Operation in this chapter).

NOTE: When troubleshooting an electrical problem on your Sonic Boom System, refer to information regarding the sonic boom light in this section. Also, use the Diagnostic Display (see Special Tools in this chapter) to test electronic control unit (ECU) inputs and outputs.

Sonic Boom Light

The Sonic Boom System is designed to automatically adjust the sprayer boom height if changes in the turf surface are detected. The sonic boom light should be illuminated whenever the vehicle ignition switch is ON and the sonic boom switch is in either the automatic or manual position.

The sonic boom light flashing quickly indicates that the Sonic Boom System is in the calibration mode. This mode allows the spray booms to be adjusted for the desired boom height. The calibration mode lasts for twenty (20) seconds after which the boom light should quit flashing.

NOTE: A sequence of switch movements is necessary to engage the calibration mode. Refer to the Sonic Boom Kit Installation Instructions for this sequence.

The sonic boom light flashing slowly indicates that a system error has been encountered. If the boom light is flashing slowly, lower the affected boom(s) with the boom actuator switch(es) to clear the error. If the error continues, there may be an issue with the Sonic Boom System electronic control unit (ECU). If this occurs, see Diagnostic Display and Troubleshooting Chart in this section.

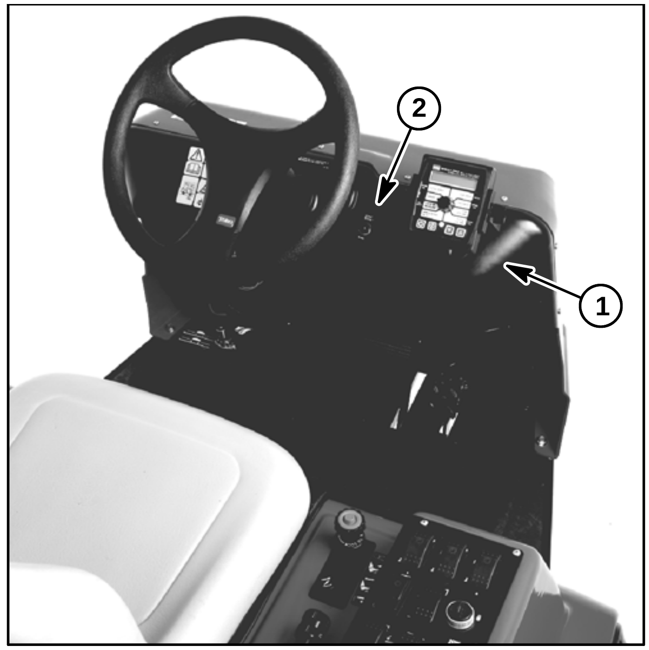


Figure 27

1. **Dash panel**
2. **Boom light location**

Sonic Boom Calibration

The Sonic Boom sensor calibration process is critical to the correct operation of the Sonic Boom system. The calibration process establishes the sensor target distance between the boom and the turf surface. Typically, this distance is approximately twenty (20) inches. Steps needed for proper calibration are identified in the Sonic Boom Kit Installation Instructions.

While calibrating the Sonic Boom sensors, it is best to perform the calibration process on turf. A shiny surface (e.g. cement shop floor) can skew sensor signals. Also, ensure the calibration area is free of buildings, trees, underground plumbing and other machines that could interfere with sensor signals.

Diagnostic Display

The Sonic Boom System is equipped with an electronic control unit (ECU) which controls machine sonic boom electrical functions. The ECU monitors various input switches (e.g. boom actuator switches, sonic boom sensors) and energizes outputs to actuate relays for appropriate machine functions.

For the ECU to control the machine as desired, each of the inputs (switches and sensors) and outputs (relays) must be connected and functioning properly.

The Diagnostic Display (see Special Tools in this chapter) is a tool to help the technician verify correct electrical functions of the machine.

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of the Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to harness connector. The machine will not operate without the loopback connector installed on the harness. Store the Diagnostic Display in a dry, secure, indoor location and not on machine.

Verify Diagnostic Display Input Functions

1. Park vehicle on a level surface, stop the engine and apply the parking brake.

2. Locate Sonic Boom wire harness communication port and loopback connector under the vehicle dash panel. Carefully unplug loopback connector from harness connector.

3. Connect the Diagnostic Display connector to the wire harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 28).

4. Turn the vehicle ignition switch to the ON position, but do not start vehicle.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to input switches and the **green** text refers to ECU outputs.

5. Make sure that the "INPUTS DISPLAYED" LED, on lower right column of the Diagnostic Display, is illuminated. If "OUTPUTS DISPLAYED" LED is illuminated, press the toggle button on the Diagnostic Display to change to "INPUTS DISPLAYED" LED.

CAUTION

When testing ECU inputs with the Diagnostic Display, boom actuators may be energized causing the spray booms to move. Be cautious of potential sprayer component movement while verifying inputs with the Diagnostic Display.

6. The Diagnostic Display will illuminate the LED associated with each of the inputs when that input switch is closed. Individually, change each of the switches from open to closed (e.g. toggle sonic mode switch), and note that the appropriate LED on the Diagnostic Display will illuminate when the corresponding switch is closed. Repeat on each switch that is possible to be changed by hand (see Inputs and LED Operation chart on following page).

7. If appropriate LED does not toggle on and off when switch state is changed, check all wiring and connections to that switch and/or test switch. Replace any defective switches and repair any damaged wiring.

8. After input functions testing is complete, disconnect the Diagnostic Display connector from the harness connector and plug loopback connector into wire harness.

Figure 28

Diagnostic Display Inputs	Diagnostic Display LED Operation
AUTO MODE	Sonic mode switch in auto position: LED ON Sonic mode switch not in auto position: LED OFF
L RAISE	Left boom actuator switch in raise position: LED ON Left boom actuator switch not in raise position: LED OFF
L LOWER	Left boom actuator switch in lower position: LED ON Left boom actuator switch not in lower position: LED OFF
R RAISE	Right boom actuator switch in raise position: LED ON Right boom actuator switch not in raise position: LED OFF
R LOWER	Right boom actuator switch in lower position: LED ON Right boom actuator switch not in lower position: LED OFF
L NO SNSR DATA	ECU has detected an invalid reading from left sensor: LED ON Left sensor operating normally: LED OFF
L NOT TRACKING	Left boom not tracking to target within 5 seconds: LED ON Left sensor operating normally: LED OFF
R NO SNSR DATA	ECU has detected an invalid reading from right sensor: LED ON Right sensor operating normally: LED OFF
R NOT TRACKING	Right boom not tracking to target within 5 seconds: LED ON Right sensor operating normally: LED OFF
L – SNSR FEEDBACK	ECU receiving signal from left sensor: LED ON ECU not receiving signal from left sensor: LED OFF
R – SNSR FEEDBACK	ECU receiving signal from right sensor: LED ON ECU not receiving signal from right sensor: LED OFF

NOTE: When the vehicle ignition switch is in the OFF position, all Diagnostic Display LED's should be OFF.

NOTE: Initial calibration of the Sonic Boom sensors is required for proper operation of ECU inputs. Refer to your Sonic Boom Kit Installation Instructions for information on initial sensor calibration.

NOTE: Right and left side Sonic Boom sensors are identical so they can be exchanged to assist in troubleshooting. If a problem follows the exchanged sensor, an electrical problem likely exists with the sensor. If the problem remains unchanged, something other than the sensor is the problem source (e.g. switch, circuit wiring).

Verify Diagnostic Display Output Functions

The Diagnostic Display also has the ability to detect which output solenoids or relays are energized by the electronic control unit (ECU). This is a quick way to determine which electrical component is malfunctioning.

NOTE: An open output (e.g. an unplugged connector or a broken wire) cannot be detected with the Diagnostic Display.

1. Park vehicle on a level surface, stop the engine and engage the parking brake.

2. Locate Sonic Boom System wire harness and loopback connector under the vehicle dash panel. Carefully unplug loopback connector from harness connector.

3. Connect the Diagnostic Display connector to the harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (see Special Tools in this chapter).

4. Turn the ignition switch to the ON position.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to input switches and the **green** text refers to ECU outputs.

5. Make sure that the “OUTPUTS DISPLAYED” LED, on lower right column of the Diagnostic Display, is illuminated. If “INPUTS DISPLAYED” LED is illuminated, press the toggle button on the Diagnostic Display to change the LED to “OUTPUTS DISPLAYED”.

NOTE: It may be necessary to toggle between “INPUTS DISPLAYED” and “OUTPUTS DISPLAYED” several times to perform the following step. To change from inputs to outputs, press toggle button once. This may be done as often as required. **Do not press and hold toggle button**.

6. Attempt to operate the desired function of the machine. The appropriate output LED’s should illuminate on the Diagnostic Display to indicate that the ECU is turning on that function. The outputs can be checked with the vehicle ignition switch in the ON position and the engine not running.

A. If the correct output LED’s do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur.

B. If the output LED’s are on as specified, but the booms do not function properly, suspect a failed electrical component, an open in the tested circuit or a non-electrical problem (e.g. binding of the boom hinge). Repair as necessary.

C. If each input switch is in the correct position and functioning correctly, but the output LED’s are not correctly illuminated, this indicates an ECU problem. If this occurs, contact your Toro Distributor for assistance.

7. After output functions testing is complete, disconnect the Diagnostic Display connector from the harness connector and plug loopback connector into wire harness.

Diagnostic Display Outputs	Diagnostic Display LED Operation
L BOOM – RAISE	Left boom is rising: LED ON Left boom is stationary: LED OFF
R BOOM – RAISE	Right boom is rising: LED ON Right boom is stationary: LED OFF
POWER ON/ERROR	Power to ECU: LED ON No power to ECU: LED OFF System error: LED flashing slowly
L BOOM MOTOR	ECU output exists to energize left power switch relay: LED ON No ECU output to left power switch relay: LED OFF
R BOOM MOTOR	ECU output exists to energize right power switch relay: LED ON No ECU output to right power switch relay: LED OFF

Troubleshooting Chart

The chart that follows contains suggestions that can be used to assist in diagnosing Sonic Boom System performance issues. These suggestions are not all–inclusive. Also, consider that there may be more than one cause for a machine problem.

NOTE: When troubleshooting an electrical problem on your Sonic Boom System, refer to information regarding the sonic boom light in this section. Also, use the Diagnostic Display (see Special Tools in this chapter) to test electronic control unit (ECU) inputs and outputs.

Problem	Possible Cause
Sonic boom light is not illuminated.	Sonic mode switch is in the OFF position. 5 amp or 10 amp fuse in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). Sonic boom light or circuit wiring is faulty. Sonic mode switch or circuit wiring is faulty.
LED on one of the sonic boom sensors is not illuminated.	Sonic boom sensor or circuit wiring is faulty.
LED on both of the sonic boom sensors is not illuminated.	Sonic mode switch is in the OFF position. 5 amp fuse in sonic boom fuse block is faulty. Sonic mode switch or circuit wiring is faulty.
One of the boom actuators will not retract.	30 amp auto resetting fuse for affected boom actuator is faulty. Power switch relay or circuit wiring for affected boom actuator is faulty. One or both of the H–bridge relays or circuit wiring for the affected boom actuator is faulty. Boom actuator switch or circuit wiring for affected boom actuator is faulty. Affected boom actuator or circuit wiring is faulty.
Neither of the boom actuators will retract.	Loop back connector is unplugged from wire harness connector. 5 amp or 10 amp fuse in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). Both of the boom actuator 30 amp auto resetting fuses are faulty. ECU or circuit wiring is faulty.

Problem	Possible Cause
One of the boom actuators will not extend.	30 amp auto resetting fuse for affected boom actuator is faulty. Power switch relay or circuit wiring for affected boom actuator is faulty. Boom actuator switch or circuit wiring for affected boom actuator is faulty. Affected boom actuator or circuit wiring is faulty.
Neither of the boom actuators will extend.	Loop back connector is unplugged from wire harness connector. 5 amp or 10 amp fuse in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). 30 amp auto resetting fuse is faulty in both boom actuators. ECU or circuit wiring is faulty.
One of the booms does not automatically follow ground irregularities. Boom can be controlled with boom actuator switch.	On affected boom, the sonic boom sensor cover is on sensor or is hanging in sensor path. On affected boom, the sensor filter is dirty or damaged. Calibration of the Sonic Boom sensors is incorrect. On affected boom, the sonic sensor angle needs adjustment. Sonic sensor or circuit wiring for affected boom is faulty. ECU or circuit wiring is faulty.
Neither boom automatically follows ground irregularities. Booms can be controlled with boom actuator switches.	Sonic mode switch is not in the AUTO position. Sonic boom sensor covers are on both sensors or are hanging in sensor path. The filters on both sensors are dirty or damaged. Calibration of the Sonic Boom sensors is incorrect. The sonic sensor angle on both booms need adjustment. Both sonic sensors or circuit wiring are faulty. ECU or circuit wiring is faulty.

Service and Repairs

Sonic Mode Switch

The sonic mode switch is used as an input for the ECU to activate the Sonic Boom System. This switch has three (3) positions: automatic, manual and off. The sonic mode switch is located on the console.

If the sonic mode switch is in the automatic position, the sonic sensors will be activated to allow automatic movement of the boom. The tips of the booms will remain at a constant distance from the ground. The boom switches can be used to raise/lower the booms when the sonic mode switch is in the automatic position.

If the sonic mode switch is in the manual position, the sonic sensors are disabled. The boom switches are used to raise/lower the booms when the sonic mode switch is in the manual position.

If the sonic mode switch is in the OFF position, the booms will remain in position. The boom actuators will not be energized regardless of sonic boom sensor activity or change in boom switch position.

Testing

1. Before disconnecting the sonic mode switch for testing, the switch and its circuit wiring should be tested as a ECU input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the sonic mode switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the sonic mode switch and circuit wiring **are not** functioning correctly, proceed with test.

2. Park vehicle on a level surface, stop engine, engage parking brake and remove key from ignition switch.

3. Disassemble console to gain access to sonic mode switch.

4. Disconnect harness electrical connector from the sonic mode switch.

5. The switch terminals are marked as shown in Figure 9. The circuit logic of the sonic mode switch is shown in the chart to the right. 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. Replace switch if testing identifies a faulty switch.

6. If the sonic mode switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in this chapter).

7. After testing is completed, connect wire harness connector to the sonic mode switch.

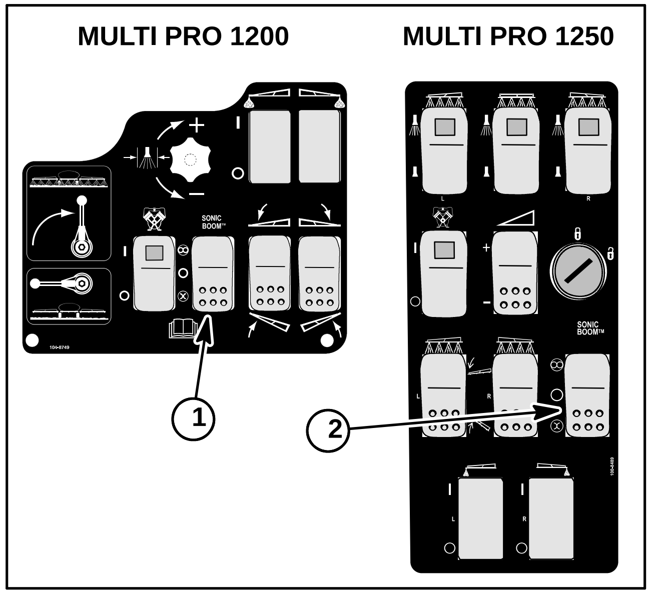


Figure 8

1. **Mode switch (MP 1200)**
2. **Mode switch (MP 1250)**

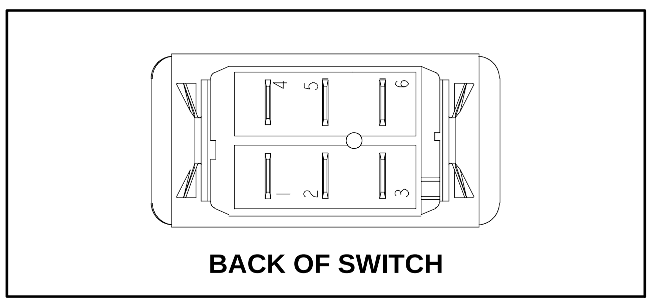


Figure 9

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
AUTOMATIC	2 + 3 5 + 6	2 + 1 5 + 4
OFF	NONE	ALL
MANUAL	2 + 1 5 + 4	2 + 3 5 + 6

Relays

The Sonic Boom System uses six (6) identical relays to control the boom actuators and ultimately the boom height. Three (3) of the relays control the right actuator and the other three (3) relays control the left actuator. The electronic control unit (ECU) controls the operation of the relays. The relays are located on a mounting plate under the vehicle dash panel (Fig. 31) and can be identified by a label on the wire harness connector.

For each actuator, a power switch relay and two (2) H–bridge relays are used. The power switch relay is energized by the ECU whenever the actuator is to be energized to change boom height (either lowered or raised). Both H–bridge relays are energized by the ECU when a boom is to be raised. The energized bridge relays provide current flow to the actuator so the actuator retracts. The H–bridge relays are not energized when a boom is to be lowered. The non–energized bridge relays provide current flow to the actuator so the actuator extends.

Testing

1. Park vehicle on a level surface, stop engine, engage parking brake and remove key from ignition switch.

2. Locate relay to be tested and disconnect wire harness connector from relay. Remove relay from mount plate for 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 from the measured value of the component you are testing.

3. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay terminals 30 and 87 should have continuity as +12 VDC is applied to terminal 85. The relay terminals 30 and 87 should not have continuity as +12 VDC is removed from terminal 85.

5. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. With terminal 86 grounded, apply +12 VDC to terminal 85. The relay terminals 30 and 87A should not have continuity as +12 VDC is applied to terminal 85. The relay terminals 30 and 87A should have continuity as +12 VDC is removed from terminal 85.

7. Disconnect voltage and multimeter test leads from the relay terminals. Replace relay if necessary.

8. Secure relay to mount plate and connect wire harness connector to relay.

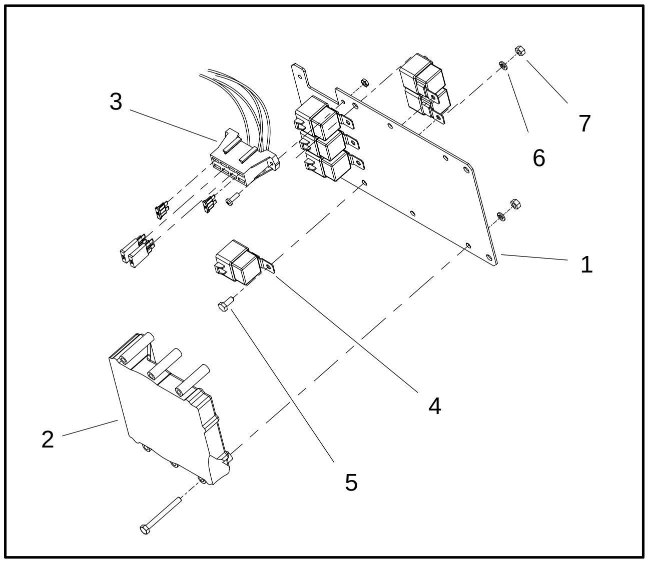


Figure 31

1. **Mount plate**
2. **Electronic control unit**
3. **Sonic boom fuse block**
4. **Relay (6 used)**
5. **Cap screw (4 used)**
6. **Lock washer (4 used)**
7. **Nut (4 used)**

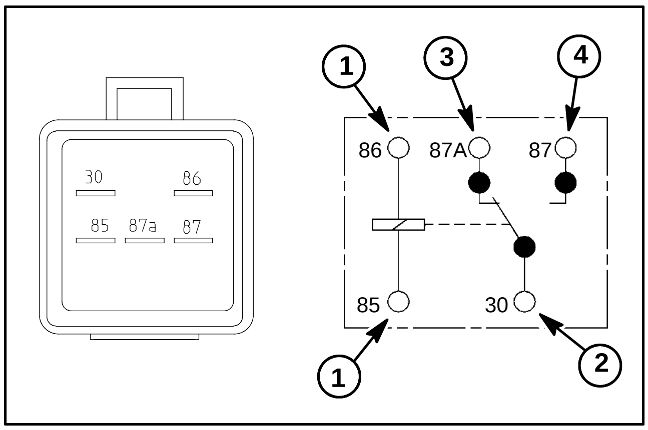


Figure 32

1. **Coil terminal**
2. **Common terminal**
3. **Normally closed term.**
4. **Normally open term.**

Electronic Control Unit (ECU)

The Sonic Boom System uses an electronic control unit (ECU) to control electrical system operation. The ECU is attached to a mounting plate under the vehicle dash panel (Fig. 33).

