Part No. 08164SL (Rev. A)

Service Manual

Workman® MDE

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 Workman MDE.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manual and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manual and Parts Catalog 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 Workman MDE is 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. Review and understand the contents of the Operator's Manual and Operator's DVD before starting and operating the vehicle. Become familiar with the controls and know how to stop the vehicle and engine quickly. Additional copies of the Operator's Manual are 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.

While Operating

WARNING

The Workman MDE is an off-highway vehicle only. It is not designed, equipped or manufactured for use on public streets, roads or highways.

1. Sit on the operator seat when starting and operating the vehicle.

2. Before starting the vehicle:

   A. Make sure that the battery charger is disconnected from the vehicle charger receptacle.

   B. Engage the parking brake.

   C. Make sure accelerator pedal is not depressed.

   D. Check position of forward/reverse switch and Hi/Low speed switch.

3. Before getting off the operator seat:

   A. Stop vehicle, turn on/off switch OFF and remove key from switch.

   B. Apply the parking brake.

4. If vehicle is parked on incline, chock or block the wheels after getting off the vehicle.

Maintenance and Service

1. Before servicing or making adjustments to the vehicle, stop vehicle, turn on/off switch to OFF, engage parking brake and remove key from the on/off switch.

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

3. Do not use open pans of flammable cleaning fluids for cleaning parts.

4. Keep battery area free of excessive grease, grass, leaves and dirt.

5. Disconnect batteries before servicing the machine. Carefully remove one of the battery cables from the battery pack as the first step in any repair. Once a battery cable has been removed, the electrical system on the vehicle can be safely worked on. Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened with the cable removal. Reattach the removed cable to the battery pack as the last step in any repair.

6. When using metal, uninsulated tools around batteries, do not allow tools to contact both positive and negative battery terminals simultaneously.

7. Remove jewelry and watches before servicing electrical components of the vehicle.

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

9. Battery gases can explode. Keep cigarettes, sparks and flames away from the batteries. Always service, store and charge the vehicle batteries in a well ventilated area.

10. Never use an open flame to check level or leakage of battery electrolyte.

11. When connecting the battery charger to the vehicle, connect the charger cord to the vehicle charger receptacle before plugging the charger power cord into an outlet. After charging the vehicle batteries, unplug the charger power cord from the outlet before disconnecting the charger cord from the vehicle charger receptacle.

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

13. 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 nonconformance with safety standards and the warranty may be voided.

14. When raising the machine to change tires or to perform 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 to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in the Operator's Manual and in this Chapter).

Jacking and Other Instructions

Jacking Vehicle

DANGER

POTENTIAL HAZARD
- **A vehicle that is not properly supported may become unstable.**

WHAT CAN HAPPEN
- **The vehicle may move or fall. Personal injury or damage to the machine may result.**

HOW TO AVOID THE HAZARD
- **Make sure vehicle is parked on a solid level surface, such as a concrete floor.**
- **Make sure on/off switch is OFF and key is removed from the switch before getting off the vehicle.**
- **Before raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle.**
- **Always chock or block wheels to prevent the vehicle from rolling.**
- **Make sure proper hoists and jack stands are used to raise and support the vehicle.**

Jacking Locations

1. Jack front of the vehicle on the front of the frame behind the towing tongue (Fig. 1).

2. Jack rear of the vehicle under each rear axle tube. Do not jack vehicle below the transaxle case (Fig. 2).

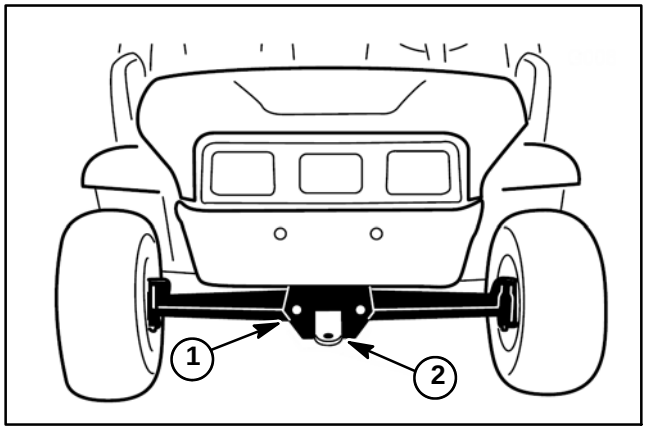

Figure 1

1. **Front frame**
2. **Towing tongue**

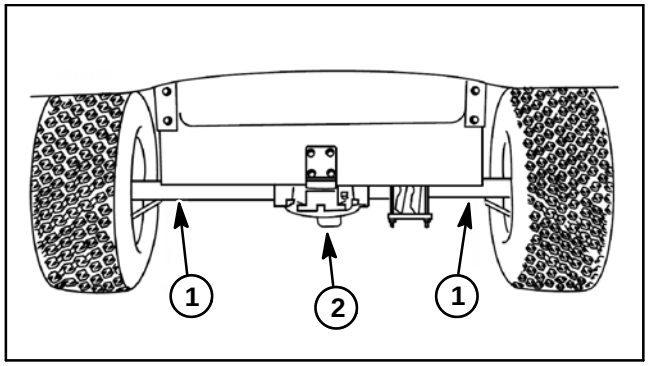

Figure 2

1. **Rear axle tube**
2. **Transaxle case**

Towing Vehicle

IMPORTANT: Frequent or long distance towing of the Workman MDE is not recommended.

In case of emergency, the vehicle can be towed for a **short** distance. See Operator's Manual for towing information.

IMPORTANT: If vehicle is towed, make sure that on/off switch is in the OFF position and key is removed from switch.

Transporting Vehicle

When moving the vehicle long distances, use a trailer or flatbed truck. Make sure vehicle is secured to the trailer properly. See Operator's Manual for transport information.

Safety and Instruction Decals

There are several safety and instruction decals attached to your Workman vehicle. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in the Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

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Chapter 2

Product Records and Maintenance

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Product Records

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

Maintenance

Maintenance procedures and recommended service intervals for the Workman MDE are covered in the Operator's Manual. Refer to that publication when performing regular vehicle maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

1 mm = 0.03937 in. **0.001 in. = 0.0254 mm**

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. 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 (e.g. Nylock nut), hardness of the surface underneath the fastener's head or similar condition which affects the installation.

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

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

Fastener Identification

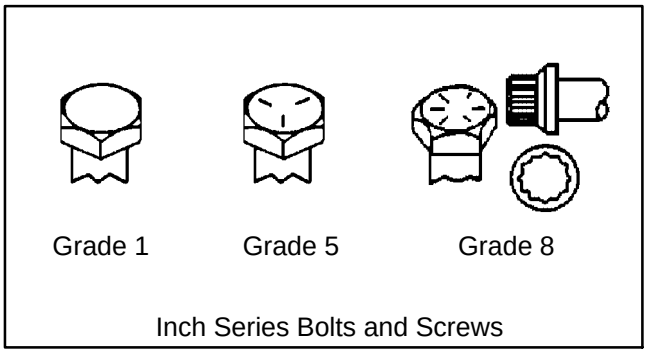

Figure 1

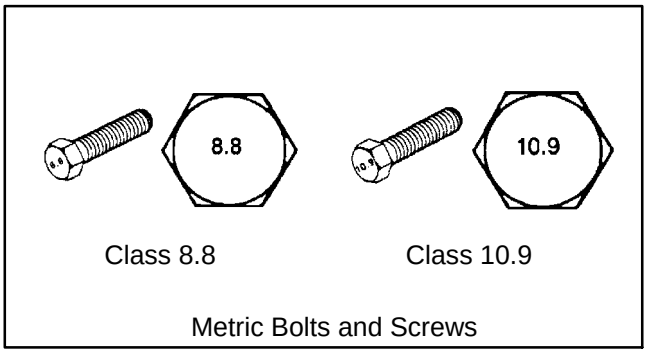

Figure 2

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

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	**in-lb**	**N-cm**	**in-lb**	**N-cm**	**in-lb**	**N-cm**
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 - 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 - 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 - 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 - 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 - 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	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 ± 5	58 ± 7
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
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 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 - 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 - 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 - 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 - 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 - 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 - 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
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 ± 48	644 ± 65	667 ± 66	904 ± 89

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 engine oil 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 Series)

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 ± 6 in-lb	644 ± 68 N-cm	78 ± 8 in-lb	881 ± 90 N-cm
M6 X 1.0	96 ± 10 in-lb	1085 ± 113 N-cm	133 ± 14 in-lb	1503 ± 158 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	28 ± 3 ft-lb	38 ± 4 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	54 ± 6 ft-lb	73 ± 8 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	93 ± 10 ft-lb	126 ± 14 N-m
M16 X 2.0	166 ± 17 ft-lb	225 ± 23 N-m	229 ± 23 ft-lb	310 ± 31 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 46 ft-lb	610 ± 62 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 engine oil 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

Chapter 3

Electrical System

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General Information

The Workman MDE uses a 48 volt DC electrical system that is an isolated circuit. The vehicle frame is not used for any ground connections.

The vehicle controller monitors operator and vehicle inputs to determine voltage to the traction motor. If a problem exists that will prevent normal vehicle operation, an LED on the controller and the vehicle status light on the dash panel will flash a fault code to assist in identifying the problem.

After performing any repair on electrical components on the vehicle, make sure that wiring is routed and secured so as to prevent abrasion or contact with moving parts.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

Opening Battery Circuit

To prevent allowing a current path through tools used during vehicle electrical circuit repairs, remove one of the battery cables from the battery pack as the first step in any repair (Fig. 1). Once a cable has been removed, the electrical system on the vehicle can be safely worked on. Take care during repairs, however, to not allow tools or vehicle components to complete the battery circuit that was opened with the cable removal.

Reattach the removed cable to the battery pack as the last step in any repair. Secure cable on each battery terminal with lock washer and nut. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

Battery pack cable routing is shown in Figure 2.

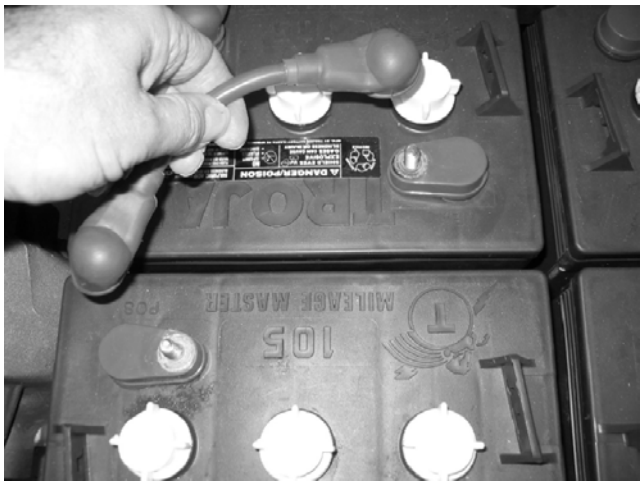

Figure 1

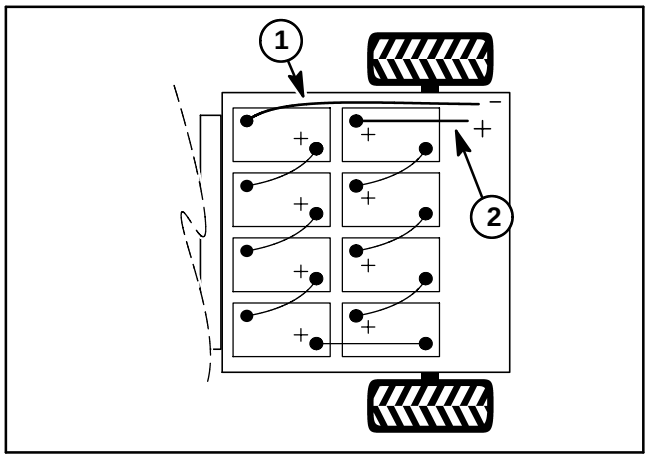

Figure 2

1. Negative cable to vehicle 2. Positive cable to vehicle

Electrical Diagrams

The electrical schematic, circuit drawings and wire harness drawings for the Workman MDE are located in Chapter 6 – Electrical Diagrams.

Vehicle Operation

The Workman MDE electrical system uses a 48 volt battery pack, an electric traction motor, a vehicle controller and numerous other electrical components to allow vehicle operation.

Eight, 6 volt, deep cycle batteries that are connected in series provide current for a 48 volt DC, high torque traction motor, the vehicle controller and vehicle accessories (headlights, horn, various optional accessories). The batteries are discharged as the vehicle is used so charging the batteries after using the vehicle is necessary. A battery discharge indicator gauge on the dash provides the operator with information on battery charge level. Demands on the vehicle during use (speed, payload, incline use), battery condition (age, charge level), ambient temperature and vehicle condition will all put constraints on how long a vehicle can be used before the batteries are discharged.

An automatic, 115 VAC (230 VAC on international models) battery charger is included with the vehicle. An interlock switch on the vehicle charger receptacle prevents the vehicle from operating when the charger cord is plugged into the vehicle.

The electric traction motor directly drives a double reduction transaxle with differential. Operator inputs for forward/reverse, supervisor switch position (high or low speed) and accelerator pedal position are used by the controller to determine voltage to the traction motor.

The traction motor is cooled with an external fan. Additionally, the motor is protected from overheating by a thermal switch in the motor housing. If unsafe motor temperature is sensed by the switch, the controller is signaled to limit vehicle speed and torque until the motor temperature reduces to a normal level.

The vehicle controller is a sealed electronic logic device that uses inputs from several vehicle components to control motor speed and direction. These inputs include several switches (on/off, forward/reverse, accelerator, supervisor, charger), a motor temperature sensor, an accelerator pedal potentiometer and the vehicle contactor (solenoid). The controller also provides regenerative braking to assist in slowing the vehicle. The controller has fault detection capabilities to help identify system problems. Battery current is available to the controller whenever the on/off switch is ON which energizes the main contactor. A high current fuse protects this high current circuit.

The Workman controller also provides a roll off warning in instances when the vehicle begins to move (roll away) after being stopped. On an incline and with the on/off switch in the ON position, if the vehicle starts moving, the alarm will sound warning the operator that the vehicle is moving. When the vehicle goes into this roll–off mode, regenerative braking will limit vehicle speed.

Vehicle accessories include headlights, horn and optional electrical equipment. The accessories contactor (solenoid) on the vehicle provides battery current to these components when the on/off switch is ON. Fuses provide circuit protection for these accessories.

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.

NOTE: Workman MDE vehicles use a 48 volt, DC electrical system. If multimeter is not of the auto–range type, make sure to properly set multimeter range before performing any voltage test.

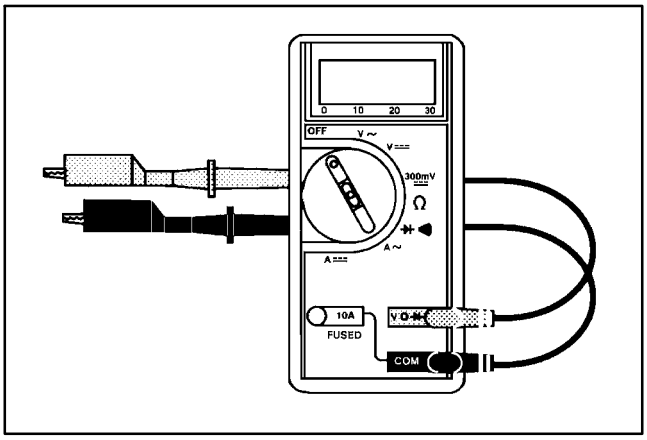

Figure 3

Battery Terminal Protector

Battery Terminal Protector is an aerosol spray that should be used on all battery and controller terminals to reduce corrosion problems. Apply terminal protector after cable has been secured to terminal.

Toro Part Number: **107-0392**

Figure 4

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Toro Part Number: **107-0342**

Figure 5

Battery Watering Dispenser

Use the battery watering dispenser when adding distilled water to vehicle batteries.

Toro Part Number: **TOR4102**

Figure 6

Battery Hydrometer

Use the battery hydrometer when measuring specific gravity of battery electrolyte. Obtain hydrometer locally.

Figure 7

Battery Lift Strap

Use the battery lift strap to remove and install batteries from the vehicle. Lift strap allows use of case loops on battery tops as safe battery lifting points. Obtain battery lift strap locally.

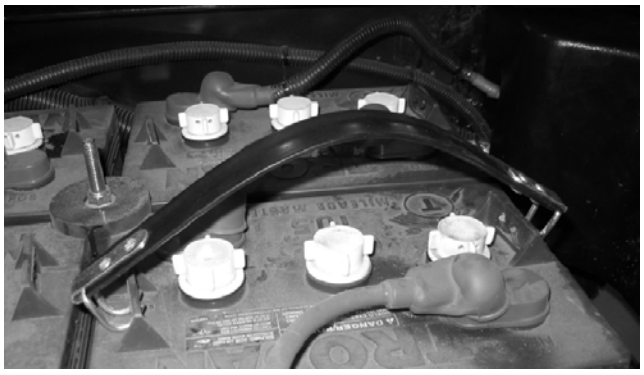

Figure 8

36/48 Volt Battery Discharge Unit

The 36/48 Volt Battery Discharge Unit is recommended for quick and accurate load testing for the batteries on the Workman MDE. This tool is used to determine the capacity of the Workman battery pack and also for finding a faulty battery (or batteries) in the battery pack.

Toro Part Number: **TOR4106**

Figure 9

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect a battery cable from the battery pack to open the battery circuit unless a test procedure requires battery voltage.

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this vehicle (see Electrical Schematic in Chapter 6).

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

General Run Problems

NOTE: Check vehicle status light on dash panel and controller LED for possible faults whenever diagnosing vehicle problems (see Controller in the Component Testing section of this chapter).

Problem	Possible Causes
Main contactor clicks, but vehicle will not operate.	Battery charge is low. Battery cables are loose, corroded or damaged. Cable connection(s) at controller is/are loose or corroded. Cable connection(s) at traction motor is/are loose or corroded. Traction motor is faulty. Controller is faulty.
Nothing happens when on/off switch is turned to ON.	Battery charge is extremely low. Battery cables are loose, corroded or damaged. Cable connection(s) at controller is/are loose or corroded. 10 ampere fuse (F2) to the on/off switch is loose or blown. Fusible link FL2 is faulty. Main fuse (F1) is loose or blown. The on/off switch or circuit wiring is faulty. Controller is faulty.

General Run Problems (Continued)

Problem	Possible Causes
Traction motor stops during operation.	Wiring to the traction motor components (e.g. main contactor, controller, traction motor) loose, corroded or damaged (see Electrical Schematic in Chapter 6 – Electrical Diagrams). Battery cables are loose, corroded or damaged. Controller is overheated. Traction motor is overheated. Traction motor is faulty. Brake or transaxle problem (see Chapter 4 – Transaxle and Brakes).
Vehicle runs slowly.	Supervisor speed limit switch in slow position. Tire pressure is low (see Chapter 5 – Chassis). Brakes improperly adjusted (see Chapter 4 – Transaxle and Brakes). Battery charge is extremely low. Controller is overheated. Traction motor is overheated.
Vehicle movement is erratic or jerky.	Collar on throttle is loose. Accelerator potentiometer is improperly adjusted. Accelerator system is out of adjustment.

Battery Charger Operation

Light Status	Indicates
Green light on battery charger illuminated (not flashing).	Batteries is fully charged. Vehicle ready to operate.
Green light on battery charger flashing.	Slow flash (once per second): Batteries being charged (batteries less than 80% charged). Continue charging. Rapid flash (four times per second): Batteries being charged (batteries more than 80% charged). Continue charging.
Red light on battery charger flashing.	Rapid flash: Charger timer shutoff has occurred after 20 hours of charging. Slow flash: No current to charger. Check AC outlet.

Battery Charger Problems

Problem	Possible Causes
Battery charger does not turn on.	AC outlet fuse/circuit breaker blown. AC outlet is faulty. Vehicle wiring is loose or damaged (see electrical schematic in Chapter 6 – Electrical Diagrams). Fusible link FL1 is faulty. Vehicle charger interlock switch or circuit wiring faulty. Vehicle charger receptacle or circuit wiring damaged. Battery charger is faulty.
Battery charger does not turn off.	Battery charger is faulty. NOTE: Charging new batteries or charging batteries in cold temperatures may require extended charge time to achieve full charge.
Battery charger fuse blows.	Vehicle battery polarity is reversed (vehicle battery cables incorrectly attached). Vehicle charger receptacle polarity is reversed. Battery charger is faulty.
The AC outlet circuit breaker or fuse blows when using the battery charger.	Overloaded AC circuit. Battery charger is faulty.

Accelerator Switch Adjustment

1. Position vehicle on a level surface, turn on/off switch OFF and remove key.

2. With the accelerator pedal released, check that the distance between the head of the accelerator switch stop cap screw and the body of the switch is 5/8 inch (15.9 mm) (Fig. 12).

3. If distance is incorrect, loosen lock nut and adjust accelerator switch stop cap screw position (Fig. 11).

4. After adjustment, make sure that switch plunger is not bottomed out when accelerator pedal is released.

5. Calibrate accelerator system after adjusting accelerator switch (see Accelerator System Calibration in this section).

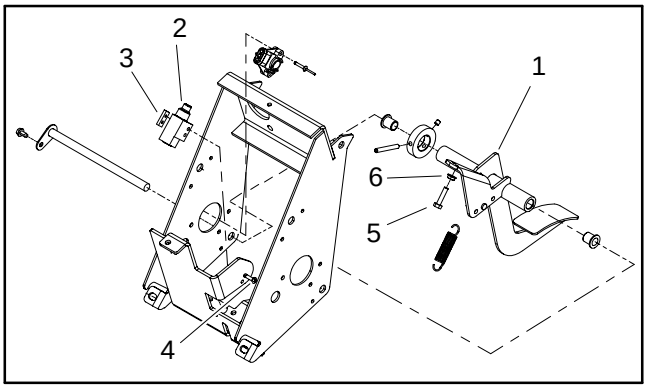

Figure 10

1. Accelerator pedal
2. Accelerator switch
3. Plate
4. Screw (2 used)
5. Switch stop cap screw
6. Lock nut

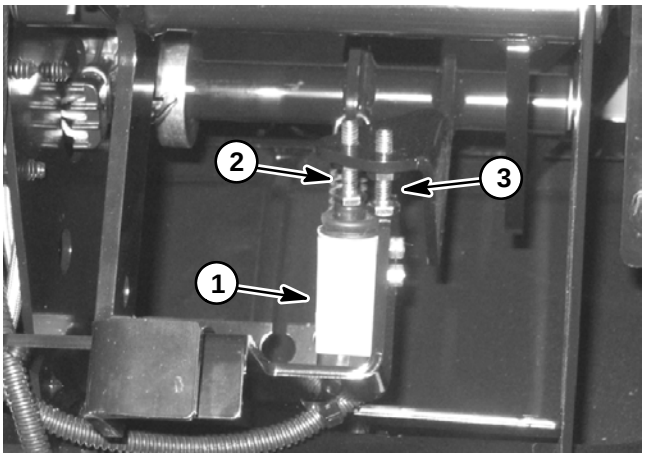

Figure 11

1. Accelerator switch
2. Switch stop cap screw
3. Accelerator stop cap screw

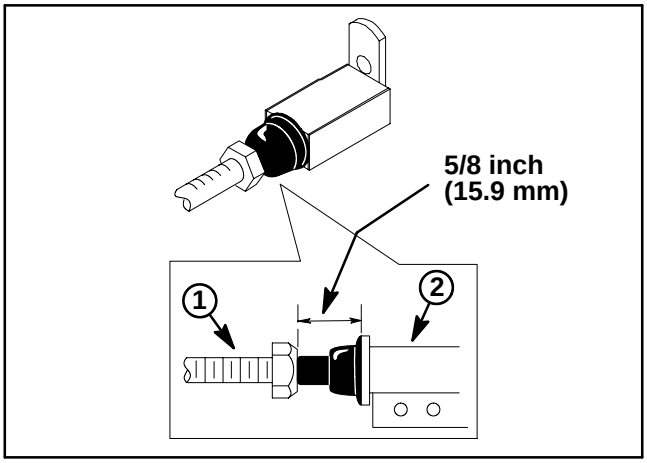

Figure 12

1. Switch stop cap screw
2. Accelerator switch

Accelerator Potentiometer Adjustment (Potentiometer with Short Lever)

NOTE: The following adjustment procedure should be used on vehicles that have a potentiometer that includes a short lever (Figure 14). If potentiometer has a long lever, use the procedure on the following page.

The accelerator potentiometer is used as one of the inputs for the vehicle controller and is attached to the pedal frame under the dash (Fig. 13). A collar with roll pin on the accelerator pedal shaft positions the accelerator potentiometer lever. Potentiometers with a short lever use a roll pin that extends approximately 1 1/2 inches (38 mm) out of the collar.

If the accelerator potentiometer is out of adjustment, the diagnostic light on the dash will flash six (6) times. Additionally, if vehicle movement is erratic and jerky, potentiometer adjustment and calibration of the accelerator system should be performed.

Adjustment

1. Position vehicle on a level surface, turn on/off switch OFF and remove key. Make sure that accelerator potentiometer is securely attached to the pedal frame of the machine.

2. Check accelerator switch adjustment and adjust if necessary (see Accelerator Switch Adjustment in this section).

3. Check movement of the potentiometer lever:

   A. With the accelerator pedal released, the roll pin on the throttle position collar should keep the potentiometer lever from 0.050" to 0.100" (1.3 to 2.5 mm) from the lower stop on the potentiometer body (Figure 14).

   B. With the accelerator pedal fully depressed, the input lever of the potentiometer should not contact the upper stop on the potentiometer body (Figure 15).

4. If potentiometer lever movement is incorrect, adjust location of collar on accelerator pedal shaft:

   A. Loosen two (2) set screws that secure throttle position collar to throttle pedal shaft and reposition collar to allow correct potentiometer movement. Make sure that there is clearance between roll pin and side of potentiometer lever to prevent binding.

   B. Remove set screws one at a time from collar and apply Loctite #242 (or equivalent) to set screw threads. Install and tighten set screws to secure collar to accelerator pedal shaft.

   C. Recheck potentiometer lever movement.

5. Calibrate accelerator system after any accelerator potentiometer adjustment (see Accelerator System Calibration in this section).

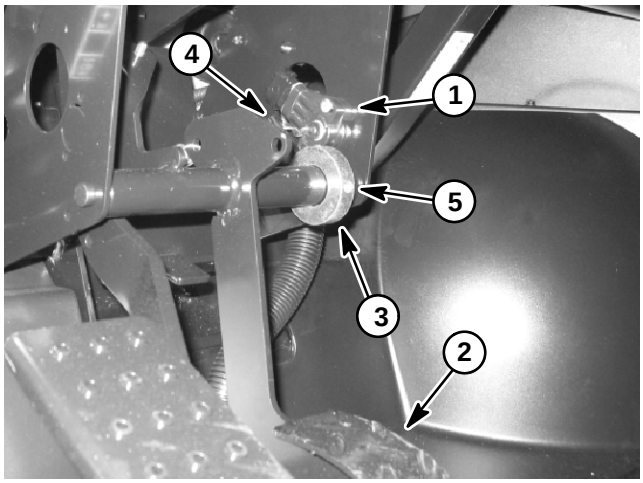

Figure 13

1. **Potentiometer**
2. **Accelerator pedal**
3. **Throttle position collar**
4. **Roll pin**
5. **Set screw (2 used)**

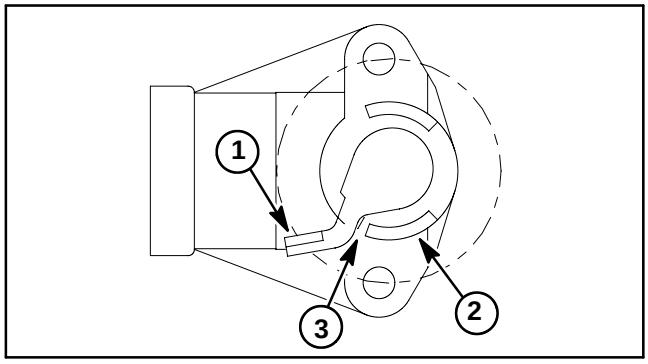

Figure 14

1. **Potentiometer lever (accelerator pedal released)**
2. **Potentiometer lower stop**
3. **Gap of 0.050" to 0.100" (1.3 to 2.5 mm)**

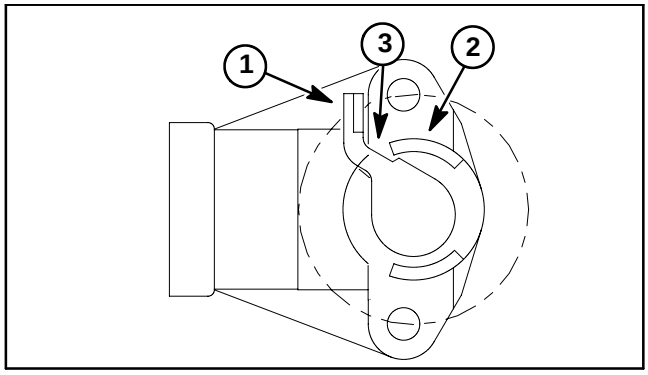

Figure 15

1. **Potentiometer lever (accelerator pedal fully depressed)**
2. **Potentiometer upper stop**
3. **No lever contact with stop**

Accelerator Potentiometer Adjustment (Potentiometer with Long Lever)

NOTE: The following adjustment procedure should be used on vehicles that have a potentiometer with a long lever (Figure 15.1). If potentiometer has a short lever, use the procedure on the preceding page.

The accelerator potentiometer is used as one of the inputs for the vehicle controller and is attached to the pedal frame under the dash (Fig. 15.2). A collar with roll pin attached to the accelerator pedal shaft positions the accelerator potentiometer lever. Potentiometers with a long lever use a roll pin that extends approximately 3 inches (76 mm) out of the collar.

If the accelerator potentiometer is out of adjustment, the diagnostic light on the dash will flash six (6) times. Additionally, if vehicle movement is erratic and jerky, potentiometer adjustment and calibration of the accelerator system should be performed.

Adjustment

1. Position vehicle on a level surface, turn on/off switch OFF and remove key. Make sure that accelerator potentiometer assembly is securely attached to the pedal frame of the machine.

2. Check accelerator switch adjustment and adjust if necessary (see Accelerator Switch Adjustment in this section).

3. With the accelerator pedal released, inspect location of roll pin on throttle position collar and potentiometer lever. The roll pin should just contact the potentiometer lever without rotating the lever (Figure 15.2).

4. If necessary, adjust location of collar on accelerator pedal shaft so that roll pin is properly positioned:

   A. Loosen two (2) set screws that secure throttle position collar to throttle pedal shaft and reposition collar so that roll pin on the throttle position collar just contacts the potentiometer lever without rotating the lever. Make sure that there is clearance between roll pin and side of potentiometer lever to prevent binding.

   B. Remove set screws one at a time from collar and apply Loctite #242 (or equivalent) to set screw threads. Install and tighten set screws to secure collar to accelerator pedal shaft.

   C. Recheck potentiometer lever movement.

5. Calibrate accelerator system after any accelerator potentiometer adjustment (see Accelerator System Calibration in this section).

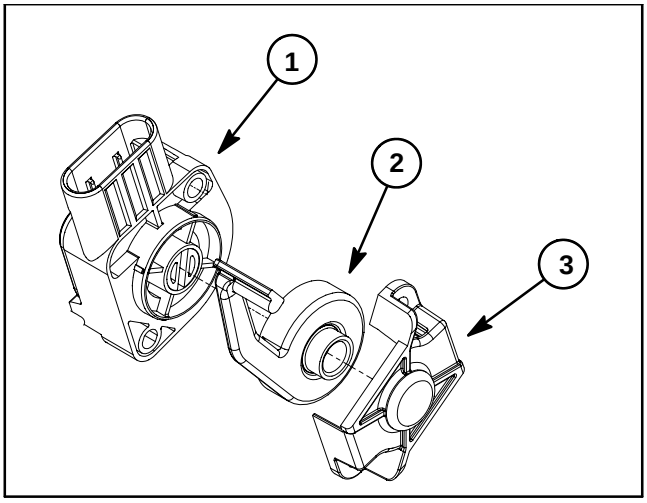

Figure 15.1

1. **Potentiometer**
2. **Lever**
3. **Retainer**

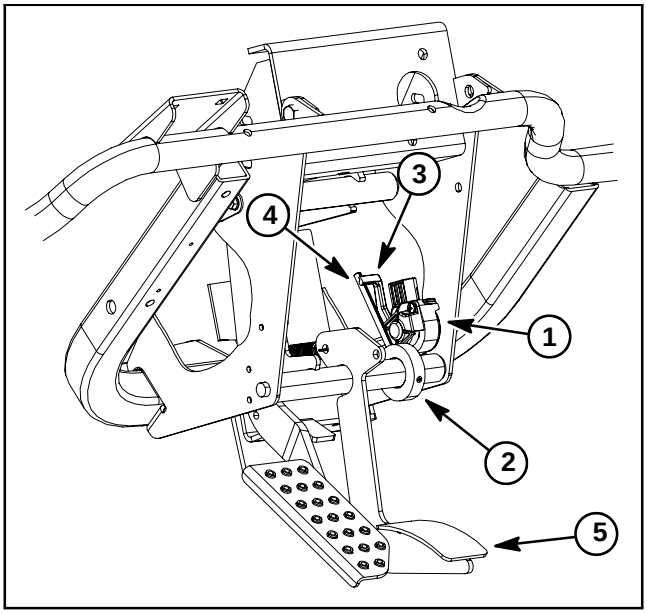

Figure 15.2

1. **Potentiometer**
2. **Collar**
3. **Lever**
4. **Roll pin**
5. **Accelerator pedal**

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Accelerator System Calibration

The accelerator system on the Workman MDE includes the accelerator pedal assembly, the accelerator potentiometer, the accelerator switch and the controller. If any of these components are adjusted, removed or replaced, the following calibration procedure should be performed. Additionally, if vehicle movement is erratic, jerky or if the diagnostic light on the dash is flashing six (6) times, calibration of the accelerator system should be performed.

1. Position vehicle on a level surface, turn on/off switch OFF and remove key. Raise box and secure with prop rod. Remove controller cover.

2. Check accelerator switch adjustment and adjust if necessary (see Accelerator Switch Adjustment in this section).

3. Check accelerator potentiometer adjustment and adjust if necessary (see Accelerator Potentiometer Adjustment in this section).

4. Using a jumper wire, connect gray controller lead to ground post (B–) on controller (Fig. 16).

NOTE: During calibration, the vehicle status light on the dash should flash the same as the controller LED.

5. Turn on/off switch ON. The alarm should sound and the controller LED should flash six (6) times.

6. Slowly depress accelerator pedal until the alarm momentarily stops and hold pedal in position. This should take a very small movement of the pedal. Once alarm resumes, release accelerator pedal completely.

7. Depress and hold accelerator pedal fully. Alarm will momentarily stop while controller calibration occurs. Hold pedal fully depressed until alarm resumes and then release pedal.

8. If calibration process was successful, alarm will chirp and diagnostic light on the dash will be lit continuous (not flashing). If alarm continues to sound or if diagnostic light is flashing, turn on/off switch OFF and repeat steps 5, 6 and 7.

9. Turn on/off switch OFF and remove key. Disconnect jumper wire from gray controller lead and controller ground post (B–).

10. Install controller cover and lower box.

11. If vehicle operation continues to be erratic after completing the accelerator system calibration procedure, evaluate the components in the accelerator system: accelerator switch, accelerator potentiometer, accelerator pedal, circuit wiring and controller.

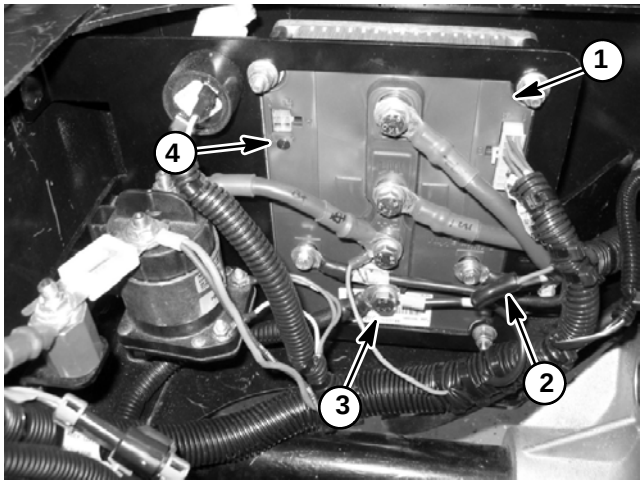

Figure 16

1. Controller
2. Gray controller lead
3. Ground post (B–)
4. Controller LED

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. disconnect the harness wire connectors from the vehicle on/off switch before doing a continuity check on the on/off switch).

CAUTION

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

On/Off Switch

The Workman on/off switch is located on the dash panel (Fig. 17). The switch has two (2) positions (OFF and ON) and three (3) switch terminals. Only two of the terminals are used on the Workman MDE. The switch terminals are positioned as shown in Figure 18.

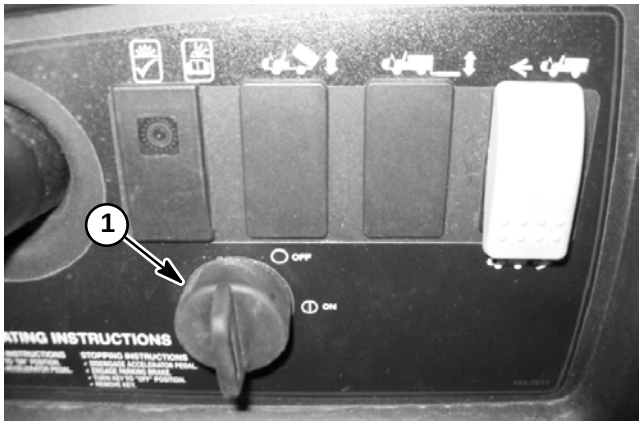

Figure 17

1. On/Off switch

Testing

CAUTION

When testing the on/off switch for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

When the on/off switch is in the OFF position, no continuity should exist between the common (center) switch terminal and the switched (side) terminal. In the ON position, continuity should exist between the common (center) switch terminal and the switched (side) terminal.

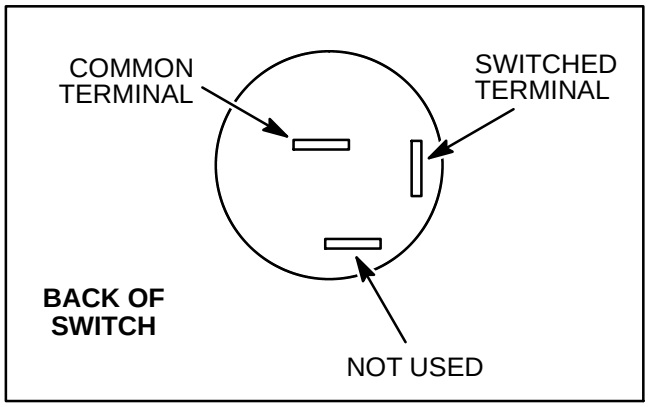

Figure 18

Battery Discharge Indicator and Hour Meter Gauge

The combination battery discharge indicator and hour meter gauge is located on the dash panel (Fig. 19).

The battery indicator identifies state of charge of the battery pack. The battery indicator reads full (10 bars) when the battery pack is fully charged (approximately 51 volts). As battery pack voltage decreases with vehicle use, fewer battery indicator bars are shown.

