Manual: **901358**
Model: **PPT45**
Serial Number: **374782 and higher**

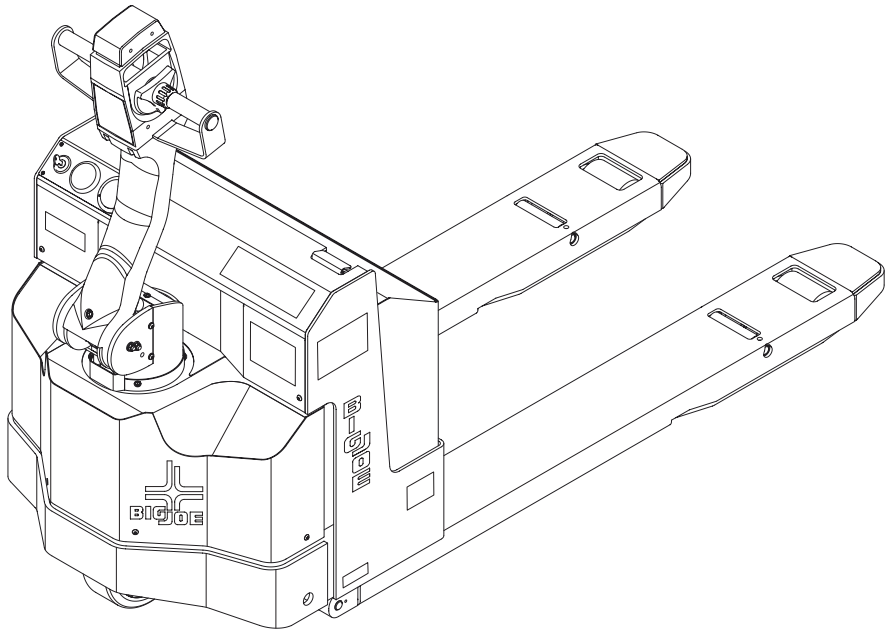
This manual is effected by the following supplements. They can be found in the Service Manual Index CD on the left side of the screen under "Supplements To Manuals."

SUPPLEMENT	TITLE
245	BATTERY SAFETY AND MAINTENANCE

PPT 45 Series

Self-Propelled,
Pallet Lift Truck
Serial Number 374782
and higher

Operation
Maintenance
Repair Parts List



Manual No. 901358

SAFETY SECTION

SAFETY WARNINGS

Throughout this manual the following Warning Words will be used in conjunction with important operator instructions. The listing below shows the level of the warnings.

DANGER

⚠ DANGER

This is the highest level statement. Failure to follow the listed instructions will most likely result in severe injury or death.

WARNING

⚠ WARNING

This is a statement of serious hazard. Failure to follow the listed instructions could place the individual at risk of serious injury or death. The statements used with this level of warning deal with a safe operating procedure. If the procedure is ignored, the possibility of personal injury may exist.

CAUTION

⚠ CAUTION

The statements used with this level of warning deal with a safe operating procedure. If the procedure is ignored, the possibility of personal injury may exist.

IMPORTANT

IMPORTANT

This type of statement is used to draw attention to a procedure that needs to be followed to prevent machine damage.

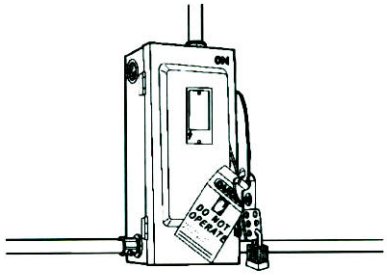
Energy Isolation

During the servicing of the PPT 45 it may be required to work with and around electrical power. In most cases, the truck will be serviced with the batteries disconnected. However, some of the service procedures may require working with the battery connected or within the battery charger. As required, the lockout and tagout of the main power supply will be required and will need to be indicated as shown below.

Lockout: The placement of a lockout device on an energy-isolating device (breaker panel, etc.), in accordance with an established procedure, ensuring that the energy- isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Tagout: The placement of a tagout device on an energy- isolating device (circuit breaker), in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled cannot be operated until the tagout device is removed.

An appropriate locked out and tagged out power supply is shown in the illustration below. The tag, as suggested by the illustration below, should accompany lockout devices used for this safety function.



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Section 1
DESCRIPTION

1-1. INTRODUCTION

This publication describes the PPT 45 lift truck manufactured by Big Joe Manufacturing Company, Lincolnwood, Illinois 60646. Covered in this manual are operating instructions, planned maintenance instructions, lubrication procedures, corrective maintenance procedures and a complete parts list with parts location illustrations.

By following the recommendations contained in this manual, you will receive many years of dependable service from your Big Joe lift truck.

1-2. GENERAL DESCRIPTION

The self-propelled PPT 45 truck, Figure 1-1, lifts and transports payloads up to 4500 pounds on rigid forks.

The forward and reverse motion is controlled by either of two control levers mounted on the control head. Stopping and turning is controlled by the steering arm. Lift and Lower is controlled by pushbuttons located on the control head. The battery-powered lift truck is quiet and without exhaust fumes.

The reversible DC motor propels the lift truck in forward or reverse direction throughout the available speed range. The PPT 45 lift truck can be driven with forks raised or lowered. The lift truck must be operated and stored in an area where it will be protected from the elements.

1-3. NAMEPLATE

The nameplate (Figure 1-2) is the key for identifying many of the features of your lift truck. It provides information such as:

- Model number
- Serial number
- Maximum capacity, load center, and maximum lift height
- If applicable, alternate capacity, load center, and maximum lift height
- Truck weight without battery
- Minimum weight of battery
- Battery voltage

Refer to Figure 1-1 for serial number location, if the nameplate becomes lost or illegible.

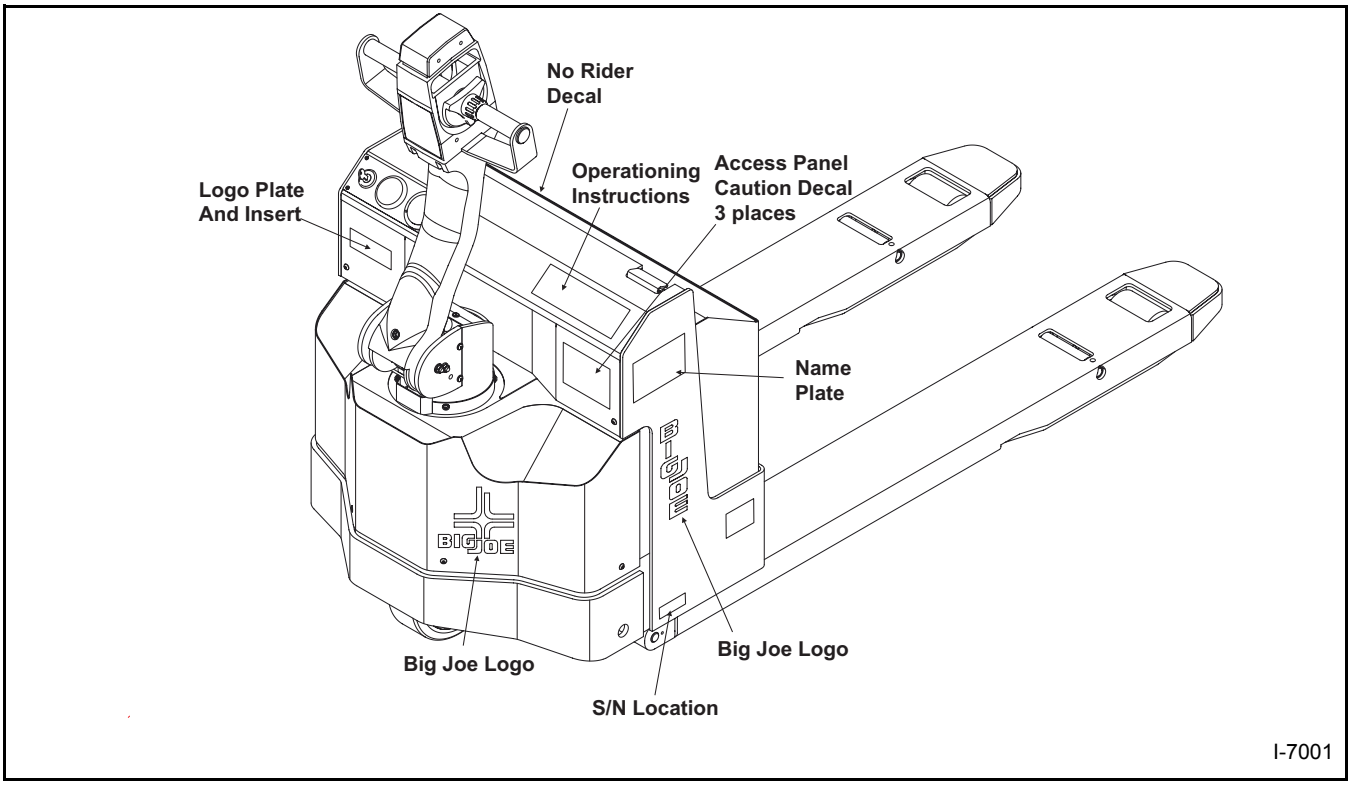

Figure 1-1. PPT 45 Orientation

1-4. SAFETY FEATURES

The PPT 45 is designed and engineered to provide maximum safety for operator and payload. Some of the safety features incorporated into the design are:

- Deadman brake to apply mechanical brake and cut off drive power when the steering arm is released.
- Belly-button switch to reverse truck should the operator accidentally pin himself against a wall or obstruction when backing up in slow speed.
- All control functions automatically return to 'OFF" when released.
- Externally accessible quick-disconnect battery plug within operator's reach.
- Separately fused control circuits and power circuits.
- Lift carriage backrest to help stabilize the load.
- Readily accessible HORN button.
- Slip-resistant hand grips to provide a firm hand hold for operator.
- Flow control valve regulates maximum load lowering speed within prescribed limits.
- Relief valve maintains hydraulic pressure within prescribed limits.
- High visibility color scheme of truck provides visual alert of trucks presence.

1-5. OPTIONS

Big Joe offers options and accessories for the PPW 45 lift truck such as:

- Cold conditioning package
- Load backrest extension
- Skid adapter
- Casters

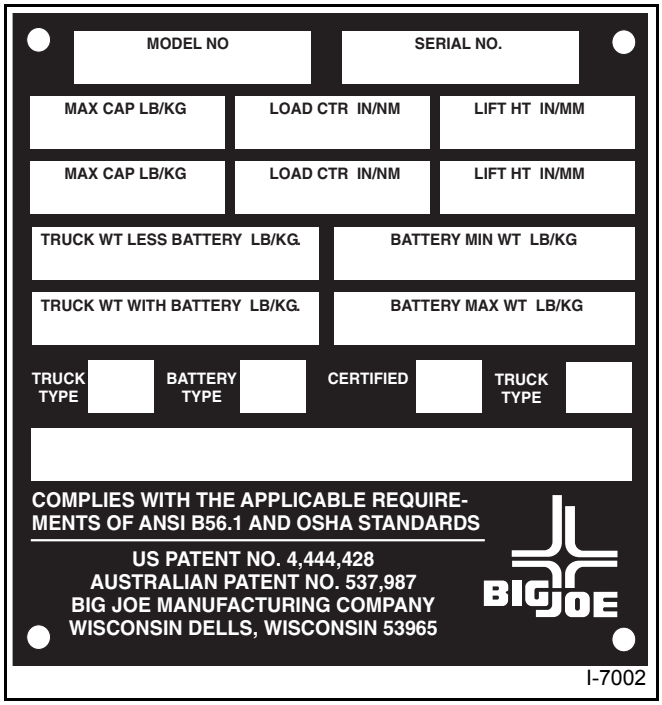

Figure 1-2. Name Plate

Section 2
OPERATION

2-1. GENERAL

This section gives detailed operating instructions for the PPT 45 lift truck. The instructions are divided into the various phases of operations, such as operating lift, driving, and stopping. Routine precautions are included for safe operation.

2-2. OPERATING PRECAUTIONS

⚠ WARNING

Improper operation of the lift truck may result in operator injury, or load and/or lift truck damage. Observe the following precautions when operating the PPT 45 lift truck.

1. Do not operate this truck unless you have been trained and authorized to do so and have read all warnings and instructions in this manual and on the truck.
2. Do not operate this truck until you have checked its condition. Give special attention to Tires and Rollers, Horn, Battery, Controller, Lift System, Brakes, Steering Mechanism, Guards and Safety Devices.
3. Operate truck only from designated operation position. Wear foot protection. Do not carry passengers.
4. Observe applicable traffic regulations. Yield right of way to pedestrians. Slow down and sound horn at cross aisles and wherever vision is obstructed.
5. Start, stop, travel, steer and brake smoothly. Slow down for turns and on uneven or slippery surfaces that could cause truck to slide or overturn. Use special care when traveling without load, as the risk of overturn may be greater.
6. Always look in direction of travel. Keep a clear view, and when load interferes with visibility, travel with load or lifting mechanism trailing.
7. Use special care when operating on ramps-travel slowly, and do not angle or turn. Travel with lifting mechanism or load downhill.
8. Do not overload truck. Check nameplate for capacity and load center information.
9. Before lifting, be sure load is centered, forks are completely under load, and load is as far back as possible against load backrest.
10. Do not handle loads that are higher than the load backrest unless load is secured so that no part of it could fall backward.
11. When leaving truck, neutralize travel control. Fully lower lifting mechanism and set brake. When leaving truck unattended or storing for prolonged periods, disconnect battery.

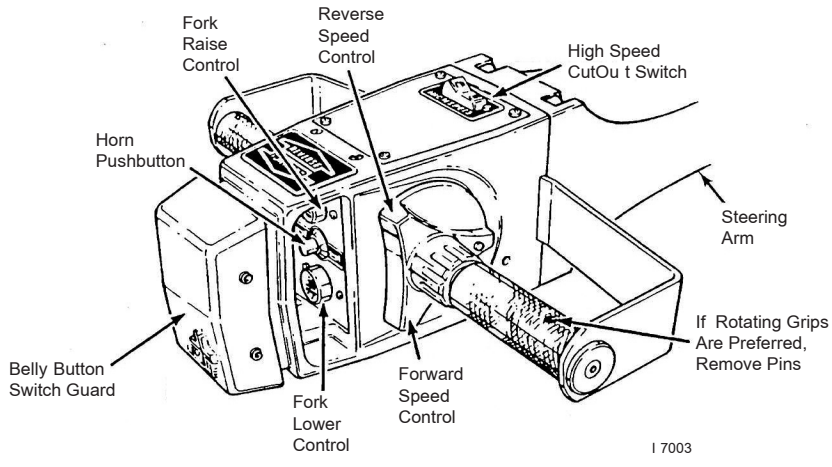

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Figure 2-1. Steering Control

2-3. GENERAL CONTROL OPERATION

The speed control (Figure 2-1), located on each side of the control head, provides fingertip control for driving the truck. Rotating, or pressing the speed control downwards moves the truck in the FORWARD direction. As the speed control is pressed, it closes electrical contacts for first speed, or creep, in the forward direction. Pressing the speed control farther increases the speed of the truck. The speed control is infinitely variable, which means that the farther the control is pressed, the faster the truck will move.

NOTE: The truck is equipped with a High Speed Cutout Switch, located on the control head, higher travel speeds will be available. With this switch in the OFF position, standard travels speeds are available. Place the switch in the ON position to enable the highest travel speed.

Rotating or pressing the speed control upwards moves the truck in the REVERSE direction. The upper portion of the speed control controls the reverse speeds in the same manner.

The pushbutton switches, located behind the belly button switch guard, activate the lift-lower controls and the horn.

The brake is applied by lowering or raising the steering arm. When the steering arm is lowered or raised approximately half way the brakes are partially applied. When the steering arm is raised completely vertical, the brakes are fully applied. (See Figure 2-2) All traction control power is shut off when the brake is engaged. When the steering arm is in the upright position, the brake acts as a parking brake. Deadman braking occurs when the handle is released and spring action raises it to the upright position.

2-4. DRIVING AND STOPPING PROCEDURES

2-4.1 Standard Travel

1. If equipped, turn on the key switch. Grasp the grips of the steering arm so that the speed control can be comfortably operated by either thumb.
2. Lower the steering arm to a comfortable position above horizontal to disengage the brake and to energize the electrical circuits.
3. To move forward (with load trailing), slowly press the speed control downwards. Press the forward speed control farther to increase speed. If engaged, the High Speed cutout switch will disable the highest travel speeds.
4. To slow down or stop, release the speed control and lower or raise the steering arm to the horizontal or vertical position. In those positions, the brake pads apply pressure to the brake disc slowing or stopping the truck.

   NOTE: Procedures for movement in reverse are the same as in the forward direction.
5. To travel in reverse, lower steering arm to a comfortable position above horizontal and slowly press the speed control upwards.

2-4.2 Creep Travel

1. Creep, or the slowest travel speed, is available in both forward and reverse.
2. Lower the handle from the vertical position until you hear a "click" which indicates that the controls are energized. See Figure 2-2.
3. Rotate the speed control for either forward or reverse travel.

IMPORTANT

With the control handle in the creep position, creep speed will be the only speed available no matter how far the speed control is rotated.

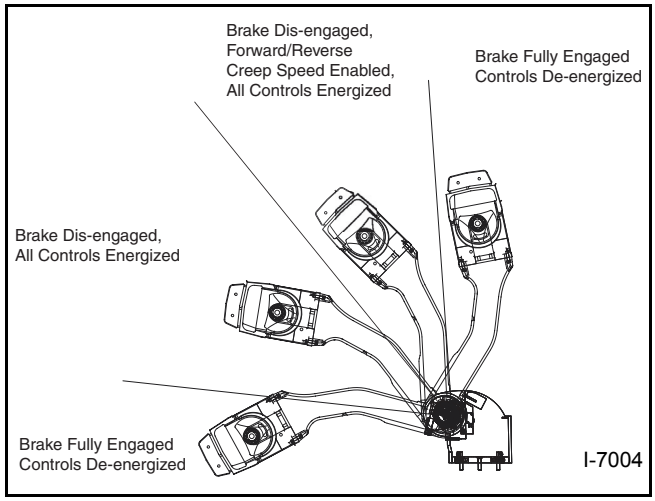


Figure 2-2. Brake Arm Actuation

2-5. BELLY-BUTTON SWITCH. (FIGURE 2-1)

The belly-button switch (Figure 2-1) minimizes the possibility of the driver being pinned by the steering arm while driving the lift truck forward in slow speed. If the guard presses against the operator while the lift truck is being driven forward, the guard actuates a switch, which changes the direction of the lift truck to reverse direction in low speed.

2-6. STEERING ARM RETURN SPRING

The steering arm return spring automatically raises the steering arm to the upright position when the steering arm is released. If the steering arm snaps up abruptly, or does not fully raise, the steering arm return spring requires adjustment. Return truck to maintenance for adjustment.

2-7. LIFT AND LOWER CONTROLS

Lift/Lower Control buttons are located on the steering control head, behind the belly button switch guard. (Figure 2-1)

- To lift the forks, push in **LIFT** button and hold until forks reach desired height.
- To lower the forks, push in **LOWER** button and hold until forks descend to desired height.

2-8. LOADING AND UNLOADING

1. Move truck to location where load is to be picked up.
2. Using the **BACKWARD** speed control, move truck backward into position so forks are within pallet or skid, the load is centered over the forks and as far back toward the backrest as possible.
3. Raise forks to lift load.
4. Drive to area where load is to be placed.
5. Move truck to position load at the delivery location.
6. Lower the load until it rests squarely in place and the forks are free.
7. Using the **FORWARD** speed control, slowly move the truck straight forward to remove forks from pallet.

2-9. PARKING

When finished with moving loads, drive truck to its maintenance or storage area. If equipped, turn off the key switch. If the lift truck is designed to use a remote charger, disconnect battery cable from the truck receptacle and connect it to the chargers receptacle. If the lift truck is equipped with an internal charger, connect the power cable to the charger plug to charge the batteries.

Charge batteries as necessary. Refer to battery care instructions, Section 3-4.

NOTES:

Section 3
MAINTENANCE

3-1. GENERAL

Maintenance includes both the operator daily check procedures and scheduled maintenance, which must be performed by a qualified service technician. Any problems noted during the operator's daily inspection or the monthly and quarterly scheduled maintenance procedures must be corrected by a qualified maintenance technician.

3-2. OPERATOR DAILY CHECKS

Table 3-1 is a checklist identifying both visual and operational checks that must be performed by the operator on a daily basis to ensure the safety of the equipment. Optional items are noted as such.

⚠ WARNING

- **If the truck is found to be in need of repair, unsafe, or contributes to an unsafe condition, report it immediately to your designated authority.**
- **If during operation, the truck becomes unsafe, report it immediately.**
- **Do not operate the truck until it has been restored to safe operating condition.**
- **Do not make any unauthorized repairs or adjustments.**

3-3. MONTHLY AND QUARTERLY CHECKS

Table 3-2 is a monthly and quarterly inspection and service chart based on normal usage of equipment. Normal use is eight hours per day, five days per week for a total of 40 hours per working week. If the lift truck is used in excess of forty hours per week, the frequency of inspection and service should be increased accordingly.

3-4. BATTERY CARE

⚠ WARNING

- **Hydrogen gas that vents from lead acid batteries can explode. Do not smoke, use an open flame, or create an arc or sparks in the vicinity of the batteries. Ventilate well when in an enclosed space and when charging.**
- **The batteries contain SULFURIC ACID, which causes severe burns. Do not get acid in eyes, on the skin or clothing. In case of contact, flush immediately and thoroughly with clean water. Obtain medical attention when eyes are affected.**

3-4.1 General

The life of the batteries can be extended by giving them proper care. Perform a daily check of the batteries whether or not the equipment is in daily use.

IMPORTANT

- DO NOT overcharge the batteries or battery life will be shortened.
- DO NOT allow batteries to become completely discharged (specific gravity 1.150 or less for flooded cell batteries. Maintenance free battery charge level is not measured by specific gravity). This will also greatly shorten battery life.

Table 3-1. Daily Checks

VISUAL CHECKS	
ITEM	**PROCEDURE**
DAMAGE	Check for bent, dented or broken parts.
LEAKS	Check drive unit and hydraulic system.
TIRES AND WHEELS	Check drive wheel and load wheels for wear, damage, binding, etc.
FORKS	Check for bends and misalignment.
CABLES AND HOSES	Check that they are in place and not damaged.
BATTERY	If your unit is equipped with flood cell batteries, check the water level and vent caps for damage or plugging.
	IMPORTANT: If the lift truck is equipped with maintenance free batteries, DO NOT attempt to remove battery caps.
BATTERY CONNECTOR	Check for cracks, burns and for tight connections with truck receptacle.
GUARDS	Check load backrest, covers and guards for damage.
SAFETY DEVICES	Check that warning labels, data plates, etc. are in the same condition as originally equipped.
FRAME AND SERVICE COVER	Check for damaged paint, cracks in welds or other damage.
OPERATIONAL CHECKS	
HORN	Check for sound.
STEERING	Check for binding or excessive play. Excessive play will be indicated by a physical shifting or movement of the transmission.
TRAVEL	Check all speed ranges, forward and reverse. No unusual noise should be present.
HYDRAULIC CONTROLS	Check lift and lower for binding or unusual noises, etc.
BRAKES	Check that brake stops truck within a safe distance and works smoothly. Check dead-man brake by releasing handle.
HOUR METER	Check for proper operation.
PARKING BRAKE	Make sure it holds the truck in place.
BATTERY CHARGE INDICATOR	Check that battery discharge indicator is on "full" or the specific gravity of batteries, as checked with a hydrometer, indicates full charge.
BELLY BUTTON SWITCH	In an open and unrestricted area check for proper operation.

Table 3-2. Monthly and Quarterly Inspection and Service Chart

NOTE: The following service checks should be performed by a qualified service technician.

INTERVAL	INSPECTION OR SERVICE
Monthly	Clean drive motor and check condition of commutator, brushes, and springs (Section 4-5).
Monthly	Clean hydraulic pump motor and check condition of commutator, brushes, and springs (Section 4-8).
Monthly	Check brake for proper operation.
Monthly	Check load wheels for wear. A poly load wheel must be replaced if worn to within 1/16 inch of hub. Check for separation from hub.
Monthly	Check drive wheel for wear. A poly drive wheel must be replaced if wheel is worn to within 1 inch of hub. Check for separation from hub.
Monthly	Inspect wiring for loose connections and damaged insulation.
Monthly	Inspect contactor for proper operation.
Monthly	Check deadman brake switch for proper operation.
Quarterly	Check lift cylinder for leakage.
Quarterly	Check for excessive jerking of steering arm when stopping or starting.
Quarterly	Check brake pads for wear. Brake pads must be replaced when air gap can not be adjusted to tolerances shown in Section 4-4 Brakes.

3-4.2 Battery Removal

The PPT 45 has three optional battery sets, a single industrial battery, a set of two 12 V batteries or a set of four 6V batteries.

Each of the battery sets is enclosed in a removable case. Removal of battery requires that the electrical cables to the lift truck be disconnected. When the cables have been disconnected, the batteries or battery case can be removed from the lift truck. (Section 4-7).

⚠ CAUTION

The battery cases are heavy and can contain flooded cell batteries. Use appropriate lifting devices to remove the battery case from the lift truck.

3-4.3 Testing and Charging of Lead Acid Battery

Use the following procedure for flooded cell batteries:

NOTE: If the lift truck is equipped with maintenance free batteries, skip steps 1 and 2. DO NOT attempt to open maintenance free battery caps.

1. Obtain a battery hydrometer.
2. Use the hydrometer to check specific gravity of each cell.

   NOTE: Battery specific gravity readings should agree within ±0.025 from cell to cell. If variation is greater, the battery may have to be replaced.

IMPORTANT

Be sure that no cell plates are exposed (not covered by fluid) before charging. Add distilled water sufficient to just cover top of cell plates. DO NOT over fill cells.

Use distilled water only. Impurities in tap water will damage battery plates.

3. Charge batteries in accordance with hydrometer readings.

⚠ WARNING

- **Do not service batteries while they are being charged.**
- **Do not connect or disconnect battery from charger while charger is on.**

NOTE: A fully charged battery has a specific gravity of 1.260 to 1.275.

4. After charging, again check water level in each cell of the flooded cell batteries. Water level must cover plates but not be higher than the base of the battery cell filler neck.

3-5. LUBRICATION

Refer to Table 3-3 for recommended types of grease and oil. Table 3-3, in conjunction with Figure 3-1, identifies the items requiring periodic lubrication and where they are located on the lift truck.

Table 3-3. Recommended Lubricants (See Table 3-4 for Application)

No. 1	Transmission oil - EP SAE 80W-go. Capacity - 1.5 quart. Big Joe No. 055780 (Replace with 055790. 1W-30, if cold conditioning option for continuous operation below 320F is installed).
No. 2	Grease-Lithium base, general purpose. Big Joe No. 055750 (Replace with 055753 if cold conditioning option for continuous operation below 320F is installed).
No. 3	Hydraulic oil. Big Joe No. 900855 (Gallon) or 900893 (Quart). (Replace with 055784 if cold conditioning option for continuous operation below 320F is installed)
No. 4	Engine lubricating oil - No. 20

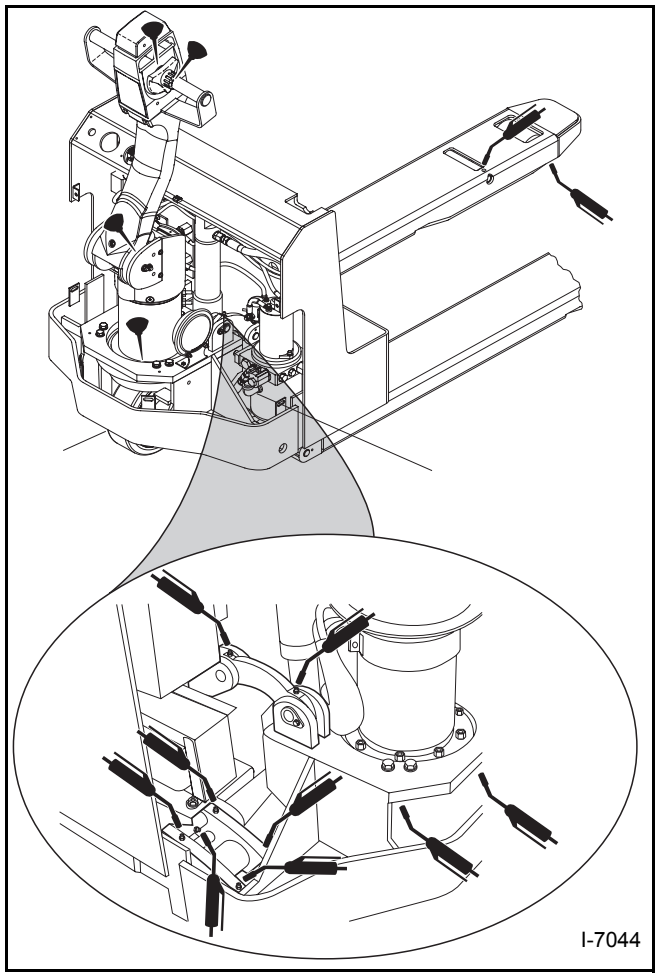


Figure 3-1. Lubrication Locations

Table 3-4. Lubrication Chart

Time Interval	Figure 3-1 Index	Location	Method Of Application	Type (Table 3-4)	Application of Lubricant
Semi-Annually		Steering Arm Elbow	Oil Can	No. 4	1 or 2 drops each time serviced
Annually	2	Transmission Housing	Can	No. 1	Fill to plug level
Semi-Annually	1	Hydraulic Reservoir	Can	No. 3	Lower carriage, fill to 1 inch below elbow tap in reservoir
40 hours		Lift Linkage, includes load wheels*	Grease Gun	No. 2	Pump until you see old grease leave bushing
Semi-Annually		Drive unit turntable bearings	Grease Gun	No. 2	5 or 6 pumps into each of two bearing grease fittings.

*Raise lift truck to gain access to load wheels grease zerk. Illustration above shows only one side of the lift truck. Repeat procedure on the other side of the truck.

NOTES:

Section 4
ADJUSTMENT AND REPAIR

4-1. GENERAL

This section contains information and procedures for maintenance of the PPT 45 lift trucks. Maintenance includes adjustment, and repair.

The illustrations in this section identify lift truck maintenance parts. The callouts on each illustration correspond to the reference index numbers in the applicable text.

Parts listings are provided in Section 7 of this manual. The parts list provides the Big Joe Manufacturing Company part number, the part description, and the quantity of the part required in the assembly.

When identifying each part to be ordered, visually compare the part in the illustration with the actual part needed. To assure proper identification of each part being ordered, include your truck model number and serial number (see nameplate), the part number description and quantity of the part(s) needed. If the nameplate becomes lost or illegible, refer to Figure 1-1 for other serial number locations.

4-2. PART NUMBER IDENTIFICATION

To determine the part number of a replacement part, identify the assembly in which the part is used and in Section 7, locate the illustration of the appropriate assembly. Find the index number for the part on the illustration and refer to that index number in the parts list. If the part number is NP, order the next higher assembly. If the part number is VAR, order by part name with truck model number and serial number

If the part is listed with more than one part number, select the proper part number by comparing the description in the parts list with the specifications of your truck. Refer to the nameplate to determine application to your truck.

4-3. STEERING ARM AND CONTROL HEAD

WARNING: Testing of belly-button safety switches in operation should be limited to areas clear of obstacles against which an operator could be pinned. Use low speed in forward.

4-3.1 Belly-Button Switch Adjustment.

If the actuator gap of the belly-button switch needs adjustment, proceed as follows (Figure 4-1):

1. Disconnect the battery.
2. Drive out the roll pins that secure the belly-button casting (Figure 4-1). Drive from the left to the right.

   NOTE: While removing the belly-button casting, the two return springs will drop free. Catch the springs while pulling the casting away to prevent their loss.

3. Bend actuator levers of belly-button switches to adjust the gap between rollers and belly-button casting as required (See Figure 4-1).

IMPORTANT

If too small a gap exists between bellybutton switch actuator rollers and the belly-button casting, one or both of the belly-button switches may be actuated constantly.

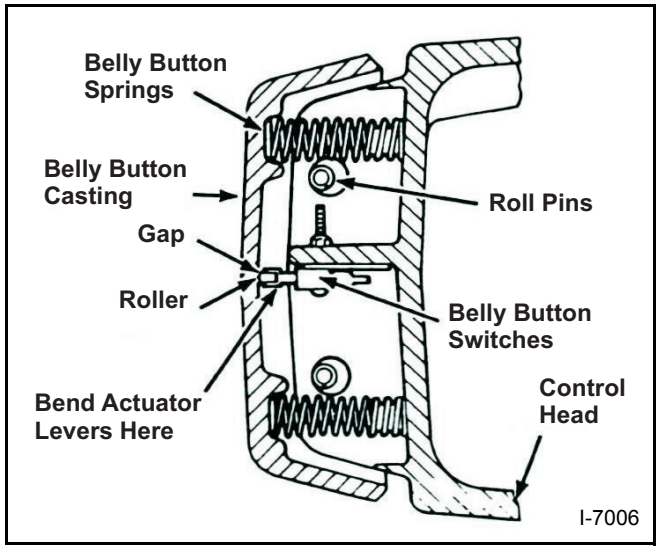


Figure 4-1. Steering Arm Control Head

4. Reinstall belly-button casting, making certain all parts are back in place. Check operation of the belly-button safety switches by pressing the belly-button casting while listening for the 'click' that indicates that the switches have actuated.

   NOTE: The click should be heard when the belly-button casting has moved about 50 percent of its normal travel distance. If the click is heard at the beginning of travel, the switches may actuate at inappropriate times. If the click is heard near the end of travel, they should be adjusted to activate earlier.

5. Repeat steps 2 through 4 until pressing the bellybutton casting actuates the switches properly
6. Reconnect battery and turn power ON with keyswitch. In an open, unrestricted area and traveling at a low speed in forward (towards operator), press the belly-button casting inwards to confirm that the belly-button switches reverse the truck direction.

4-3.2 Potentiometer Testing and Adjustment

1. Disconnect the battery
2. Remove screws (20 and 64, Figure 4-2) and access covers (40 and 66).
3. Check gap between rollers on directional switches (7) and surface of cam (46). If required, adjust position of bracket (50) to obtain a 0.03-0.06 inch clearance.
4. Disconnect the connector round located at contactor panel, connecting the control cable and wire harness. Set an ohmmeter to the RXIK (1000) scale and connect across pin contacts of wires 7 and 11 at the control cable pin housing.
5. Slowly press the control lever (52, Figure 4-2) in the forward direction until a click indicating forward switch closure is heard. Ohmmeter should indicate 4550 ohms (± 250 ohms).
6. If incorrect reading is obtained, use access hole, in the side of the control head (Figure 4-3) to gain access to the potentiometer. (3, Figure 4-2). Insert a screwdriver blade into the slot on the back side of the potentiometer (Figure 4-3) and turn slightly. Vary the amount and direction of screwdriver rotation until the specified value is achieved.
7. Repeat step 5 while pressing control lever in reverse direction. Meter readings should be the same as for the forward direction (± 200 ohms). If meter readings are not the same, adjust position of bracket (44, Figure 4-2) as necessary to obtain the same values. Adjust the potentiometer again if necessary.
8. Reassemble the control head.

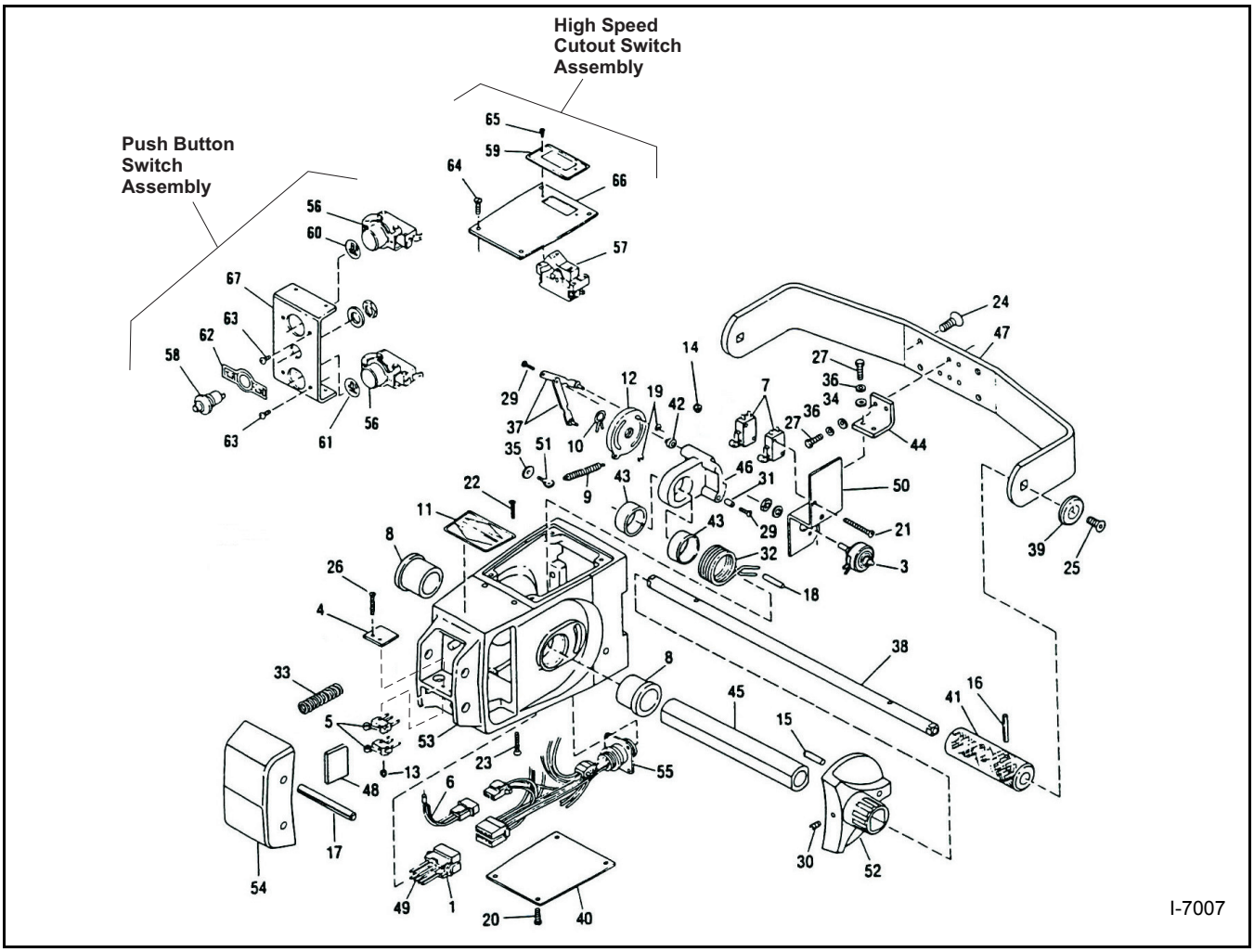


Figure 4-2. Control Head Assembly

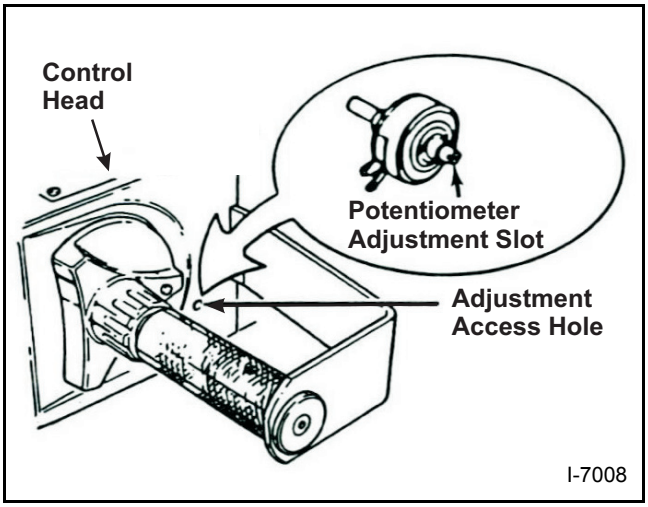


Figure 4-3. Control Head Potentiometer Adjustment

4-3.3 Control Head Switch Replacement

1. Disconnect the battery.

   NOTE: Access to belly-button switches (5, Figure 4-2) is provided by removal of safety cover (54). Access to other switches is provided by removal of top cover (66), bottom cover (40), and switch plate (67).

2. Refer to Section 4-3.1, if necessary to gain access to a defective belly-button switch.

   NOTE: Switch operation may be checked with a continuity light containing a battery, or with an ohmmeter.

3. Replace a defective belly-button switch (5) as follows:

   a. Remove locknuts (13) and screw (26) to release belly-button switch (5) and insulator (4).

b. Tag and disconnect electrical wires from bellybutton switchs.

c. Connect electrical wires to new belly-button switchs, as noted during removal.

d. Install insulator (4) and belly-button switch (5) and secure with screws (26) and locknuts (13).

e. Adjust belly-button switch (Section 4-3.1).

4. Replace a defective high speed cutout switch (57) as follows:

a. Disconnect the battery.

b. Remove screws (64) and top cover (66).

c. Remove screws (65) to release cutout switch (57).

d. Tag and disconnect electrical wires from the old cutout switch (57).

e. Connect electrical wires to new cutout switch (57) to the same terminals from which they were removed.

f. Install cutout switch (57) into the control head and secure with screws (65).

g. Install control head top cover (66) and secure with screws (64).

h. Connect battery.

5. Replace a defective pushbutton switch (56 or 58) as follows:

a. Disconnect the battery.

b. Remove screws (64) and top cover (66).

c. Remove screws (20) and bottom cover (40).

d. Remove screws (22 and 23) to release switch plate (67).

e. Remove screws (63) to remove lift or lower switch (56).

f. Remove nut and washer (61) from back of horn switch (58) to remove it from the switch plate (67).

g. Tag and disconnect electrical wires from defective switch.

h. Connect wires to new switch, as noted during removal.

i. To install lift or lower switch (56), slide the new switch through back of switch plate (67) and secure with screws (63).

j. To install horn switch (58), slide the switch through the front of switch plate (67) and secure with its washer and nut.

k. Install switch plate (67) and secure with screws (22 and 23).

l. Install top cover (66) and secure with screws (64).

m. Install bottom cover (40) and secure with screws (20).

n. Connect the battery.

4-3.4 Steering Arm.

1. Steering Arm Return Spring Adjustment (Figure 4-4)

⚠ WARNING

The steering arm will fall when the tension on the return spring is released.

The tension on the steering arm return spring should allow the steering arm to return gently to the upright position. Excessive tension on the steering arm return spring will cause the steering arm to snap up and may cause damage to the electrical cable or to the spring.

If the steering arm does not fully return, first check for binding in the wiring harness before making any adjustments. If no binding is found, then the problem is with the steering arm return spring. Refer to Figure 4-4 and proceed as follows to adjust the steering arm return spring tension.

a. Hold the steering arm (2, Figure 4-4) in the upright position and make sure the arm cannot fall.

b. Insert a 5/16 inch Allen wrench through hole in bottom of steering arm (2) and loosen screw (20). The spring tube (25) will rotate counterclockwise when screw (20) is loosened.

c. With a pair of vise-grip pliers, grip the flat surfaces of spring tube (25) and rotate clockwise 180 degrees.

NOTE: The flat surfaces are on the protruding end of the spring tube (25), where the pins (15 and 16) are installed.

d. Hold spring tube (25) in rotated position and tighten screw (20) to secure.

e. Check the spring action by lowering the steering arm (2) and returning it to the upright position two or three times.

f. If necessary repeat steps a through e, increasing or decreasing amount of rotation of the spring tube (25) until steering arm (2) returns gently to full upright position.

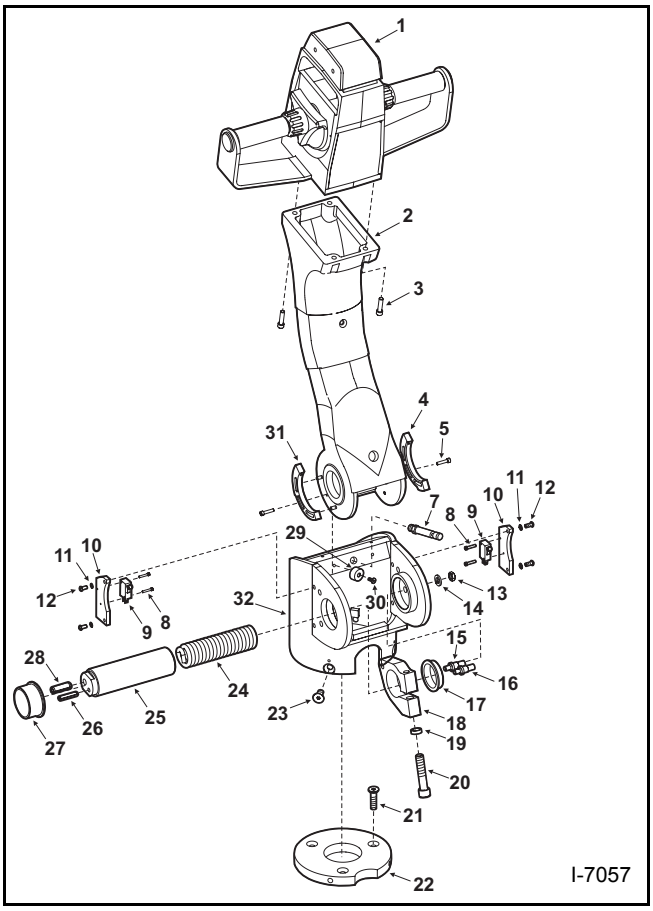


Figure 4-4. Steering Arm Spring

4-3.5 Steering Arm Spring Replacement

The steering arm return spring (24, Figure 4-4) is replaced while the steering arm (2) is in the upright position.

a. Disconnect battery.

b. Remove control head by removing the four capscrews (3). Remove the control from the control arm and disconnect the round control cable connector.