Power is provided to the ECU when the vehicle ignition switch is ON. A 5 amp fuse provides circuit protection for this logic power to the ECU. The fuse is located in the Sonic Boom System fuse block.

The ECU monitors the states of the following components as inputs: the sonic mode switch, the two (2) boom actuator switches and the two (2) boom sonic sensors.

The ECU controls electrical output to the sonic boom light and the six (6) relays that are part of the Sonic Boom System. Circuit protection for the ECU outputs is provided by a 10 amp fuse located in the Sonic Boom System fuse block.

Because of the solid state circuitry built into the ECU, there is no method to test it directly. The ECU may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

IMPORTANT: Before performing welding on the machine, disconnect both cables from the battery and disconnect wire harness connector from the ECU. These steps will prevent damage to the machine electrical system.

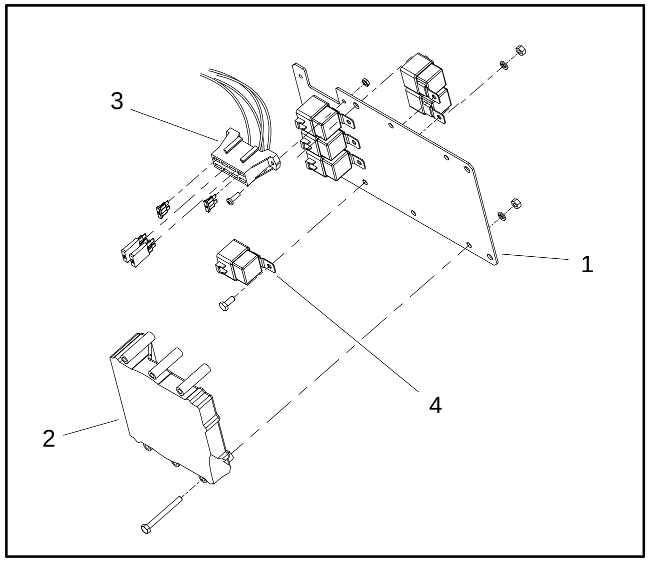


Figure 33

1. **Mount plate**
2. **Electronic control unit**
3. **Sonic boom fuse block**
4. **Relay (6 used)**

Sonic Sensor

Two (2) identical sonic sensors are used in the Sonic Boom System. The sensors are mounted to the spray booms (Fig. 34). During sprayer operation with the sonic mode switch in the automatic position, the sonic sensors will provide inputs for the electronic control unit (ECU) to keep the booms at a constant distance from the ground.

During sprayer operation, the sonic boom sensor continually sends an impulse signal and then receives an echo as the signal bounces off the turf. The ECU establishes the sensor distance from the ground based on the time between the sensor signal generation and the received echo. The ECU then determines if the boom height is different than the calibrated height and, if necessary, energizes the appropriate boom actuator to change the boom height.

Sensors and protection tubes should be rotated above parallel with the ground for proper sonic sensor operation. Refer to the Sonic Boom Kit Installation Instructions for sonic sensor setup information.

The sonic sensor includes a LED that should be illuminated during sprayer operation regardless of whether the sonic mode switch is in manual or automatic mode. The intensity of the LED can be used to assure that the sensor is properly adjusted on the spray boom.

The sonic sensors and their circuit wiring can be tested as ECU inputs with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). Because of the solid state circuitry built into the sensors, there is no method to test them directly. The sensors may be damaged if an attempt is made to test them with an electrical test device (e.g. digital multimeter or test light)

IMPORTANT: Do not spray water at or on the sensors. Water sprayed under even household pressure can damage the sensor. Always install sensor cover (item 7) on sensor before washing the sprayer. Also, install cover when sprayer is not in use.

As required, use a damp cloth to clean the sensors. Make sure that the sensor covers (item 7) are clean and dry before installing them on sensors.

The patch (item 13) that is adhered to the sensor is designed to allow moisture to escape from inside the sensor housing. The patch should be replaced if it is deteriorated or has loosened from the sensor.

Inspect the foam sensor filter (item 11) for damage or excessive debris buildup. Replace filter if necessary.

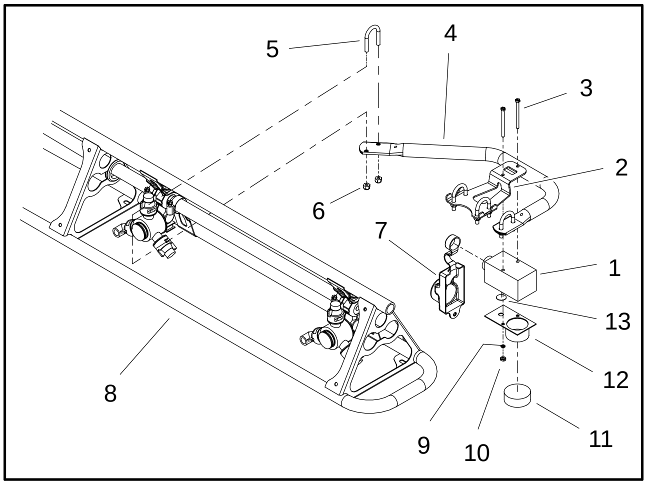


Figure 34

1. **Sonic sensor**
2. **Sensor bracket**
3. **Screw (2 used)**
4. **Protection tube**
5. **U-bolt (4 used)**
6. **Lock nut (8 used)**
7. **Sensor cover**
8. **Spray boom (RH shown)**
9. **Lock washer (2 used)**
10. **Nut (2 used)**
11. **Foam sensor filter**
12. **Sensor shield**
13. **Patch**

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Electrical Diagrams

Table of Contents

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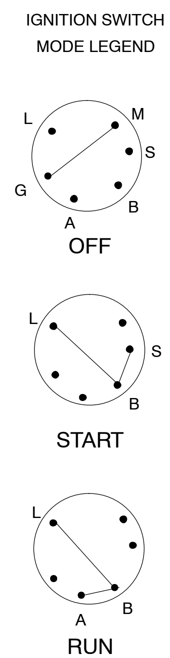
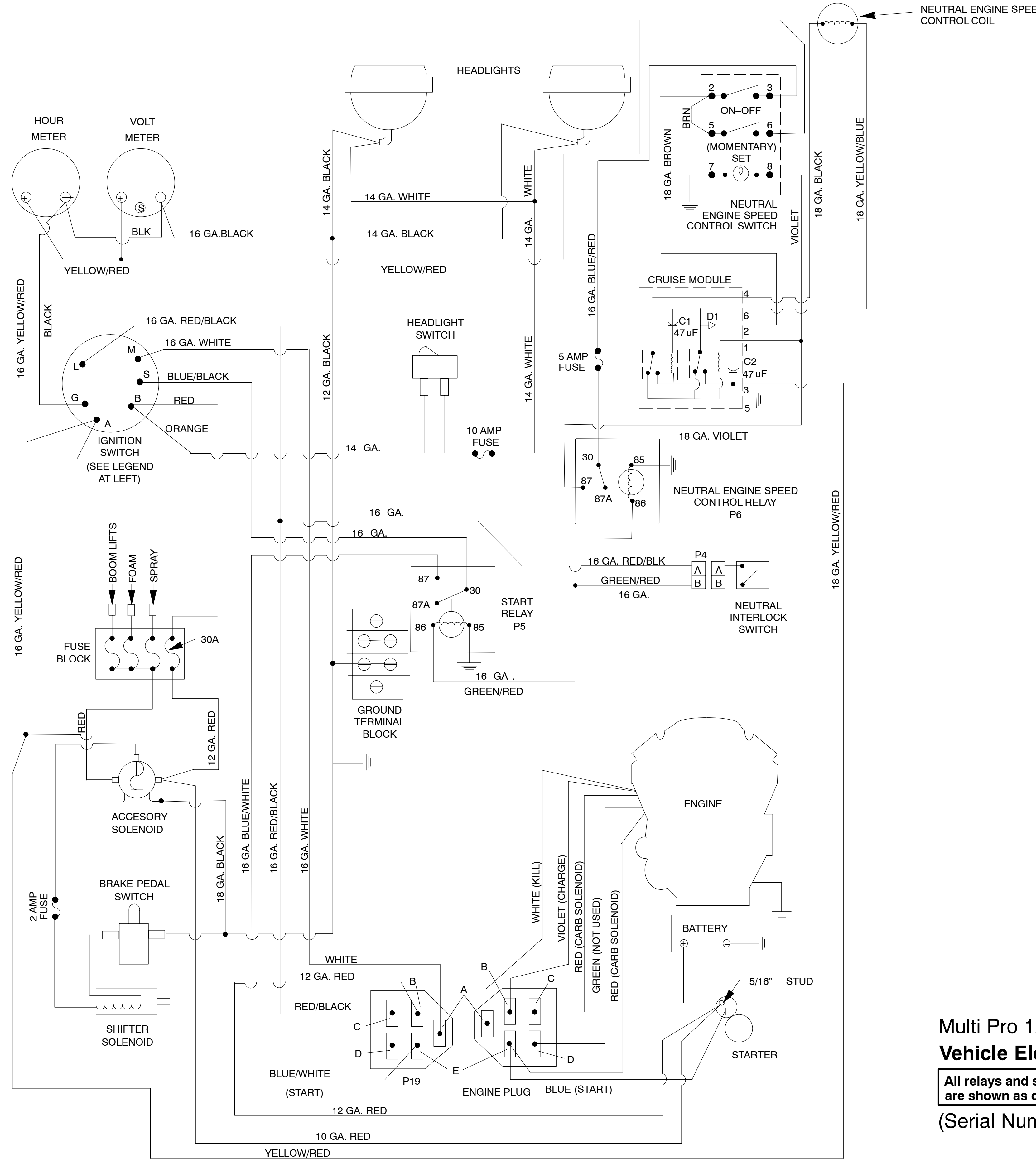




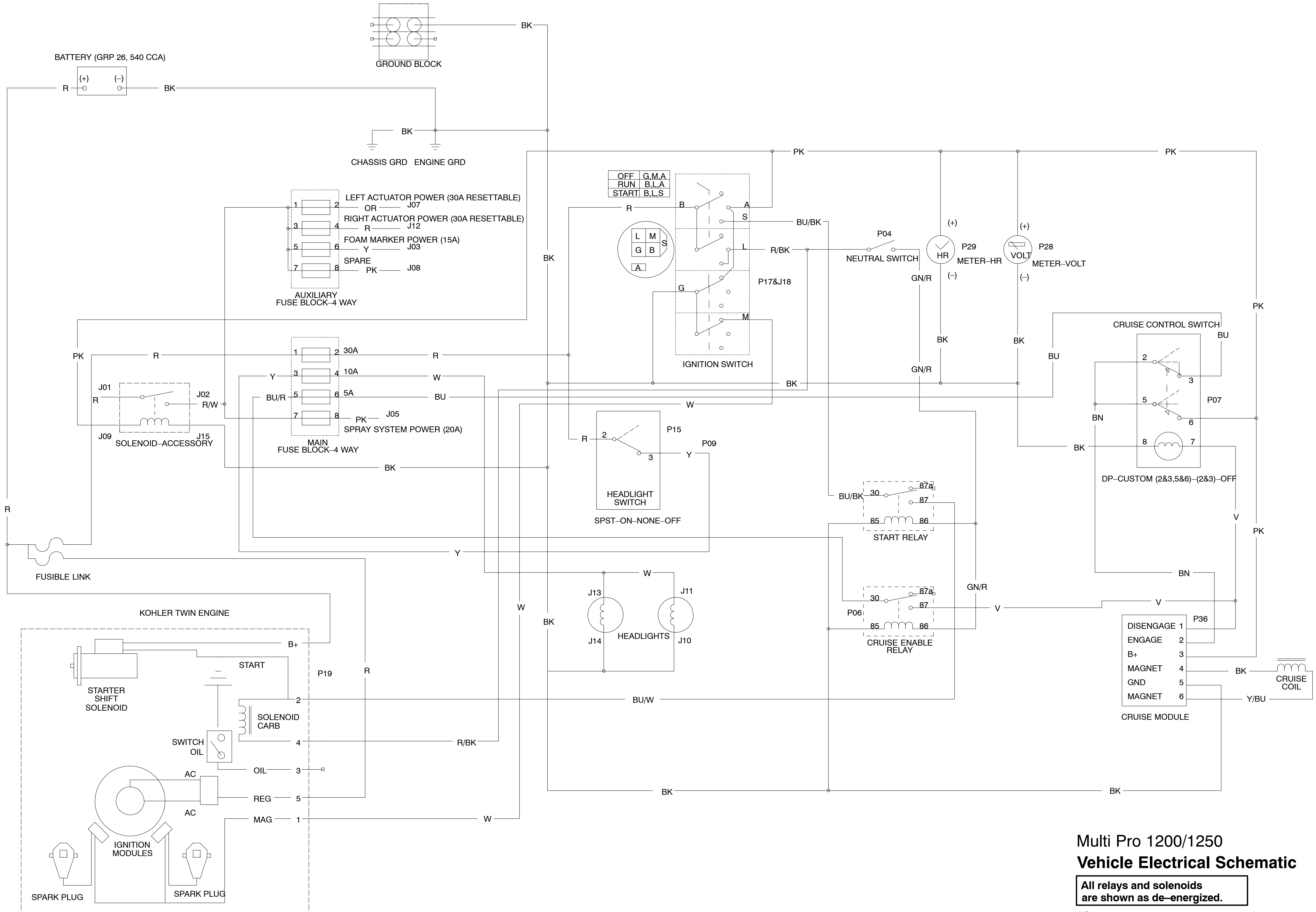
NOTE: BRAKE PEDAL SWITCH, SHIFTER SOLENOID AND 2 AMP FUSE USED ONLY ON MACHINES WITH SERIAL NUMBERS BELOW 250000000.

Multi Pro 1200/1250

Vehicle Electrical Schematic

All relays and solenoids are shown as de–energized.

(Serial Numbers Below 260000000)

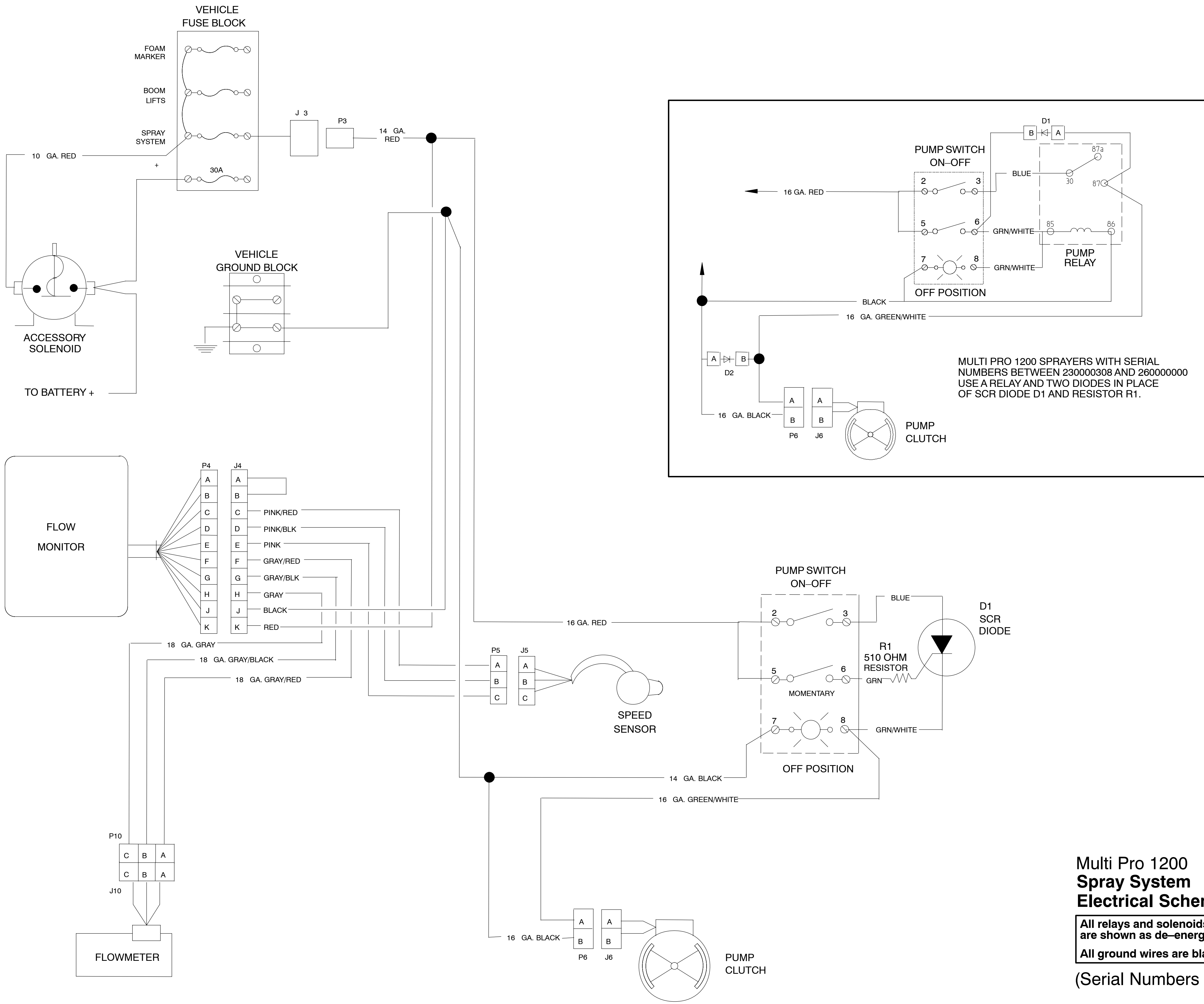


Multi Pro 1200/1250

Vehicle Electrical Schematic

All relays and solenoids are shown as de–energized.

(Serial Numbers Above 260000000)

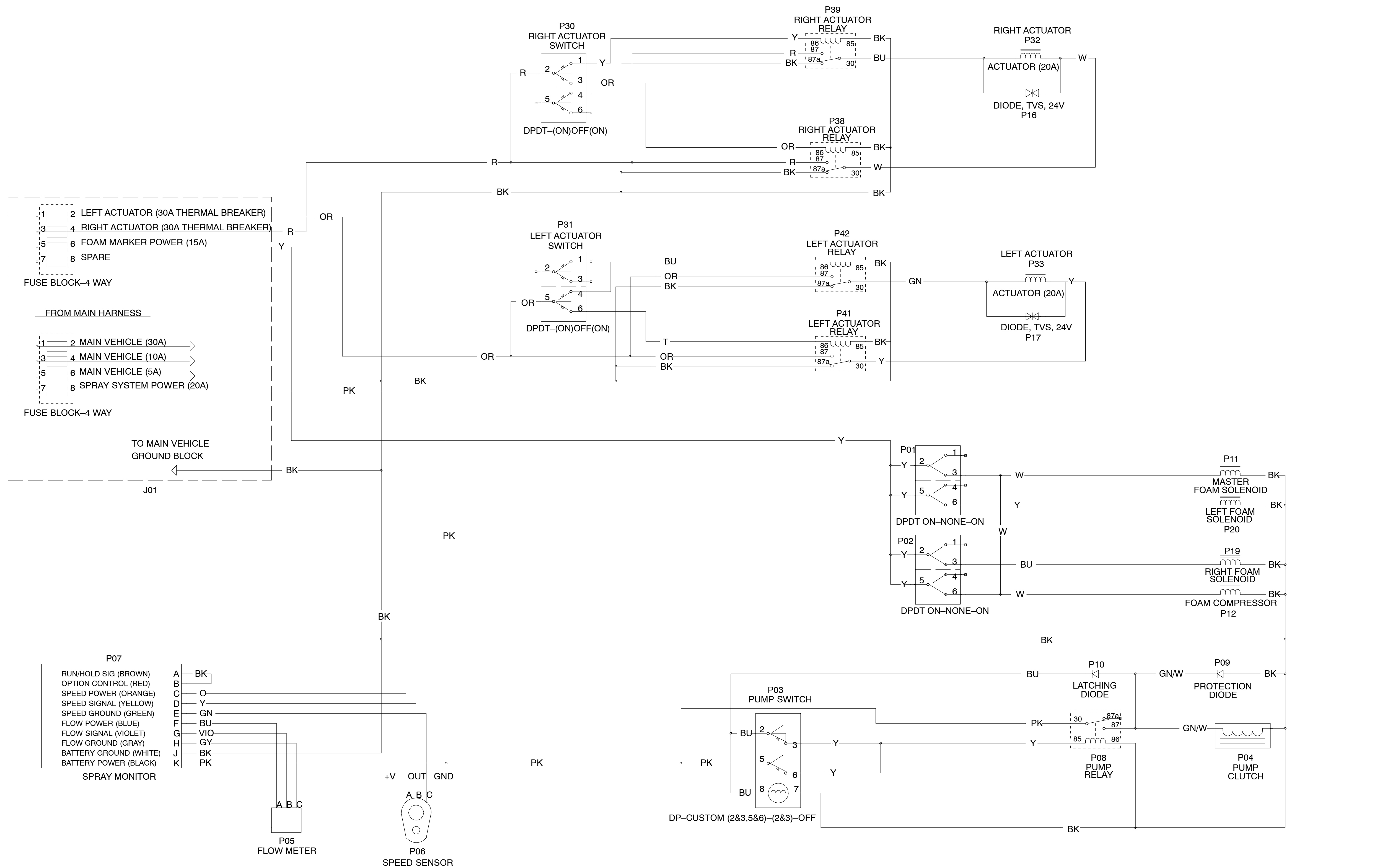


Multi Pro 1200
Spray System
Electrical Schematic

All relays and solenoids are shown as de–energized.