When the battery indicator reaches 2 bars, a warning light illuminates and a battery icon flashes on the gauge face to identify that battery charge level is extremely low. At this point, the batteries should be charged.

If the battery indicator reaches 1 bar, the warning light begins flashing and the vehicle will go into an energy saving mode: vehicle speed will be reduced to 3 MPH. At this point, the batteries should be charged to prevent serious battery damage.

The hour meter registers operating time of the vehicle. Whenever the vehicle is in motion, the hour meter should increase one tenth every six (6) minutes of operation. If the vehicle remains stationary for thirty (30) seconds (even if the on/off switch is ON), the hour meter quits increasing.

The back of the gauge is shown in Figure 20. A wire harness connector plugs into the gauge. Terminals 1, 2 and 5 are not used on the Workman MDE. See Chapter 6 – Electrical Diagrams for schematic and wire harness information.

If the battery discharge indicator or the hour meter prove to be inaccurate, the gauge should be replaced.

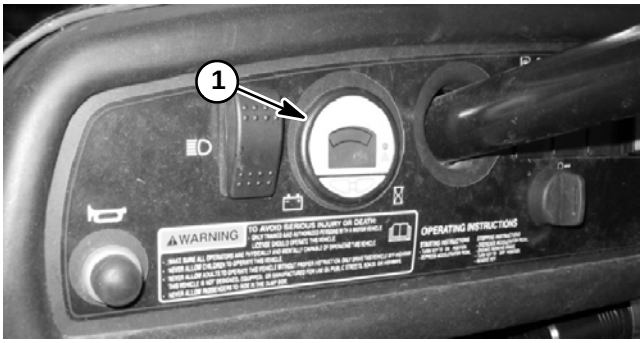

Figure 19

1. Battery discharge indicator and hour meter

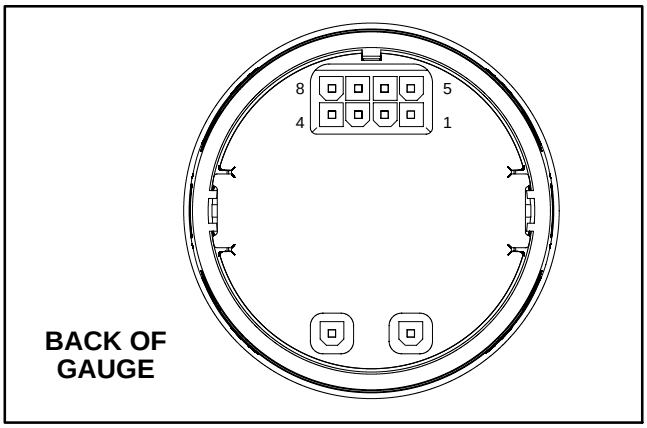

Figure 20

Vehicle Direction (Forward/Reverse) and Headlight Switches

The vehicle direction (forward/reverse) switch (Fig. 21) and headlight switch (Fig. 22) are located on the control panel. These two switches have identical logic.

The vehicle direction switch is one of several inputs for the vehicle controller and allows the direction (forward/reverse) of the vehicle to be changed by the operator.

The headlight switch allows the headlights to be turned on and off.

NOTE: The headlight system on the Workman MDE consists of two (2) 24 volt lamps connected in series. If one lamp is burned out or disconnected, neither lamp will illuminate.

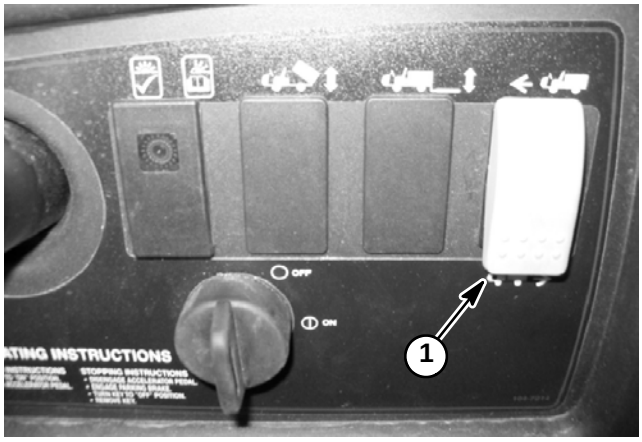

Figure 21

1. **Direction switch**

Testing

The switch terminals for these switches are marked as shown in Figure 23. The circuitry of the switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

Figure 22

1. **Headlight switch**

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF / FORWARD	1 + 2	4 + 5
ON / REVERSE	2 + 3	5 + 6

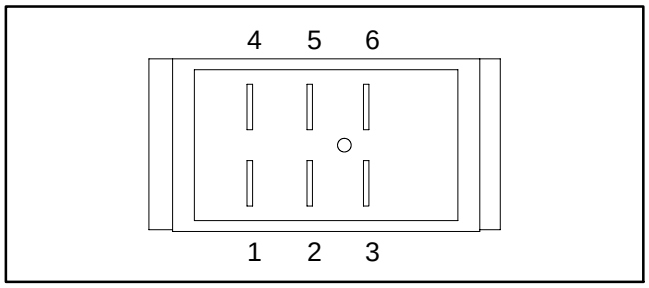

Figure 23

Vehicle Status Light

The vehicle status light is located on the control panel (Fig. 24). During normal operation, the status light should be continuously illuminated. A vehicle electrical problem will be identified by a flashing status light.

The vehicle status light and LED on the vehicle controller should have the same condition (off, illuminated or flashing). If the vehicle status light does not illuminate when the on/off switch is turned ON, check the LED on the vehicle controller to make sure it is illuminated. If the controller LED is illuminated and the vehicle status light is not illuminated, check the vehicle status light and circuit wiring.

See Controller (in this section) and your Operator's Manual for information on a flashing vehicle status light.

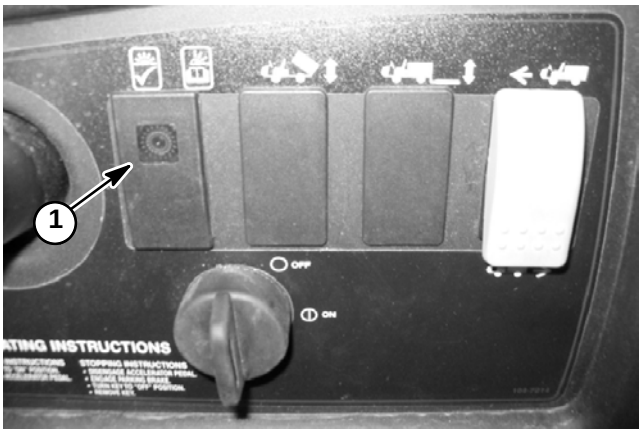

Figure 24

1. Vehicle status light

Testing

1. Make sure on/off switch is turned OFF. Remove key from switch.

2. Disconnect wire harness from vehicle status light.

IMPORTANT: The vehicle status light is a 12 volt DC component. Do not test the light using jumper wires from the vehicle battery pack (48 VDC).

3. The terminals for the light are marked as shown in Figure 25. Correctly connect 12 VDC source to the light terminals.

4. Light should illuminate. Remove voltage source from the light and reconnect wire harness. Replace status light if needed.

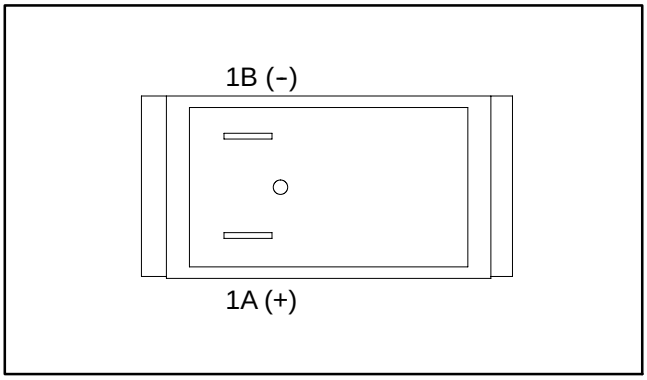

Figure 25

Supervisor Speed Limit Switch

The supervisor speed limit switch is open in OFF position (key vertical) and closed in ON position (key rotated clockwise). The speed limit switch is one of several inputs for the vehicle controller and allows the speed of the vehicle to be limited.

Test the switch by disconnecting the wiring and connecting a continuity tester across switch terminals A and D (Fig. 26). Rotate key to ON position: there should be an indication of continuity. Rotate key to OFF position: there should be no continuity.

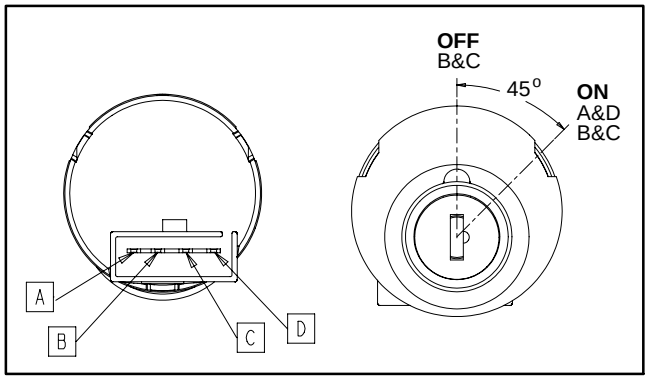

Figure 26

Audio Alarm (Reverse)

The audio alarm sounds when the direction (forward/reverse) switch is placed in the reverse position. The alarm is located under the controller cover beneath the cargo box.

Testing

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

IMPORTANT: The audio alarm is a 12 volt DC component. Do not test the alarm using jumper wires from the vehicle battery pack (48 VDC).

1. Make sure on/off switch is turned OFF. Remove key from switch. Raise cargo box and remove controller cover.

2. Disconnect wire harness connectors from alarm (Fig. 27). Using jumper wires, correctly connect 12VDC source to the alarm terminals noting polarity shown on alarm decal.

3. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit or replace alarm if needed.

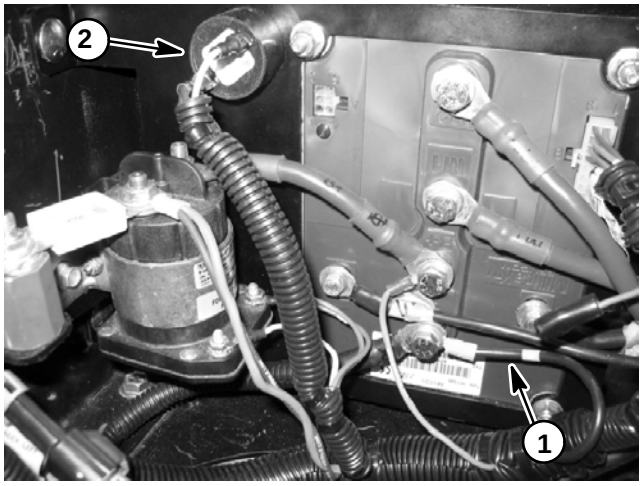

Figure 27

1. Controller **2. Audio alarm**

Charger Interlock Switch

The charger interlock switch is located behind the charger receptacle plate on the front of the seat base (Fig. 28). When the battery charger is plugged into the charger receptacle, the interlock switch closes and provides an input to the vehicle controller to inhibit vehicle operation.

NOTE: The vehicle should not operate if the charger plug is connected to the charger receptacle.

1. Make sure vehicle on/off switch is OFF. Remove key from switch.

2. Remove receptacle plate from front of seat base.

3. Locate charger interlock switch on rear of receptacle plate. Disconnect harness connector from the switch.

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

5. When the switch plunger is extended there should not be continuity between the switch terminals.

6. When the switch plunger is depressed, there should be continuity between the switch terminals.

7. Replace switch if needed.

8. Reconnect harness connector to switch. Install receptacle plate to front of seat base.

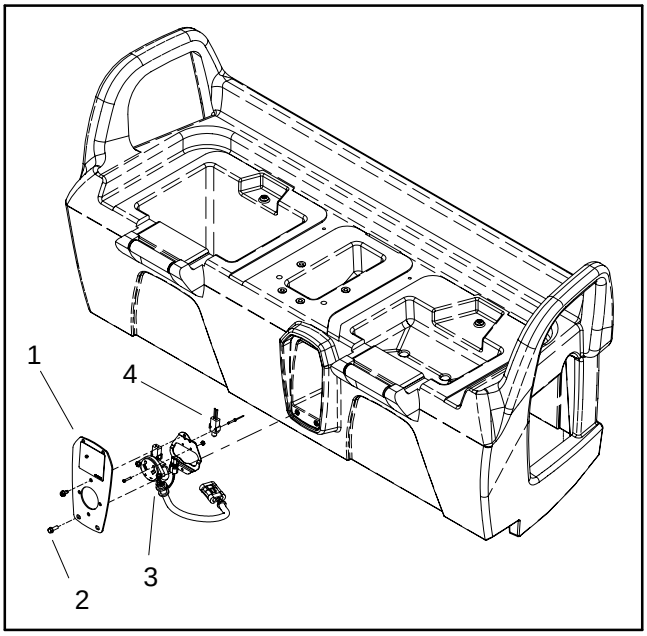

Figure 28

1. **Receptacle plate**
2. **Screw (4 used)**
3. **Charger receptacle**
4. **Charger interlock switch**

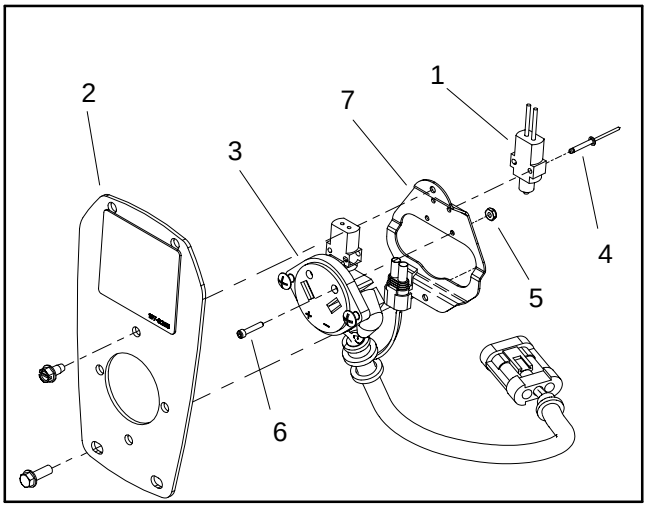

Figure 29

1. **Charger interlock switch**
2. **Switch plate**
3. **Charger receptacle**
4. **Rivet (2 used)**
5. **Lock nut (2 used)**
6. **Socket head screw**
7. **Mount bracket**

Main and Accessories Contactors

Two contactors (solenoids) are used on the Workman MDE for circuit control.

The main contactor provides current to the vehicle controller and is energized when the on/off switch is ON. The main contactor is located under the controller cover beneath the cargo box (Fig. 30).

The accessories contactor provides current to the headlights, horn and optional electrical accessories. The accessories contactor is energized when the on/off switch is ON. The accessories contactor is located beneath the dash panel.

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) that is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Make sure on/off switch is turned OFF. Open the battery circuit by removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter and Fig. 31).

2. Locate contactor that is to be tested. Disconnect all vehicle harness electrical connections from contactor. Note wire connector locations on contactor for reassembly purposes.

3. Using jumper wires, apply 48 VDC directly across the contactor coil posts (Fig. 32). The contactor should click. With the contactor coil energized, resistance across the main contact posts should be less than **1 ohm**.

4. Remove voltage from contactor coil posts. The contactor should click. With the contactor coil not energized, resistance across the main contact posts should be **infinite ohms**.

5. Measure resistance across the contactor coil posts (Fig. 32):

   A. For the main contactor, the resistance should be approximately 126 ohms.

   B. For the accessories contactor, the resistance should be approximately 200 ohms.

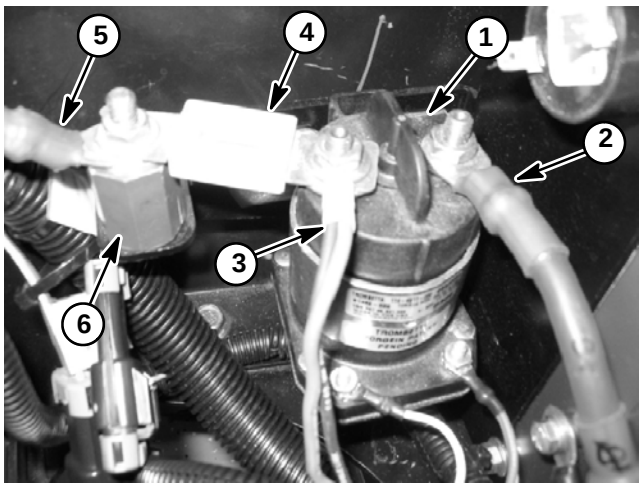

Figure 30

1. Main contactor
2. Cable to controller B+
3. Wire harness connector
4. Fuse (F1)
5. Positive battery cable
6. Isolator

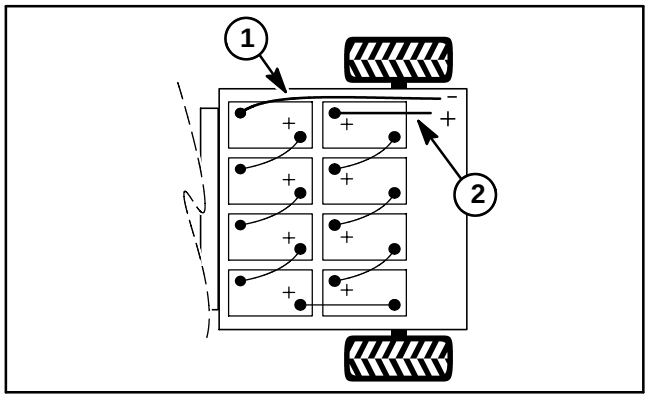

Figure 31

1. Negative cable to vehicle
2. Positive cable to vehicle

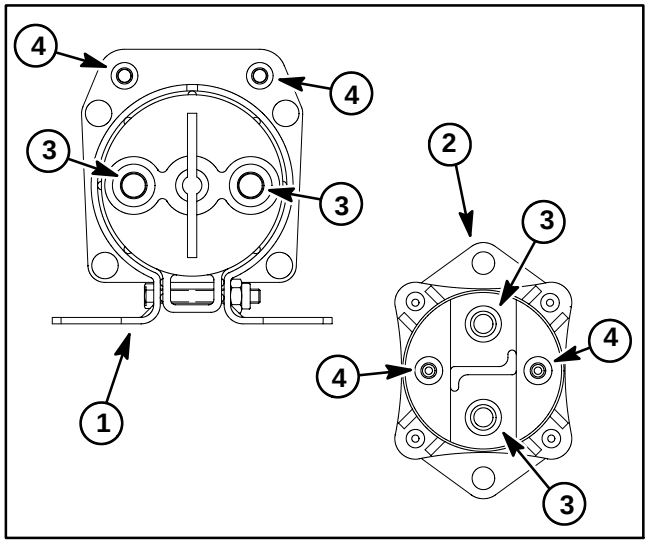

Figure 32

1. Main contactor
2. Accessories contactor
3. Main contact posts
4. Contactor coil posts

6. Replace contactor if necessary.

7. Connect electrical connections to contactor. If main contactor connections were removed, use Figure 33 as a guide for reattaching cable and wire harness connections.

8. Connect battery cable that was removed from battery pack.

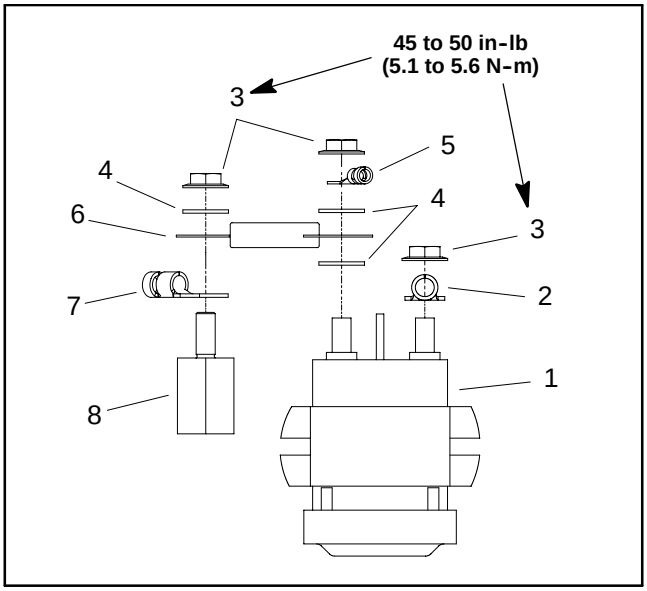

Figure 33

1. Main contactor
2. Cable to controller B+
3. Lock nut
4. Flat washer
5. Wire harness connector
6. Fuse (F1)
7. Positive battery cable
8. Isolator

Fuses

There are three (3) fuses in the Workman electrical system.

Two (2) of the fuses are located beneath the steering column (Fig. 34). These fuses supply power to the following:

The upper 10 ampere fuse (F2) supplies power to the on/off switch and switched circuits.

The lower 10 ampere fuse (F3) supplies power to optional accessories.

The third fuse (F1) is located under the controller cover beneath the cargo box (Fig. 35). This fuse is rated at 355 amperes continuous and allows current flow between the batteries and the vehicle. If this fuse has failed, vehicle operation will not occur.

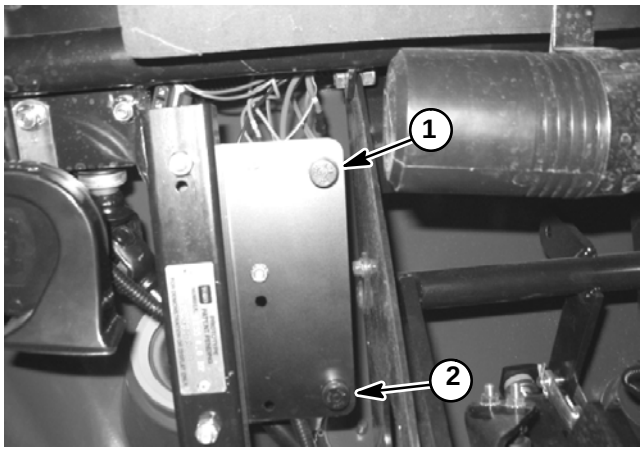

Figure 34

1. **Fuse (F2)**
2. **Fuse (F3)**

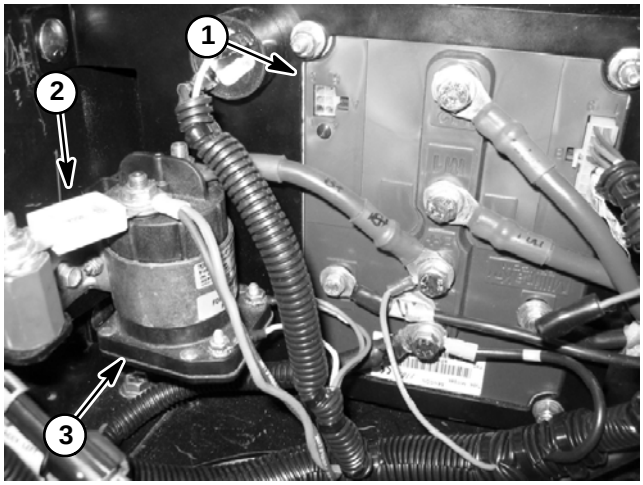

Figure 35

1. **Controller**
2. **Fuse (F1)**
3. **Main contactor**

Testing

CAUTION

When testing fuses for continuity with a multimeter (ohms setting), make sure that fuse is removed from circuit.

IMPORTANT: Before removing fuse F1 (355 Amp) for testing, open the battery circuit by removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

Make sure on/off switch is turned OFF. Remove fuse to check continuity. The test meter should read **less than 1 ohm**.

If fuse F1 was removed, torque the nuts that secure the fuse from **45 to 50 in-lb (5.1 to 5.6 N-m)**.

Fusible Links

The wiring harness for the Workman includes three (3) fusible links for circuit protection (Fig. 36).

Two (2) fusible links attach to the same main contactor post as the main fuse. One of these fusible links (FL2) is used for the switched power circuit. The other fusible link (FL1) protects the charger circuit.

The third fusible link (FL3) is attached to the controller B+ terminal. This link provides protection for the charge indicator/hour meter gauge.

If any of these fusible links should fail, the affected circuit will not function. See Chapter 6 – Electrical Diagrams for schematic and wire harness information.

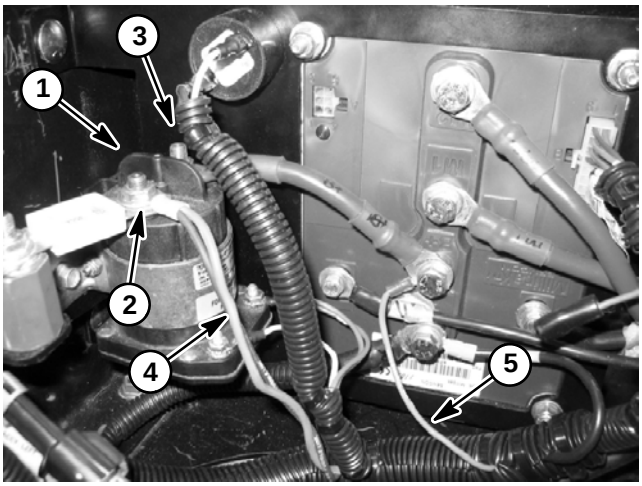

Figure 36

1. **Main contactor**
2. **Main fuse contactor post**
3. **Switched contactor post**
4. **Fusible links FL1 & FL2**
5. **Fusible link FL3**

Accelerator Switch

The accelerator switch is a four terminal, two circuit switch that is located on the control pedal frame (Fig. 37). The Workman MDE uses only one of the switch circuits (terminals 3 and 4). When the accelerator pedal is depressed, the switch allows a closed circuit (input) for the controller to allow traction motor operation. When the accelerator pedal is released, the switch provides an open circuit (no input) for the controller to prevent traction motor operation.

Testing

1. Park vehicle on a level surface, turn on/off switch OFF and remove key from switch.

2. Locate accelerator switch on pedal frame under dashboard of vehicle.

3. Unplug wiring harness connector from accelerator switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the switch terminals for both switch positions. Verify continuity between switch terminals using the following table:

PLUNGER POSITION	CONTINUITY	NO CONTINUITY
IN	1 and 2	3 and 4
OUT	3 and 4	1 and 2

5. When reconnecting wiring harness connector to switch after testing, harness connector and switch terminal area should be filled with dielectric gel (see Special Tools) to prevent corrosion of connection terminals. Apply gel fully to both harness connector and switch terminal area, plug harness connector into switch to distribute gel, unplug harness connector, reapply gel to both surfaces and replug harness connector into switch.

6. If switch replacement is needed, see Accelerator Switch Adjustment procedure in the Adjustments section of this chapter.

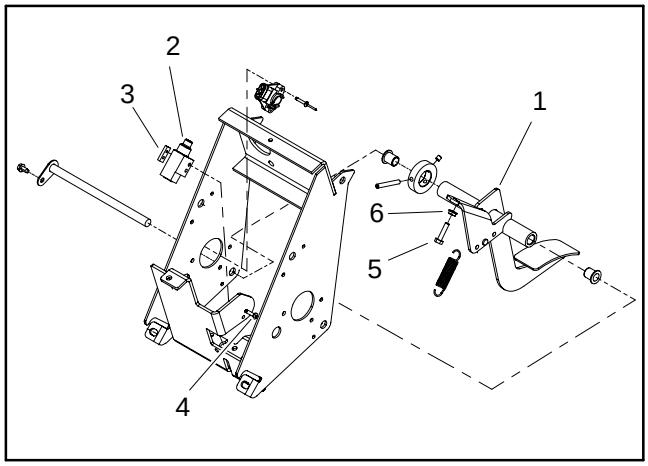

Figure 37

1. **Accelerator pedal**
2. **Accelerator switch**
3. **Plate**
4. **Screw (2 used)**
5. **Stop cap screw**
6. **Lock nut**

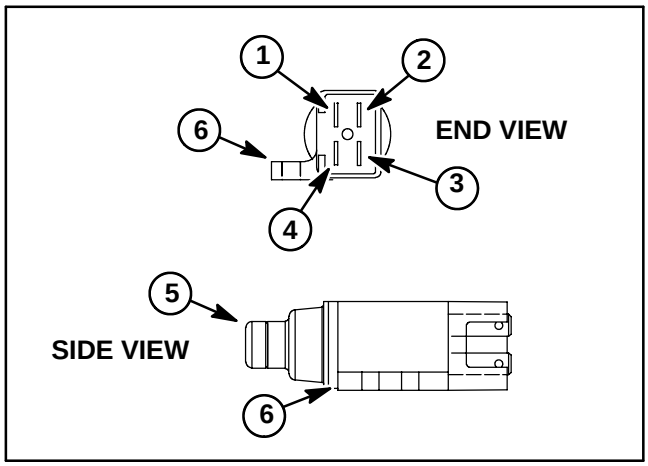

Figure 38

1. **Terminal 1**
2. **Terminal 2**
3. **Terminal 3**
4. **Terminal 4**
5. **Switch plunger**
6. **Mounting tab**

Accelerator Potentiometer

The accelerator potentiometer is attached to the pedal frame under the dash (Fig. 39). This potentiometer is used as one of the inputs for the vehicle controller to command vehicle speed. The accelerator pedal positions the accelerator potentiometer lever. When the operator presses or releases the accelerator pedal, the potentiometer resistance changes. This resistance change is used by the controller to determine current flow to the traction motor.

Two styles of potentiometer have been used on Workman MDE vehicles. Vehicles with serial numbers below 310000000 have a potentiometer with a short lever (Fig. 40). This potentiometer is rotated by a roll pin that extends approximately 1 1/2 inches (38 mm) out of the collar. Vehicles with serial numbers above 310000000 have a potentiometer with a long lever (Fig. 41). This potentiometer is rotated by a roll pin that extends approximately 3 inches (76 mm) out of the collar. If a potentiometer on an earlier vehicle has been replaced, it may have a potentiometer with a long lever.

If the accelerator potentiometer is out of adjustment, the diagnostic light on the dash will flash six (6) times. Additionally, if vehicle movement is erratic or jerky, calibration of the accelerator system should be performed. See Accelerator Potentiometer Adjustment and Accelerator System Calibration in the Adjustments section of this chapter.

Before suspecting a faulty potentiometer, follow adjustment procedures for the accelerator switch, accelerator potentiometer and acceleration system calibration found in the Adjustments section of this chapter.

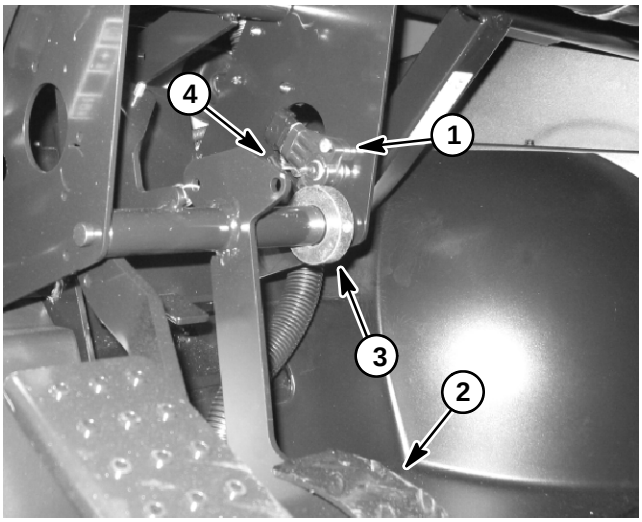

Figure 39

1. **Potentiometer**
2. **Accelerator pedal**
3. **Collar**
4. **Roll pin**

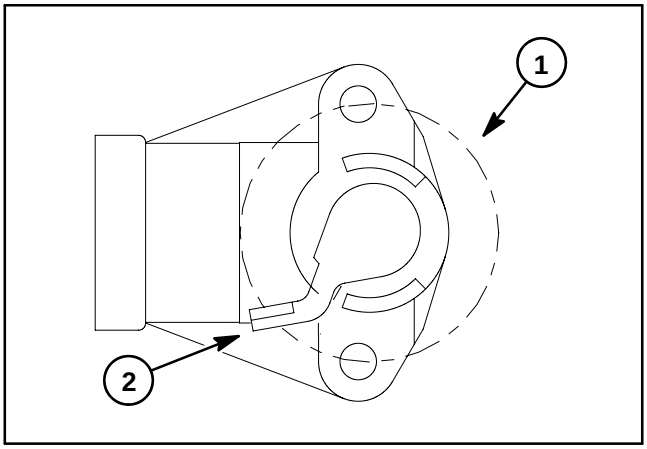

Figure 40

1. **Potentiometer**
2. **Lever (short)**

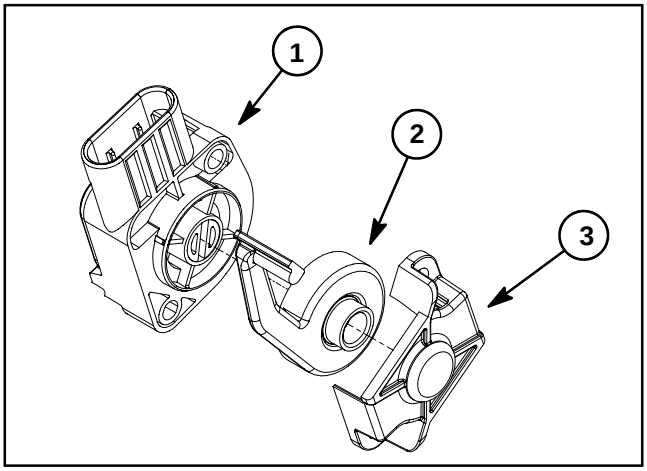

Figure 41

1. **Potentiometer**
2. **Lever (long)**
3. **Retainer**

Controller

The Workman controller is secured to the rear frame under the controller cover beneath the cargo box (Fig. 40). The controller uses inputs from several vehicle switches (on/off, forward/reverse, accelerator pedal, supervisor, charger interlock, motor temperature, accelerator potentiometer) to accurately control vehicle speed, vehicle direction (forward and reverse) and regenerative braking. An internal thermal sensor prevents overheating of the controller.

Cable connections for the controller are as follows:

Terminal B–: Negative (–) battery cable and wire harness ground.

Terminal B+: Positive (+) cable from main contactor post and wire harness fusible link (FL3).

Terminal M1: Cable to traction motor armature A2 post.

Terminal M2: Cable to traction motor armature A1 post.

Terminal F1: Cable to traction motor field F1 post.

Terminal F2: Cable to traction motor field F2 post.

When installing cables to controller, torque screws at terminals B–, B+, M1 and M2 from **85 to 90 in-lb (9.6 to 10.2 N-m)** and torque screws at terminals F1 and F2 from **55 to 60 in-lb (6.2 to 6.8 N-m)** (Fig. 41). Apply Toro battery terminal protector (see Special Tools) to controller connections after tightening terminal screws.

If wire harness connector is removed from controller, both harness connector and controller socket should be filled with dielectric gel to prevent corrosion of connection terminals and potential controller damage. Apply gel fully to both harness connector and controller socket, plug harness connector into controller to distribute gel, unplug harness connector, reapply gel to both surfaces and plug harness connector into controller.

A LED exists on the controller to identify normal operation or faults that will prevent the vehicle from operating correctly. The vehicle status light on the dash panel displays the same information as the LED on the controller. See chart below for light pattern fault codes identified by the controller LED and vehicle status light.

NOTE: If the controller LED and vehicle status light are flashing, attempt to reset the controller by turning the on/off switch to OFF, waiting a few seconds and then turning the switch to ON. If LED and status light continue flashing, proceed with fault code identification and necessary action.

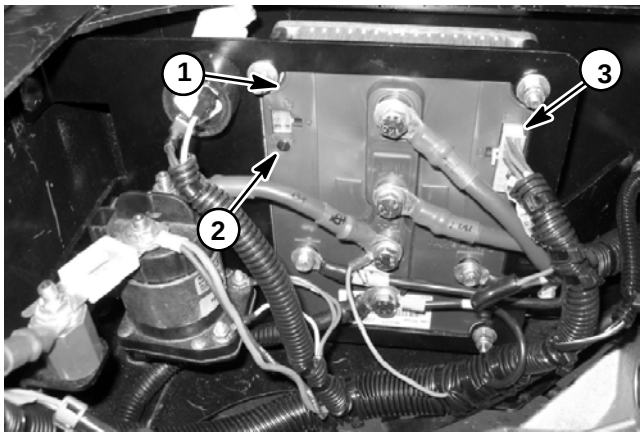

Figure 40

1. **Controller**
2. **Controller LED**
3. **Wire harness connector**

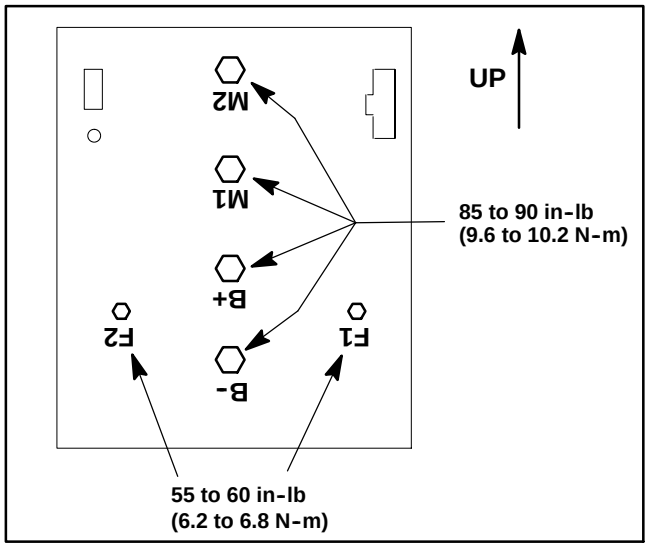

Figure 41

Light Pattern	Cause	Necessary Action
Always on (not flashing)	System functioning correctly.	None
Always off	System inoperable.	Check for low battery voltage, faulty fuse(s), loose battery cable connections, damaged battery cables and/or faulty main contactor. If batteries, cables and other electrical components are in good condition, controller replacement may be necessary.

1 Flash	System inoperable.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset correctly, controller replacement may be necessary.
2 Flashes	The accelerator pedal was depressed when on/off switch was turned ON.	Turn on/off switch OFF, release accelerator pedal and turn on/off switch to ON. If controller does not reset correctly, accelerator switch adjustment may be necessary or switch may be faulty.
3 Flashes	System inoperable.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset, check battery pack voltage and all battery cable connections. Also check main contactor wire and cable connections and main contactor. NOTE: If main contactor audibly clicks when on/off switch is turned ON, problem is most likely a faulty wire or cable connection. Controller replacement may be necessary.
4 Flashes	Main contactor malfunction.	Turn on/off switch OFF, wait several seconds and turn on/off switch ON. If controller does not reset, inspect main contactor (see Main and Accessories Contactors in this section). Check main contactor wire and cable connections. If problem continues, contactor replacement may be necessary.
5 Flashes	The charger cord is plugged into the vehicle charger receptacle.	Turn on/off switch OFF, unplug charger cord from vehicle and turn on/off switch ON. If controller does not reset correctly, check charger interlock switch.
6 Flashes	Accelerator control (accelerator switch and potentiometer) is out of adjustment.	Adjust accelerator switch and potentiometer (see Accelerator Switch and Accelerator Potentiometer adjustment/calibration in the Adjustments section of this chapter).
7 Flashes	Battery voltage is out of range.	Inspect and test vehicle batteries and battery cable connections (see Battery Service in the Service and Repairs section of this chapter).
8 Flashes	The controller is overheated.	The vehicle will continue to operate but at reduced power until the controller temperature lowers.
9 Flashes	The traction motor is overheated (battery discharge indicator displays more than 1 bar). The battery is nearly discharged and the vehicle is in the energy saving mode (reduced speed and battery discharge indicator displays 1 bar with red light illuminated).	Stop vehicle and allow motor to cool before continuing operation. Traction motor high temperature switch may be faulty. Charge the batteries immediately to prevent battery damage.