⚠ WARNING

The steering arm will fall downward when the tension on the return spring is released.

c. Hold steering arm (2) and make sure the arm cannot fall.

d. With a piece of chalk or crayon, draw a straight line from center of spring tube (11, Figure 4-4) outward onto steering tube, marking an alignment match mark to assist in re-installation.

e. Insert a 5/16 inch Allen wrench through hole in bottom of steering arm (25, Figure 4-4). Loosen and remove screw (20) and spacer (19).

IMPORTANT

Unless properly supported, steering arm (2) will drop out of the steering tube when the spring tube (25, Figure 4-4) is removed.

f. Put a block under steering arm (2) at steering tube.

g. With a pair of vise-grip pliers, grip the flat surfaces of spring tube (25, Figure 4-4) and slowly pull it free from the steering arm (2), steering tube and tube clamp (18, Figure 4-4).

NOTE: The flat surfaces are on the protruding end of the spring tube (25), where the pins (15 and 16) are installed. Steering arm return spring (24) will remain inside the spring tube (25).

h. Remove steering arm return spring (24) from spring tube (25). If spring is severely jammed and will not come loose, use punch and drive the 1/4-inch diameter roll pin (26) into the tube. Save pin for re-use. Remove the spring. Tap roll pin back into place.

i. Lubricate the ends and the outer surface of the new steering arm return spring (24) with a lithium base general purpose grease.

j. Insert spring (24) into spring tube (25) and press in, making sure that one spring loop eye fits over the 3/8-inch pin (28) at the closed end of the spring tube.

k. Slide spring tube (25) into pivot cap and steering arm (2) through tube clamp (18). Slowly rotate spring tube a few degrees each way until the steering arm return spring (24) snaps into place over spring pin (15).

l. Install spacer (19) and screw (20), but do not tighten. Align match mark on the spring tube (25) with the line drawn in step e. Tighten screw (20).

m. Remove block from under steering arm.

n. Install control head.

o. Refer to paragraph 4-3.4, step 1, above, and, if necessary, adjust the tension on steering arm return spring.

p. Reconnect battery.

4-3.6 Electrical Control Cable Replacement.

NOTE: Fully raise the forks to enable cover removal.

1. Disconnect battery.
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).

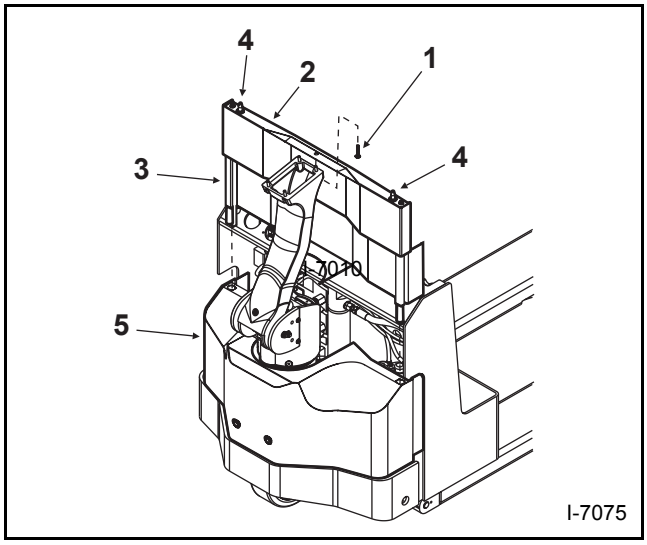


Figure 4-5. Upper Motor Compartment Cover Removal

4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Remove 4 screws (3, Figure 4-4) that fasten control head assembly to steering arm.

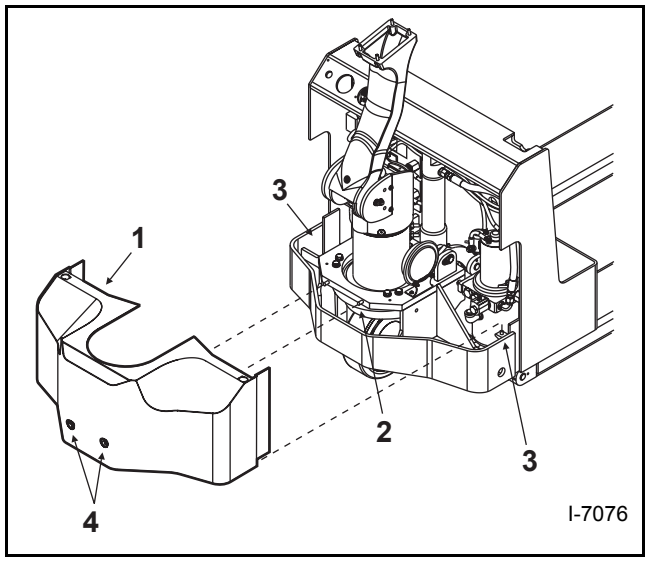


Figure 4-6. Lower Motor Compartment Cover Removal

6. Disconnect the exposed control cable connector (74, Figure 4-7).

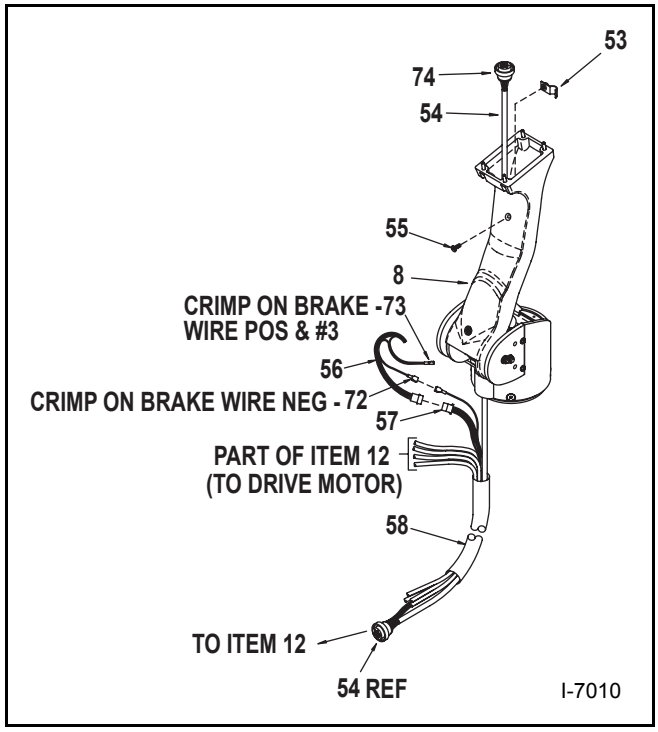


Figure 4-7. Control wiring Harness

7. Remove cable clamp (53) located within the control arm by loosening screw (55).
8. Disconnect connector (54) located inside the motor compartment, above the top end of the hydraulic cylinder.

9. Cut off connector (74) from the top end of the cable.

   NOTE: Measure the amount of excess cable that is located at the top end of the control arm. Make sure to leave this additional amount of new cable.

   Tape the loose end of the new cable to the cut end of the old cable before removing the old cable from the control arm.

10. Pull the cut end of cable out of the control arm from below. Make sure to pull the new cable through until the new connector has just enough slack to enable connection to the control head.
11. Remove the four screws (1, Figure 4-8) from the ring guard (3) and slide the guard upwards.
12. Remove the two cable clamps to free drive motor and control cable bundle. Note routing of cable, and position of cable clamps, to ensure proper installation.
13. Cut the electrical tape at both ends of the braided fabric sleeve that is bundling the cables and slide the sleeve towards one end. This will release the pressure on the sleeve making cable removal easier.

IMPORTANT

Take care not to cut or damage the four red brake controls wires that are bundled with the control cable.

14. Pull the old control cable out of the bundle and remove the cable from the lift truck.
15. Using electrical tape, wrap the loose ends of the new cable together.
16. With the braided fabric sleeve in the relaxed condition, thread the new cable through the braided sleeve. Make sure to leave enough cable at each end of the braided sleeve to enable connections to be made properly.
17. Group all cables coming from drive motor, dead-man switch and control cable, and reinstall cable clamp (53, Figure 4-7). Make sure to remove excess slack from the new cable assembly before securing with cable clamp.
18. Secure one end of the braided fabric sleeve to the cable bundle with electrical tape. Pull the fabric sleeve taught and securely tape the remaining end of the fabric sleeve to the cable bundle with electrical tape.
19. Reposition ring guard, (3, Figure 4-8) and secure with screws (1).

IMPORTANT

Improper cable adjustment will damage cable. If too tight, cable will tear when steering arm is in up position. If too loose, cable will buckle or be pinched when steering arm is in down position.

20. Work steering arm up and down a few times to assure that the electrical control cable is not binding.
21. Pivot transmission through entire turning range, make sure that all electrical cables and wire leads will flex properly and not become caught or pinched at any time.
22. Reinstall wires 1 through 12 into pin locations 1 through 12, respectively in the new connector. See Figure 4-9.
23. Reattach the round control cable connector (54, Figure 4-7) within the motor compartment.
24. Reinstall the control head assembly, attaching the round connector to the end of the new control harness (74, Figure 4-7) and secure with screws (3, Figure 4-4).
25. Install brake tube cover plate (2, Figure 4-8).

    NOTE: Fully raise the forks to enable cover reinstallation.

26. Reinstall service cover plates by installing the main cover plate (4, Figure 4-8) onto the four locating pins (7 and 8). **NOTE:** Make sure the rear two cover pins (7) are visible in the rubber grommets (9).
27. Slide the two middle cover plate arms (5, Figure 4-8) through the holes along the front edge of the main cover plate (4). Slide your fingers between upper cover plate (6) and middle cover plate (5). Pull upper cover plate (6) downwards, lowering the cover plate so that the two locating pins (10) will slide under the top of the upper framework.
28. Release the upper cover plate. Make sure the locating pins seat in the upper framework grommets and secure the upper cover plate with the screw (11).
29. Connect the battery and test operate the lift truck.

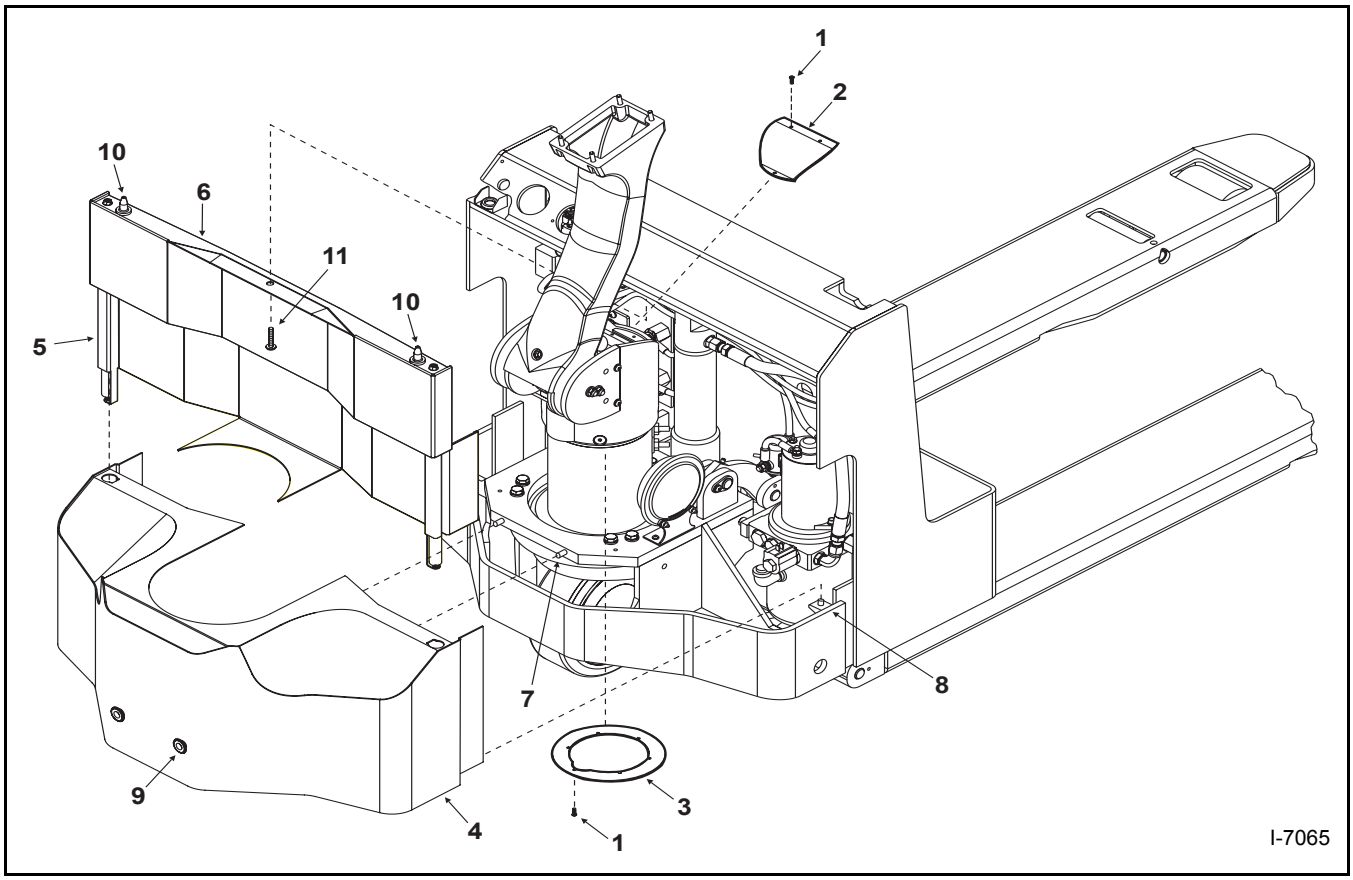


Figure 4-8. Motor Compartment Service Covers

HOUSINGS		004705 CABLE
PIN NO.	WIRE NO.	WIRE COLOR
1	1	BLACK
2	2	RED
3	3	BLUE
4	4	ORANGE
5	5	YELLOW
6	6	BROWN
7	7	RED W/BLACK STRIPE
8	8	BLUE W/BLACK STRIPE
9	9	ORANGE W/BLACK STRIPE
10	10	YELLOW W/BLACK STRIPE
11	11	BROWN W/BLACK STRIPE
12	12	BLACK W/RED STRIPE

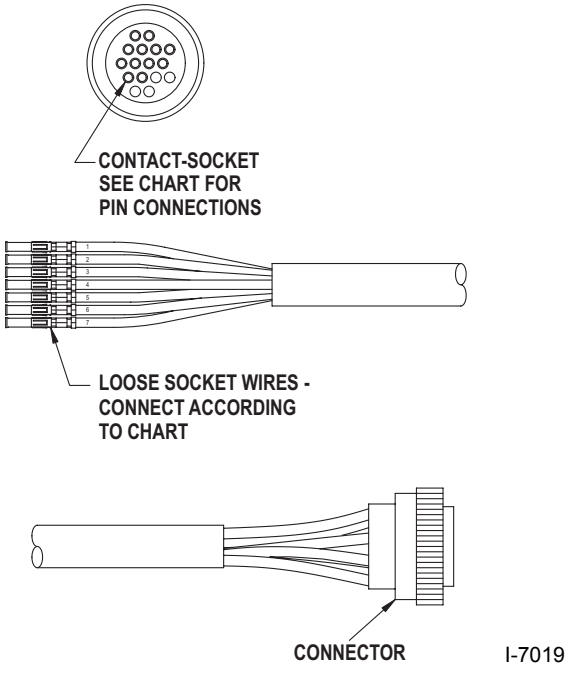


Figure 4-9. Control Cable Connections

4-4. BRAKES

4-4.1 Brake Pad Adjustment

1. Disconnect battery.
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Remove the four screws (1) securing the guard ring (3) and slide the guard ring upwards as much as possible.

⚠ CAUTION

Removing the mounting screws will loosen the steering arm. Support the arm to prevent injury from falling steering arm.

6. Remove the four screws (23, Figure 4-4) securing the steering arm to the drive motor assembly and remove the steering arm, providing access to the brake assembly.

NOTE: Use caution when removing the steering arm that brake and control head cables are not disconnected or damaged.

7. Locate the rubber seal on the brake assembly (1, Figure 4-10) Slide the rubber cover seal upwards onto the armature to enable access to the adjustment points (2).
8. Adjust the air gap between the armature plate (2, Figure 4-11) and the stator (1) using the three hexagon screws (3). Using standard feeler gauges, adjust to achieve the dimension "SLU" at each hex nut, which sets the gap for the armature plate (Table 4-1). When the adjustment has been made at each hex nut, recheck all other hex nuts to verify the adjustment.

Table 4-1. Brake Pad Air Gap Adjustment Measurement

Size	16
SLU	0.012" (0.3 mm)

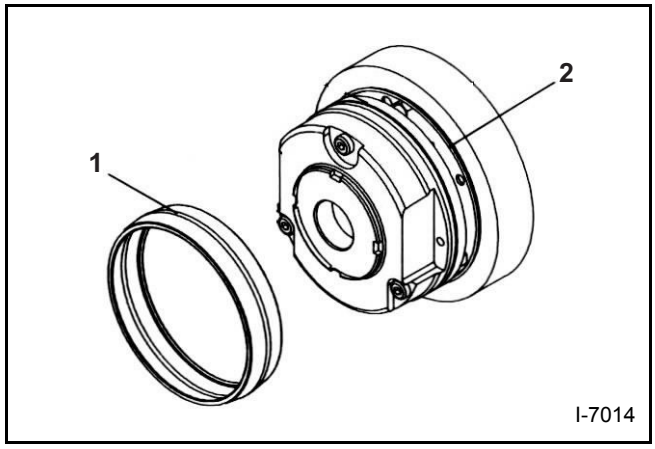


Figure 4-10. Electric Brake Assembly

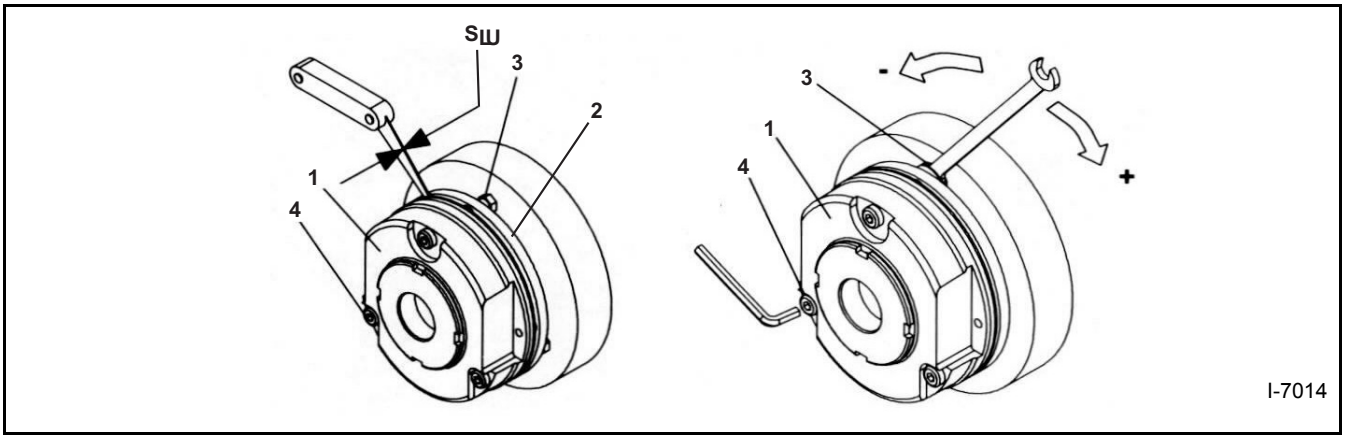


Figure 4-11. Brake Pad Adjustment

9. Reinstall the rubber cover seal (1, Figure 4-10). Make sure to seat the seal around the base of the armature plate and the lower groove in the armature.
10. Reinstall the steering arm.
11. Remove blocking and lower truck
12. Reconnect the battery and test the brake function.
13. Repeat brake adjustment as needed to make sure that the stops properly.

4-4.2 Brake Pad Replacement

Replace the brake if it does not engage when the steering arm is raised to within 15 degrees from its park position or lowered to within 15 degrees from its lowest position (Figure 2-2) and brake pad adjustment does not improve braking. Proceed as follows:

1. Disconnect battery.
2. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
3. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
4. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
5. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
6. Remove the four screws (1) securing the guard ring (3) and slide the guard ring upwards as much as possible.

⚠ CAUTION

Removing the mounting screws will loosen the steering arm. Support the arm to prevent injury from falling steering arm.

7. Remove the four screws (23, Figure 4-4) securing the steering arm to the drive motor assembly.

   NOTE: Use caution when removing the steering arm that brake and control head cables are not disconnected or damaged.

8. Remove the three brake assembly mounting bolts (1, Figure 4-12).

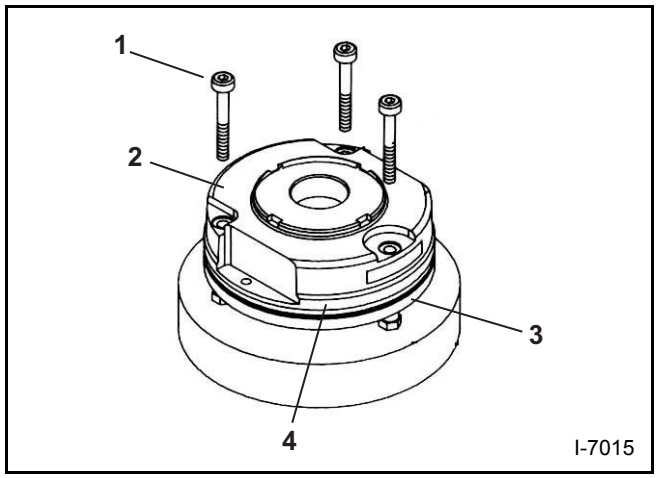


Figure 4-12. Brake Assembly

9. Lift the brake assembly (2) off of the drive motor assembly.

IMPORTANT

The splined hub on the brake hub (3, Figure 4-13) assembly must be positioned downwards, towards the center of the motor assembly. If the brake hub is not assembled in this fashion, damage to the splined gear may result.

10. Slide the rubber cover seal (5, Figure 4-13) upwards, loosening the friction plate (4) and brake hub (3) assembly.
11. Remove and replace the friction plate (4) and brake hub (3) assemblies.

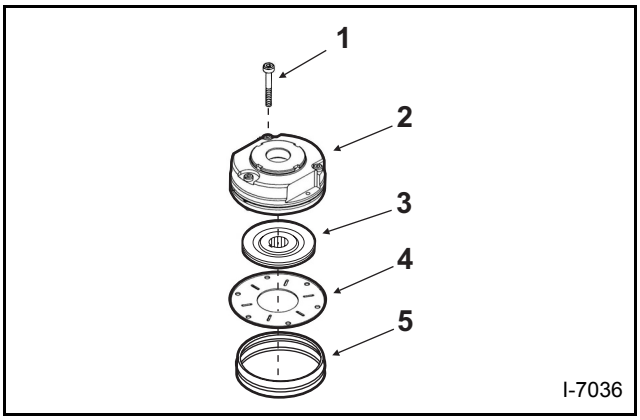


Figure 4-13. Brake Parts

12. Align the friction plate mounting holes with the mounting bolt holes.

IMPORTANT

Make sure that the raised edge of the friction plate (4) is facing upwards toward the brake hub assembly.

13. Insert the three mounting bolts (1, Figure 4-13) through the brake assembly and reposition over the splined shaft on the drive motor assembly.
14. Secure the three brake assembly mounting bolts (1). Torque the bolts to 17 ft. lbs. (23 Nm).
15. Adjust the brake air gap. See Section 4-4.1 Brake Pad Adjustment.
16. Slide the rubber cover seal into place.
17. Reinstall the steering arm assembly. Secure the 4 mounting bolts (23, Figure 4-4).

    NOTE: Make sure to route the electric wires and cable through the semi-circular notch in the brake assembly mounting plate (22, Figure 4-4) on top of the drive motor assembly.

18. Reposition the guard ring (3, Figure 4-8) and secure with the four mounting screws (1).
19. Reinstall service cover plates by installing the main cover plate (4, Figure 4-8) onto the four locating pins (7 and 8). **NOTE:** Make sure the rear two cover pins (7) are visible in the rubber grommets (9).
20. Slide the two middle cover plate arms (5, Figure 4-8) through the holes along the front edge of the main cover plate (4). Slide your fingers between upper cover plate (6) and middle cover plate (5). Pull upper cover plate (6) downwards, lowering the cover plate so that the two locating pins (10) will slide under the top of the upper framework.
21. Release the upper cover plate. Make sure the locating pins seat in the upper framework grommets and secure the upper cover plate with the screw (11).
22. Remove blocking and lower truck.
23. Reconnect the battery.

4-4.3 Replacement of Brake Assembly

1. Disconnect battery.
2. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
3. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
4. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
5. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2, 3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
6. Remove the four screws (1) securing the guard ring (3) and slide the guard ring upwards as much as possible.

⚠ CAUTION

Removing the mounting screws will loosen the steering arm. Support the arm to prevent injury from falling steering arm.

7. Remove the four screws (23, Figure 4-4) securing the steering arm to the drive motor assembly.

    NOTE: Use caution when removing the steering arm that brake and control head cables are not disconnected or damaged.

8. Remove the three brake assembly mounting bolts (1, Figure 4-14).

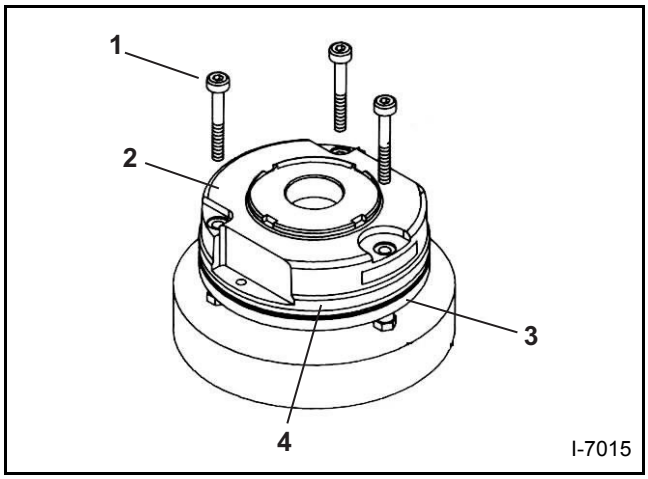


Figure 4-14. Brake Parts

9. Trace the wire harness to the Creep and Deadman switches.

IMPORTANT

Note connections before removing wires.

Remove the wires from the two switches and disconnect the three wire connector.

10. Cut the red and blue wires as close to the crimp-on connector as possible.

    NOTE: A new crimp-on connector is included with the replacement brake assembly.

11. Remove the old brake assembly (2, Figure 4-14).
12. Install new brake assembly and secure with the three cap screws (1, Figure 4-14).
13. Using the provided crimp-on connector connect the red and blue wires to the wiring harness.
14. Adjust the brake air gap. See Section 4-4.1 Brake Pad Adjustment.
15. Reinstall the steering arm assembly. Secure the 4 mounting bolts (23, Figure 4-4).

    NOTE: Make sure to route the electric control cable through the semi-circular notch in the brake assembly mounting plate on top of the drive motor assembly.

16. Reposition the guard ring (3) and secure with the four mounting screws (1, Figure 4-8).
17. Reinstall service cover plates by installing the main cover plate (4, Figure 4-8) onto the four locating pins (7 and 8). **NOTE:** Make sure the rear two cover pins (7) are visible in the rubber grommets (9).
18. Slide the two middle cover plate arms (5, Figure 4-8) through the holes along the front edge of the main cover plate (4). Slide your fingers between upper cover plate (6) and middle cover plate (5). Pull upper cover plate (6) downwards, lowering the cover plate so that the two locating pins (10) will slide under the top of the upper framework.
19. Release the upper cover plate. Make sure the locating pins seat in the upper framework grommets and secure the upper cover plate with the screw (11).
20. Remove blocking and lower truck
21. Reconnect the battery.

4-4.4 Replacement of Dead-Man Switch

1. Disconnect the battery.
2. Block the wheels to prevent the truck from rolling.
3. Remove the steering tube cover plate (2, Figure 4-8).
4. Remove the switch mounting bracket mounting screws (3, Figure 4-15).

   NOTE: When standing at the control head, the Dead Man Switch is located on the right hand side of the steering tube.

IMPORTANT

DO NOT loosen the mounting screws for the dead-man actuation cams.

5. Remove the switch mounting bracket (2) and switch assembly (1).
6. Note the wire connections to the switch.

IMPORTANT

Make sure to note the terminals to which the wires are connected.

7. Remove the switch (1) from the mounting bracket (2) and install new switch onto mounting bracket.
8. Reconnect wiring to match the original switch.
9. Reinstall switch mounting bracket onto steering tube.

IMPORTANT

Make sure not to pinch any of the wires when reinstalling the mounting bracket.

10. Reinstall steering tube cover plate.
11. Reconnect battery, remove wheel blocking and test operate truck to verify dead-man switch operation.

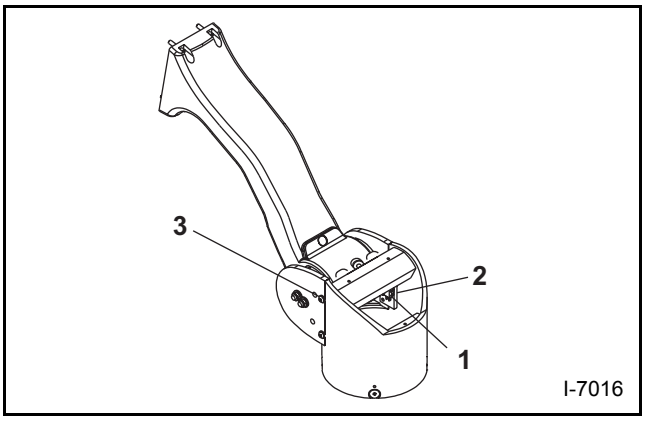


Figure 4-15. Dead Man Switch

4-4.5 Replacement of Creep Travel Switch

1. Disconnect the battery.
2. Block the wheels to prevent the truck from rolling.
3. Remove the steering tube cover plate (2, Figure 4-8).
4. Remove screws (3, Figure 4-16) securing the dead-man switch mounting bracket.

   NOTE: When standing at the control head, the Creep Travel Switch is located on the left hand side of the steering tube.

IMPORTANT

DO NOT loosen the mounting screws for the creep travel actuation cams.

5. Remove the switch mounting bracket (2) and switch assembly (1).
6. Note the wire connections to the switch.

IMPORTANT

Make sure to note the terminals to which the wires are connected.

7. Remove the switch (1) from the mounting bracket (2) and install new switch onto mounting bracket.
8. Reconnect wiring to match the original switch.
9. Reinstall switch mounting bracket onto steering tube.

IMPORTANT

Make sure not to pinch any of the wires when reinstalling the mounting bracket.

10. Reinstall steering tube cover plate.
11. Reconnect battery, remove wheel blocking and test operate truck to verify dead-man switch operation.

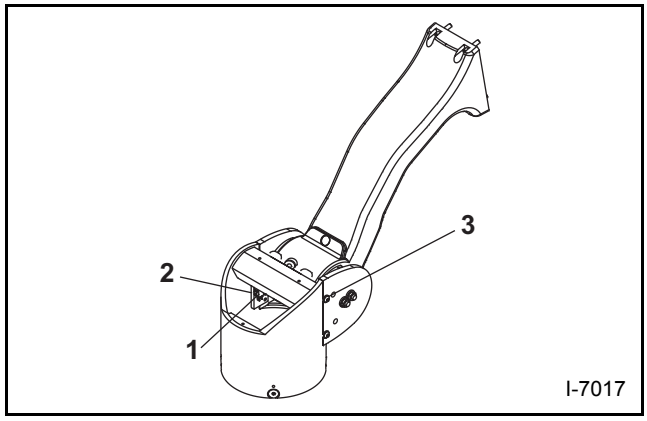


Figure 4-16 . Creep Travel Switch

4-4.6 Replacement of Control Arm Shock Absorber

If the control arm snaps upwards when it is released and the arm impacts the two rubber stops (2, Figure 4-17), observe the operation of the control arm shock absorber (1). The shock absorber should contact the control arm before the arm contacts the rubber bumpers, slowing the upward travel speed. If the shock absorber does not function in this way, it needs to be replaced.

1. Hold control arm in a lowered position.
2. Remove the old shock absorber (1).
3. Install new shock absorber.
4. Hold the control arm in the operating position and release. The shock absorber should slow the upward travel of the control arm.

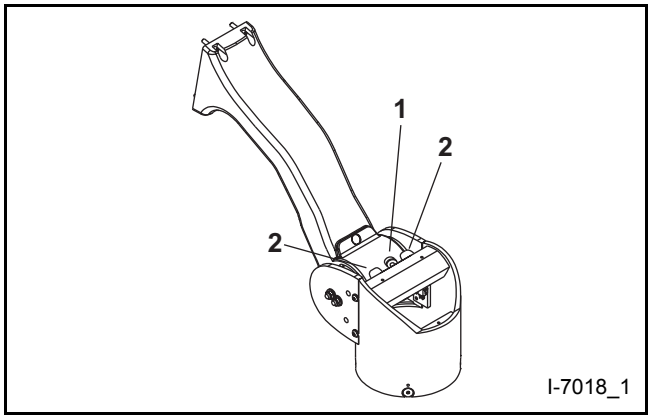


Figure 4-17. Control Arm Shock Absorber

4-5. DRIVE MOTOR, TRANSMISSION, DRIVE WHEEL, AND PIVOT TUBE ASSEMBLY

4-5.1 Drive Motor Servicing.

The drive motor exposed surfaces should be cleaned at least once a month to assure proper cooling of motor. Use an air hose to blow bust off of motor surfaces.

If the truck does not run and the drive motor is at fault, disconnect the battery and inspect brushes (2, Figure 4-19) and commutator (on armature). Replace brushes if they are worn. Remove rough spots on the commutator with fine sandpaper.

IMPORTANT

Make sure to remove any sandpaper particles or dust from the commutator before reassembly.

4-5.2 Inspect and replace worn brushes as follows:

NOTE: Fully raise the forks to enable cover removal.

1. Disconnect battery.
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Make sure the four cables to the drive motor are properly labeled Al, A2, Fl, and F2; then disconnect the cables from the drive motor.
6. Move the power and control cable bundle out of the way. Loosen and remove the motor headband (1, Figure 4-18).

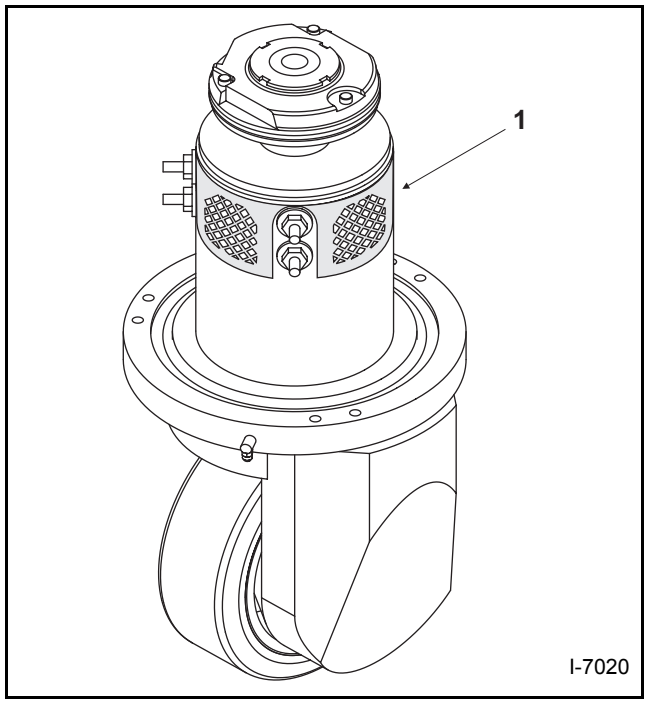


Figure 4-18. Remove Motor Headband

7. Loosen the mounting screw on each brush power lead and remove brush.

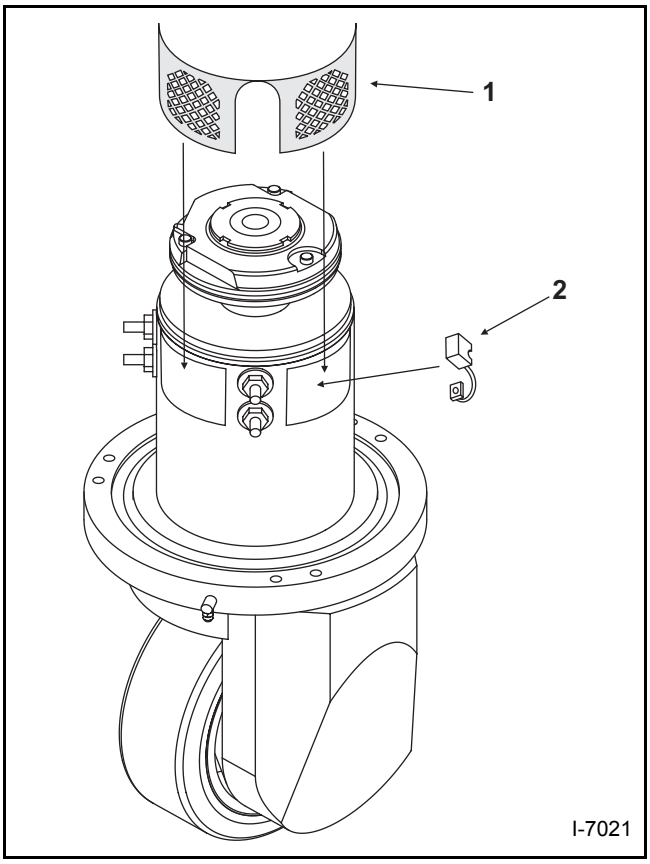


Figure 4-19. Replace Motor Brushes

IMPORTANT

Make sure that the brush spring is not removed from the support pin or allowed to unwind.

8. Install new brush, reseat brush spring and secure the electrical lead.
9. Repeat Steps 3 and 4 for remaining brushes.

4-5.3 Inspect commutator assembly.

If the brushes are not worn and the motor does not run, inspect the commutator for wear or damage as follows:

NOTE: Fully raise the forks to enable cover removal.

1. Disconnect power.
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
6. Remove the four screws (1) securing the guard ring (3) and slide the guard ring upwards as much as possible.

⚠ CAUTION

Removing the mounting screws will loosen the steering arm. Support the arm to prevent injury from falling steering arm.

7. Remove the four screws (23, Figure 4-4) securing the steering arm to the drive motor assembly.

   NOTE: Use caution when removing the steering arm that brake and control head cables are not disconnected or damaged.

8. Remove spring clip, splined gear and woodruff key (1, 2 and 3, Figure 4-20).
9. Remove allen head screws (4) and motor end plate (5).
10. Remove headband assembly (1, Figure 4-18).
11. Remove commutator end-head assembly (7, Figure 4-20) and upper bearing (9).

IMPORTANT

Make sure to remove the spring washer (13) and save for reassembly.

12. Remove all brushes (12).

13. Remove the brush box assembly (10) and brush springs (11).
14. Inspect the commutator assembly (14) for signs of wear or burns. If the commutator shows signs of wear, use fine sandpaper to resurface commutator contact surfaces.

IMPORTANT

Make sure that no sandpaper particles or other foreign matter enters the open motor.

If the commutator is burned, the motor must be fully rebuilt or replaced.

15. Clean the commutator of sand particles and reassemble the motor in reverse of disassembly procedure.
16. Reinstall the steering arm.
17. Reinstall service cover plates by installing the main cover plate (4, Figure 4-8) onto the four locating pins (7 and 8). **NOTE:** Make sure the rear two cover pins (7) are visible in the rubber grommets (9).
18. Slide the two middle cover plate arms (5, Figure 4-8) through the holes along the front edge of the main cover plate (4). Slide your fingers between upper cover plate (6) and middle cover plate (5). Pull upper cover plate (6) downwards, lowering the cover plate so that the two locating pins (10) will slide under the top of the upper framework.
19. Release the upper cover plate. Make sure the locating pins seat in the upper framework grommets and secure the upper cover plate with the screw (11).
20. Reconnect battery and test operate the truck.

4-5.4 If the motor needs to be replaced, remove it from the transmission as follows:

NOTE: Fully raise the forks to enable cover removal.

1. Disconnect power
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
6. Remove pivot tube cap (2, Figure 4-8) from the pivot tube.
7. Label and disconnect wires leading to the deadman switch and creep travel switch.
8. Remove four control head mounting screws and control head, then disconnect control cable at the round connector.
9. Remove the cable clamp securing the control cable inside the steering arm.
10. Remove control cable from steering arm.
11. Remove the four screws securing the steering arm and remove the steering arm.
12. Remove steering arm assembly.
13. Make sure the four cables to the drive motor are properly labeled Al, A2, Fl, and F2; then disconnect the cables (1, Figure 4-21) from the drive motor.

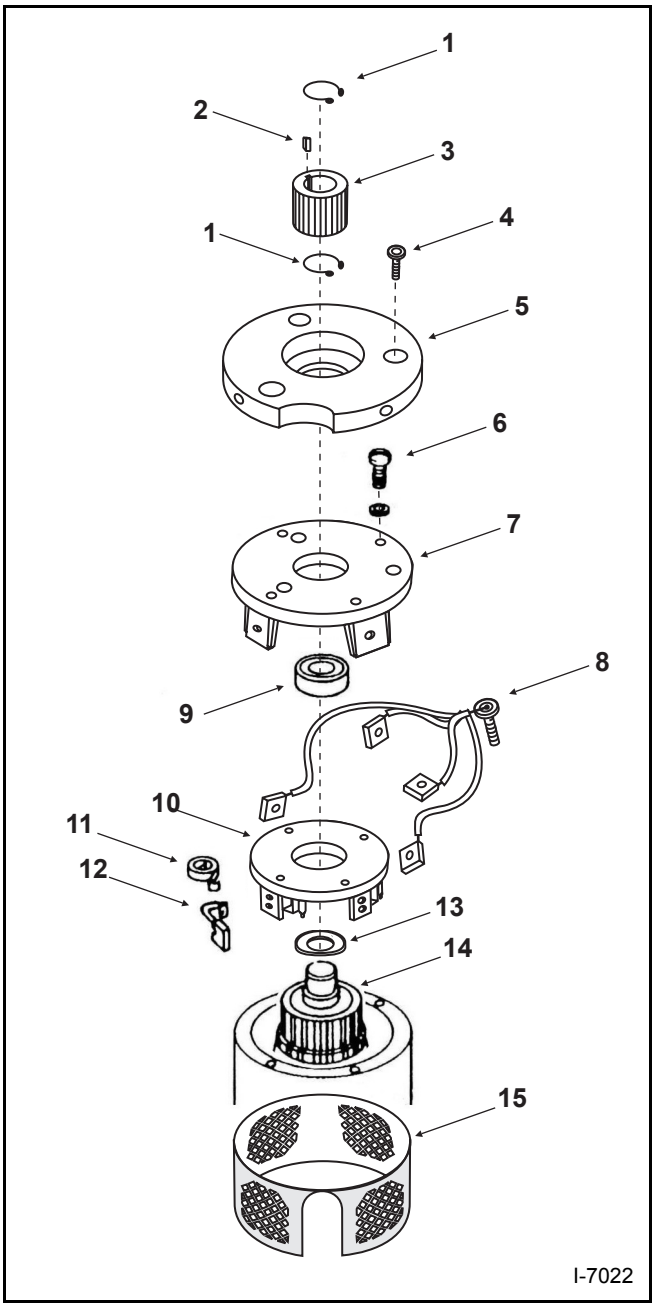


Figure 4-20. Motor Commutator

IMPORTANT

Note the location and routing of the control cables for the reassembly process.

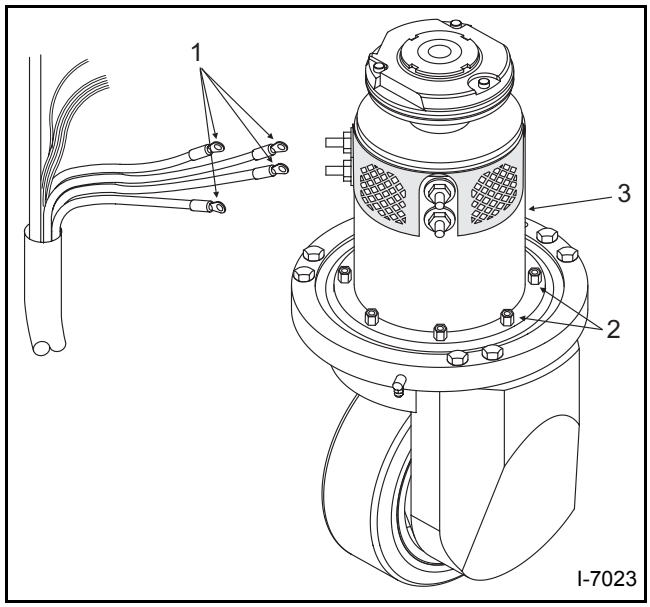


Figure 4-21. Motor Removal

14. Remove the eight hexhead cap screws (2) holding the motor mounting plate to the transmission.
15. Remove the motor and mounting ring assembly (3).
16. Install new drive motor onto transmission. Make sure to align the splined shaft on the motor with the splined receiver on the top of the transmission.