All ground wires are black.

(Serial Numbers Below 260000000)

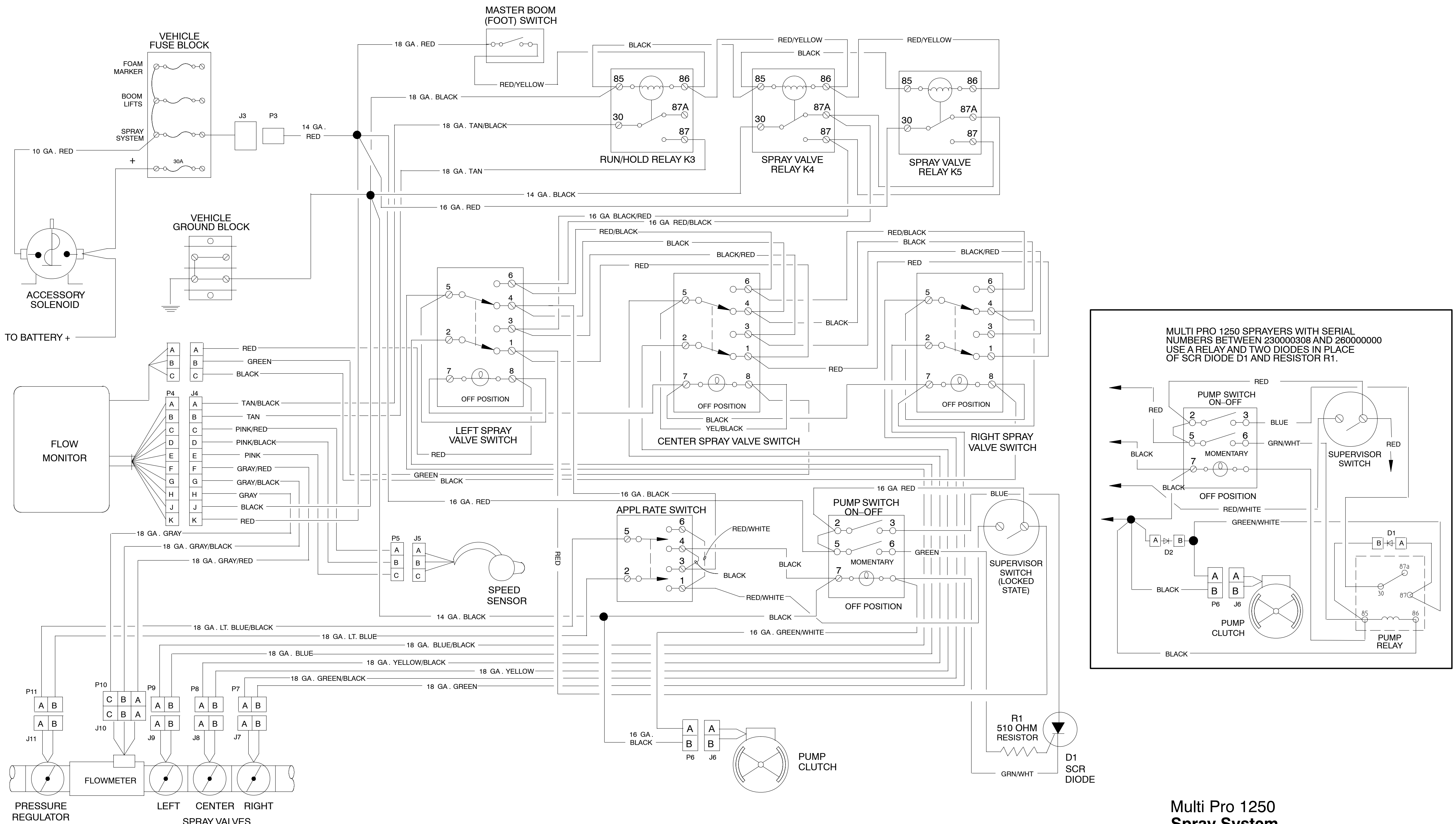


Multi Pro 1200
Spray System
Electrical Schematic

All relays and solenoids are shown as de–energized.

All ground wires are black.

(Serial Numbers Above 260000000)

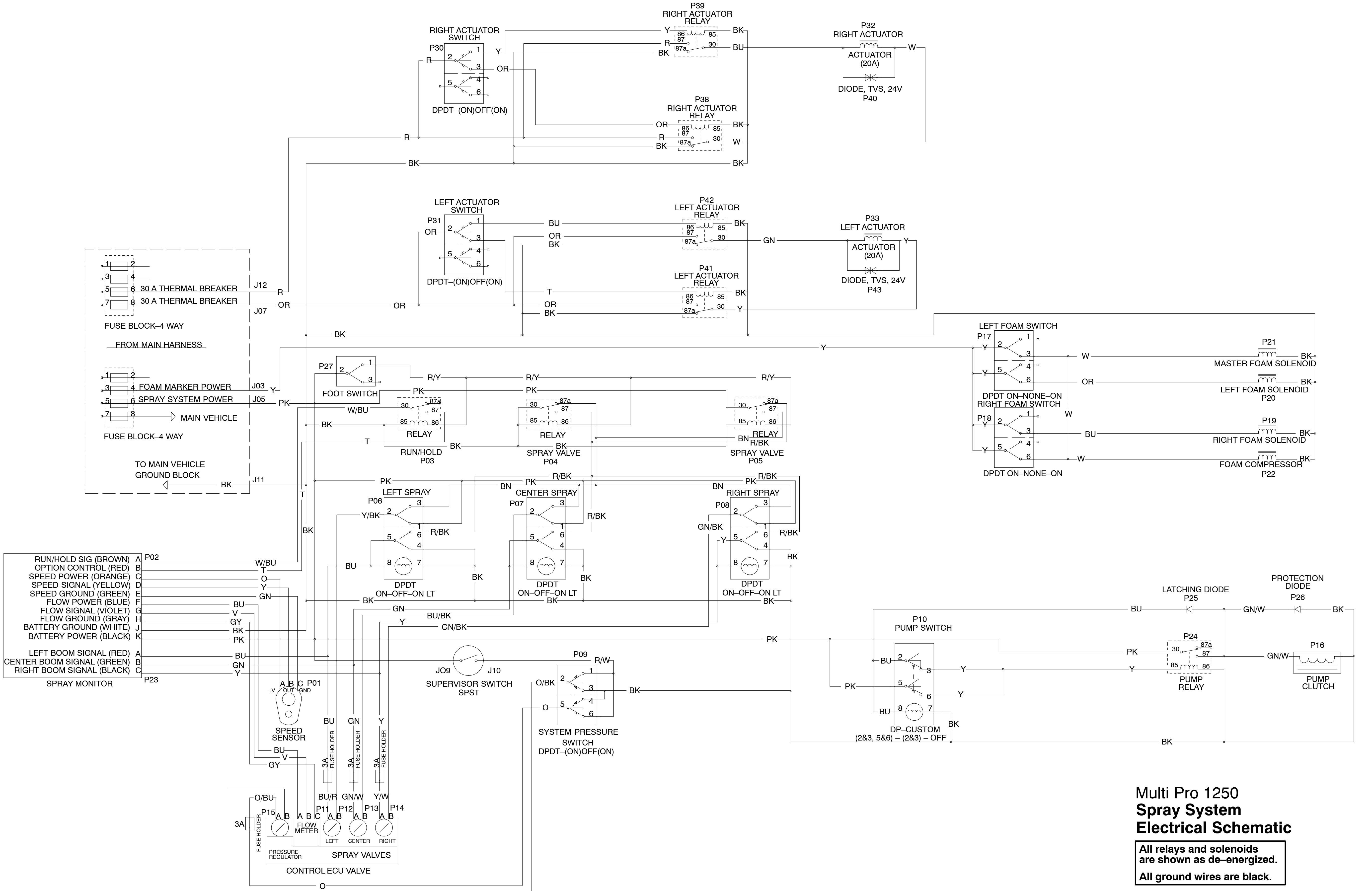


Multi Pro 1250
Spray System
Electrical Schematic

All relays and solenoids are shown as de–energized.

All ground wires are black.

(Serial Numbers Below 260000000)



Multi Pro 1250

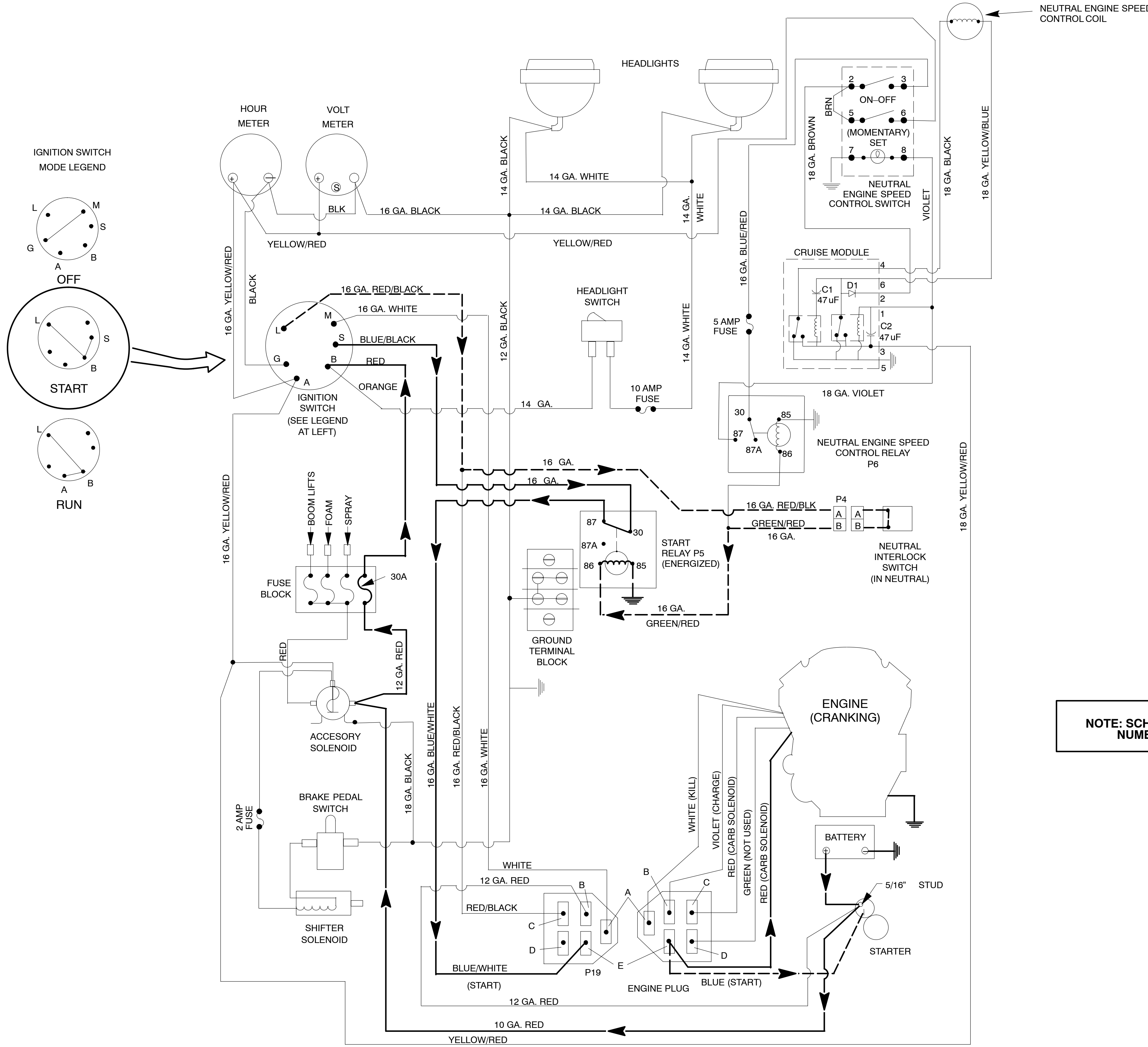
Spray System

Electrical Schematic

All relays and solenoids are shown as de–energized.

All ground wires are black.

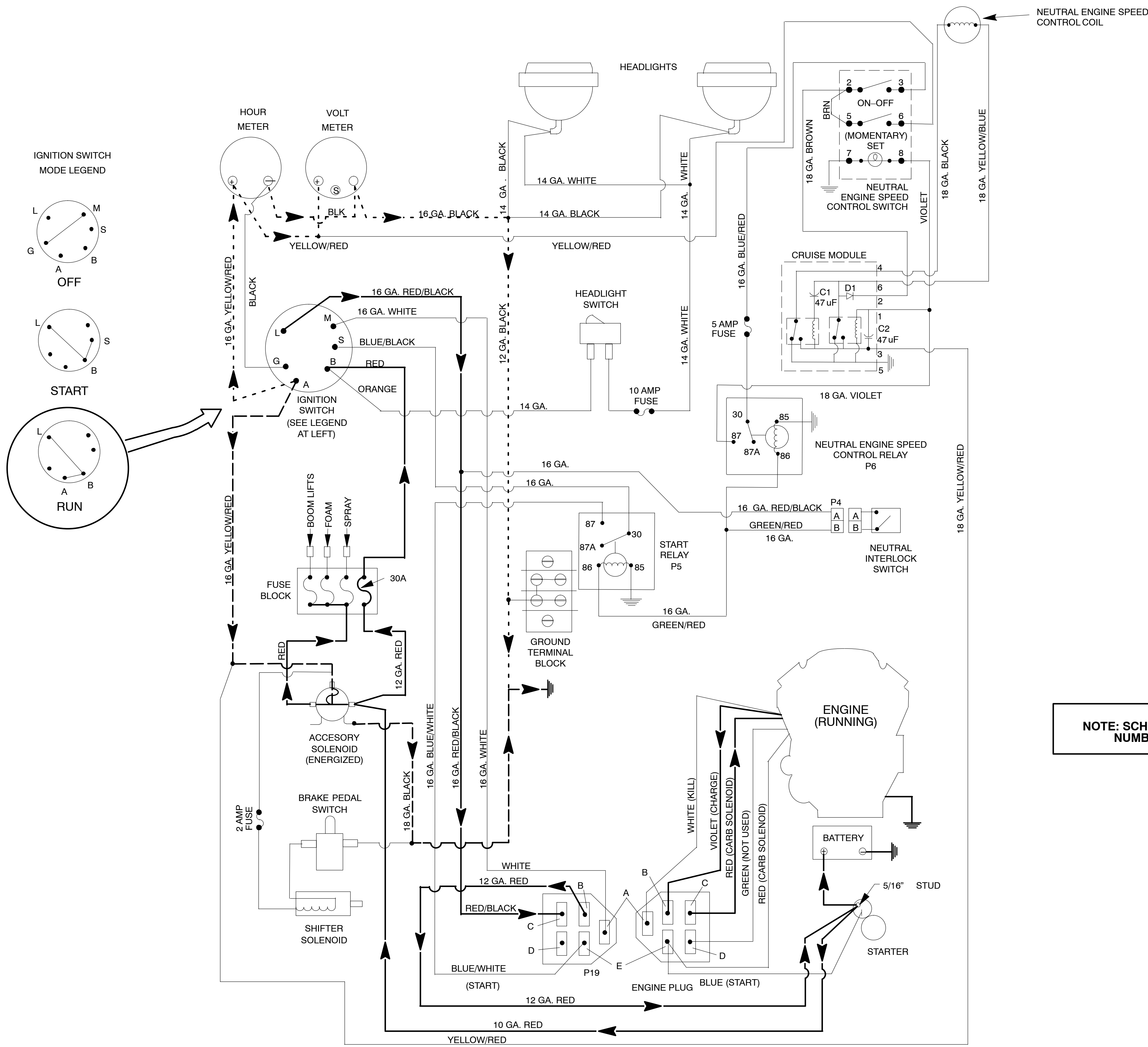
(Serial Numbers Above 260000000)



NOTE: SCHEMATIC FOR MACHINE WITH SERIAL NUMBER BELOW 260000000 SHOWN.

Multi Pro 1200/1250
Start Circuit

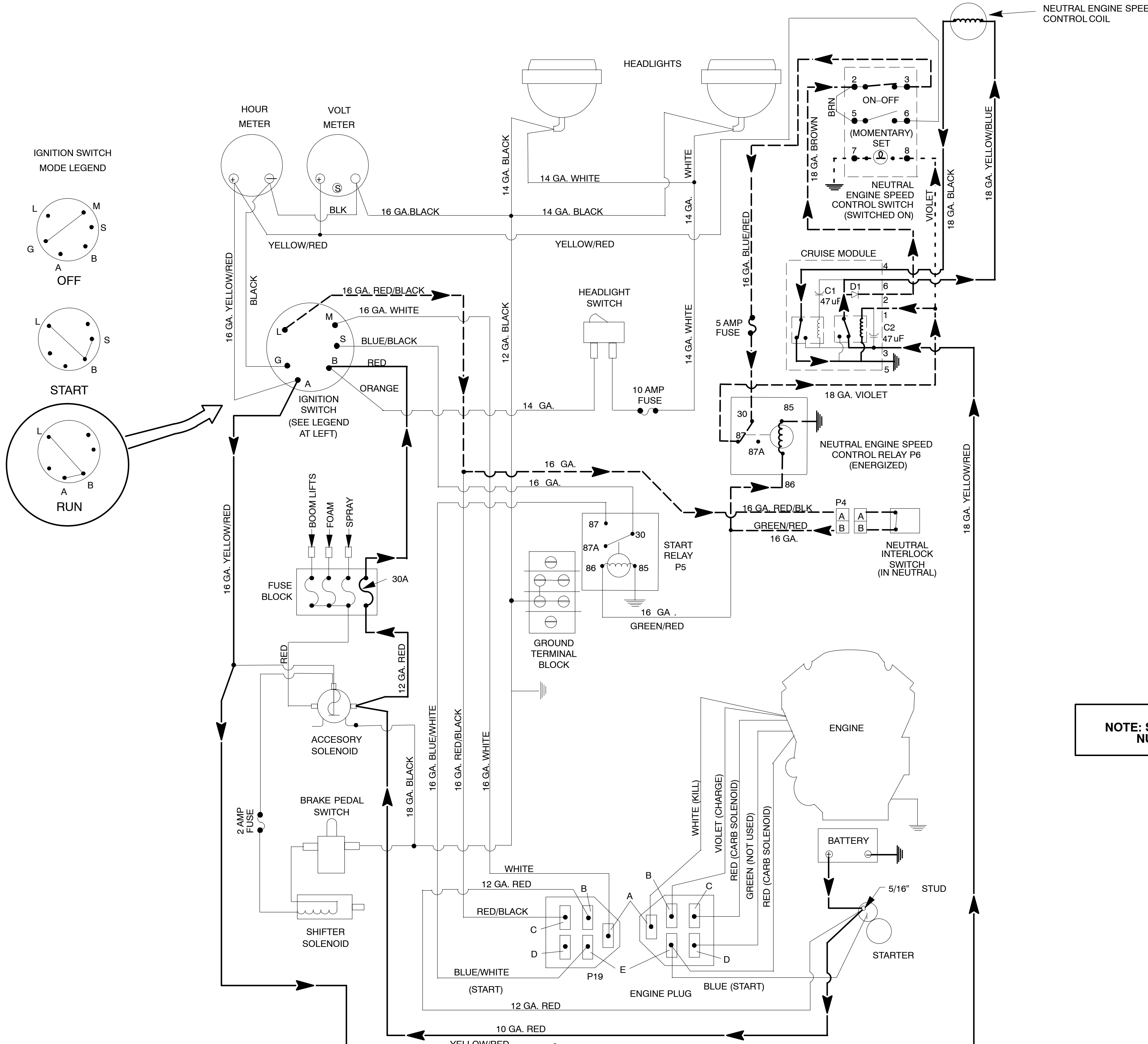
Power Current
Control Current
Indicator/Gauge Current
Logic Direction



NOTE: SCHEMATIC FOR MACHINE WITH SERIAL NUMBER BELOW 260000000 SHOWN.