Battery Service

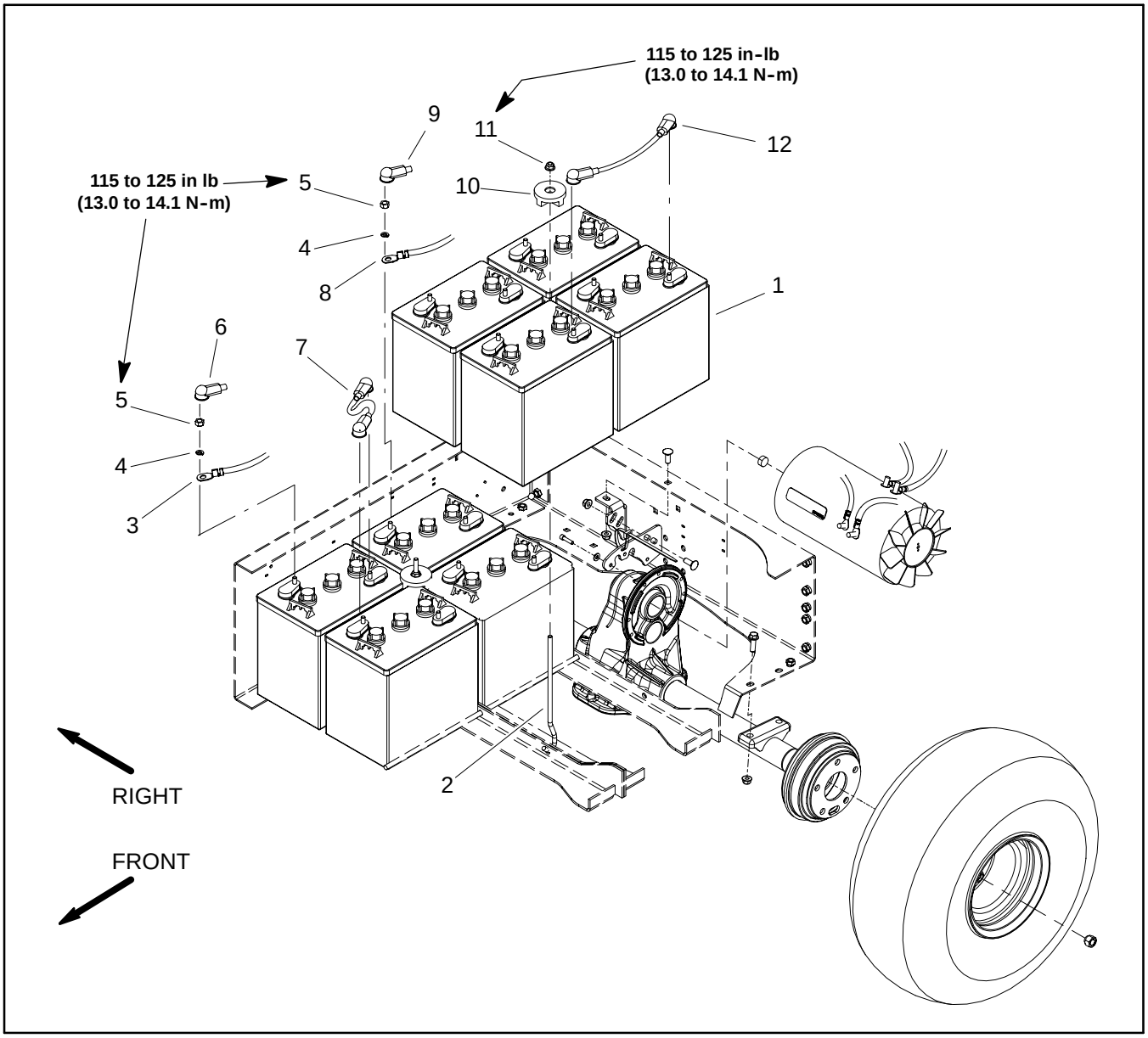

Figure 42

1. **Battery (8 used)**
2. **Battery rod (2 used)**
3. **Negative cable to vehicle**
4. **Lock washer (2 used per battery)**
5. **Hex nut (2 used per battery)**
6. **Cable terminal boot**
7. **Battery cable (6 used)**
8. **Positive cable to vehicle**
9. **Cable terminal boot**
10. **Battery retainer (2 used)**
11. **Flange nut (2 used)**
12. **Battery cable**

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

Battery Specifications:

Trojan model T-145 Battery (6 Volt Deep Cycle)
Weight: 72 lbs (33 kg)
Capacity: 210minutes @ 56.25 amps discharge

Battery Removal (Fig. 42)

WARNING

POTENTIAL HAZARD:
The battery terminals, metal tools and metal vehicle parts could short together.
WHAT CAN HAPPEN:
Sparks can cause battery gasses to explode.
Damaged cables could short against metal vehicle parts and cause sparks.
HOW TO AVOID THE HAZARD:
When removing or installing the batteries, do not allow the battery terminals to short against metal parts of the vehicle.
Do not allow metal tools or metal vehicle parts to short between the battery terminals or battery cables.
Always keep the battery retainers in place to protect and secure the batteries.

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

1. Position vehicle on a level surface, set parking brake, turn on/off switch OFF and remove key.

2. Raise cargo box and secure with prop rod.

3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

4. Once initial cable has been removed from vehicle, disconnect and remove remaining battery cables from all battery terminals.

5. Remove flange nuts (item 11) and battery retainers (item 10) used to secure batteries to vehicle (Fig. 43).

6. Make sure that all battery filler caps are on tightly.

IMPORTANT: When removing batteries from vehicle, do not lift batteries using battery terminals as lift points: battery damage may occur.

7. Using case loops on battery tops as lifting points, remove batteries from vehicle.

Battery Installation (Fig. 42)

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

1. Make sure vehicle on/off switch and all accessories are OFF. Raise cargo box and secure with prop rod.

2. Make sure the battery supports are clean and repainted if necessary. Make sure cables, terminals, rods and hold down retainers are in good condition.

IMPORTANT: When installing batteries into vehicle, do not lift batteries using battery terminals as lift points: battery damage may occur.

3. Using case loops on battery tops as lifting points, set batteries on the battery supports with battery posts properly orientated (Fig. 44). Make sure that battery rods are positioned to allow installation of retainers.

4. Install two (2) battery retainers and nuts to secure batteries to vehicle (Fig. 43). Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

5. Install all but one of the battery cables used to connect battery pack including the positive (red) cable and negative (black) cable from vehicle (Figures 42 and 44). Make sure that cables are connected to correct battery terminal noting battery polarity. Install lock washer and nut on each battery terminal. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)** to secure cables.

6. Connect final battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

7. Apply Toro battery terminal protector (see Special Tools) to all battery posts and cable connectors to reduce corrosion after connections are made. Make sure that terminal boots are positioned over all connections.

8. Lower and secure cargo box.

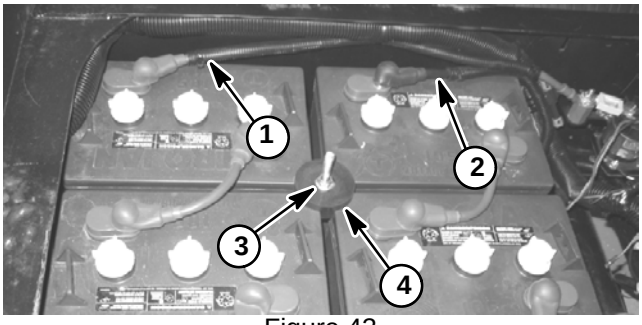

Figure 43

1. **Negative cable to vehicle**
2. **Positive cable to vehicle**
3. **Flange nut**
4. **Battery retainer**

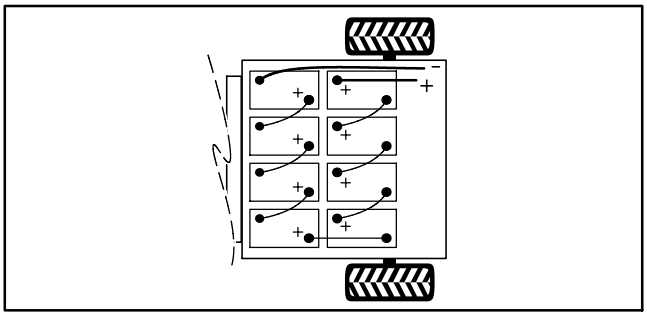

Figure 44

Battery Charging

When the vehicle is not in use, it is recommended to keep the batteries charged by connecting the battery charger that is included with the vehicle. The Workman MDE charger is designed to automatically charge the batteries fully without overcharging. Indicator lights (green and red) and an ammeter on the charger give information about the charging operation.

Make sure to have the battery cell plates covered with electrolyte before charging the batteries (Fig. 45). Periodically (at least every 50 operating hours) check electrolyte level in the batteries and add distilled water to ensure proper charging and the best battery performance and life.

Colder temperatures will increase the time needed to fully charge the batteries. NEVER attempt to charge frozen batteries. Also, if temperatures below freezing are expected, do not add water to battery after charging as added water could freeze and damage battery.

For additional battery charging information, see your Operator's Manual and the Battery Charger Operating Instructions.

Battery Inspection and Maintenance

WARNING

POTENTIAL HAZARD:
Battery electrolyte contains sulfuric acid which is a deadly poison and it causes severe burns.
WHAT CAN HAPPEN:
If you carelessly drink electrolyte you could die or if it gets onto your skin you will be burned.
HOW TO AVOID THE HAZARD:
Do not drink electrolyte and avoid contact with skin, eyes or clothing. Wear safety glasses to shield your eyes and rubber gloves to protect your hands.
Fill the battery where clean water is always available for flushing the skin.
Follow all instructions and comply with all safety messages on the electrolyte container.

1. Check for cracks in battery case caused by overly tight or loose hold–down retainer. Replace any battery that is cracked and/or leaking.

2. Check battery terminal posts for corrosion. Use a terminal brush to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, make sure the filler caps are on tightly.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling.

4. Check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse battery with clean water.

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

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

IMPORTANT: Do not add acid to the battery. Use only distilled water to adjust the electrolyte level.

6. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, add just enough **distilled** water to the cell to cover the plates. Replace filler caps and charge the battery. After charging, check electrolyte level in all cells and add **distilled** water until the level is 1/8" (3 mm) below the bottom of the fill well (Fig. 45).

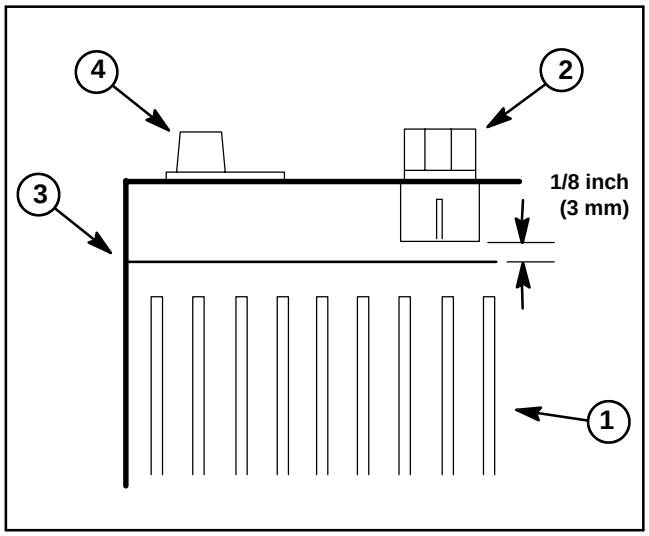

Figure 45

1. Battery plates
2. Filler cap
3. Electrolyte level
4. Battery terminal

Battery Testing

When testing batteries in the Workman MDE, it is important to test all batteries. Proper performance of the vehicle depends on all batteries being in good condition. Testing will determine if one (or more) of the batteries needs to be replaced.

1. The preferred testing procedure is to use the Lester Electrical 36/48 Volt Battery Discharge Unit (Model 17770). This instrument puts a known discharge load (56.25 Amps) on the battery pack until the battery pack reaches 42 volts. A timer incorporated into the discharger measures the time needed to reach that voltage level. Battery capacity and remaining life can be determined from the test results. Refer to Discharge Unit Operating Instructions for further information.

Other types of battery load testers can also be used to test the Workman batteries. Many locally available battery load testers do not, however, have any adjustment on the load that is put on the battery. Results received from using load testers should follow the recommendations of the load tester manufacturer.

2. If the Lester Battery Discharge Unit (or other load tester) is not available, an alternate battery test can be done using a multimeter to perform a voltage test of each battery. Use the following procedure:

A. For accurate voltage testing, allow batteries to remain idle (no charging, no discharging) for at least 6 hours and preferably 24 hours.

B. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter). Then, disconnect both cables from battery to be tested.

C. Measure the battery voltage with the multimeter. Record battery voltage. The measured voltage will determine battery state of charge.

D. If voltage readings below 70% charged (see Fig. 46) exist, charge battery and take voltage measurements again. If voltage remains low after charging, consider battery replacement.

3. A third option for battery testing is to perform a specific gravity test of the battery electrolyte using a hydrometer. Use the following procedure:

IMPORTANT: Make sure the area around the battery fill caps is clean before removing the caps.

A. Remove battery filler caps. Do not add water prior to testing specific gravity of battery electrolyte. If electrolyte level is low, add **distilled** water and charge battery before performing specific gravity test.

B. Measure the specific gravity of each cell with a hydrometer. Fill and drain the hydrometer two to four times before drawing a sample. At the same time, take the temperature of the cell.

C. Have enough electrolyte in the hydrometer to completely support the hydrometer float. Record the hydrometer reading and return the electrolyte to the battery cell.

D. Repeat test for remaining battery cells.

E. 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 Specific Gravity Reading	1.245
	ADD (20° above 80°F)	0.008
	Correction to 80°F	1.253

F. The specific gravity of all battery cells should be 1.277 ± 0.007. If low cell readings exist (see Fig. 46), charge battery and take specific gravity readings again.

G. If specific gravity of any cells remain low after complete charging, battery should be replaced.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.277	6.37
90%	1.258	6.31
80%	1.238	6.25
70%	1.217	6.19
60%	1.195	6.12
50%	1.172	6.05
40%	1.148	5.98
30%	1.124	5.91
20%	1.098	5.83
10%	1.073	5.75

Figure 46

Battery Storage

If the vehicle will be stored for any period of time, check battery electrolyte level, adjust level if needed and then connect battery charger to vehicle. Allow charger to remain connected to vehicle during storage to prevent battery discharge and potential battery damage.

If the vehicle will be stored for more than 30 days and the battery charger cannot be used for some reason, charge the batteries fully. Either store batteries on a shelf or in the vehicle. Store the batteries in a cool atmosphere to avoid quick deterioration of the charge in the batteries. To prevent batteries from freezing, make sure they are fully charged before storage. During the storage period, charge the batteries at least once every three (3) months to prevent battery damage. Before returning the vehicle to service, make sure to fully charge the batteries.

Traction Motor Brushes

The traction motor in the Workman MDE uses eight (8) brushes. Traction motor brushes should be inspected every 500 hours of operation or annually.

Inspection

1. Make sure that on/off switch is OFF. Raise and latch cargo box to allow access to traction motor.

2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

3. Unlatch headband of traction motor and reposition headband to allow inspection of a brush at the top of the motor.

4. If end of brush is even with the brush holder (Figs. 47 and 49), brushes should be removed from motor for inspection and measurement (see Traction Motor Service in this section).

5. In most instances, wear of all traction motor brushes should be similar to wear found on the top brushes. If inspection of remaining brushes is needed or if brushes require replacement, traction motor should be removed from vehicle (see Traction Motor and Traction Motor Service in this section).

6. If vehicle is often operated in severely dirty environments, brush should be removed from motor to allow inspection of mating surface of brush (Fig. 48). If brush surface is rough, pitted, arced or scored, additional brush and/or motor inspection should be completed (see Traction Motor and Traction Motor Service in this section).

7. Visually inspect commutator surface of motor armature. If commutator surface is rough, pitted, arced or scored, additional motor inspection should be completed (see Traction Motor and Traction Motor Service in this section).

8. After brush inspection, make sure brush is correctly installed in brush holder and tensioned by spring. Refit headband to traction motor and latch headband.

9. Carefully connect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

10. Lower and secure cargo box.

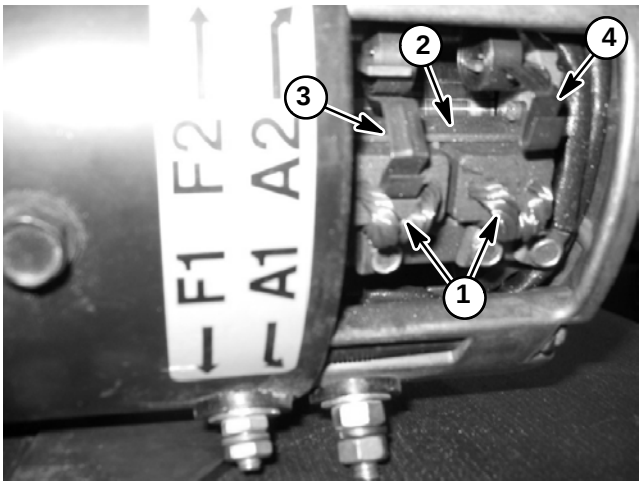

Figure 47

1. **Brush**
2. **Brush holder**
3. **Brush spring (tensioned)**
4. **Brush spring (released)**

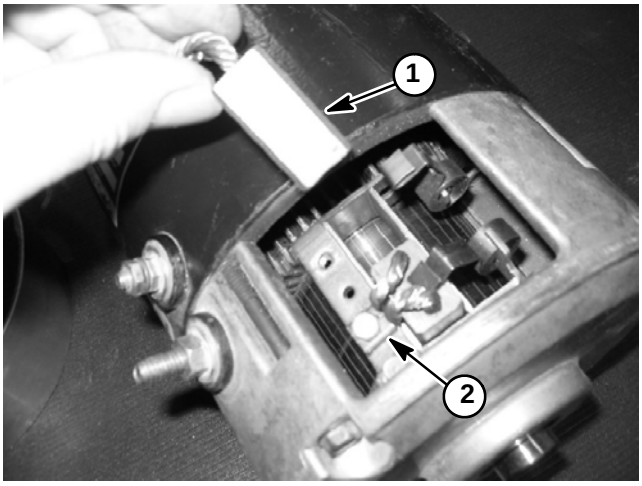

Figure 48

1. **Removed brush**
2. **Cap screw**

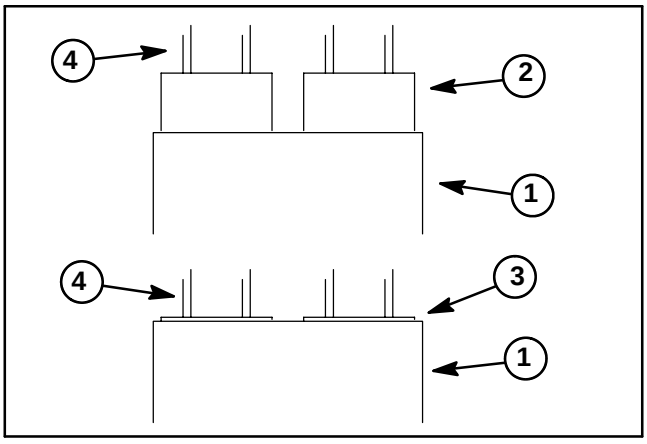

Figure 49

1. **Brush holder (side view)**
2. **Normal brush**
3. **Worn brush**
4. **Brush shunt wire**

Traction Motor

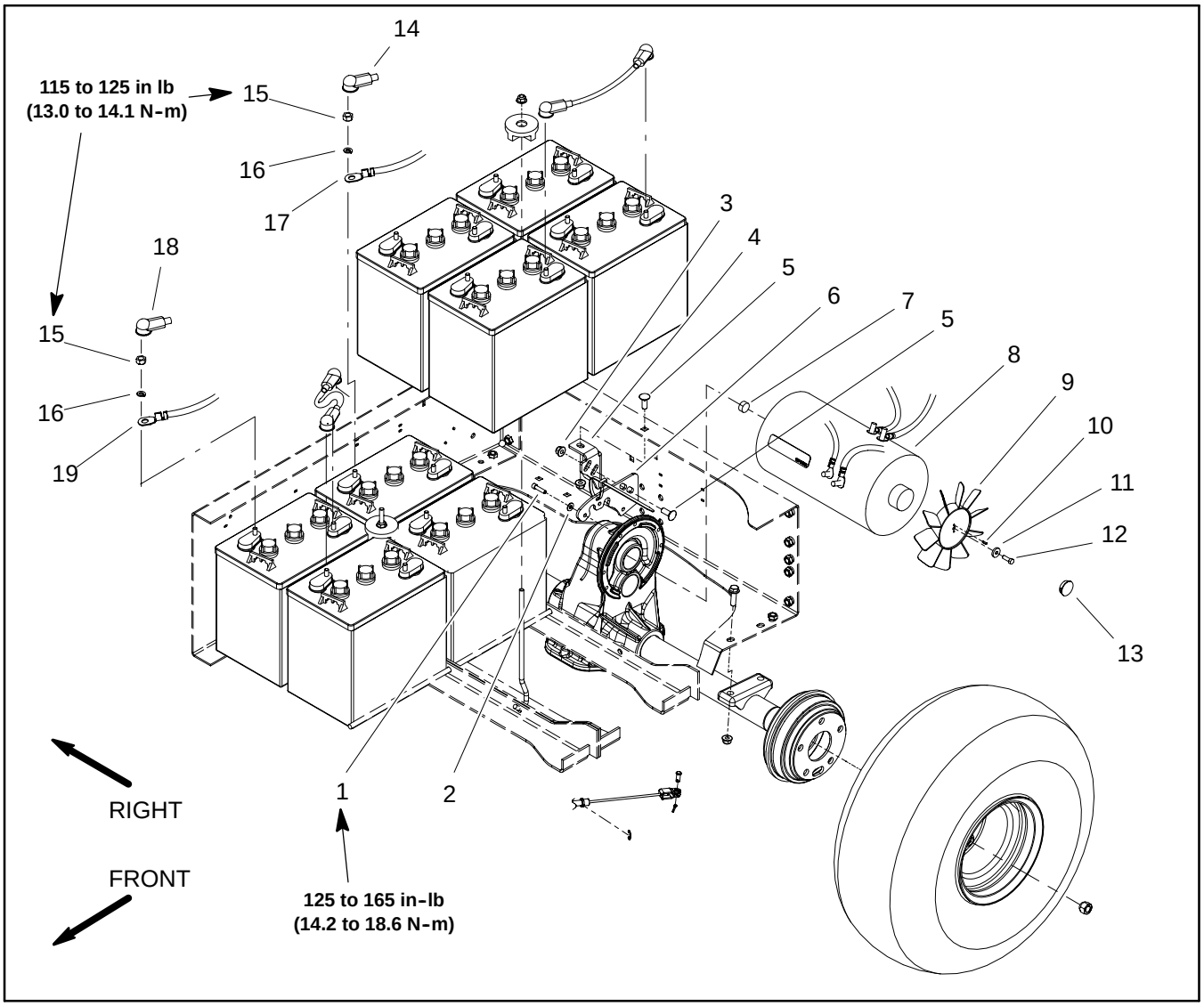

Figure 50

1. **Socket head screw (6 used)**
2. **Flat washer (6 used)**
3. **Flange nut**
4. **Support bracket**
5. **Carriage screw**
6. **Transaxle mount plate**
7. **Rubber damper**
8. **Traction motor**
9. **Fan**
10. **Roll pin (2 used)**
11. **Washer**
12. **Socket head screw**
13. **Plastic cap (fits in rear frame)**
14. **Cable terminal boot**
15. **Hex nut**
16. **Lock washer**
17. **Positive battery cable**
18. **Cable terminal boot**
19. **Negative battery cable**

Removal (Fig. 50)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from switch.

2. Remove cargo box from vehicle (see Cargo Box Removal in Service and Repairs section of Chapter 5 – Chassis).

3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of this chapter).

NOTE: Label all electrical leads for assembly purposes.

IMPORTANT: When removing wires from motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut while loosening upper nut (Fig. 52). If terminal studs are allowed to turn during upper nut removal, internal motor damage can occur.

4. Disconnect wires from traction motor (Fig. 51):

   A. While retaining lower nut, remove upper nut and wire connector from motor terminals A1, A2, F1 and F2.

   B. Unplug motor temperature sensor from vehicle wire harness. Note location of cable tie that secures temperature sensor wires to vehicle.

   C. Position disconnected wires away from motor.

5. Remove plastic plug from rear frame to allow access to socket head screw that retains fan to traction motor. Remove screw and washer and then remove fan from motor.

CAUTION

To prevent motor damage and personal injury, make sure that traction motor is well supported as it is removed. Motor weighs approximately 62 pounds (28.1 kg).

6. Support traction motor to prevent it from falling. Two suggestions for traction motor support are as follows:

IMPORTANT: Damage to traction motor field coils will result if eyebolt is threaded into motor housing to far.

   A. Remove silver flange head screw from top of motor and carefully install a 3/8 – 16 eyebolt into motor (Fig. 53). Thread eyebolt into motor approximately four (4) turns taking care to not bottom eyebolt into internal field coils. Secure eyebolt with jam nut. Use eyebolt for support and as a lifting point for motor removal.

   B. Use lifting strap wrapped around motor housing for support and as a lifting point for motor removal.

7. Remove six (6) socket head screws (item 1) and flat washers (item 2) that secure motor to transaxle.

8. Slide motor away from transaxle to disengage motor shaft from transaxle input shaft. Carefully lift motor from vehicle. Take care to not damage thermal switch while motor is removed.

9. Locate and retrieve rubber damper from motor shaft internal spline.

10. If needed, remove two (2) roll pins from motor shaft.

Installation (Fig. 50)

1. If removed, install two (2) roll pins into motor shaft.

2. Make sure that rubber damper is installed into the motor shaft internal spline with the damper flat side toward the motor (Fig. 51).

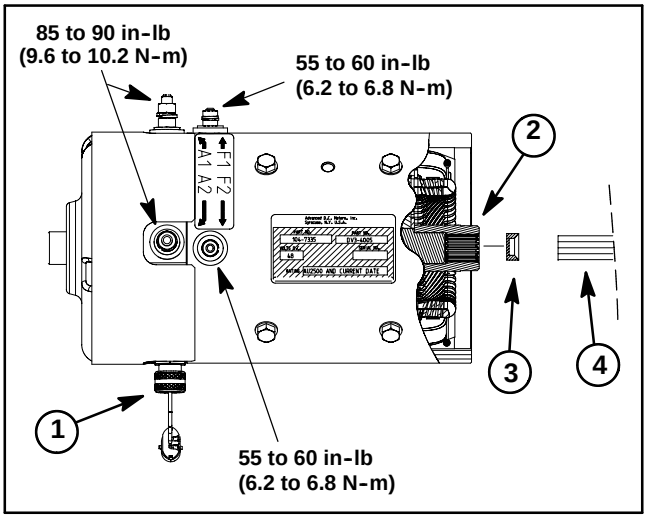

Figure 51

1. Thermal switch
2. Motor shaft spline
3. Rubber damper
4. Transaxle input shaft

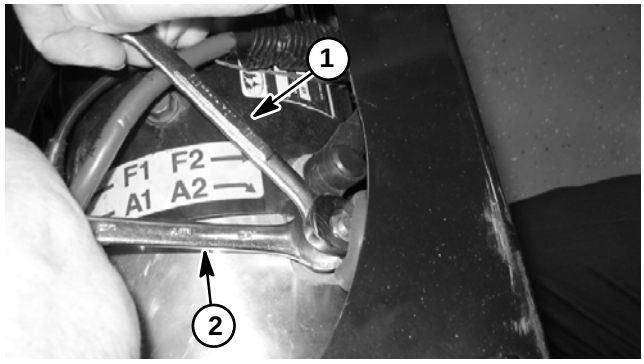

Figure 52

1. Loosening/tightening wrench (upper nut)
2. Retaining wrench (lower nut)

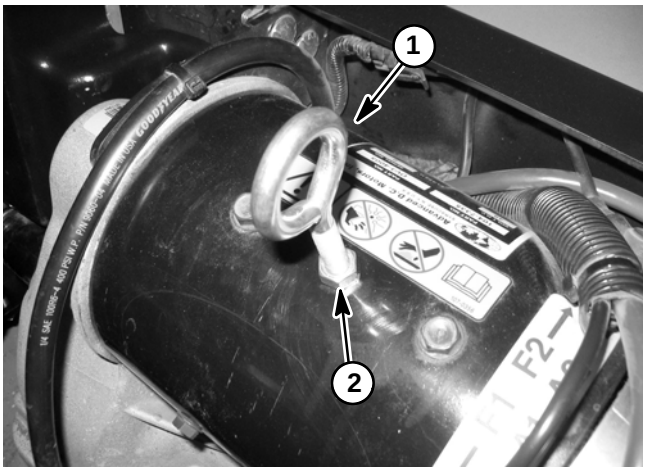

Figure 53

1. Eyebolt
2. Jam nut

3. Apply antiseize lubricant or axle grease to the splines of the transaxle and motor shafts. Apply grease to lip of seal in transaxle bore.

CAUTION

To prevent motor damage and personal injury, make sure that traction motor is well supported as it is installed. Motor weighs approximately 62 pounds (28.1 kg).

4. Carefully lower motor into vehicle. Align motor shaft with transaxle input shaft and slide motor to transaxle. Take care to not damage thermal switch while installing motor.

5. Align mounting holes of motor, transaxle and transaxle mount plate. Secure motor to transaxle with six (6) socket head screws (item 1) and flat washers (item 2). Torque screws from **125 to 165 in-lb (14.2 to 18.6 N-m)**.

IMPORTANT: When connecting wires to motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut while tightening upper nut (Fig. 52). If terminal studs are allowed to turn during upper nut installation, internal motor damage can occur.

6. Connect wires to traction motor (Fig. 51):

   A. Make sure that fasteners and cable connectors are properly positioned on motor terminals (Fig. 55).

   B. Install correct cable connector and nut to motor terminals A1 and A2. While retaining lower nut, torque upper nut on terminals A1 and A2 from **85 to 90 in-lb (9.6 to 10.2 N-m)**.

   C. Install correct wire connector and nut to motor terminals F1 and F2. While retaining lower nut, torque upper nut on terminals F1 and F2 from **55 to 60 in-lb (6.2 to 6.8 N-m)**.

   D. Plug motor temperature sensor connector into vehicle wire harness.

7. Position fan to traction motor and secure with socket head screw and washer. Install plastic plug in hole in rear frame.

8. Carefully connect removed battery cable to battery terminals. Install lock washers and nuts on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

9. Install cargo box to the rear frame (see Cargo Box Installation in Service and Repairs section of Chapter 5 - Chassis).

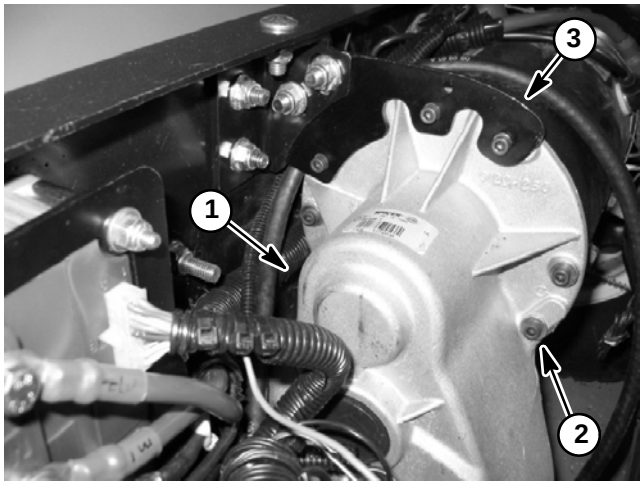

Figure 54

1. **Transaxle**
2. **Screw/washer (6 used)**
3. **Transaxle mount plate**

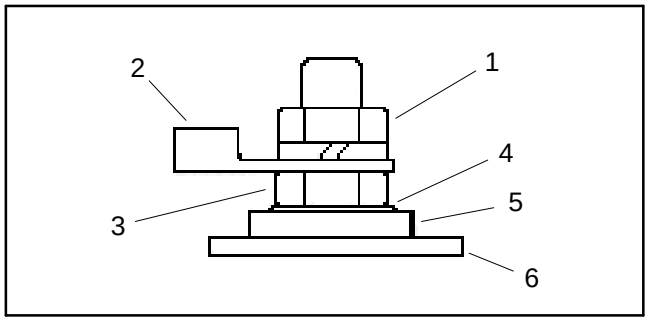

Figure 55

1. **Upper nut**
2. **Cable connector**
3. **Lower nut**
4. **Flat washer**
5. **Insulating washer**
6. **Motor housing**

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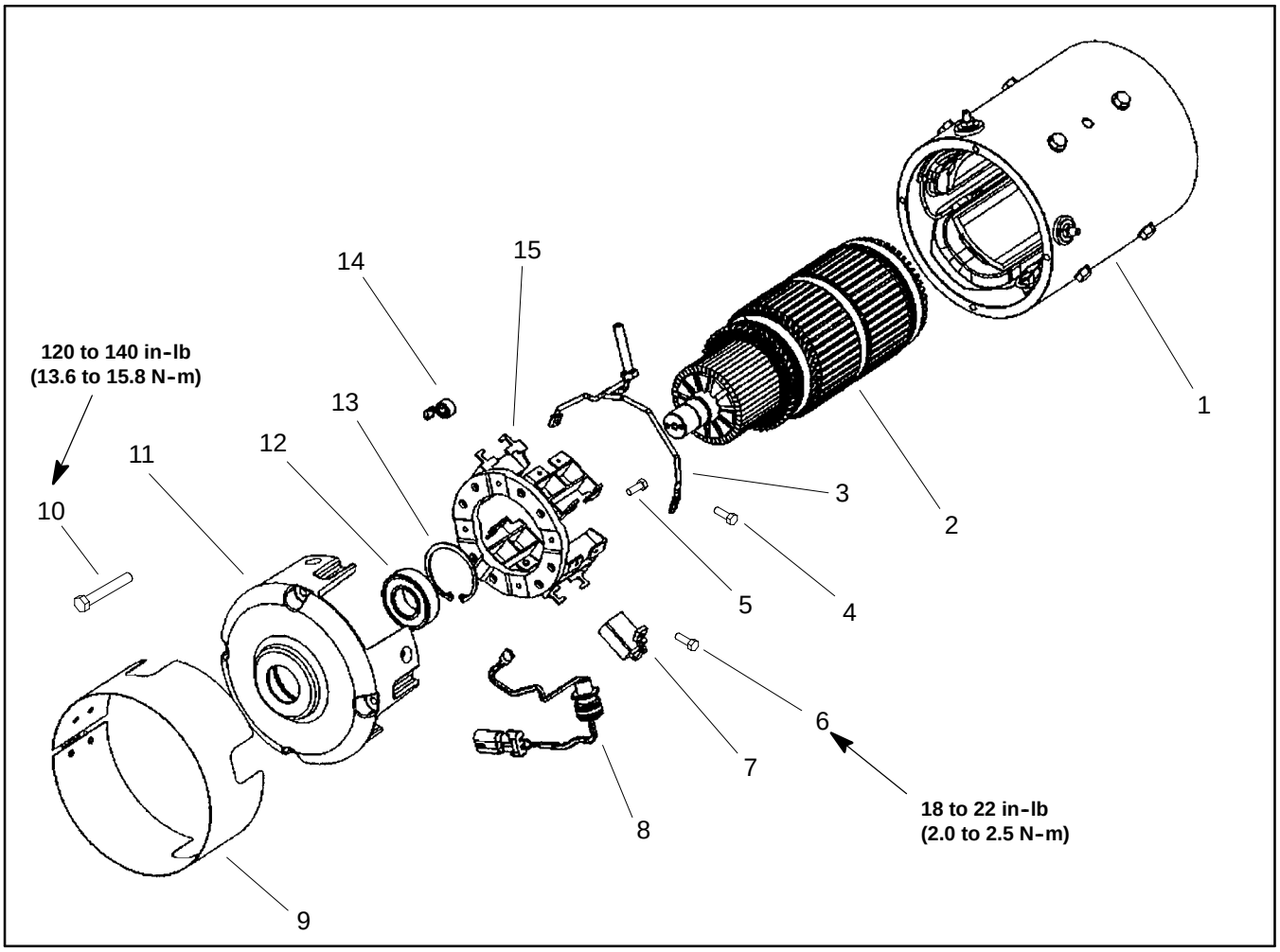

Figure 56

1. Frame and field assembly
2. Armature
3. Brush lead (2 used)
4. Cap screw (2 used per brush lead)
5. Cap screw (4 used)
6. Cap screw (8 used)
7. Brush (8 used)
8. High temperature sensor
9. Headband
10. Bolt (4 used)
11. Commutator end head
12. Bearing
13. Retaining ring
14. Brush spring (8 used)
15. Brush box

Disassembly (Fig. 56)

1. Unlatch and slide headband from traction motor.

2. Pull back the brush springs and latch them in the open position on the spring holders. Slide brushes from the brush holders.

3. Use an arbor press or a bearing puller to remove the armature from the commutator end head and frame and field assembly (Fig. 57).

4. Remove four (4) bolts that secure the commutator end head to the frame and field assembly. Remove commutator end head from frame and field assembly.

5. Remove the retaining ring and press bearing from the commutator end head. Discard the bearing.

CAUTION

When using compressed air for cleaning motor components, follow all safety instructions, including wearing eye and respiratory protection.

6. Carefully blow out any accumulated carbon dust and dirt from the commutator end head and the frame and field assembly using clean, oil free, compressed air.

Brush Service

1. Check the brush springs for correct alignment on the back of the brush. A brush spring that does not apply equal pressure on the center of the brush will cause the brush to wear unevenly. Check for correct clearance and freedom of brush movement in the holder.

2. Replace brushes that are worn to a length of 0.620" (16 mm). Also, replace brushes if they show signs of uneven wear or show signs of overheating, such as discolored brush shunts and brush springs.

3. Brushes should always be replaced in complete sets of eight. Use identical replacement parts; do not substitute brush grades as the brushes are matched to the motor type and application to provide the best service. Substituting brushes of the wrong grade can cause premature commutator failure and excessive brush wear. Remove old brushes and replace with identical replacement parts. Hold brush shunts in position and torque brush screws from **18 to 22 in-lbs (2.0 to 2.5 N-m)** (Fig. 59). Make sure brushes move freely in the holders and that shunts do not interfere with brush spring movement.

4. Make sure the brush box assembly is tight on the commutator end head. Replace brush box assemblies in the commutator end head if they are physically damaged or brush holders are loose on the brush plate.