    NOTE: When the motor has been removed, the transmission sump will be exposed. Cover opening to prevent foreign objects from falling into the transmission.
17. Install the eight hexhead cap screws.
18. Reconnect the four cables to the drive motor. Make sure to match the cable label to the terminal.

⚠ CAUTION

Make sure that wires do not contact sharp edges of any assembly. Vibration can cause the insulation to become damaged leading to an electrical hazard.

IMPORTANT

Make sure to relocate the motor control cables as they were initially installed.

19. Reconnect the steering arm.
20. Reinstall control cable into steering arm and secure with cable clamp.
21. Connect control cable using the round connector in the control head.
22. Reinstall control head assembly.
23. Reinstall service cover plates by installing the main cover plate (4, Figure 4-8) onto the four locating pins (7 and 8). **NOTE:** Make sure the rear two cover pins (7) are visible in the rubber grommets (9).
24. Slide the two middle cover plate arms (5, Figure 4-8) through the holes along the front edge of the main cover plate (4). Slide your fingers between upper cover plate (6) and middle cover plate (5). Pull upper cover plate (6) downwards, lowering the cover plate so that the two locating pins (10) will slide under the top of the upper framework.
25. Release the upper cover plate. Make sure the locating pins seat in the upper framework grommets and secure the upper cover plate with the screw (11).
26. Reconnect the battery.
27. Test operate the lift truck.

4-5.5 Transmission Assembly Removal.

NOTE: The transmission does not have any user serviceable parts. If the transmission is the cause of travel problems, it will need to be replaced.

NOTE: Fully raise the forks to enable cover removal.

1. Disconnect battery.
2. Remove motor compartment service cover plates by removing screw (1, Figure 4-5) from the upper cover plate (2). The screw is located in the center of the upper cover plate, securing the cover plate to the upper framework.
3. Slide your fingers between upper cover plate (2) and middle cover plate (3). Pull upper cover plate downwards approximately 1 ½" and then pull the upper and middle cover plates (2, 3) outwards and lift the upper cover assembly off of the main cover assembly (5).
4. The main cover plate assembly (1, Figure 4-6) is held in position by four locating pins (2,3). Lift upwards along the front edge of the main cover plate assembly and then pull backwards, removing the cover plate from the locating pins and then lift the cover plate from the lift truck.
5. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
6. Remove pivot tube cap (2, Figure 4-8) from the pivot tube.
7. Label and disconnect wires leading to the deadman switch and creep travel switch.
8. Remove four control head mounting screws and control head, then disconnect control cable at the round connector.
9. Remove the cable clamp securing the control cable inside the steering arm.
10. Remove control cable from steering arm.
11. Remove the four screws securing the steering arm and remove the steering arm.
12. Remove steering arm assembly.
13. Remove the drive motor. See Section 4-5.4.

    NOTE: An alternate method is to remove the motor and transmission assembly from the truck, then remove the motor.

14. Support the transmission assembly and remove the six bolts (1, Figure 4-22) securing the transmission assembly to the truck and remove the transmission and drive wheel assembly (2).
15. Remove the drive wheel (4) from the transmission by removing the five lug nuts (3).
16. Install new transmission by reversing steps 2 - 14 above.

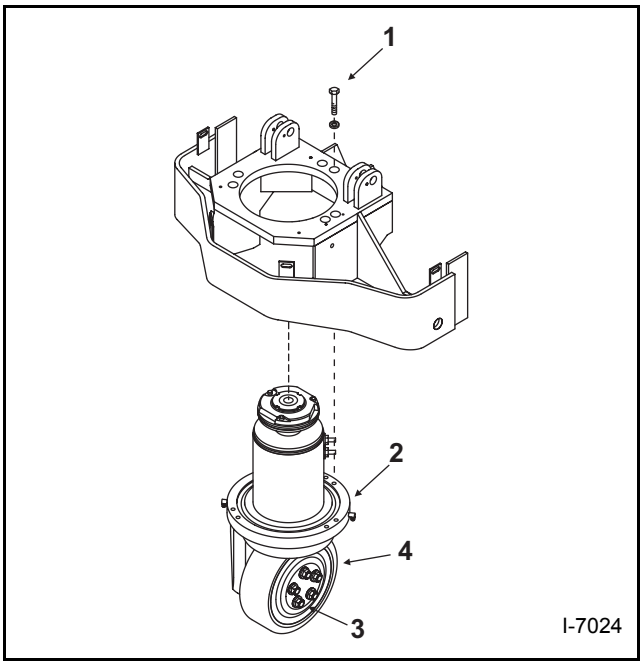


Figure 4-22. Transmission Removal

4-6. BASE, FRAME AND FORK SECTION

4-6.1 General

The base and frame section of the truck includes the information plates, decals, fork section and load wheels. Make certain that all decals remain on the truck and are legible. If decals are damaged or missing, they must be replaced.

4-6.2 Load Wheel Replacement

1. Raise forks.
2. Block the drive wheel to prevent the truck from rolling.
3. Jack up the forks to raise the load wheels off the floor. Securely block the forks in the raised position by positioning supports under both fork tips.
4. Remove the load wheel and bearing assembly.
   a. Remove the Phillips head screw (1, Figure 4-23) securing the load wheel keeper pin (2) and remove the keeper pin.
   b. When the keeper pin is removed the load wheel assembly (4) and spacers (3) will drop free.

      NOTE: Inspect the load wheel assembly. If the load wheel is worn within 1/8" of the metal sleeve, or is cracked or damaged, replace the entire load wheel and bearing assembly. Big Joe recommends that both load wheel assemblies be replaced at the same time. This ensures level and safe operation of the lift truck.

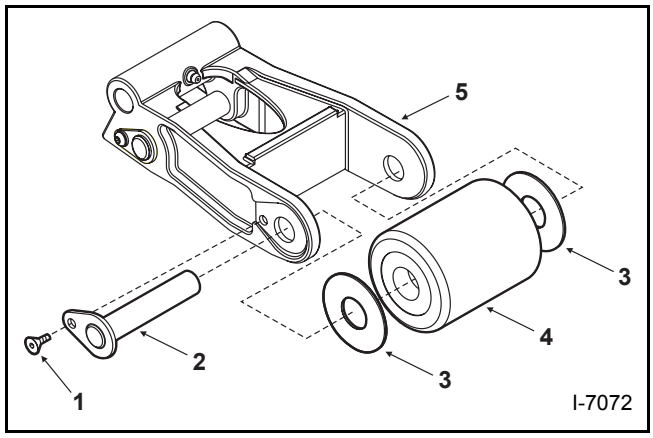


Figure 4-23. Load Wheel Replacement

5. Install new load wheel and bearing assembly.
   a. Partially insert the load wheel keeper pin (2) into the load wheel housing (5).
   b. Install one spacer (3) onto the shaft, between the arms of the load wheel housing.

      NOTE: Make sure that the bearings are fully seated on each side of the load wheel (4) and are flush with the outside edge of the load wheel assembly.

   c. Position the load wheel assembly (4) between the arms of the load wheel housing (5).
   d. Slide keeper pin (2) part way through the load wheel assembly and insert the remaining spacer(s) (3).
   e. Fully seat the load pin and secure it in position with the Phillips head screw (1).
6. Repeat installation steps 4 and 5 for the other load wheel assembly.

4-6.3 Frame Assembly: Fork Section and Lift Linkage Repair and Replacement.

1. Lift Linkage repair and replacement:
   a. Lift complete truck to height sufficient to permit access to lift linkage under forks. Provide blocking under power section frame and at tips of forks.
   b. Remove screws (11, Figure 4-24) that secure the lower support pins (9) to the pivot weldment (8). Remove both support pins from the pivot weldment.
   c. Drive roll pin (2) from pivot weldment (8).
   d. Remove lift link support pin (5) from pivot weldment.

      NOTE: Using a fine tip marker, draw a match mark line across the end of the lift link support pin and onto the pivot weldment. This line will assist in realigning the pin hole in the shaft with the pin hole in the link lift shaft.

   e. Remove the roll pin (2) and remove the pivot shaft (7) from power section. Remove pivot weldment (8) and lower the pull rod assembly (6) and link shaft to the floor.
   f. Replace worn or damaged lift link components
   g. Reassemble lift linkage by reversing steps "a" through "e" above.
2. Pull Rod Removal and Installation
   a. Remove roll pin (2, Figure 4-24) from the fork section and remove shaft (1).
   b. Pull load wheel housing (4) out of the fork section to gain access to the keeper pin (34). Remove hex head lock bolt (11) and keeper pin (34) allowing the lower pull rod casting (32) to be removed from the load wheel housing (4).
   c. Remove hex head bolt (11) securing pivot shaft (9) from each side of the pivot tube and lower the pivot tube to the ground.
   d. Remove the Phillips head screw (11) and pivot pin (5) holding the upper pull rod casting from the pivot tube. This will allow the pull rod to be fully removed from the lift truck.

      NOTE: If replacing only one of the entire pull rod assemblies or parts of one pull rod assembly, take the initial pull rod assembly setting measurements from the existing installed pull rod assembly.

   e. Install the lower pull rod casting (32) into the load wheel housing (4) and secure with keeper pin (34) and hex head bolt (11).
   f. Install the load wheel assembly (4) into fork section and secure with shaft (1) and roll pin (2).
   g. Loosen the locknut (30) at the upper pull rod casting (28) and rotate the hex shaped pull rod (31) until the measurement taken from the existing installed pull rod assembly has been matched. Fully tighten the locknut (30).
   h. Visually compare the position of both load wheel housings (4). If necessary, repeat adjustment in Step F until both load wheels align.
   i. Remove supports from the truck and lower the unit to the ground.
      i. Check to make sure that both load wheel housings retract equally.
      ii. Fully raise the truck and make sure that the forks are level.
      iii. Repeat Step F as required to level forks.
   j. Make sure that the jam nut (30) has been fully tightened.

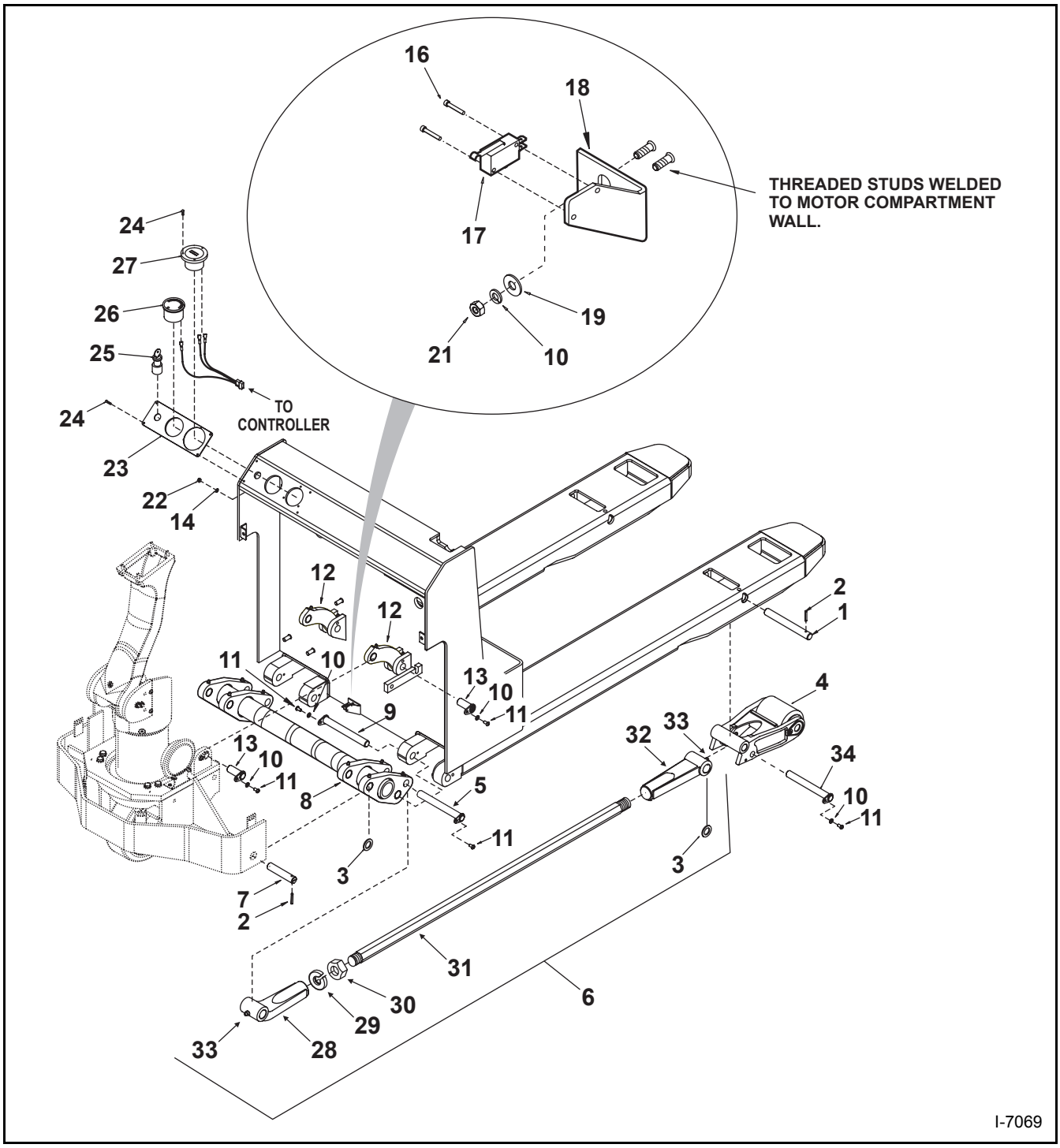


Figure 4-24. Lift Linkage Assembly

3. Power Section Frame Repair:

   a. Repair of power section frame is limited to chasing damaged threads and welding of any broken welds.

   b. Replace a worn or damaged U-clip nuts as needed.

Removal of components mounted on power section frame may be necessary to complete repairs/welding of frame, refer to table of contents for identification of instructions on such components.

4-7. ELECTRICAL

4-7.1 Battery Removal and Replacement

1. The batteries are enclosed in the battery compartment.
2. Remove the battery compartment cover by removing the lock handle (1, Figure 4-27), and lifting the battery compartment cover (2) off the lift truck or by opening the battery compartment service doors (1, Figure 4-25).

⚠ WARNING

- **Batteries available for the lift truck vary in weight. A suitable hoist and sling arrangement must be used to prevent injury.**
- **Batteries may contain electrolyte. Use extreme caution when handling lead acid batteries.**

3. Disconnect the battery plug (3, Figure 4-26) from the connector.
4. Disconnect battery cables (4 and 5) from batteries.
5. Remove batteries (6) from lift truck.

⚠ CAUTION

The 6V battery pack with charger and the 24V flooded cell industrial battery packs will require the use of a lifting device to safely remove the battery.

NOTE:
- The PPT 45 has three optional battery sets, a single 24V flooded cell industrial battery, a set of four 6V batteries or a set of two 12V batteries.
- Each of the battery sets is enclosed in a removable case. Removal of the battery packs requires that the electrical cables to the lift truck be disconnected. When the cables have been disconnected, the batteries or battery case can be removed from the lift truck.
- Depending on the battery installed, spacers may be utilized to secure the batteries. Make sure to replace the spacers in the appropriate locations.

6. Install new batteries and reconnect power cables.

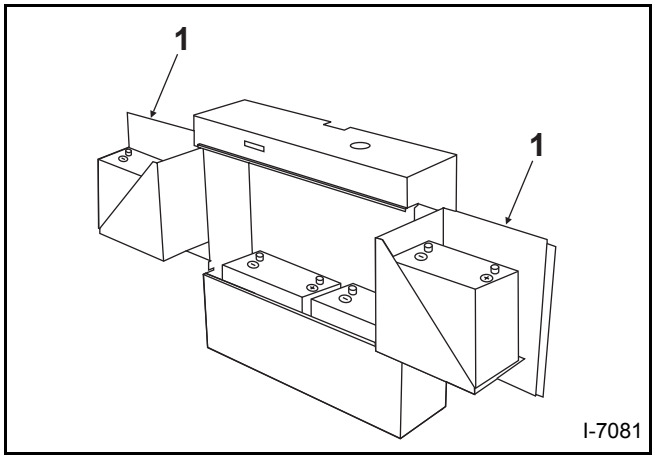


Figure 4-25. Battery Compartment Service Doors

4-7.2 Battery Cable Assemblies Replacement.

1. Disconnect batteries (Section 4-7.1).
2. Trace the cable (1, Figure 4-26 or 4, 5 and 6 Figure 4-27) that needs to be replaced from the battery compartment into the motor compartment.
3. Remove the cable from the appropriate insulated stand-off (2).

   NOTE: Note the additional cables (3, 4) attached to the insulated stand-off.

4. Remove the cable assembly from the truck.

   NOTE: Cable connectors are factory applied and are not individually replaceable.

5. Route replacement cable assembly from the battery compartment into the motor compartment.

⚠ CAUTION

Make sure that wires do not contact sharp edges of any assembly. Vibration can cause the insulation to become damaged leading to an electrical hazard.

6. Attach the new cable to the appropriate insulated stand-off.

   NOTE: Make sure to reattach the additional cables removed from the insulated stand-off.

7. Reconnect cables to the battery.

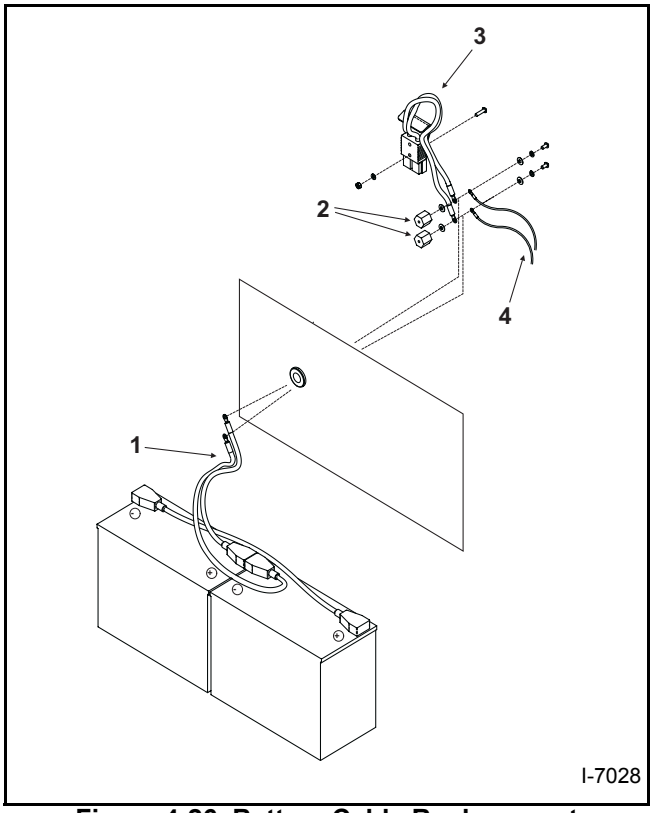


Figure 4-26. Battery Cable Replacement

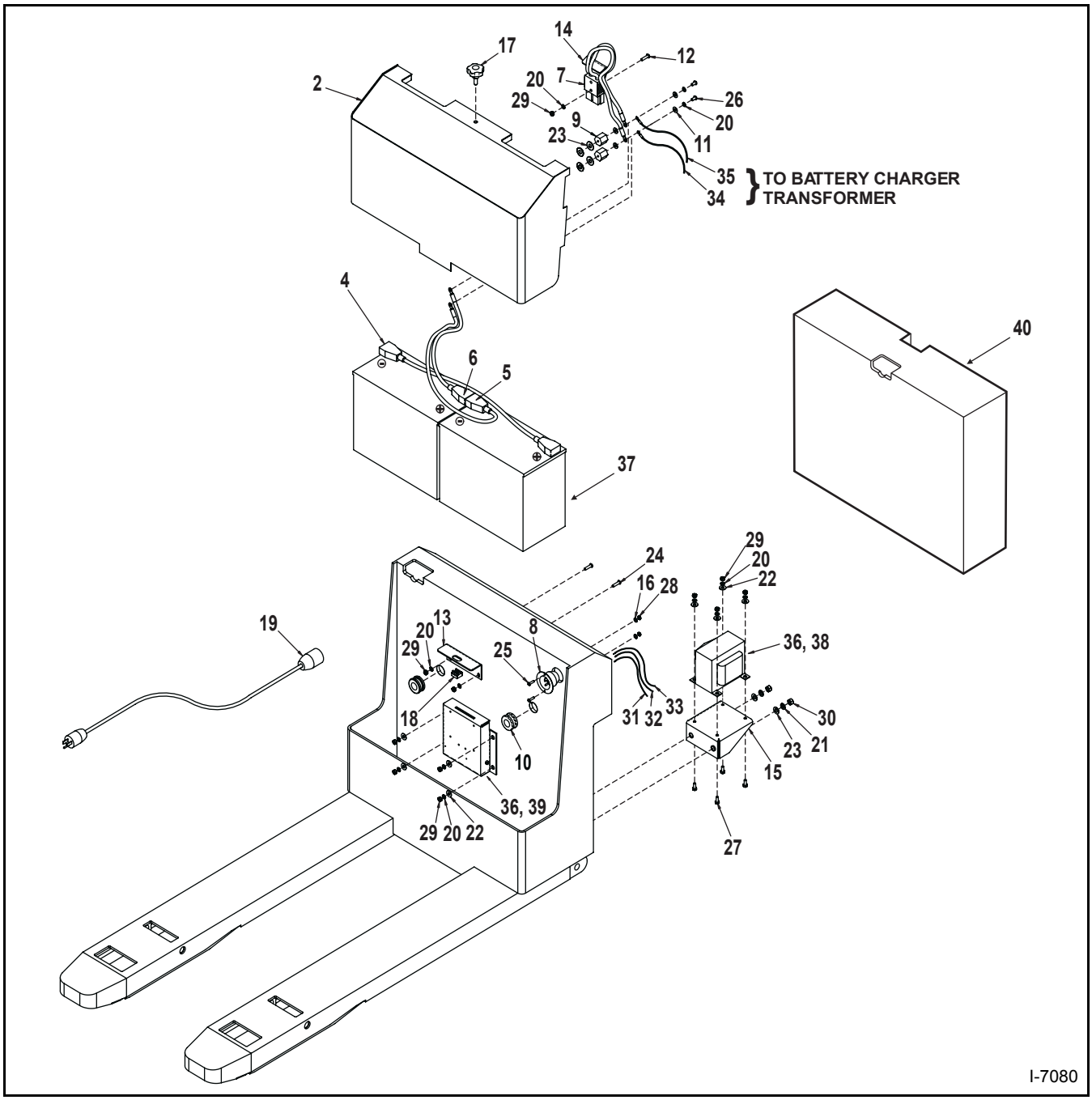


Figure 4-27. Battery Installation

4-7.3 Transistor/Contactor Panel

NOTE: Erratic operation of the truck may be caused by defective controller components. Before removing the contactor control panel, perform troubleshooting procedures per paragraph 6-3, to determine corrective action to be taken.

1. Contactor Panel Removal.
   a. Disconnect the battery.
   b. Remove screws (5, 7 and 9, Figure 4-8), lockwashers, flat washers, and motor compartment covers (6, 8 and 10).
   c. Refer to Figure 4-28 and tag and disconnect all electrical wires and cables, which connect to the contactor panel (1).
   d. Remove nuts and lockwashers to release and remove the contactor panel assembly.

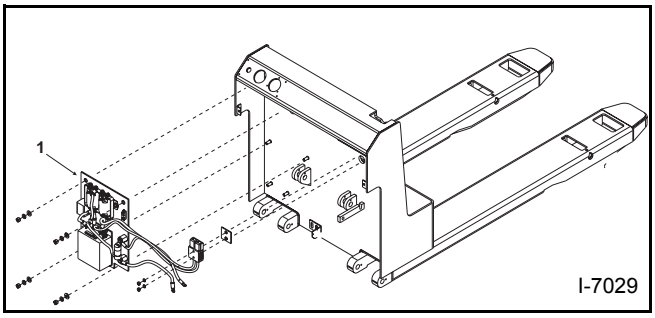


Figure 4-28. Contactor Panel Removal

2. Contactor Panel Disassembly
   a. Refer to Figure 4-30 for the location and identity of the major replacement components mounted on the panel and remove defective part.

      NOTE: The forward and reverse contactors used on this panel are not repairable and must be replaced if defective.

3. Contactor Panel Reassembly
   a. Install replacement parts in same location and orientation as the defective part removed.
   b. Connect all electrical wires and cable assemblies, as noted during removal and shown on Figure 4-30.

⚠ CAUTION

Make sure that wires do not contact sharp edges of any assembly. Vibration can cause the insulation to become damaged leading to an electrical hazard.

4. Contactor Panel Reinstallation.
   a. Install contactor panel and secure with lockwashers and nuts.
   b. Refer to Figure 4-30 and wiring diagrams (Figure 4-36). Connect all electrical wires and cables to the contactor panel, as noted during removal.

⚠ CAUTION

Make sure that wires do not contact sharp edges of any assembly. Vibration can cause the insulation to become damaged leading to an electrical hazard.

   c. Install motor compartment (service) cover and secure.
   d. Connect the battery.

4-7.4 Horn Replacement.

To replace the horn, proceed as follows:

1. Tag and disconnect all electrical connections from horn..
2. Remove nuts, lockwashers and flat washers (2, Figure 4-29) to release and remove the horn (1).
3. Check the spike suppressor assembly (3) for damage. If any part is damaged, the entire spike suppressor assembly must be replaced.
4. Install horn (1) and secure with nuts, flat washers and lockwashers (2).
5. Connect all electrical wires to the horn, as noted during removal.
6. Install motor compartment (service) cover and.
7. Connect the battery.

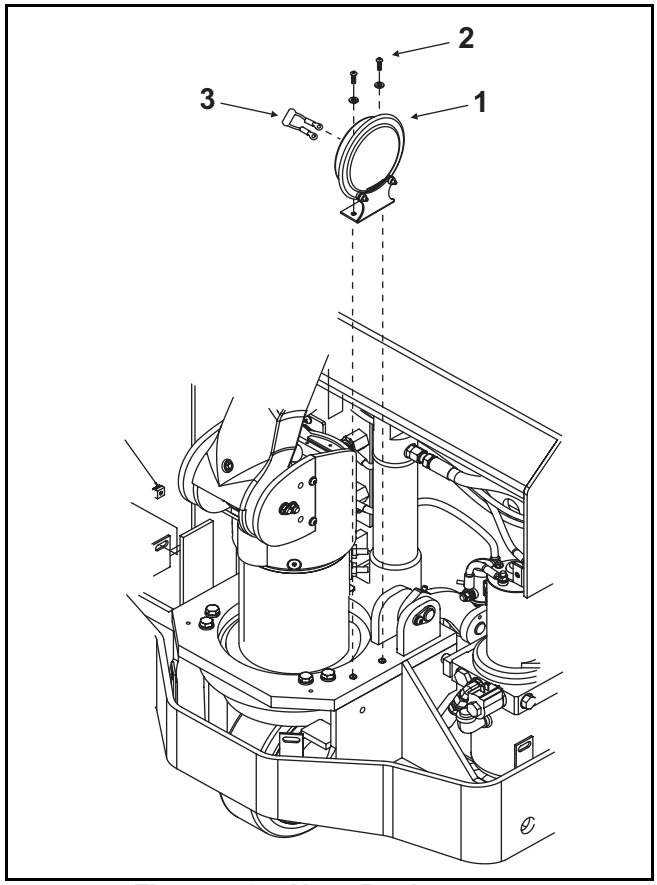


Figure 4-29. Horn Replacement

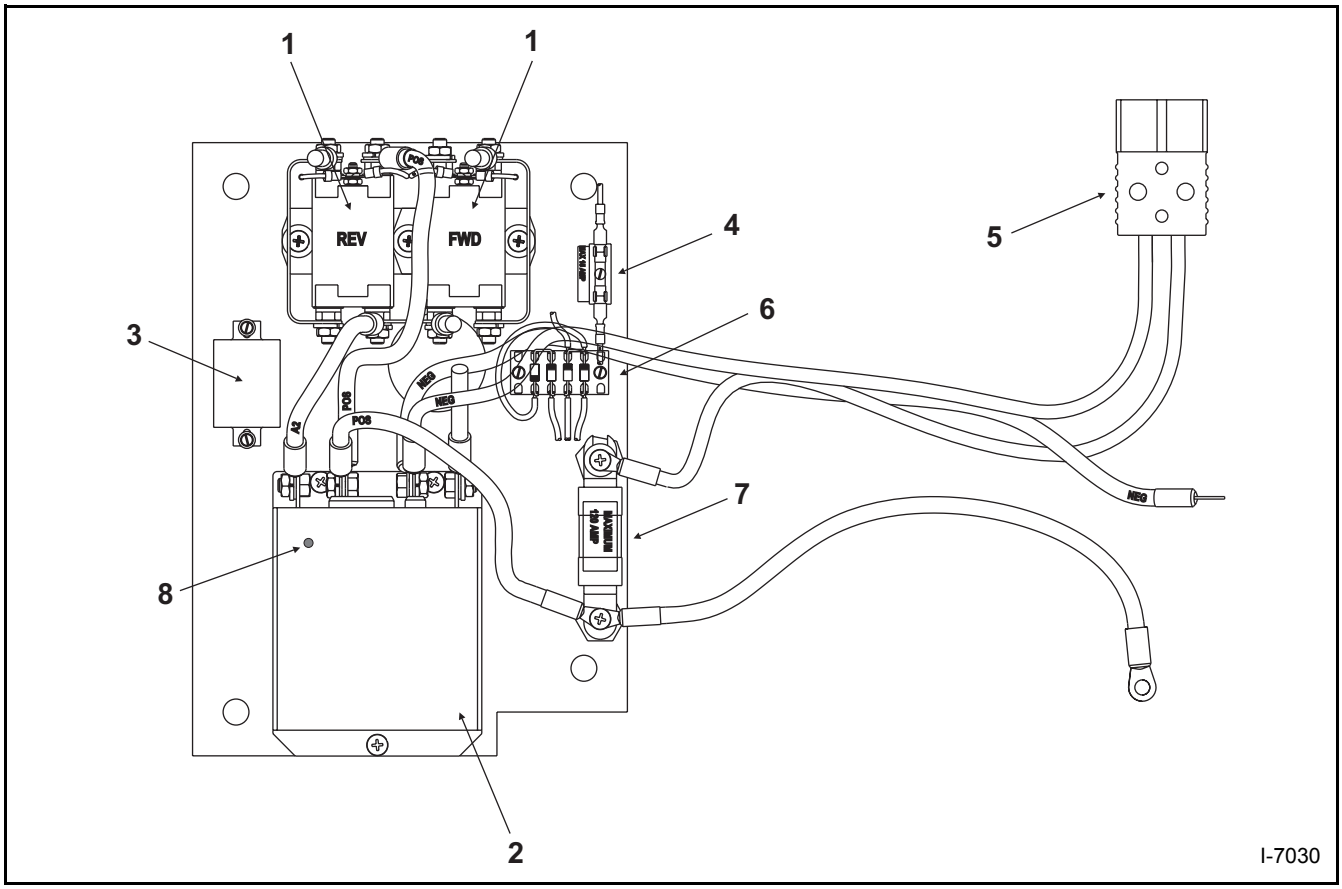


Figure 4-30. Contactor Panel Replacement Parts

4-7.5 Battery Charger

NOTE: If the lift truck is equipped with a heavy duty 24V steel case flooded cell industrial battery, the charger is remotely located. The charger for the trucks equipped with two 12V batteries is built into the truck and the charger for trucks equipped with the 6V battery pack is built into the battery pack.

4-7.5.1 24V Gel-Cell Batteries

The Gel-Cell battery charger (1, Figure 4-31) is split into two components. The transformer is mounted below the contactor panel in the motor compartment. The controller is mounted in the upper right side of the power section frame. The power plug (2) is located above the battery cover. The charge status indicator, which built into the controller, is readable through the opening in the top surface of the battery cover.

To charge the batteries, plug the charger into 110 V AC power.

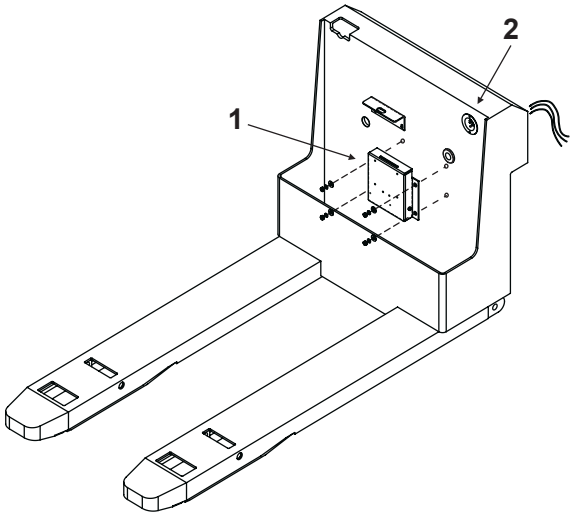
4-7.5.2 Medium Duty 24V Flooded Cell Battery Pack

The 24V Flooded cell battery pack is a self contained unit with batteries and charger built into the battery case. The charger (3, Figure 4-31) is split into two components, the transformer in the lower section of the battery case and the controller located at the top of the case. The power plug (2) is located on the front of the battery case. The charge status indicator, which is built into the charger controller, is readable through the front of the battery case, next to the power plug.

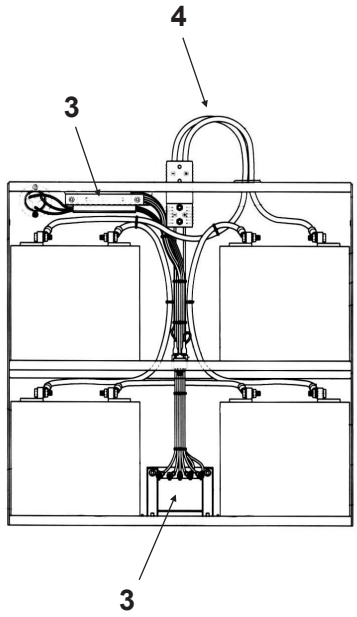
To charge the battery pack, move the battery connector from the truck plug into the battery pack plug, and then plug the charger into 110 V AC power.

4-7.5.3 Heavy Duty 24V Steel Case Flooded Cell Industrial Battery (Not shown)

The 24V heavy duty industrial battery is charged with a remote charger. To charge the battery, unplug the battery connector from the truck plug and plug the charger into the charge plug.



Two 12V Batteries W/truck Mounted Charger

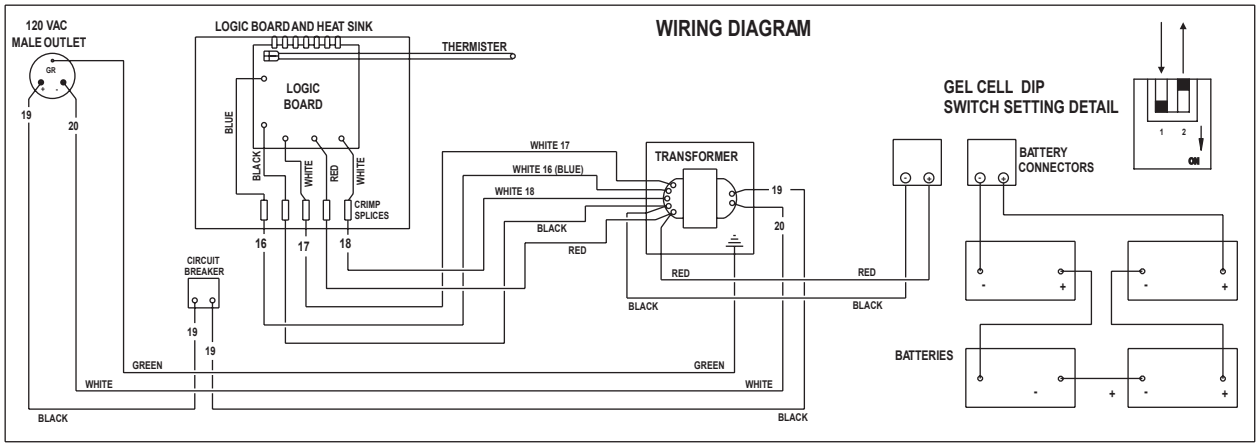


Four 6V Battery Pack and Charger

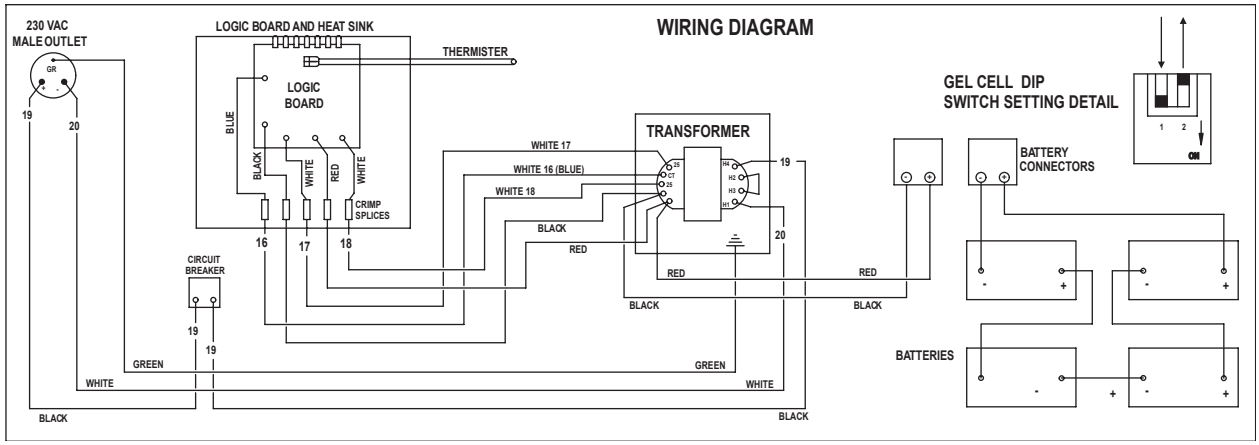
I-7032-2

Figure 4-31. Battery Pack and Charger Variations

MAINTENANCE FREE BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 120 VAC



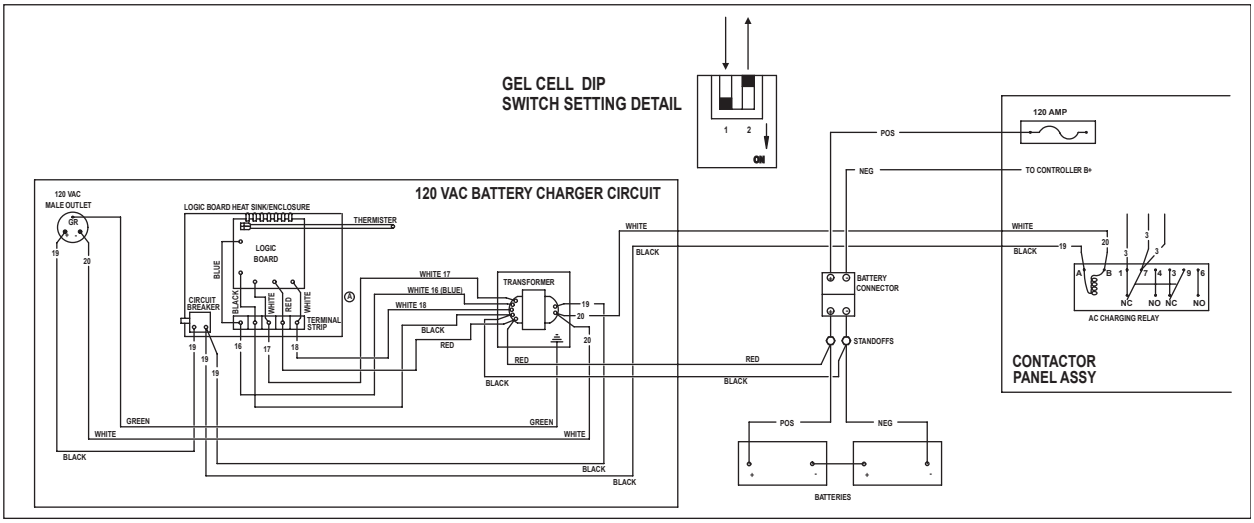
MAINTENANCE FREE BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 230 VAC



I-7093

Figure 4-32. Maintenace Free Battery Pack Wiring Diagrams

MAINTENANCE FREE BATTERY PACK (TWO 12V) W/HCARGER ASSEMBLY - 24 V, 135 AH, 120 VAC



MAINTENANCE FREE BATTERY PACK (TWO 12V) W/HCARGER ASSEMBLY - 24 V, 135 AH, 230 VAC

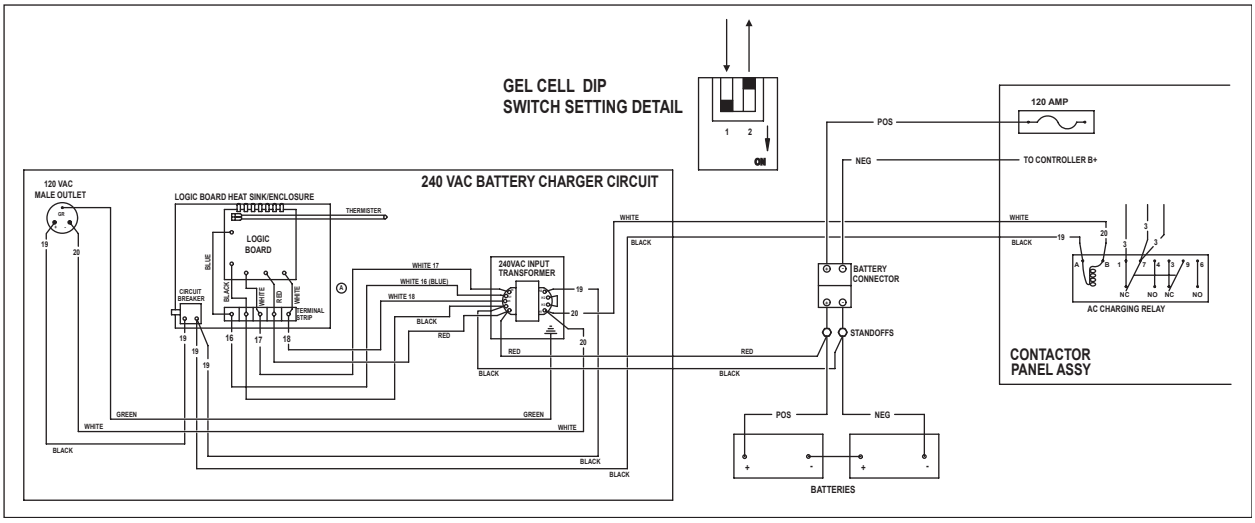


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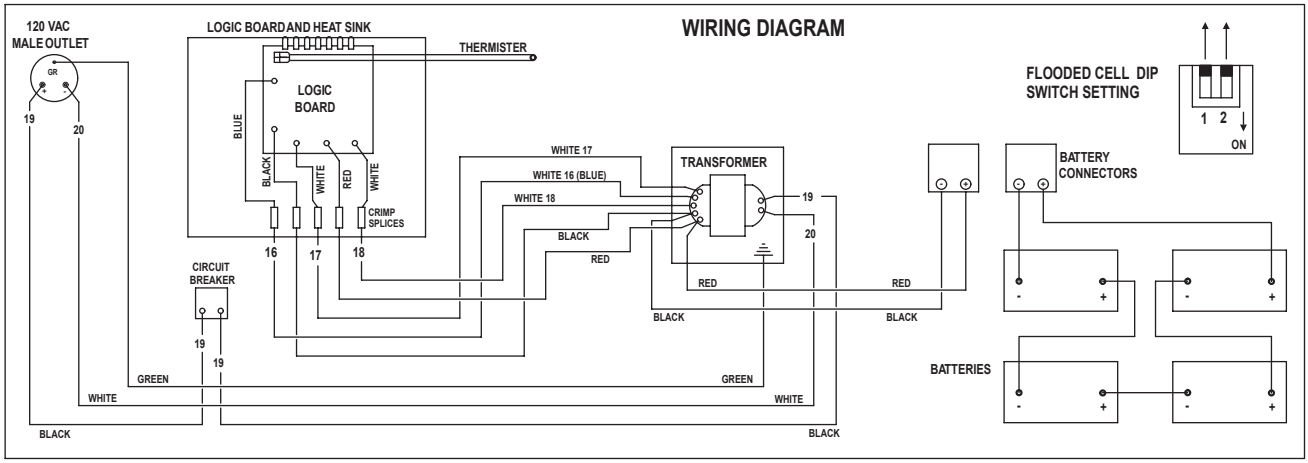
Figure 4-33. Maintenace Free Battery Pack Wiring Diagrams

FLOODED CELL BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 120 VAC



FLOODED CELL BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 230 VAC

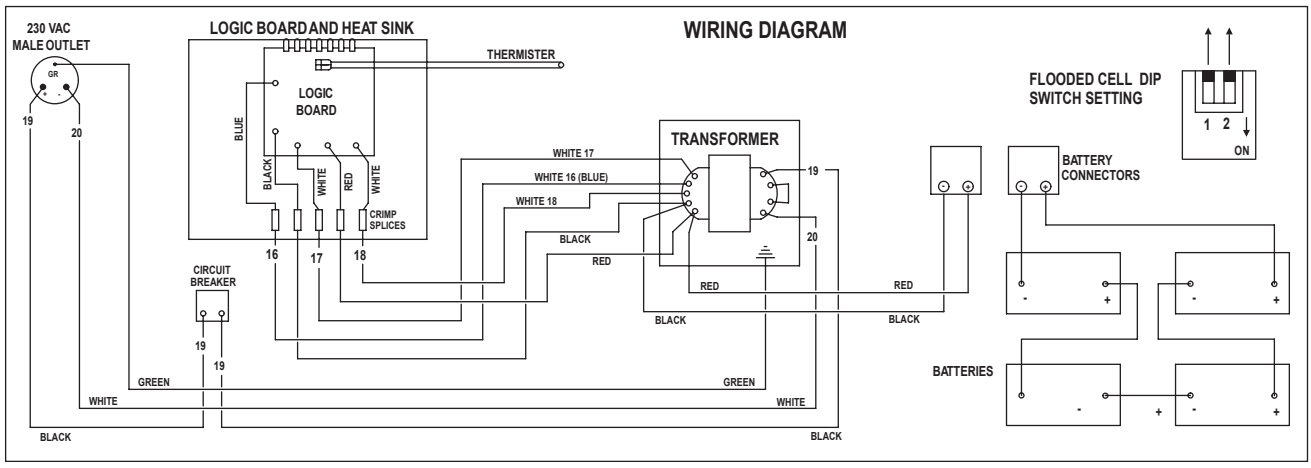


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Figure 4-34. Flooded Cell Battery Pack Wiring Diagrams

4-7.6 BATTERY DISCHARGE INDICATOR

Replacement parts for the battery discharge indicator are detailed in Figure 7-7. Refer to the wiring diagram to help ensure proper connections.