Multi Pro 1200/1250
Run Circuit

Power Current
Control Current
Indicator/Gauge Current
Logic Direction

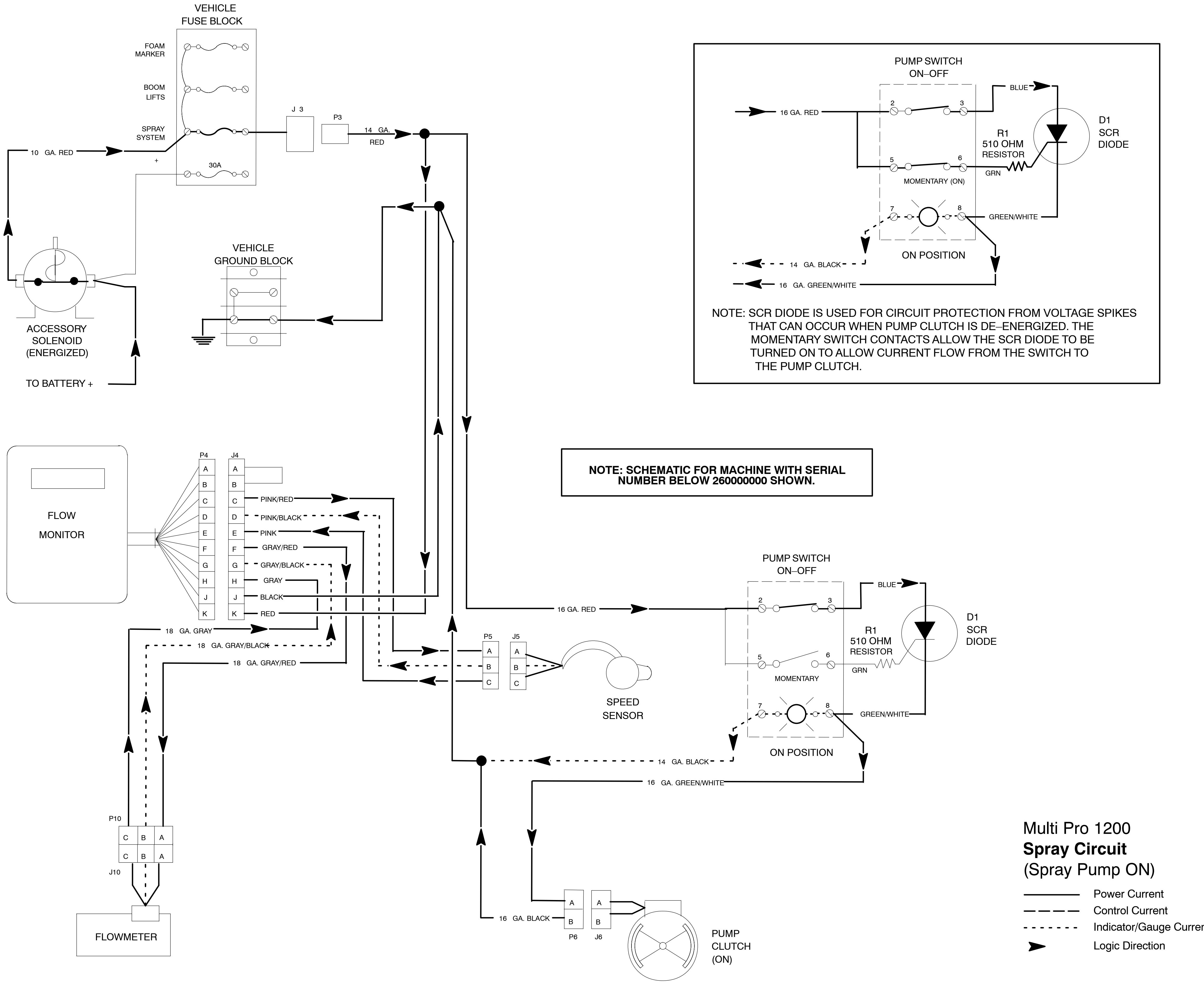


NOTE: SCHEMATIC FOR MACHINE WITH SERIAL NUMBER BELOW 260000000 SHOWN.

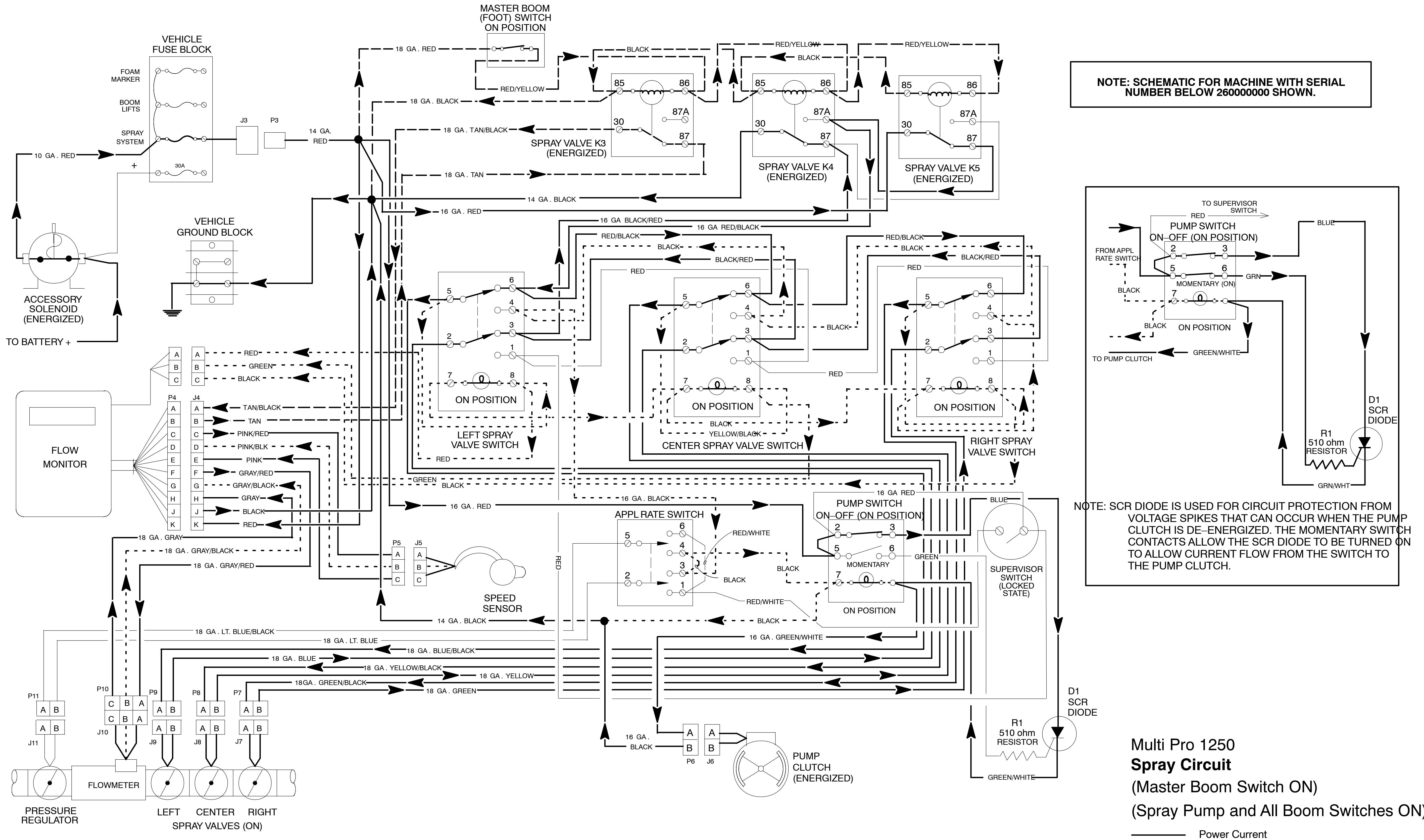
Multi Pro 1200/1250

Neutral Engine Speed Control Circuit

——— Power Current
— — — Control Current
- - - - - - - Indicator/Gauge Current
➤ Logic Direction



Multi Pro 1200
Spray Circuit
(Spray Pump ON)



Multi Pro 1250

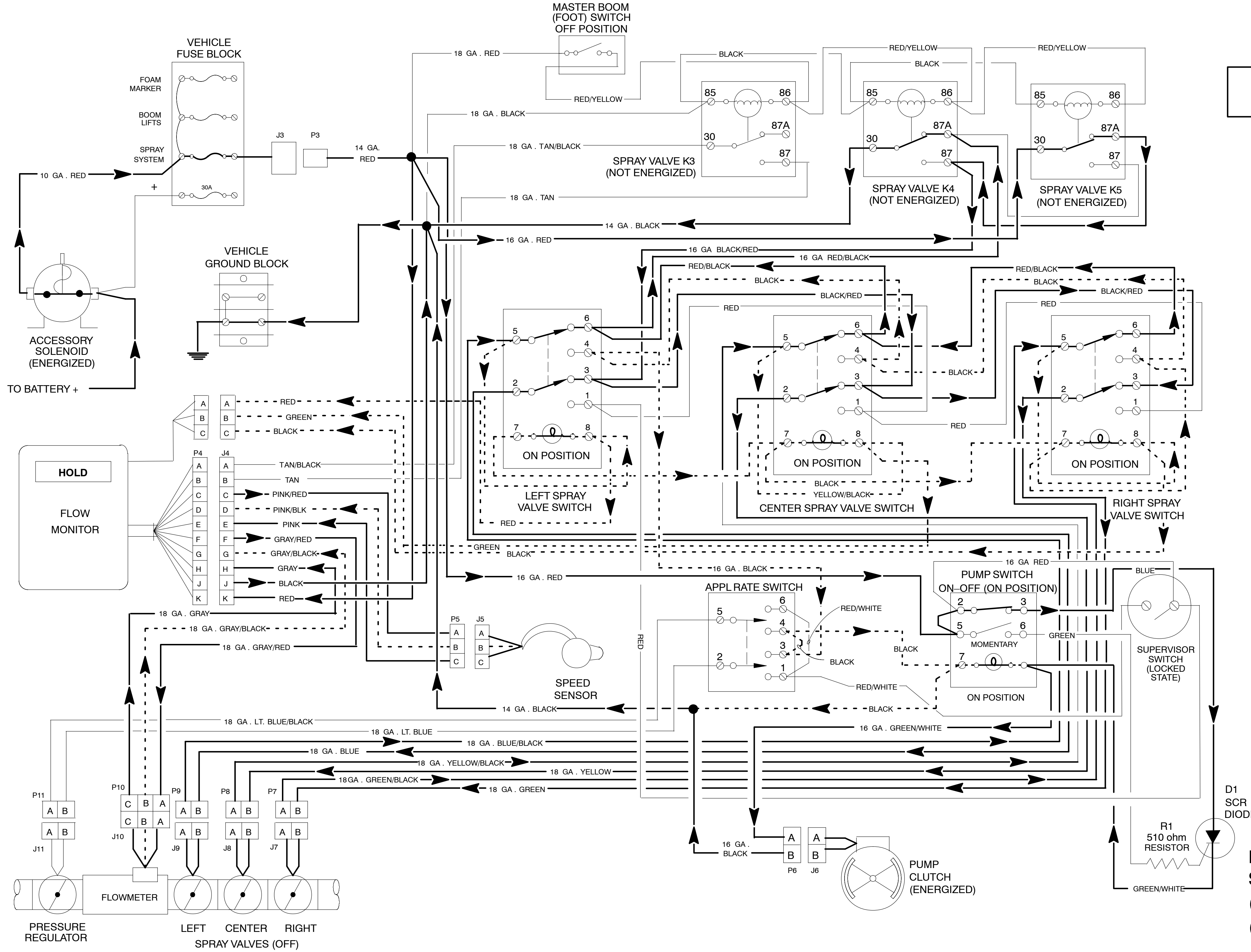
Spray Circuit

(Master Boom Switch ON)

(Spray Pump and All Boom Switches ON)

———	Power Current
— — —	Control Current
- - - -	Indicator/Gauge Current
➤	Logic Direction

NOTE: SCHEMATIC FOR MACHINE WITH SERIAL NUMBER BELOW 260000000 SHOWN.



Multi Pro 1250

Spray Circuit

(Master Boom Switch OFF)

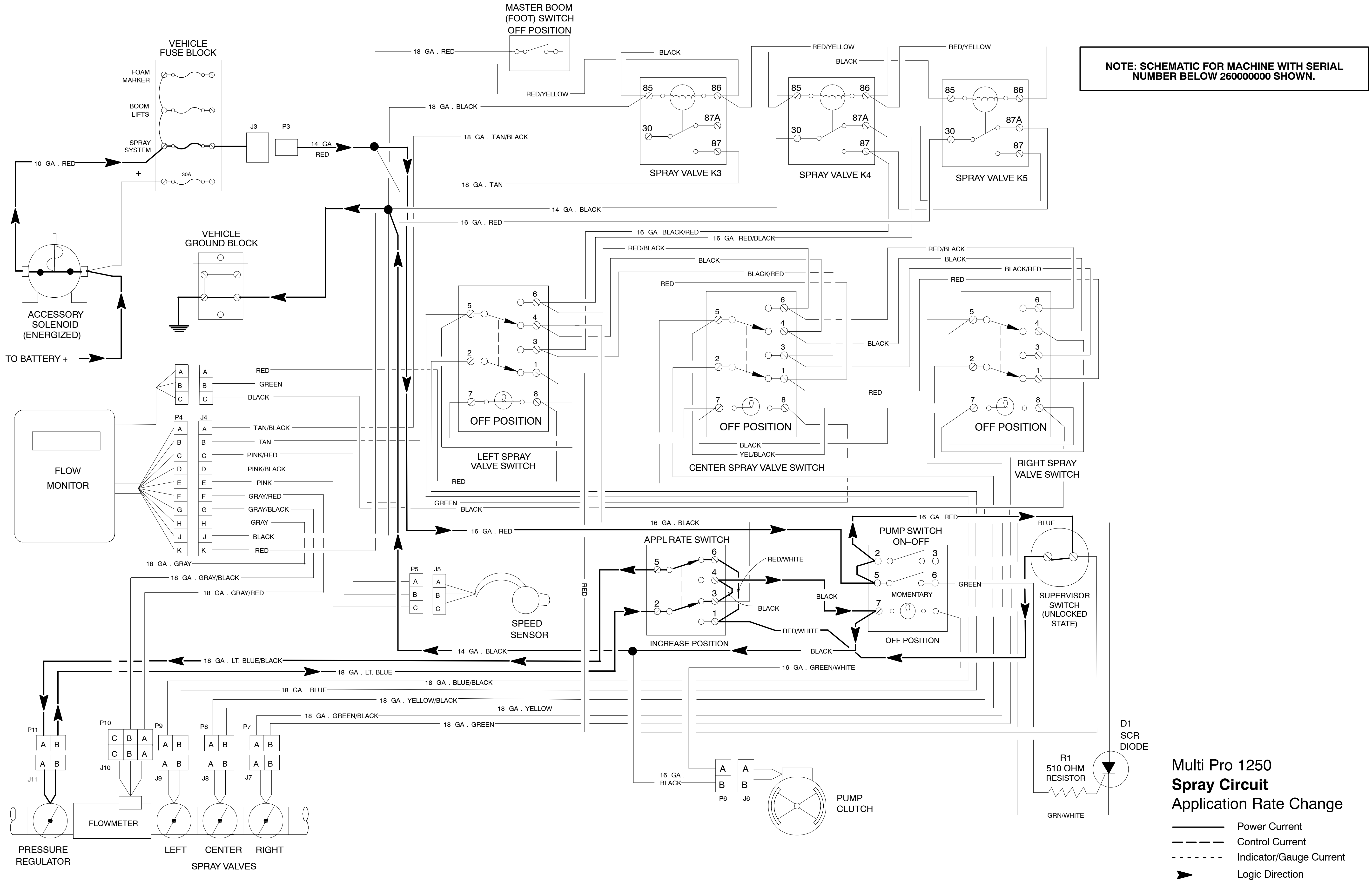
(Spray Pump and All Boom Switches ON)