5. Brush springs should be checked for proper tension using the following procedure (Fig. 58):

A. Place paper strip between brush face and commutator. Hook spring scale as shown.

B. Pull spring scale on a line directly opposite the line of force exerted by the brush spring. When the paper strip begins to move freely, read the spring tension on the scale. Brush tension for a new brush should be 65 ounces (1820 grams) and for a worn brush should be 40 ounces (1120 grams).

Frame and Field Service

1. Motors that have been disassembled for servicing should be given a complete inspection of the frame and field assembly. If damage to the field coils or frame is found, replace traction motor. Individual frame and field components are not available.

2. Accumulated carbon dust, grease and other foreign material can produce a ground path from the field winding to the frame. The frame and field should be cleaned with Safety-Kleen 105 washing solvent or equivalent. After cleaning, the frame and field must be oven-dried for one hour at 300°F (148° C) to remove any cleaning residue.

3. It is also recommended that the field be coated with PD George 1000-70 or RanBar B-535-5S varnish for proper insulation protection. Both recommended varnishes are Class H water-soluble varnishes. A similar air-dry varnish may also be used providing it has a Class H rating.

4. Screws securing the pole pieces to the frame should be torqued from **250 to 300 in-lb (28.3 to 33.9 N-m) (Fig. 59)**.

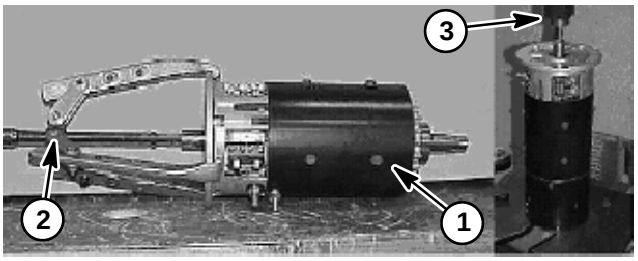

Figure 57

1. **Motor housing**
2. **Puller**
3. **Arbor press**

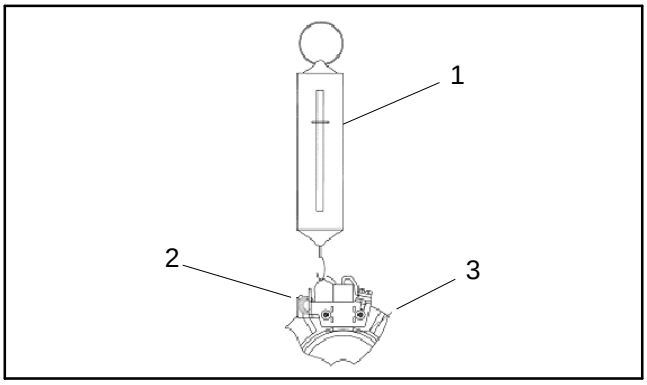

Figure 58

1. **Spring scale**
2. **Brush spring**
3. **Paper**

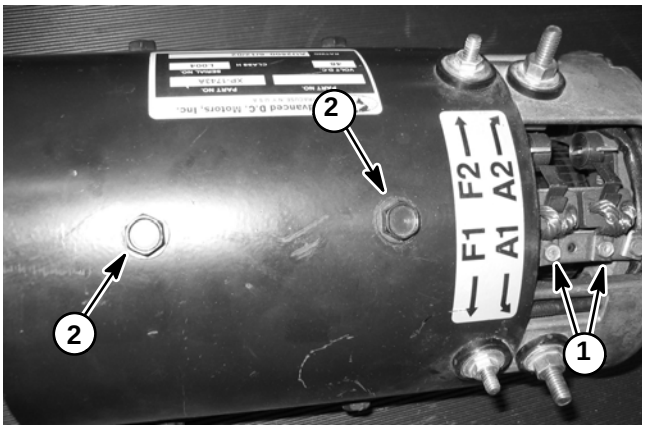

Figure 59

1. **Brush screw**
2. **Pole piece screw**

Commutator Service

1. Chuck armature on the commutator end−bearing journal and support the drive end of armature using the ”live” center of the shaft. With the armature supported on both ends, measure the commutator runout and the bar to bar differences with a dial gauge. Total indicated runout should not exceed 0.003” (0.08 mm) and not more than 0.0005” (0.013 mm) between any two bars. If the readings fall outside this limit, the commutator must be turned and re−undercut.

2. If the commutator must be turned, use only high quality cutting tools with a controlled cutting rate. Remove only enough copper to bring total indicated runout and bar to bar height differences into specification.

3. The minimum commutator diameter is 2.750” (70 mm). If the commutator diameter falls below this diameter after turning, the armature must be replaced.

4. After the commutator is turned, undercut the mica to a uniform depth of 0.040” (1.0 mm). Be careful to only cut the mica and not increase the slot width (Fig. 60).

CAUTION

When using compressed air for cleaning motor components, follow all safety instructions, including wearing eye and respiratory protection.

5. After undercutting, use No. 00 sandpaper to lightly remove any burrs left from the undercutting operation. Clean commutator with dry, oil free compressed air and recheck commutator runout.

Armature Testing

Before an armature is reassembled into the motor, the following tests should be performed:

NOTE: Armature is wave wound and can be short circuit tested in the following manner.

1. Check for grounded circuits by placing one test lead of a dielectric tester on the commutator and the other lead at the armature shaft. If the test light comes on, the armature is grounded.

2. Check for short circuits by placing the armature on a growler. Use a long, flat piece of metal (such as a hacksaw blade) to locate any shorted windings.

If armature is found to be shorted, grounded or otherwise damaged, replace the traction motor.

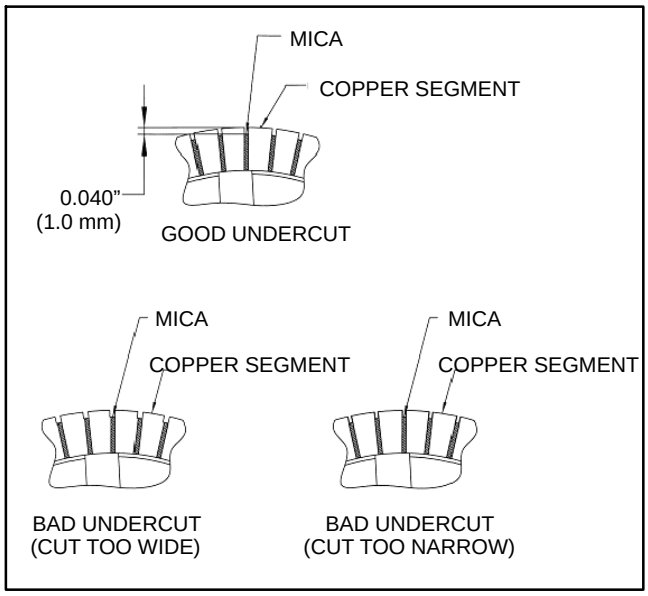

Figure 60

Traction Motor Specifications

BRUSH LENGTH		
Maximum	1.300 in	33 mm
Minimum	0.620 in	16 mm
BRUSH SPRING TENSION		
New Brush	65 ounces	1820 grams
Worn Brush	40 ounces	1120 grams
COMMUTATOR		
New Diameter	2.920 in	74 mm
Minimum Diameter for Reslotting	2.800 in	71 mm
Reject Diameter	2.750 in	70 mm

Assembly (Fig. 56)

NOTE: After the motor has been disassembled, it is recommended that a new commutator end head bearing be installed because the removed bearing may have been damaged during disassembly. Although the bearing may appear and feel good, the bearing could be "brinelled" (races or balls deformed) and may exhibit noise and vibration problems or fail within a relatively short period of service. When installing new bearing, always press against the race that is absorbing the pressure or bearing damage may occur.

1. After servicing the commutator and brushes, re-assemble the wiring in the commutator end head as originally found. Ensure the wiring does not contact metal and rotating parts. Also, make sure that the wiring allows the brushes to move unrestricted in the brush holders.

2. Press a new bearing into the commutator end head, pressing on the bearing outer race only (Fig. 61). Secure bearing with retaining ring.

3. Position the commutator end head to the frame and field assembly and secure with four (4) bolts. Torque bolts from **120 to 140 in-lb (13.6 to 15.8 N-m)**.

4. Ensure the brushes are pushed out of the way.

5. While supporting the inner-race of the bearing in commutator end head, carefully press the armature into the end head and bearing assembly (Fig. 61).

6. Position brushes in brush holders and carefully release the brush springs allowing the brushes to contact the commutator. Make sure brush shunts do not interfere with spring movement.

7. Repair or replace the headband if damaged. Install the headband on the motor.

8. Make sure that lower nuts are properly tightened on traction motor terminals (Fig. 62 and 63). Lower nuts on F1 and F2 terminals should be torqued from **50 to 60 in-lb (5.7 to 6.8 N-m)**. Lower nuts on A1 and A2 terminals should be torqued from **110 to 140 in-lb (12.4 to 15.8 N-m)**.

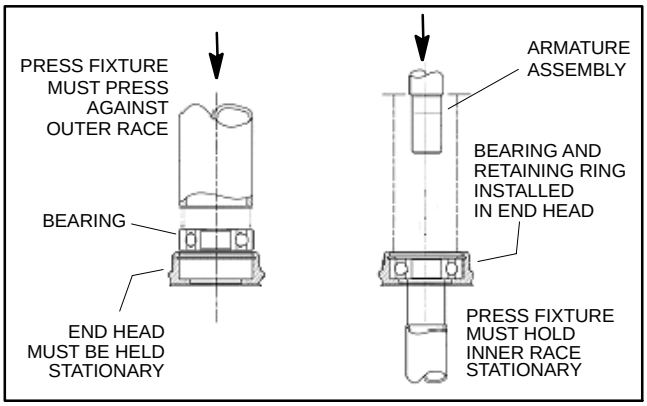

Figure 61

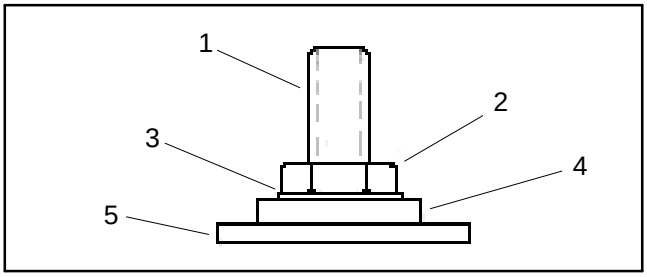

Figure 62

1. **Terminal**
2. **Lower nut**
3. **Flat washer**
4. **Insulating washer**
5. **Motor housing**

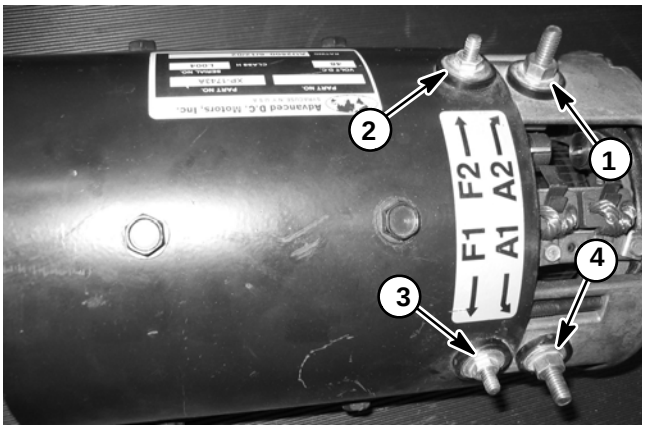

Figure 63

1. **A2 terminal**
2. **F2 terminal**
3. **F1 terminal**
4. **A1 terminal**

Battery Charger

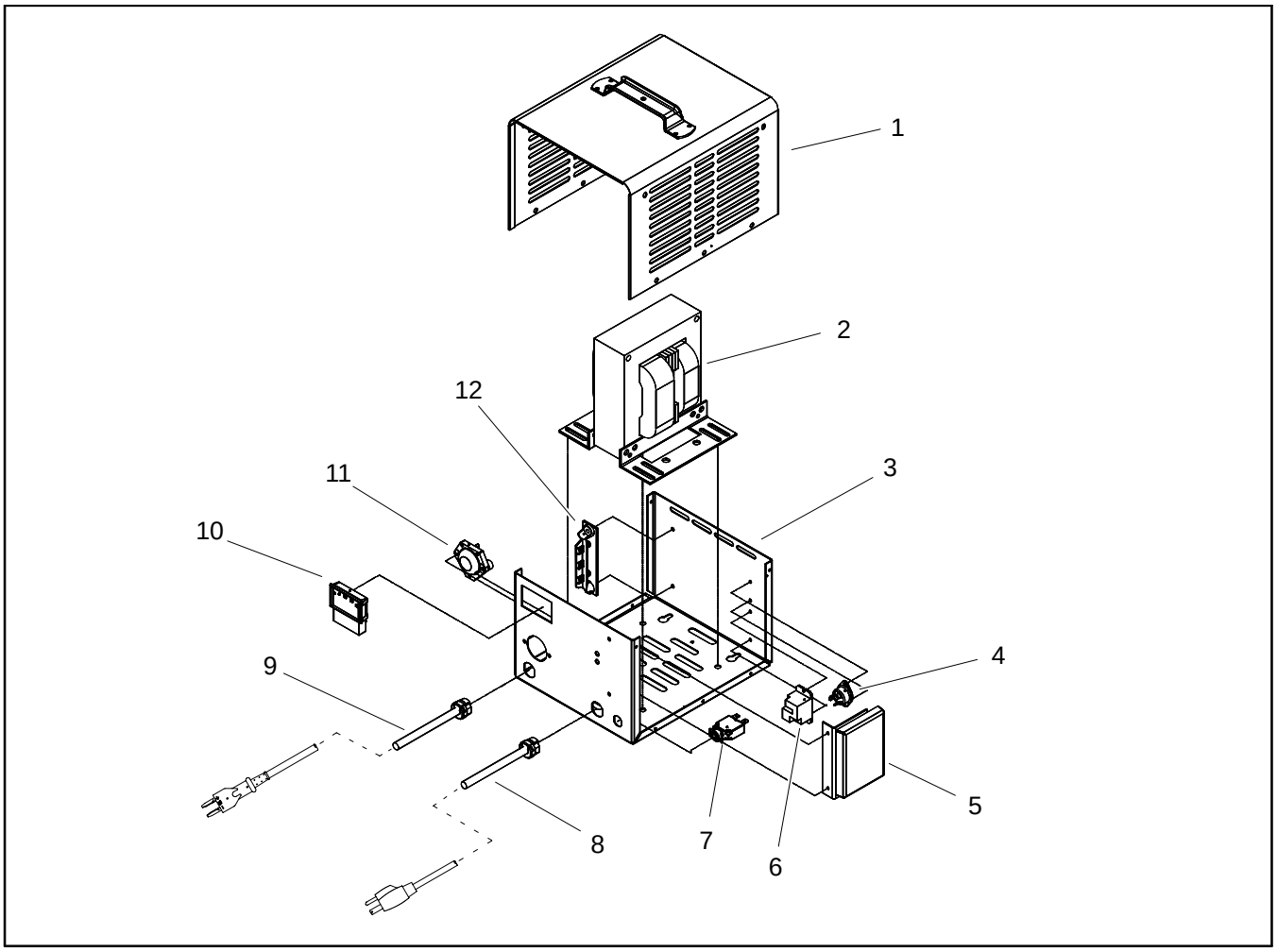

Figure 64

1. **Upper case**
2. **Transformer**
3. **Lower case**
4. **SCR assembly**
5. **Control board**
6. **Relay**
7. **Circuit breaker**
8. **AC cordset**
9. **DC cordset**
10. **Ammeter**
11. **Fuse**
12. **Diode assembly**

For service of the battery charger, see the Lester Electrical Technician Service Guide at the end of this chapter.

Chapter 4

Transaxle and Brakes

Table of Contents

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman MDE vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

Specifications

Item	Description
Transaxle Transaxle Fluid Capacity Transaxle Fluid	 2 quarts (1.9 liters) 10W–30 Motor Oil
Brake Fluid	DOT 3

Troubleshooting

Brakes

Problem	Possible Cause
Brake pedal goes to the floor.	Rear brake shoes are excessively worn. Front brake pads are excessively worn. Brake fluid level low. Brake fluid leak at hose, caliper or wheel cylinder. Brake master cylinder faulty.
Brake pedal is spongy.	Rear brake drums are excessively worn or damaged. Rear brake shoes are not burnished. Air in brake lines.
Brakes pull to either side.	Tire pressure is incorrect or uneven between tires. Brake linings are contaminated. Front wheel alignment (toe–in) is incorrect. Rear brake shoes are distorted. Tires on same axle are unmatched.
Brakes squeal.	Brake lining is glazed or saturated. Rear shoe–to–shoe springs are weak or broken. Rear brake shoes are distorted. Brake drums and shoes are dusty. Rear brake drums are scored or out–of–round.

Brakes (continued)

Problem	Possible Cause
Brakes drag.	Parking brake is applied. Rear shoe–to–shoe springs are weak or broken. Brake pedal is binding. Brake linings are saturated. Rear brake drums are bent or out–of–round. Front brake calipers or rotors are damaged.
Brake pedal is hard to push.	Incorrect brake lining material. Brake pedal linkage is binding.
Wheels lock–up when braking.	Brake linings are contaminated, worn or damaged. Wheel or transaxle bearings are damaged. Rear brake shoe–to–shoe springs are weak. Rear brake drums are grooved in the contact face with brake shoes.
Brakes fade.	Brake drums or rotors are overheated. Brake linings are saturated.
Vehicle surges at slow speeds and chatters at fast speeds.	Brake drums or rotors are bent or out–of–round.

Rear Wheels and Brakes

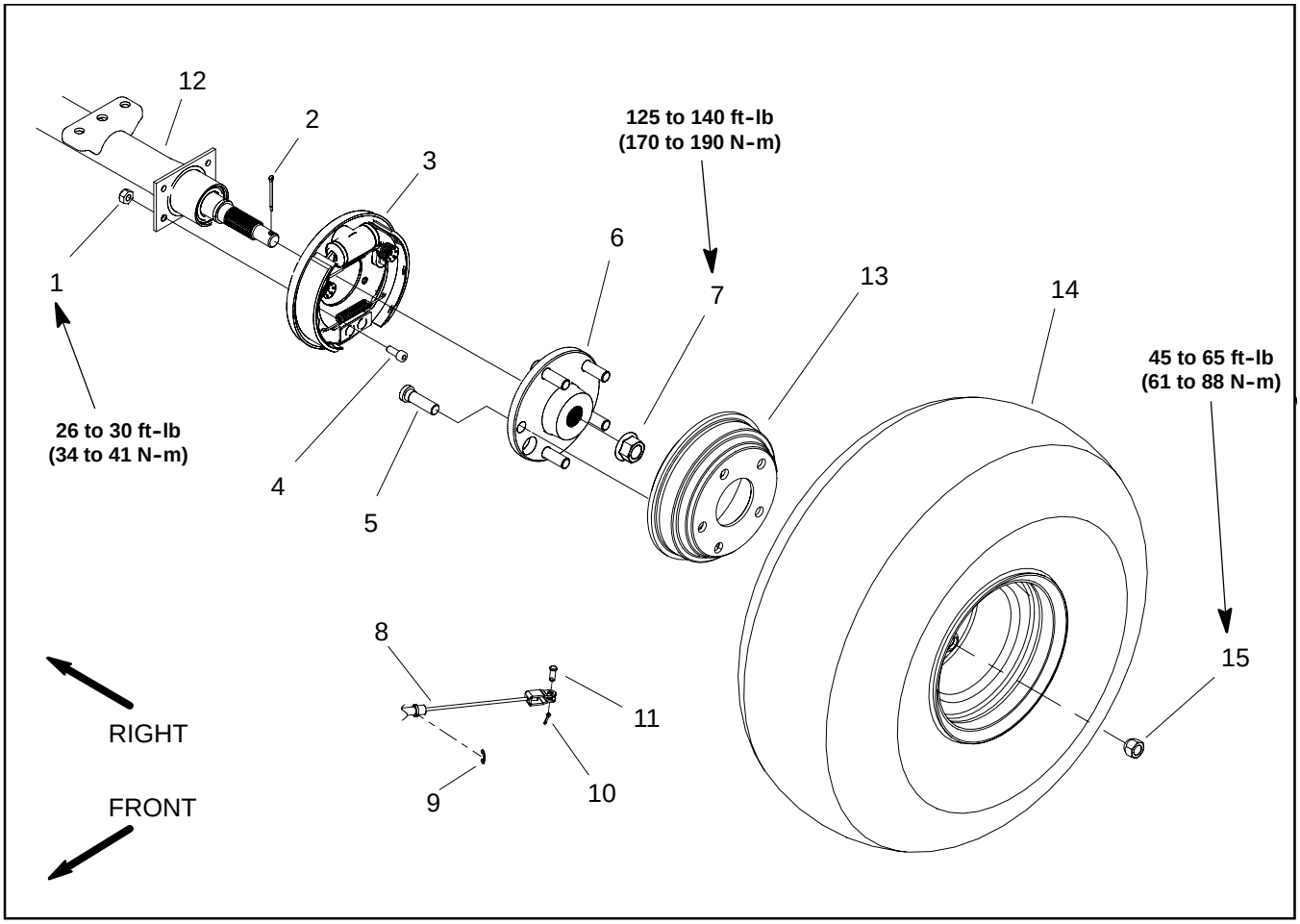

Figure 1

1. **Lock nut (4 used per side)**
2. **Cotter pin**
3. **Brake assembly (LH shown)**
4. **Socket head screw (4 used per side)**
5. **Wheel stud (5 used per side)**
6. **Wheel hub**
7. **Flange nut**
8. **Parking brake cable**
9. **Retaining ring**
10. **Cotter pin**
11. **Clevis pin**
12. **Transaxle**
13. **Brake drum**
14. **Rear wheel assembly**
15. **Lug nut (5 used per side)**

Removal (Fig. 1)

1. Park vehicle on a level surface, turn on/off switch OFF and remove key from the on/off switch.

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Operator's Manual and Chapter 1 - Safety.

2. Chock wheels not being jacked up. Lift rear wheel off the ground using a jack and place appropriate jack stand beneath the rear frame to support vehicle.

NOTE: To remove brake drum, it may be necessary to loosen parking brake cable adjustment or remove parking brake cable from brake actuator lever.

3. Remove five (5) lug nuts, wheel assembly and brake drum from the wheel hub.

4. Remove cotter pin and flange nut that secure wheel hub (item 7) to the transaxle shaft.

5. Remove wheel hub from transaxle.

6. If necessary, use press to remove wheel studs from hub.

7. If necessary, remove brake assembly from transaxle:

A. Remove cotter pin and clevis pin securing the parking brake cable bracket to the brake actuator lever (Fig. 2).

B. Clean hydraulic brake line area of rear brake cylinder to prevent contamination. Loosen and disconnect hydraulic brake line from wheel cylinder. Plug brake line and position it away from wheel cylinder.

C. Remove four (4) socket head screws and lock nuts securing the brake assembly to the transaxle. Remove brake assembly from the transaxle.

Installation (Fig. 1)

IMPORTANT:The parking brake actuation levers should be positioned above the transaxle mount. When positioned correctly, the levers will point toward the rear of the vehicle (Fig. 2).

1. If brake assembly was removed from axle, install brake assembly to transaxle.

A. Secure brake assembly to the transaxle with four (4) socket head screws and lock nuts. Torque lock nuts from **26 to 30 ft-lb (34 to 41 N-m)**.

B. Position and secure hydraulic brake line to wheel cylinder (Fig. 3). Torque banjo bolt from **15 to 21 ft-lb (21 to 28 N-m)**.

C. Secure parking brake cable bracket to the brake actuator lever with clevis pin and cotter pin (Fig. 2).

2. If wheel studs were removed from wheel hub, use press to install wheel studs into hub. Make sure to fully press studs into hub.

3. Slide wheel hub onto transaxle shaft. Install flange nut to secure wheel hub to the transaxle shaft. Torque nut from **125 to 140 ft-lb (170 to 190 N-m)**. Install cotter pin.

4. Slide brake drum onto wheel hub.

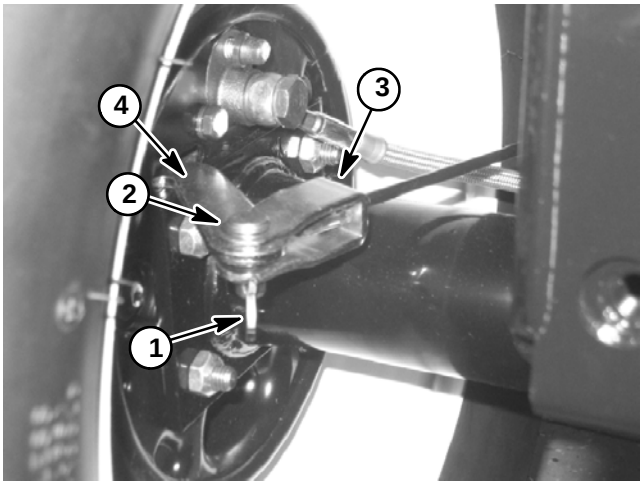

Figure 2

1. **Cotter pin**
2. **Clevis pin**
3. **Brake cable bracket**
4. **Brake actuator lever**

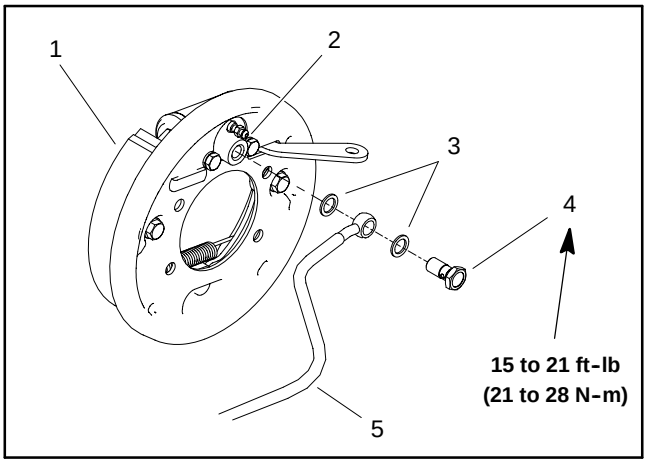

Figure 3

1. **Brake assembly**
2. **Wheel cylinder**
3. **Banjo washer**
4. **Banjo bolt**
5. **Brake line**

5. Position wheel assembly to the vehicle with valve stem facing out and secure with five (5) lug nuts.

6. Lower vehicle to ground. Torque lug nuts in a crossing pattern from **45 to 65 ft-lb (61 to 88 N-m)**.

7. Bleed brakes (see Bleed Brake System in this section).

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.

Burnish Brake Shoes

To provide maximum brake performance after rear brake shoes are replaced, burnish new brake shoe linings.

IMPORTANT:To prevent brake overheating, do not drive vehicle with the brakes applied.

IMPORTANT:When burnishing brake shoes, do not allow the brakes to lock up. Also, allow brakes to cool between stops.

1. Drive vehicle while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

2. Make several normal stops with the vehicle going in the reverse direction.

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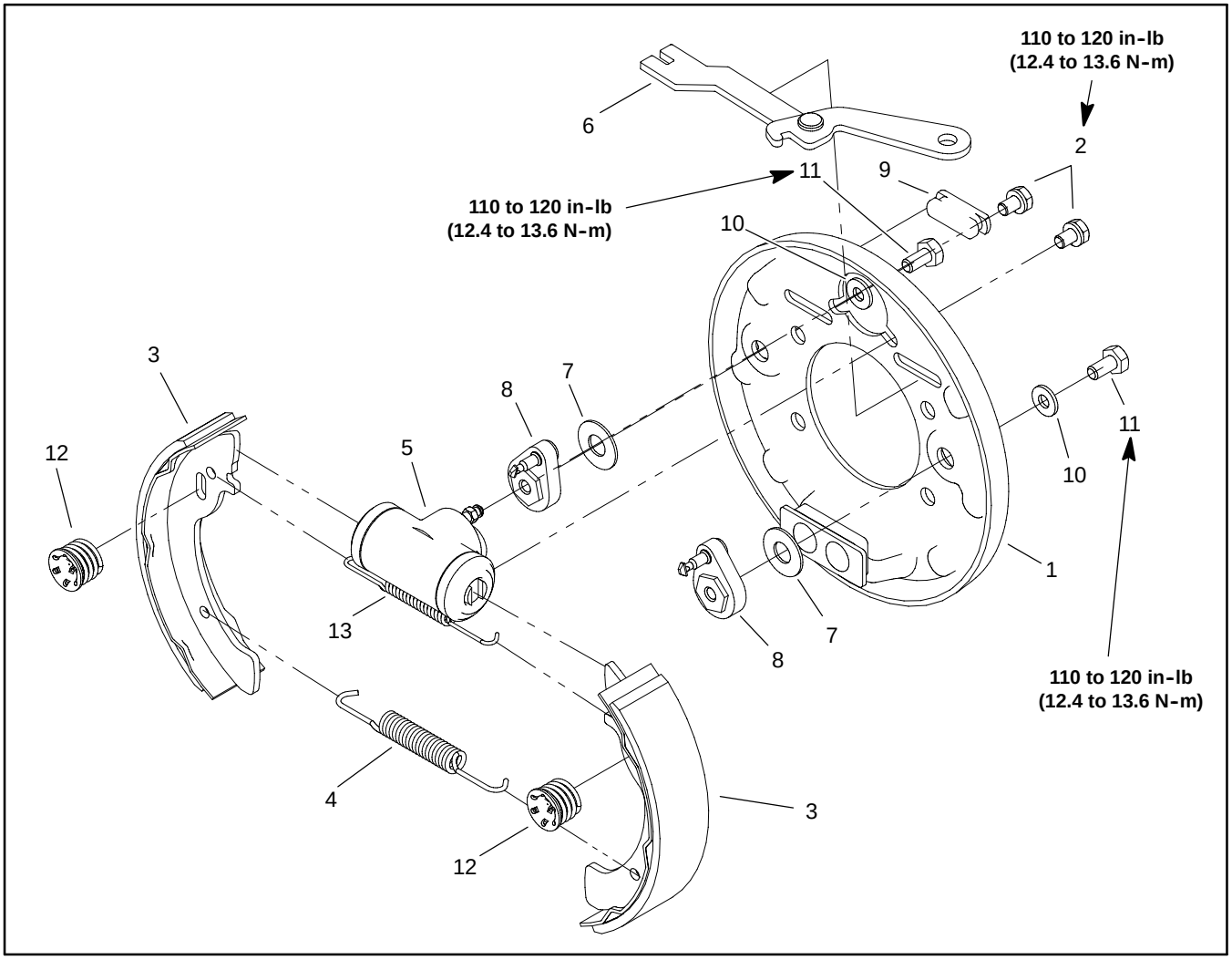

Figure 4

1. Brake backing plate
2. Washer head screw
3. Brake shoe
4. Lower spring
5. Wheel cylinder
6. Parking brake lever (LH shown)
7. Belleville washer
8. Adjuster lever
9. Dust cover
10. Flat washer
11. Bolt
12. Shoe hold down cup and spring
13. Upper spring

Disassembly (Fig. 4)

CAUTION

Be careful when removing springs from brake shoes. The springs are under heavy load 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 required, slide parking brake lever from slot and dust cover in backing plate.

5. If necessary, remove two (2) washer head screws that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

6. If necessary, remove bolts 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 (Fig. 4)

1. Inspect brake drums.

   IMPORTANT:Brake drum machining is not recommended. Replace 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 6.320" (160.5 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 can be removed with sandpaper.

2. Inspect brake shoe linings.

   IMPORTANT:Replace 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 on adjuster levers for bends, rust and corrosion. Replace as necessary.

3. Inspect backing plate surfaces, which contact with the brake shoes for grooves that may restrict shoe movement. Replace plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace plate if cracked, warped or excessively rusted.

4. Inspect adjuster levers for deformation. Replace levers if deformation or excessive rust is found.

5. Replace parking brake cables if frayed, stretched or kinked.

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 surface that contacts shoe webs.

   D. Both surfaces of belleville washers that are positioned between adjuster levers and backing plate.

2. If removed, position lubricated belleville washer between lever adjuster and backing plate. Secure adjuster to backing plate with washer and bolt. Torque bolt from **110 to 120 in−lb (12.4 to 13.6 N−m)**.

3. If removed, secure wheel cylinder to backing plate with two (2) washer head screws. Torque screws from **110 to 120 in−lb (12.4 to 13.6 N−m)**.

4. If removed from backing plate, slide parking brake lever into slot and dust cover in backing plate.

5. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, parking brake lever, wheel cylinder and pin on adjuster lever. Secure shoes to backing plate with shoe hold down cups and springs.

CAUTION

Be careful when installing springs to brake shoes. The springs are under heavy load and may cause personal injury.

6. Secure brake shoes with upper and lower springs.

Hydraulic Brake System

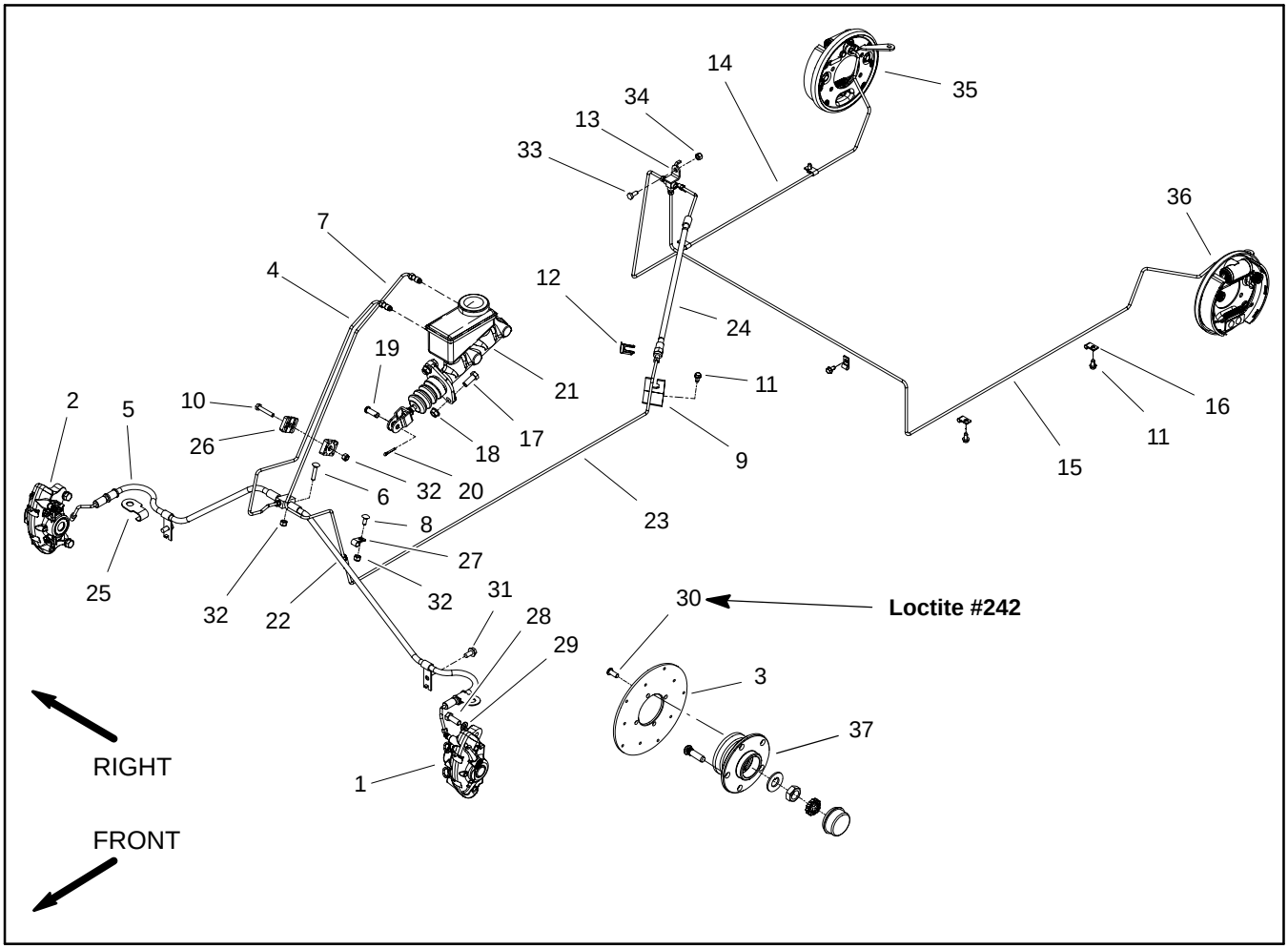

Figure 5

1. **Brake caliper (LH)**
2. **Brake caliper (RH)**
3. **Brake rotor (2 used)**
4. **Front brake tube**
5. **Front brake hose**
6. **Carriage screw**
7. **Rear brake tube**
8. **Carriage screw**
9. **Rear brake hose bracket**
10. **Cap screw**
11. **Thread forming screw (6 used)**
12. **Clip**
13. **Tee fitting**
14. **Rear brake tube (RH)**
15. **Rear brake tube (LH)**
16. **Insulated clip (5 used)**
17. **Cap screw (2 used)**
18. **Flange nut (2 used)**
19. **Clevis pin**
20. **Cotter pin**
21. **Master cylinder**
22. **Union fitting**
23. **Rear brake tube**
24. **Rear brake hose**
25. **Hose bracket (2 used)**
26. **Tube clamp (2 used)**
27. **R–Clamp**
28. **Cap screw (2 per caliper used)**
29. **Lock washer (2 per caliper used)**
30. **Socket head screw (4 per rotor used)**
31. **Washer head screw (2 used)**
32. **Lock nut**
33. **Cap screw**
34. **Lock nut**
35. **Rear brake (RH)**
36. **Rear brake (LH)**
37. **Wheel hub assembly (2 used)**

When performing service work on the Workman MDE hydraulic brake system, make sure to thoroughly clean components before disassembly. Use Figure 5 as a guide for removal and installation of hydraulic brake components.

Bleed Brake System

1. Connect a suitable transparent hose to bleeder valve on a wheel cylinder or caliper. Submerge other end of hose in a glass container partially filled with clean brake fluid.

2. Have a second person pump brake pedal several times, then hold pedal down firmly.

3. With pedal firmly depressed, open bleeder valve 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 brake cylinders and calipers.

CAUTION

After servicing the brakes, always check the brakes 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 brake pedal is solid.