4-7.6.1 Battery Discharge Indicator Replacement.

1. If the battery discharge indicator (1, Figure 4-35) does not accurately represent the battery charge, replace the battery discharge indicator (1).

   NOTE: If the Discharge Indicator does not function properly, check the 5 Amp fuse located on the rear side of the indicator before replacing the indicator. The indicator must be removed from the display panel to enable access to the fuse. If the fuse has not blown, replace the discharge indicator as follows:

2. To replace the battery discharge indicator (1), proceed as follows:

   a. Disconnect the battery.

   b. Tag and disconnect terminals behind the indicator.

   c. Remove two lock nuts and U-bracket to release and remove the indicator.

      NOTE: Replacement indicator will be furnished with nuts and U-bracket. The original U-bracket may be reused, if not damaged.

   d. Install new battery discharge indicator (1) and secure with supplied U-bracket and nuts. If required, trim the U-bracket legs to proper length, or reuse the old U-bracket.

   e. Reconnect terminals as noted during charge indicator removal.

   f. Connect the battery.

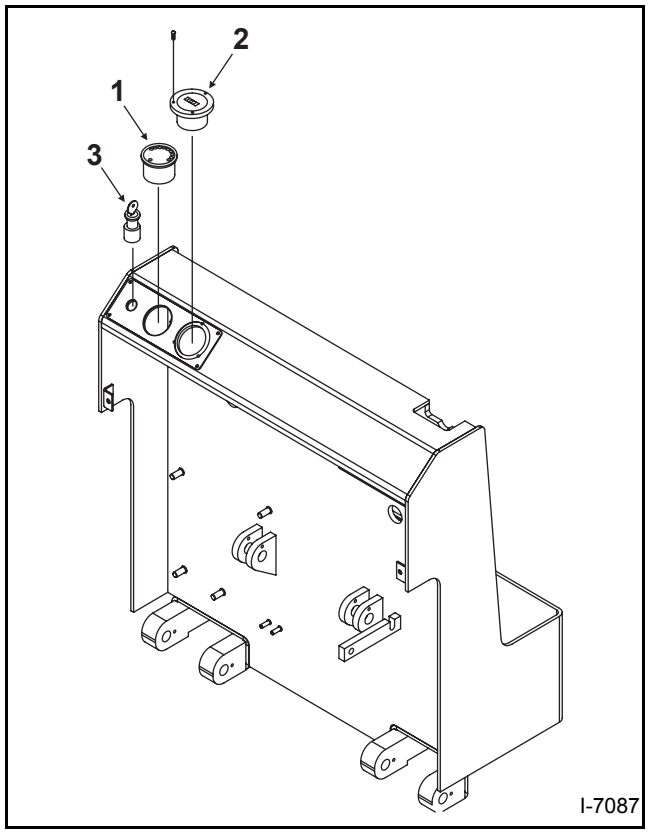


Figure 4-35. Indicator Replacement

4-7.7 HOURMETER.

The hour meter (2, Figure 4-35) is available for attachment to the motor circuits to indicate use of the drive and lift functions to help ensure proper connections.

4-7.7.1 Hour meter Replacement.

1. Operation of the hour meter (2) may be checked against a watch.
2. To replace the hour meter (2), proceed as follows:
   a. Disconnect the battery.
   b. Remove the 3 screws, lock washers and nuts found around the "bezel" or outer ring of the meter and remove the hour meter from the panel.
   c. Tag and disconnect the terminal and diode from the hour meter.
   d. Reconnect the terminal and diode to the new hour meter (2).
   e. Install the new hour meter into the panel and secure with the 3 screws, lock washers and nuts.
   f. Connect the battery.

4-7.8 KEYSWITCH.

The optional key switch is item 3, Figure 4-35. The key switch installation is accomplished by inserting the supplied wiring into wire number 3, of control panel harness, at the slip-on connector of the in-line fuse. Refer to the wiring diagram to help ensure proper connections.

4-7.9 WIRE HARNESS TESTING.

1. Wire harnesses are illustrated and identified on the figures in this manual containing the components they are associated with. As an aid to testing, individual wires in each harness have their wire numbers permanently marked on both ends. Refer to the wiring diagram shown in Figure 4-36.
2. Testing procedures are as follows:
   a. Disconnect the battery.
   b. Tag and disconnect electrical wires as necessary.
   c. Disconnect plug(s) and/or receptacle(s), if any
   d. Using a multimeter, check all individual wire leads for continuity. Continuity must exist in each individual wire lead.
3. If a wire harness fails continuity test, it must be replaced. Make careful note of harness routing, and location of any clamps or wire ties before removing. Route new harness, and install any clamps or wire ties, as noted during removal.
4. Connect electrical wires, as noted during removal.
5. Connect any plug(s) and/or receptacle(s), as noted during removal.
6. Connect the battery.

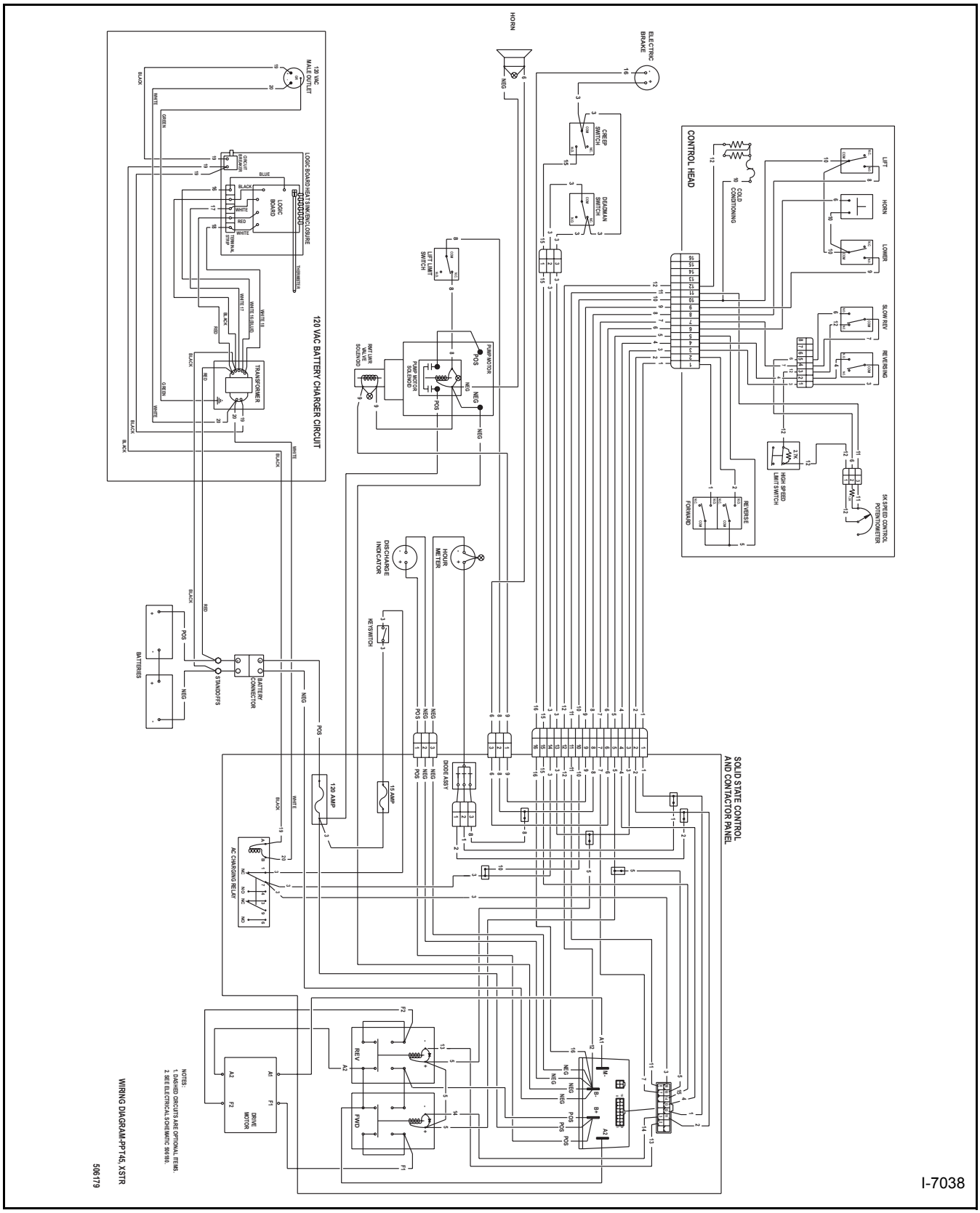


Figure 4-36. Electrical Schematic

4-8. HYDRAULICS.

4-8.1 Line and Fitting Replacement.

⚠ DANGER

- **Hydraulic oil under pressure can penetrate the skin. It is toxic and can damage tissue. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. NEVER USE YOUR HANDS. Obtain immediate medical attention from a medical provider knowledgeable with hydraulic fluid injuries if pressurized hydraulic fluid pierces the skin. Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.**
- **When forks are raised, pressure exists in the hydraulic system lines and fittings. To ensure release of pressure, forks must be fully lowered and the battery disconnected before performing any maintenance on the hydraulic system.**

NOTE: Leaking hydraulic fittings may be repaired by simply tightening the fittings. If this does not repair the leak, the fittinìg or line must be replaced.

1. Lower forks fully.
2. Disconnect battery (Section 4-7.1).
3. Remove motor compartment (service) cover.

IMPORTANT

Hydraulic oil can damage parts. Wipe off any oil immediately. Provide a container under line or fitting, before disconnecting.

4. Refer to Figure 4-37 and remove leaking line (2) or fitting and replace it with a new line or fitting.
5. Remove the vent plug and elbow (5 & 6, Figure 4-37). Check level of hydraulic oil. Hydraulic oil must be one inch below bottom of elbow (5). If required, add hydraulic oil to bring to proper level. Use hydraulic oil listed in Table 3-3.
6. Reinstall the vent plug (6).
7. Reconnect the battery and operate the lift lower button to refill cylinder and lines with hydraulic oil.
8. Lower forks fully and disconnect battery.
9. Recheck hydraulic oil level, see Steps 5 and 6.
10. Install motor compartment (service) cover.
11. Reconnect the battery.

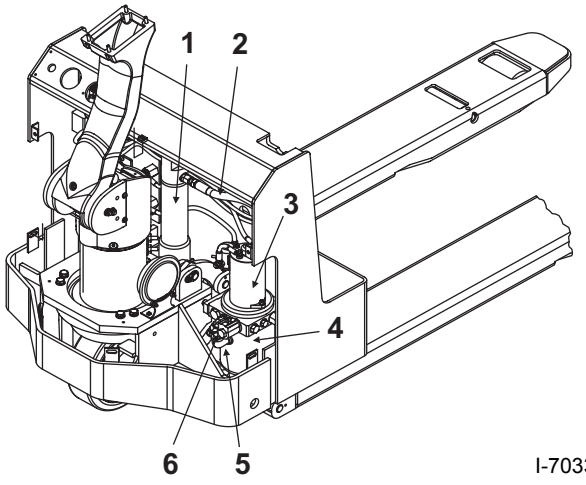


Figure 4-37. Hydraulic System

4-8.2 Hydraulic Pump, Motor, and Reservoir Assembly.

The hydraulic pump/motor assembly can be disassembled and repaired. Portion of the motor and control valves can be repaired, however, a defective pump requires that the entire unit be replaced. The removal and repair of the pump assembly is as follows:

⚠ DANGER

- **Hydraulic oil under pressure can penetrate the skin. It is toxic and can damage tissue. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. NEVER USE YOUR HANDS. Obtain immediate medical attention from a medical provider knowledgeable with hydraulic fluid injuries if pressurized hydraulic fluid pierces the skin. Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.**
- **When forks are raised, pressure exists in the hydraulic system lines and fittings. To ensure release of pressure, forks must be fully lowered and the battery disconnected before performing any maintenance on the hydraulic system.**

4-8.2.1 Motor Brush Replacement

1. Disconnect battery from lift truck.
2. Remove upper and lower service covers.
3. Remove both motor bolts and washers (1, 2, Figure 4-38).
4. Remove the motor cover (3) to access the brush assemblies.
5. Remove the lead from the starter solenoid.
6. Using a flat blade screwdriver, release the spring (5) holding each brush (4) and pull brush from its holder.

   NOTE: The brushes are divided into two sets (4), each connected separately to the motor. Make sure to note the location of each brush lead assembly.

7. Remove the brush connector mounting screws and/or nuts to release the brush assemblies (4).
8. Replace both sets of brushes by reversing the above steps.

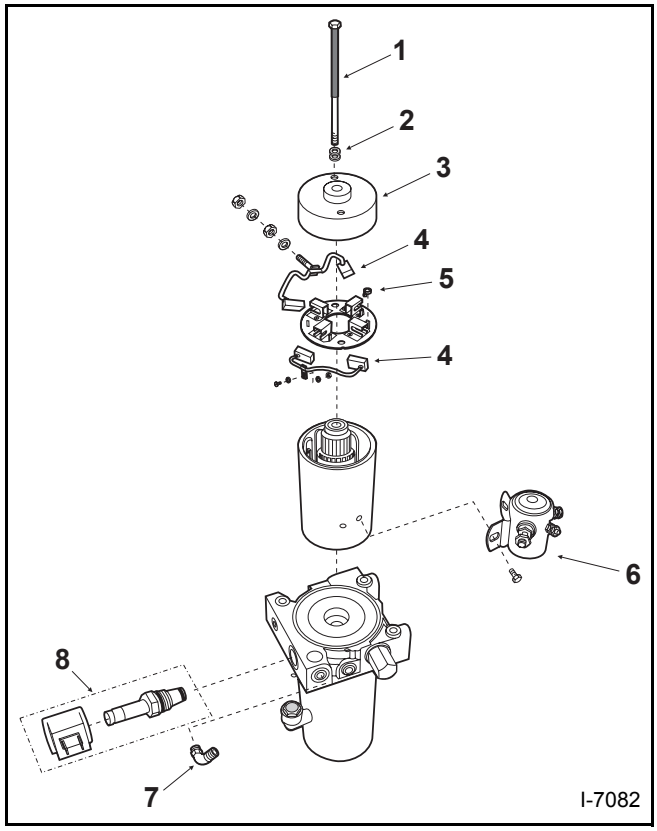


Figure 4-38. Hydraulic Motor Assembly

4-8.2.2 Relief Valve Assembly

The relief valve assembly is only available when the entire adapter kit is replaced.

4-8.2.3 Solenoid Valve Assembly

1. Disconnect electrical lead from solenoid assembly (8, Figure 4-38).
2. Remove the solenoid magnet assembly from the valve stem.
3. Remove the valve stem assembly.
4. Reinstall valve stem and solenoid.
5. Reconnect electrical lead to solenoid.

4-8.2.4 Motor Starter Replacement

1. Remove electrical leads from motor starter (6, Figure 4-38). **NOTE:** Make sure to note which cable attaches to motor starter terminals.
2. Remove both motor starter mounting screws.
3. Remove motor starter (6).
4. Replace motor starter by reversing above steps.

4-8.2.5 Hydraulic Strainer Assembly

NOTE: It may be necessary to remove the hydraulic pump/motor assembly from the lift truck to complete this procedure.

1. Remove the reservoir assembly (4, Figure 4-39) from the pump/motor assembly.

   NOTE: The reservoir will be filled with hydraulic oil. Place a container under the pump assembly to catch any hydraulic oil and place protective covers over other internal components to protect them from spilled hydraulic fluid.

2. Remove the bolt (10) securing the strainer assembly (8) to the bottom of the pump.

   NOTE: Make sure to remove the O-ring (9) from the pump assembly.

3. Remove the two metal support brackets (11) from the strainer tube.
4. Install metal support brackets onto the new strainer assembly.
5. Install new O-ring into the port for the strainer assembly. **NOTE:** Coat the O-ring with hydraulic oil to prevent damage during reassembly.
6. Install strainer assembly onto the pump and secure with the screw.
7. Reinstall reservoir assembly (4) and secure with screws (3).
8. Fill hydraulic reservoir by removing hydraulic tank breather plug (6). Use approved Big Joe hydraulic fluid.
9. Reinstall breather plug (6) and reconnect battery.
10. Bleed air from the hydraulic system by repeatedly raising and lowering lift truck until action is smooth.

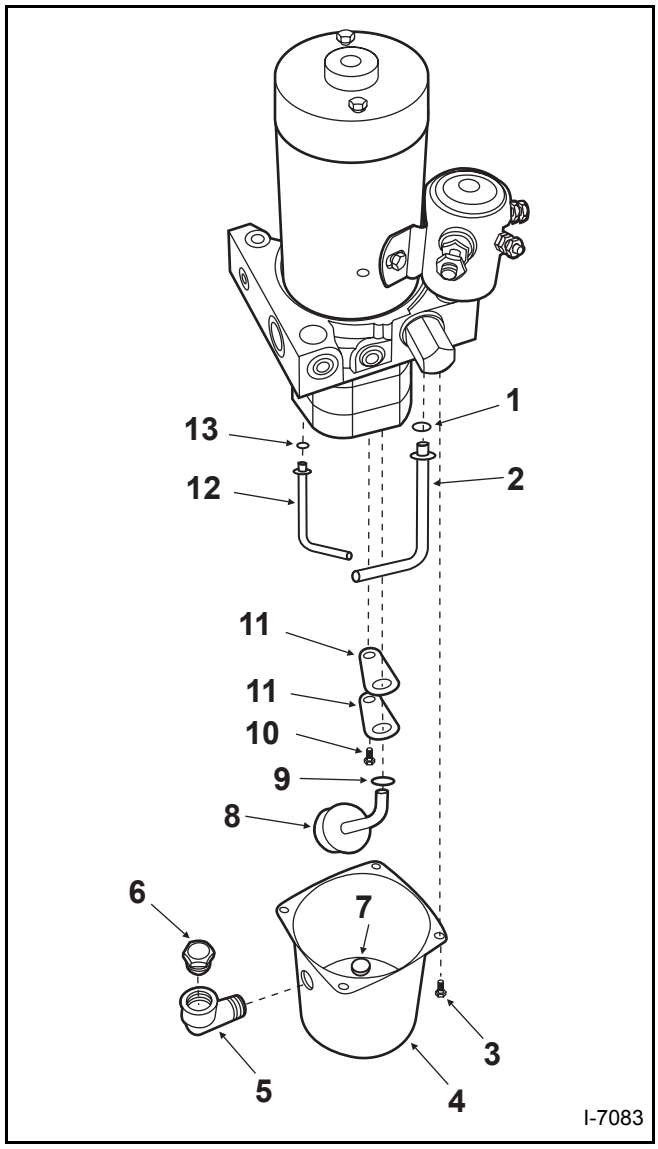


Figure 4-39. Hydraulic Reservoir Assembly

4-8.2.6 Reservoir Assembly O-Ring

1. Remove the reservoir assembly (4, Figure 4-39) from the pump/motor assembly.

   NOTE: The reservoir will be filled with hydraulic oil. Place a container under the pump assembly to catch any hydraulic oil and place protective covers over other internal components to protect them from spilled hydraulic fluid.

2. Remove O-ring support bracket (2, Figure 4-40) and O-ring (1).
3. Install new O-ring (1). **NOTE:** Coat the O-ring with hydraulic oil to prevent damage during reassembly.
4. Reinstall and secure reservoir assembly (4, Figure 4-39).
5. Fill hydraulic reservoir by removing hydraulic tank breather plug (6, Figure 4-39). Use approved Big Joe hydraulic fluid.
6. Reinstall breather plug (6) and reconnect battery.
7. Bleed air from the hydraulic system by repeatedly raising and lowering lift truck until action is smooth.

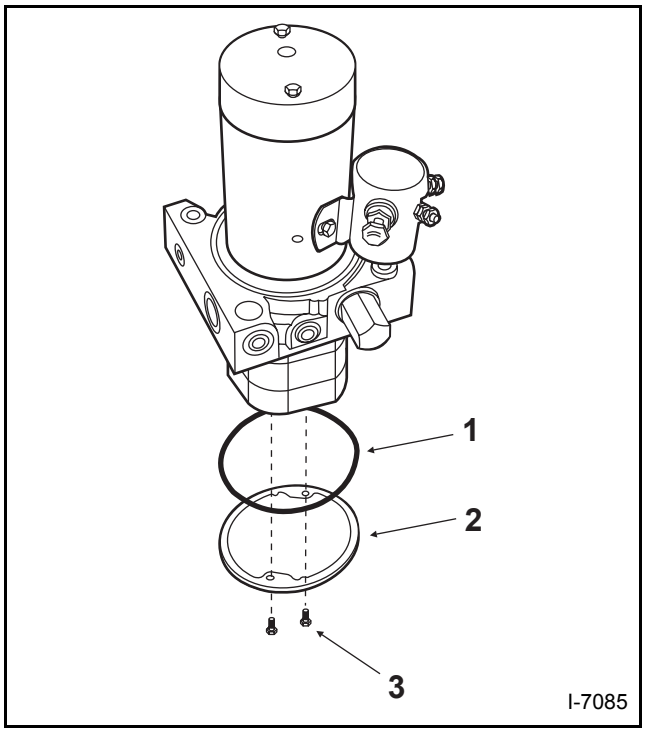


Figure 4-40. Reservoir O-Ring Assembly

4-8.2.7 Replace Hydraulic Pump/Motor Assembly

1. Disconnect battery from lift truck.
2. Remove upper and lower service covers.
3. Remove the electrical lead (1, Figure 4-41) from solenoid valve.
4. Remove main power lead (1) from wiring harness to the motor starter (6).
5. Remove hydraulic line (2) from pump outlet fitting.
6. Loosen and remove mounting bolts (3) and washers (4, 5) holding the hydraulic pump assembly to the lift truck chassis, and remove the pump assembly (7).
   NOTE: The hydraulic reservoir will be filled with hydraulic oil. Place a container under the pump assembly to catch any hydraulic oil and place protective covers over other internal components to protect them from spilled hydraulic fluid.
7. Install new hydraulic pump assembly by reversing above steps.
8. Fill hydraulic reservoir by removing hydraulic tank breather plug (6, Figure 4-39). Use approved Big Joe hydraulic fluid.
9. Reinstall breather plug (6) and reconnect battery.
10. Bleed air from the hydraulic system by repeatedly raising and lowering lift truck until action is smooth.

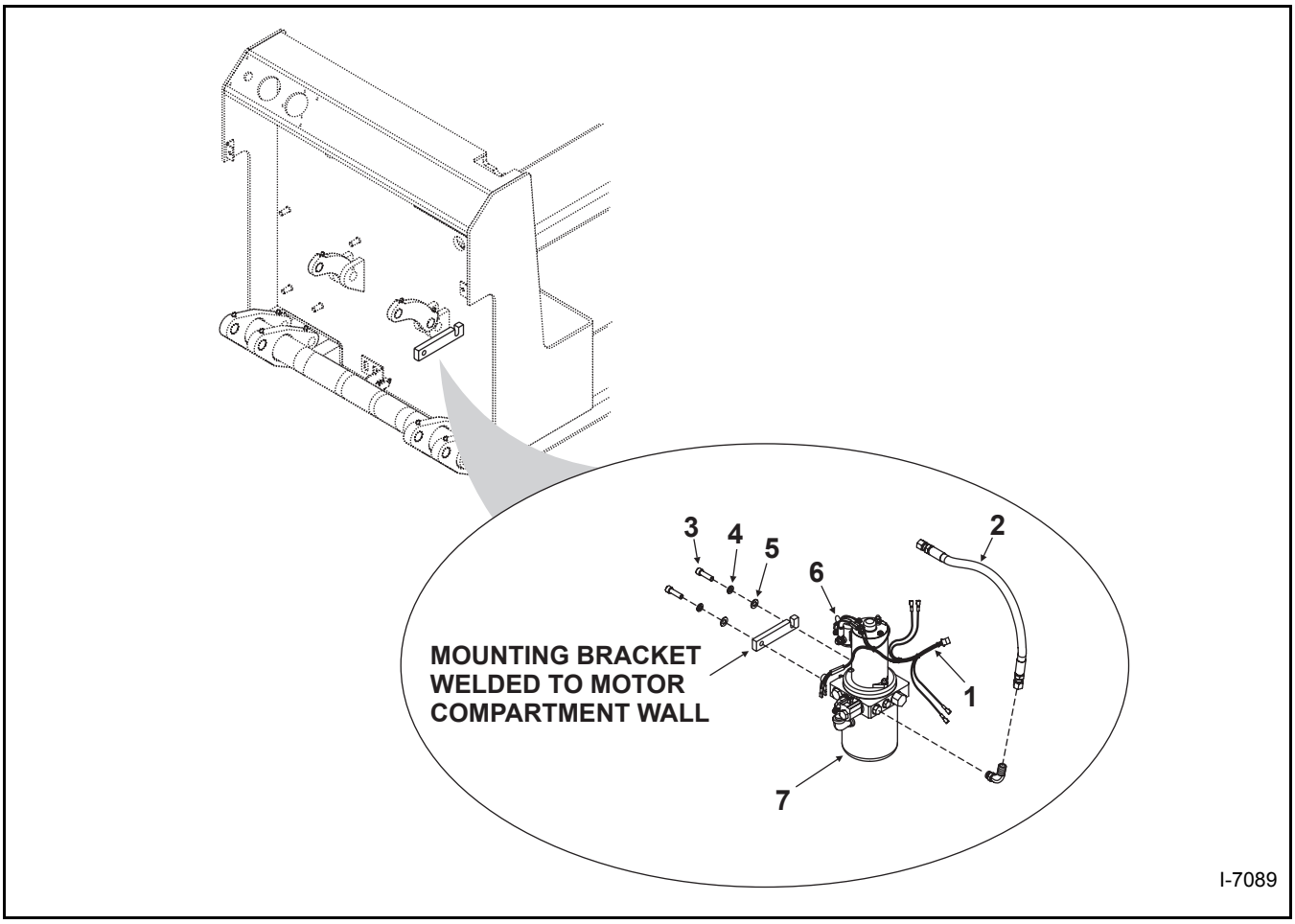


Figure 4-41. Hydraulic Pump/Motor Assembly

4-8.2.8 Replace Hydraulic Pump Assembly

1. Disconnect battery from lift truck.
2. Remove upper and lower service covers.
3. Remove the electrical lead (32, Figure 4-41) from solenoid valve.
4. Remove main power lead from wiring harness to the motor starter (32).
5. Remove hydraulic line (31) from pump outlet fitting.
6. Loosen and remove mounting bolts (38) holding the hydraulic pump assembly to the lift truck chassis, and remove the pump assembly.
   NOTE: The hydraulic reservoir will be filled with hydraulic oil. Place a container under the pump assembly to catch any hydraulic oil and place protective covers over other internal components to protect them from spilled hydraulic fluid.
7. Remove hydraulic reservoir (4, Figure 4-39).
8. Remove Hydraulic Strainer Assembly. See Section 4-8.2.5.
9. Using a ¼" thin wall deep socket, remove the bolts (3, Figure 4-42) securing hydraulic pump (2) to the adapter assembly (1).
10. Remove the hydraulic pump and O-ring (4).
11. Reinstall hydraulic pump by reversing steps 3 through 8.

    NOTE: Lubricate the O-ring with hydraulic fluid before installation.

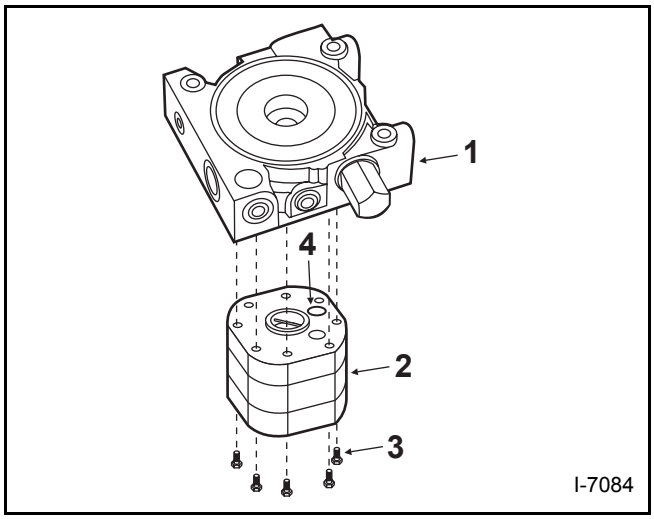


Figure 4-42. Hydraulic Pump Replacement

4-8.3 Lift Cylinder Removal

1. Disconnect batteries.
2. Lift complete truck to height sufficient to permit access to under side of hydraulic cylinder (1, Figure 4-37). Provide blocking under power section frame and at tips of forks.
3. Remove hydraulic supply line (2). Plug open end of hydraulic line to prevent fluid loss.

   NOTE: The cylinder may have some hydraulic oil in it.
4. Remove screw from the lower cylinder support.

   NOTE: This screw is reached from below.
5. Remove upper keeper pin.
6. Remove cylinder.
7. Install new cylinder by reversing Steps 3 - 5.

IMPORTANT

When reinstalling the hydraulic supply line make sure that it does not touch the electrical stand-off or any other component that could cause wear and premature failure.

4-8.4 Lift Cylinder Repair

To rebuild or replace components in a lift cylinder, proceed as follows:

1. Secure the lift cylinder in a vise, clamping lightly at the base of the cylinder.
2. With spanner wrench, remove the cylinder head (2, Figure 4-43) from the cylinder weldment (7).
3. Withdraw the cylinder rod (3) from the cylinder

   NOTE: If the cylinder weldment (7), cylinder rod (3), or cylinder head (2) is damaged, the entire lift cylinder must be replaced.
4. Replace all wipers, seals and damaged or worn pads (1, 4, 5, 6).
5. Coat all parts with the correct hydraulic oil (Table 3-3).
6. Insert cylinder rod (3), with attached pads, wipers and seals into the cylinder weldment (7).
7. Install cylinder head and tighten to 5-7 lbs/ft.

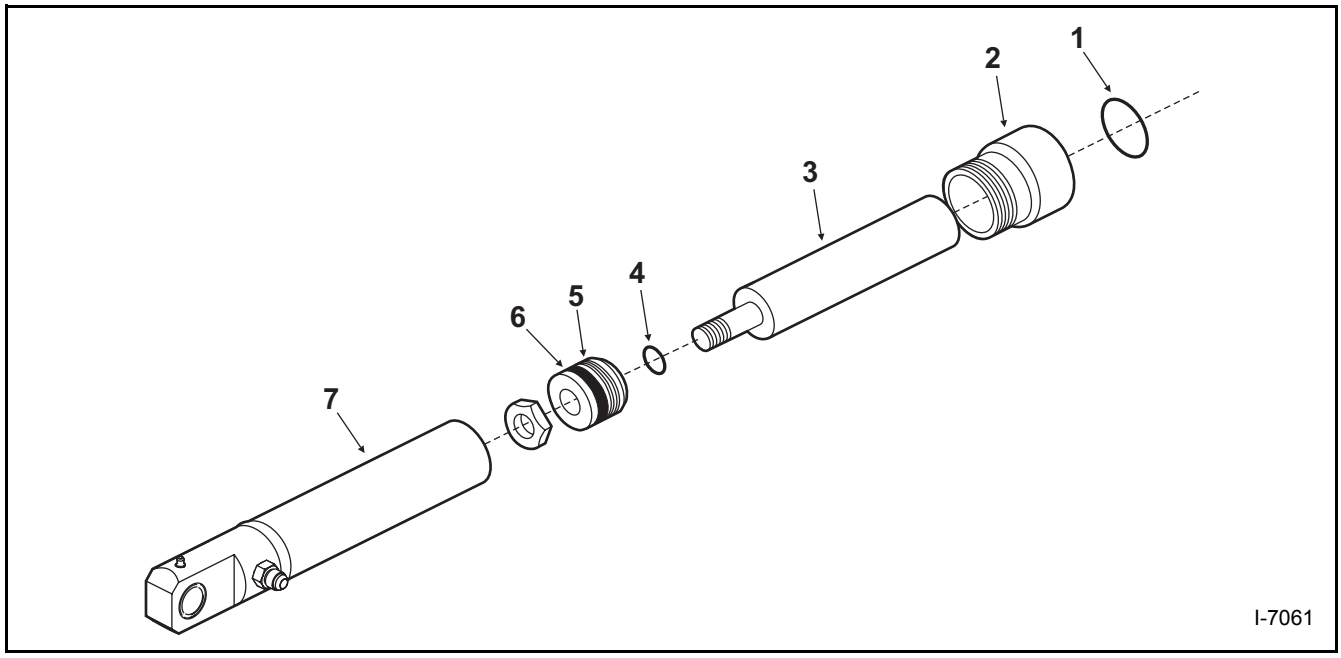


Figure 4-43. Lift Cylinder Assembly

4-8.5 Hydraulic Pressure Adjustment.

The relief valve is factory set to open at the rated pressure setting for the pump (not to exceed 2,575 psi) and rarely needs adjusting.

⚠ DANGER

- **Hydraulic oil under pressure can penetrate the skin. It is toxic and can damage tissue. Always use a piece of wood or cardboard to check for suspected hydraulic leaks. NEVER USE YOUR HANDS. Obtain immediate medical attention from a medical provider knowledgeable with hydraulic fluid injuries if pressurized hydraulic fluid pierces the skin. Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.**
- **When forks are raised, pressure exists in the hydraulic system lines and fittings. To ensure release of pressure, forks must be fully lowered and the battery disconnected before performing any maintenance on the hydraulic system.**

If you suspect that the relief valve is malfunctioning, perform the following procedures:

1. Lower forks as far as they will go.
2. Remove motor compartment (service) cover.
3. Disconnect hose (2, Figure 4-37) from elbow (9, Figure 4-37) at pump and connect a pressure gauge of adequate range (0-3,000 psi) to the elbow.
4. Activate pump motor and observe reading on pressure gauge. If pressure reading is between 2,475 and 2,575 psi, the relief valve is functioning properly and does not need adjustment. If pressure reading is below 2,475 psi or above 2,575 psi, proceed as follows to adjust relief valve:

IMPORTANT

Do not set pressure too high or hydraulic system may be damaged. Factory recommended limits of 2,475 to 2,575 psi should be observed. Under no circumstances should pressure be set above 2,575 psi.

5. Remove protective cover nut from relieve valve assembly (3, Figure 4-38) to gain access to adjusting screw. With pump motor running, observe pressure gauge and set pressure between 2,475 and 2,575 psi by turning adjusting screw (3) clockwise to increase pressure or counterclockwise to decrease pressure.
6. Deactivate pump motor, disconnect pressure gauge, and reconnect hose.
7. Install motor compartment (service) cover.

4-9. DECALS AND TRIM.

4-9.1 Painting Requirements.

Clean all dirt, scale, and other foreign matter from surfaces to be painted. Touch up paint on frames and pull rods with yellow enamel (Big Joe P/N 901201). Touch up paint on remaining parts with black satin enamel (Big Joe P/N 901202).

4-9.2 Decals and Plates.

Refer to Figure 1-1 for location and identification of decals and information plates. Make sure decals and plates are legible and securely attached.

Section 5
OPTIONS

5-1. COLD CONDITIONING PACKAGE.

Continuous operation of the PPT lift trucks at temperatures below 32° F (freezing) in applications such as meat lockers and freezers, requires the changing of oils and grease, and modification of the control head and deadman switch as shown in Figure 5-1. For intermittent operation under 32° F, the oils and grease need not be changed. Refer to the wiring diagram to help ensure proper connections.

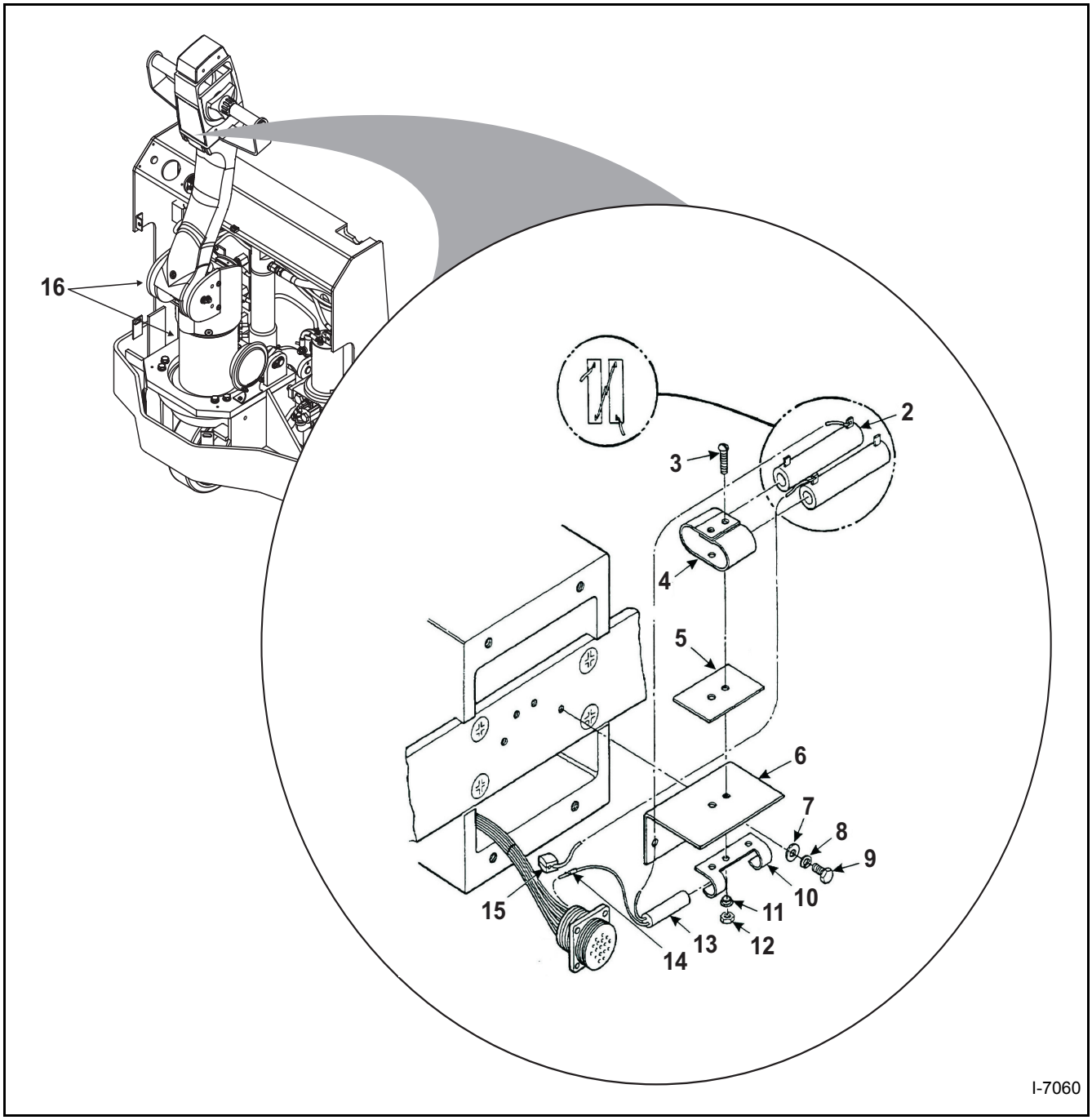


Figure 5-1. Cold Conditioning Package

5-2. LOAD BACKREST

NOTE: The optional load backrest comes in two variations, one used with two 12-V or 24-V industrial battery pack and the other is used with the four 6-V Maintenance Free battery pack.

5-2.1 Replacement of existing backrest

1. Position the proper backrest (1, Figure 5-2 and Figure 5-3) at the bottom of the frame weldment and install two screws (2, Figure 5-3) in the lower holes. DO NOT tighten the screws at this point.
2. Rotate the backrest into the upright position and install the remaining screws (2) in the upper holes.
3. Fully tighten all screws.

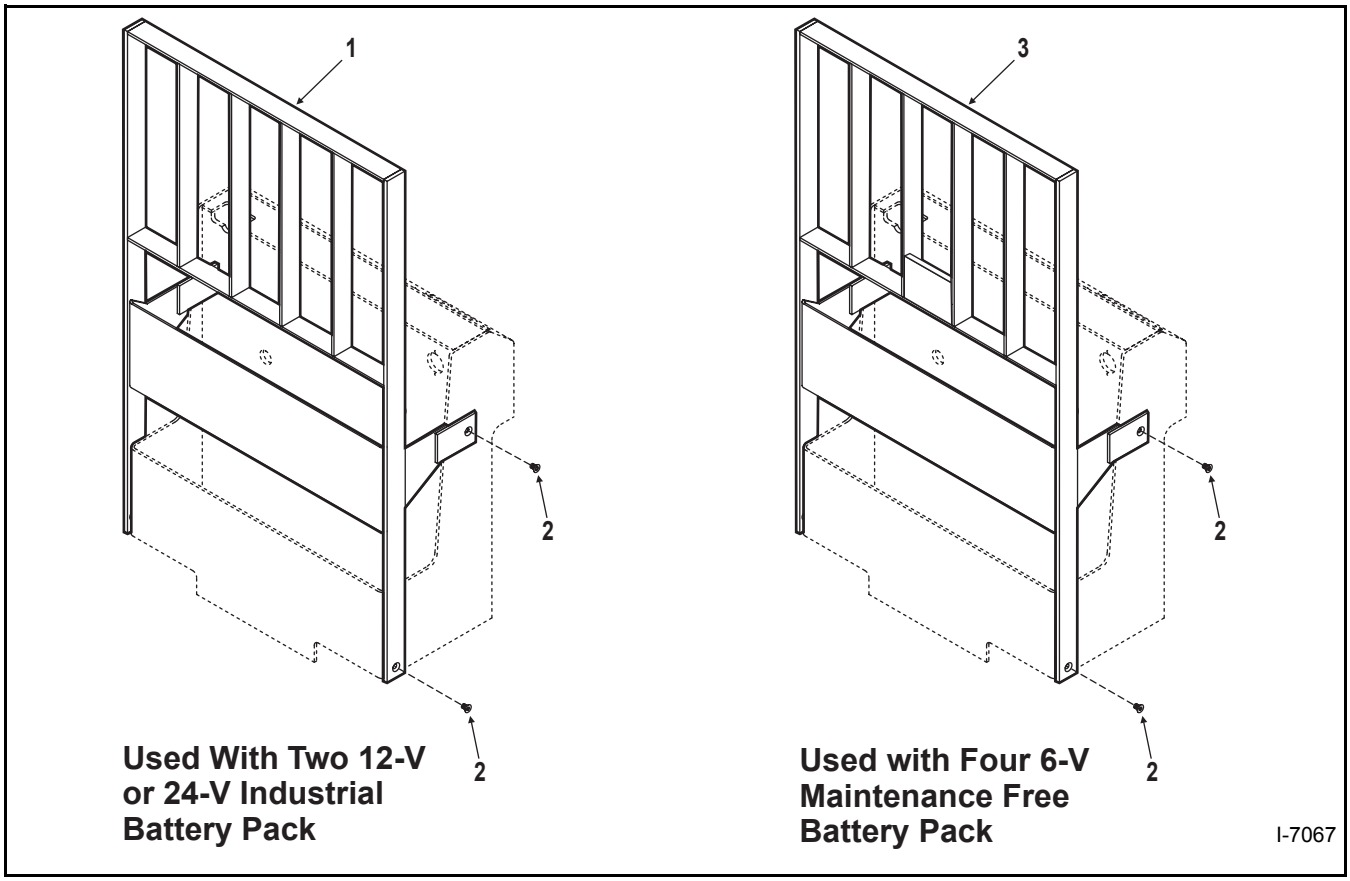


Figure 5-2. Load Backrest

5-2.2 Installation of a new backrest

1. Disconnect and remove batteries
2. Locate, drill and tap four thru holes as shown in Figure 5-3.
3. Position the backrest (1, Figure 5-3) at the bottom of the frame weldment and install two screws (2) in the lower holes. DO NOT tighten the screws at this point.
4. Reinstall batteries.
5. Rotate the backrest into the upright position and install the remaining screws (2) in the upper holes.
6. Fully tighten all screws.