Power Current

Control Current

Indicator/Gauge Current

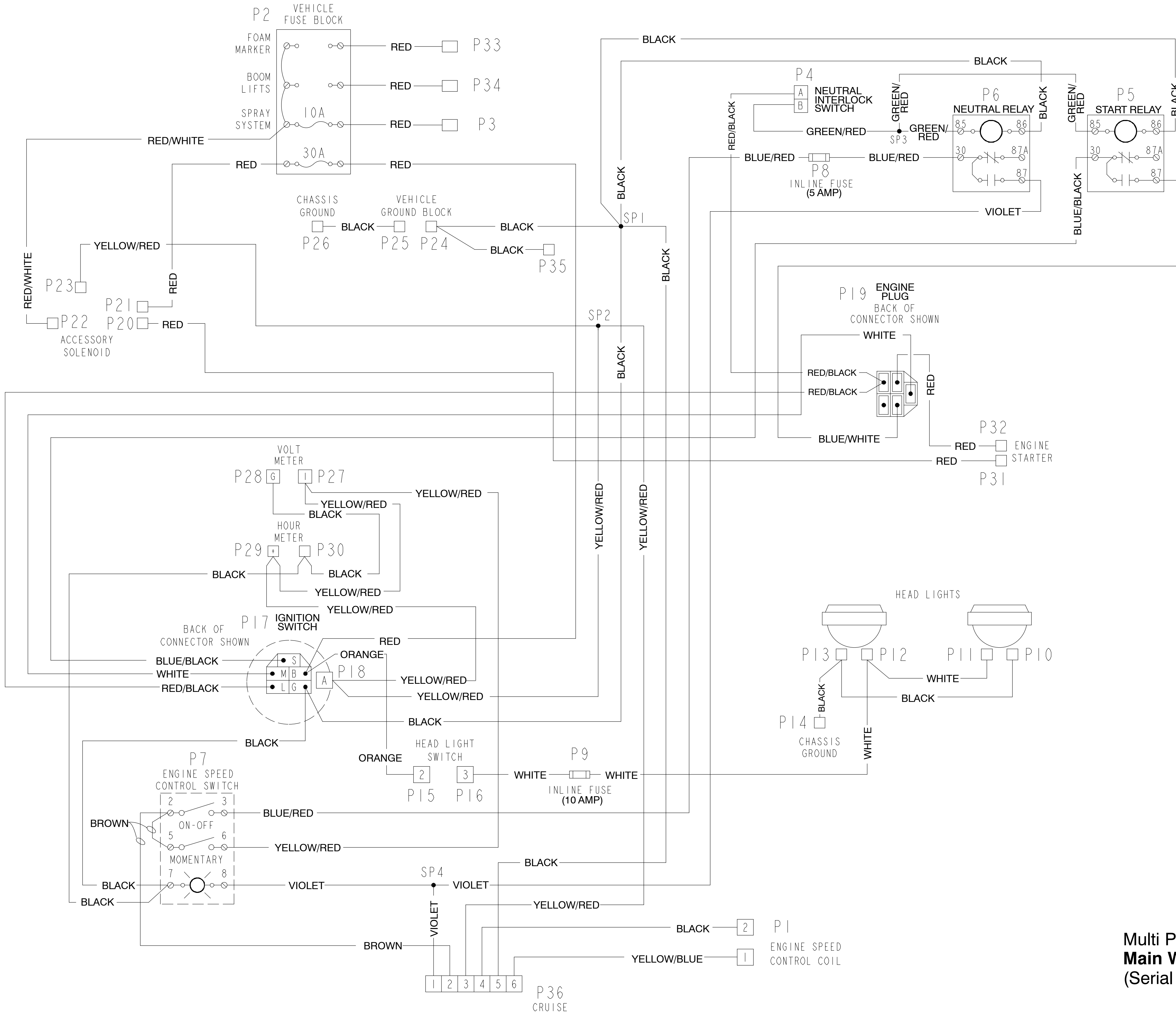
Logic Direction



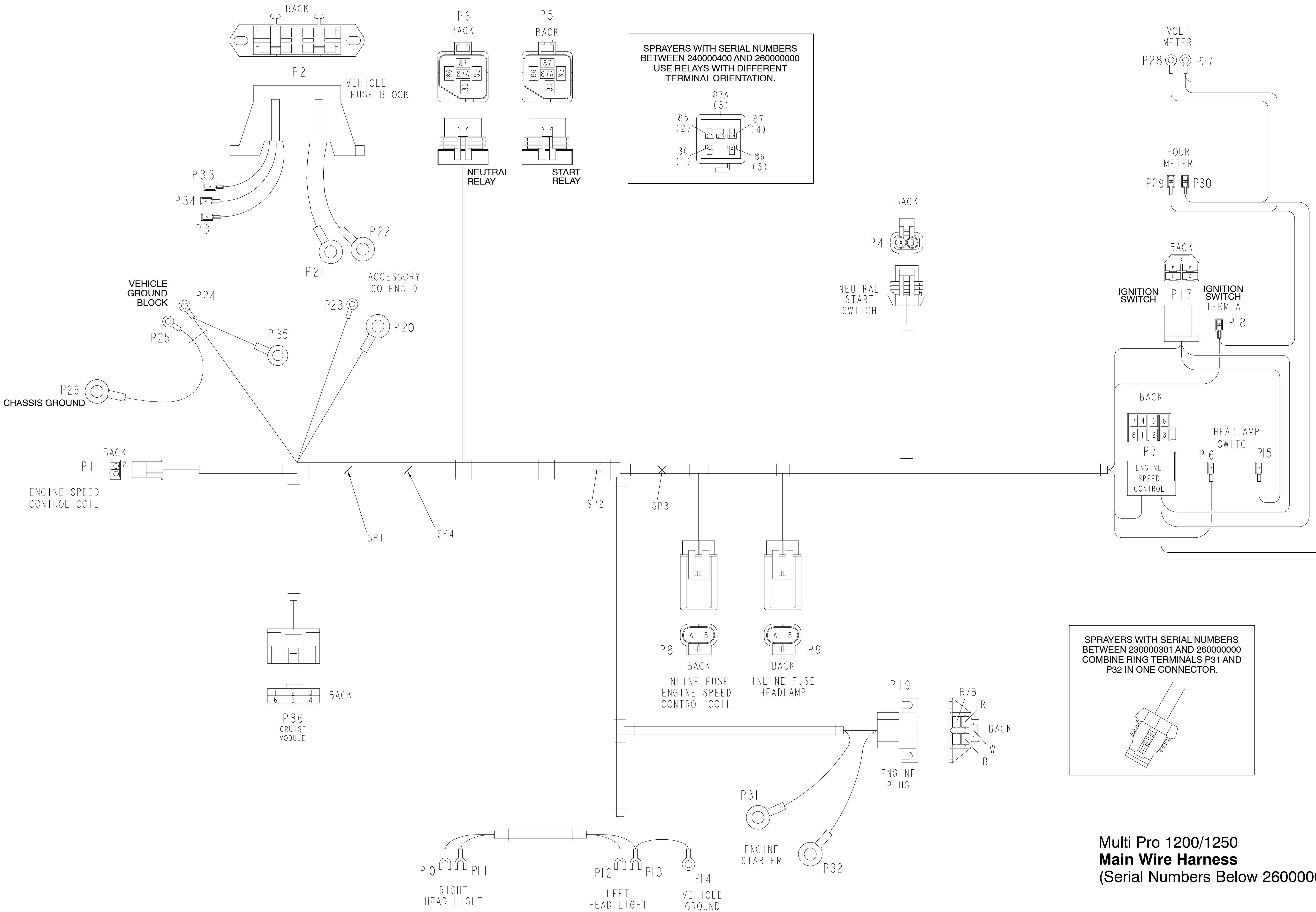
Multi Pro 1250

Spray Circuit

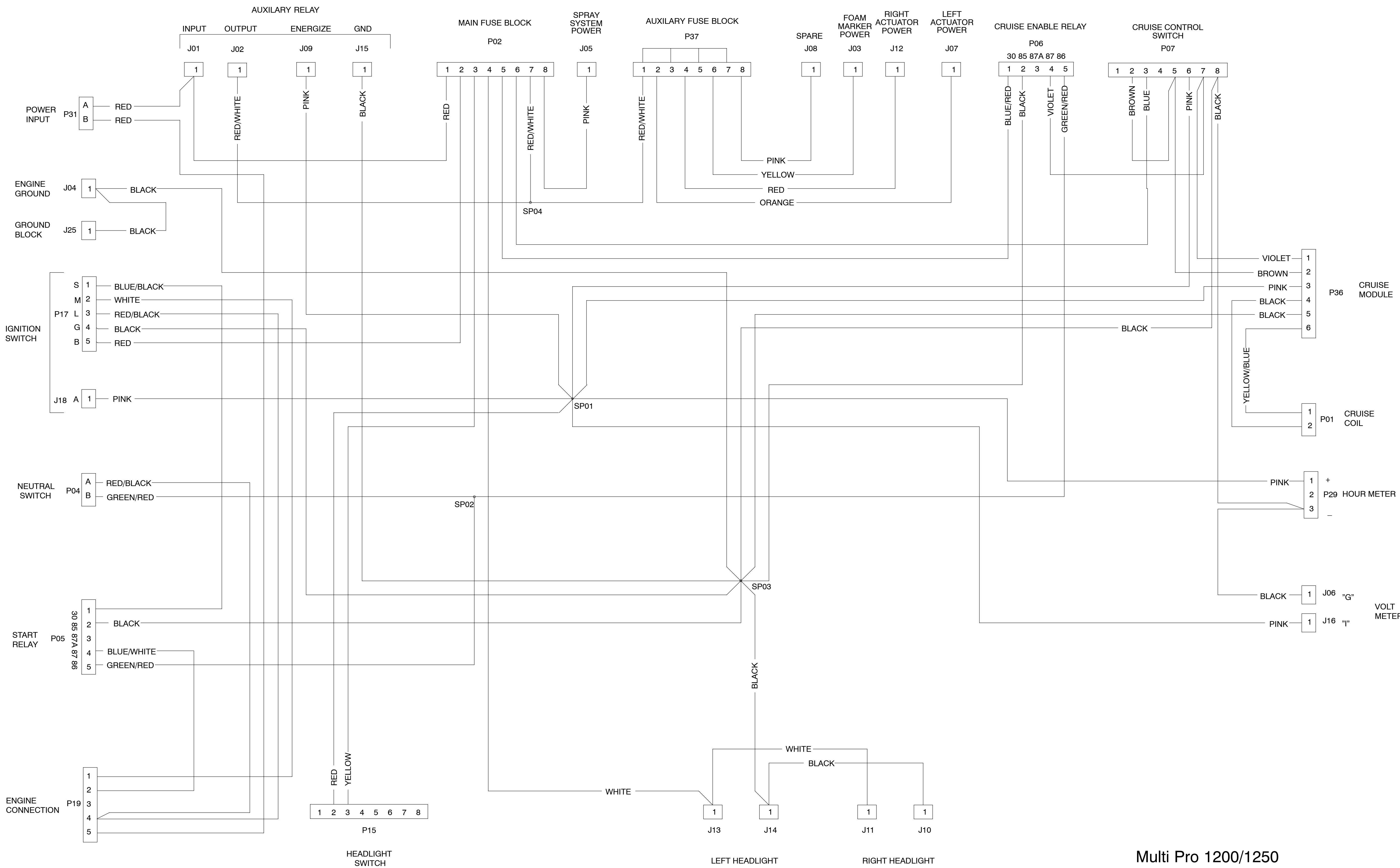
Application Rate Change



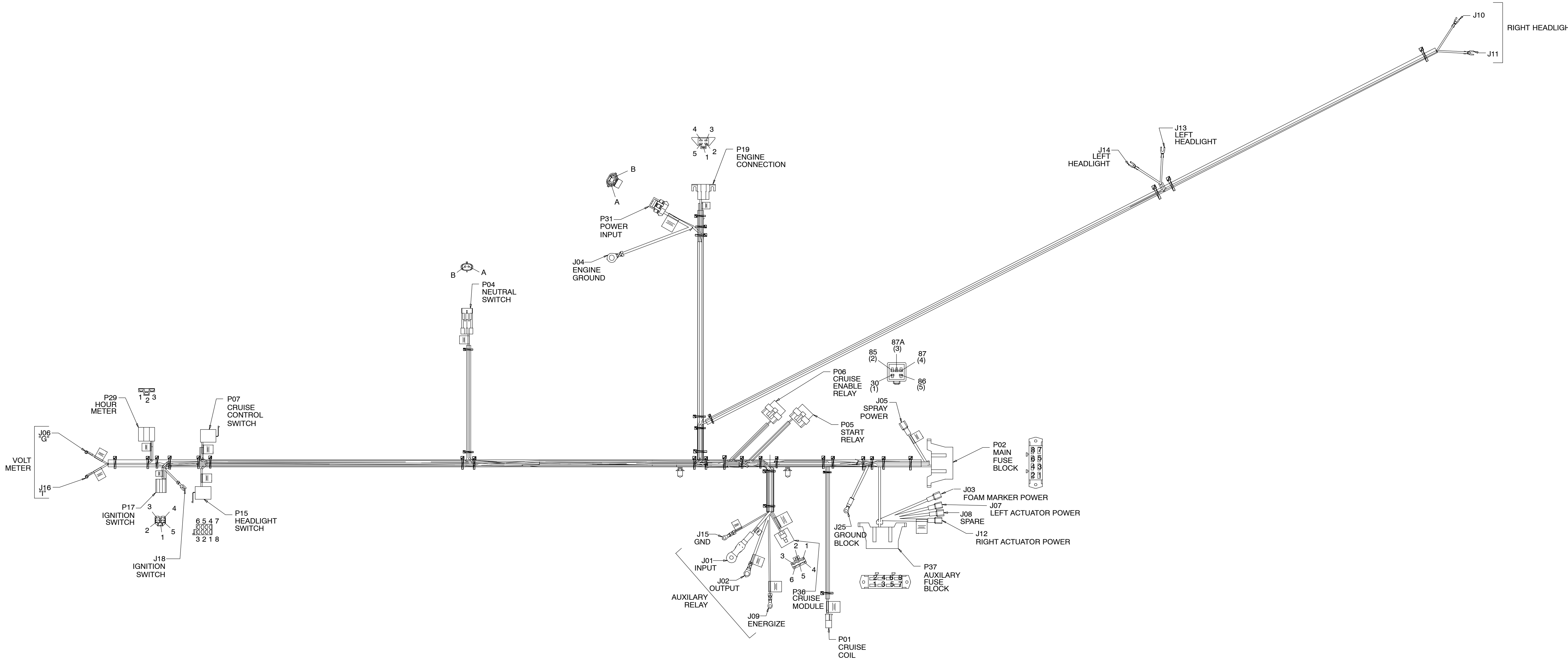
Multi Pro 1200/1250
Main Wire Harness
(Serial Numbers Below 260000000)



Multi Pro 1200/1250
Main Wire Harness
(Serial Numbers Below 260000000)



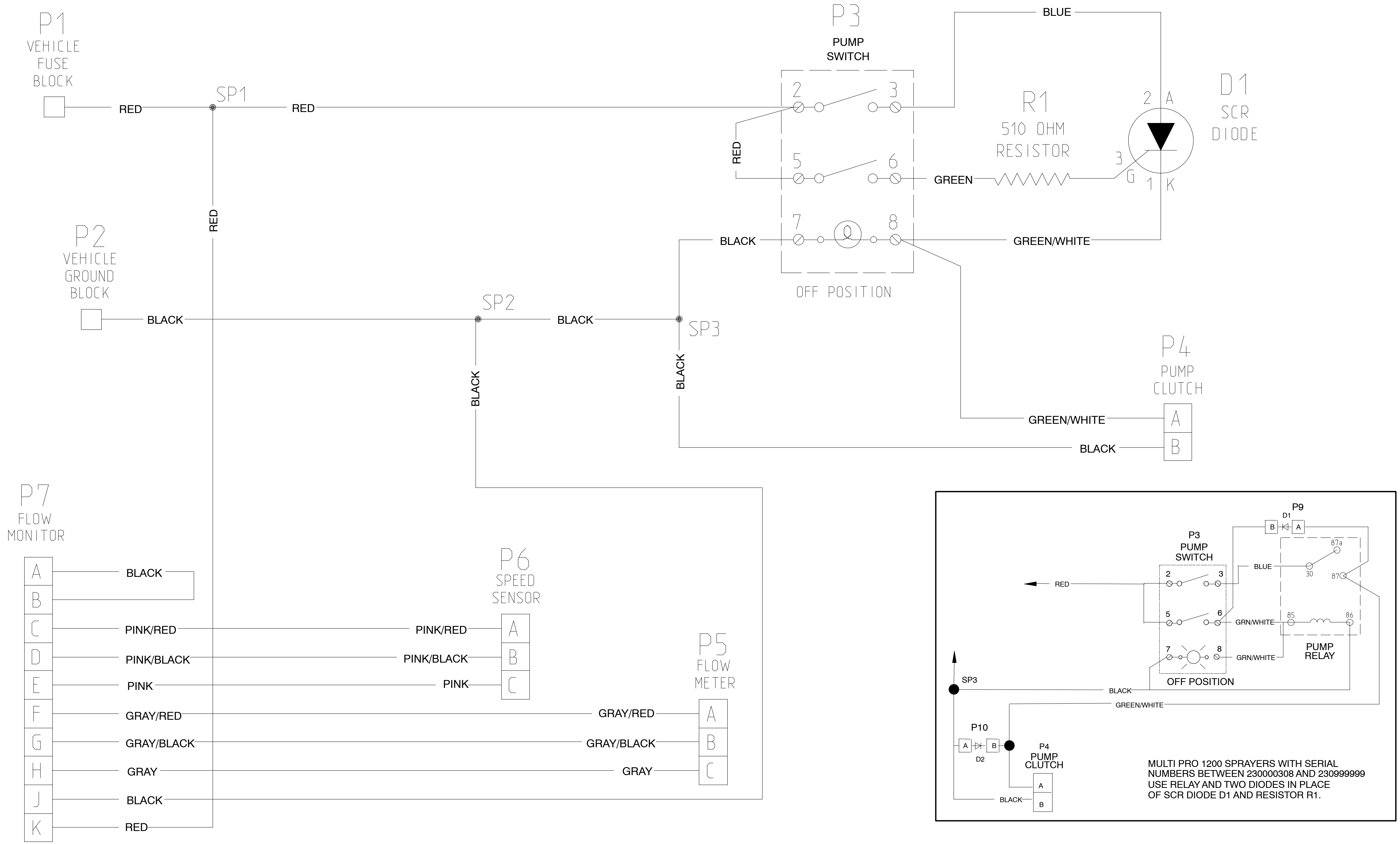
Multi Pro 1200/1250
Main Wire Harness
(Serial Numbers Above 260000000)



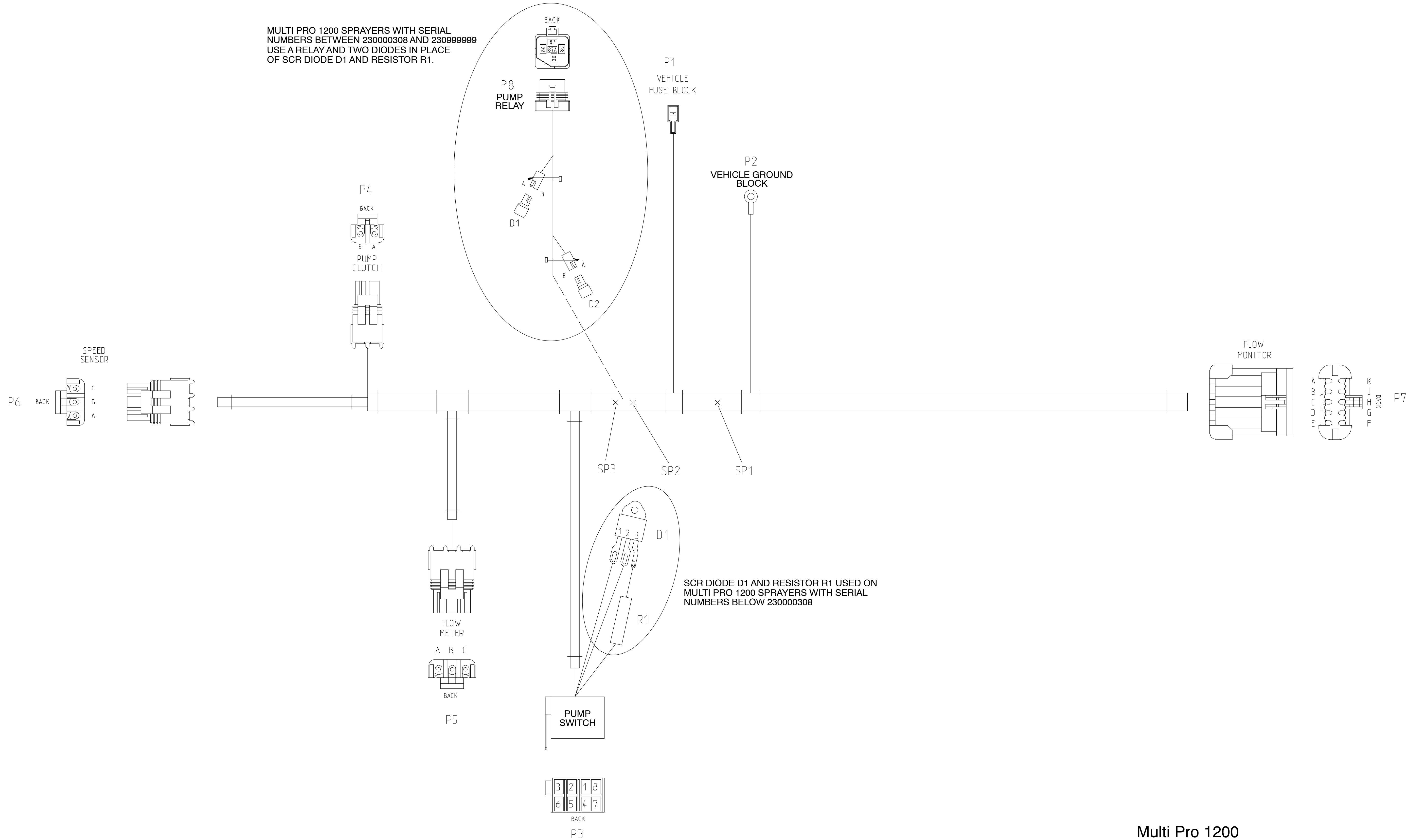
Multi Pro 1200/1250

Main Wire Harness

(Serial Numbers Above 260000000)