Front Brake Calipers

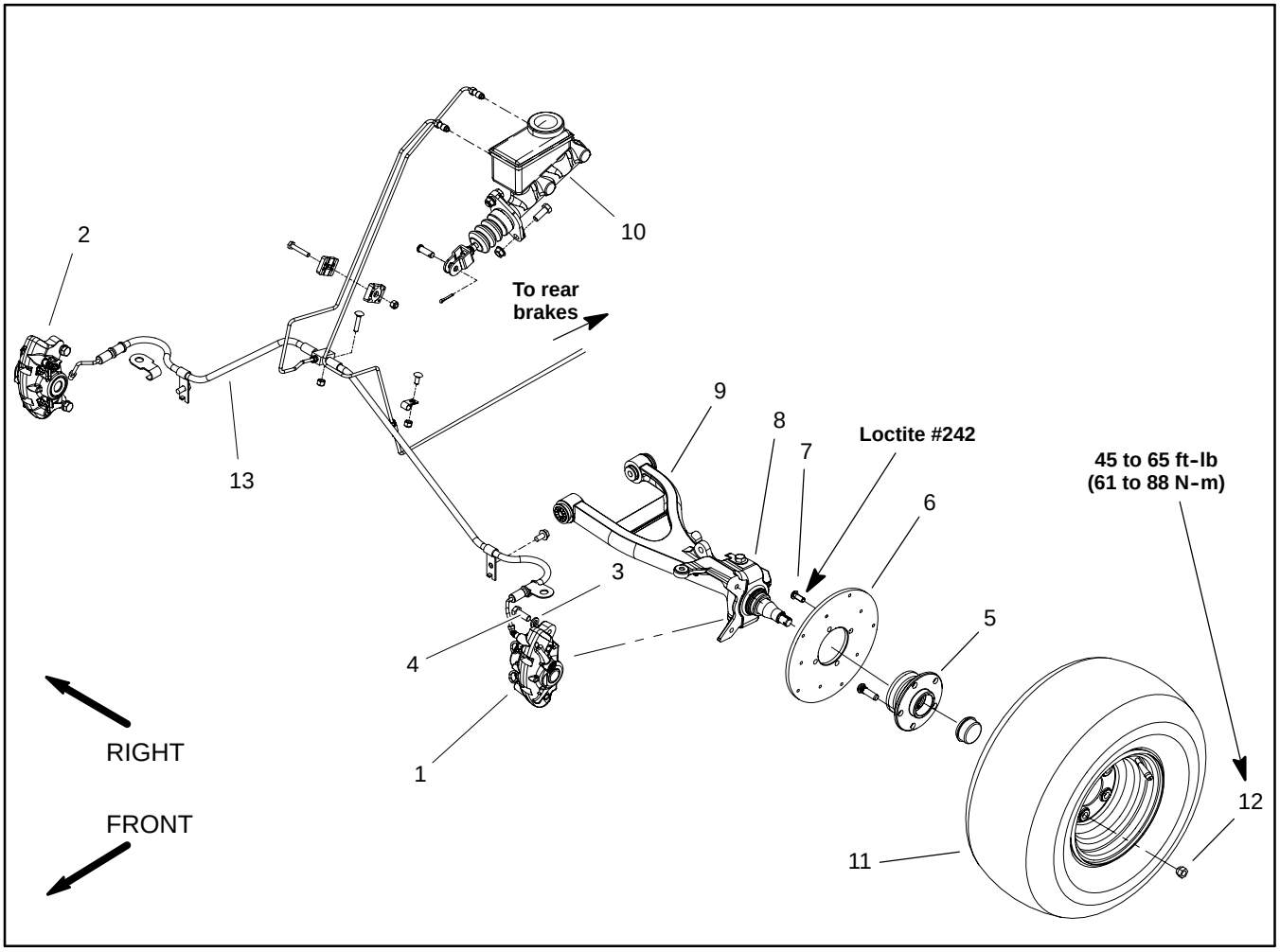

Figure 6

1. **LH brake caliper**
2. **RH brake caliper**
3. **Lock washer (2 per caliper used)**
4. **Cap screw (2 per caliper used)**
5. **Wheel hub assembly**
6. **Brake rotor**
7. **Socket head screw (4 per rotor used)**
8. **Spindle (LH shown)**
9. **A-arm (LH shown)**
10. **Brake master cylinder**
11. **Wheel assembly**
12. **Lug nut (5 used per wheel)**
13. **Front brake hose**

Removal (Fig. 6)

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

> **WARNING**
>
> **Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.**

2. Chock wheels not being jacked up. Jack front wheel off the ground and support machine with appropriate jack stands.

3. Remove front wheel from machine (see Lower Steering and Front Wheel Removal in the the Service and Repairs section of Chapter 5 – Chassis).

4. Clean hydraulic brake line area of brake caliper to prevent contamination. Loosen and disconnect brake line from caliper. Plug brake line and position it away from caliper.

5. Remove two (2) cap screws and lock washers that secure the brake caliper to the spindle.

6. Slide brake caliper from brake rotor and remove caliper from machine.

7. If necessary, remove brake pads from caliper (Fig. 7):

   A. Remove anti–rattle clip from caliper.

   B. Remove pins from caliper by prying with a flat blade screwdriver through loop in pins.

   C. Slide brake pads from caliper. For assembly purposes, note orientation of inner and outer pads as the pads are not the same.

   D. Replace the brake pads if the friction material is worn to less than 1/32” (0.8 mm).

8. If brake rotor service is necessary, see Lower Steering and Front Wheels in the Service and Repairs section of Chapter 5 – Chassis.

Installation (Fig. 6)

1. If brake pads were removed from caliper, install pads (Fig. 7):

   A. If brake pads are being replaced, it will be necessary to push caliper pistons back into the caliper bore before installing new pads.

   B. Slide brake pads into caliper. Make sure that friction material on pads is toward brake rotor position.

   C. Secure pads into caliper with two (2) pins. Make sure that pins snap into caliper slots. Install anti–rattle clip to caliper, pin and brake pads.

2. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

3. Align caliper mounting holes with spindle. Secure caliper with two (2) cap screws and lock washers.

4. Install brake hose to caliper.

5. Install front wheel assembly.

6. Lower machine to ground. Torque lug nuts in a crossing pattern from **45 to 65 ft–lb (61 to 88 N–m)**.

7. Bleed brakes (see Bleed Brake System in this section).

> **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.

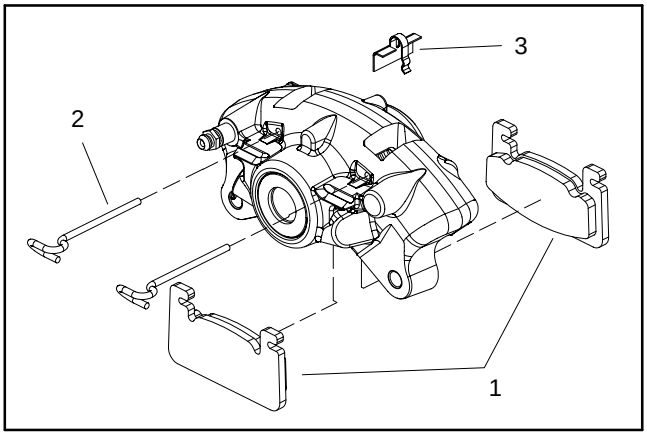

Figure 7

1. **Brake pad**
2. **Pin (2 used)**
3. **Anti–rattle clip**

Brake Master Cylinder

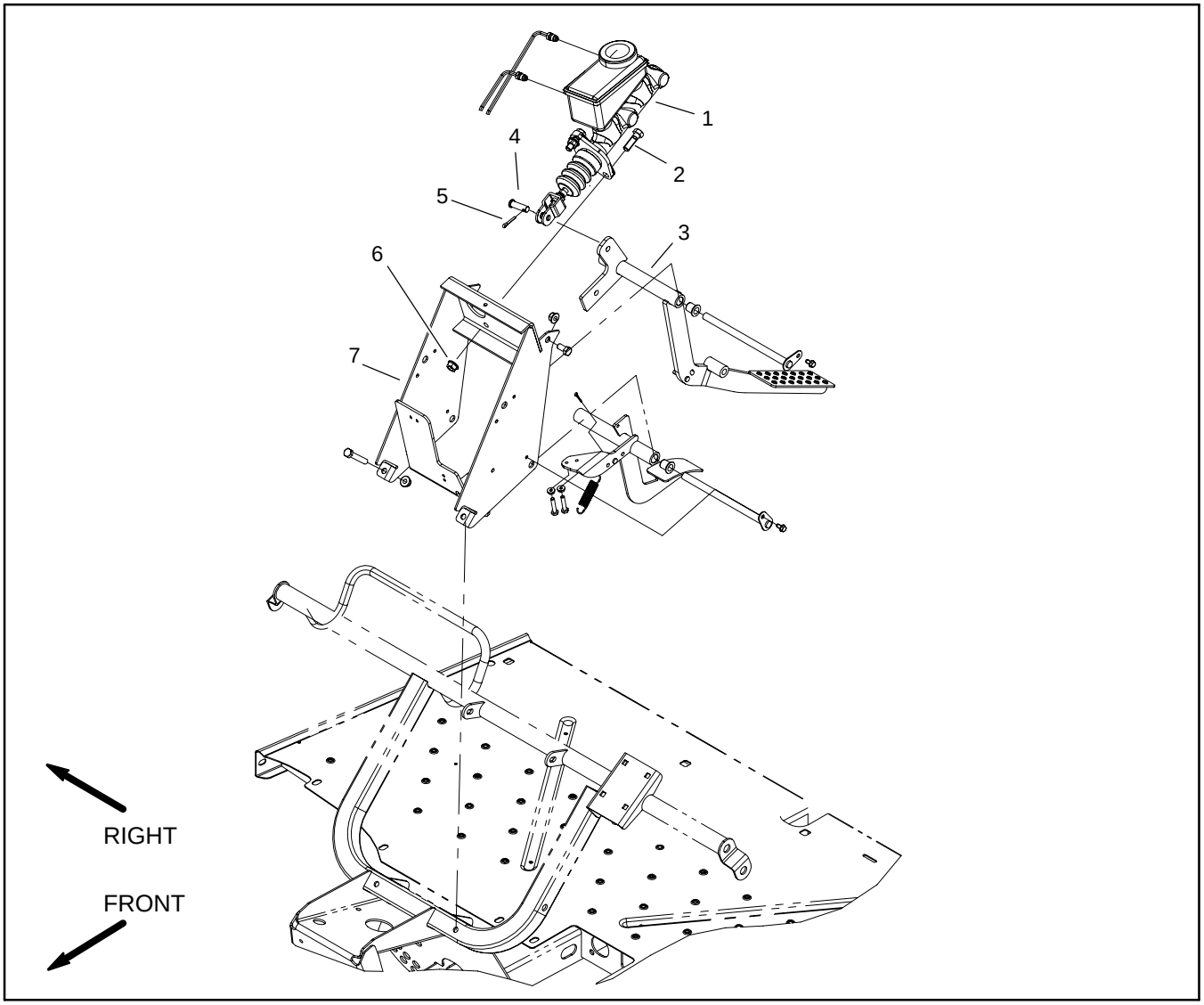

Figure 8

1. **Master cylinder**
2. **Cap screw**
3. **Brake pedal**
4. **Clevis pin**
5. **Cotter pin**
6. **Flange head nut**
7. **Pedal frame**

Removal (Fig. 8)

1. Raise and support front hood.

2. Remove cotter pin from the clevis pin that connects master cylinder to brake pedal.

3. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and position them away from master cylinder.

4. Remove flange head nuts from cap screws that secure master cylinder to pedal frame.

5. Pull master cylinder from machine.

Installation (Fig. 8)

1. Position master cylinder to pedal frame and secure with cap screws and flange nuts.

2. Remove plugs from brake lines. Install brake lines to master cylinder.

3. Connect master cylinder to brake pedal with clevis pin and cotter pin.

4. Lower and secure front hood.

5. Bleed brakes (see Bleed Brake System in this chapter). Check brake operation.

Brake Master Cylinder Service

Disassembly (Fig. 9)

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.

Assembly (Fig. 9)

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.

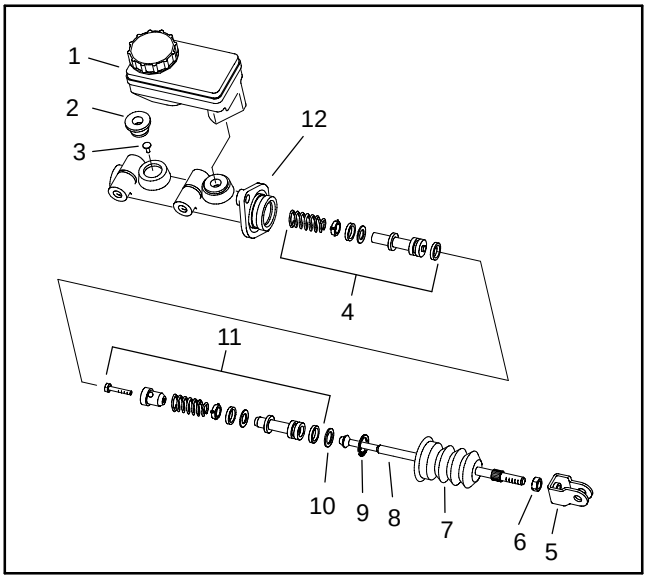

Figure 9

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**

Parking Brake

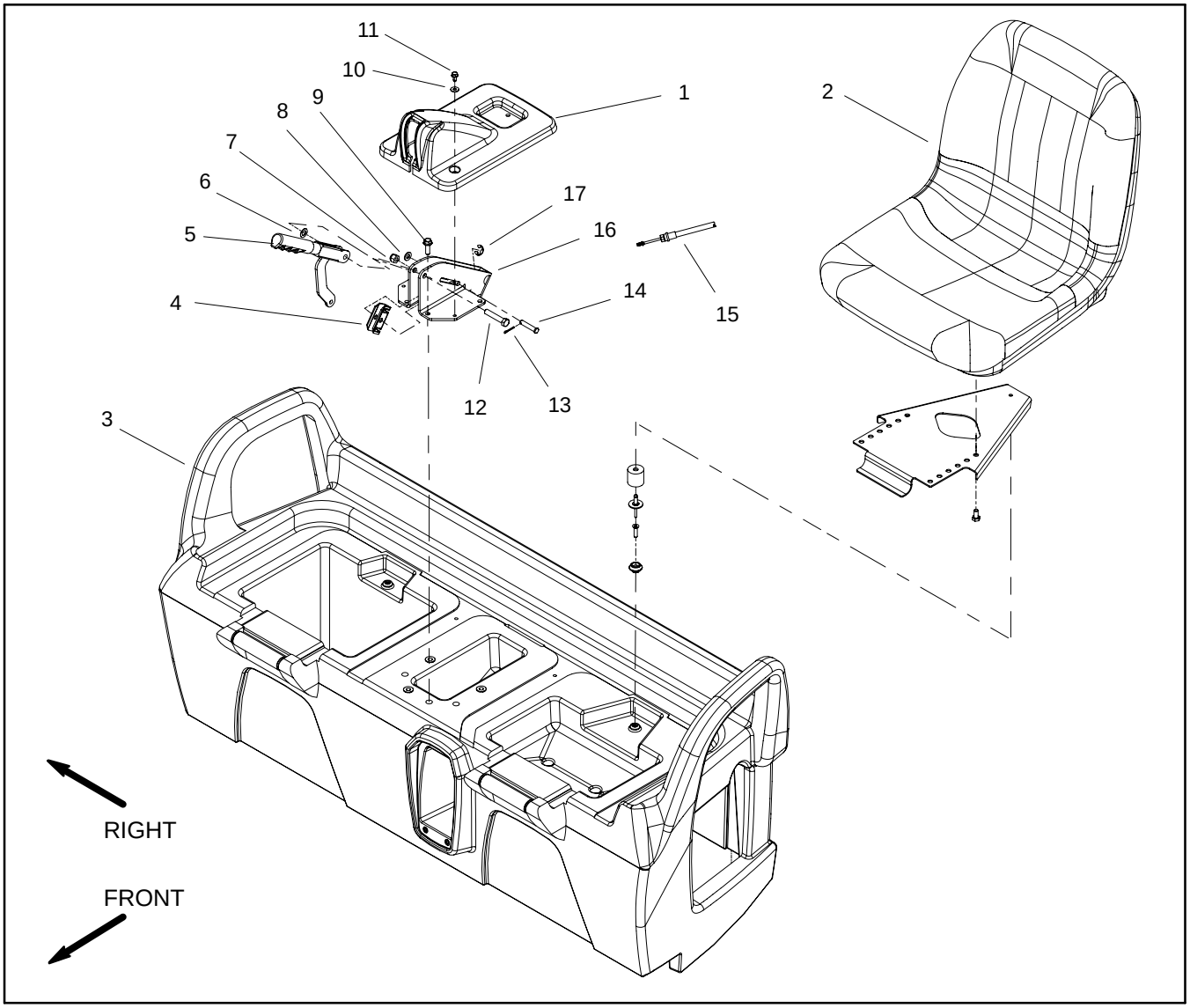

Figure 10

1. **Parking brake cover**
2. **Operator seat**
3. **Seat base**
4. **Cable equalizer bracket**
5. **Parking brake lever**
6. **Curved washer**
7. **Lock nut**
8. **Flat washer**
9. **Flange head screw (4 used)**
10. **Flat washer (2 used)**
11. **Screw (2 used)**
12. **Cap screw**
13. **Cotter pin**
14. **Clevis pin**
15. **Parking brake cable (2 used)**
16. **Parking brake support**
17. **Cable retaining ring (2 used)**

Disassembly (Fig. 10)

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

2. Disconnect both parking brake cables from rear of machine:

   A. Remove cotter pin and clevis pin that secures each parking brake cable end to brake lever.

   B. Remove retaining ring that secures each parking brake cable to frame.

   C. Remove screw and flange nut that secure each R−clamp to rear frame.

3. Note routing of brake cables for assembly purposes.

4. Remove parking brake cover from seat base.

5. Remove four (4) flange head screws that secure parking brake support to seat base.

6. Carefully remove parking brake support and brake cables from machine. Take care to not damage brake cables while removing them from seat base opening.

7. Remove brake cables from parking brake support and cable equalizer bracket using Figure 10 as a guide.

Assembly (Fig. 10)

1. Secure brake cables to parking brake support and cable equalizer bracket using Figure 10 as a guide.

2. Route brake cables through seat base opening taking care to not damage cables. Position parking brake support to seat base.

3. Secure parking brake support to seat base with four (4) flange head screws.

4. Position brake cables to rear brake assemblies using cable routing noted during disassembly.

5. Secure brake cables to rear of machine:

   A. Secure each R−clamp to rear frame with screw and flange nut.

   B. Secure each parking brake cable to frame with retaining ring.

   C. Secure each parking brake cable end to brake lever with clevis pin and cotter pin.

6. Check parking brake operation and adjust if necessary.

Transaxle

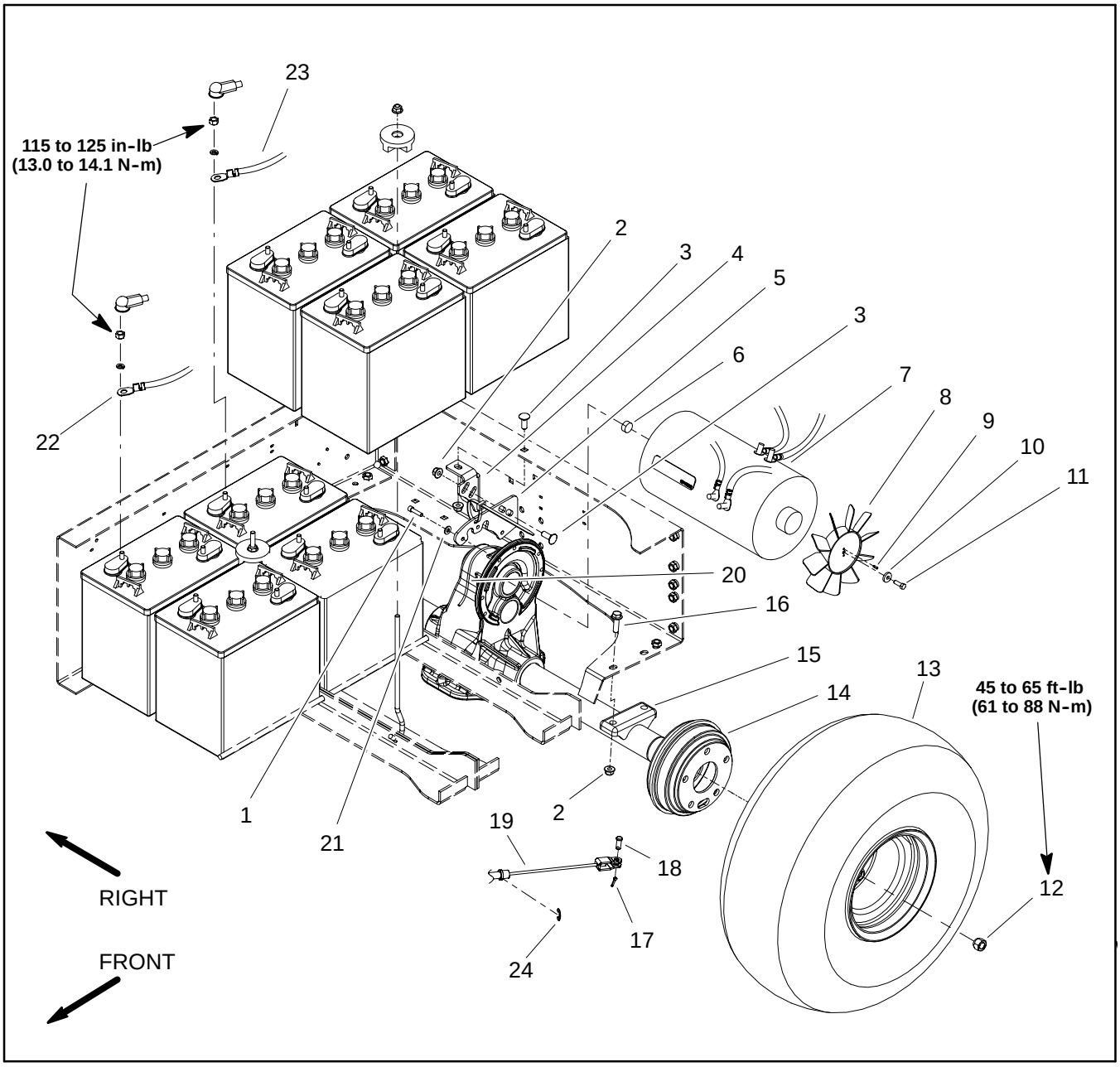

Figure 11

1. Socket head screw (6 used)
2. Flange nut
3. Carriage screw (5 used)
4. Support bracket
5. Transaxle mount plate
6. Rubber damper
7. Traction motor
8. Fan
9. Roll pin (2 used)
10. Washer
11. Socket head screw
12. Lug nut (5 used per wheel)
13. Wheel assembly
14. Brake drum
15. Transaxle
16. Flange head screw (4 used)
17. Cotter pin
18. Clevis pin
19. Parking brake cable
20. Transaxle vent hose
21. Flat washer (6 used)
22. Negative battery cable
23. Positive battery cable
24. Retaining ring

Removal (Fig. 11)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from switch.

2. Remove cargo box from vehicle (see Cargo Box Removal in Service and Repairs section of Chapter 5 – Chassis).

3. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).

NOTE: Label all electrical leads for assembly purposes.

IMPORTANT: When removing cables from traction motor terminals (A1, A2, F1 and F2), use a wrench to retain lower nut before loosening upper nut (Fig. 12). If terminal studs are allowed to turn during upper nut removal, internal motor damage can occur.

4. Disconnect cables from traction motor:

   A. While retaining lower nut, remove upper nut and cable connector from motor terminals A1, A2, F1 and F2.

   B. Unplug motor temperature sensor from vehicle wire harness.

   C. Position disconnected cables away from motor.

WARNING

Before jacking up the vehicle, review and follow Jacking Instructions in Operator's Manual and in Chapter 1 – Safety.

5. Jack up rear of vehicle enough to remove rear wheels.

   A. Chock the front and rear of both front tires to prevent the vehicle from moving.

   B. Support both sides of the rear frame with jackstands positioned just in front of the axle tubes. This will allow the transaxle to be removed from the rear of the vehicle.

6. Remove rear wheels from vehicle.

7. Remove cotter pins and clevis pins that secure parking brake cables to brake actuator levers (Fig. 13). Position brake cables away from transaxle assembly.

8. Clean hydraulic brake line area of rear brake cylinders to prevent contamination. Loosen and disconnect hydraulic brake line from both wheel cylinders. Plug brake lines and position them away from wheel cylinders.

9. Attach hoist to the transaxle and motor assembly. Make sure lifting device is attached so it can hold the full weight of the transaxle and traction motor.

10. Loosen and remove two (2) flange nuts and carriage screws that secure transaxle mount plate (item 5) to support bracket (item 4) (Fig. 14).

11. Remove four (4) flange head screws and flange nuts securing the transaxle to the rear frame.

12. Carefully lower transaxle and motor assembly from the rear of the vehicle.

13. If necessary, remove traction motor from transaxle (see Traction Motor Removal in Service and Repairs section of Chapter 3 – Electrical System).

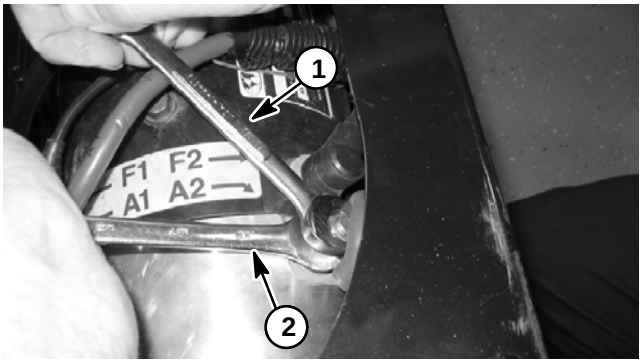

Figure 12

1. **Loosening/tightening wrench (upper nut)**
2. **Retaining wrench (lower nut)**

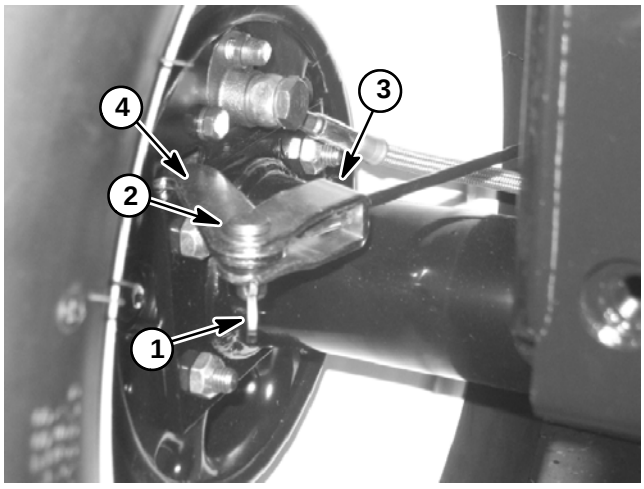

Figure 13

1. **Cotter pin**
2. **Clevis pin**
3. **Brake cable bracket**
4. **Brake actuator lever**

Installation (Fig. 11)

1. If removed, install traction motor to transaxle (see Traction Motor Installation in Service and Repairs section of Chapter 3 – Electrical System).

2. Position transaxle and motor assembly to the rear frame. Loosely install all fasteners used to secure transaxle to vehicle. Tighten fasteners in the following order:

   A. Tighten four (4) flange head screws and flange nuts that secure transaxle to the rear frame.

   B. Tighten two (2) flange nuts and carriage screws that secure transaxle mount plate (item 5) to support bracket (item 4).

3. Install parking brake cables to brake actuator levers with clevis pins and cotter pins.

4. Position and secure hydraulic brake lines to wheel cylinders (Fig. 3). Torque banjo bolts from **15 to 21 ft-lb (21 to 28 N-m)**.

5. Position wheel assemblies to the vehicle with valve stems facing out. Secure each wheel with five (5) lug nuts.

6. Lower vehicle from jackstands. Torque lug nuts in a crossing pattern from **45 to 65 ft-lb (61 to 88 N-m)**.

7. Connect wires to traction motor (Fig. 15):

   IMPORTANT: When connecting cables to motor terminals (A1, A2, F1 and F2), use a back-up wrench to retain lower nut before tightening upper nut (Fig. 12). If terminal studs are allowed to turn during upper nut installation, internal motor damage can occur.

   A. Install cable connector and upper nut to motor terminals A1 and A2. While retaining lower nut, torque upper nut on terminals A1 and A2 from **85 to 90 in-lb (9.6 to 10.2 N-m)**.

   B. Install cable connector and upper nut to motor terminals F1 and F2. While retaining lower nut, torque upper nut on terminals F1 and F2 from **55 to 60 in-lb (6.2 to 6.8 N-m)**.

   C. Plug motor temperature sensor connector into vehicle wire harness.

8. Carefully connect removed battery cable to battery terminals. Install lock washers and nuts on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

9. Install cargo box to the rear frame (see Cargo Box Installation in Service and Repairs section of Chapter 5 – Chassis).

10. Check brakes for proper operation.

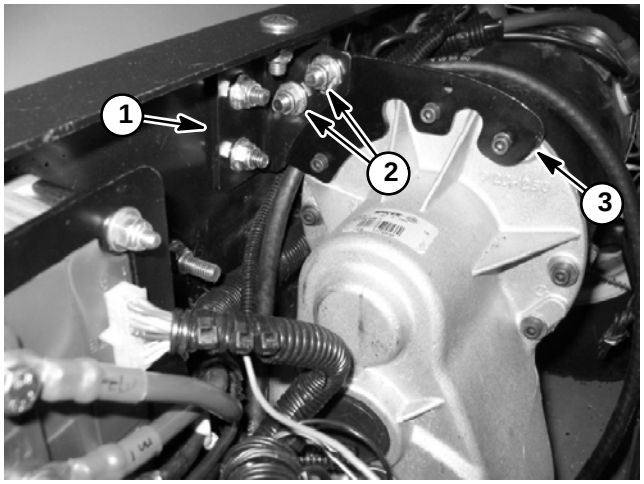

Figure 14

1. **Support bracket**
2. **Carriage screws/nuts**
3. **Transaxle mount plate**

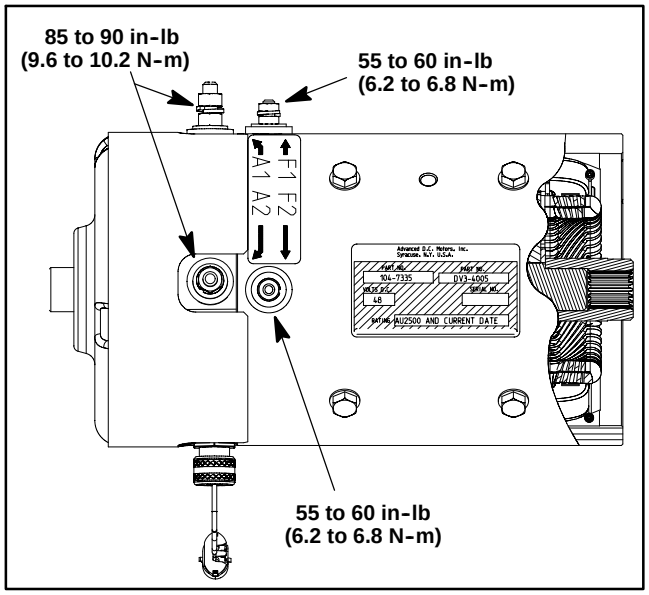

Figure 15

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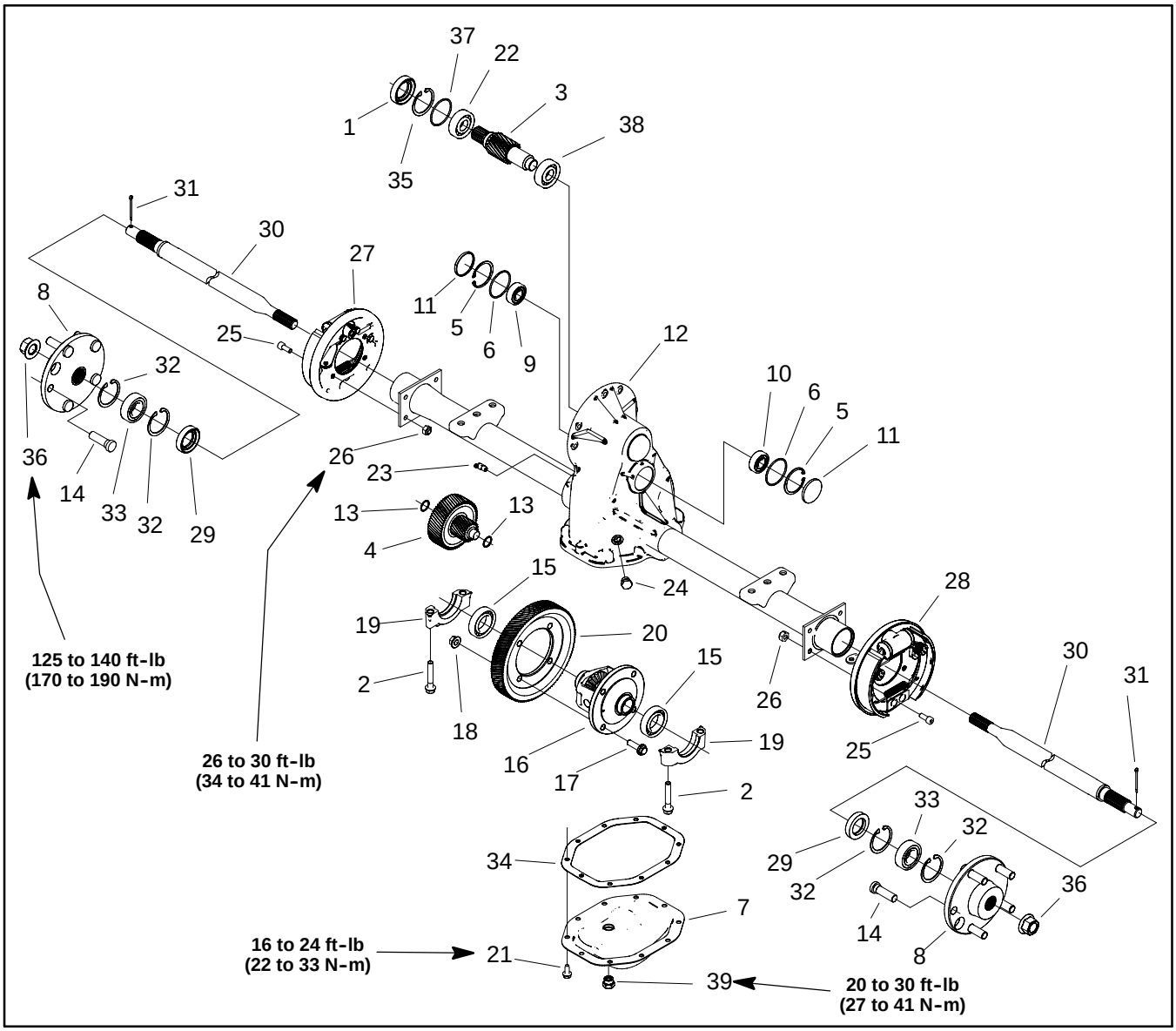

Figure 16

1. Oil seal
2. Bearing cap bolt (2 used per cap)
3. Input shaft
4. Intermediate shaft & gear
5. Retaining ring (2 used)
6. O-ring (2 used)
7. Cover plate
8. Wheel hub (2 used)
9. Ball bearing
10. Ball bearing
11. Endcap plug (2 used)
12. Transaxle housing
13. O-ring (2 used)
14. Wheel stud (5 used per hub)
15. Ball bearing (2 used)
16. Differential assembly
17. Hex screw (4 used)
18. Lock nut (4 used)
19. Bearing cap (2 used)
20. Final drive gear
21. Screw (10 used)
22. Ball bearing
23. Vent elbow
24. Plug
25. Socket head screw (4 used per brake)
26. Lock nut (4 used per brake)
27. LH brake assembly
28. RH brake assembly
29. Oil seal (2 used)
30. Axle shaft (2 used)
31. Cotter pin (2 used)
32. Bearing retaining ring (4 used)
33. Ball bearing (2 used)
34. Gasket
35. Retaining ring
36. Flange nut (2 used)
37. O-ring
38. Ball bearing
39. Plug

NOTE: For service of the transaxle, see the Spicer Off-Highway Components Model 12 (Electric) Maintenance Manual at the end of this chapter.

Chapter 5

Chassis

Table of Contents

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

Specifications

Item	Description
Front tire (22 x 9.5 – 10, 4 ply) pressure	8 to 22 PSI (55 to 152 kPa)
Rear tire (22 x 9.5 – 10, 4 ply) pressure	8 to 22 PSI (55 to 152 kPa)
Wheel lug nut torque (front and rear)	45 to 65 ft-lb (61 to 88 N-m)
Brake Fluid	DOT 3

Special Tools

Order special tools from your Toro Distributor.

Spanner Wrench

Use spanner wrench to rotate front shock absorber collar which changes the length of the shock spring to affect front wheel camber. Make sure that vehicle is jacked up off the ground to allow shock spring to be at full extension before using spanner wrench.

Toro Part Number: **TOR6010**

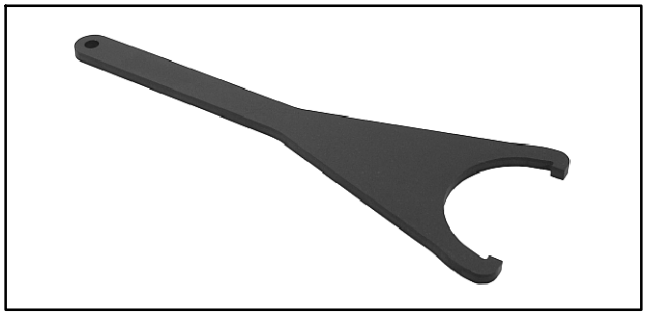

Figure 1

Shock Spring Compressor

Use shock spring compressor to remove spring from front shock absorber.

Toro Part Number: **TOR6015**

Figure 2

Troubleshooting

Suspension and Steering

Problem	Possible Cause
Front end is noisy.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Front end components are loose or worn. Steering gearbox is damaged or worn.
Rear end is noisy.	Rear wheel lug nuts are loose. Transaxle problem (see Chapter 4 – Transaxle and Brakes).
Excessive steering play.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Steering linkage is loose or worn. Tie rod ends are loose or worn. Steering gearbox is damaged or worn.
Front end shimmies.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Front wheel alignment (toe–in) is incorrect. Steering linkage is loose or worn. Tie rod ends are loose or worn. Bushings in A–arm are worn.
Vehicle is unstable or wanders.	Tire pressure is low or uneven between tires. Wheel lug nuts are loose. Front wheel bearings are loose. Front wheel alignment (toe–in) is incorrect. Steering column bushings are worn. Bushings in A–arm are worn. Steering gearbox is damaged or worn.

Suspension and Steering (continued)

Problem	Possible Cause
Steering is hard.	Tire pressure is low or uneven between tires. Front wheel alignment (toe–in) is incorrect. Steering linkage is binding or damaged. Steering gearbox is damaged or worn.
Vehicle pulls to one side when not braking.	Tire pressure is low or uneven between tires. Front wheel alignment (toe–in) is incorrect. Steering or suspension component is bent or damaged.

Adjustments

Adjust Front Wheel Camber

1. Adjust front tire pressures to 12 PSI (82 kPa) before checking front wheel camber.

2. Either add weight to the driver's seat equal to the average operator who will run the machine or have an operator on the vehicle operator's seat. The weight or operator must remain on the seat for the duration of this front wheel camber procedure.

3. On a level surface, roll the vehicle straight back from 6 to 10 feet (2 to 3 meters) and then straight forward to the original starting position. This will allow the suspension to settle into the normal operating position.

4. Make sure that the front wheels are facing straight ahead.

5. Measure the front wheel camber on both front wheels:

   A. Place a 90º square on the ground with the vertical edge touching the face of the tire (Fig. 2.1).

   B. From the same part of the rim, measure the distance from the top and bottom of the rim to the square. Record the two (2) measurements.