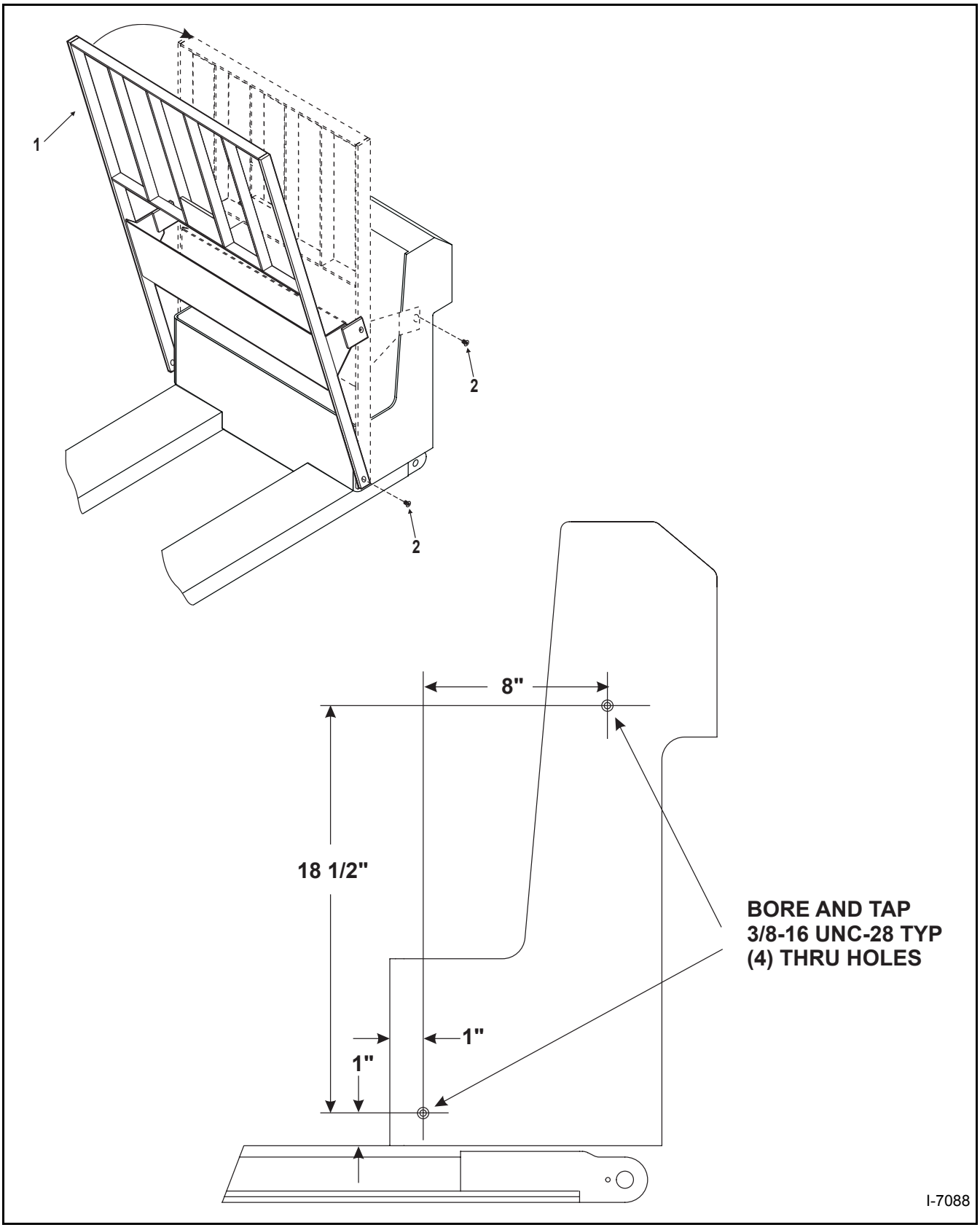


Figure 5-3. Installation of New Backrest

5-3. LOAD STABILIZER.

The load stabilizers are available as an optional item at the time the PPT 45 Lift Truck is purchased. Figure 5-4 presents the parts breakdown for reference only, field installation of the stabilizers is not recommended.

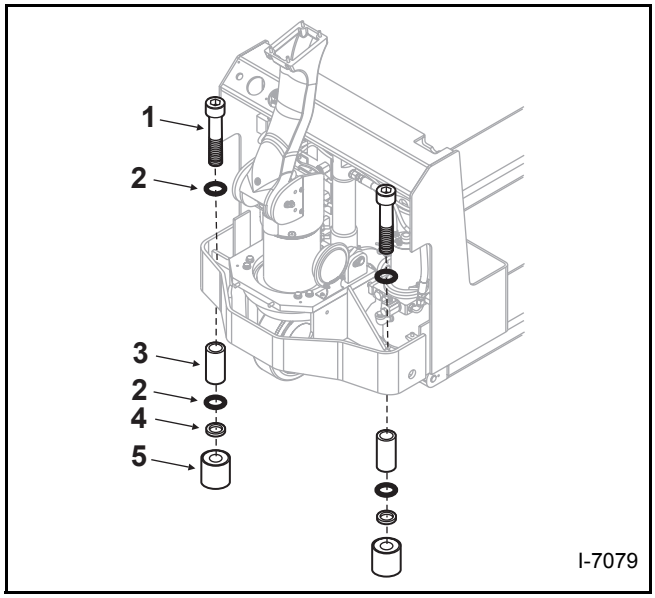


Figure 5-4. Load Stabilizers

Section 6
TROUBLESHOOTING

6-1. TROUBLESHOOTING CHART

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Truck will not run, lift system does not operate.	a. 120 AMP fuse blown	Check fuse Replace if necessary
	b. Battery dead or disconnected.	Check battery and quick disconnect (Section 4-7.1)
	c. Defective wiring.	Check for open circuit and repair as required.
	d. Key switch, if equipped, defective.	Bypass key switch to determine if bad
Truck does not run forward or reverse. All other functions operate normally.	a. Check all wiring. A loose connection may be the cause of malfunction.	Tighten all loose connections before further troubleshooting
	b. Defective Deadman/brake switch.	Check and replace switch if defective.
	c. Switch in control head broken.	Check and replace switch if defective.
	d. Transistor control fault may need to be reset.	Move control arm up into the neutral position to reset.
Truck runs forward but not in reverse.	Defective switch in control head, or defective contactor.	Check for positive dc voltage at wire F-2 on reverse contactor. If not present when steering arm is in operating position and control lever is in reverse, reverse switch is defective. If voltage is present, contactor is defective.
Truck runs in reverse but not in forward.	Defective switch in control head, or defective contactor.	Check for positive dc voltage at wire F-1 on forward contactor. If not present when steering arm is in operating position and control lever switch is in forward, forward switch is defective. If voltage is present, contactor is defective.
Truck runs forward and in reverse at lower speeds; will not run at high speed.	Defective speed control switch in control head, or defective by-pass contactor.	Check resistance at High Speed switch. If the reading is the same in either position, the High Speed switch is bad. Replace switch.Check for variable resistance at the potentiometer when direction control is activated. If not noted, replace potentiometer.
Truck does not slow with brake, or brake does not engage	a. Defective brake/deadman switch. b. Defective brake solenoid.	Check brake/deadman switch for continuity. If none found when the control arm is in the brake position, replace switch.Replace brake assembly.
Oil sprays or flows from lift cylinder.	Defective seal in lift cylinder.	Overhaul lift cylinder and install new seal and wiper ring. See Section 4-8.4 Lift Cylinder Repair

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Squealing sounds when lifting forks.	a. Oil level too low. b. Lift linkage binding.	Add oil to reservoir.Apply grease.
Lift carriage does not lift to top.	Oil level too low.	Add oil to reservoir
Weak, slow or uneven action of hydraulic system.	a. Defective pump or relief valve. b. Worn lift cylinder seal. c. Load larger than capacity. d. Defective lift motor solenoid.e. Battery charge low.	Check pressure. Adjust valve.Replace cylinder seal.Refer to I.D. plate for capacity.Replace.Charge battery.
Forks do not lift, pump motor does not run.	a. Battery is dead or disconnected. b. Defective wiring. c. Defect in electrical system for operating pump motor	Check and recharge if required.Check and repair as required.Check lift switch in control head, as well as the solenoid on the pump motor. Repair or replace.
Forks do not lift, motor runs.	Defect in hydraulic system.	Check the oil level in the reservoir and the oil lines to the lift cylinders, and repair as required.If normal, check the hydraulic pump, and relief valve. Repair, or adjust.
Forks lift, but will not go down.	Defect in hydraulic system.	Check lowering control switch and lowering valve; look for blockage in hydraulic line. Repair/adjust as required.
Load will not hold	a. Oil bypassing internally between check valve and adapter body. b. Worn lift cylinder seal.	Disassemble, clean, and reassemble Replace worn parts as required.Replace cylinder seal.
Forks creep downward under load when in a raised position.	Leak in hydraulic system cylinder seal or lowering valve.	Check lowering solenoid valve and internal check valve for blockage preventing valve from closing completely to block oil. Look for leaking fitting in hydraulic line. Check pump for leakage back into reservoir. Repair or replace as required.
Steering arm does not return to the upright position.	a. Return spring improperly adjusted. b. Binding electrical cable.	Readjust spring tension.Check and free the binding item. Verify that the cable has not been damaged. Repair or replace as needed.
Truck moves forward when arm is pulled down.	a. Belly-button switch defective. b. Short in control head	Check for short, and repair or replace as necessary.Check wiring and repair as required.
Steering arm jerks excessively starting or stopping the truck.	Drive wheel worn.	Replace drive wheel if worn to within 3/8 inch of hub.
Drive motor is jerky.	Motor commutator damaged.	Replace motor.

6-2. CONTACTOR TESTING

Make certain battery is in good condition and fully charged before beginning tests.

6-2.1 Contactor Testing

1. Make certain battery is in good condition and fully charged before beginning tests.
2. Elevate rear (drive wheel) of truck
3. Reconnect the battery.
4. Place the VOM test meter on the 50V scale and connect the test probes to the (+) and (-) coil connections of the suspect contactor (Figure 6-1).

   NOTE: Testing of the reverse contactor is shown in Figure 6-1.
5. If the truck is equipped with a keyswitch, turn it on and place the steering control in the run position (brake off) and depress the speed control,
6. Voltage should read 24 volts, as applicable. It voltage does not read 24 volts the problem is in the switches or wiring leading to the contactor unit. (See Section 6-6.2 for switch testing.) If 24 volts is present, the problem is in the contactor unit, and the contactor must be disassembled and detective parts replaced.

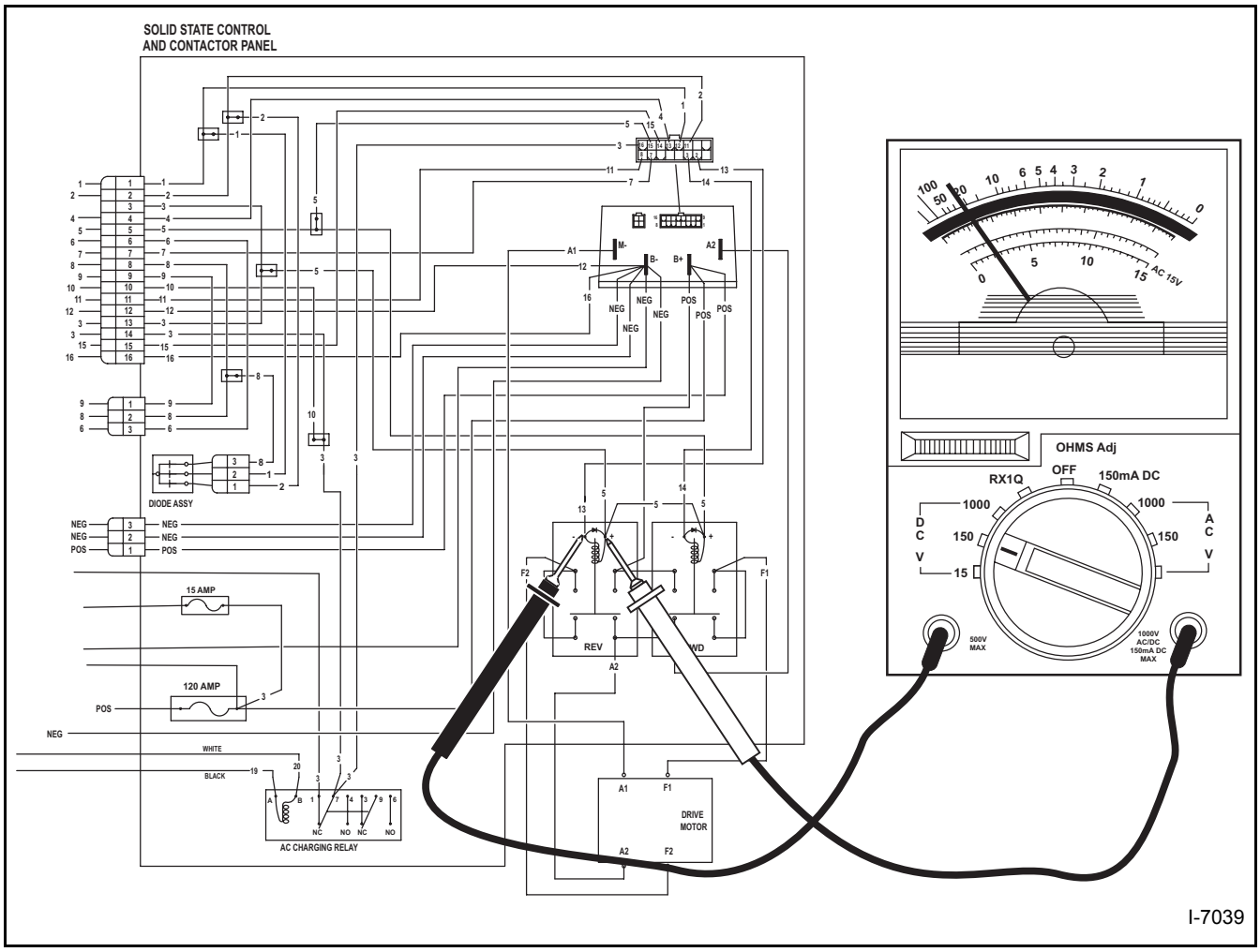


Figure 6-1. Contactor Testing

6-2.2 Switch Testing.

1. Disconnect the battery
2. Set the VOM test meter on the RX1 scale.
3. Connect the meter test probes to the common #5 (#10 for push button switches) and the suspect switch lead at the terminal connector.

   NOTE: #2 switch lead for the reverse switch is shown in Figure 6-2.

4. If the truck is equipped with a keyswitch, turn it on, lower the control handle to the driving position and depress the suspect switch.
5. Resistance should read zero ohms or a small amount of ohms.
6. If resistance is present (10 ohms or more), the switch or wiring leading to the connector is defective and must be repaired or replaced.

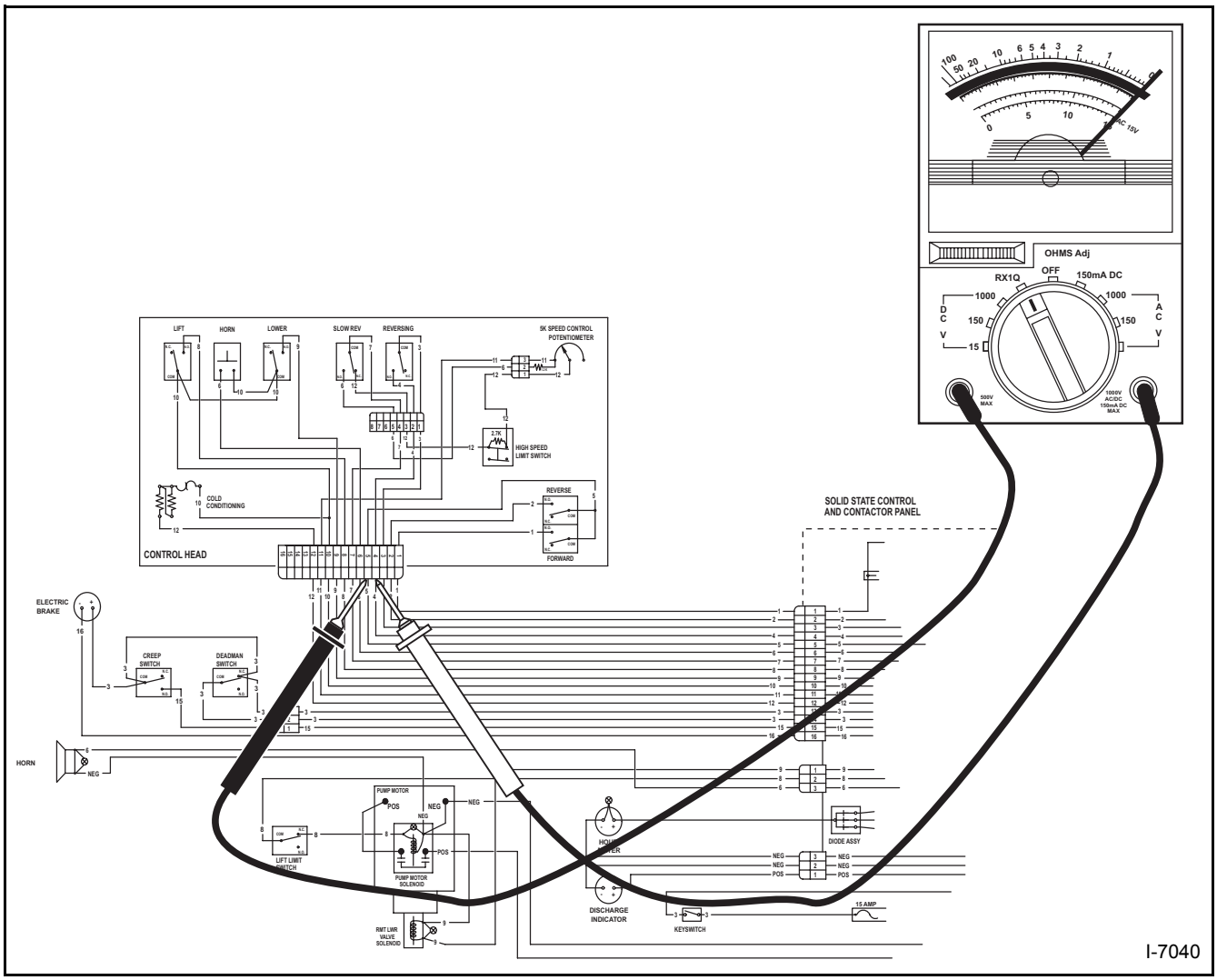


Figure 6-2. Switch Testing

6-3. TRANSISTOR CONTROLLER TROUBLE-SHOOTING

The basic Big Joe Transistor Controlled Electrical System is shown in schematic form in Figure 6-3. Refer to the wiring diagrams included in Chapter 4 for complete wiring diagram for this truck. Refer to these diagrams and the schematic for tracing of electrical circuits during troubleshooting and testing procedures.

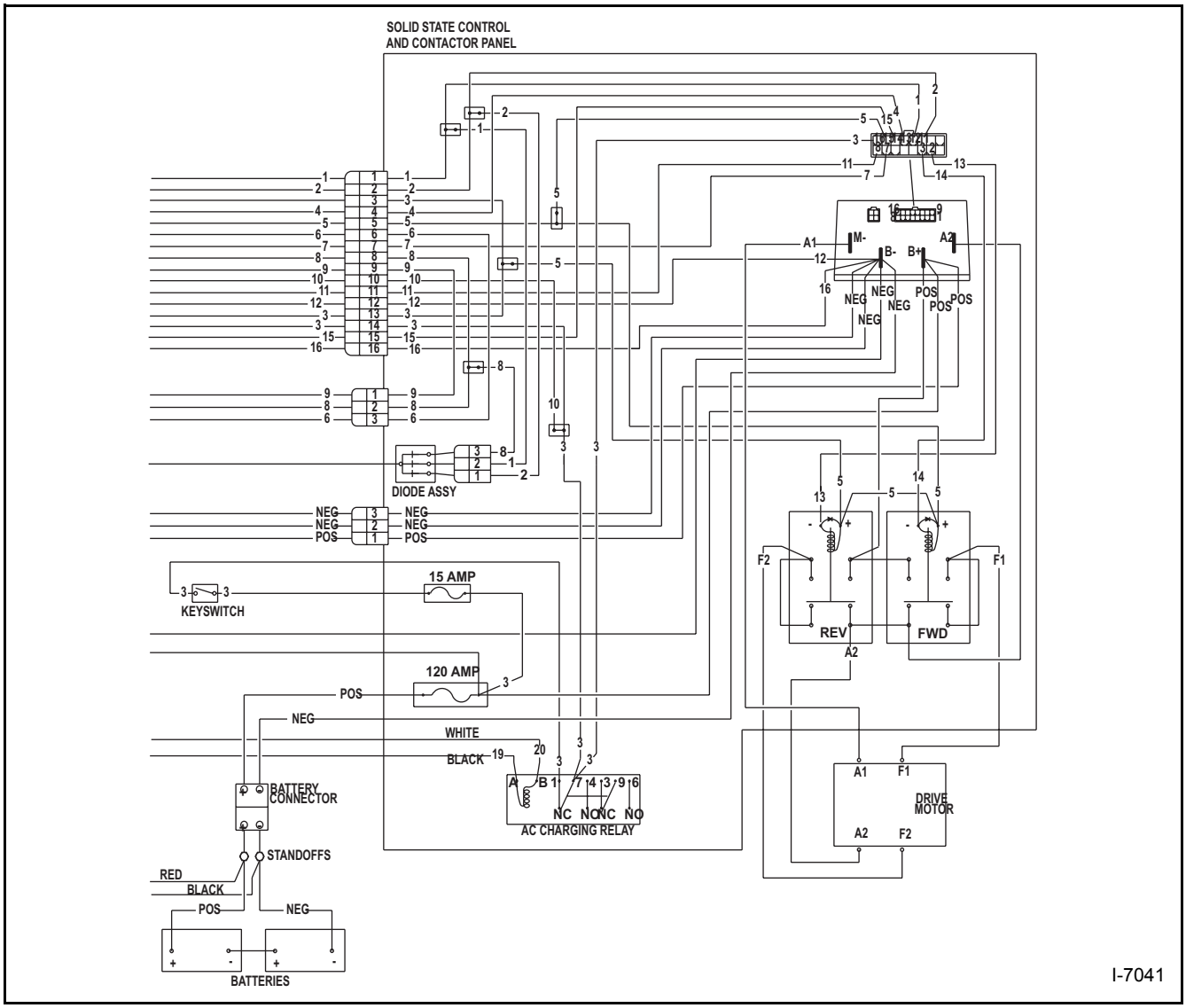


Figure 6-3. Transistor Controller Schematic

6-3.1 Circuit Operation

While operation of the transistorized control system is transparent to the operator, it is helpful to understand the operating principles and features of the transistor controller when troubleshooting trucks equipped with this controller. The controller (2, Figure 6-4) is mounted on the contactor electrical panel, installed within the motor compartment of the lift truck. Figure 6-6 identifies the contacts of a typical controller.

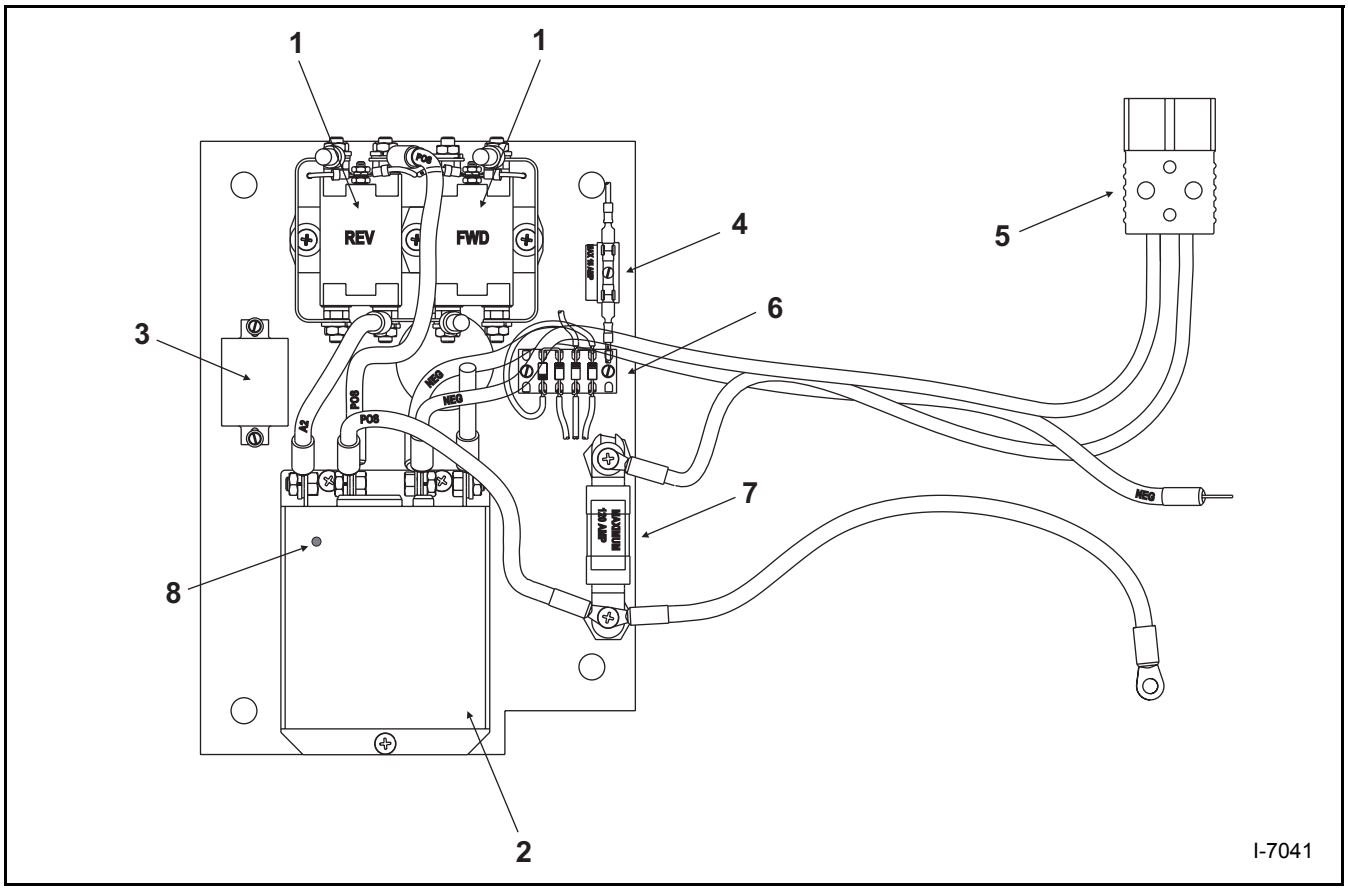


Figure 6-4. Contactor Panel Parts

1. Smooth Stepless Operation.

   The Big Joe custom transistor controller allows superior control of the vehicle's drive motor speed. The amount of current delivered to the motor is set by varying the 'on" time (duty cycle) of the controllers transistors. This technique, called "pulse width modulation" (PWM), permits silent, stepless operation.

2. Current Multiplication.

   During acceleration and during reduced speed operation, the controller allows more current to flow into the motor than flows out of the battery. The controller acts like a DC transformer, taking in low current and high voltage (the full battery voltage) and putting out high current and low voltage. The battery only has to supply a fraction of the current that would be required by a conventional controller (in which the battery and motor current are always equal). The current multiplication feature gives vehicles using these controllers greater driving range per battery charge.

3. Acceleration Limiting.

   A built-in acceleration limiting circuit maintains a maximum rate of power increase to the motor. If full throttle is applied at start-up, the acceleration ramp setting determines how quickly the output of the controller increases. When full throttle is applied, the standard controller setting requires approxi-

mately one second to reach full output. This feature contributes to smooth, even starts. (See adjustment instructions to adjust acceleration rate setting.)

4. Current Limiting.

   The transistor controllers limit the motor current to a preset maximum. This feature protects the controller from damage that might result if the current were limited only by the motor demand. The current limit feature also protects the rest of the system. By eliminating high current surges during vehicle acceleration, the stresses on the motor and batteries are reduced and their efficiency and service life are improved. Because of the smoother operation, there is less wear and tear on the vehicle drive train.

   The maximum motor current can be factory-set to a lower value than the standard maximum if requested. For further flexibility, the current limit setting on some models is field-adjustable. (See adjustment instructions.)

5. Plugging.

   A form of electrical braking, called plugging, can be used to slow the vehicle. When the motor is reversed with the accelerator advanced (i.e.. when the vehicle is moving forward, the direction control is moved to the REVERSE position), the armature acts as a generator. Current from the armature flows through a plug diode in the controller. The controller regulates the current in the motor field winding to give an appropriate level of plugging torque. The vehicle slows smoothly to a stop, and then automatically accelerates in the other direction. A 1 kHz tone will be heard during plugging. The maximum plugging current is factory set per customer requirements, and is also field adjustable (see adjustment instructions).

6. Under-voltage Protection.

   The control circuitry requires a minimum battery voltage to function properly. The controller is designed so its output is gradually reduced if the battery voltage falls below a certain level. The cutoff voltage is listed in the specifications (see Table 6-1). Reducing the output to the motor allows the battery voltage to recover, and an equilibrium is established in which the battery supplies as much current as it can, without falling below the minimum voltage cutoff.

7. Over-voltage Protection.

   As with the under-voltage protection, the controller has a means of preventing operation when battery voltages reach an "over-voltage" situation, a condition where battery voltages are too high for proper functioning. Excess voltage can occur from an unregulated battery charger or from improper or faulty wiring.

Table 6-1. Controller Specifications.

Big Joe Model	90 /200-02
Input Voltage	24
Current Limit	250 Amps*
Rating:	
1 Minute	250 Amps
2 Minute	200 Amps
5 Minutes	150 Amps
1 Hour	100 Amps
Under-voltage Cutout	16 V
Max F/R current	2 Amps
Operating Frequency	15 kHz
*60 second rating.	

8. Thermal Protection.

   Because of their design, the controllers barely get warm to the touch in normal operation. However, overheating can occur if the controller is undersized for its application or becomes overloaded. If the internal temperature of the controller exceeds 165° F (74° C) the current limit is automatically reduced. The current limit continues to drop steadily until at 200° F (94° C) it is reduced to zero and the truck will not function. This feature allows the vehicle to be operated at a reduced performance level in order to permit maneuvering out of the way and stopping in a safe location. After the controller cools down, full current limit and performance return automatically.

   Although this action is not damaging to the controller, it does suggest a mismatch. If thermal cutback occurs often in normal vehicle operation, the controller is probably undersized for the application, and a higher current model should be used. The controller shifts frequency during an "over temperature" condition from its normal 15 kHz to 1 kHz, providing an audible tone alerting the operator to the over temperature condition.

   The controller is also protected from under temperature operation. Should the controllers internal temperature fall below -13° F (-25° C) (for example being parked overnight in an icehouse), the current limit will be 1/3 the maximum. Once the controller warms above 77° F (25° C), full current limit and performance return automatically.

9. Accelerator Fault Protection (Runaway Protection).

   To prevent uncontrolled operation, the controller shuts off the motor output in the event a short circuit fault in the accelerator or its wiring is detected. The throttle configuration is a 2-wire potentiometer ranging from 5000 ohms for full off to 0 ohms for full on. The controller returns to normal operation when the fault (e.g., accelerator wiring, broken connectors, potentiometers that fail or are set to start at 0) has been corrected.

10. Controller Fault Detection.

    An internal micro-controller automatically maintains surveillance over the functioning of the controller. When a fault is detected, the appropriate fault code is signaled via the LED, externally visible on the side of controller (See 8, Figure 6-4 for LED location on controller). The diagnostic codes flashed by the LED are listed in Table 6-4.

    If the fault is critical, the controller is automatically disabled. Faults can be caused internally (e.g.. shorted transistors) or externally (e.g., wrench or hardware dropped across controller terminals). While disabled, the controller's direction contactor output and internal logic are both off.

    Faults are detected by monitoring the controllers M-output. If the M-output remains low for more than 20 ms, a fault is detected. Fault protection is disabled for throttle demand greater than 80%.

    To recover from a fault, the F/R switch must be turned off and back on again. If the fault has been corrected, the controller will turn back on.

    The automatic fault detection system includes:

    - Contactor coil open / shorted driver (F/R and shunt contractor)
    - Contactor driver over-current / contactor coil short
    - Contactor welded
    - Emergency reverse circuit check
    - M- output fault
    - Memory checks upon start-up
    - Over-voltage cutback
    - Power supply out of range (internal)
    - Throttle fault
    - Under-voltage cutback
    - Watchdog (external and internal)
    - Watchdog (internal)

11. Hand Held Programmer (Optional)

    A hand held programmer is available that is designed specifically for use with the controller. It serves dual functions of reading diagnostic data provided by the controller and adjusting certain performance values of the controller. The programmer (Part Number 005472-02) is available through your Big Joe dealer. If you require dealer location information, contact Big Joe Manufacturing Co. phone number 847-675-8700.

12. Fault Recording.

    Fault events are recorded in the controller's memory. However, multiple occurrences of the same fault are recorded as one occurrence

    The fault event list can be loaded into the programmer for readout. The Special Diagnostics mode provides access to the controller's diagnostic history file. The history file contains the entire fault event list created since the diagnostic history file was last cleared. The standard Diagnostics mode provides information about only the currently active faults.

13. Fault Recovery (including recovery from disable).

    Almost all faults require a cycling of the KSI (Key Switch Input) or brake input to reset the controller and enable operation. The only exceptions are shown in Table 6-2.

Table 6-2. Fault Recovery Exceptions.

FAULT RECOVERY	
Anti-tie down	Release and re-select Mode 1
Contactor over-current	When condition clears
Emergency reverse	Belly Button switch re-applied or brake cycled
HPD (High Pedal Disable)	Lower throttle to below HPD threshold
Over-voltage	When battery voltage drops below over-voltage setting
SRO	When proper sequence is followed
Thermal cutback	When temperature comes within range
Throttle fault	Clears when condition gone
Under-voltage	When battery voltage rises above under-voltage level

14. Emergency Reverse: Enhanced Plugging Current.

    Emergency reverse (or "belly button") switches are mounted on the handles of walkie vehicles. The emergency reverse switch is wired to the controller and other vehicle electronics in such a way that if the button is pressed against the operator by the advancing vehicle, the controller enables enhanced plugging current to slow the vehicle and reverse its direction. After the button is released, normal controller operation is not resumed until neutral (no movement) is selected or until the brake is cycled (brake, then release). However, repeatedly pressing the belly button will reactive the emergency reverse function.

15. Arcless F/R Switching.

    Each time the F/R switch passes through neutral, the controller's output is rapidly turned off (even if the throttle is held on) so that all motor current has stopped by the time the direction contactor drops out. Controller output always starts at zero and increases smoothly at the set acceleration rate each time a new direction is selected. Bypass contactor operation is also arcless, when interrupting currents less than the controller's current limit.

16. High Pedal Disable (HPD)

    When the controller Key Switch Input (KSI) is turned on, it will sense a "high" (advanced accelerator) situation and will inhibit the output until the accelerator is released and reapplied. By preventing the unit KSI from being turned on with the throttle depressed, this safety feature (also called Neutral Start) required the truck to start smoothly from zero throttle when the battery is plugged in. It also protects against sudden starts caused when problems in the throttle linkage (e.g., bent parts, broken return spring) give a partial or full throttle signal to the controller, even with the accelerator released, when the battery is plugged in.

6-3.2 GENERAL SYSTEM CHECKOUT.

Carefully complete the following checkout procedure. If you find a problem during the checkout, refer to Section 5 for further information.

The checkout can be conducted with or without the handheld programmer. However, the checkout procedure is easier with a programmer. To evaluate the system without a programmer, observe the LED and note the flashing pattern and refer to Table 6-4 for the code description.

⚠ CAUTION

- **Put the vehicle up on blocks to get the drive wheel off the ground before beginning these tests.**
- **Turn the keyswitch off and make sure that the brake is applied (brake switch open), the throttle is in neutral, and the forward/reverse switches are open.**
- **Do not stand, or allow anyone else to stand, directly in front of or behind the vehicle during the tests.**

1. If a programmer is available, connect it to the programmer connector (6, Figure 6-7) on the controller.
2. Turn the lift truck key switch to the ON position. The programmer should "power up" with an initial display (2, Figure 6-5), and the controllers Status LED should begin steadily blinking a single flash. If neither happens, check for continuity in the key switch circuit and controller ground.
3. If you are using a programmer, put it into the diagnostic mode by pressing the "Menu Navigation Key" (1, Figure 6-5). Using the Navigation key, select the Faults menu. Display the Faults menu by pressing the Right side of the Navigation key. Press the Right side of the Navigation key again to display the list of System Faults. The display should indicate "No Known Faults."

   Release the brake by pulling down the control arm into the operating position. The controllers LED should continue blinking a single flash and the programmer should continue to indicate no faults. If there is a problem, the LED will flash a diagnostic code and the programmer will display a diagnostic message. If you are conducting the checkout without a programmer, look up the LED diagnostic code in Table 6-4.

When the problem has been corrected, it may be necessary to cycle the brake in order to clear the fault code.

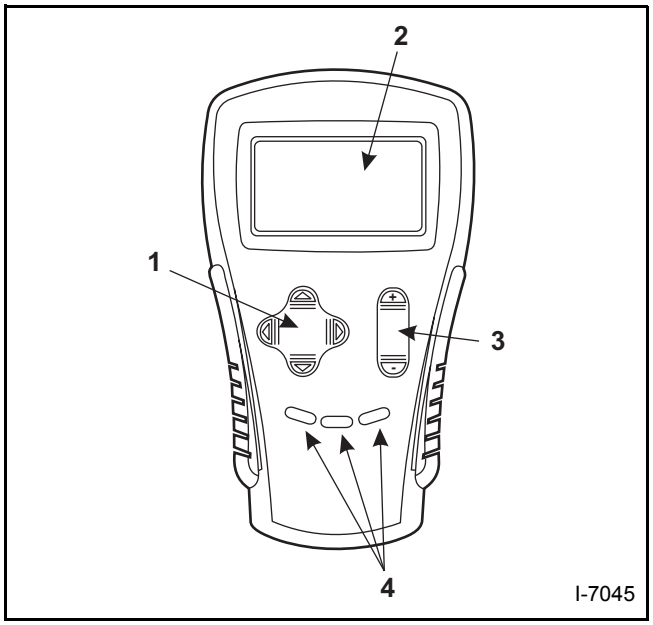


Figure 6-5. Hand Held Programmer

4. With the brake released, select a direction and operate the throttle. The motor should begin to turn in the selected direction. If it does not, verify the wiring to the forward/reverse switches, forward/ reverse contactors and motor. The motor should run proportionally faster with increasing throttle. If not, refer to Section 5.
5. If you are using a programmer, put it into the test mode by using the Navigation key (1) to select the "Monitor" menu. Select the Monitor mode by pressing the "Right" arrow on the Navigation key. Press the Navigation key "Down" arrow to scroll down to observe the status of the forward, reverse, brake, emergency reverse, and mode switches. Cycle each switch in turn, observing the programmer. Each input should show the correct state on the programmer.
6. Check the controller's fault detection circuitry as described in Section 6-3.1, Step 10.
7. Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good top speed.
8. Test the plug braking of the vehicle. The vehicle should smoothly slow to a stop and reverse direction, with the audible plugging tone.
9. Verify that all options, such as high pedal disable (HPD), static return to off (SRO), and anti-tie-down, are as desired.
10. Check to see whether the emergency reverse (belly button) feature is working correctly. Verify that the circuit is operational by momentarily disconnecting one of the emergency reverse wires. The vehicle should be disabled and a fault indicated.

6-3.3 ADJUSTMENT

To change a parameter using the programmer, use the Navigation key (1) to select the "PROGRAM" menu. Press the Right key to display a listing of program settings. Scroll down the Program Listing until the desired parameter is highlighted on the display. Press the Right key to display the settings for the item selected. Press the Increase/Decrease key ("+" or "-") (3, Figure 6-5) until the desired value setting is reached. The parameter is now set at the desired value. All programming occurs in real time. That means the parameter can be changed while the vehicle is in operation.

Some parameters are dependant on other parameters. When the programmer is being used to adjust a parameter and a limit is reached, the display will stop changing.

NOTE: Changing the value of the related parameter may allow the original parameter to be adjusted further.

Table 6-3. Adjustment Settings

Function	Setting
Creep Speed	7
Mode 1- Plugging Current Limit	80A
Mode 1 - Acceleration Rate	1.0s
Mode 2 -Plugging Current Limit	80A
M ode 2 - Acceleration rate	1.0
Mode 2 - Maximum Speed	85%

6-4. DIAGNOSTICS.

The motor controller provides diagnostics information to assist in troubleshooting drive system problems. The diagnostics information can be obtained in two ways:

- Reading the appropriate display on the programmer
- Observing the fault codes issued by the Status LED. The Status LED is located on the side of the controller. See 8, Figure 6-4 for location of the LED on the controller.

During normal operation with no faults present, the Status LED flashes a single flash at approximately 1 flash/second. If the controller detects a fault, a 2-digit fault identification code is flashed continuously until the fault is corrected. For example, three flashes followed by two flashes is code "3,2" appears in the LED code table as:

000 00	000 00	000 00
(3,2)	(3,2)	(3,2)

The codes are listed in Table 6-4. The "0" 's in Table 6-4 indicate an illuminated LED. For suggestions about possible causes of the various faults, refer to 6-1 Troubleshooting Chart at the beginning of this section.

Operational faults, such as an over-temperature situation, are cleared as soon as the operation is brought within range. Non-operational faults, such as a throttle fault, usually requires the brake or key switch to be cycled after the problem is remedied.

Table 6-4. LED Codes

LED Code		Explanation
LED Off	Not illuminated	No power or defective controller
Solid On	Always on	Defective controller
Single Flash	0	Controller operational, no faults
1 - 2	0 00	Hardware fail-safe error
1 - 3	0 000	M- fault or motor output short
1 - 4	0 0000	Sequencing fault (SRO)
2 - 1	00 0	5k W-0 or throttle wiper input fault
2 - 2	00 00	Emergency reverse circuit check fault (BB wiring)
2 - 3	00 000	High-pedal-disable fault (HPD)
2 - 4	00 0000	Throttle pot low open or shorted to B+ or B-
3 - 1	000 0	Contactor or shunt driver over current
3 - 2	000 00	Welded direction contactor
3 - 3	000 000	Not used - reserved for future use
4 - 1	0000 0	Low battery voltage
4 - 2	0000 00	Overvoltage
4 - 3	0000 000	Thermal cutback
4 - 4	0000 0000	Not used - reserved for future use

NOTE: Only one fault is indicated at a time and faults are not presented in the sequence shown in Table 6-4.

6-4.1 Programmer Diagnostics

With a programmer, diagnostics and troubleshooting is more direct than with the LED alone. The programmer presents complete diagnostic information in plain language - no code to decipher. Faults are displayed in the Diagnostic Menu, and the status of the controller inputs/outputs is displayed in the Test Menu.

The following 4-step process is generally used for diagnosing and troubleshooting an inoperative vehicle using the programmer:

1. Visually inspect the vehicle for obvious problems:
2. Diagnose the problem:
3. Test the circuitry with the programmer:
4. Correct the problem.

Repeat the last three steps as necessary until the vehicle is operational.

Refer to the Troubleshooting Chart (Section 6-1.) for suggestions covering a wide range of possible faults.

6-4.2 Diagnostic History

The handheld programmer can be used to access the controller's diagnostic history file. When the programmer is connected to the unit, the error log file is automatically uploaded into the handheld programmer.

To see the present status of the unit, use the Menu Navigation Key (1, Figure 6-5) to select:

Faults->System Faults.

To access this log, use the Menu Navigation Key to select:

Faults->Fault History

The faults are shown as a code and descriptive text. If there are multiple faults, you have to scroll through the list using the Up and Down Buttons on the Menu Navigation Key

The faults may be intermittent faults, faults caused by loose wires, or faults caused by operator errors. Faults such as contactor faults may be the result of loose wires: contactor wiring should be carefully checked out. Faults such as HPD or over-temperature may be caused by operator habits or by overloading.

After a problem has been diagnosed and corrected, clearing the diagnostic history file is recommended. This allows the controller to accumulate a new file of faults. By checking the new diagnostic history file at a later date, you can quickly determine whether the problem has been completely fixed.

To clear the diagnostic history file, select:

Faults->Clear Fault History.

You will be asked to confirm your actions. Use the "plus" arrow (+) for yes to clear the menu and the "minus" arrow (-) (3, Figure 6-5) to cancel your selection and not clear the Fault History.

6-4.3 Test the Fault Detection Circuitry

1. Put the vehicle up on blocks to get the drive wheel off the ground.
2. Disconnect the battery and make sure the key-switch is in the "OFF" position.
3. Using an inline fuse holder fitted with a 10 amp fuse and alligator clips, connect the controller's M and B- terminals. See 3, 4, Figure 6-7.
4. Reconnect the battery and turn the key switch to the "ON" position. Release the brake and apply the throttle. The motor should not operate and the direction contactors should not pull in.
5. Leave the key switch on and remove the in-line fuse wire. The vehicle status should continue to remain off.
6. Cycle the key switch off and on. Release the brake and apply the throttle. The vehicle should now operate normally.