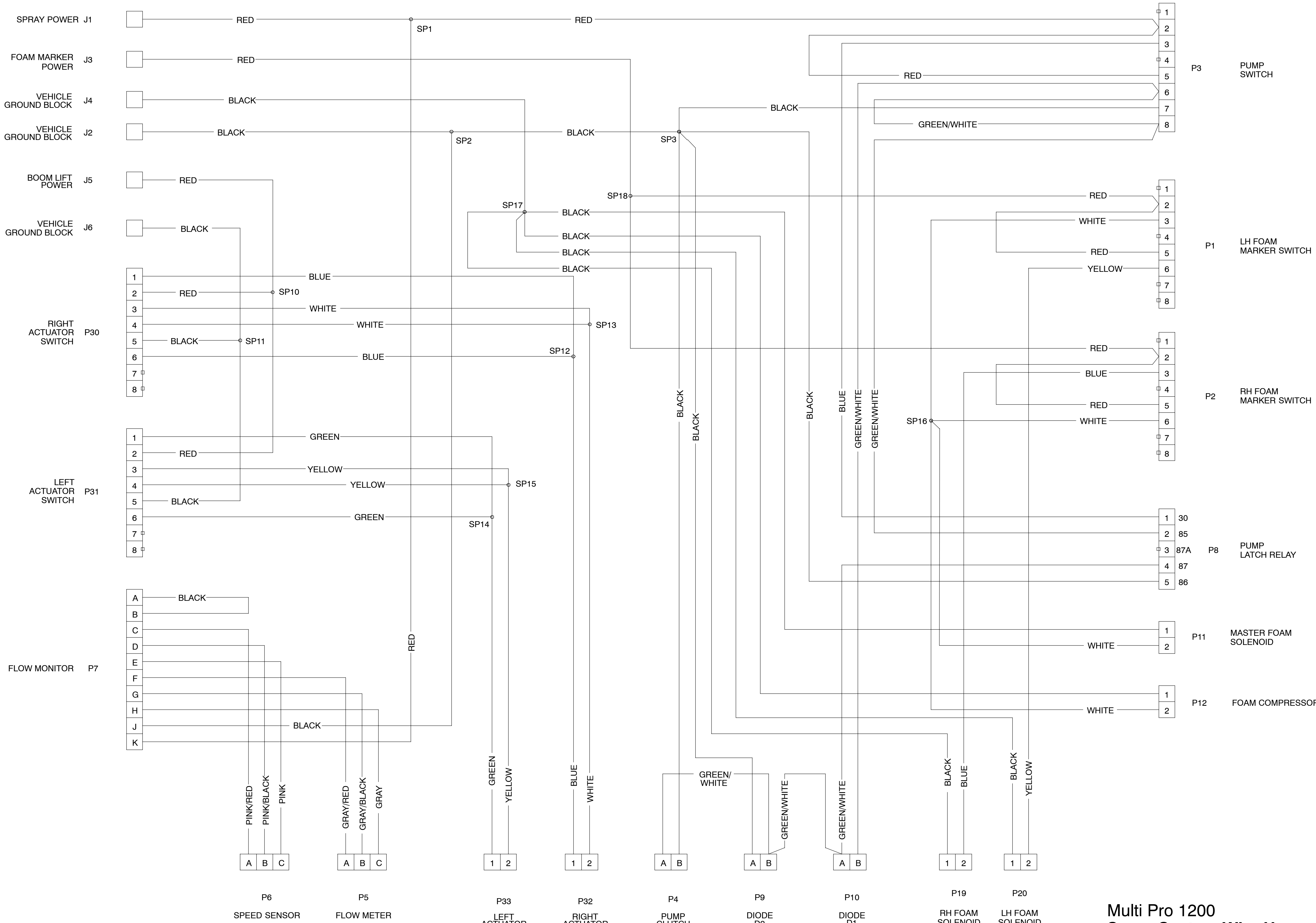
Multi Pro 1200
Spray System Wire Harness
(Serial Numbers Below 240000400)



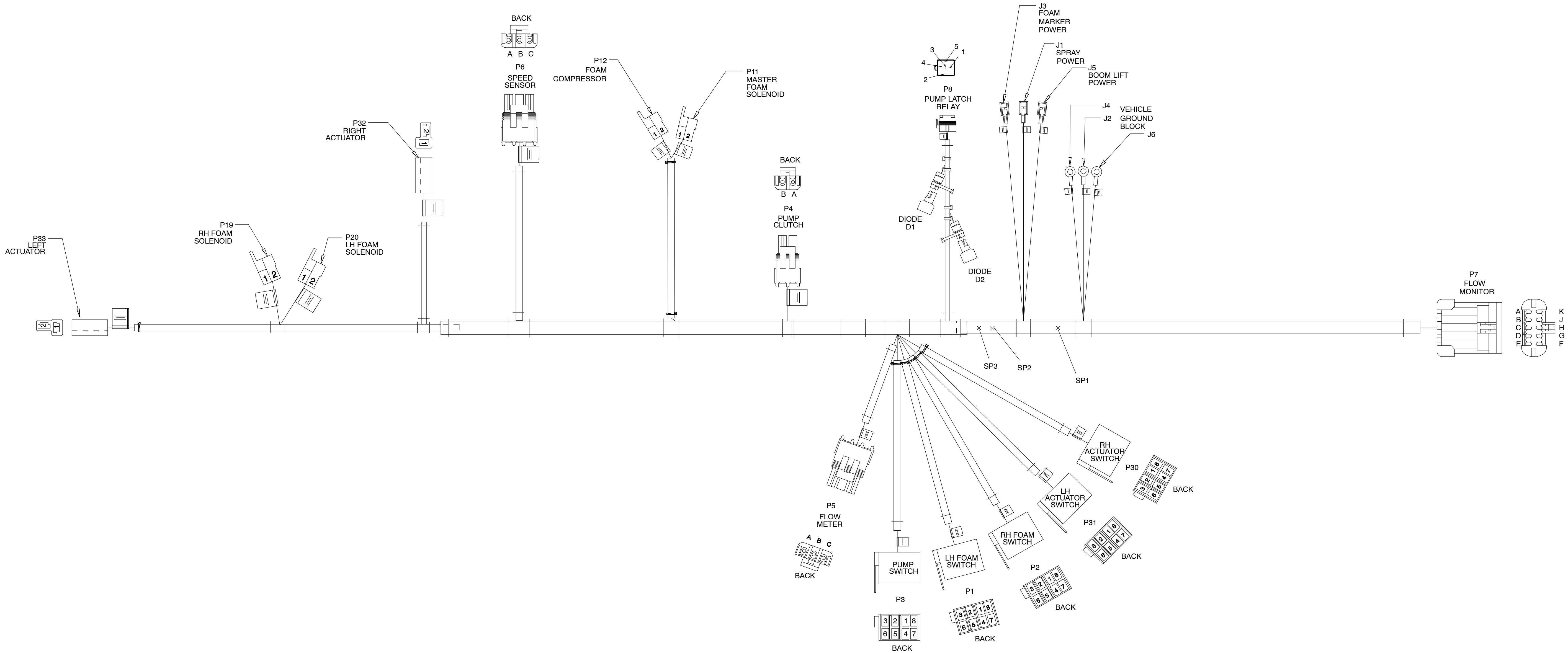
Multi Pro 1200

Spray System Wire Harness

(Serial Numbers Below 240000400)



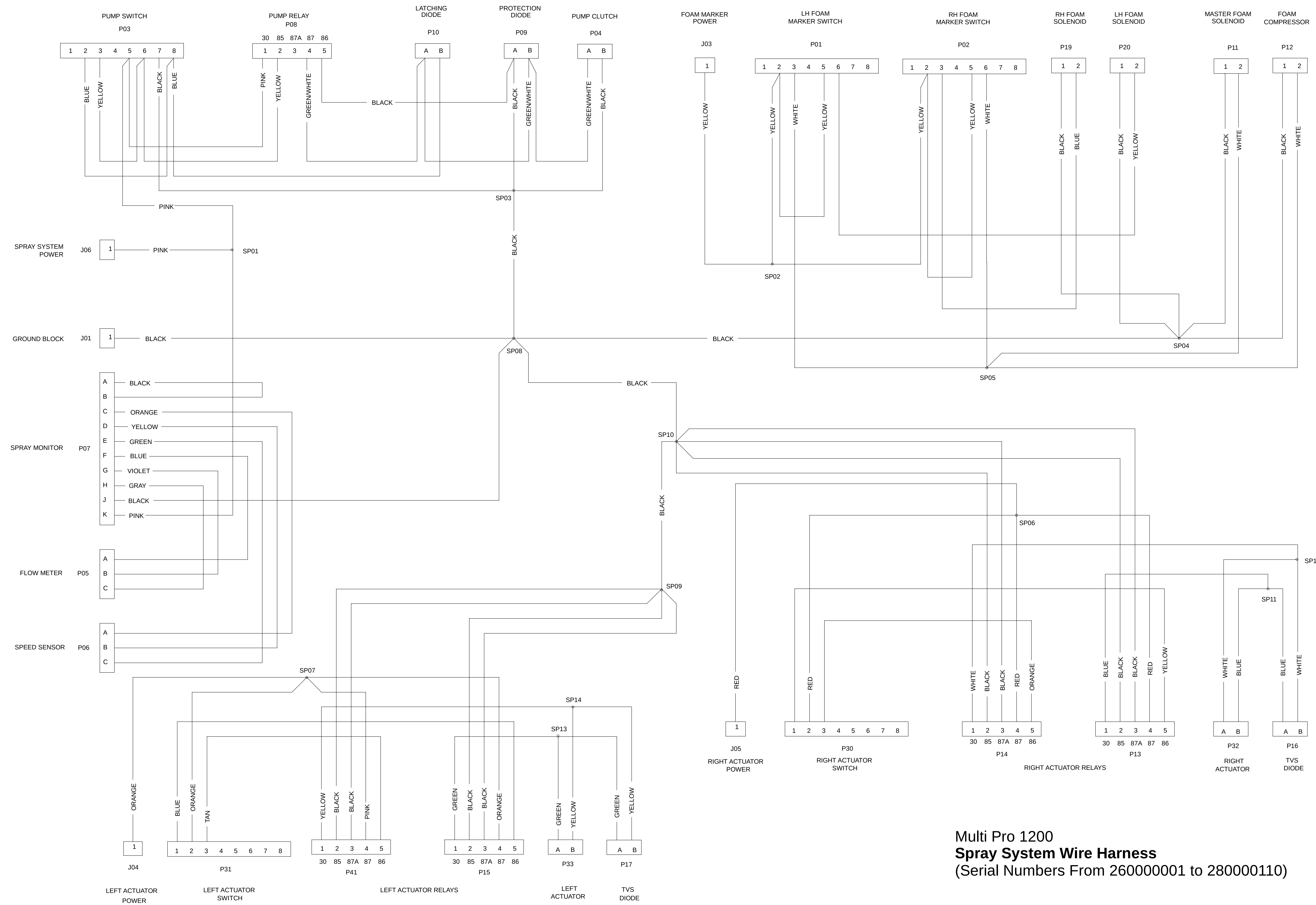
Multi Pro 1200
Spray System Wire Harness
(Serial Numbers From 240000401 To 250999999)



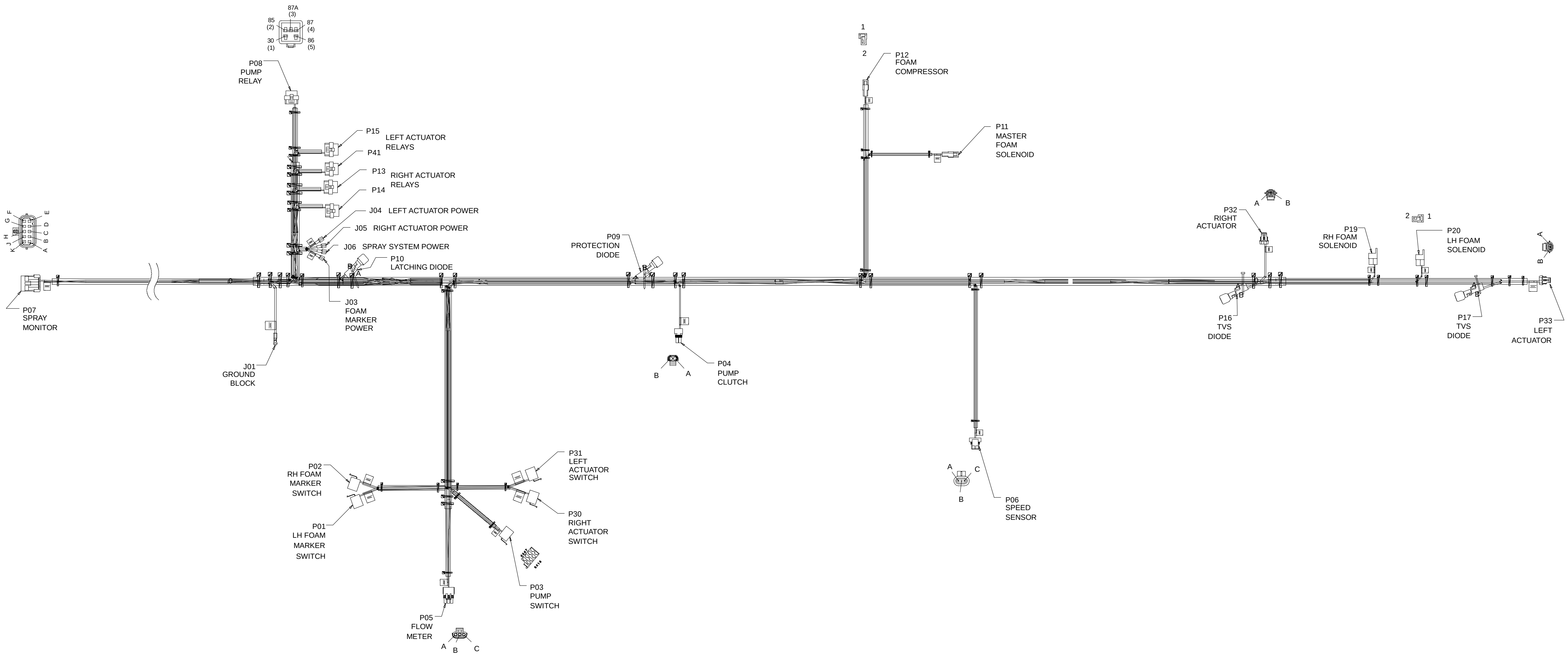
Multi Pro 1200

Spray System Wire Harness

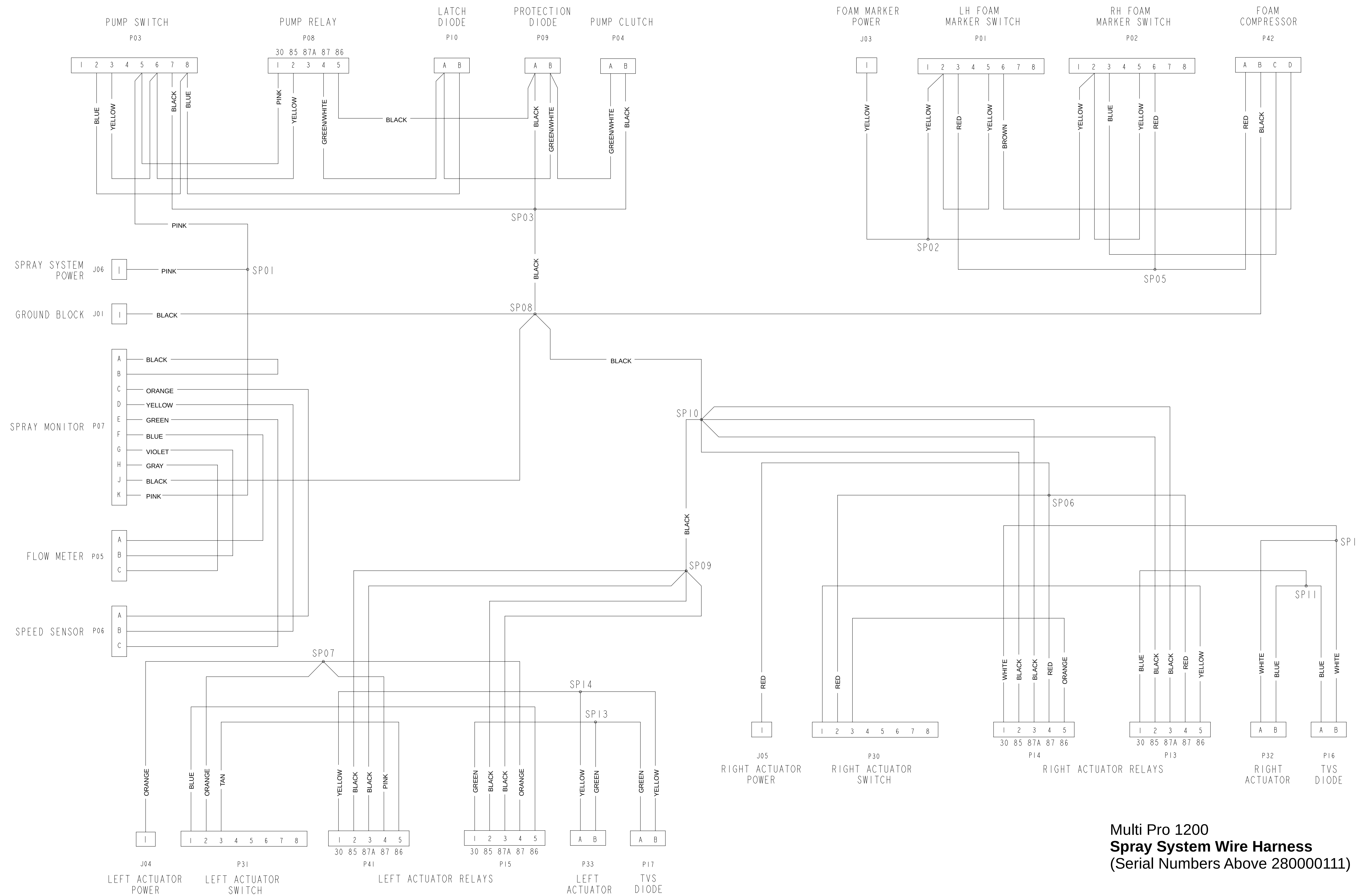
(Serial Numbers From 240000401 To 250999999)



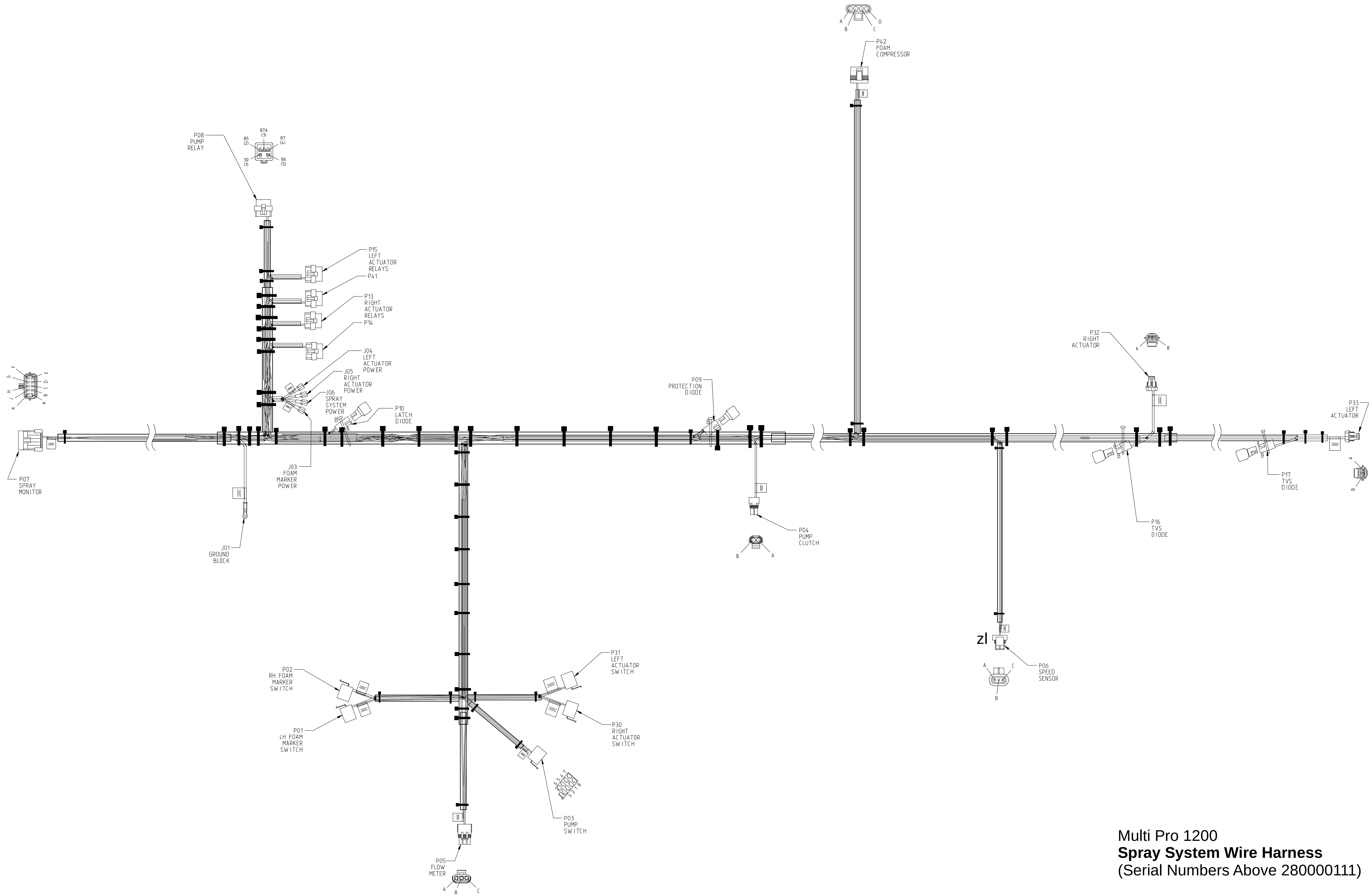
Multi Pro 1200
Spray System Wire Harness
(Serial Numbers From 260000001 to 280000110)