   C. The measurement at the bottom of the rim should be 0.090" (2.3 mm) larger than the top measurement. This measurement allows for a camber of 0+1/2 degree.

   D. Repeat measurement procedure for other front wheel.

6. If camber measurement for either wheel is incorrect, adjust shock absorber spring to correct camber for that wheel:

   A. Chock wheels to prevent the vehicle from moving. Use a jack to raise vehicle and allow shock absorber to extend. This will allow easier shock spring adjustment.

   B. Use spanner wrench (TOR6010: see Special Tools in this chapter) to rotate shock absorber collar which changes the length of the shock spring (Fig. 2.2). If the bottom camber measurement was too short, rotate the collar to reduce the length of the shock spring. If the bottom camber measurement was too long, rotate the collar to increase the length of the shock spring.

   C. Lower vehicle to level surface.

7. Repeat steps 2 through 6 until front wheel camber on both wheels is correct.

8. After camber adjustment, check front wheel toe-in (see Adjust Front Wheel Toe-in in this section).

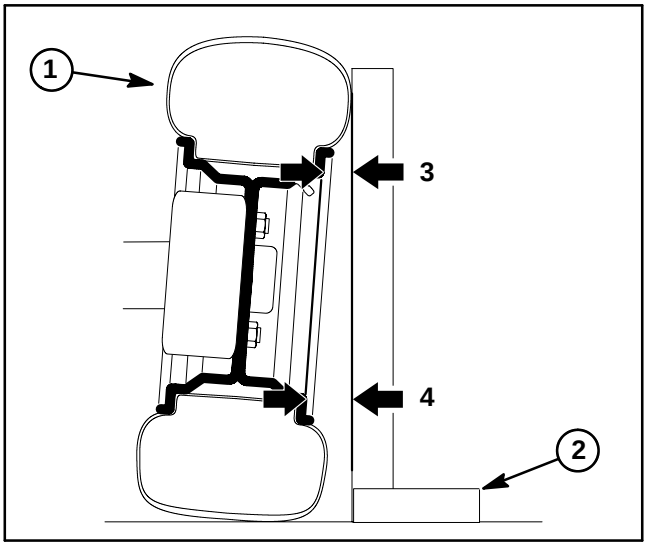

Figure 2.1

1. **Front wheel**
2. **90º square**
3. **Top measurement**
4. **Bottom measurement**

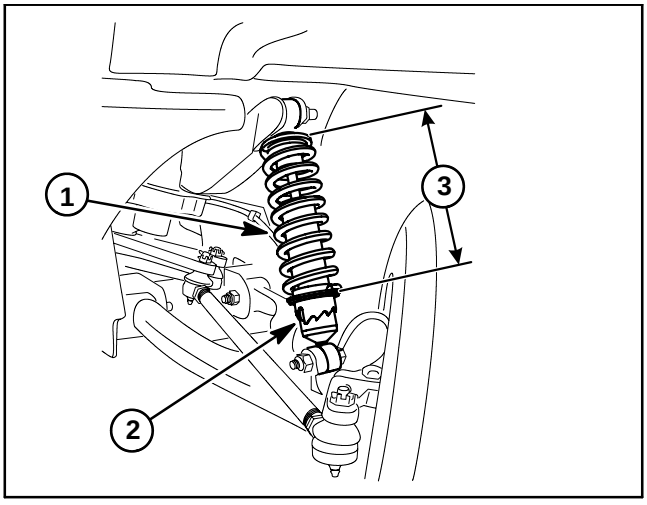

Figure 2.2

1. **Shock absorber spring**
2. **Collar**
3. **Spring length**

Adjust Front Wheel Toe−in

NOTE: Before adjusting front wheel toe−in, make sure that front wheel camber is correctly adjusted (see Adjust Front Wheel Camber in this section).

1. Adjust front tire pressures to 12 PSI (82 kPa) before checking front wheel camber.

2. Either add weight to the driver's seat equal to the average operator who will run the machine or have an operator on the vehicle operator's seat. The weight or operator must remain on the seat for the duration of this front wheel camber procedure.

3. On a level surface, roll the vehicle straight back from 6 to 10 feet (2 to 3 meters) and then straight forward to the original starting position. This will allow the suspension to settle into the normal operating position.

4. Make sure that the front wheels are facing straight ahead.

5. Measure distance between the front tires at axle height at both the front and rear of the tires (Fig. 2.3). Front wheel toe−in should be from 0 to 1/4 inch (0 to 6 mm).

6. If the front wheel toe−in is incorrect, adjust as follows:

   A. Loosen jam nuts at both ends of tie rods (Fig. 2.4).

   B. Rotate both tie rods to move front of tire inward or outward.

   C. Tighten tie rod jam nuts when toe−in adjustment is correct.

7. Ensure that there is full steering travel in both directions.

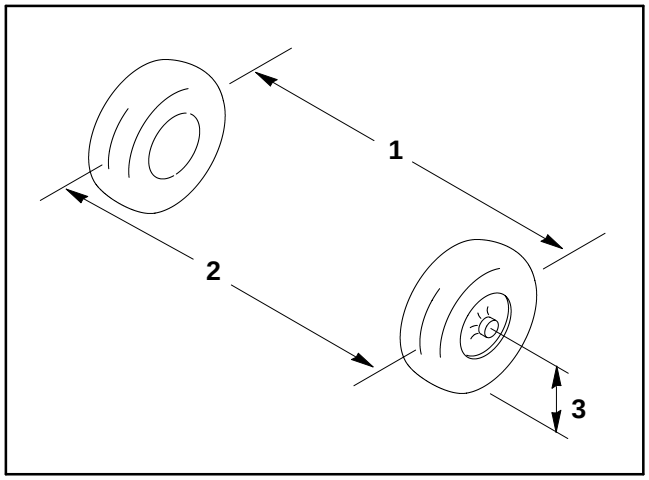

Figure 2.3

1. **Tire center line (back)**
2. **Tire center line (front)**
3. **Axle center line**

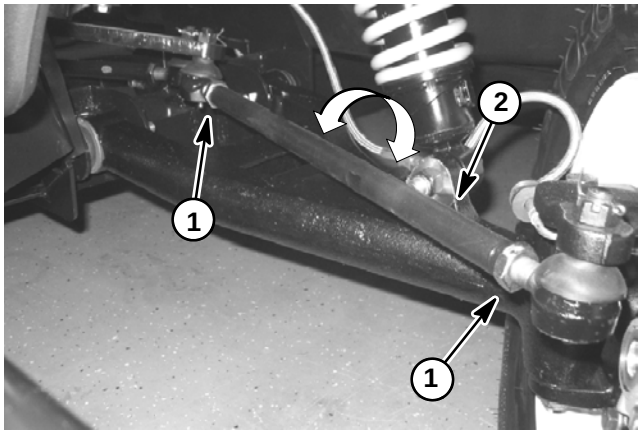

Figure 2.4

1. **Jam nut**
2. **Tie rod**

Check Tire Pressure

The tire pressure range for front and rear tires is 8 to 22 PSI (55 to 152 kPa). The tire pressure needed is determined by the payload carried.

Lower air pressure will provide less compaction, a smoother ride and fewer tire marks. Lower pressure should not be used for heavy payloads at higher speeds.

Higher pressures should be used for heavier payloads at higher speeds. Do not exceed the maximum tire pressure.

Inspect Tires and Wheels

Operating accidents, such as hitting curbs, can damage a tire or rim and also disrupt wheel alignment, so inspect wheel condition (tire and rim) and wheel alignment (toe–in) after any accident.

Check wheels to ensure they are mounted securely. Torque wheel lug nuts (front and rear) from **45 to 65 ft-lb (61 to 88 N–m)**.

If desired, tires can be moved from one position of the vehicle to another to extend tread life (e.g. front tires to rear and rear tires to front). All tires are the same size.

Upper Steering

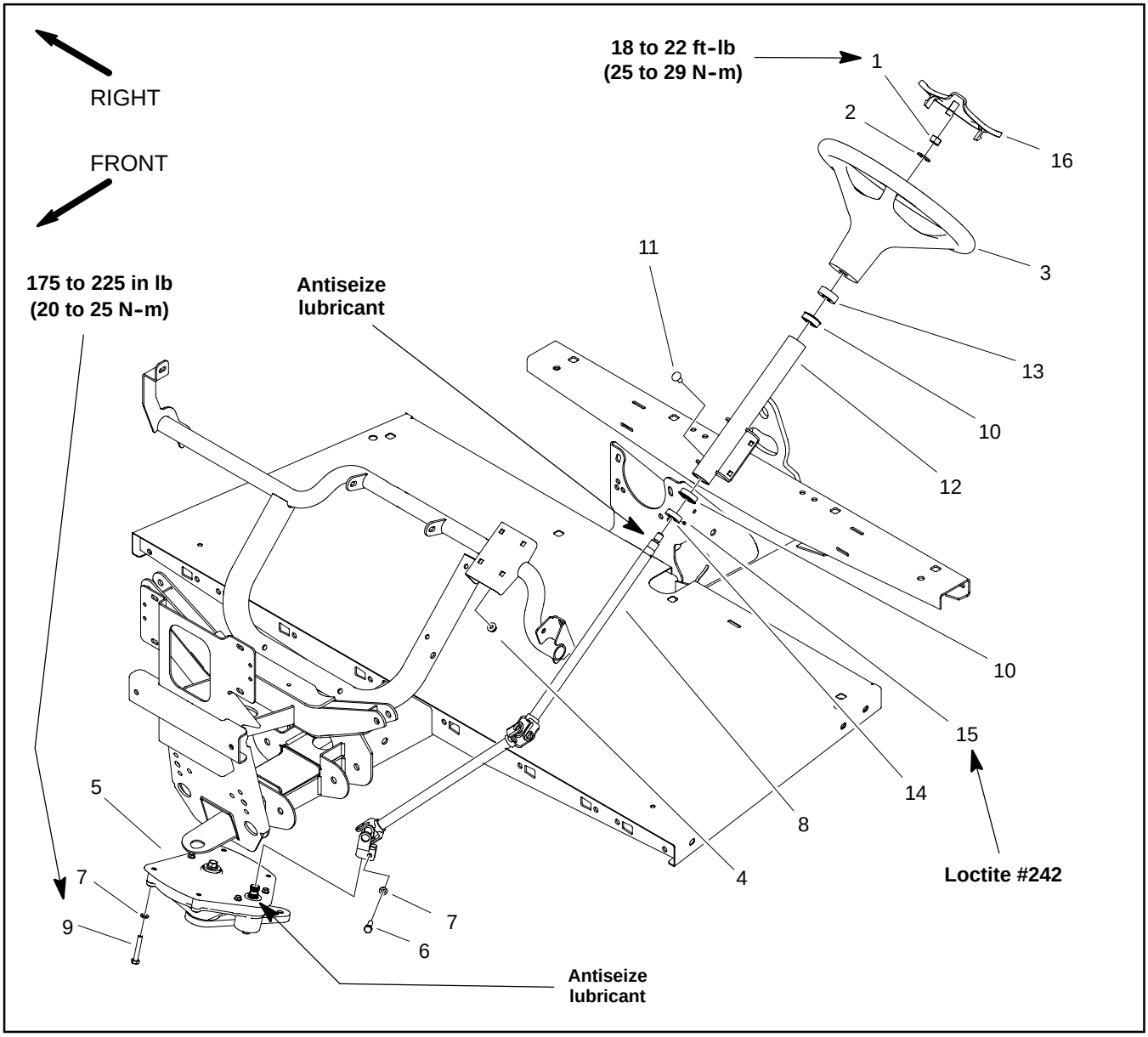

Figure 1

1. **Hex nut**
2. **Flat washer**
3. **Steering wheel**
4. **Flange nut (4 used)**
5. **Steering box assembly**
6. **Cap screw**
7. **Lock washer (6 used)**
8. **Steering shaft**
9. **Cap screw (4 used)**
10. **Bearing (2 used)**
11. **Carriage bolt (4 used)**
12. **Steering column**
13. **Dust cover**
14. **Collar**
15. **Set screw**
16. **Steering wheel cover**

Disassembly (Fig. 1)

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

2. Raise front hood to gain access to the steering components.

3. Carefully remove steering wheel cover from the steering wheel. Remove nut and flat washer securing the steering wheel to the steering shaft. Pull steering wheel from the shaft.

4. Remove cap screw and lock washer securing the lower steering shaft knuckle to the steering gearbox input shaft. Pull knuckle from the gearbox shaft.

5. Support steering column to prevent it from falling. Remove four (4) flange nuts and carriage screws securing the steering column to the mounting plate on the frame.

6. Remove dust cover (item 13) from the steering shaft. Replace cover if damaged. Slide steering shaft out of the steering column.

7. Disconnect both tie rods from the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Removal in this section).

8. Remove four (4) cap screws and lock washers that secure the steering gearbox to the tower plate on the front frame. Remove gearbox from the tower plate.

Assembly (Fig. 1)

1. Position steering gearbox to the tower plate of the front frame with the Pitman arm facing down and to the rear. The gearbox shaft must be to the left side of the tower.

2. Secure steering gearbox to the tower plate with four (4) cap screws and lock washers. Torque screws from **175 to 225 in-lb (20 to 25 N-m)**.

3. Make sure that collar (item 14) is positioned on steering shaft. Insert steering shaft up through the steering column.

4. Secure steering column to the mounting plate on the frame with four (4) carriage screws and flange nuts.

NOTE: Apply antiseize lubricant to the steering gearbox input shaft before installing to steering shaft knuckle.

5. Position knuckle of the lower steering shaft onto the gearbox input shaft. Secure knuckle to the steering gearbox shaft with cap screw and lock washer.

6. Make sure that collar (item 14) is just below steering column. If necessary, re-position collar on steering shaft. Apply Loctite #242 (or equivalent) to collar set screw and secure collar with set screw.

7. Place dust cover onto the steering shaft.

8. Connect both tie rods to the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Installation in this section).

NOTE: Apply antiseize lubricant to the steering shaft taper before installing the steering wheel.

9. Position front tires straight ahead. Slide steering wheel onto the steering shaft so that the leg of the “Y” formed by the wheel struts is directed towards the operator platform.

10. Secure steering wheel to shaft with flat washer and nut. Torque nut from **18 to 22 ft-lb (25 to 29 N-m)**. Install steering wheel cover to wheel.

11. Lower front hood.

12. Check front wheel alignment and adjust if necessary.

13. Make sure that front wheels move fully in both directions without contacting any front end components.

Steering Gearbox

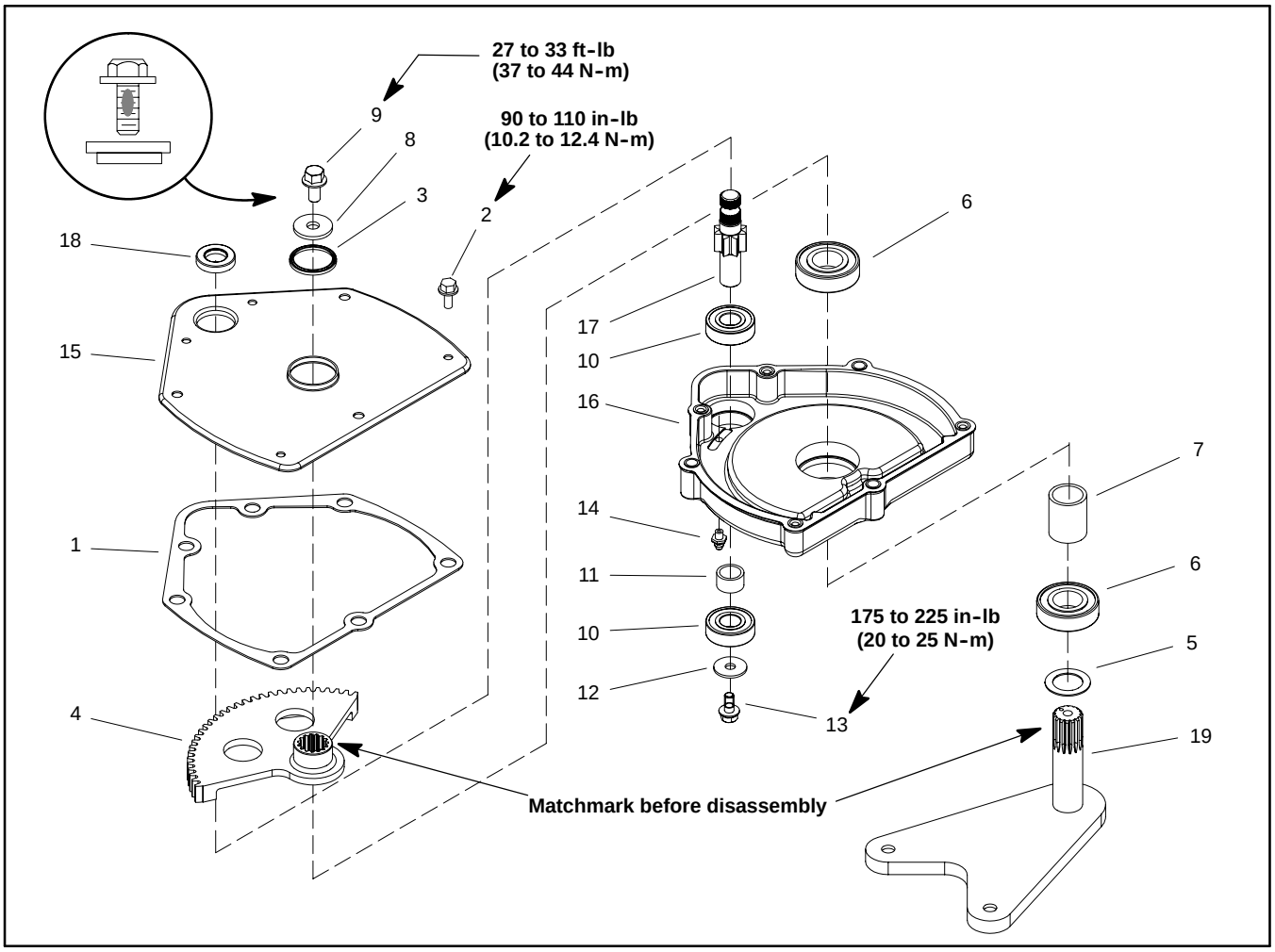

Figure 2

1. Gasket
2. Hex washer head screw (3 used)
3. Seal
4. Sector gear
5. Flat washer
6. Ball bearing
7. Output shaft spacer
8. Stepped washer
9. Flange head screw with patch lock
10. Ball bearing
11. Input shaft spacer
12. Flat washer
13. Flange head screw with patch lock
14. Lube fitting
15. Steering housing cover
16. Steering housing
17. Pinion gear
18. Oil seal
19. Pitman arm

Disassembly (Fig. 2)

IMPORTANT:Do not reuse flange head screw with patch lock after it has been removed.

1. Remove flange head screw with patch lock (item 9) and stepped washer (item 8) from Pitman arm. Discard flange head screw.

2. Remove flange head screw with patch lock (item 13) and flat washer (item 12) from pinion gear shaft. Discard flange head screw.

3. Remove three (3) hex washer head screws (item 2) securing the housing cover and gasket to the steering housing. Remove cover and gasket from the housing. Replace gasket if damaged.

4. Inspect gears. Sector and pinion gear teeth must be free of damage that prevents them of free movement.

5. Remove pinion gear (item 17) from the housing.

IMPORTANT:Matchmark pitman arm shaft and sector gear. Their position is critical during reassembly.

6. Separate Pitman arm (item 19) from the sector gear (item 4) and steering housing and remove from the housing.

7. Inspect bearings. Bearings must spin smoothly and be free of damage. Press bearings and spacer out of housing if necessary.

8. Inspect seals. Seals must be free of rips and tears. Replace seals if necessary.

Assembly (Fig. 2)

IMPORTANT:Always replace ball bearings as a set.

1. If ball bearings were removed:

   A. Press new bearing into housing from the inside first.

   B. Turn housing over. Insert spacer and press new bearing into housing.

2. If seals were removed, press new seals into housing. Seal lips should be facing up.

3. Place flat washer (item 5) onto shaft of the Pitman arm (item 19). Insert shaft into steering housing.

IMPORTANT:The position of the Pitman arm and sector gear is critical during gearbox assembly. If either or both of these parts is replaced, make sure their alignment matches the matchmark position of the original gear and arm.

4. Position sector gear (item 4) onto the spline of the Pitman arm shaft.

IMPORTANT:Make sure sector gear is centered to the pinion gear.

5. Insert pinion gear (item 17) into the small bearing in the steering housing.

6. Fill steering housing with number 2 general purpose grease. Make sure all gear teeth on the sector and pinion gears are covered with grease.

7. Place gasket and steering housing cover onto the housing. Secure cover to housing with three (3) hex washer head screws (item 2). Torque screws from **90 to 110 in-lb (10.2 to 12.4 N-m)**.

IMPORTANT:Flange head screws with patch lock (items 9 and 13) should be replaced whenever they are removed.

8. Secure stepped washer and flange head screw with patch lock (item 9) to the Pitman arm (item 8). Make sure to position stepped washer as shown in Figure 2. Torque screw from **27 to 33 ft-lb (37 to 44 N-m)**.

9. Secure flat washer (item 12) and flange head screw with patch lock (item 13) to the pinion gear shaft. Torque screw from **175 to 225 in-lb (20 to 25 N-m)**.

10. After assembly is completed, make sure that pitman arm rotates freely from stop to stop without binding.

Lower Steering and Front Wheels

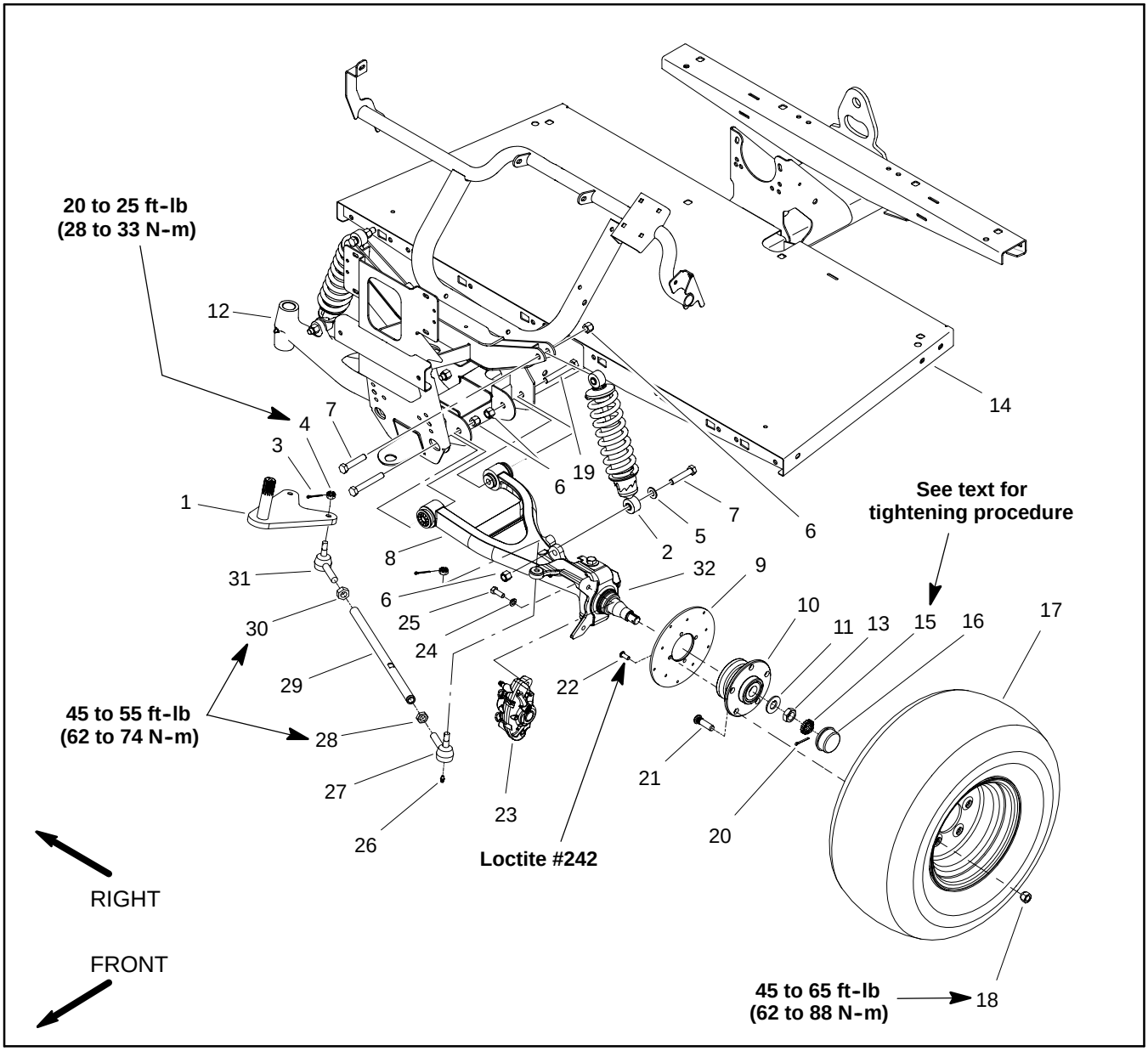

Figure 3

1. Steering gearbox pitman arm
2. Shock absorber (2 used)
3. Cotter pin
4. Slotted hex nut
5. Flat washer
6. Lock nut (3 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Brake rotor
10. Wheel hub assembly
11. Tab washer
12. RH A-arm
13. Jam nut
14. Front frame
15. Nut retainer
16. Dust cap
17. Wheel assembly
18. Lug nut (5 used per wheel)
19. Cap screw (2 used per A-arm)
20. Cotter pin
21. Wheel stud (5 used per hub)
22. Socket head screw (4 used per rotor)
23. Brake caliper (LH shown)
24. Lock washer (2 used per caliper)
25. Cap screw (2 used per caliper)
26. Grease fitting
27. Ball joint (LH threads)
28. Jam nut (LH threads
29. Tie rod tube
30. Jam nut (RH threads)
31. Ball joint (RH threads)
32. Spindle (LH shown)

Removal (Fig. 3)

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

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Remove lug nuts and pull wheel assembly from machine.

4. Remove brake caliper from spindle (see Front Brake Caliper in this section). Position caliper away from wheel hub and spindle.

5. Carefully pry dust cap from wheel hub.

6. Remove cotter pin and nut retainer from spindle.

7. Remove jam nut that secures wheel hub to spindle. Slide wheel hub with bearings and brake rotor from spindle.

8. Disassemble the wheel hub (Fig. 4):

   A. Pull the seal out of the wheel hub.

   B. Remove bearings from both sides of the wheel hub. Clean bearings in solvent. Make sure bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

   C. If necessary, remove wheel studs and brake rotor from wheel hub.

9. Remove spindle (Fig. 5):

   A. Remove cotter pin and castle nut securing tie rod ball joint to the spindle. Separate ball joint from the spindle. Remove tie rod from steering gearbox pitman arm if necessary.

   B. Remove lock nut and cap screw securing the spindle to the A–arm. Separate spindle from A–arm.

   C. Locate and remove thrust washer from bottom of kingpin sleeve in A–arm and brake hose clip from top of A–arm. Remove kingpin sleeve from A–arm if necessary.

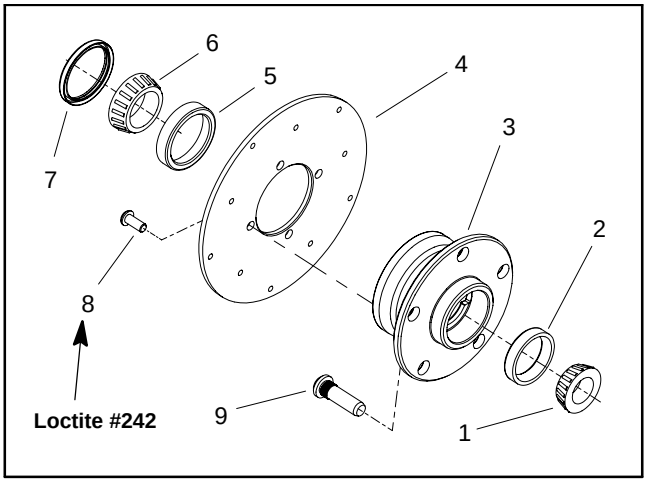

Figure 4

1. **Outer bearing cone**
2. **Outer bearing cup**
3. **Wheel hub**
4. **Brake rotor**
5. **Inner bearing cup**
6. **Inner bearing cone**
7. **Seal**
8. **Socket screw (4 used)**
9. **Wheel stud (5 used)**

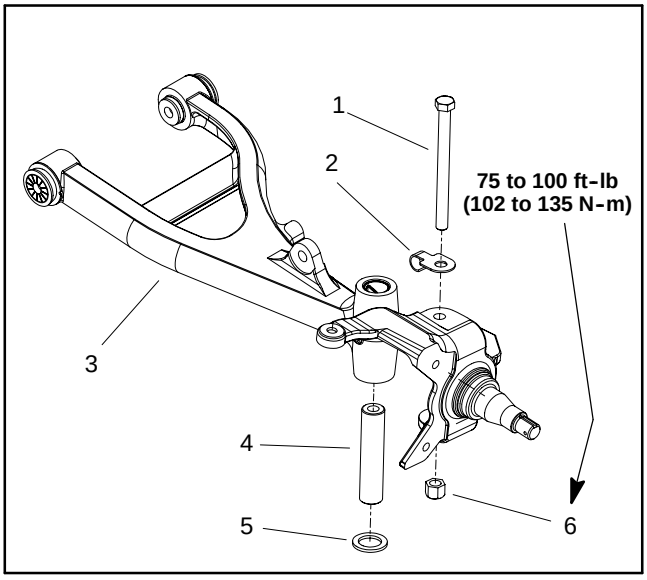

Figure 5

1. **Cap screw**
2. **Brake hose clip**
3. **A–arm (LH shown)**
4. **Kingpin sleeve**
5. **Thrust washer**
6. **Lock nut**

Installation (Fig. 3)

1. Install spindle as follows (Fig. 5):

   A. Make sure king pin sleeve is positioned into the pivot hub of the A–arm. Sleeve must extend through the bottom of the hub.

   B. Place thrust washer onto the bottom of the king pin sleeve. Then place spindle over the A–arm hub, king pin sleeve and thrust washer.

   NOTE: Make sure cap screw is inserted down through the spindle and A–arm hub.

C. Install brake hose clip onto cap screw. Secure spindle to A−arm hub with cap screw and lock nut. Torque fasteners from **75 to 100 ft−lb (102 to 135 N−m)**.

2. Install tie rod:

   A. Position tie rod assembly to spindle and pitman arm so that tie rod groove (LH threads) is orientated toward the left side of the machine (Fig. 6).

   B. Insert tie rod ball joints down through the spindle and up through the Pitman arm. Secure with castle nuts.

   C. Torque castle nuts from **20 to 25 ft−lb (28 to 33 N−m)** to secure ball joint while aligning castle nut slot with hole in ball joint stud. If necessary to align holes, castle nut torque may be slightly more than specification. Install cotter pin.

3. Assemble wheel hub (Fig. 4):

   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 inner bearing into the cup on inboard side of the wheel hub.

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

   C. Lubricate the inside of the new seal and press it into the wheel hub.

   D. If brake rotor was removed, position rotor to hub with chamfered edge toward hub. Apply Loctite #242 (or equivalent) to socket head screws and secure rotor to hub.

4. Slide wheel hub assembly onto spindle. Install outer bearing, tab washer and jam nut onto spindle.

5. Rotate the wheel by hand and tighten the jam nut from **75 to 100 in-lb (8.5 to 11.3 N−m)** to set the bearings. Then, loosen the nut until the hub has end play.

6. Again, rotate the wheel by hand and tighten the jam nut from **15 to 20 in-lb (1.7 to 2.3 N−m)**.

7. Position nut retainer over jam nut and install cotter pin through spindle shaft hole. Install dust cap to hub.

8. Install brake caliper to spindle (see Front Brake Caliper in this section).

9. Install wheel assembly with valve stem facing out.

10. Lower machine to ground.

11. Torque wheel lug nuts in a crossing pattern from **45 to 65 ft−lb (62 to 88 N−m)**.

12. Lubricate tie rod ball joints and king pin.

13. Align steering and toe−in.

14. Make sure that front wheels move fully in both directions without contacting any front end components.

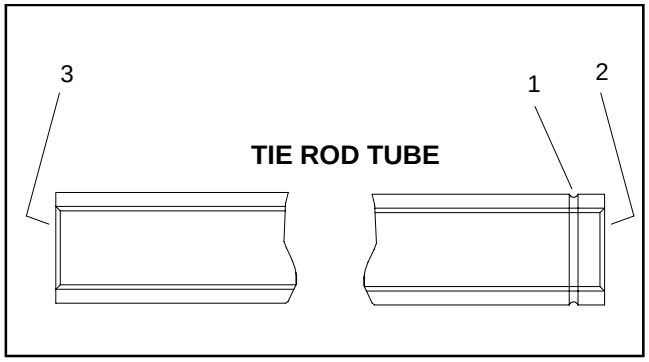

Figure 6

1. **Tie rod groove**
2. **LH threads**
3. **RH threads**

Front Shock Absorbers

Shock Removal (Fig. 9)

IMPORTANT: Any adjustment to the shock spring preload will affect the front wheel camber (see Adjust Front Wheel Camber in the Adjustments section of this chapter). Do not make shock spring adjustment without checking front wheel camber.

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

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Support a–arm to prevent it from moving after the shock is removed.

4. Remove lock nuts, cap screws and flat washer that secure shock to frame and a–arm. Remove shock absorber from vehicle.

NOTE: Use spanner wrench TOR6010 (see Special Tools in this chapter) if spring preload requires adjustment. If the spring is to be removed from the shock absorber, shock spring compressor tool TOR6015 (see Special Tools in this chapter) can be used.

Shock Installation (Fig. 9)

1. Position shock absorber to frame and a–arm brackets.

2. Secure shock absorber to vehicle.

   A. Slide upper cap screw through frame mounting holes and upper shock eye.

   B. Slide lower cap screw through flat washer, lower shock eye and a–arm mounting hole.

   C. Secure cap screws with lock nuts.

3. Lower vehicle to ground.

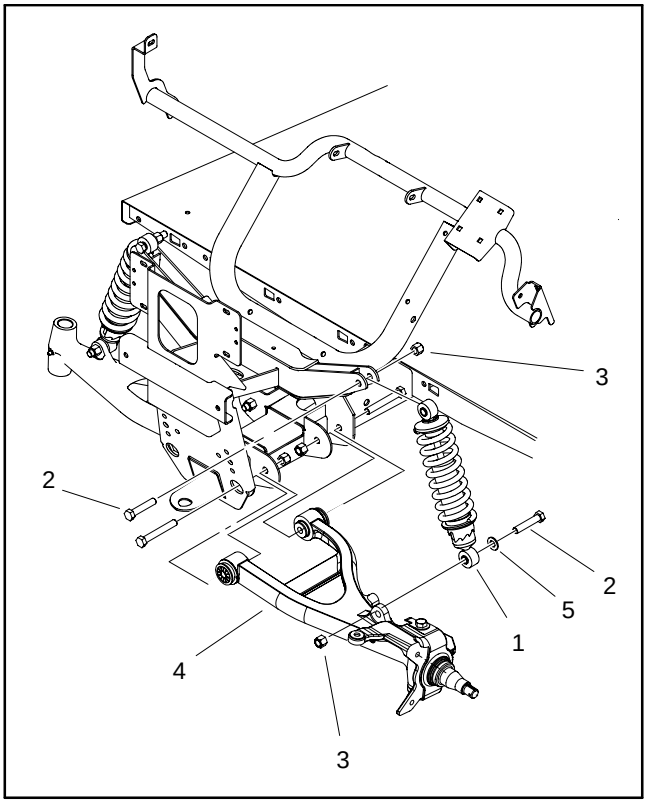

Figure 9

1. **Shock absorber**
2. **Cap screw**
3. **Lock nut**
4. **A–arm (LH shown)**
5. **Flat washer**

A-arms and Front Suspension

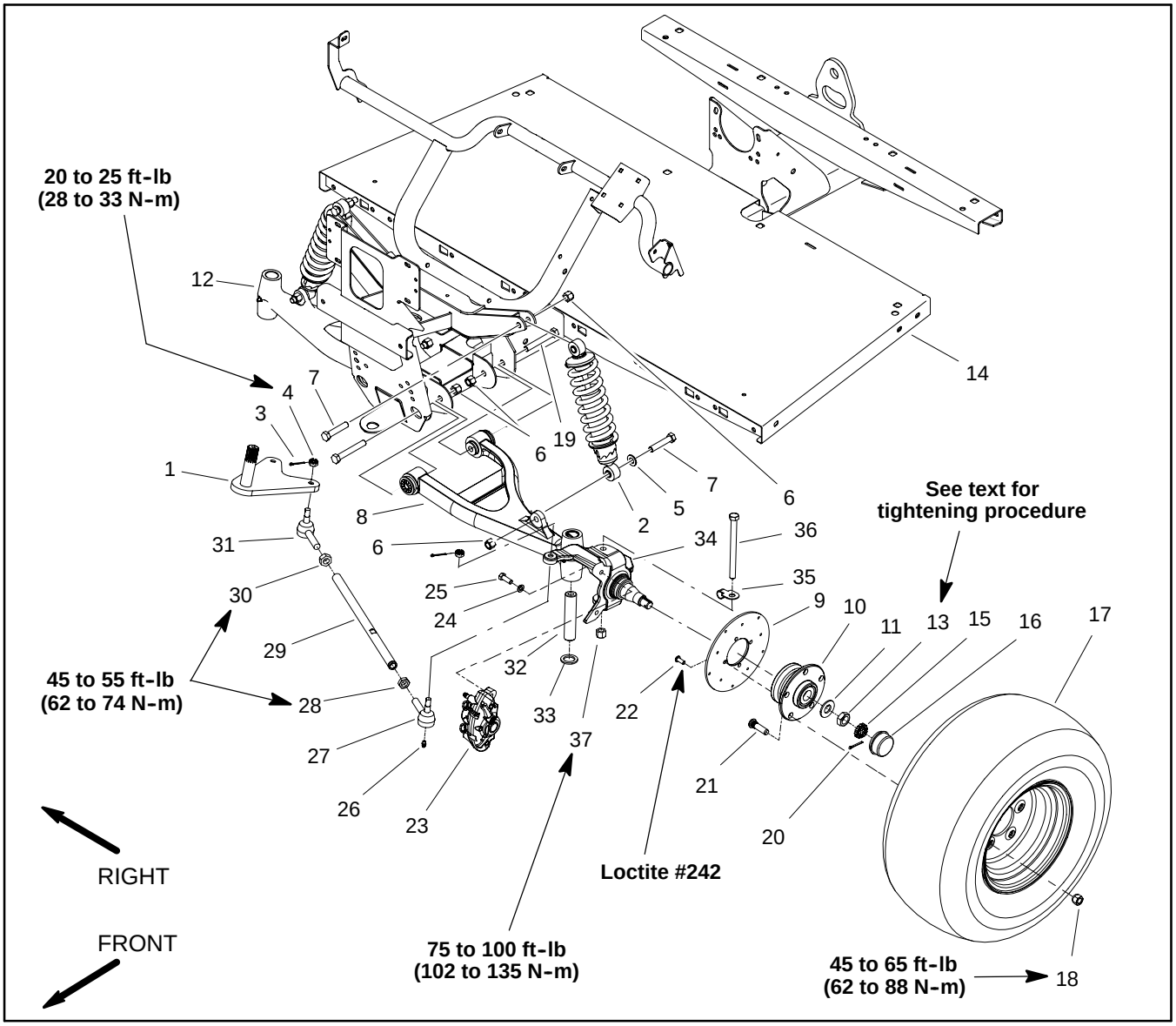

Figure 7

1. Steering gearbox pitman arm
2. Shock absorber (2 used)
3. Cotter pin
4. Slotted hex nut
5. Flat washer
6. Lock nut (3 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Brake rotor
10. Wheel hub assembly
11. Tab washer
12. RH A-arm
13. Jam nut
14. Front frame
15. Nut retainer
16. Dust cap
17. Wheel assembly
18. Lug nut (5 used per wheel)
19. Cap screw (2 used per A-arm)
20. Cotter pin
21. Wheel stud (5 used per hub)
22. Socket screw (4 used per rotor)
23. Brake caliper (LH shown)
24. Lock washer (2 used per caliper)
25. Cap screw (2 used per caliper)
26. Grease fitting
27. Ball joint (LH threads)
28. Jam nut (LH threads
29. Tie rod
30. Jam nut (RH threads)
31. Ball joint (RH threads)
32. Kingpin sleeve
33. Thrust washer
34. Spindle (LH shown)
35. Brake hose clip
36. Cap screw
37. Lock nut

A-arm Removal (Fig. 7)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Remove front wheel and spindle from A-arm (see Lower Steering and Front Wheel Removal in this section).