6-5. MAINTENANCE

There are no user-serviceable parts inside the controller. No attempt should be made to open the controller. Opening the controller may damage it and will void the warranty

The transistor controller is programmed at the factory specifically for the truck on which it is equipped. It is important to replace the controller with the correct preprogrammed performance settings to make sure that the truck operates properly. See the Illustrated Parts List for the preprogrammed controller part number.

It is recommended that the controller exterior be cleaned periodically and if a handheld programmer is available, this periodic cleaning provides a good opportunity to check the controller's diagnostic history file. It is also recommended that the controller's fault detection circuitry be checked whenever the vehicle is serviced.

6-5.1 Cleaning

IMPORTANT

If the unit is being operated in an extremely dusty location, more frequent cleaning is recommended.

1. Remove power by disconnecting the battery
2. Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controllers B+ and B- terminals.
3. Remove any dirt or corrosion from the bus bar areas on both the Forward and Reverse contactors. The controller should be wiped clean with a moist rag. Allow it to dry completely before reconnecting the battery.
4. Make sure the connections to all of the Forward and Reverse contactor bus bars are tight. Use two well insulated wrenches for this task in order to avoid stressing the bus bars.

6-5.2 Transistor Control Electrical Panel Maintenance

1. Panel Removal
   a. Disconnect the battery.
   b. Remove the motor compartment cover per instructions in Section 4 of this manual.
   c. Refer to Figure 6-4 and tag and disconnect all electrical wires and cables from the transistor control electrical contactor panel.
   d. Remove two nuts and lock washers to release and remove the electrical panel.
2. Panel Disassembly and Reassembly
   a. Refer to Figure 6-4 for identity of components of the electrical panel and as required, remove defective components.
   b. Upon reassembly of the electrical panel, inspect each connection to make sure that a good positive contact is made at all wire and cable connections.
3. Panel Installation
   a. Install the electrical panel assembly in reverse of instructions for removal.

6-6. TROUBLESHOOTING

The following procedures are to fix vehicles that will not operate properly. Refer to the basic wiring schematic (Figure 6-3) when conducting these tests. Make sure the controller is hooked up as shown in Figure 6-4. Refer to the wiring diagram and schematic for your vehicle. These tests require a general purpose volt ohmmeter. You can use either a conventional "VOM" or an inexpensive digital voltmeter.

In general, when a problem has been isolated as a fault within the controller, the controller must be replaced. If the source of the problem has not been determined or is suspected to be within other truck systems and not the controller, proceed as directed.

⚠ DANGER

- **Working on electric vehicles you must protect yourself against runaways, high current arcs, and out-gassing from lead acid batteries:**
- **Runaways**
  - **Some fault conditions could cause the vehicle to run out of control. We suggest that you jack up the vehicle and get the drive wheels off the ground before attempting these procedures or any other work on the motor control circuitry.**
- **High current arcs**
  - **Electric vehicle batteries can supply very high power for short times. If they are accidentally short circuited, arcs can occur. Always open the battery circuit (disconnect battery) before doing work on the motor control circuit. Wear safety glasses and use properly insulated wrenches to prevent accidental shorts.**

    DO NOT wear jewelry (rings, bracelets, etc) while working on the electrical controls of any lift truck.
- **Lead acid batteries**
  - **Charging or discharging batteries generates hydrogen gas, which can build up in and around the batteries. Always follow the battery manufacturers recommendations when working around batteries. Wear safety glasses.**

6-6.1 Check for Power to the Controller

1. Leave the keyswitch off for these tests (if truck is so equipped).
2. Verify that battery negative terminal (-) connects to the "B-" terminal of the controller. Connect voltmeter negative lead (-) to this point.
3. Connect voltmeter positive lead (+) to the battery side of the power fuse (2, Figure 6-6). Check for full battery voltage. If it is not there, the trouble is in the battery pack or the cables to it.
4. Connect the voltmeter positive lead (+) to the controller B+ terminal (1, Figure 6-6). You should read full battery voltage. If this voltage is zero or close to zero, the trouble is either a bad controller, a bad power fuse (2), or an incorrectly connected cable (3, 4). Trace the cable to make sure it is hooked up properly. If these check out, the controller is malfunctioning and must be replaced.

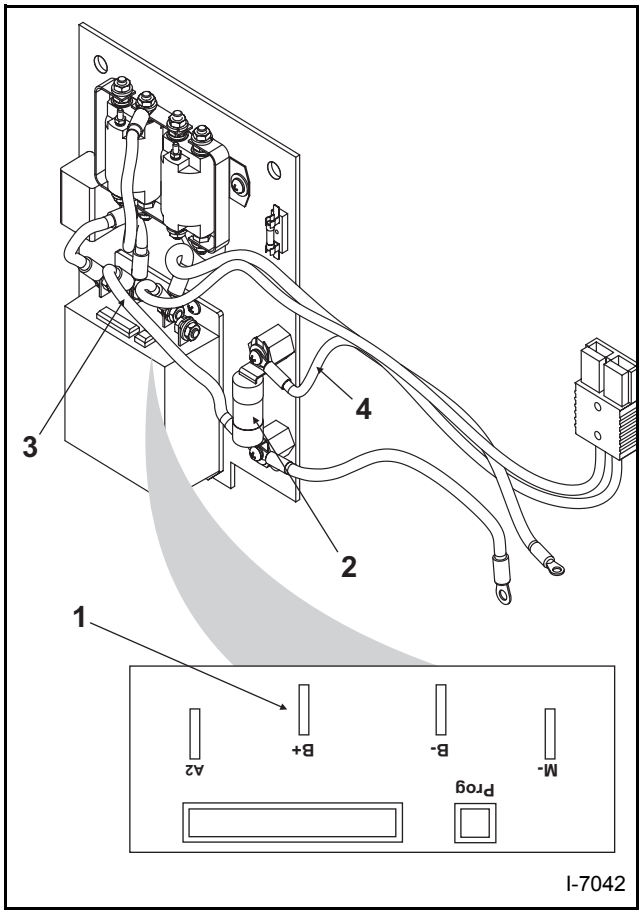


Figure 6-6. Controller Terminals

6-6.2 Check for Contactor Operation and Key-switch Input (KSI)

1. If the truck is equipped with a power key, turn the key to the ON position and move the accelerator in forward or reverse, until the micro switch operates (clicks).
2. This should cause the main contactor to operate with an audible click. Connect the voltmeter across the contactor coil terminal. You should see full battery voltage.
3. The controller KSI terminal should also be getting full battery voltage. Verify this with the voltmeter. Connect the voltmeter (-) to the controller B- terminal, and the voltmeter (+) to the controller's KSI terminal, pin 16 (wire 3) on the multi-pin connector to the controller.
4. If the contactor coil and KSI terminal are not getting voltage, that's the problem. Use the voltmeter to find out where it is not getting through. Connect the voltmeter (-) to the controllers B- terminal and check the following points with the voltmeter (+) lead to trace the flow and determine where the power loss occurs:
   a. First, check both sides of the control wiring fuse.
   b. Check both sides of the keyswitch (if truck is so equipped).
   c. Check both sides of the accelerator miscroswitch.
   d. Finally, check the contactor coil and controller KSI.
5. If the contactor coil and KSI are getting voltage, make sure that the contactor is really working by connecting the voltmeter across its big terminals. There should be no measurable voltage drop. If you see any at all, the contactor is bad.

6-6.3 Check Potentiometer Circuitry

The following procedure applies to the basic accelerator input configuration for these controllers, which is a nominal 5000 ohm potentiometer connected as a two-wire rheostat (0 ohms = full on, 5000 ohms = full off).

1. With the forks lowered, the keyswitch off, and the battery disconnected, remove the multi-pin connector going to the controller. Connect an ohmmeter to pins 7 + 8 (wires 7 + 11). Lower the control arm and measure the resistance as you move the accelerator. The resistance at the limits should be within these ranges:

   Accelerator at Start: 4300 ohms to 4800 ohms
   Accelerator at Maximum: 0 ohms to 50 ohms

2. If these resistance readings are wrong, it is because the potentiometer itself is either:
   - faulty or out of adjustment,
   - the wires to the pot are broken or misconnected,
   - the linkage is not moving the pot shaft through its proper travel,
   - or a switch, resistor, or the relay is defective or incorrectly wired. (See wiring diagram.)
3. While you have the accelerator wires off the controller, use an ohmmeter to check for a short circuit between these wires and the vehicle frame. You should see a resistance of at least 10,000 ohms. If it is lower than that, inspect the wiring for damaged insulation or contact with the frame. If necessary, replace the potentiometer.
4. Reconnect the multi-pin connector to the controller.

6-6.4 Check for controller output

1. Disconnect the wire from the direction contactors to the F/R contactor output of the controller.
2. Connect the voltmeters positive (+) lead to the controller's B+ terminal (2, Figure 6-7). Connect the voltmeter negative (-) lead to the controller's M- terminal (4).

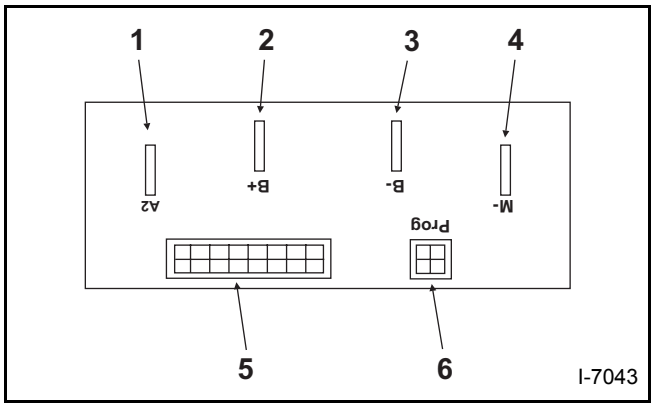
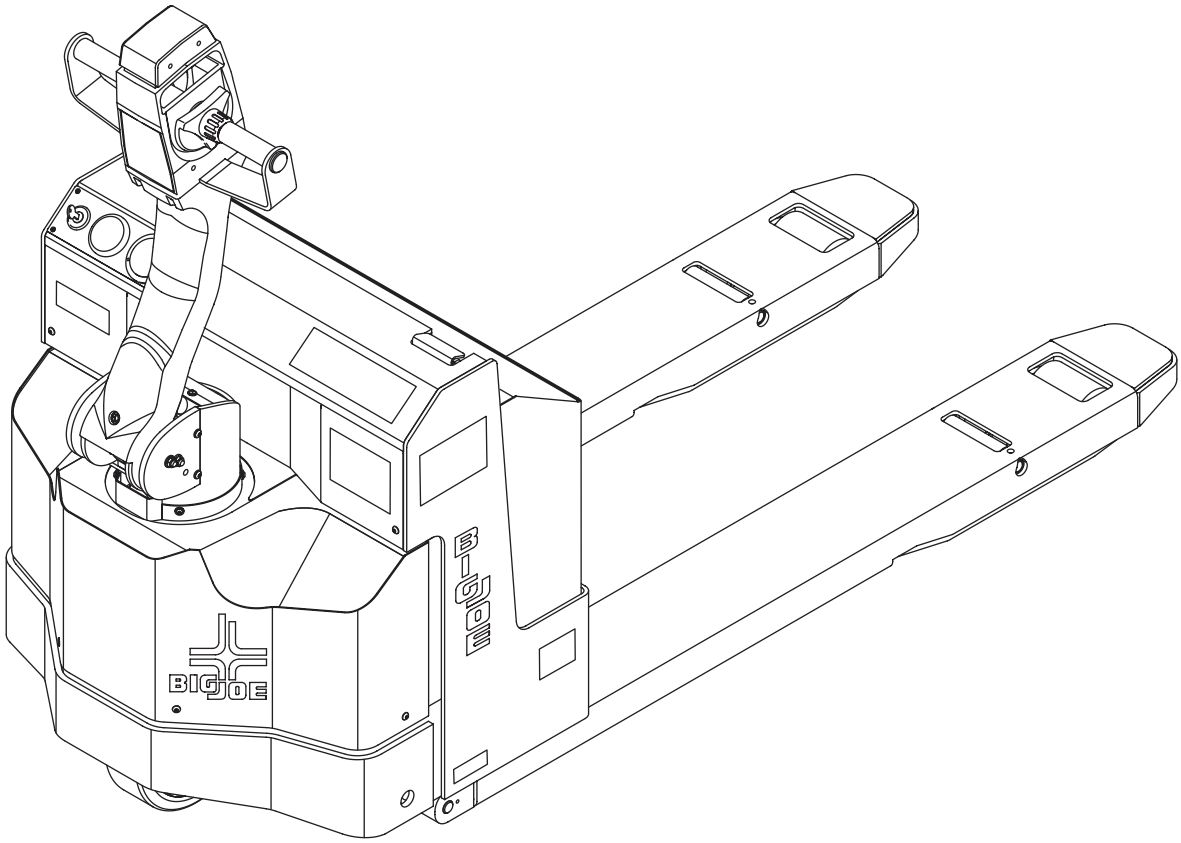


Figure 6-7. Controller Terminals

3. Connect the battery, turn on the keyswitch, move the accelerator in forward, and watch the voltmeter as you advance the accelerator. The voltmeter should read zero with the accelerator released, and should read full battery voltage with the accelerator at maximum, If it does not, the controller is bad and must be replaced. If the voltmeter readings are appropriate, release the accelerator, turn off the keyswitch, disconnect the battery, and reconnect the wire to the direction contactors.
4. The next step is to measure the current in the controller's M- lead. If you have a means of measuring this high dc current, such as a shut/meter setup or a clamp-on dc ammeter, use it. If not, we recommend that you buy an ammeter of the type that is simply held against the wire being tested. These are available for a low cost at auto parts stores. Though the accuracy of these meters is not great, they are adequate for this test.
5. Connect the battery, turn the key switch on, move the accelerator in either forward or reverse, and watch the ammeter while advancing the accelerator.
6. If you see no current flowing in the M- lead, the problem is an open circuit in the motor or the wiring between the motor and the controller. Test the following:
   a. Check the F/R switch.
   b. Verify the Reverse contactor. Check to see that the contactor is operating properly.
   c. Check the motor armature and field for opens.
7. If a high current flowing is noted in the M- lead but the motor does not run, the problem is either a short in the motor circuit, a miswired motor, or a short in the controller's internal plug diode. Test the plug diode as follows:
   a. Remove power by opening the battery circuit. Take the cable off the controller's A2 terminal (1, Figure 6-7).
   b. Use an ohmmeter to check the resistance between the controllers A2 (1) and B+ (2) terminals. You are testing the state of a diode inside the controller, so swap the two leads of the ohmmeter and look for a low resistance one way and a much higher one the other way. If your meter has a diode test function, use that setting.
   c. If you find the diode to be shorted, the controller is bad and needs to be replaced.
8. Put the A2 cable back on the controller.
9. If the plug diode is OK, there is a short in the motor circuit. An ordinary ohmmeter will not work to find the short, because the resistances of the motor windings are so low. Test the motor separately if it is suspected of having a shorted winding.
10. Verify all illustrated connections and components within the truck. See Chapter 4. If all check out and the source of the problem still has not been found, replace the controller.

NOTES:

Section 7
PARTS LIST



7-1. CONTROL HEAD ASSEMBLY

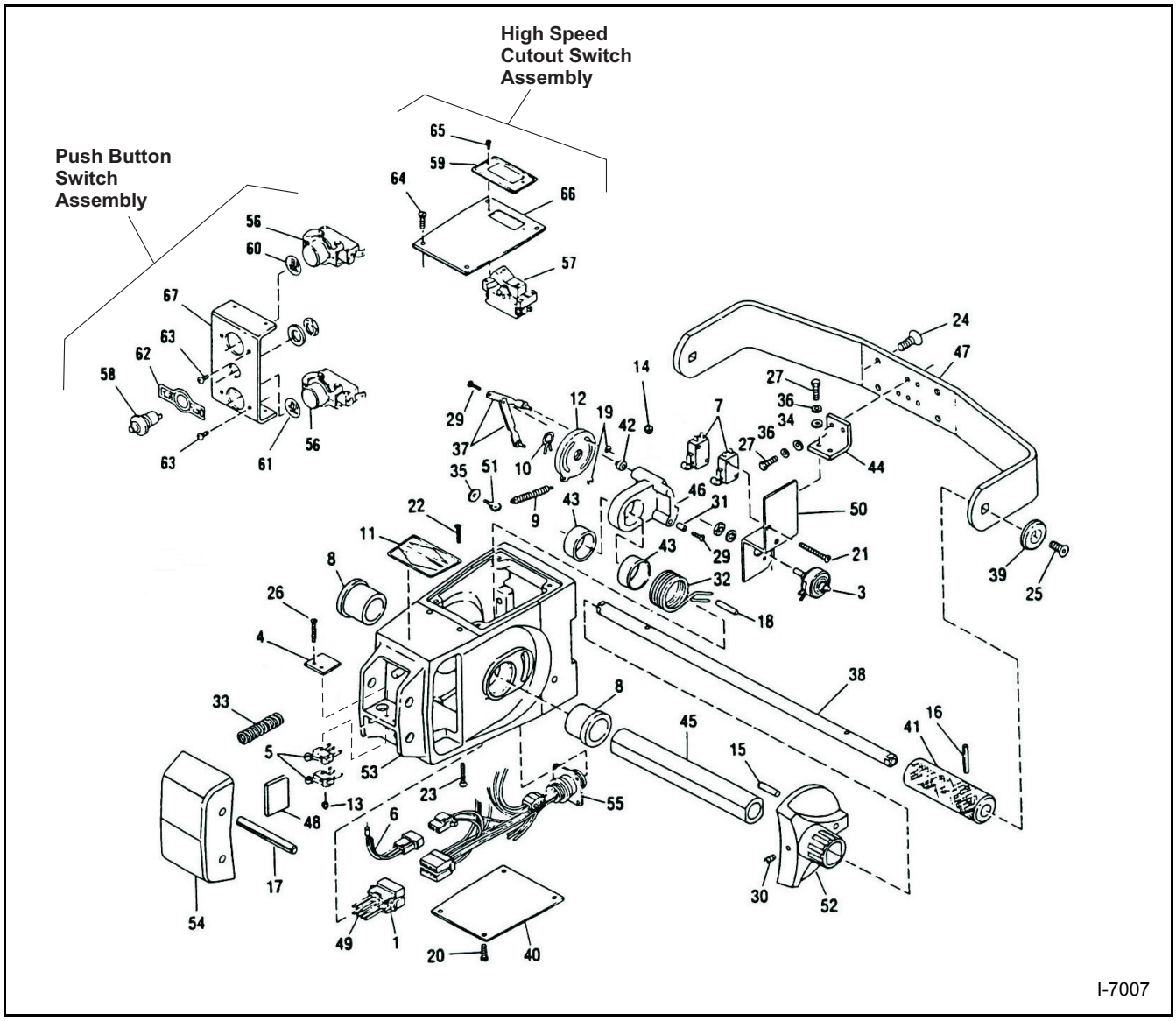


Figure 7-1. Control Head Assembly

INDEX NO.	PART NO.	PART NAME	NO. REQD.
-	506124-01	Control Head	
1	005652	Pin Housing	1
2	-	Not Used	
3	017580	Potentiometer	1
4	018202	Switch Insulator	1
5	020669	Micro Switch	2
6	505323	Wire Harness Assembly	1
7	020775	Micro Switch	2
8	052956	Flanged Bearing	2
9	053366	Return Spring	1
10	056131	Hose Clamp	1
11	056617	Forward-Reverse Decal	1
12	057262	Potentiometer Disk	1
13	059633	Hex Lock Nut, 2-56	2
14	059634	Hex Lock Nut, 4-40	2
15	060579	Dowel Pin, 1/4X15/16	2
16	060942	Roll Pin, 1/8X1-1/4	2
17	061016	Roll Pin,1/4X3	2
18	061200-01	Spirol Pin, 3/16X1	1
19	061750	"E" Retainer Ring	2
20	067416	Pan HD. Screw, 6-32X1/2	4
21	068180	Round HD. Screw, 4-40X1-1/2	2
22	069462	Flat HD. Slotted Screw, 6-32X3/4	2
23	069463	Flat HD. Slotted Screw, 6-32X1	2
24	069478	Phillips Flat HD. Screw, 1/4-20X3/4	4
25	069715	Socket Flat HD. Hex Screw, 1/4-20X3/4	2
26	070486	Pan HD. Screw, Brass	2
27	072400-01	Slotted Hex Screw, 6-32X1/2	4
28	-	Not Used	
29	072415	Pan HD. Screw, Thread Cutting, 4-40X5/8	2
30	073461	Socket Set Screw	2
31	074711	Connection Rod Spacer	1
32	075088	Return Spring	1
33	075510	Compression Spring	2
34	077007	Washer	5

7-1. CONTROL HEAD ASSEMBLY *(CONTINUED)*

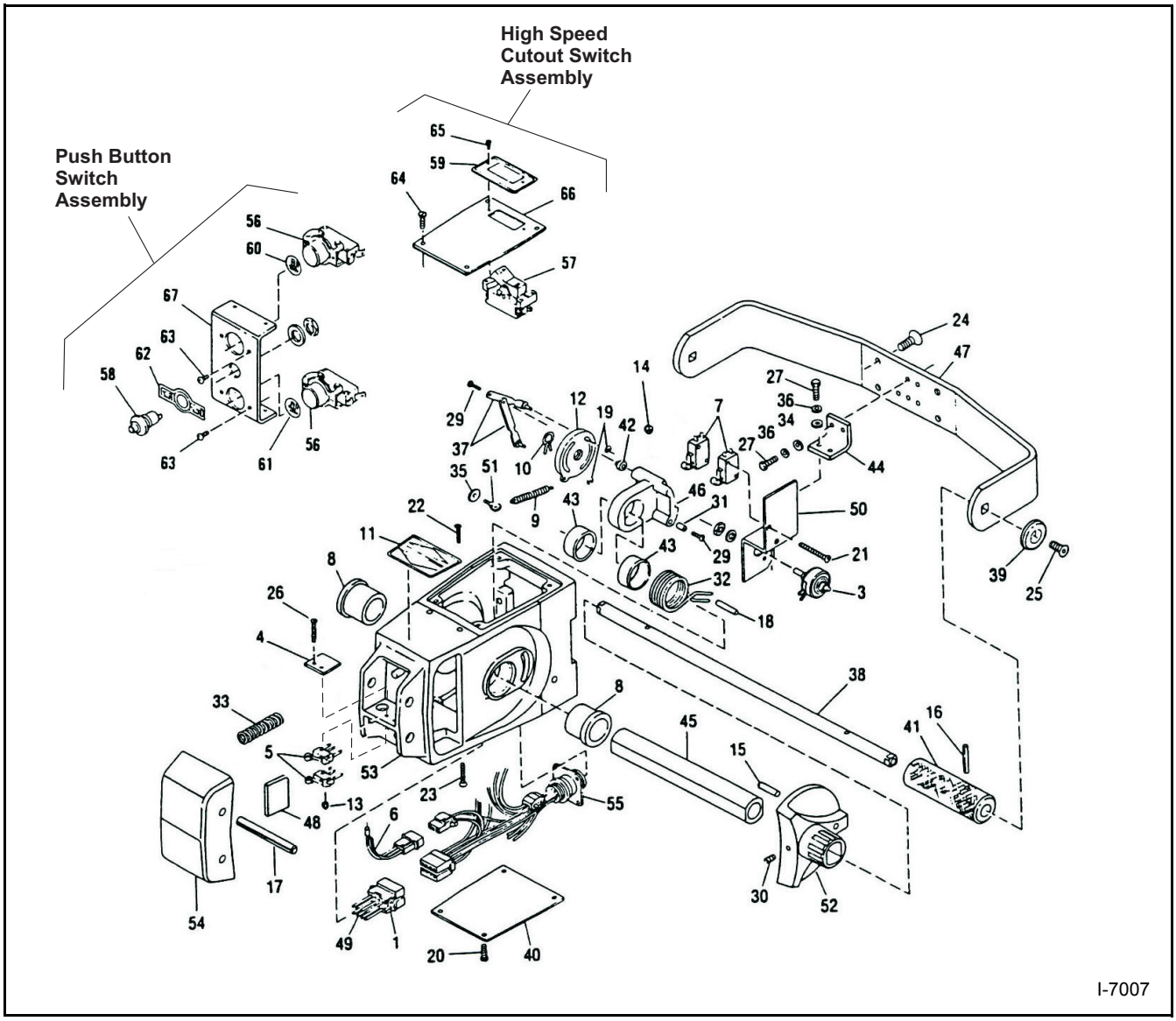


Figure 7-1. Control Head Assembly

INDEX NO.	PART NO.	PART NAME	NO. REQD.
35	-	Not Used	
36	077204	Split Lock Washer #6	4
37	400546	Connector Rod Assembly	2
38	402827	Shaft	1
39	402828	Cap	2
40	402830	Bottom Cover	1
41	404421	Tube	2
42	074724	Spacer	1
43	402836	Spacer	2
44	402837	Bracket	1
45	402839	Tube	1
46	402840	Cam	1
47	402841	Handle Guard	1
48	402843	Pad	2
49	504538-01	Wire Assembly	5
50	505052	Switch Bracket Assembly	1
51	066052	Thumb Screw, 6-32	1
52	800272	Control Lever	2
53	800273	Control Handle	1
54	800274	Safety Cover	1
55	023201	Wire Harness Assembly	1
56	020697	Pushbutton Switch	2
57	020699	Cutout Switch, High Speed	1
58	020776	Horn Pushbutton Switch	1
59	056618	High Speed Decal	1
60	056641-03	Lift Decal	1
61	056641-04	Lower Decal	1
62	056624	Horn Decal	1
63	067415	Pan HD. Screw, 6-32X1/4	4
64	067416	Pan HD. Screw, 6-32X1/2	4
65	068190	Phillips Pan HD. Screw	2
66	402833	Top Cover	1
67	402842	Switch Plate	1

7-2. STEERING ARM

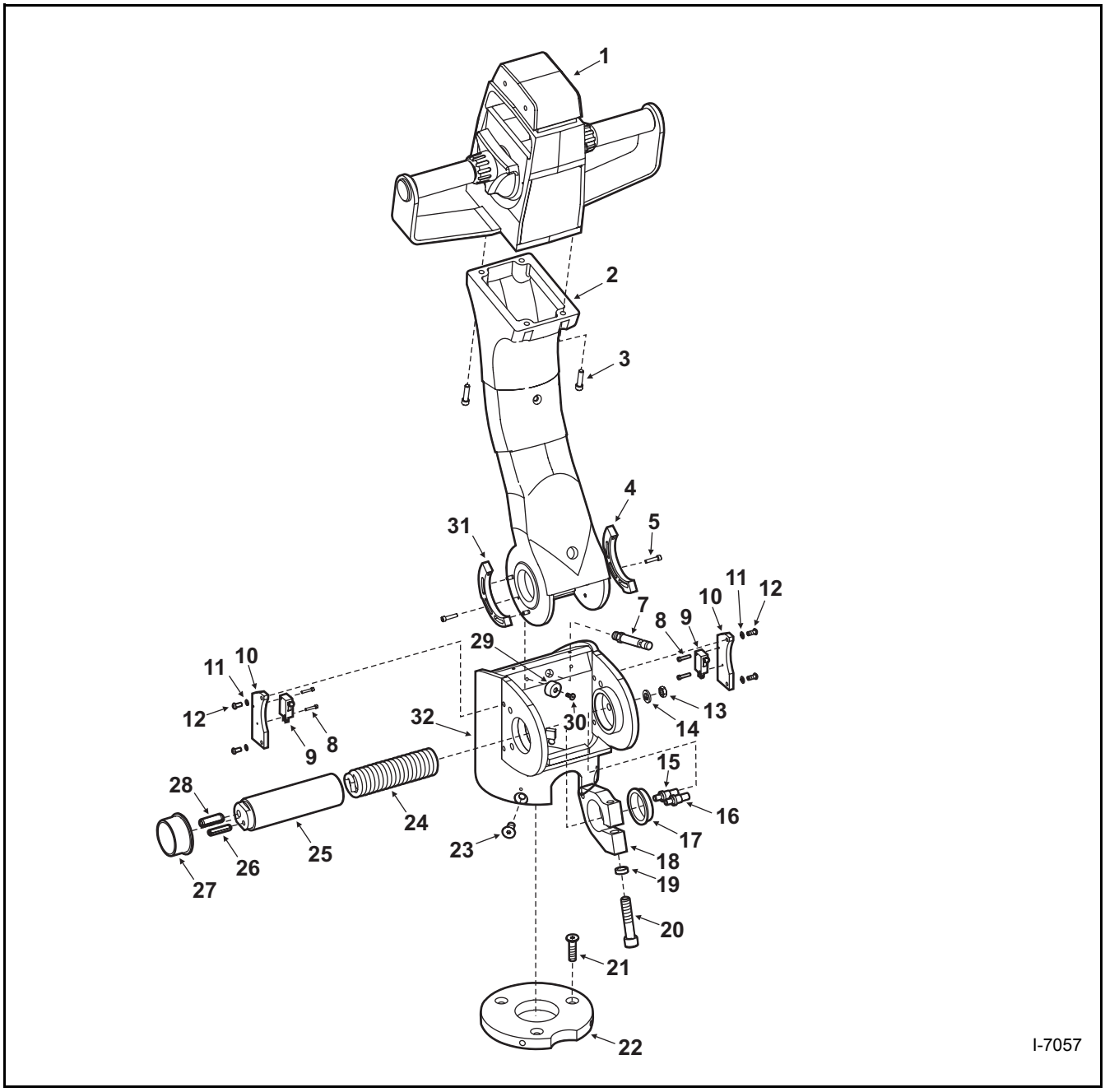


Figure 7-2. Steering Arm Assembly

Item No	Qty.	Part No.	Description
1	1	506124-01	Control Head
2	1	800310	Steering Arm
3	4	065481	Screw, Cap, Socket Head
4	1	404196	Cam, Deadman Switch
5	-	-	Not used
6	4	065530	Screw, Cap, Button Head, Nylok
7	1	074451	Shock Absorber
8	4	065472	Screw, Cap, Socket Head
9	2	020775	Switch, Micro
10	2	404210	Plate, Mounting, Micro Switch
11	4	077209	Washer, Lock
12	4	065525	Screw, Cap, Button Head, Nylok
13	2	059426	Nut, Plain Hex
14	2	077210	Washer, Lock
15	1	285302	Pin, Spring
16	1	285303	Pin, Spring
17	1	052922	Bushing, Flange, Bronze
18	1	800204	Clamp, Tube
19	1	401127	Spacer
20	1	065569	Screw, Cap, Socket Head
21	3	067435-01	Screw, Hex Head, Countersunk, Metric
22	1	404189	Mounting Plate, Motor
23	4	069717	Screw, Hex Head, Countersunk
24	1	075060	Spring, Return
25	1	501371	Tube, Spring
26	1	061006	Pin, Roll, ¼ x 1 ¼
27	1	052925	Bushing, Flange, Bronze
28	1	061050	Pin, Roll, 3/8 x 1 ¼
29	2	053042	Bumper, Round
30	2	071377	Screw, Truss Head
31	1	404197	Cam, Creep Speed
32	1	506139	Adapter

7-3. POWER SECTION PARTS

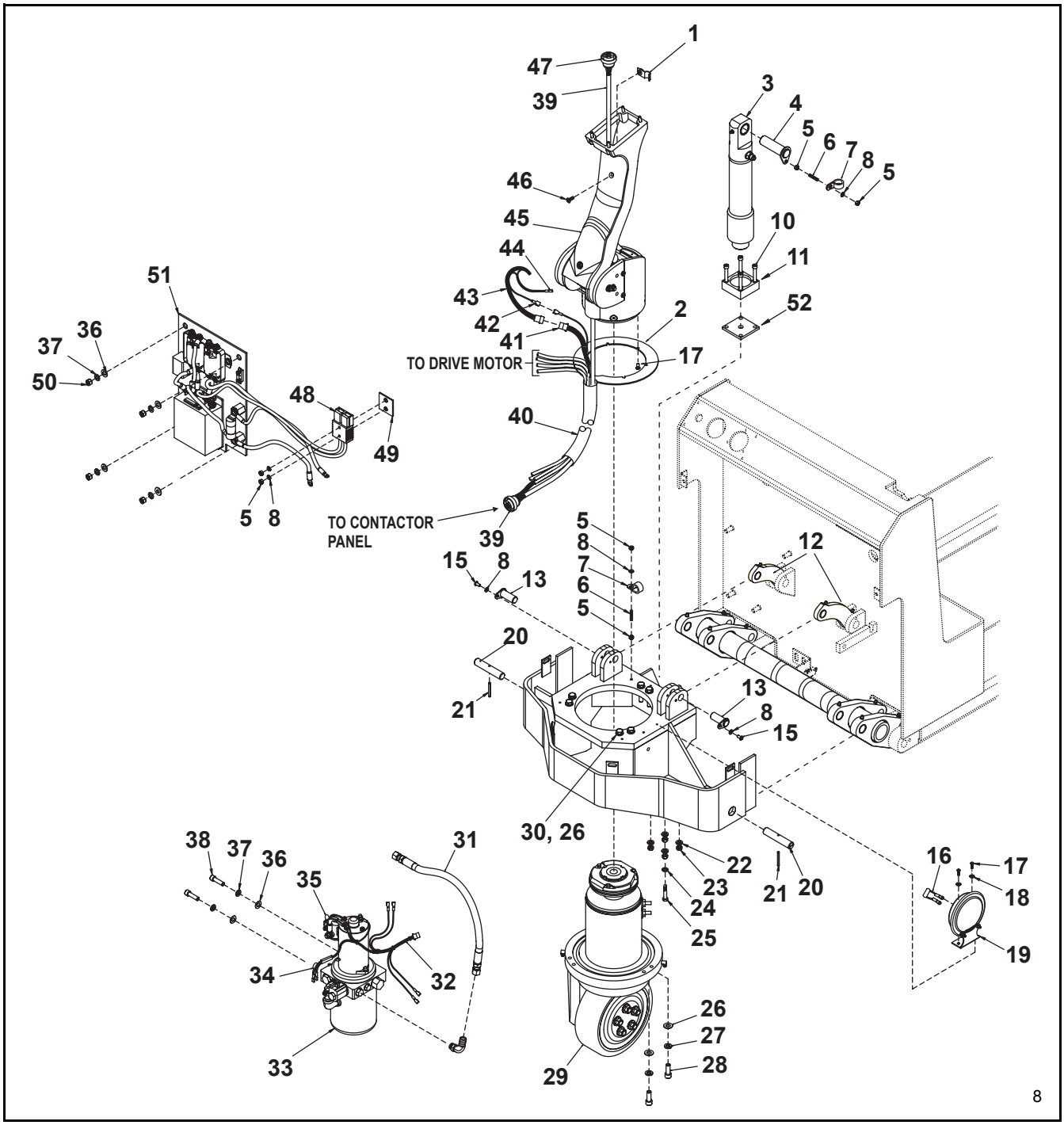


Figure 7-3. Power Section Parts

Item No	Qty.	Part No.	Description
1	1	504364	Clamp Assembly, Clinch Nut
2	1	404220	Ring Guard
3	1	506146	Hydraulic Cylinder
4	1	506142	Pin - Keeper
5	8	059421	Nut - Hex, ¼-20 UNC
6	2	075620	Stud, Threaded ¼-20 x 1¼ Lg
7	2	056135	Clamp - Cable, Cushioned
8	7	077209	Washer - Lock, ¼
9	--		Not Used
10	4	065557	Screw-SHCS, 5/16-24 UNF x 1¾ Long
11	1	404178	Bar - Cylinder, Mount
12	2	506141	Link Assembly
13	4	506137	Pin - Keeper
14	--		Not Used
15	4	065476	Screw-HHCS, ¼-20 UNC x 1/2 Long
16	1	504096	Suppressor Assembly - Spike, Horn
17	8	065531	Screw-BHCS, #10-32 UNC x ½ Long
18	2	077207	Washer - Lock, #10
19	1	009602	Horn
20	2	403977	Shaft, Pivot
21	2	061200-04	Spring, Pin - Slotted, .19 x 1 ¾ Long
22	4	077210	Washer - Lock, 5/16"
23	4	059427	Nut - Hex, 5/16-24 UNC
24	1	077031	Washer - Flat, ¼
25	1	063483	Screw - HHCS, ¼-20 x 1 ¾ Lg
26	8	077212	Washer - Lock, 7/16
27	2	077087	Washer, Flat, 13/32 I.D.
28	2	067445-01	Screw, SHCS, M 10 x 20 mm Lg
29	1	506150	Power Drive Wheel, Transmission & Motor
30	6	067443-01	Bolt - HHCS, M10 x 50 mm Long

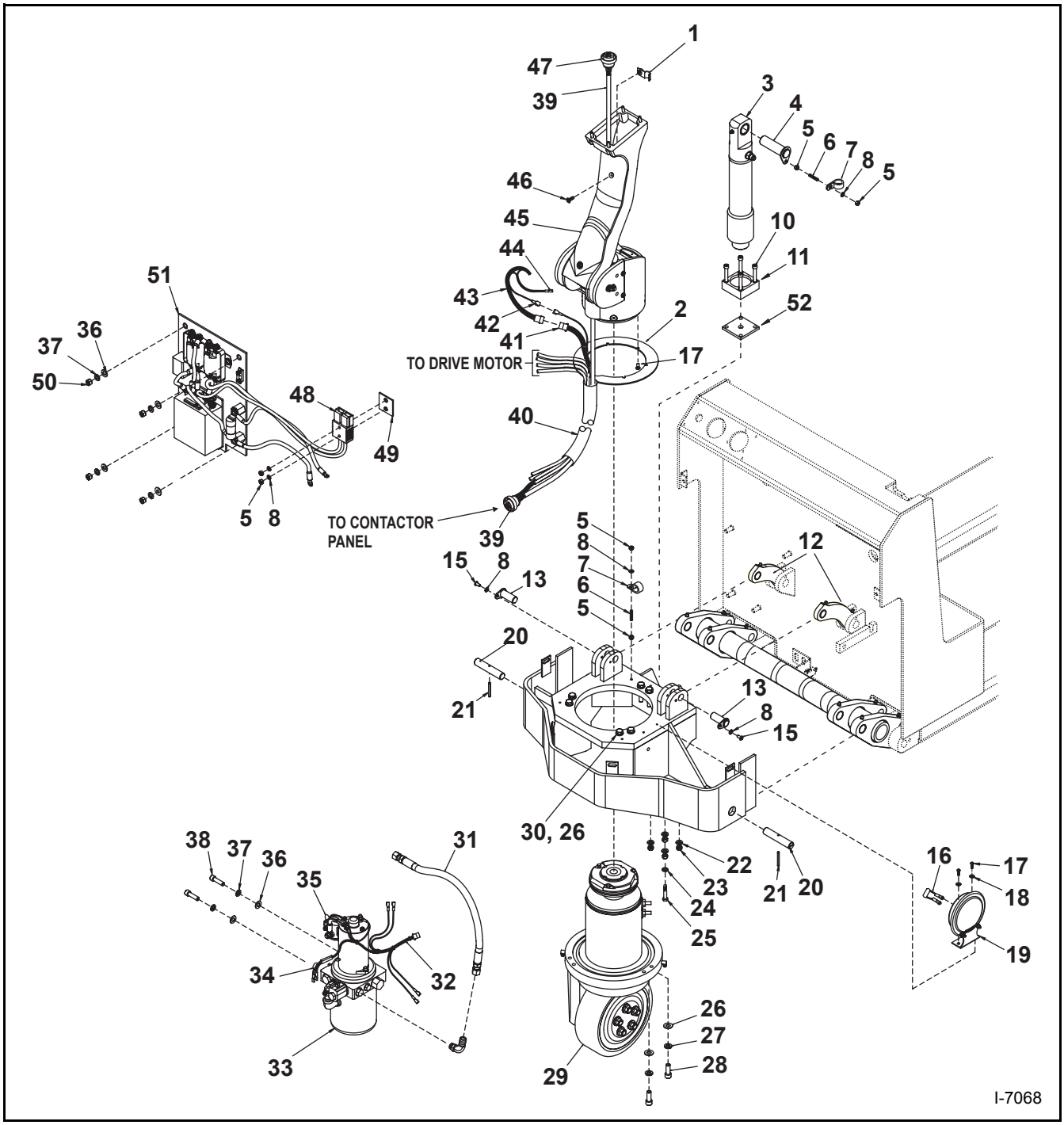


Figure 7-3. Power Section Parts

Item No	Qty.	Part No.	Description
31	1	504312-15	Hose Assembly - 3/8
32	1	023270	Wire Harness Assembly, Hydraulic
33	1	016618	Pump, Motor & Reservoir Assembly - 24 V
34	1	504116	Suppressor Assembly - Spike, Lower Solenoid
35	1	504097	Suppressor Assembly - Spike, Motor Solenoid
36	6	077056	Washer - Flat, 3/8
37	6	077211	Washer - Lock, 3/8"
38	2	064605	Screw-HHCS, 3/8-16 UNC, 1" Long
39	1	023266	Cable Assembly, Control
40	1	901451	Oversleeve - Cable, Braided
41	1	023272	Wire Harness Assembly - Brake, Switches
42	1	021257	Terminal, Tab, Male, ¼, Insulated
43	1	023273	Wire Harness Assembly - Switches
44	1	021249	Terminal, Tab, Female, 3/16
45	1	506138	Arm Assembly
46	1	069478	Screw - PFH, ¼-20 x ¾ Long
47	1	005640	Connector, Circular
48	1	005401	Connector, Battery
49	1	404225	Spacer - Connector
50	4	059429	Nut - Hex, 3/8-16 UNC
51	1	506143	Panel Assembly - Elec, PPT
52	1	404416	Mount, Cylinder Shim

7-4. TRANSMISSION, MOTOR AND BRAKE ASSEMBLY

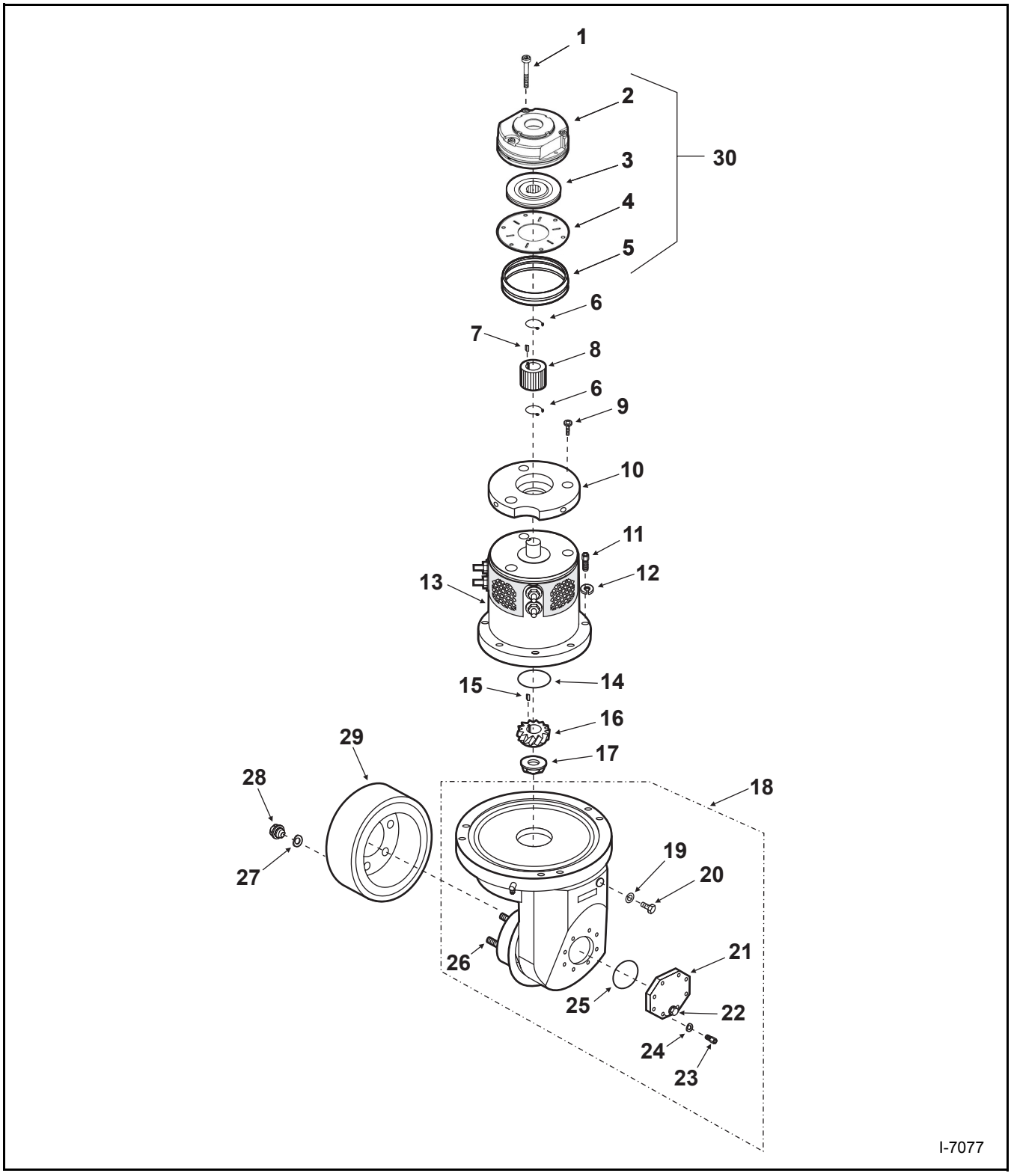


Figure 7-4. Transmission, Motor and Brake Assembly

Item No	Qty.	Part No.	Description
1	1	901700	Screws (Set of 3), Brake Assembly Mounting
2*	1	901701	Stator, Brake
3*	1	901702	Rotor, Aluminum
4*	1	901703	Plate, Friction
5*	1	901704	Cover, Brake
6	2	901705	Clip, Spring
7	1	901706	Woodruff Key
8	1	901707	Gear, Splined
9	3	067435-01	Screw, Allen Head, Countersunk, Metric, M8 x 1.25 x 35 Lg
10	1	404189	Motor End Plate
11	8	901708	Screw-Hex Socket, FL HD, M8 x 35 mm Long
12	1	901745	Washer, Lock, 8 mm ID
13	1	016051	Motor
14	1	901709	O-ring
15	1	901710	Woodruff Key
16	1	901711	Gear, Spiral
17	1	901712	Nut,
18	1	506151	Transmission Assembly, ** includes 19, 20, 21, 22, 23, 24, 25 & 26
19**	1	901747	Seal Ring, Oil Drain
20**	1	901713	Oil Filler Plug
21**	1	901714	Plate, Transmission Service Cover
22**	1	901715	Oil Drain Plug
23**	8	901716	Screw, Hex Head
24**	8	901717	Washer,
25**	1	901718	O-ring
26**	5	901747	Studs, Wheel
27	5	901720	Washer,
28	5	901721	Lug Nut
29	1	506161-01	Wheel Assembly
30	1	901745	Brake Assembly, * includes 2,3,4 & 5