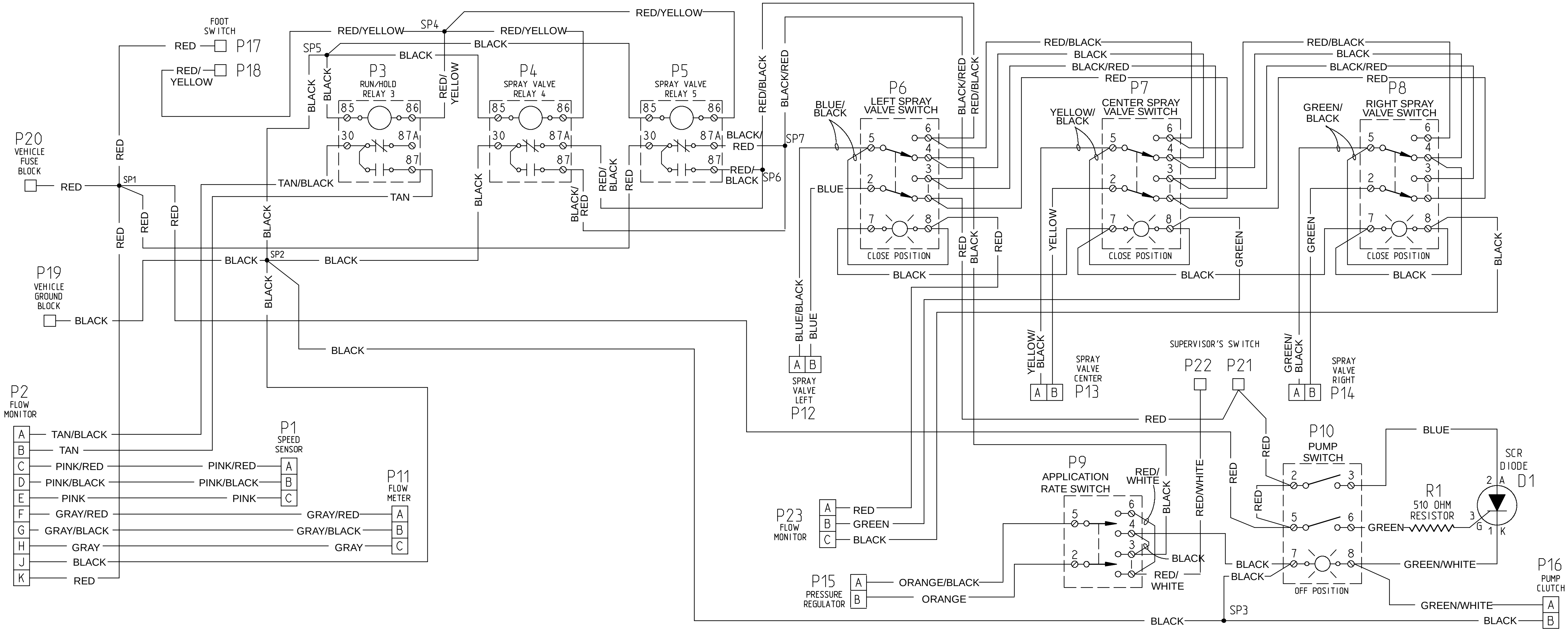
Multi Pro 1200
Spray System Wire Harness
(Serial Numbers From 260000001 to 280000110)

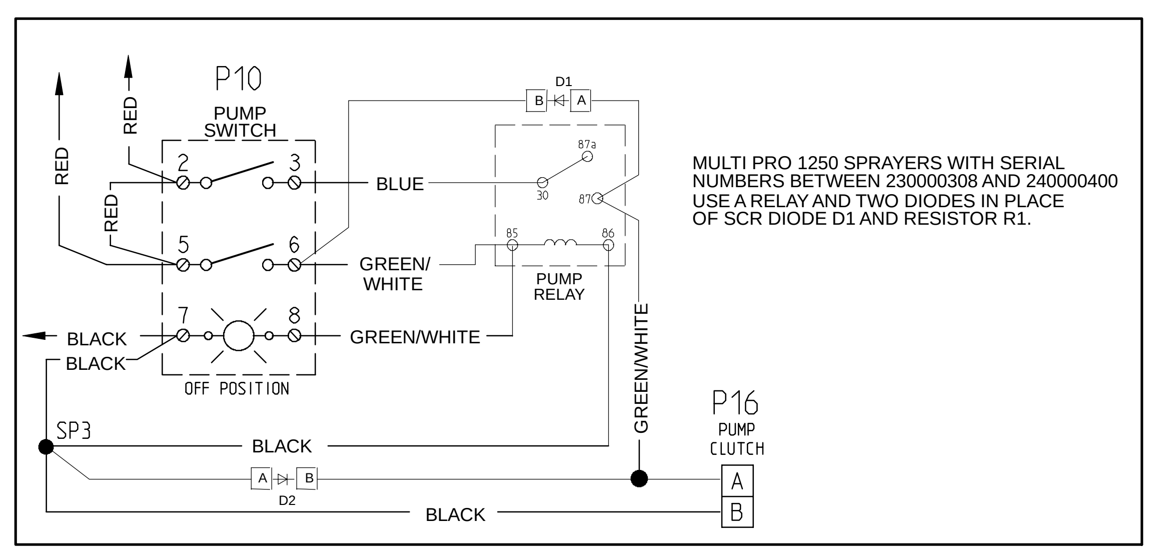


Multi Pro 1200
Spray System Wire Harness
(Serial Numbers Above 280000111)

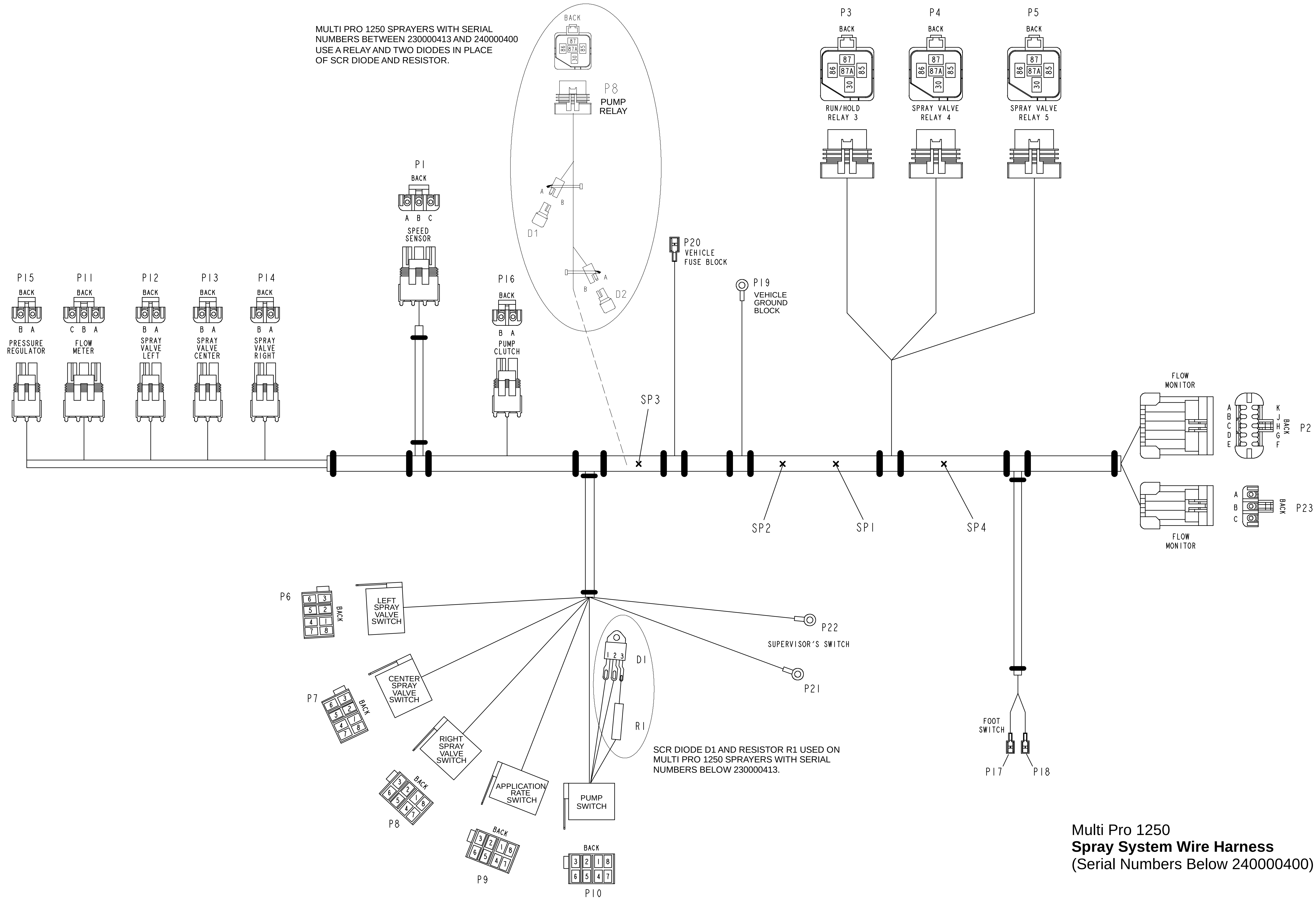


Multi Pro 1200
Spray System Wire Harness
(Serial Numbers Above 280000111)

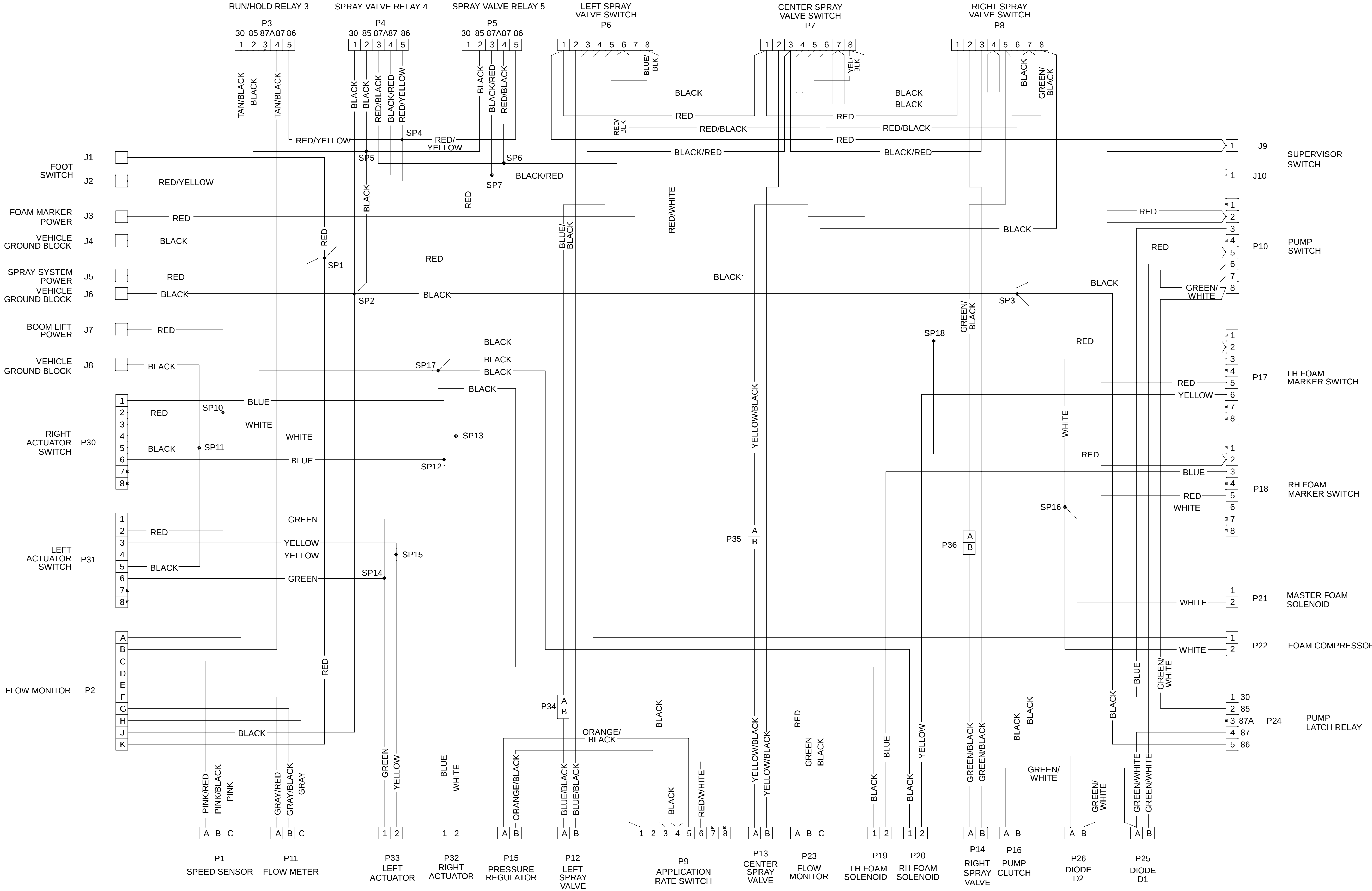




Multi Pro 1250
Spray System Wire Harness
(Serial Numbers Below 240000400)



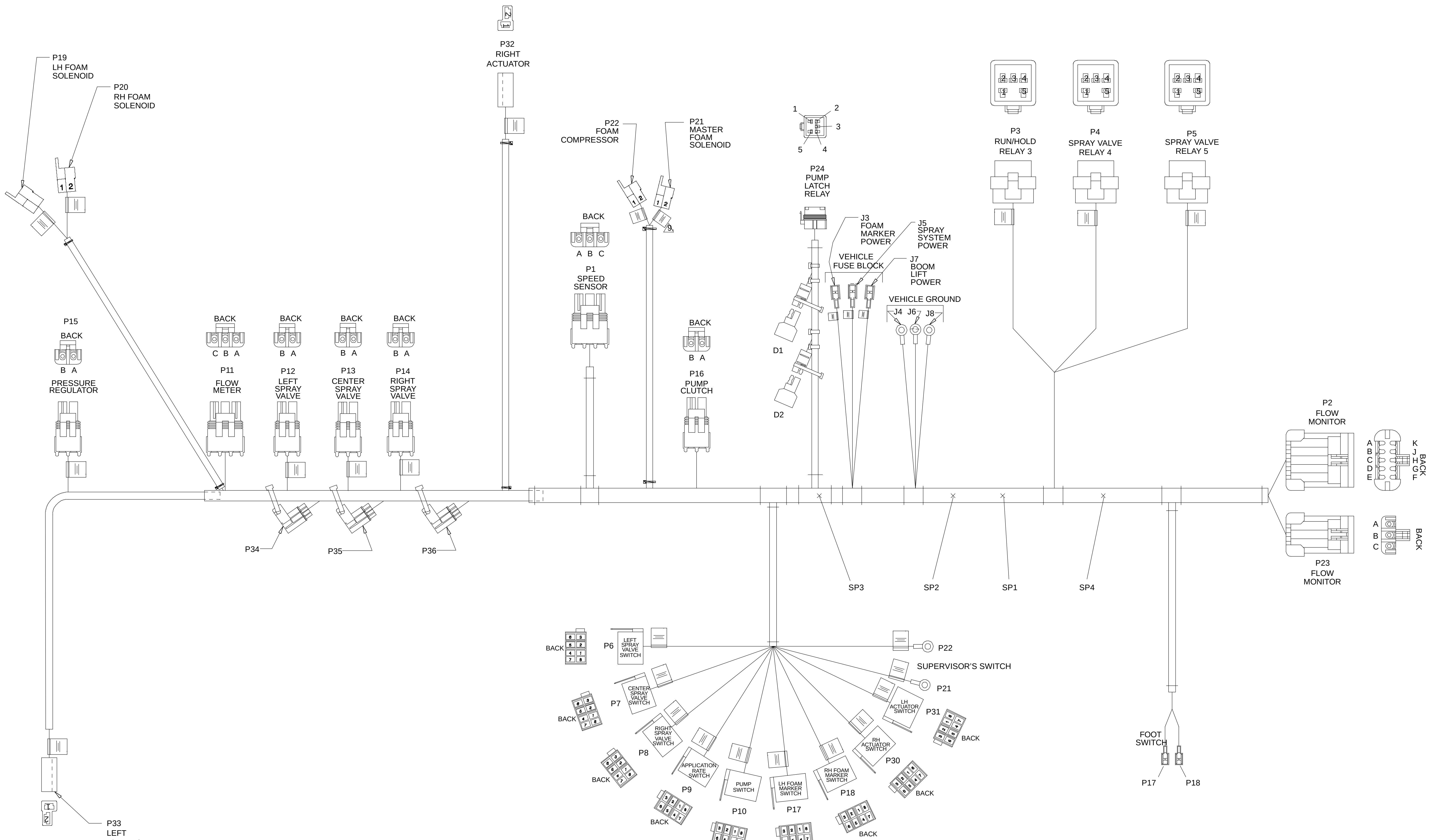
Multi Pro 1250
Spray System Wire Harness
(Serial Numbers Below 240000400)



Multi Pro 1250

Spray System Wire Harness

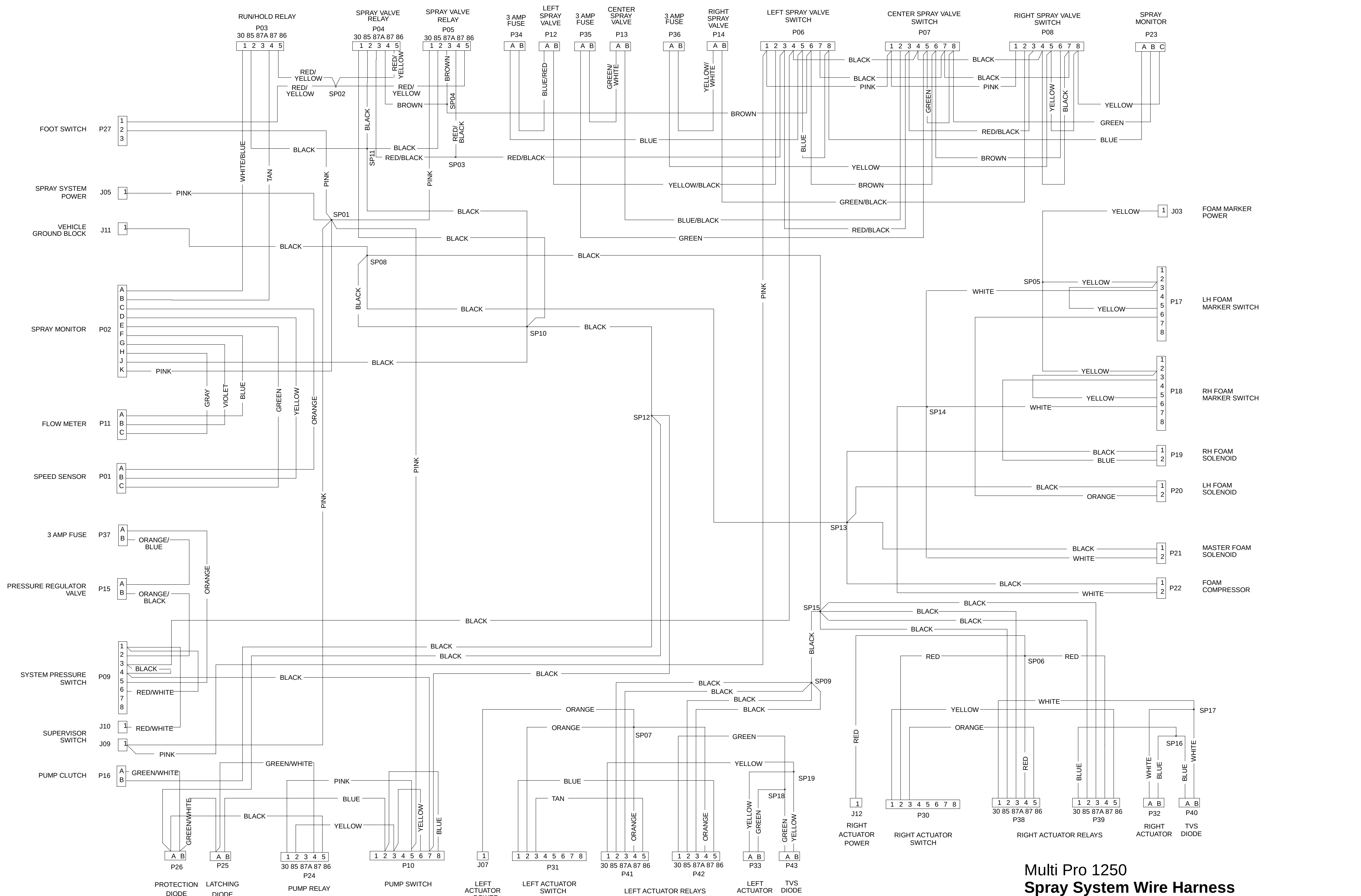
(Serial Numbers From 240000401 To 250999999)