4. Remove cap screw (item 7), flat washer (item 5) and lock nut (item 6) that secure lower end of shock absorber to A-arm.

5. Support A-arm to prevent it from falling.

6. Remove both cap screws (item 19) and lock nuts (item 6) that secure A-arm to frame. Pull A-arm from frame.

7. If necessary, remove flange bushings and straight bushings from A-arm bores (Fig. 8).

8. If necessary, remove cap screw and lock nut that secure upper end of shock absorber to frame. Remove shock absorber.

A-arm Installation (Fig. 7)

1. If bushings were removed from A-arm, press new bushings fully into bore of A-arm (Fig. 8).

2. If shock absorber was removed from frame, position shock to frame, insert cap screw from front of machine and secure with lock nut.

3. Position A-arm to the frame. Secure A-arm to the frame with cap screws (item 19) and lock nuts (item 6). Insert front screw from front of machine and rear screw from rear of machine. Do not fully tighten nuts.

4. Position lower end of shock absorber to A-arm and insert cap screw (item 7) with flat washer (item 5) from rear of shock. Secure with lock nut (item 6).

5. Fully tighten lock nuts (item 6) to secure A-arm to machine frame.

6. Install spindle and front wheel to the A-arm (see Lower Steering and Front Wheel Installation in this section).

7. Lower machine to ground. Make sure that wheel lug nuts are properly torqued in a crossing pattern from **45 to 65 ft-lb (62 to 88 N-m)**.

8. Lubricate tie rod ball joints and king pin.

9. Align steering and toe-in.

10. Make sure that front wheels move fully in both directions without contacting any front end components.

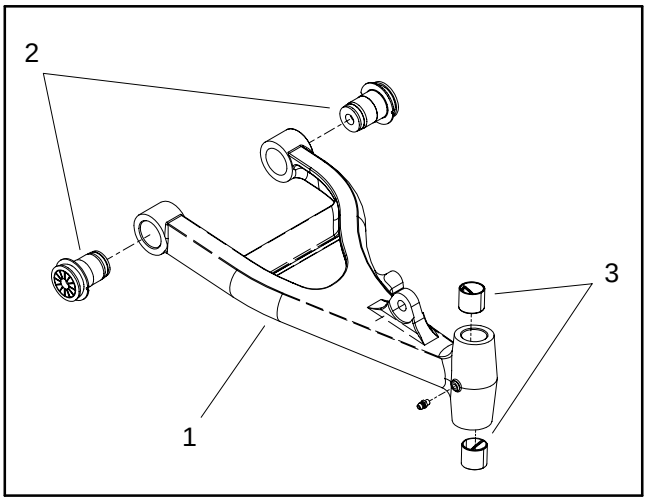

Figure 8

1. **A-arm**
2. **Flange bushing**
3. **Straight bushing**

Frame Pivot Yoke

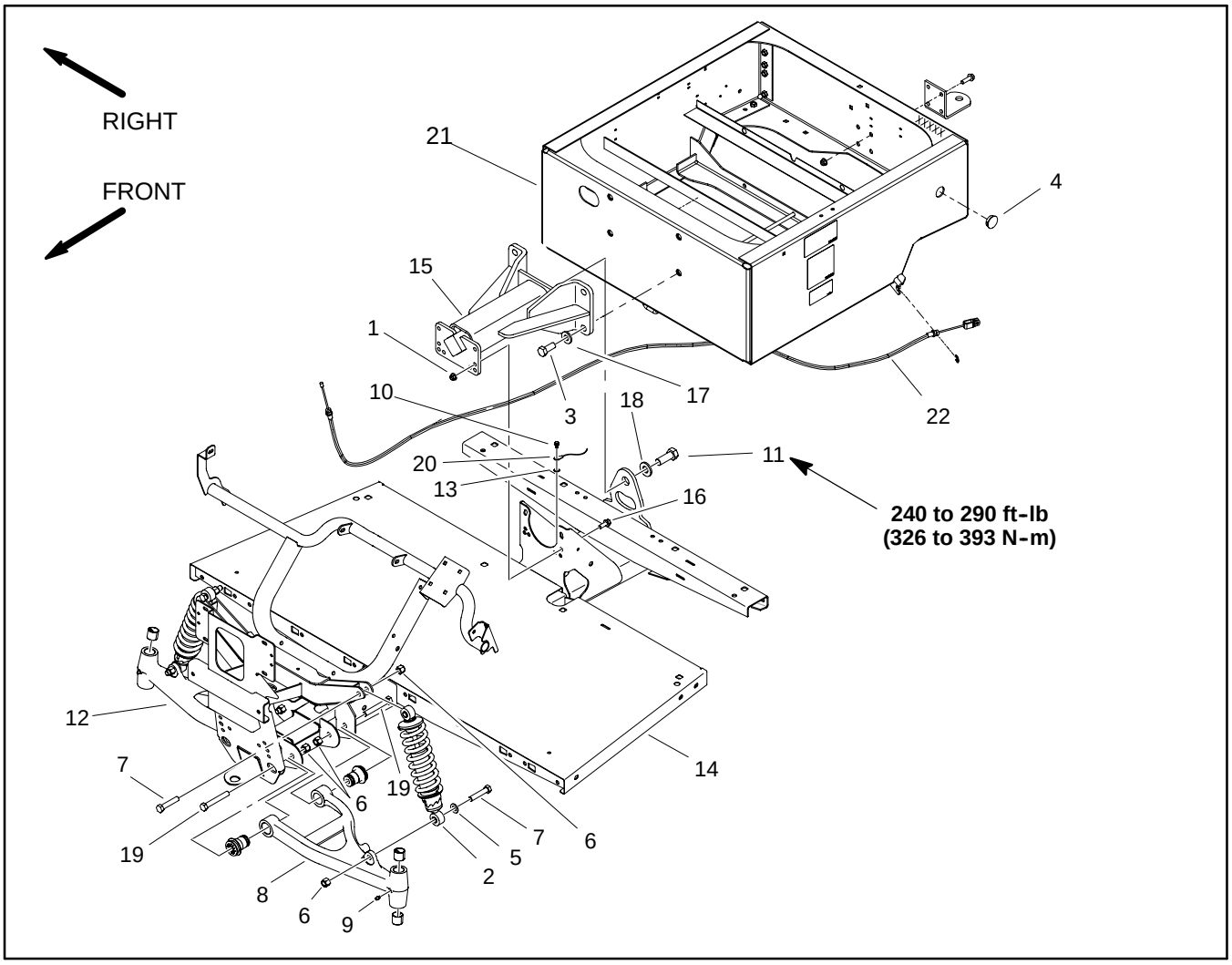

Figure 9

1. Flange nut (4 used)
2. Shock absorber (2 used)
3. Cap screw (4 used)
4. Plug
5. Flat washer
6. Lock nut (4 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Grease fitting (1 used per arm)
10. Screw
11. Cap screw
12. RH A-arm
13. Lock washer
14. Front frame
15. Pivot yoke
16. Flange head screw (4 used)
17. Flat washer (4 used)
18. Hardened washer
19. Cap screw (2 used per arm)
20. Ground cable
21. Rear frame
22. Parking brake cable (LH shown)

Pivot Yoke Removal (Fig. 9 and 10)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.

2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).

3. Remove cargo box from the rear frame (see Cargo Box Removal in this section).

4. Remove seat base from the front frame (see Seat Base Removal in this section).

WARNING

Make sure all tires are chocked to prevent the machine from moving. Before removing the pivot yoke, make sure front and rear frames are supported with jack stands. Support both the front and back of each frame.

5. Remove four (4) cap screws and flat washers securing the pivot yoke to the rear frame.

6. Remove cap screw and hardened washer securing the pivot yoke to the front frame tab.

WARNING

Support pivot yoke while removing it from the front frame to prevent dropping and causing serious injury and damage to the machine.

7. Remove four (4) flange head screws and flanged lock nuts securing the pivot yoke to the front frame. Remove pivot yoke from the machine.

Pivot Yoke Installation (Fig. 9 and 10)

WARNING

Support pivot yoke while installing it to the front frame to prevent dropping and causing serious injury and damage to the machine.

1. Position pivot yoke to the front frame so the diamond pattern faces up. Secure yoke to front frame with four (4) flange head screws and flanged lock nuts. Tighten lower two (2) fasteners first, then tighten upper two (2) fasteners.

2. Secure pivot yoke to the front frame tab with cap screw and hardened washer. Torque cap screw from **240 to 290 ft-lb (326 to 393 N-m)**.

3. Secure pivot yoke to the rear frame with four (4) cap screws and flat washers.

4. Install seat base to the front frame (see Seat Base Installation in this section).

5. Install cargo box to the rear frame (see Cargo Box Installation in this section).

6. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from **115 to 125 in-lb (13 to 14.1 N-m)**.

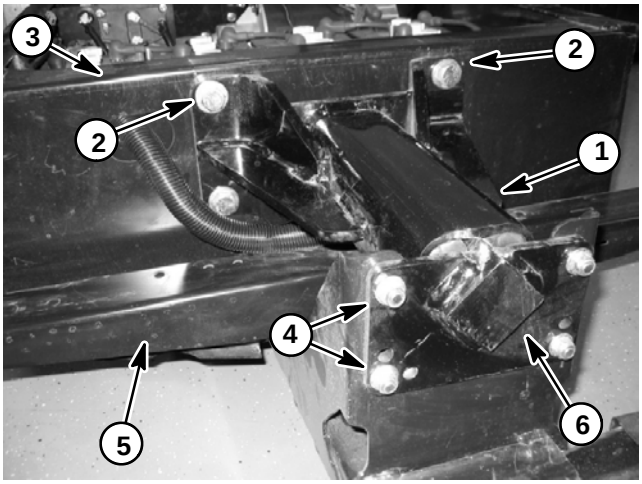

Figure 10

1. **Pivot yoke**
2. **Cap screw & flat washer**
3. **Rear frame**
4. **Flange lock nut**
5. **Front frame**
6. **Diamond pattern**

Seat Base

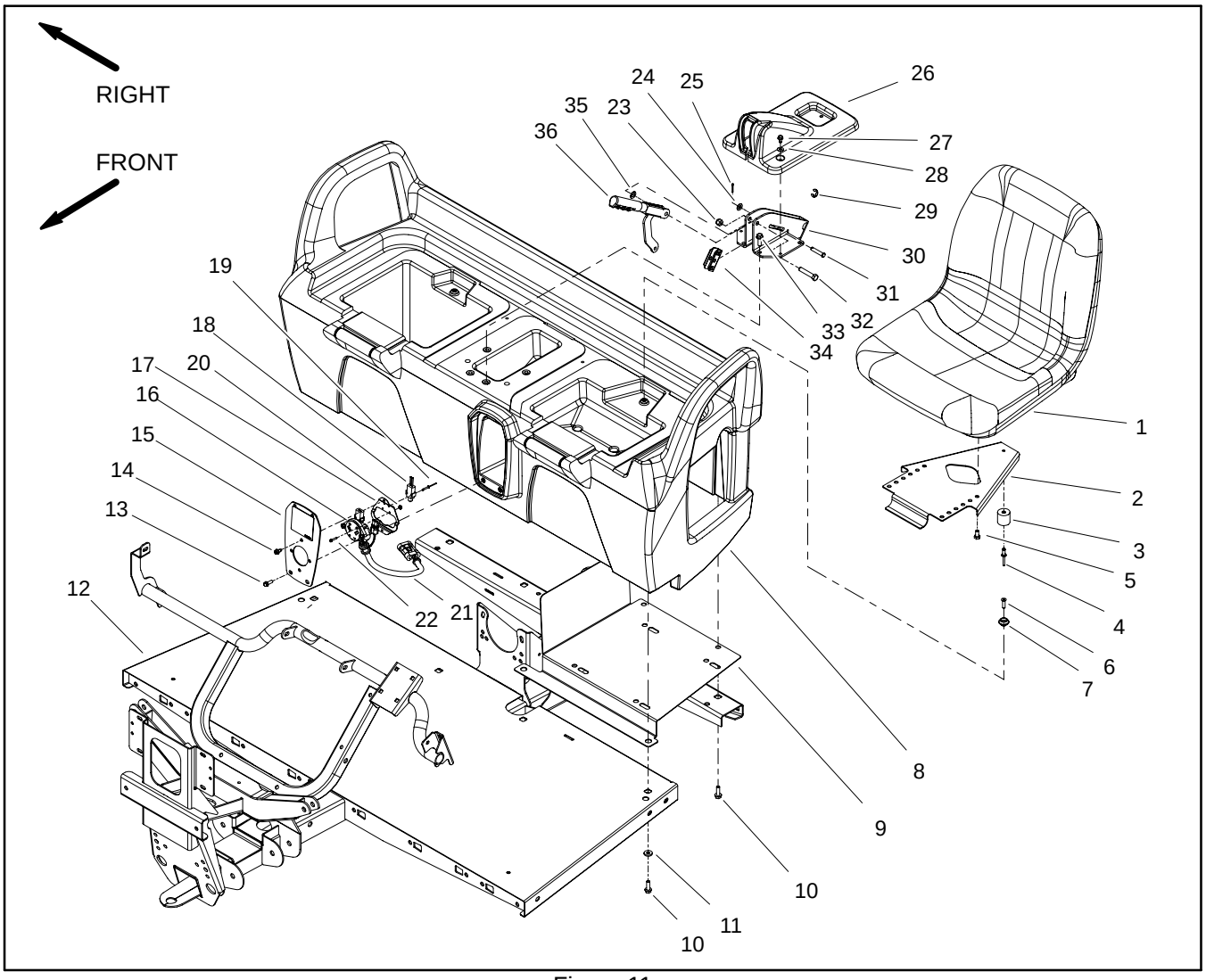

Figure 11

1. **Seat**
2. **Seat bracket**
3. **Rubber receptacle**
4. **Rivet**
5. **Cap screw (4 used per seat)**
6. **Screw**
7. **Holding post**
8. **Seat base**
9. **Seat base tray**
10. **Flange head screw (8 used)**
11. **Flat washer (4 used)**
12. **Front frame**
13. **Screw (4 used)**
14. **Washer head screw (4 used)**
15. **Charger receptacle plate**
16. **Charger receptacle**
17. **Socket mount bracket**
18. **Charger interlock switch**
19. **Pop rivet (2 used)**
20. **Lock nut (2 used)**
21. **Charger wire harness**
22. **Socket head screw (2 used)**
23. **Lock nut**
24. **Flat washer**
25. **Cotter pin**
26. **Parking brake cover**
27. **Screw (2 used)**
28. **Flat washer (2 used)**
29. **Retaining ring (2 used)**
30. **Parking brake support**
31. **Clevis pin**
32. **Cap screw**
33. **Flange head screw (4 used)**
34. **Brake cable equilizer**
35. **Curved washer**
36. **Parking brake lever**

Removal (Fig. 11)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.

2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).

3. Remove seats from seat base.

4. Remove four (4) screws (item 12) that secure receptacle plate to front of seat base. Unplug charger wire harness from vehicle wire harness and remove receptacle plate assembly from vehicle.

5. Remove parking brake assembly from seat base (see Parking Brake in the Service and Repairs section of Chapter 4 – Transaxle and Brakes).

6. Remove eight (8) flange head screws (item 10) that secure seat base to vehicle. Locate and retrieve flat washers (item 11) from screws that secure front of seat base.

7. Carefully lift seat base from vehicle.

Installation (Fig. 11)

1. Position seat base to the vehicle.

NOTE: Do not tighten fasteners securing the seat base until all fasteners are in place.

2. Install four (4) flange head screws (item 10) through holes in front frame and into rear seat base threaded inserts. Install four (4) flange head screws (item 10) and flat washers (item 11) through holes in front frame and into front seat base threaded inserts.

3. Starting at the middle of the vehicle, tighten flange head screws to secure seat base to vehicle.

4. Install parking brake assembly to seat base (see Parking Brake in the Service and Repairs section of Chapter 4 – Transaxle and Brakes).

5. Connect charger wire harness to vehicle wire harness. Secure receptacle plate to seat base with four (4) screws (item 12).

6. Install seats to vehicle.

7. Connect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

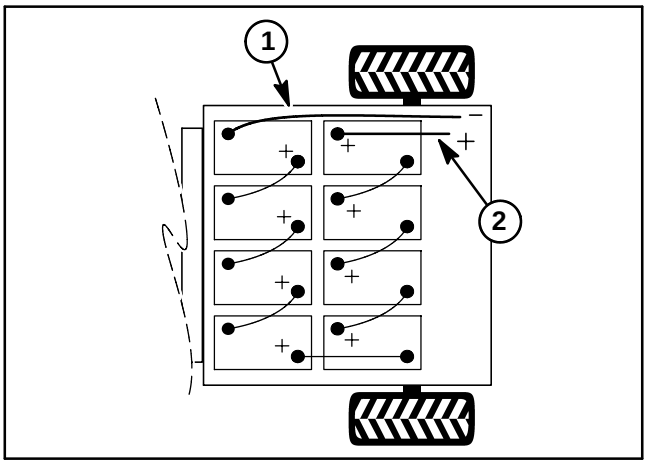

Figure 12

1. Negative cable to vehicle **2. Positive cable to vehicle**

Front Hood

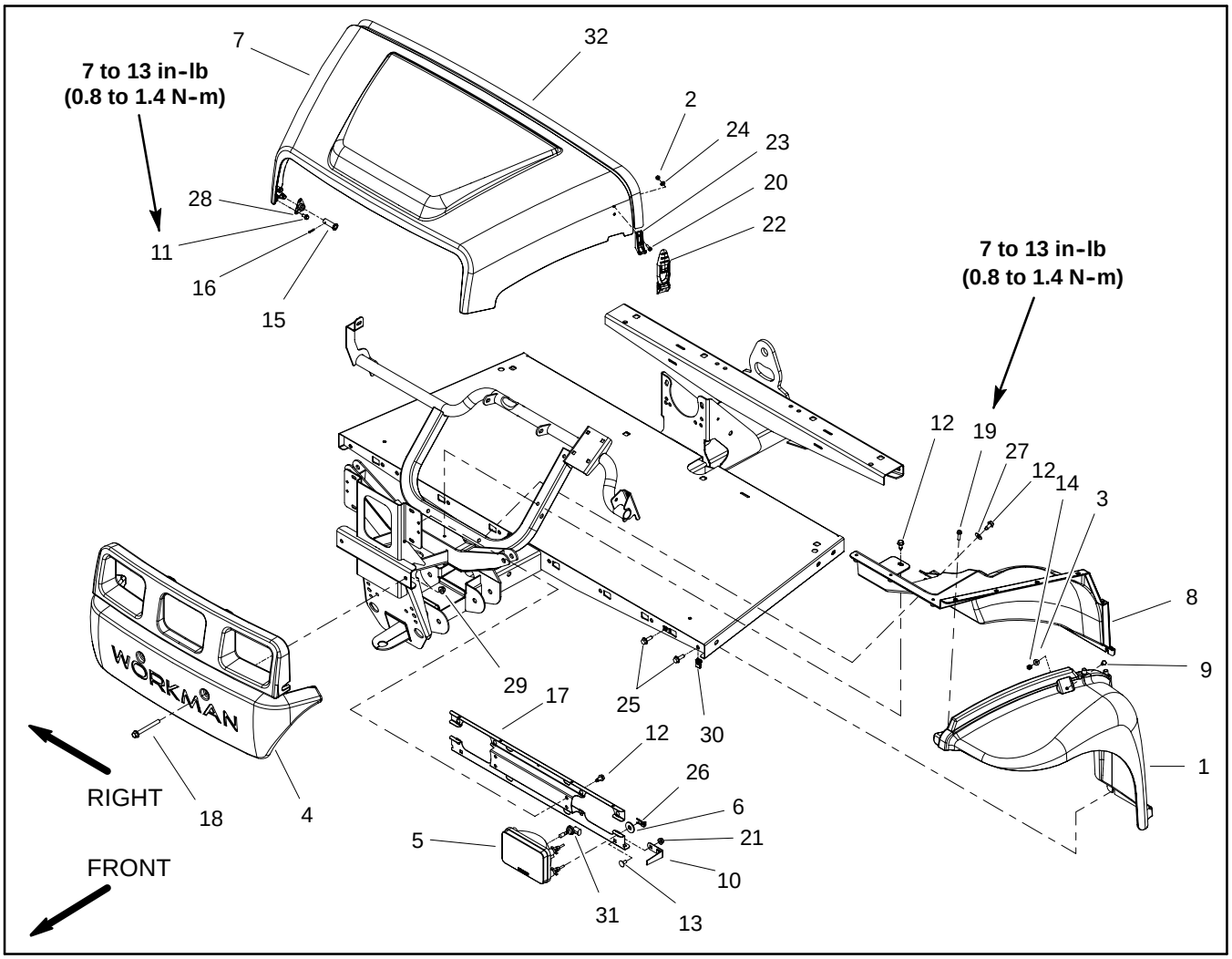

Figure 13

1. Fender (LH shown)
2. Lock nut (4 used)
3. Flat washer (2 used)
4. Front bumper
5. Headlight (2 used)
6. Washer (3 used per headlight)
7. Hood
8. Fender well (LH shown)
9. Cap screw (2 used)
10. Hood pivot keeper (2 used)
11. Screw (6 used)
12. Washer head screw (8 used)
13. Carriage screw (2 used)
14. Lock nut (2 used)
15. Pivot pin (2 used)
16. Spring pin (2 used)
17. Headlight bracket
18. Flange head screw (2 used)
19. Washer head screw (20 used)
20. Washer head screw (4 used)
21. Flange nut (2 used)
22. Rubber latch (2 used)
23. Catch (2 used)
24. Flat washer (4 used)
25. Flange head screw (10 used)
26. Clip (3 used per headlight)
27. Flat washer (2 used)
28. Retainer (2 used)
29. Flange nut (2 used)
30. Tinnerman nut (10 used)
31. Headlight bulb (24V) (2 used)
32. Foam seal

Removal (Fig. 13)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.

2. Open the battery circuit by carefully removing one of the battery cables (see Opening Battery Circuit in the General Information section of Chapter 3 – Electrical System).

3. Remove hood using Figure 13 as a guide.

Installation (Fig. 13)

NOTE: Do not tighten fasteners securing the hood until all fasteners are in place.

1. Install hood using Figure 13 as a guide. During assembly, use fastener torque specifications that are identified in Figure 13.

2. Reconnect removed battery cable to battery terminals. Install lock washer and nut on battery terminals. Torque nuts from **115 to 125 in-lb (13.0 to 14.1 N-m)**.

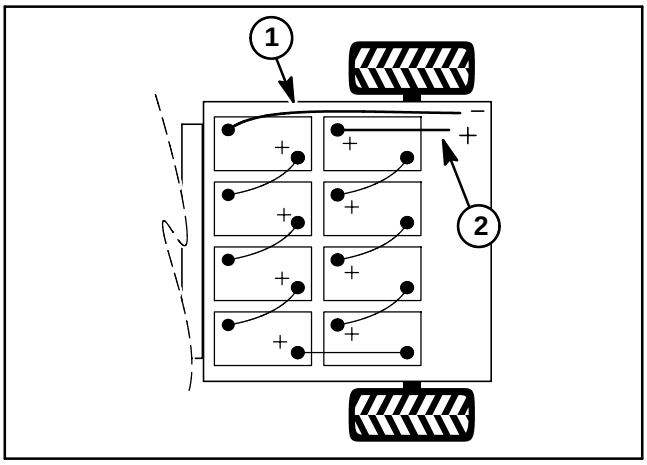

Figure 14

1. Negative cable to vehicle **2. Positive cable to vehicle**

Cargo Box (Serial Number Below 311000000)

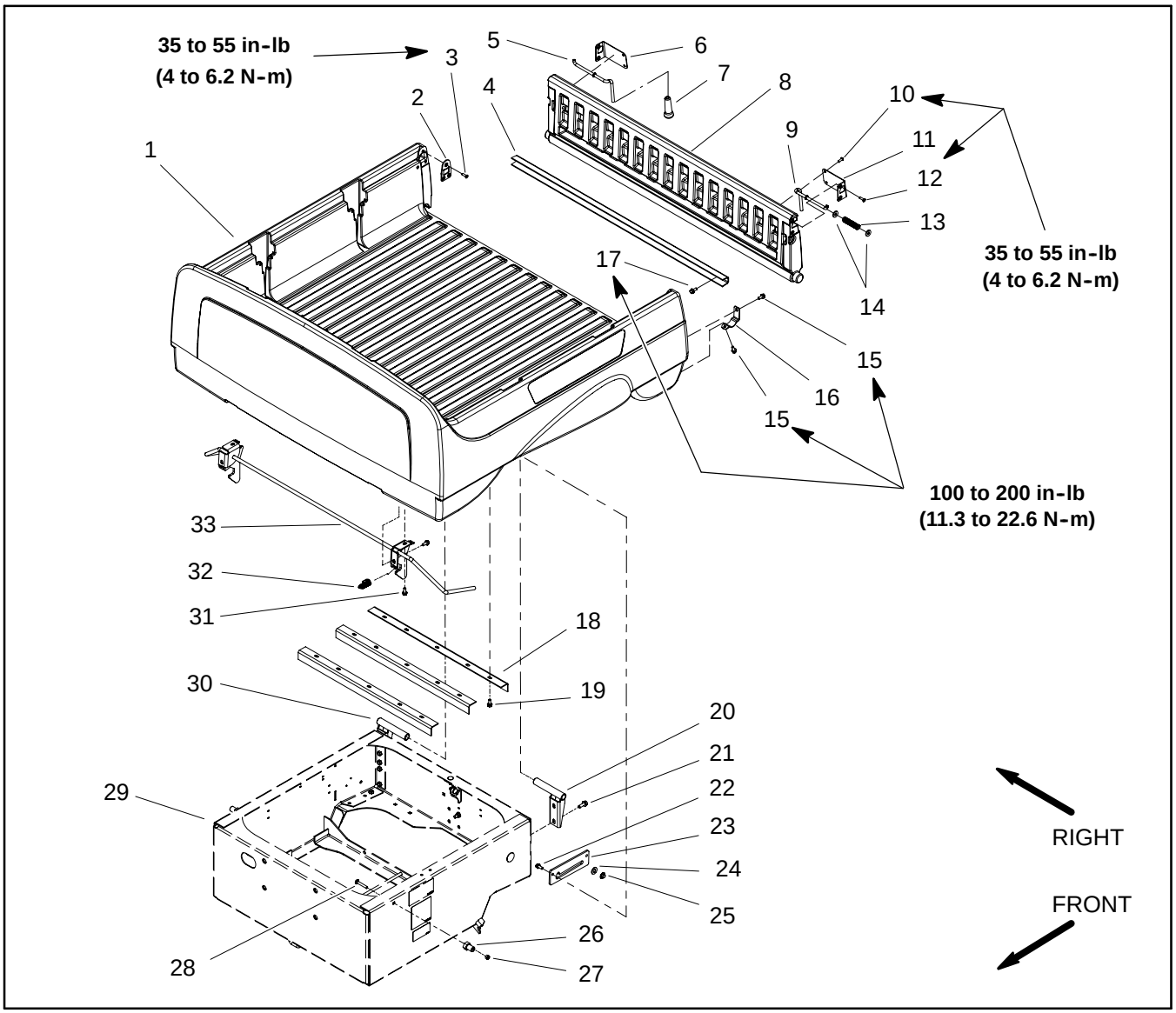

Figure 18

1. Cargo box
2. Striker plate (2 used)
3. Screw (3 per striker plate)
4. Tailgate channel
5. RH latch rod
6. RH latch bracket
7. Grip knob
8. Tailgate
9. LH latch rod
10. Screw (2 per bracket)
11. LH latch bracket
12. Screw (2 per bracket)
13. Spring
14. Flat washer
15. Flange head screw (2 per bracket)
16. Pivot bracket (2 used)
17. Flange head screw (6 used)
18. Box brace (3 used)
19. Flange head screw (5 per brace)
20. LH pivot bracket
21. Flange head screw (2 per bracket)
22. Flange head screw (2 used)
23. Prop rod bracket
24. Flat washer
25. Push nut
26. Latch pin (2 used)
27. Lock nut (2 used)
28. Carriage screw (2 used)
29. Rear frame
30. RH pivot bracket
31. Flange head screw (4 used)
32. Tension spring
33. Latch rod

Removal (Fig. 18)

1. Park vehicle on a level surface, turn on/off switch OFF, set parking brake and remove key from the on/off switch.

2. Remove two (2) flange head screws (item 21) that secure RH and LH pivot brackets (items 20 and 30) to the rear frame.

3. Release latch rod (item 33) from the latch pins (item 26). Remove cargo box from the frame. Disassemble cargo box as necessary using Figure 18 as a guide.

Installation (Fig. 18)

1. Assemble cargo box using Figure 18 as a guide.

2. Position cargo box to the frame locking the latch rod (item 33) to the latch pins (item 26).

3. Secure both pivot brackets (items 20 and 30) to the rear frame with flange head screws (item 21).

Cargo Box (Serial Number Above 311000000)

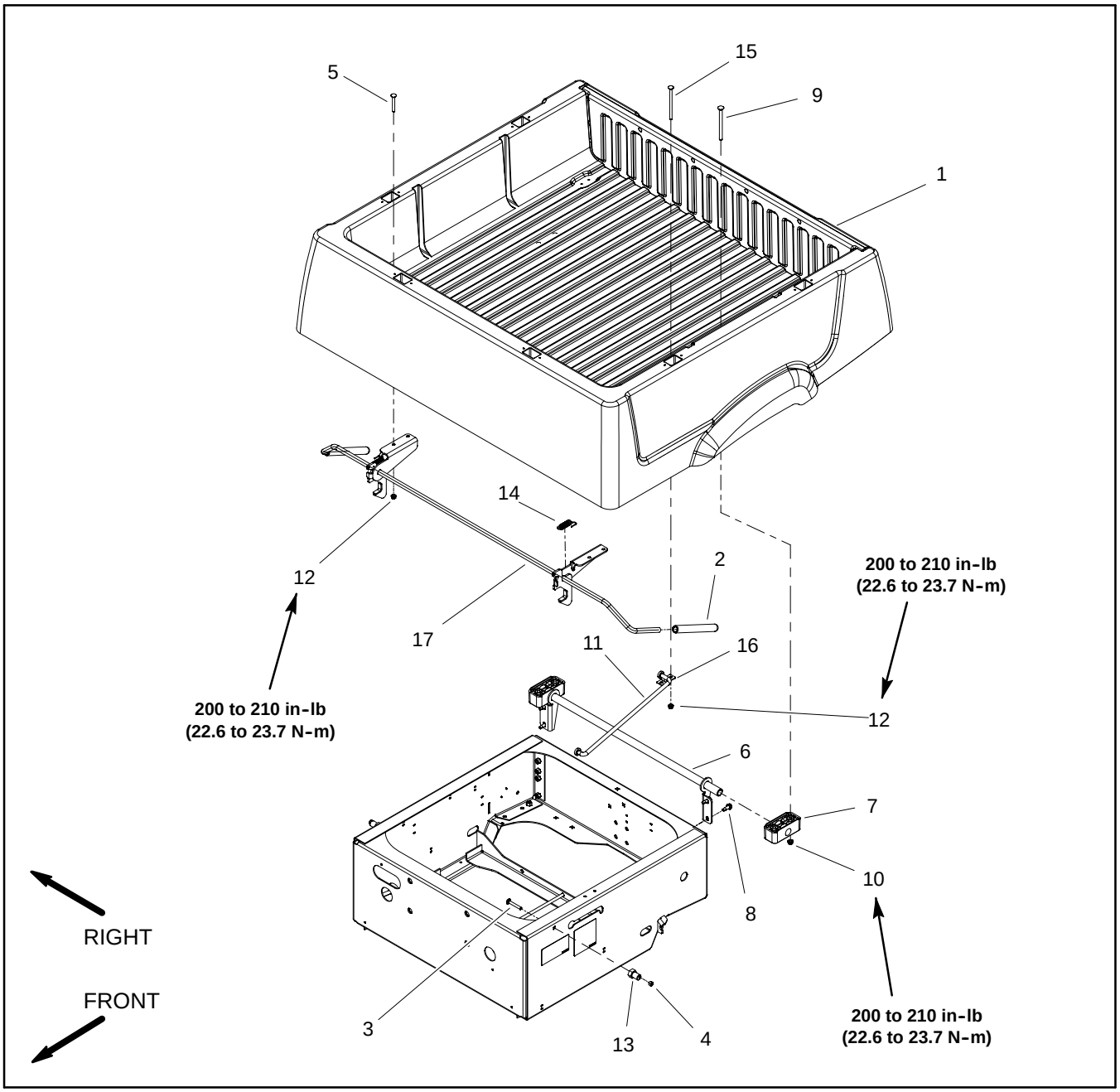

Figure 19

1. Cargo box
2. Handle
3. Carriage screw (2 used)
4. Lock nut (2 used)
5. Carriage screw (4 used)
6. Pivot bracket
7. Pivot bushing (2 used)
8. Screw (4 used)
9. Carriage screw (4 used)
10. Flange nut (4 used)
11. Prop rod
12. Flange nut (6 used)
13. Latch pin (2 used)
14. Tension spring (2 used)
15. Carriage screw (2 used)
16. Prop rod bracket
17. Latch assembly

Removal (Fig. 19)

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

2. Disassemble cargo box as necessary using Figures 19 and 20 as guides.

Installation (Fig. 19)

1. Assemble cargo box using Figures 19 and 20 as guides.

   A. When installing cargo box, use torque specifications identified in Figure 19.

   B. Adjust latch pin (item 13 in Figure 19) so that cargo box is tight to frame when latched.

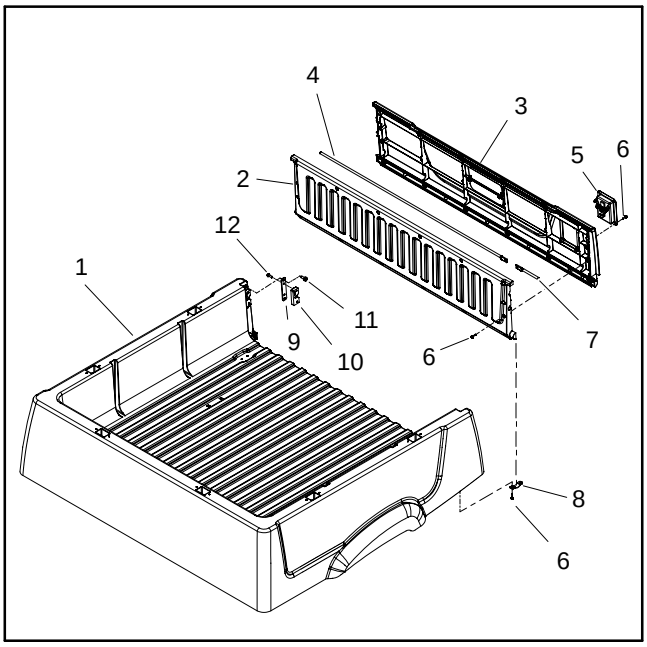

Figure 20

1. **Cargo box**
2. **Inner tailgate**
3. **Outer tailgate**
4. **RH latch rod**
5. **Latch handle**
6. **Screw (24 used)**
7. **LH latch rod**
8. **Retainer (2 used)**
9. **Striker mount (2 used)**
10. **Strike latch (2 used)**
11. **Screw (4 used)**
12. **Screw (4 used)**