* included in Reference #30, Brake Assembly

** included in Reference #18, Transmission Assembly

7-5. DRIVE MOTOR REPAIR PARTS

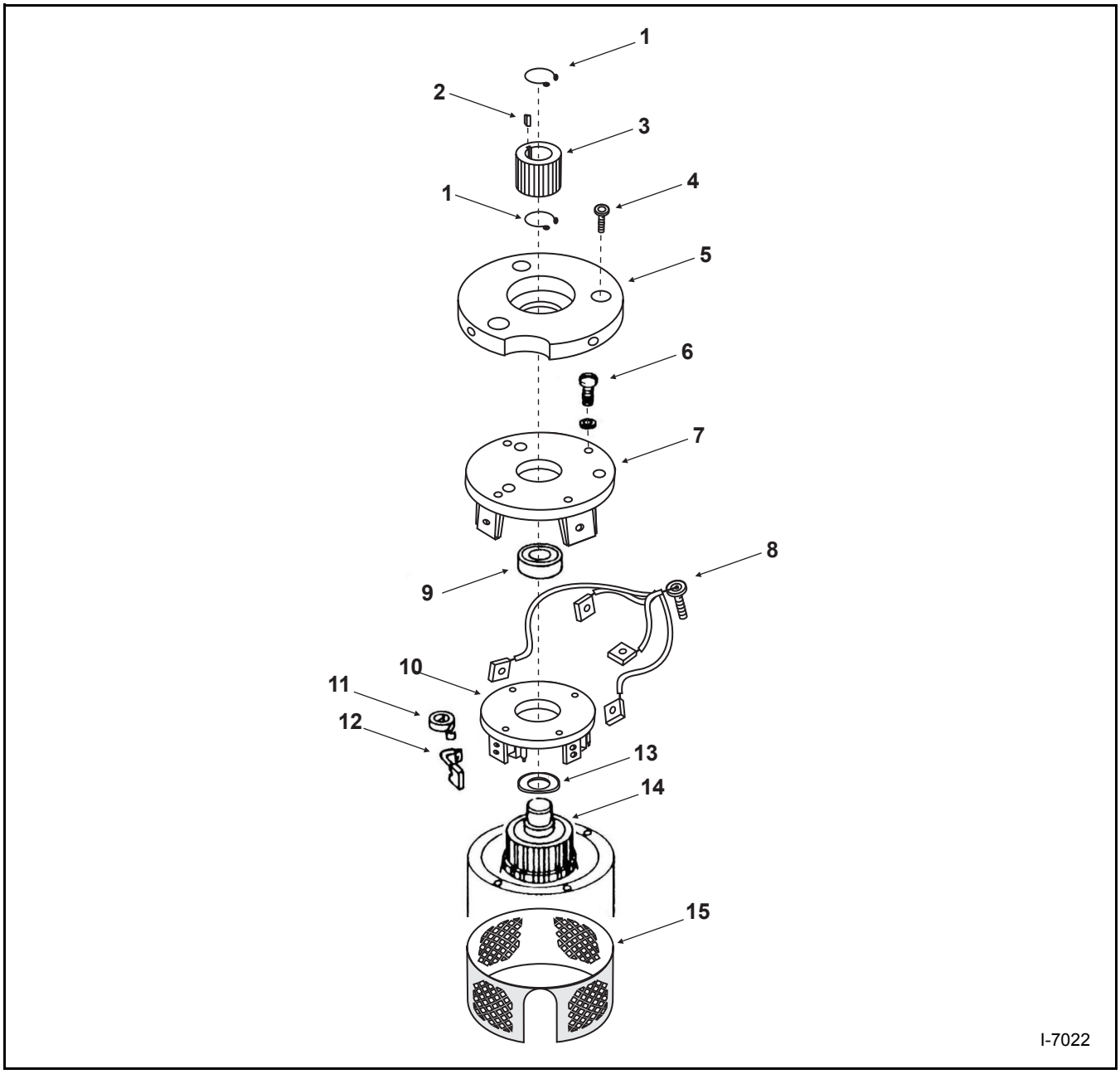


Figure 7-5. Drive Motor Repair Parts

Item No	Qty.	Part No.	Description
-	1	016051	Motor, Drive
1	2	901722	Clip, Spring
2	1	901723	Woodruff Key
3	1	901724	Gear, Splined
4	3	067435-01	Allen Head Countersunk Screw, Metric
5	1	404189	Motor, End Plate
6	4	901725	Bolt, Hex Head,
7	1	901726	Head, Commutator End
8	1	901727	Brush Lead and Terminal Connector
9	1	901728	Bearing, Commutator End
10	1	901729	Brush Box Assembly
11	1	901730	Spring, Brush (Set of four)
12	1	901731	Brush (Set of four)
13	1	901732	Washer, Spring
14	1	901733	Armature Assembly
15	1	901734	Headband Assembly

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7-6. BASE AND FRAME PARTS

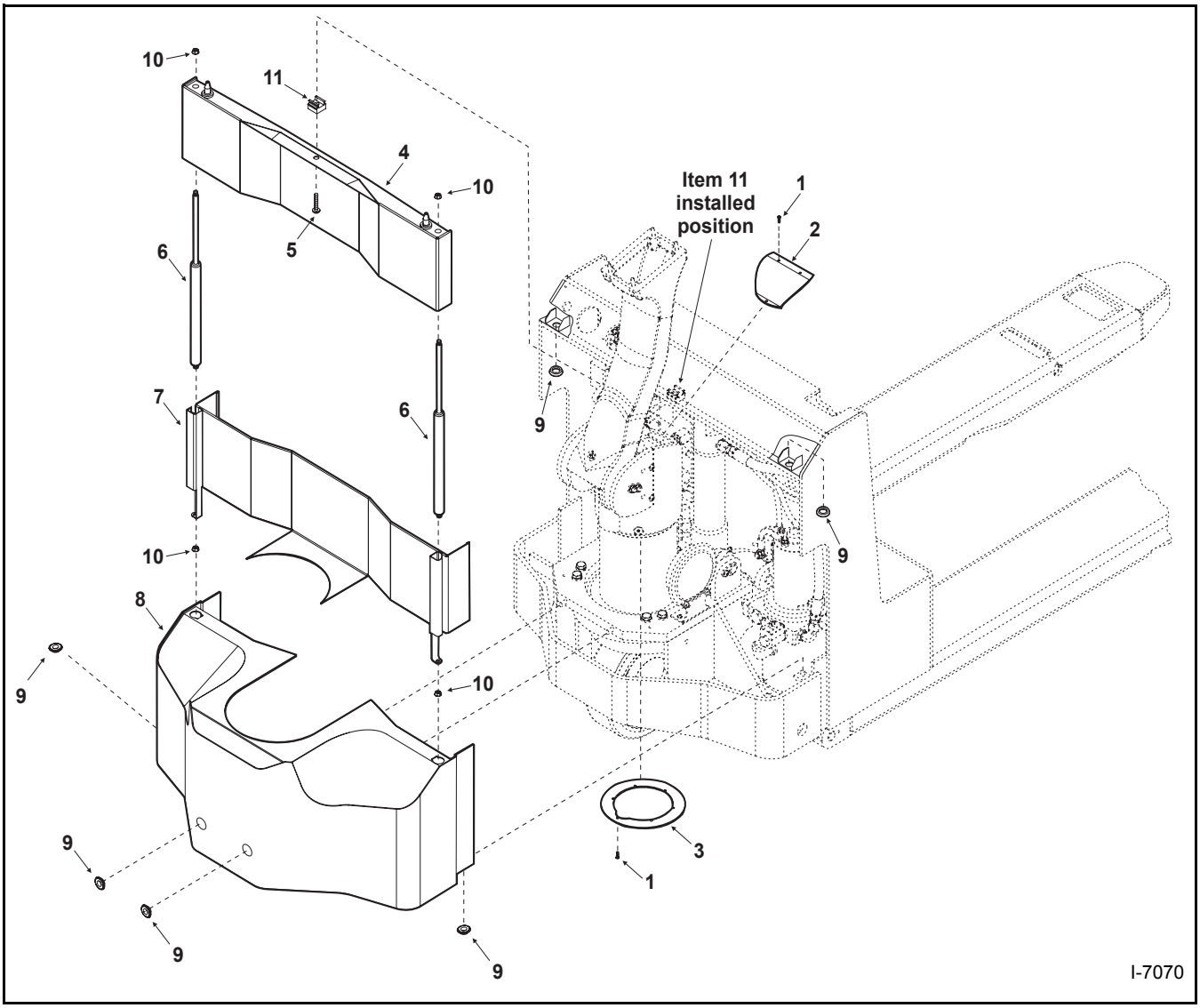

Figure 7-6. Base Frame and Parts

Item No	Qty.	Part No.	Description
1	9	065531	Screw-BHCS, #10-32 UNC x ½ Long
2	1	404221	Cover, Brake
3	1	404220	Ring, Guard
4	1	506163	Upper Cover Weldment
5	1	065527	Screw, ¼ 20 UNC x 1"
6	2	075094	Gas Spring
7	1	506164	Middle Cover Weldment
8	1	506165	Lower Cover Weldment
9	6	057520	Grommet, Snap, ½ OD x 1.12 ID
10	4	059642-02	Nut, Serrated, Flanged, 6mm
11	1	059940-01	Nut, Retainer, ¼-20

7-7. FORK SECTION PARTS

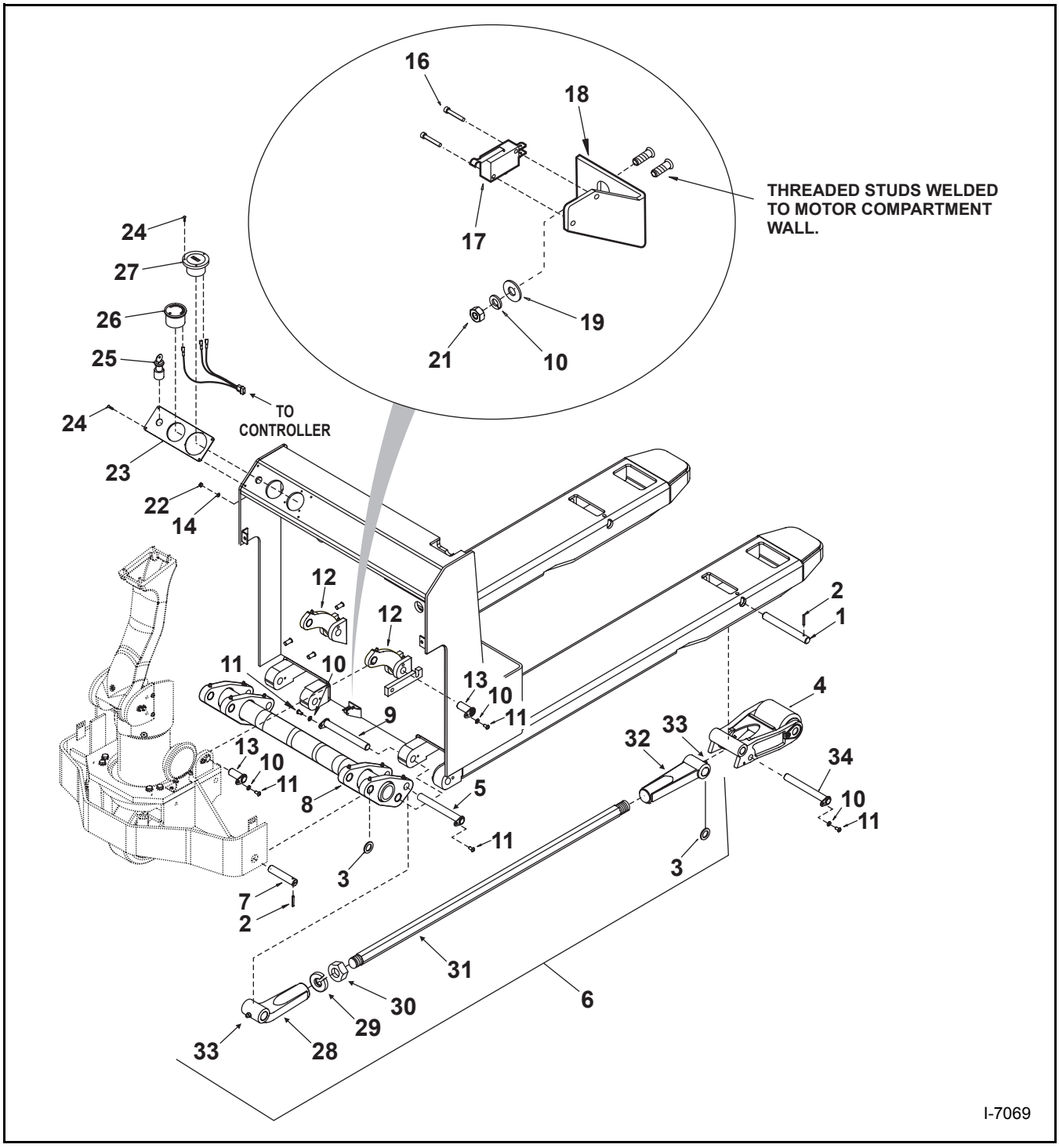

Figure 7-7. Fork Section Parts

Item No	Qty.	Part No.	Description
1	2	403980	Shaft - Pivot
2	4	061200-03	Spring, Pin - Slotted, .19 x 1¼ Long
3	A/R	077036	Washer - shim, 1.25 OD x .766 ID
4	2	506129	Load Wheel and Housing Assembly
5	2	506213	Pin, Keeper
6	2	506216-01 506216-02 506216-03	Pull Rod, 48" Fork Pull Rod, 42" Fork Pull Rod, 36" Fork
7	2	404183	Shaft - Pivot
8	1	506217	Torsion Tube
9	2	506126	Pin - Keeper
10	8	077209	Washer, Lock, ¼"
11	6	065476	Screw-HHCS, ¼-20 UNC x 1/2 Long
12	2	055204	Assembly, Link, Machined
13	4	506137	Pin - Keeper
14	4	077204	Washer - Lock, #6
15	--	--	Not Used
16	2	065472	Screw-SHCS, #4-40 UNC x ¾ Long
17	1	020801	Switch - Miniature, Snap Action
18	1	404239	Bracket - Switch
19	2	077031	Washer - Flat, ¼
20	--	--	Not Used
21	2	059421	Nut - Hex, ¼-20 UNC
22	4	059412	Nut - Hex, #6-32 UNC
23	1	404198-01	Plate - Cover, Gage
24	7	068233	Screw - SRH, #6-32 x ¾ Long
25	1	020725	Key switch
26	1	010617-02	Battery Capacity Indicator - 24V
27	1	015604	Hour Meter - 24V
28	2	055200	Rod End, Torsion Tube End
29	2	077221	Lock Washer, 7/8"
30	2	059540	Nut, Jamb, 7/8-14 UNF, LH Thread
31	2	404266 404266-01 404266-02	Pull Rod, 48" Fork Pull Rod, 42" Fork Pull Rod, 36" Fork
32	2	055202	Rod End, Load Wheel End
33	2	025716	Grease Fitting, Straight, ¼-28 NPT
34	2	506147	Pin, Keeper

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7-8. HYDRAULIC CYLINDER PARTS

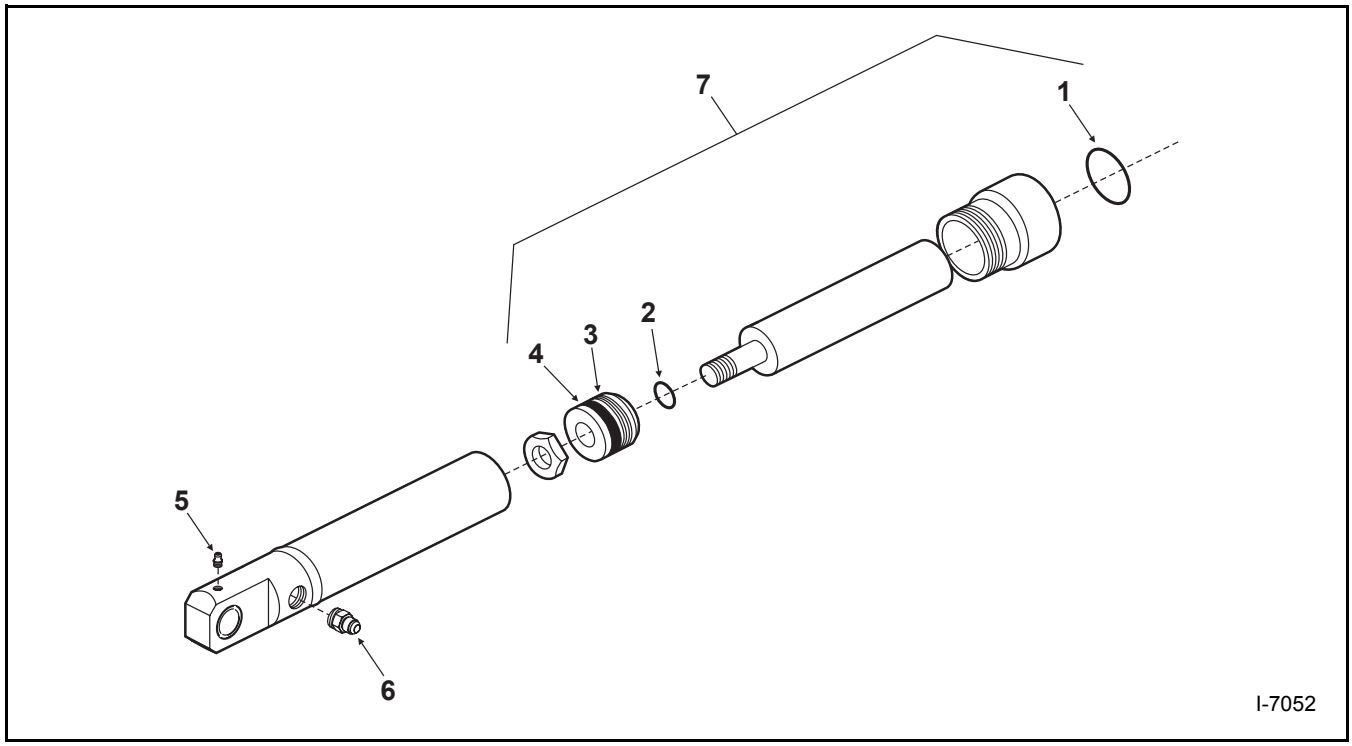


Figure 7-8. Hydraulic Cylinder Parts

Item No	Qty.	Part No.	Description
--	1	506154	Hydraulic Cylinder Assembly
1*	1	901735	O-ring
2*	1	901736	O-ring
3*	1	901737	Seal,
4*	1	901738	Seal,
5	1	025716	Grease Fitting, Straight, ¼-28 NPT
6	1	026922	Fitting, Hydraulic, 9/16-18 SAE, 9/16-18 JIC
7	1	901739	Packing Kit, includes *1, 2, 3 & 4

*Included in Reverence # 7, Packing Kit

7-9. HYDRAULIC PUMP, MOTOR, AND RESERVOIR PARTS

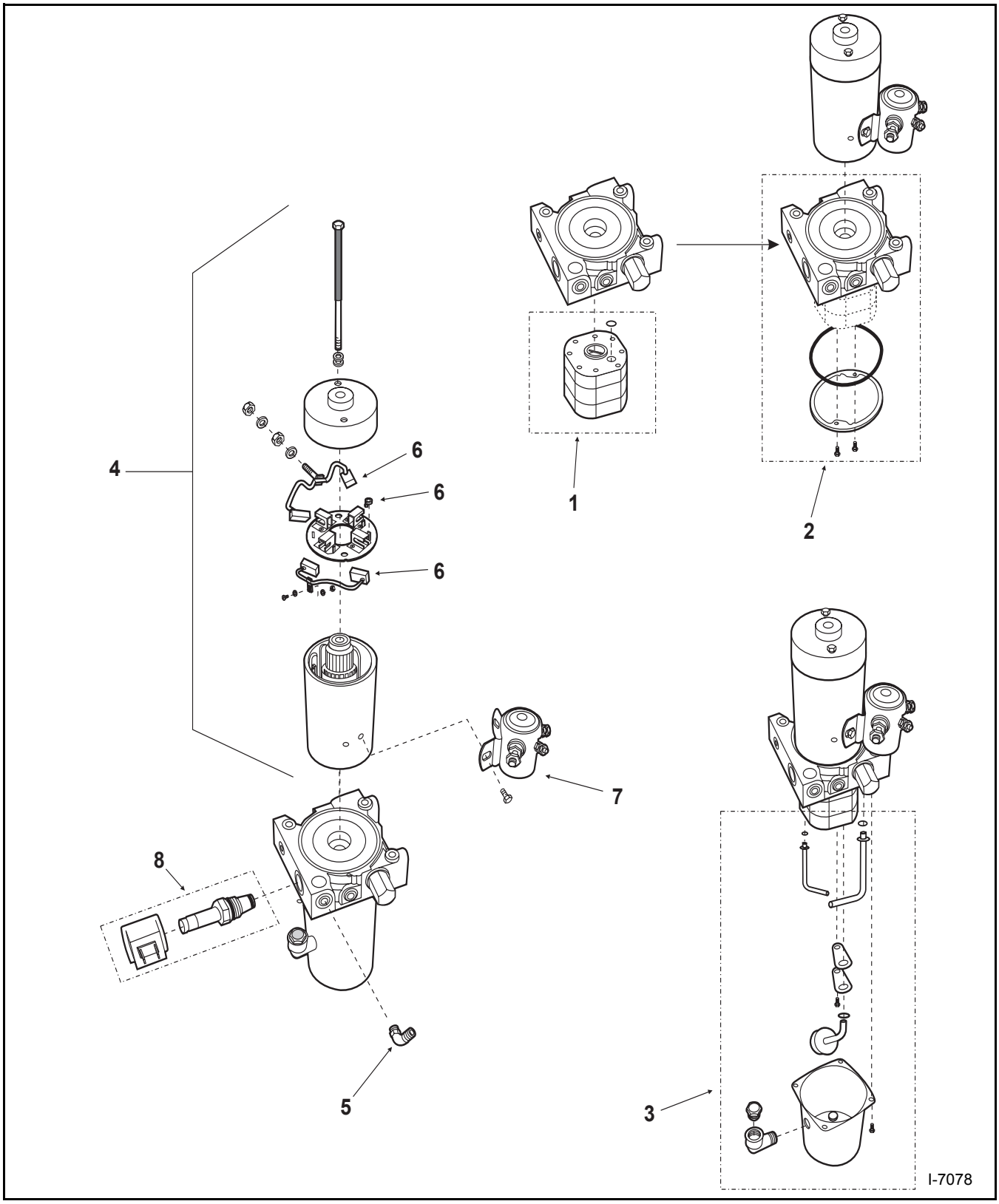


Figure 7-9. Hydraulic Pump, Motor and Reservoir Assembly Parts

Index No.	Qty	PartNo.	Part Name
	1	016618	Pump/Motor Assembly
1	1	901750	Pump Kit
2	1	901751	Adaptor Kit, includes 2 steel plugs, tube retainer, adapter, check valve, two screws for retaining ring and reservoir O-ring. Does not include Pump Kit, Item #1.
3	1	901752	Reservoir Kit, includes tubes, strainer, elbow, vent plug, magnet, retaining rings and washers and screws.
4	1	901753	Motor Assembly
5	1	025535	Elbow, 9/16
6	1	901754	Brush and Spring Set
7	1	020715	Solenoid, Motor Starter
8	1	048133	Solenoid, Release Valve

7-10. MAINTENANCE FREE BATTERY PACK (FOUR 6V) WITH 120 VAC CHARGER

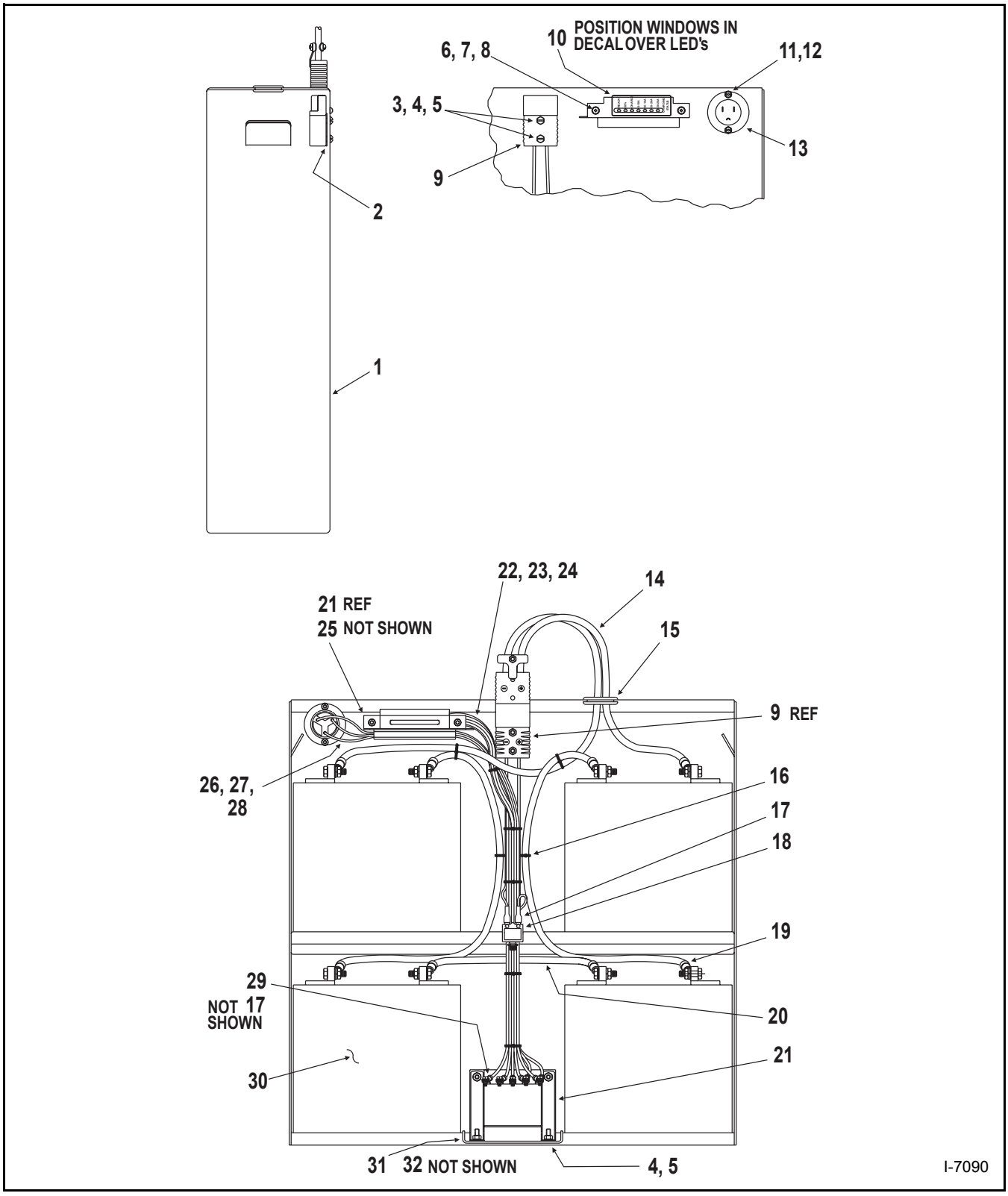


Figure 7-10. Battery Pack and 120 VAC Charger Installation - Four 6 Volt Maintenance Free

Item No	Qty.	Part No.	Description
1	1	404305	Housing, Battery
2	1	403688	Spacer, Connector
3	2	068478	Screw, SLRH, ¼-20 x 1 ¼ Lg
4	6	077209	Washer, Lock, Split, ¼
5	6	059421	Nut, Hex, ¼-20
6	2	071376	Screw, PHTH, 10-32 x ½ Lg
7	2	077208	Washer, Lock, Split, #10
8	2	059416	Nut, Hex, #10-32
9	1	506122	Connector Assembly, Charger
10	1	056680	Decal, Charger
11	2	077204	Washer, Lock, Split #6
12	2	059412	Nut, Hex, #6-32
13	1	005454	Connector, Inlet, Flanged, AC, 120 VAC
14	1	505466-02	Connector Assembly, Battery
15	1	057511	Grommet
16	8	056113	Tie, Harness
17	4	021718	Terminal, ¼ Spade, 16 AWG
18	1	003403	Circuit Breaker
19	2	504150-31	Cable Assembly, 4 AWG
20	1	504150-32	Cable Assembly, 4 AWG
21	1	004987	Charger Kit, 24V, 25A, 120 VAC
22	A/R	023010	Wire, Stranded, 10 AWG, Red
23	A/R	023011	Wire, Stranded, 10 AWG, Black
24	A/R	023036	Wire, Stranded, 10 AWG, White
25	5	005471	Connector, Splice, Crimp, 10 AWG
26	A/R	023000	Wire, Stranded, 16 AWG, Red
27	A/R	023004	Wire, Stranded, 16 AWG, Green
28	A/R	023018	Wire, Stranded, 16 AWG, Black
29	7	021262	Terminal, Ring, 10 AWG
30	4	003221	Battery, 6V, GMF
31	1	404306	Retainer, Battery
32	1	021206	Terminal, Ring, ¼" Dia

7-11. MAINTENANCE FREE BATTERY PACK (FOUR 6V) WITH 230 VAC CHARGER

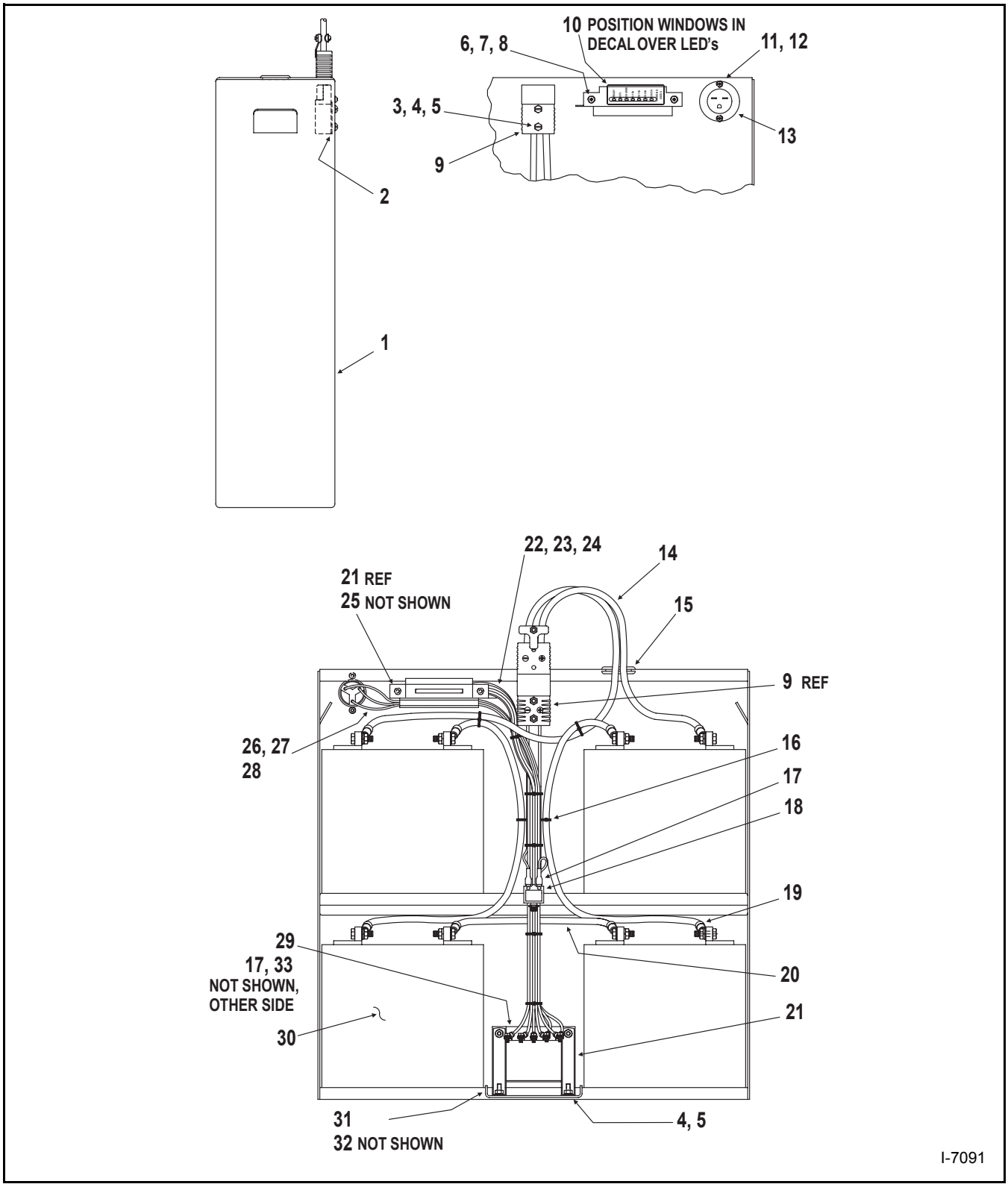


Figure 7-11. Battery Pack and 230 VAC Charger Installation - Four 6 Volt Maintenance Free

Item No	Qty.	Part No.	Description
1	1	404305	Housing, Battery
2	1	403688	Spacer, Connector
3	2	068478	Screw, SLRH, ¼-20 x 1 ¼ Lg
4	6	077209	Washer, Lock, Split, ¼
5	6	059421	Nut, Hex, ¼-20
6	2	071376	Screw, PHTH, 10-32 x ½ Lg
7	2	077208	Washer, Lock, Split, #10
8	2	059416	Nut, Hex, #10-32
9	1	506122	Connector Assembly, Charger
10	1	056680	Decal, Charger
11	2	077204	Washer, Lock, Split #6
12	2	059412	Nut, Hex, #6-32
13	1	005455	Connector, Inlet, Flanged, AC, 230 VAC
14	1	505466-02	Connector Assembly, Battery
15	1	057511	Grommet
16	8	056113	Tie, Harness
17	4	021718	Terminal, ¼ Spade, 16 AWG
18	1	003403	Circuit Breaker
19	2	504150-31	Cable Assembly, 4 AWG
20	1	504150-32	Cable Assembly, 4 AWG
21	1	004989	Charger Kit, 24V, 25A, 230 VAC
22	A/R	023010	Wire, Stranded, 10 AWG, Red
23	A/R	023011	Wire, Stranded, 10 AWG, Black
24	A/R	023036	Wire, Stranded, 10 AWG, White
25	5	005471	Connector, Splice, Crimp, 10 AWG
26	A/R	023000	Wire, Stranded, 16 AWG, Red
27	A/R	023004	Wire, Stranded, 16 AWG, Green
28	A/R	023018	Wire, Stranded, 16 AWG, Black
29	7	021262	Terminal, Ring, 10 AWG
30	4	003221	Battery, 6V, GMF
31	1	404306	Retainer, Battery
32	1	021206	Terminal, Ring, ¼" Dia
33	1	023267-03	Wire Assembly, Jumper

7-12. FLOODED CELL BATTERY PACK (FOUR 6V) WITH 120 VAC CHARGER

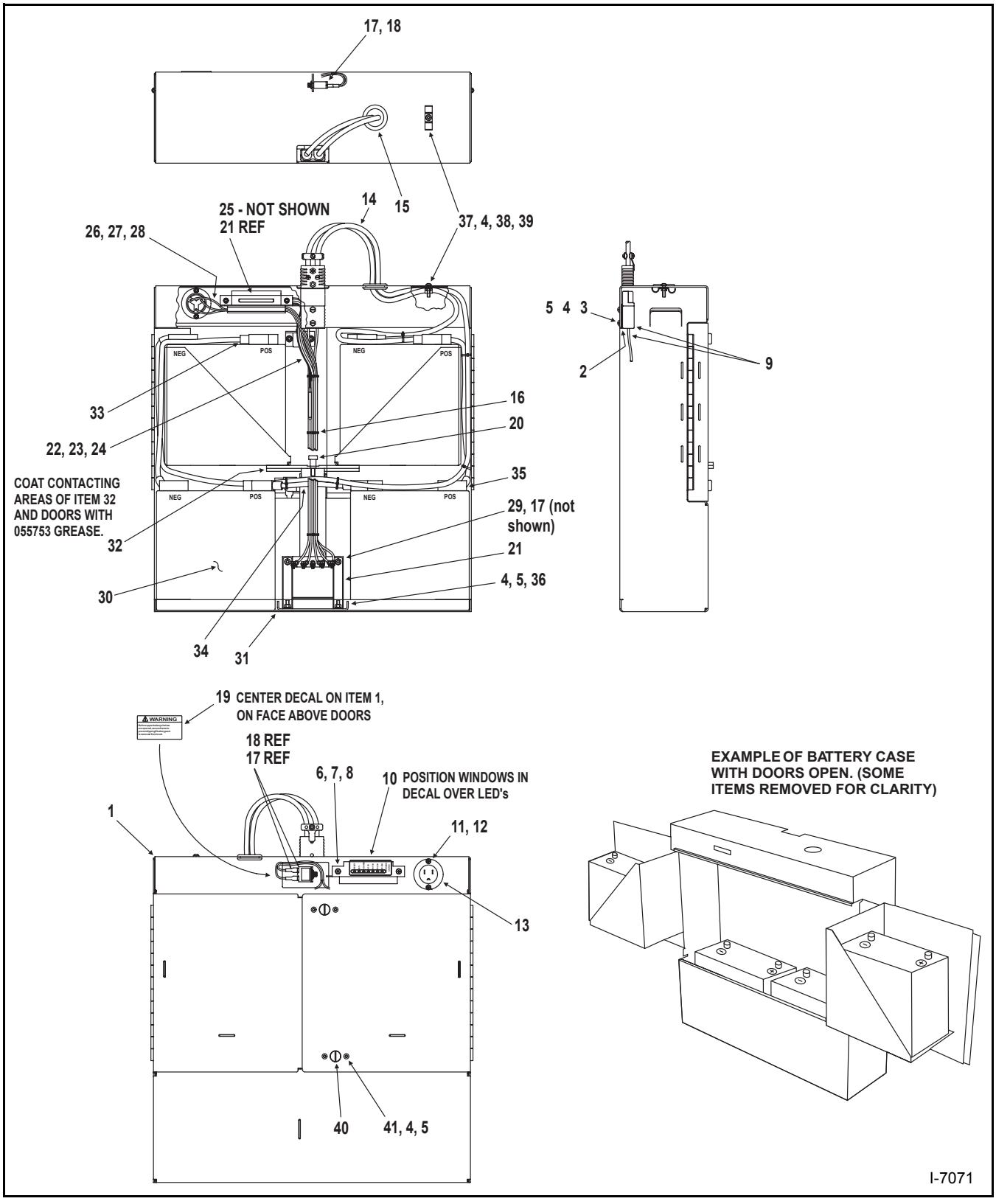


Figure 7-12. Battery Pack and 120 VAC Charger Installation - Four 6 Volt Flooded Cell

Item No	Qty.	Part No.	Description
1	1	506221	Battery Box Weldment
2	1	403688	Spacer, Connector
3	2	068478	Screw, SLRH, ¼-20 x 1 ¼ Lg
4	11	077209	Washer, Lock, Split, ¼
5	10	059421	Nut, Hex, ¼-20
6	2	071376	Screw, PHTH, 10-32 x ½ Lg
7	2	077208	Washer, Lock, Split, #10
8	2	059416	Nut, Hex, #10-32
9	1	506122	Connector Assembly, Charger
10	1	056680	Decal, Charger
11	2	077204	Washer, Lock, Split #6
12	2	059412	Nut, Hex, #6-32
13	1	005454	Connector, Inlet, Flanged, AC, 120 VAC
14	1	506230-01	Connector Assembly, Battery
15	1	057511	Grommet
16	8	056113	Tie, Harness
17	4	021718	Terminal, ¼ Spade, 16 AWG
18	1	003403	Circuit Breaker
19	1	056684	Decal, Warning, Tip
20	1	052767	Bolt, Shoulder, ½ Dia x ¾ Lg
21	1	004987	Charger Kit, 24V, 25A, 120 VAC
22	A/R	023010	Wire, Stranded, 10 AWG, Red
23	A/R	023011	Wire, Stranded, 10 AWG, Black
24	A/R	023036	Wire, Stranded, 10 AWG, White
25	5	005471	Connector, Splice, Crimp, 10 AWG
26	A/R	023000	Wire, Stranded, 16 AWG, Red
27	A/R	023004	Wire, Stranded, 16 AWG, Green
28	A/R	023018	Wire, Stranded, 16 AWG, Black
29	7	021262	Terminal, Ring, 10 AWG
30	4	003222	Battery, 6V, Flooded Cell, 178 A.H.
31	1	404306	Retainer, Battery
32	1	404414	Support Bar
33	1	506123-02	Cable Assembly, Battery, 4 AWG
34	1	506123-03	Cable Assembly, Battery, 4 AWG
35	1	506123-04	Cable Assembly, Battery, 4 AWG
36	1	021206	Terminal, Ring, ¼ Dia
37	1	065527	Screw, BHCS, ¼-20 x 1" Lg
38	1	504364	Clamp Assembly, Cable
39	1	056144	Clamp, Cable
40	2	058109	Latch, Heavy Duty
41	4	065525	Screw, BHCS, ¼-20 x 5/8" Lg.