Multi Pro 1250

Spray System Wire Harness

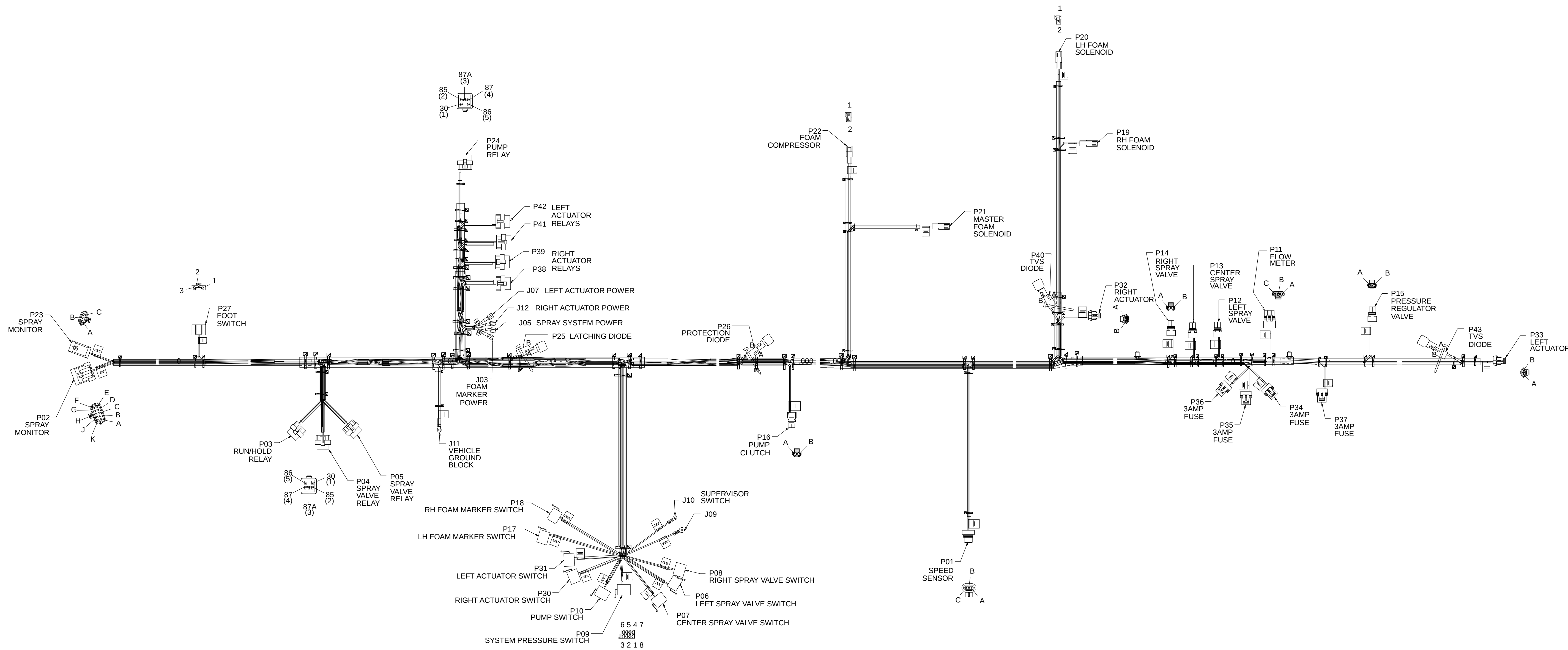
(Serial Numbers From 240000401 To 250999999)



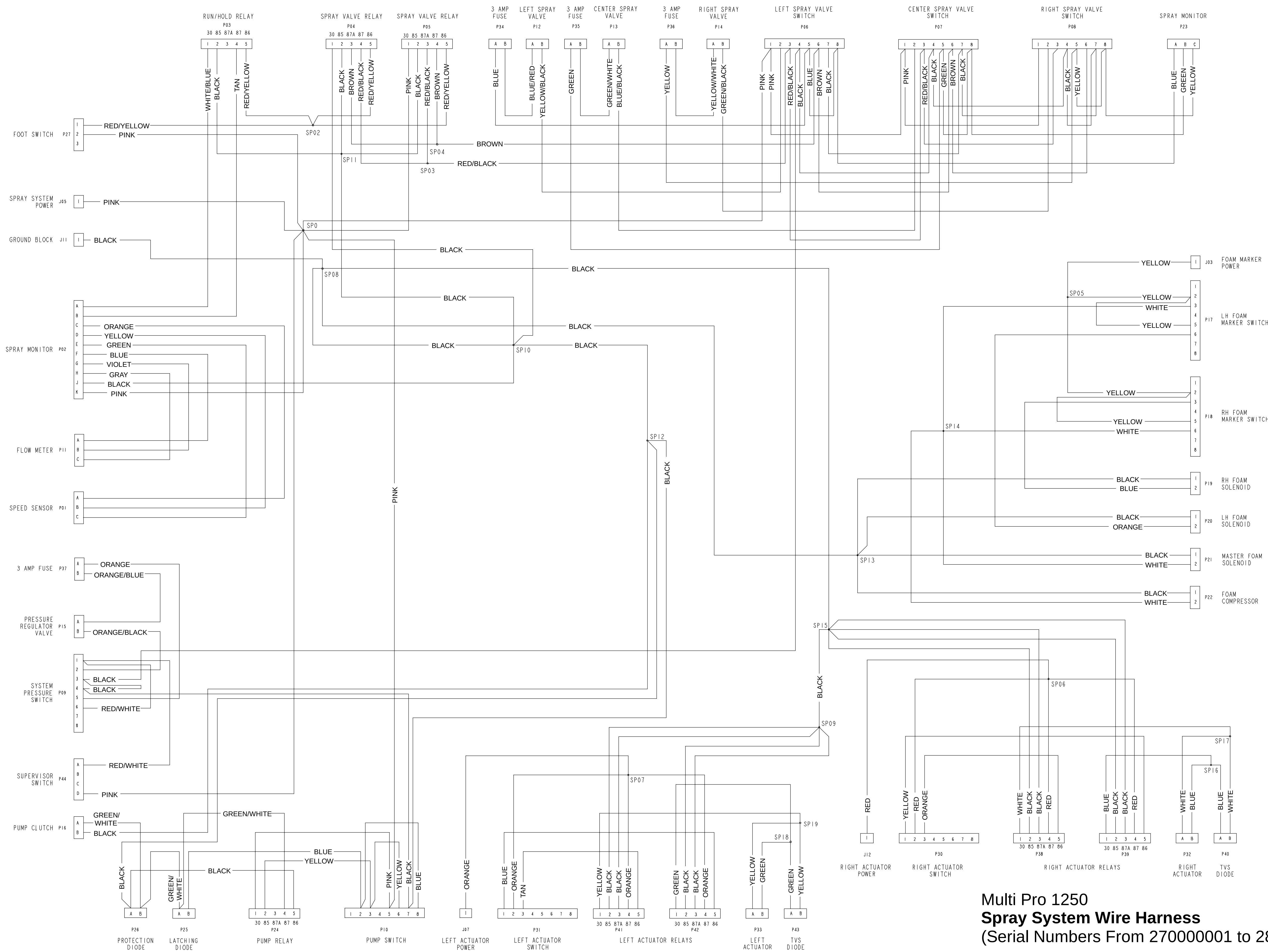
Multi Pro 1250

Spray System Wire Harness

(Serial Numbers From 260000001 to 260999999)



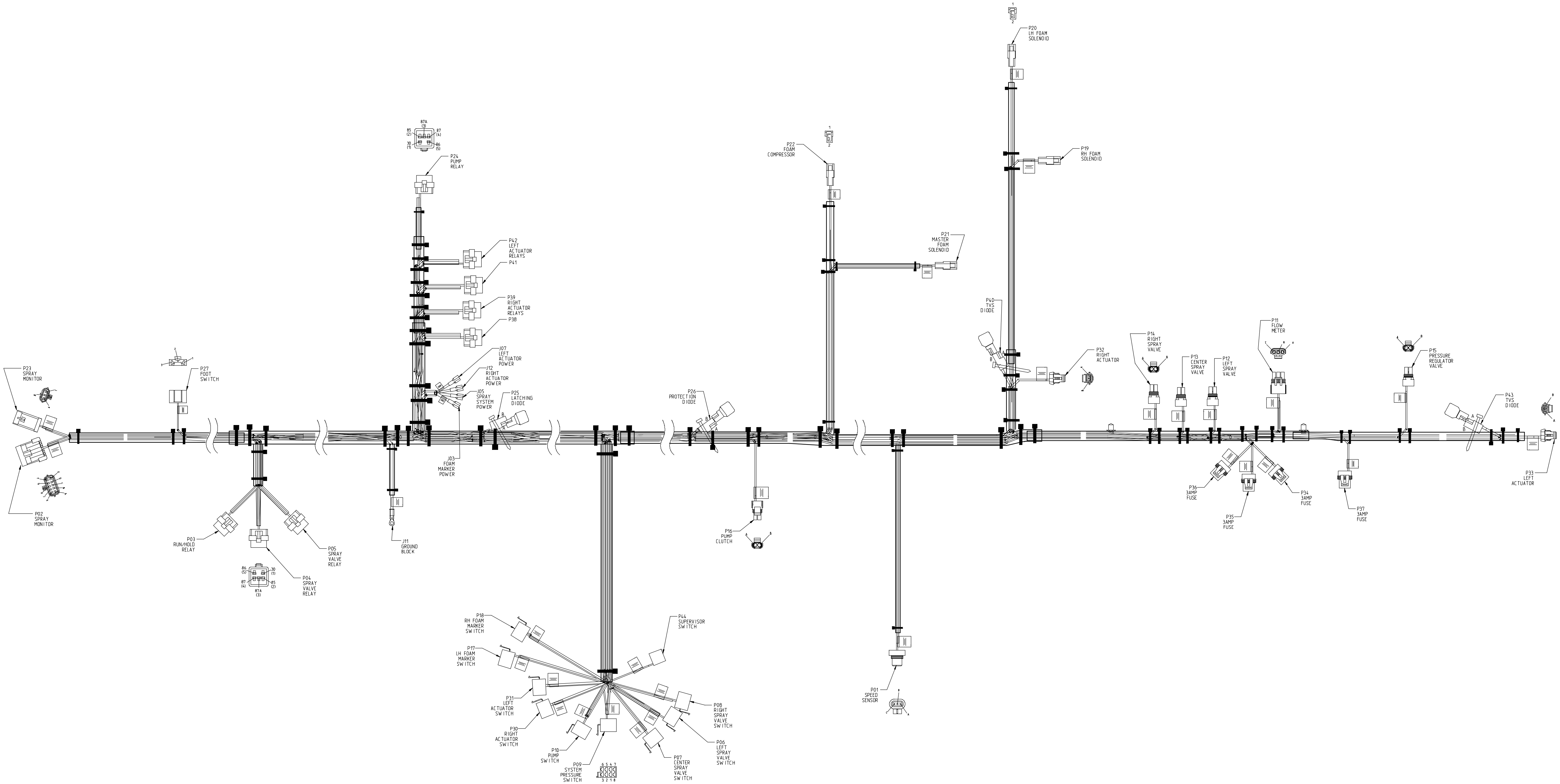
Multi Pro 1250
Spray System Wire Harness
(Serial Numbers From 260000001 to 260999999)



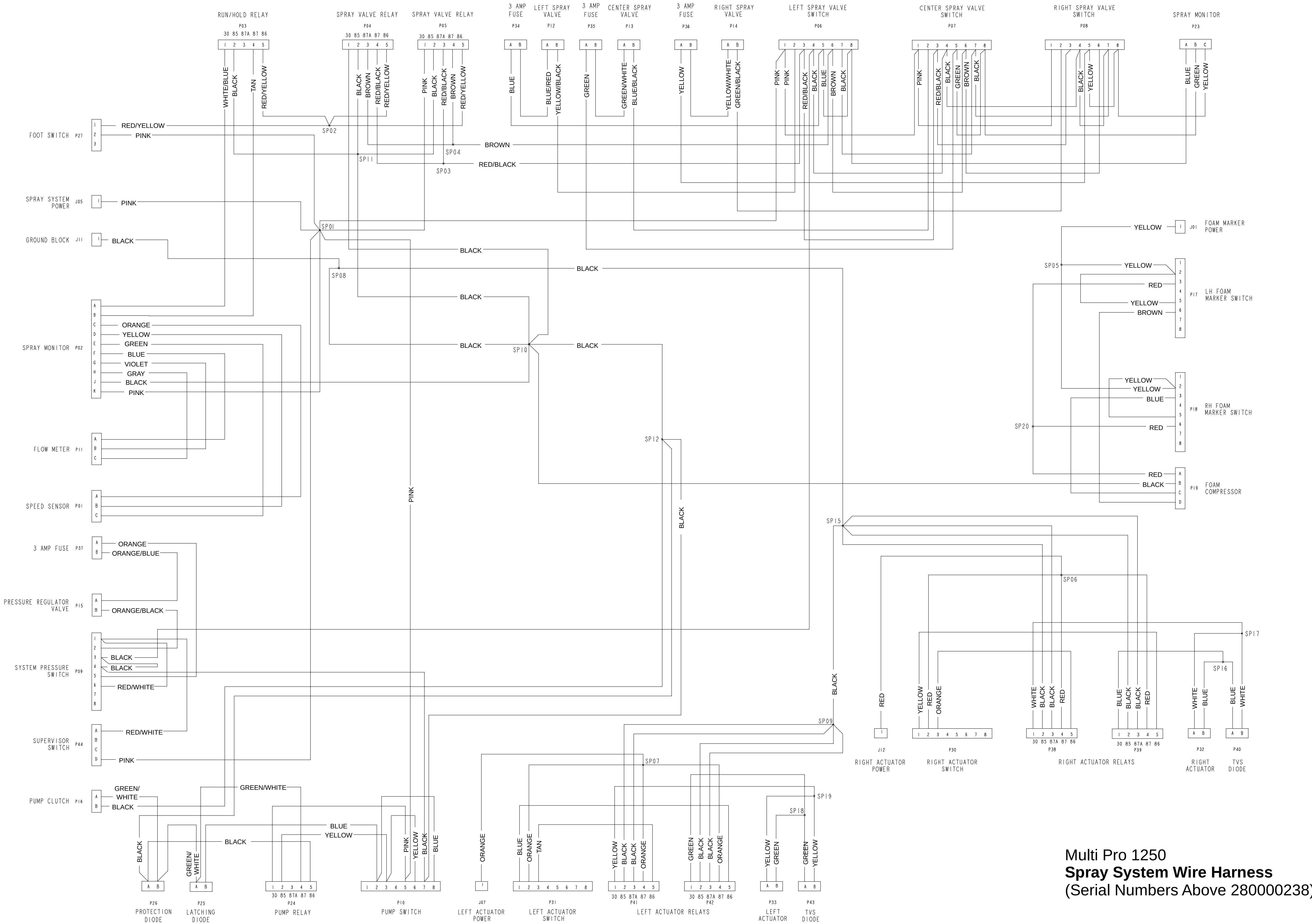
Multi Pro 1250

Spray System Wire Harness

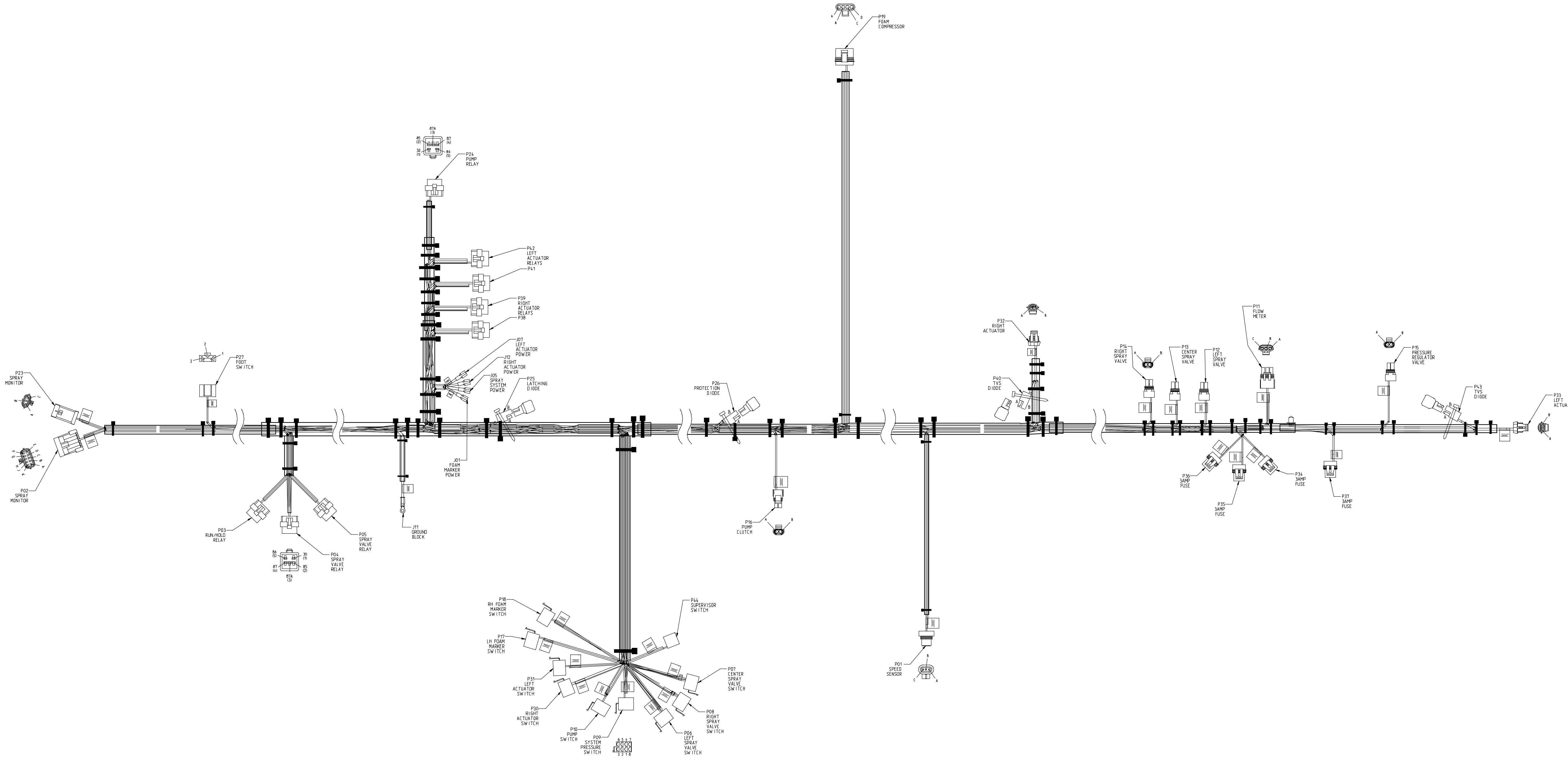
(Serial Numbers From 270000001 to 280000237)



Multi Pro 1250
Spray System Wire Harness
(Serial Numbers From 270000001 to 280000237)



Multi Pro 1250
Spray System Wire Harness
(Serial Numbers Above 280000238)



Multi Pro 1250
Spray System Wire Harness
(Serial Numbers Above 280000238)

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