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Chapter 6

Electrical Diagrams

Table of Contents

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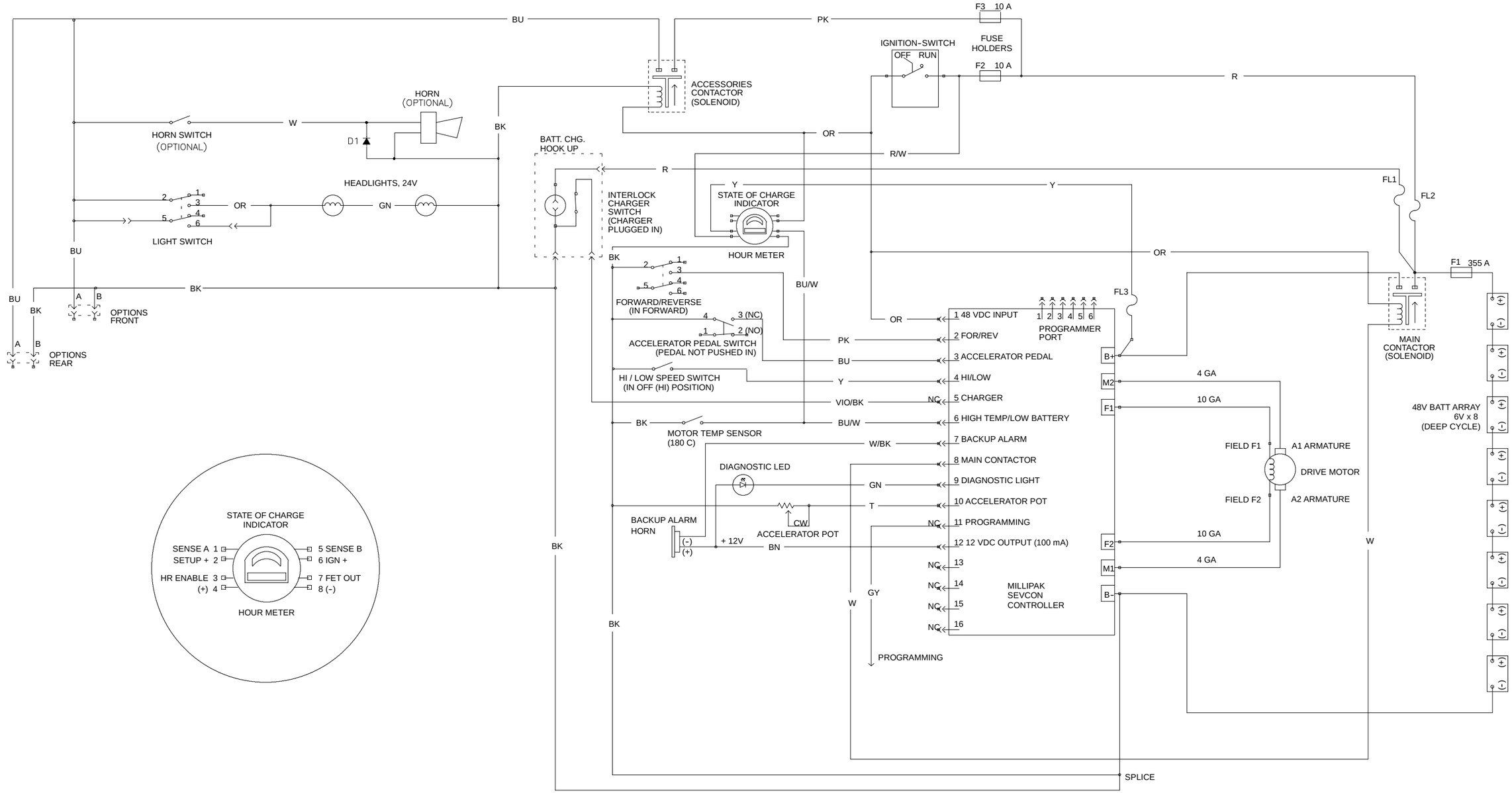
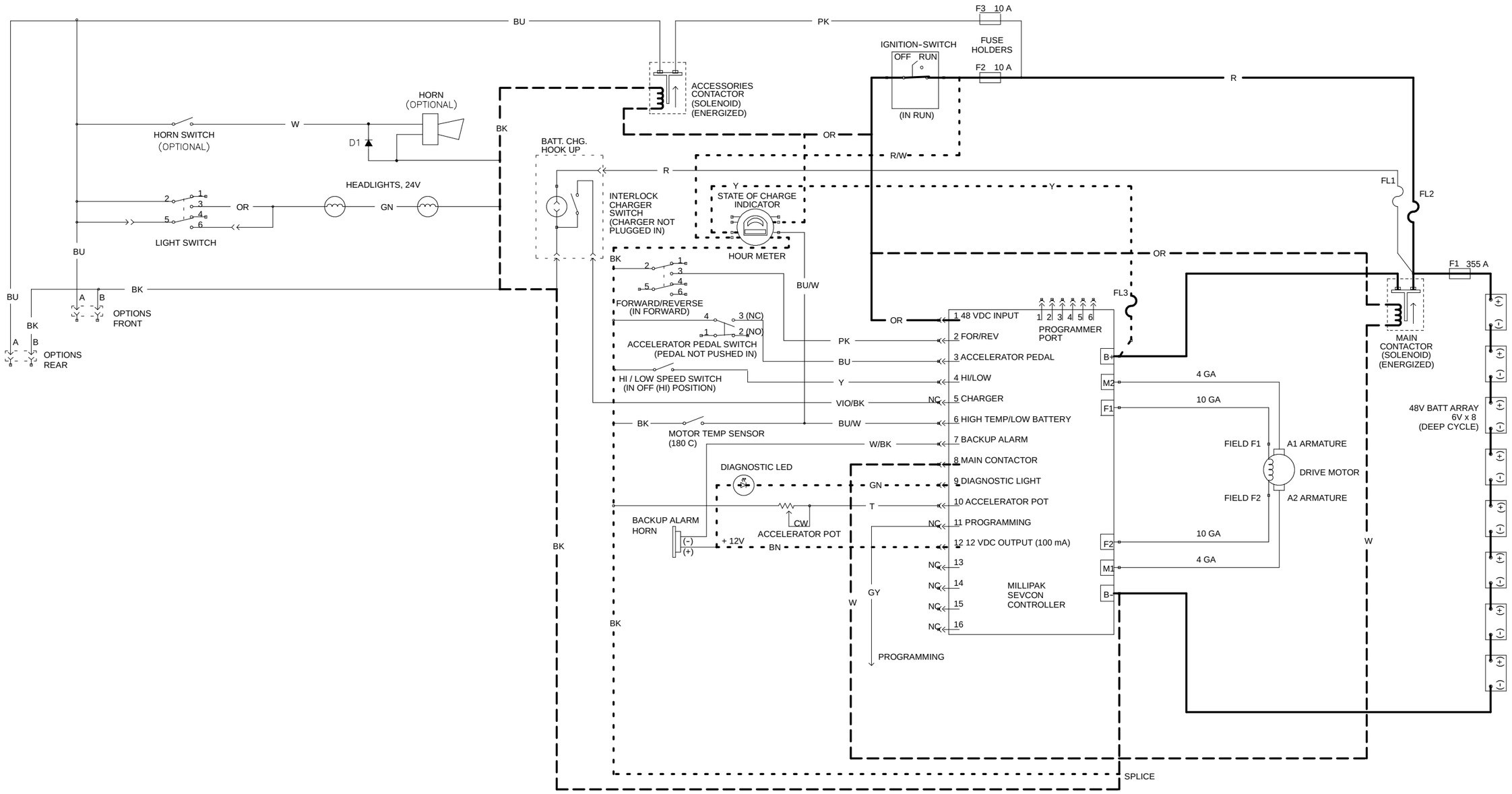


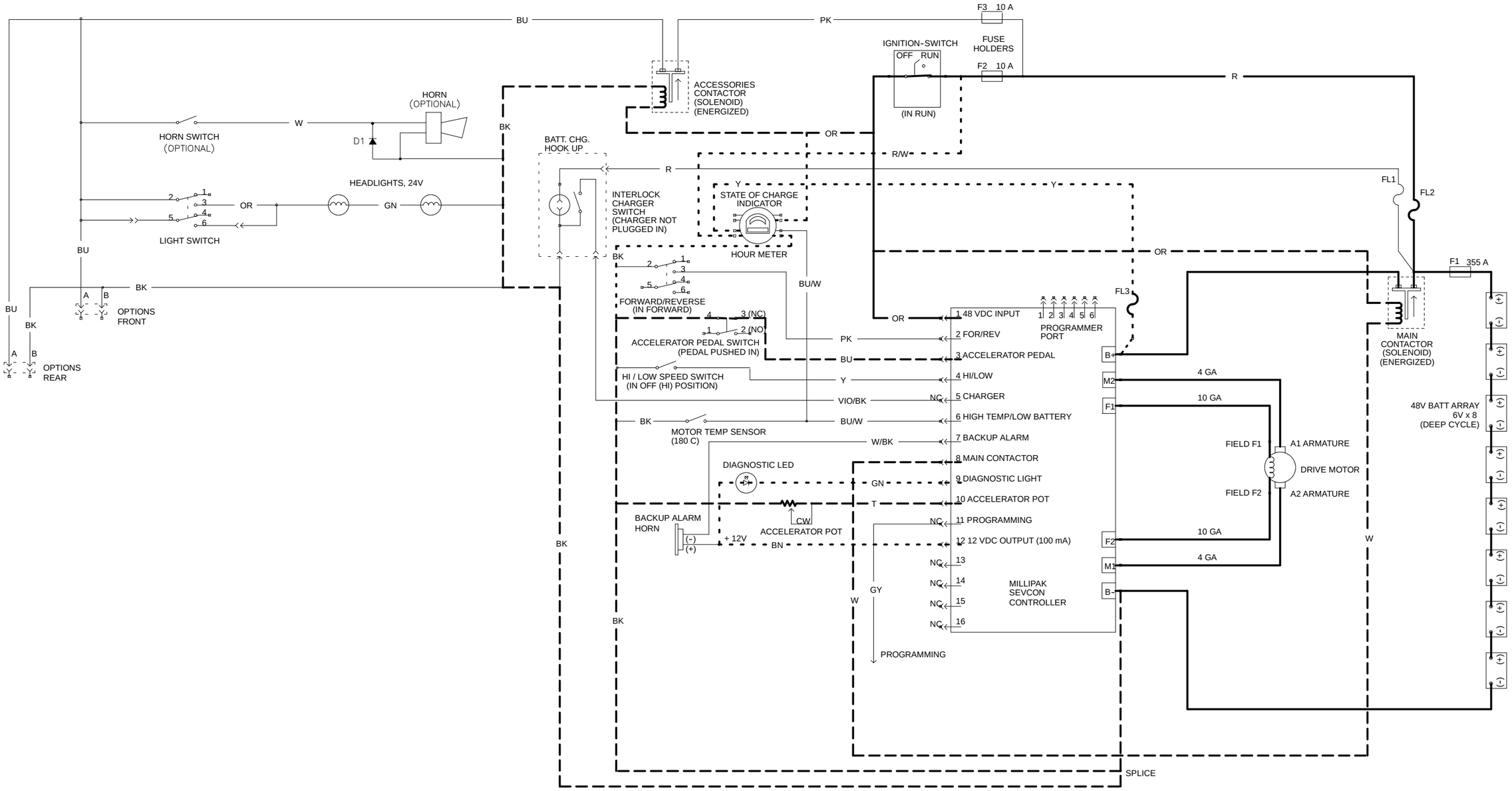
Workman MDE
Electrical Schematic
Contactors shown de-energized



Workman MDE

On/Off Switch Turned On

- Power Current
- Control Current
- Indication Current



Workman MDE

Run Circuit (Forward)

- Power Current
- Control Current
- Indication Current

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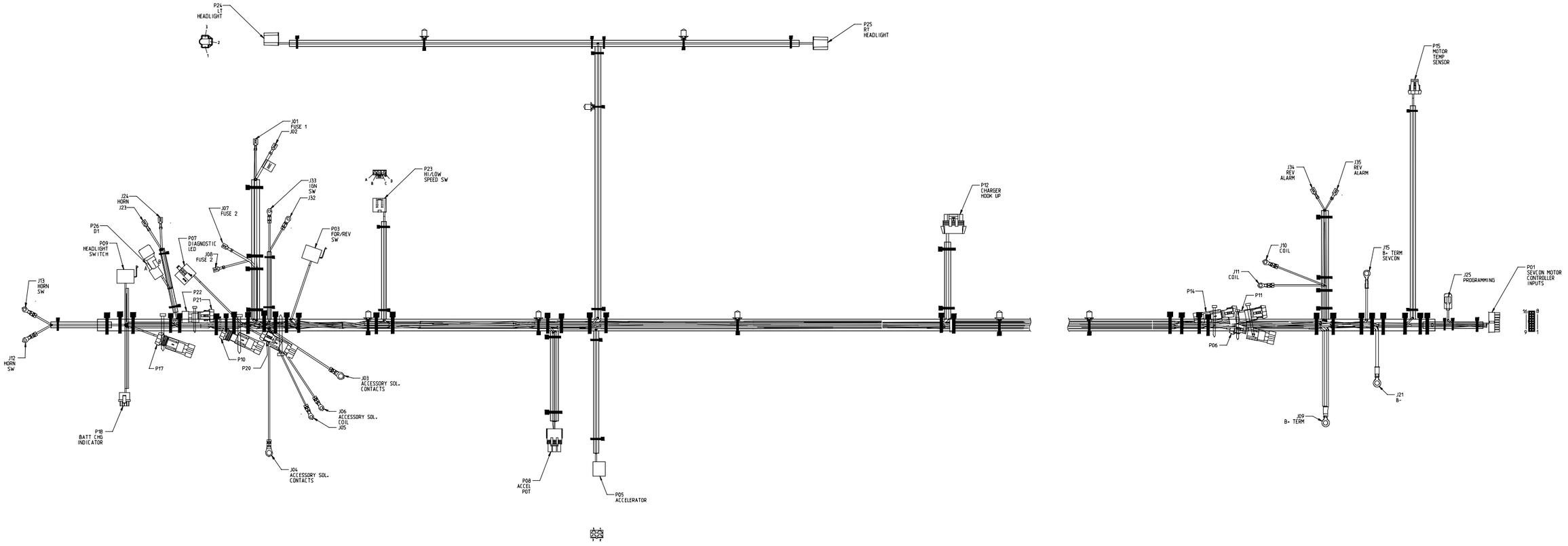
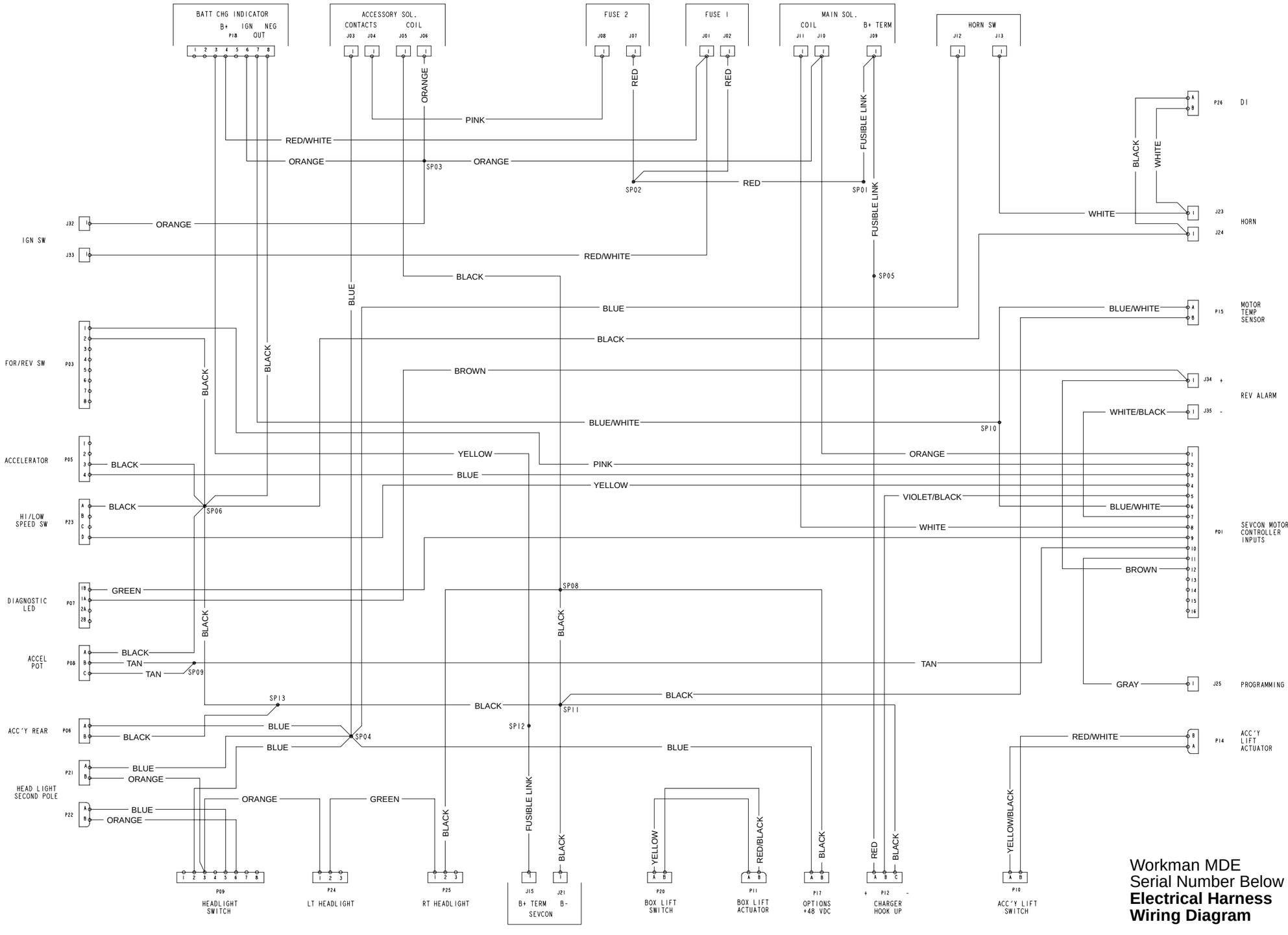
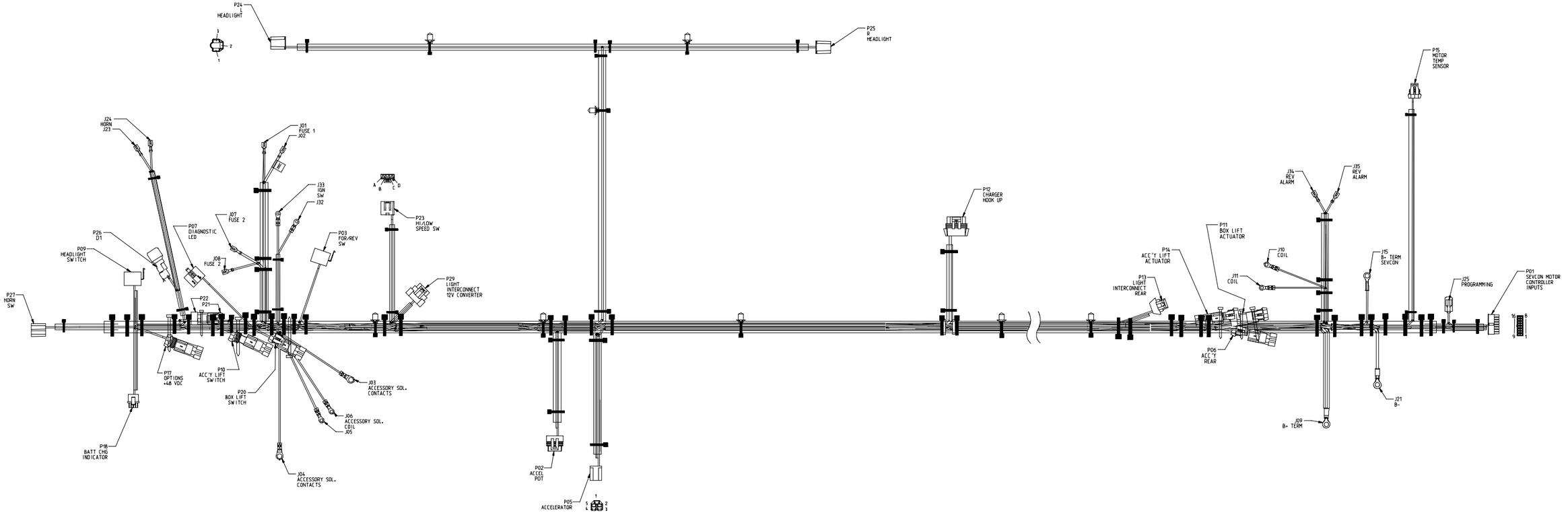


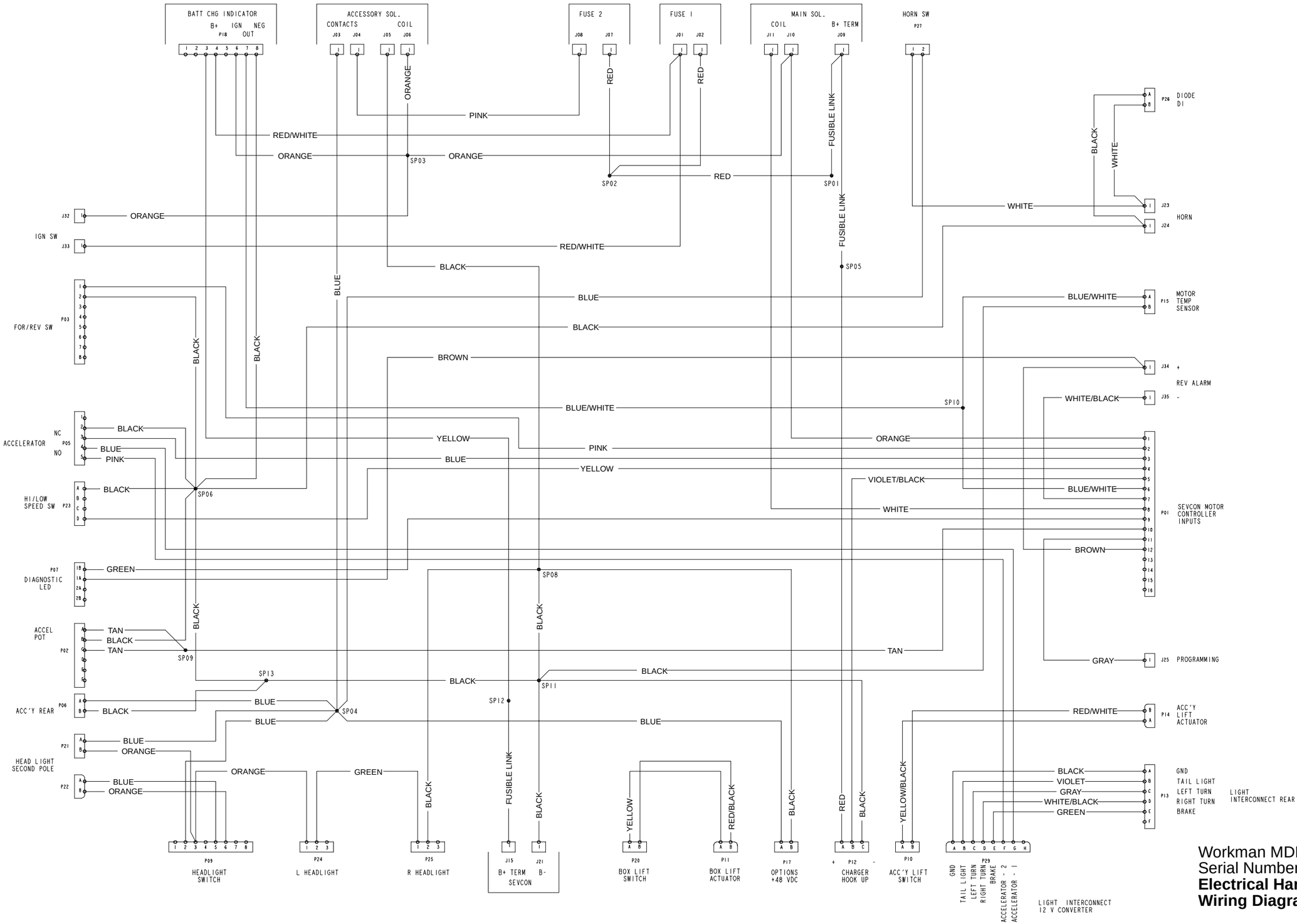
Workman MDE
Serial Number Below 310000000
Electrical Harness Drawing



Workman MDE
Serial Number Below 310000000
Electrical Harness
Wiring Diagram



Workman MDE
Serial Number Above 310000000
Electrical Harness Drawing



Workman MDE
Serial Number Above 310000000
Electrical Harness
Wiring Diagram

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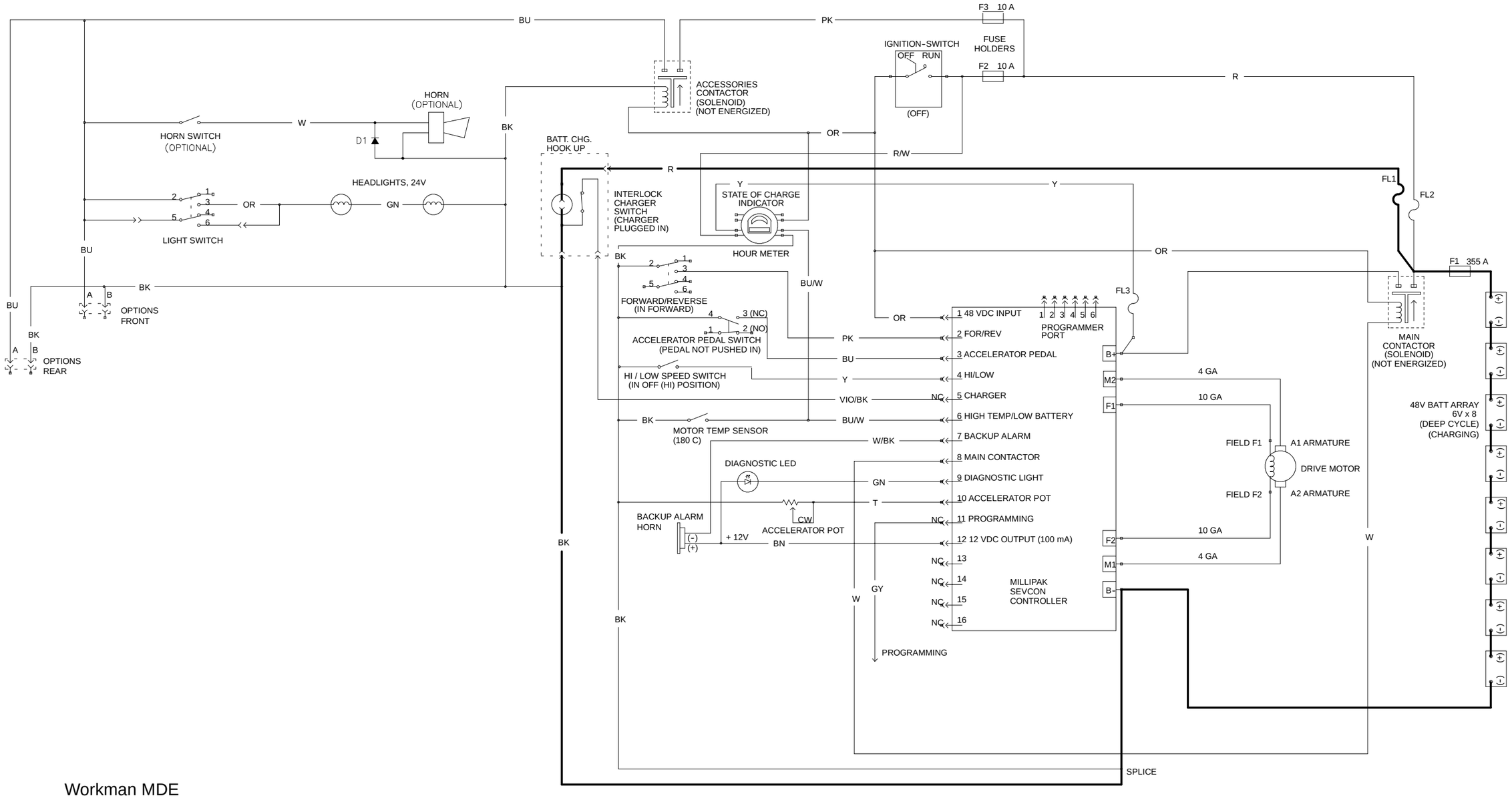

Workman MDE

Battery Charging Circuit

Power Current

Control Current

Indication Current

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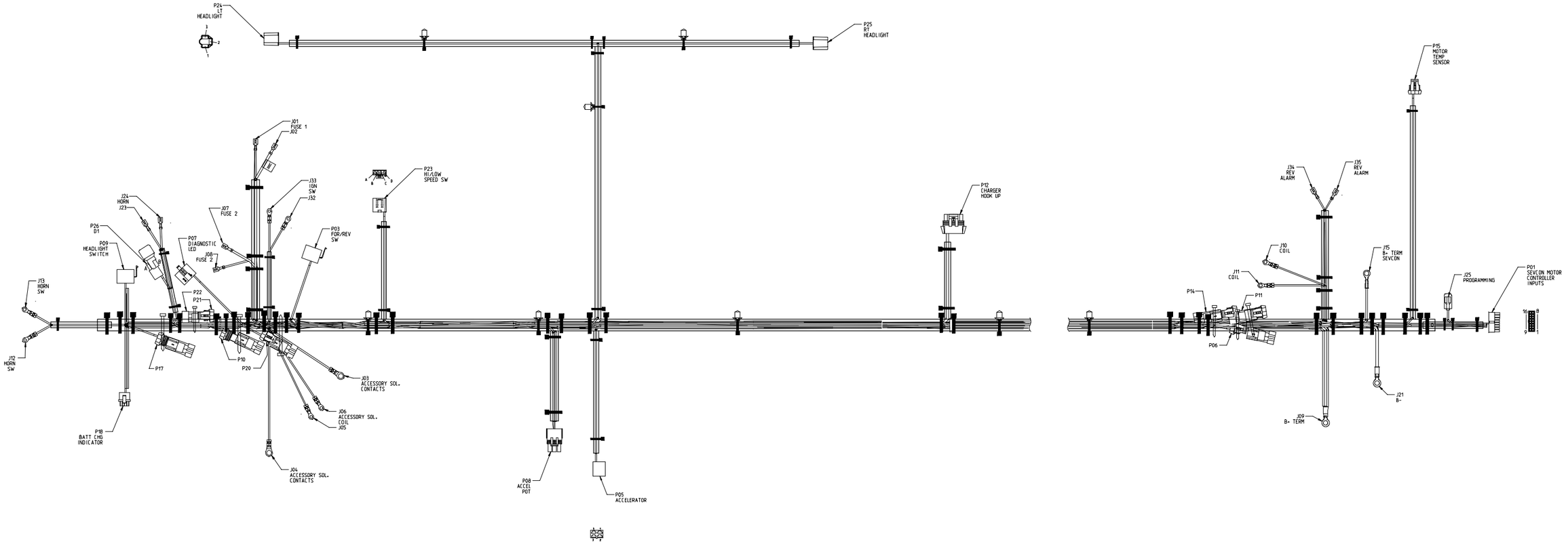
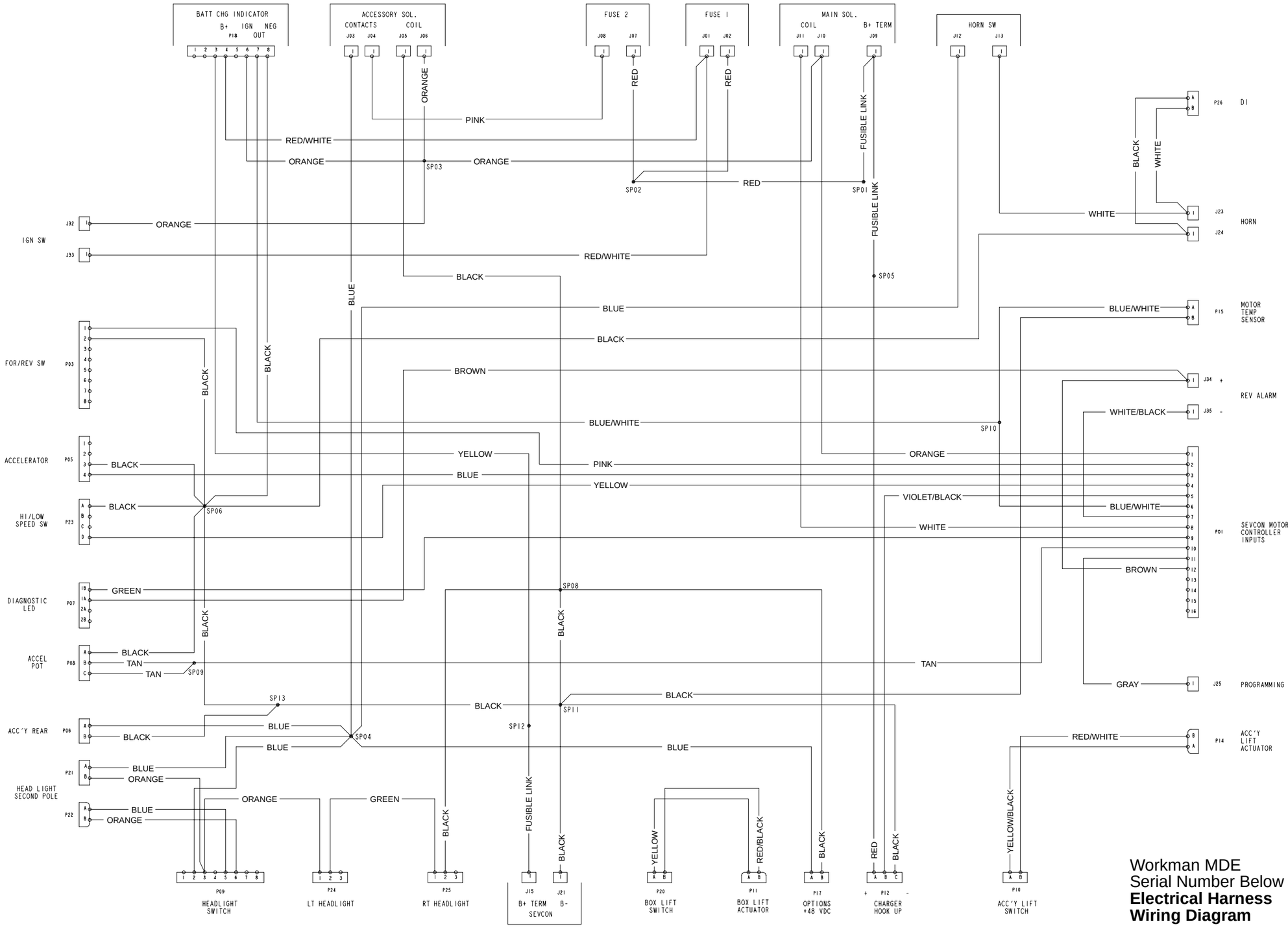
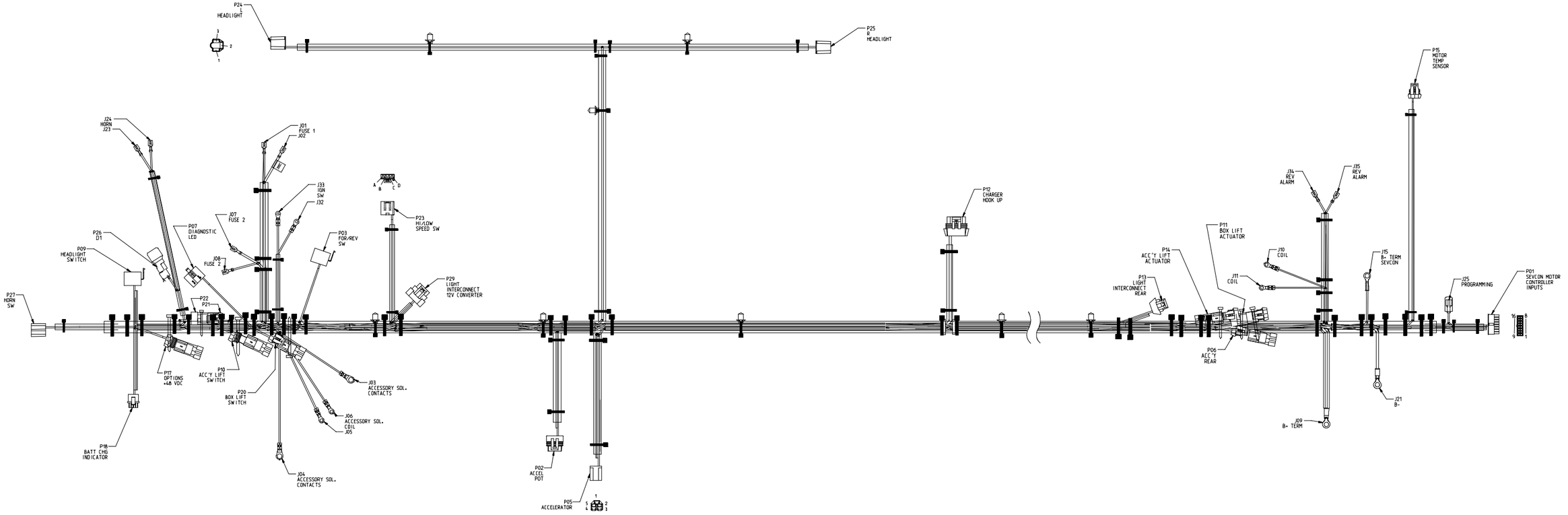


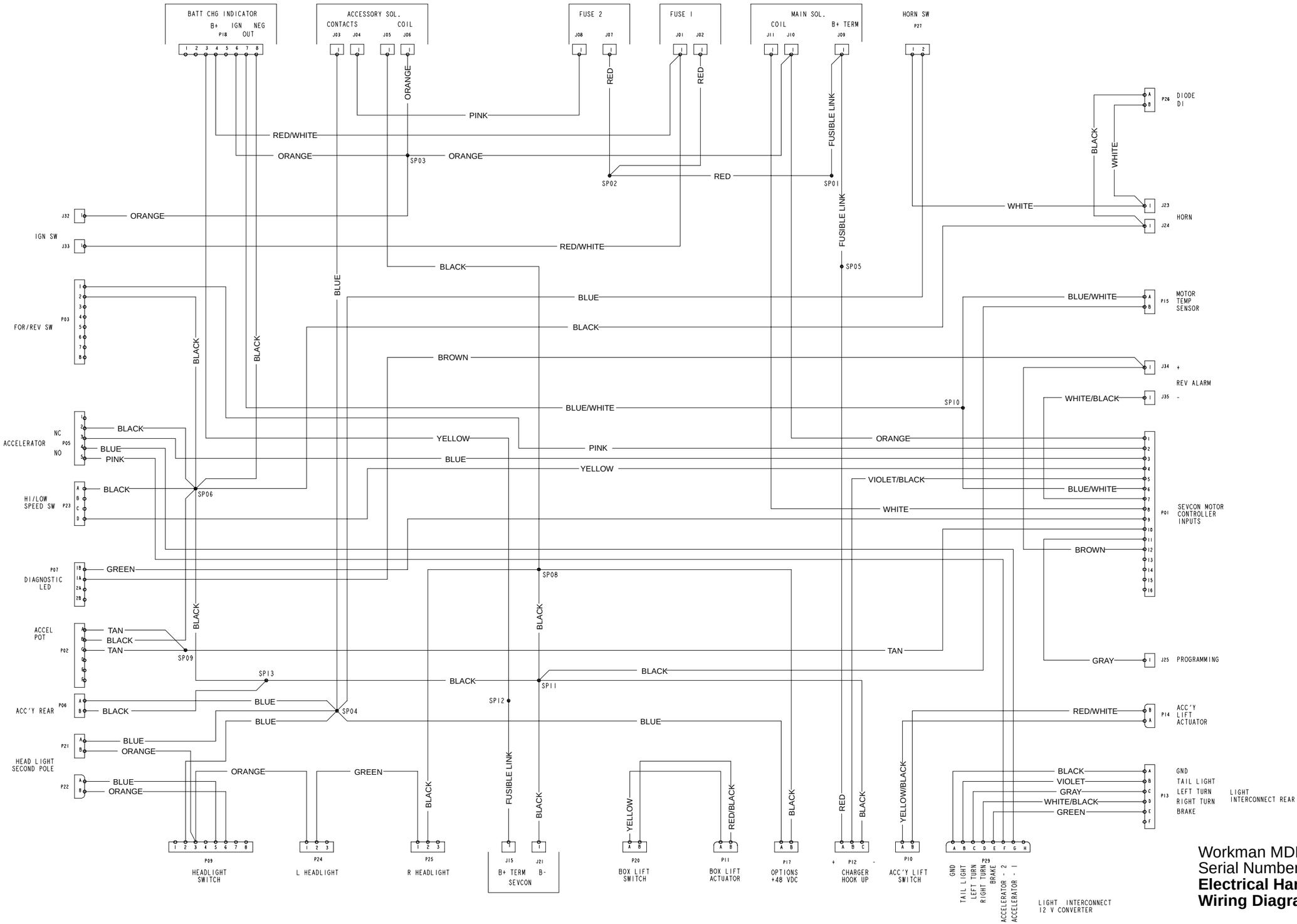
Workman MDE
Serial Number Below 310000000
Electrical Harness Drawing



Workman MDE
Serial Number Below 310000000
Electrical Harness
Wiring Diagram



Workman MDE
Serial Number Above 310000000
Electrical Harness Drawing



Workman MDE
Serial Number Above 310000000
Electrical Harness
Wiring Diagram

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