7-13. FLOODED CELL BATTERY PACK (FOUR 6V) WITH 230 VAC CHARGER

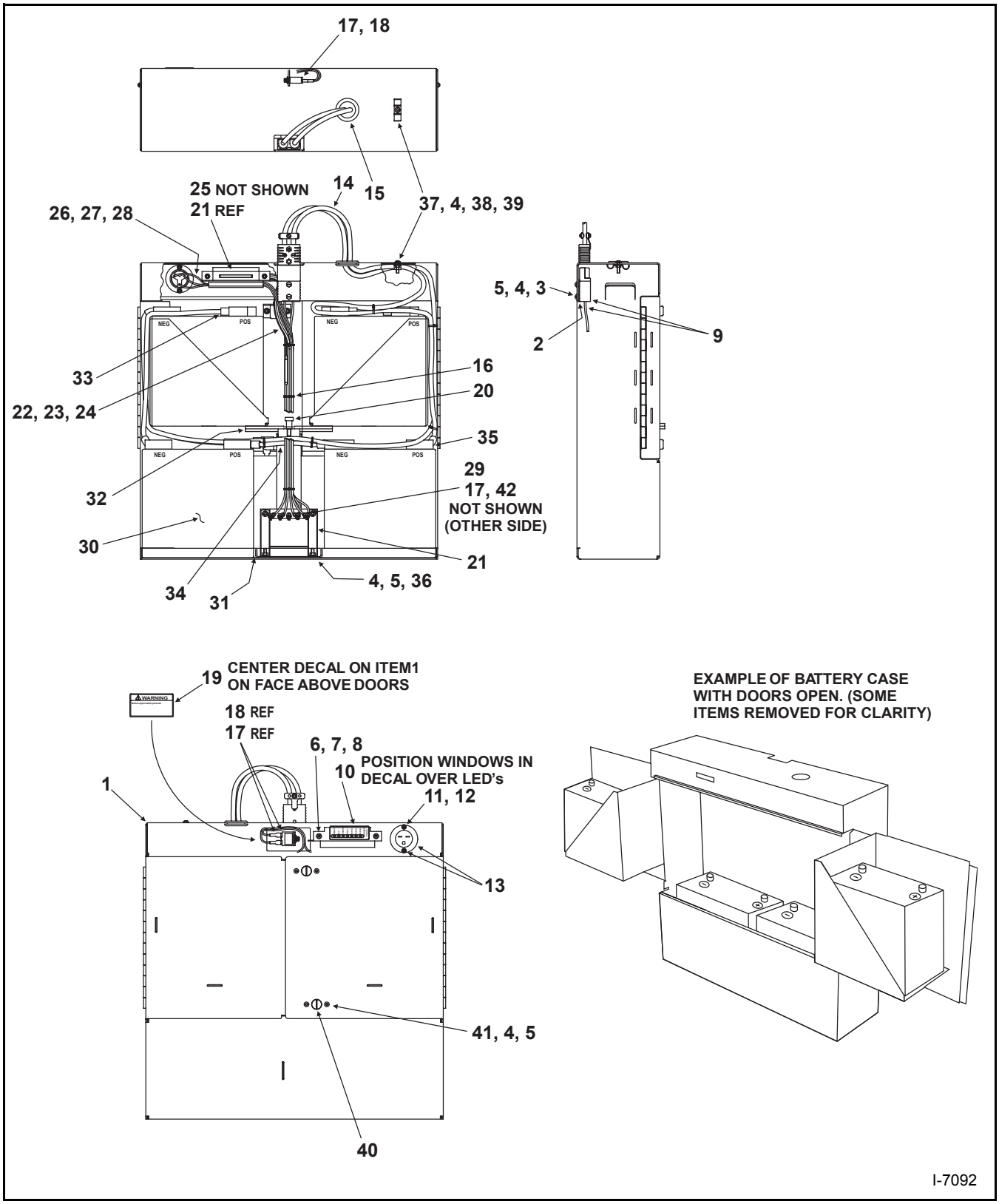


Figure 7-13. Battery Pack and 230 VAC Charger Installation - Four 6 Volt Flooded Cell

Item No	Qty.	Part No.	Description
1	1	506221	Battery Box Weldment
2	1	403688	Spacer, Connector
3	2	068478	Screw, SLRH, ¼-20 x 1 ¼ Lg
4	11	077209	Washer, Lock, Split, ¼
5	10	059421	Nut, Hex, ¼-20
6	2	071376	Screw, PHTH, 10-32 x ½ Lg
7	2	077208	Washer, Lock, Split, #10
8	2	059416	Nut, Hex, #10-32
9	1	506122	Connector Assembly, Charger
10	1	056680	Decal, Charger
11	2	077204	Washer, Lock, Split #6
12	2	059412	Nut, Hex, #6-32
13	1	005455	Connector, Inlet, Flanged, AC, 230 VAC
14	1	506230-01	Connector Assembly, Battery
15	1	057511	Grommet
16	8	056113	Tie, Harness
17	4	021718	Terminal, ¼ Spade, 16 AWG
18	1	003403	Circuit Breaker
19	1	056684	Decal, Warning, Tip
20	1	052767	Bolt, Shoulder, ½ Dia x ¾ Lg
21	1	004989	Charger Kit, 24V, 25A, 230 VAC
22	A/R	023010	Wire, Stranded, 10 AWG, Red
23	A/R	023011	Wire, Stranded, 10 AWG, Black
24	A/R	023036	Wire, Stranded, 10 AWG, White
25	5	005471	Connector, Splice, Crimp, 10 AWG
26	A/R	023000	Wire, Stranded, 16 AWG, Red
27	A/R	023004	Wire, Stranded, 16 AWG, Green
28	A/R	023018	Wire, Stranded, 16 AWG, Black
29	7	021262	Terminal, Ring, 10 AWG
30	4	003222	Battery, 6V, Flooded Cell, 178 A.H.
31	1	404306	Retainer, Battery
32	1	404414	Support Bar
33	1	506123-02	Cable Assembly, Battery, 4 AWG
34	1	506123-03	Cable Assembly, Battery, 4 AWG
35	1	506123-04	Cable Assembly, Battery, 4 AWG
36	1	021206	Terminal, Ring, ¼ Dia
37	1	065527	Screw, BHCS, ¼-20 x 1" Lg
38	1	504364	Clamp Assembly, Cable
39	1	056144	Clamp, Cable
40	2	058109	Latch, Heavy Duty
41	4	065525	Screw, BHCS, ¼-20 x 5/8" Lg.
42	1	023267-03	Wire Assembly, Jumper

7-14. BATTERY INSTALLATION, TWO-12V MAINTENANCE FREE BATTERY PACK AND INDUSTRIAL BATTERY

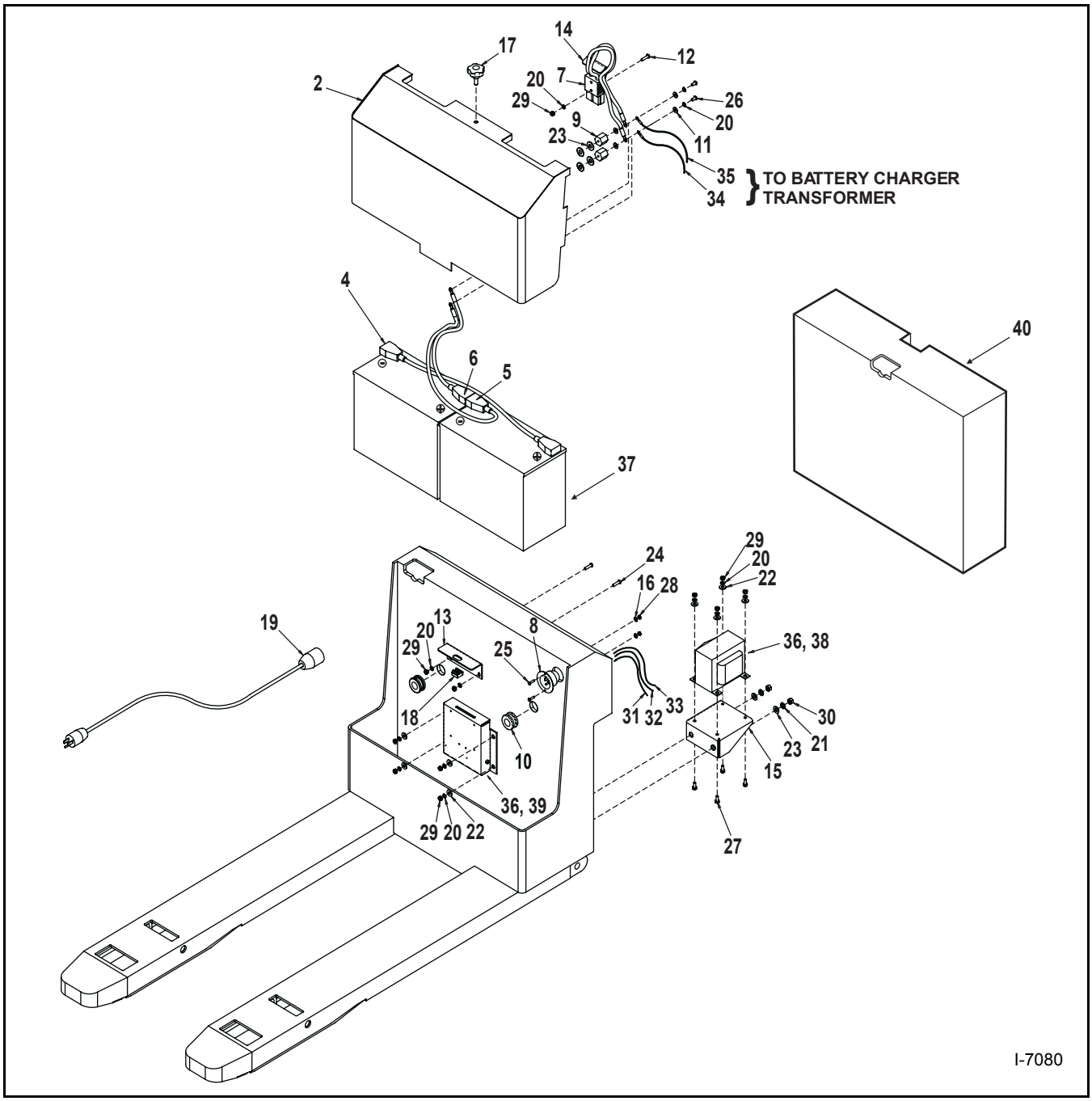
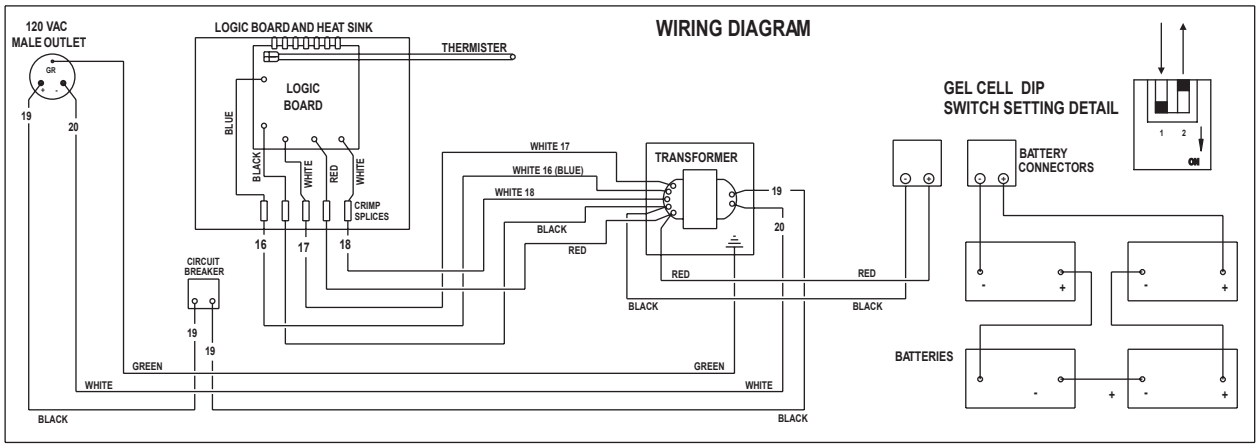


Figure 7-14. Battery Installation – Two-12V Maintenance Free Batteries and Industrial Battery

Item No	Qty.	Part No.	Description
1			
2	1	506152	Cover, Battery
3	--	--	Not Used
4	1	506123-01	Cable Assembly - Battery, 4 AWG
5	1	505469-05	Cable Assembly - Battery
6	1	505469-06	Cable Assembly - Battery
7	1	505627-03	Connector Assembly, Battery
8	1	005454	Connector, Inlet, Flanged, 120 VAC
	1	005445	Connector, Inlet, Flanged, 230 VAC
9	2	010614	Standoff, Insulator
10	2	057519	Grommet
11	4	077105	Washer, Flat, ¼, Brass
12	2	068478	Screw, RHCS, ¼-20 UNC x 1.25 Long
13	1	404206	Bracket, Battery Cover
14	1	404211	Handle, Connector, Red Metal
15	1	404229	Shelf, Transformer
16	2	077204	Washer, Lock, #6
17	1	057964	Plastic Knob
18	1	059940-02	Nut, Retainer, 3/8-16 UNC
19	1	005810	Cord, AC, Input, Charger, 120 VAC
	1	504599	Cord, AC, Input, Charger, 230 VAC
20	14	077209	Washer, Lock, ¼
21	2	077211	Washer, Lock, 3/8
22	8	077031	Washer, Flat, ¼
23	6	077056	Washer, Flat, 3/8
24	2	063480	Screw, HHCS, ¼-20 UNC x 1" Long
25	2	068233	Screw, RHCS, #6-32 UNC x ¾" Long
26	2	070489	Screw, HHCS, ¼-20 UNC x 5/8" Long, Brass
27	4	063477	Screw, HHCS, ¼-20 UNC x 5/8" Long
28	2	059412	Nut, Hex, #6-32 UNC
29	12	059421	Nut, Hex, ¼-20 UNC
30	2	059429	Nut, Hex, 3/8-16 UNC
31	1	023269	Harness Assembly, AC Receptacle, #20
32	1	023267-01	Wire Assembly, Black, #19
33	1	023267-02	Wire Assembly, Green
34	1	505675-07	Wire Assembly, #10 AWG, Black
35	1	505675-08	Wire Assembly, #10 AWG, Red
36	1	004988	Charger Assembly, 24V, 25A, 120 VAC
	1	004990	Charger Assembly, 24V, 25A, 230 VAC
37	2	003216	135 AH Maintenance Free Battery with charger
38	1	901740	Transformer, 120 VAC
	1	901756	Transformer, 230 VAC
39	1	901741	Circuit Board Assembly
40	1	003150	150AH Industrial Battery
	1	003151	170AH Industrial Battery
	1	003209	200 AH Industrial Battery

7-15. MAINTENACE FREE BATTERY PACK WIRING DIAGRAMS

MAINTENANCE FREE BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 120 VAC



MAINTENANCE FREE BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 230 VAC

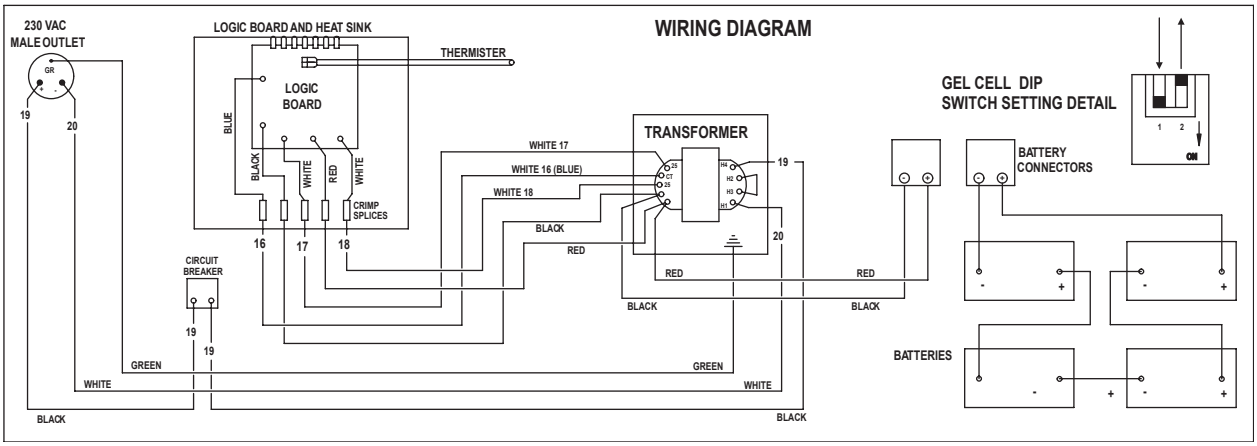


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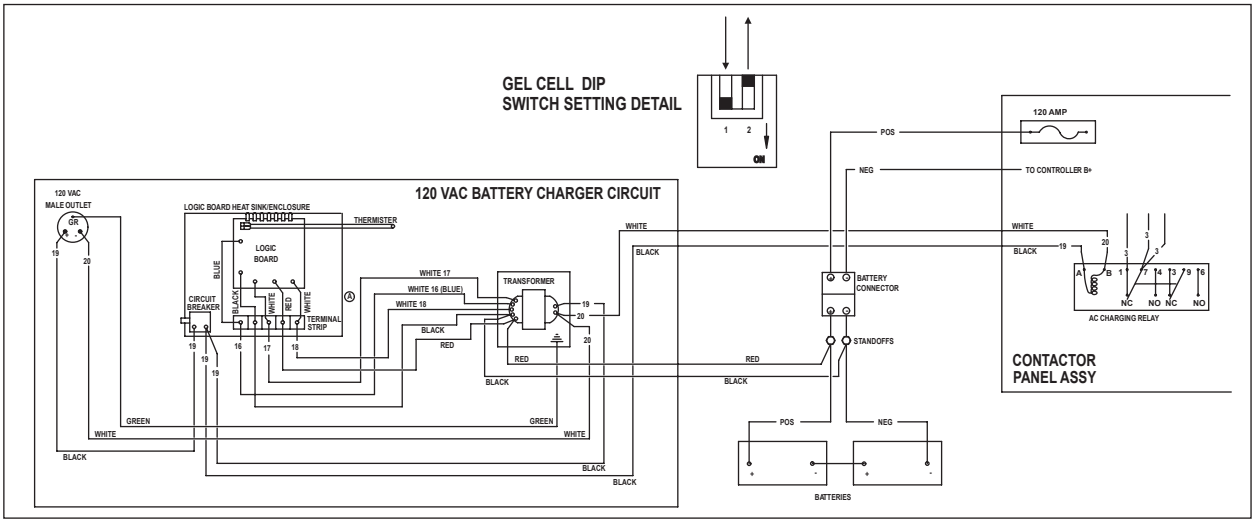
Figure 7-15. Maintenace Free Battery Pack Wiring Diagrams

MAINTENANCE FREE BATTERY PACK (TWO 12V) W/HCARGER ASSEMBLY - 24 V, 135 AH, 120 VAC



MAINTENANCE FREE BATTERY PACK (TWO 12V) W/HCARGER ASSEMBLY - 24 V, 135 AH, 230 VAC

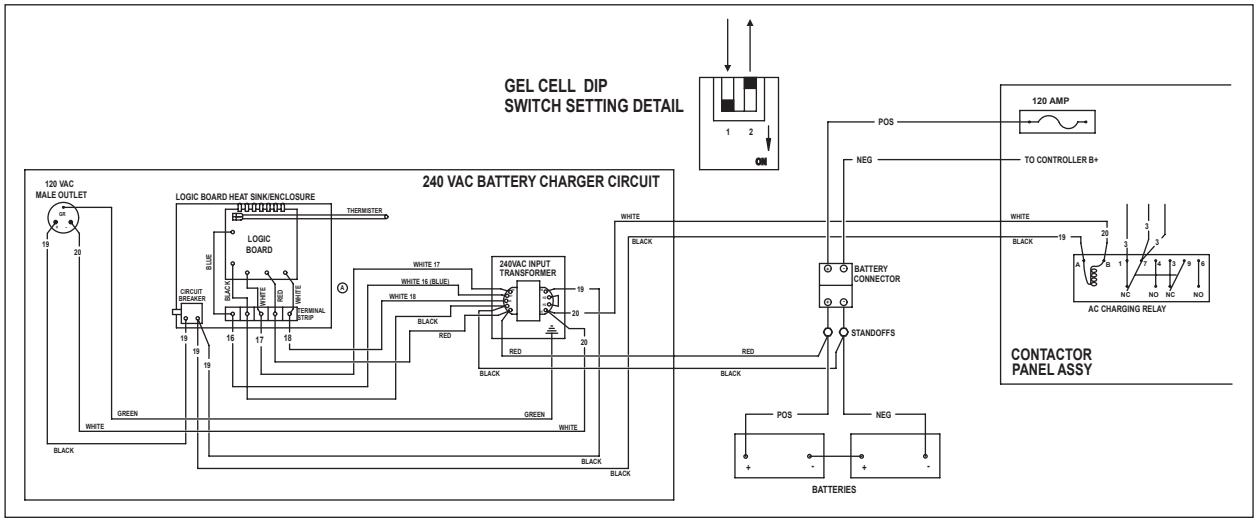


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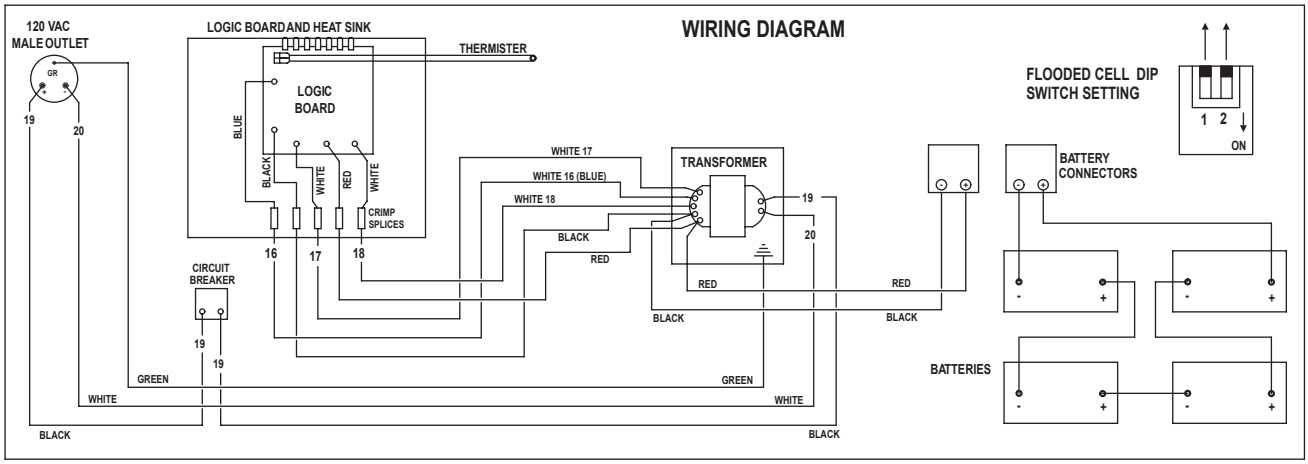
Figure 7-16. Maintenace Free Battery Pack Wiring Diagrams

7-16. FLOODED CELL BATTERY PACK WIRING DIAGRAMS

FLOODED CELL BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 120 VAC



FLOODED CELL BATTERY PACK (FOUR 6V) W/HCARGER ASSEMBLY - 24 V, 155 AH, 230 VAC

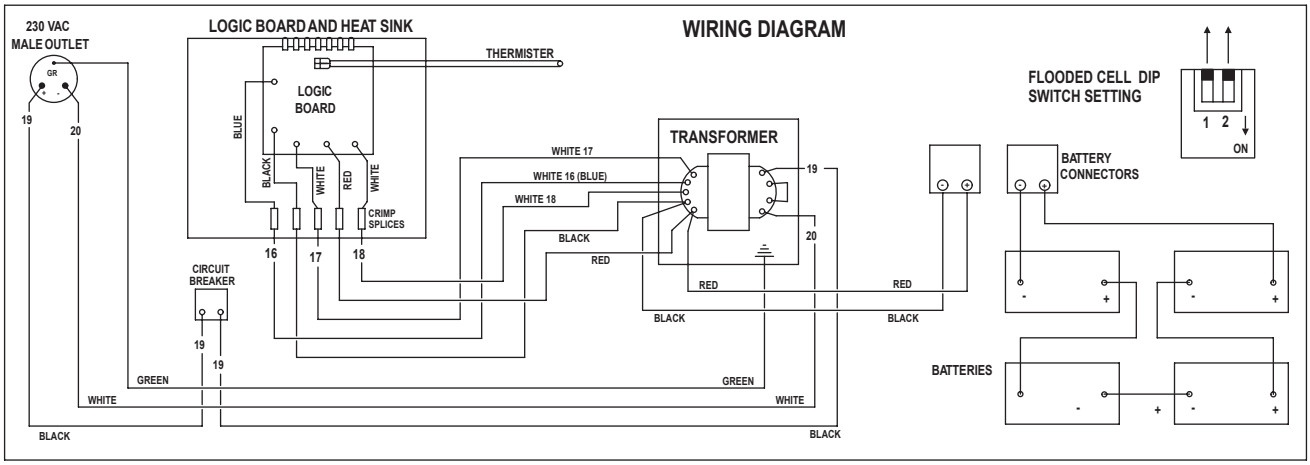


Figure 7-17. Flooded Cell Battery Pack Wiring Diagrams

7-17. CONTACTOR PANEL ASSEMBLY PARTS

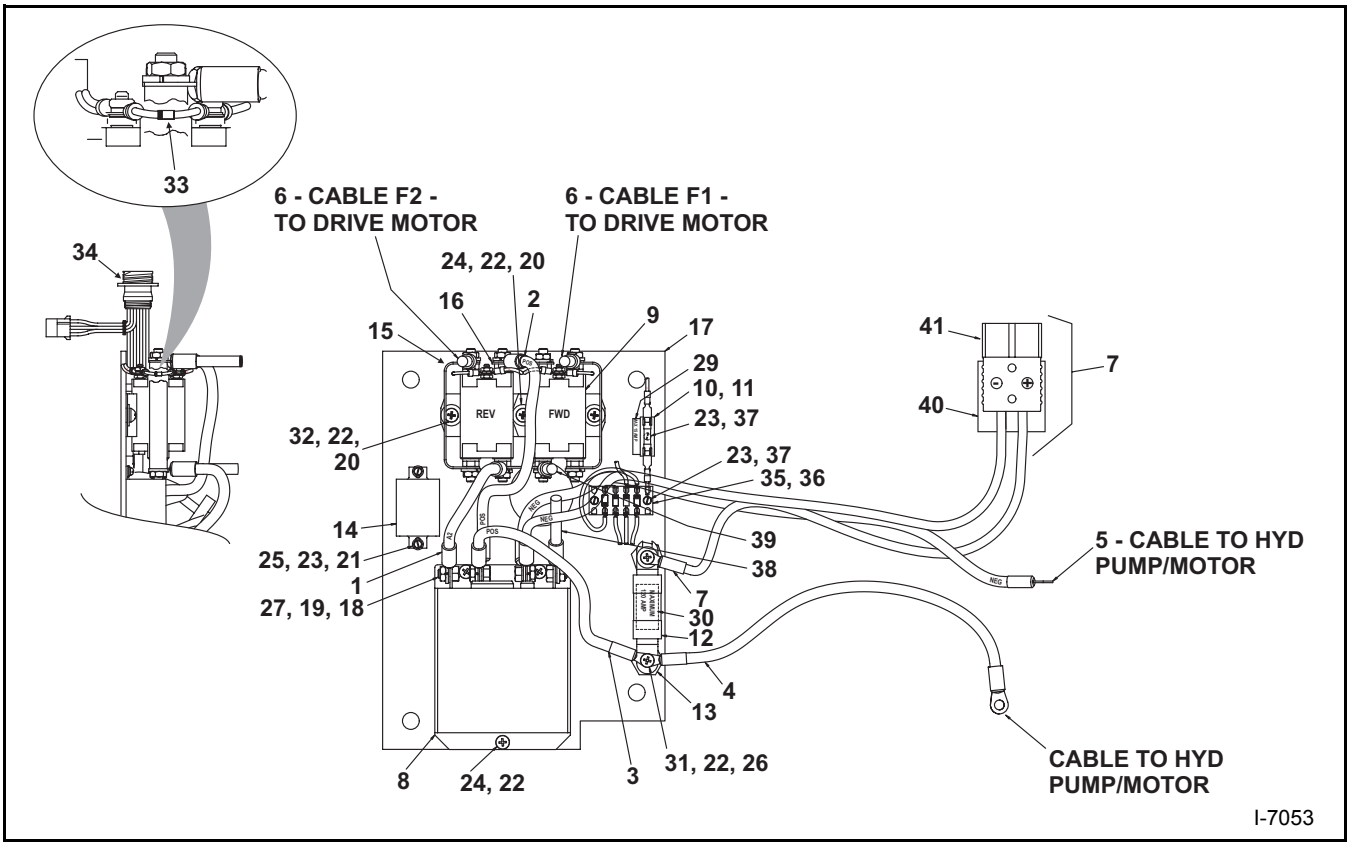


Figure 7-18. Contactor Panel Assembly Parts

Item No	Qty.	Part No.	Description
1	1	504150-17	Cable Assembly - #4 AWG
2	1	504150-25	Cable Assembly - #4 AWG
3	1	504150-26	Cable Assembly - #4 AWG
4	1	504150-27	Cable Assembly - #4 AWG
5	1	505181-07	Cable Assembly - #4 AWG
6	2	504150-28	Cable Assembly - #4 AWG
7	1	505466-01	Battery Connector Assembly
8	1	907200-03	Controller - XSTR, 250A, 24V
9	2	005667	Solenoid, Contactor, 24V
10	1	008904	Fuse Holder
11	1	008910	Fuse, AGX Type, 15 Amp
12	1	008918	Fuse, 120 Amp
13	2	010614	Standoff, Insulator
14	1	018411	Relay, Mount, Flange, AC
15	2	403548	Buss bar
16	2	403549	Buss bar
17	1	404207	Plate, Sub-panel
18	4	077210	Washer, Lock, 5/16
19	4	059526	Nut, Hex, Jam, 5/16-18 UNC
20	3	077031	Washer, Flat, ¼
21	4	077007	Washer, Flat, #6
22	8	077209	Washer, Lock, ¼
23	5	077204	Washer, Lock, #6
24	4	070481	Screw, PH, RD, HD, ¼-20 UNC x 7/16" Long
25	2	068235	Screw, PH, RD, HD, #6-32 UNC x ¼" Long
26	2	070489	Screw, PH, RD, HD, ¼-20 UNC x 5/8" Long, Brass
27	4	063552	Screw, HHCS, 5/16-18 UNC x 5/8" Long
28	2	075623-01	Stud-Weld, ¼-20 UNC x ½" Long
29	1	056504	Decal, Fuse, 15 Amp
30	1	056562	Decal, Fuse, 120 Amp
31	4	077105	Washer, Flat, ¼, Brass
32	2	070475	Screw, PH, RD, HD, ¼-20 UNC x 3/8" Long
33	2	005996	Diode Assembly, Contactor
34	1	023265	Harness Assembly, Panel, Contactor
35	1	505931	Diode Block Assembly, Hour Meter
36	1	010625	Pad, Insulating
37	3	068230	Screw - PH RD HD, #6-32 UNC x 3/8" Long
38	1	504150-29	Cable Assembly - #4 AWG
39	1	504150-30	Cable Assembly - #4 AWG
40	1	404211	Handle, Connector, Red Metal
41	1	005401	Connector, Battery

7-18. CHARGER CIRCUIT BOARD

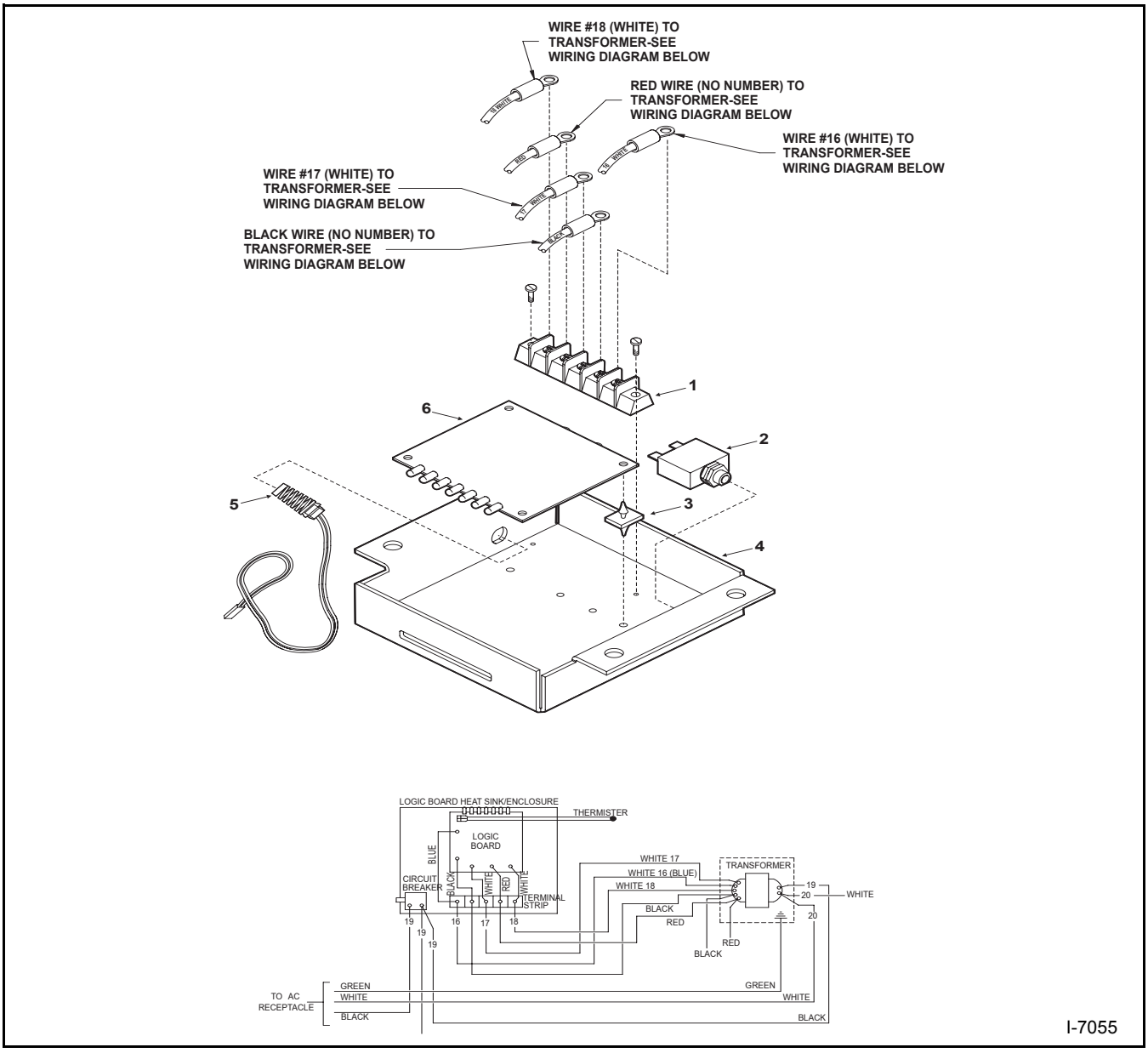


Figure 7-19. Charger Circuit Board

Item No	Qty.	Part No.	Description
	1	901741	Circuit Board Assembly
1	1	021261	Terminal Strip, 5 Pole
2	1	003403	Circuit Breaker, Thermal
3	4	010627	Support, Mounting, Circuit Board
4	1	404235	Cover, Circuit Board
5	1	901742	Thermister
6	1	901743	Circuit Board, Charger

7-19. LOAD WHEELS

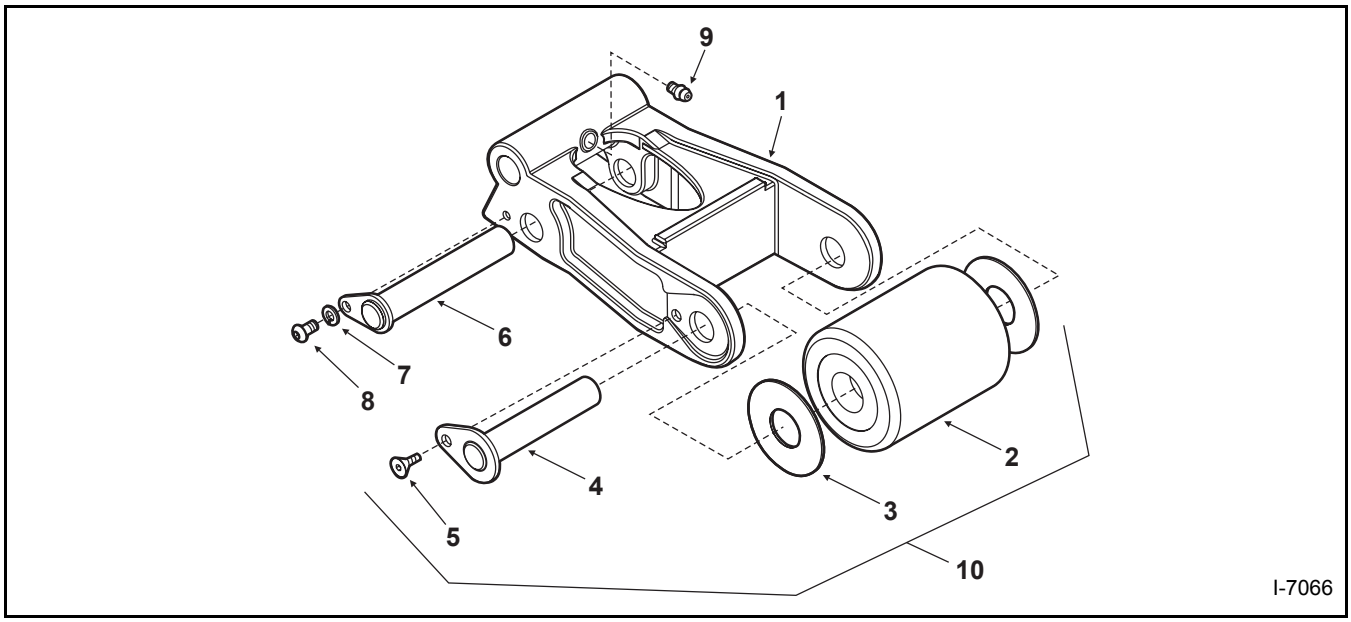


Figure 7-20. Load Wheel

Item No.	Qty.	Part No.	Description
1	1	055201	Wheel Housing
2*	1	505709	Load Wheel Assembly
3*	2	077033	Washer, Flat, 1.02 ID, 2.5 OD
4*	1	506214	Shaft - Axle
5*	1	065525	Screw, HSFLCS, ¼-20 x ½ Nylock
6	1	506147	Pin, Keeper
7	1	065476	Washer, Lock, ¼"
8	1	065525	Screw, SBHCS, ¼-20 UNC x 5/8" Lg
9	1	025716	Grease Fitting
10	1	901755	Load Wheel and Axle Kit, *includes items 2 , 3, 4 and 5

*included in Reference #10, Load Wheel and Axle Kit

7-20. OPTIONAL EQUIPMENT

7-20.1 Cold Conditioning

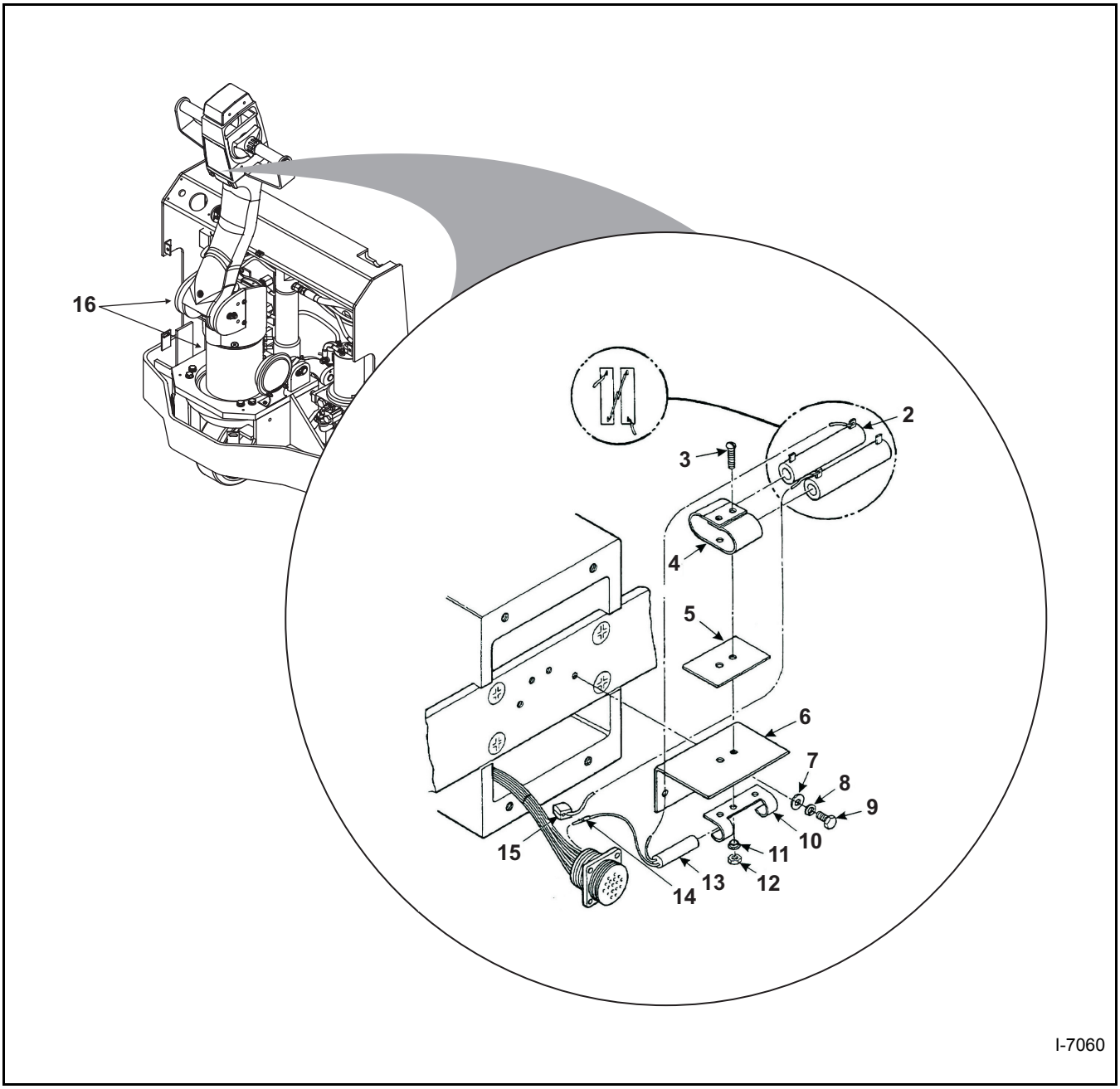


Figure 7-21. Cold Conditioning Parts

Index No.	Qty.	Part No.	Description
1	1	056491	Decal, Cold Conditioning
2	2	018909	10 0hm, 20 Watt Heat
3	2	068186	Screw
4	1	400544	Bracket, Resistor Mounting
5	1	018214	Insulator
6	1	402829	Bracket
7	2	077007	Washer
8	2	077204	Washer, Lock
9	2	072400-01	Screw
10	1	400044	Bracket, 1
11	2	403372	Insulator
12	2	059632	Nut, Lock
13	1	020736	Switch, Thermal
14	1	005643	Terminal, Contact Pin
15	1	005649	Splice
16	3	020799	Switches, Micro, Sealed
*17	A/R	055750	Grease
**18	A/R	055753	Grease
*19	A/R	055779	Hydraulic Oil
**20	A/R	055784	Hydraulic Oil
*21	A/R	055780	Transmission Oil
**22	A/R	055790	Transmission Oil

* For intermittent operation below 32° F.

** For continuous operation below 32° F.

7-20.2 Load Backrest

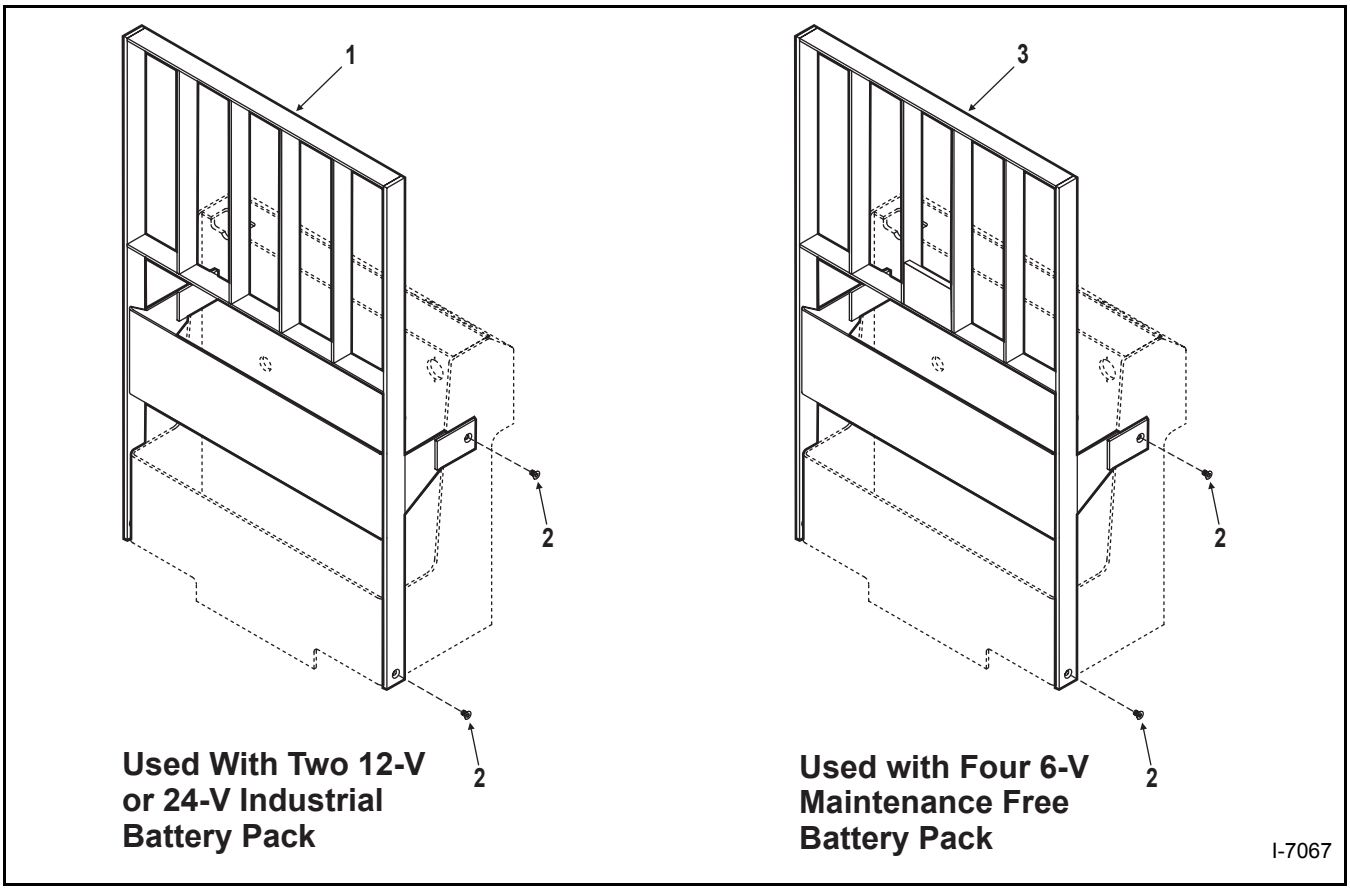


Figure 7-22. Load Backrest

Index No.	Qty.	Part No.	Description
1	1	506159	48" High Load Backrest, 2-12V Battery or 24V Industrial Battery
2	4	069712	Screw, HSFH, 3/8-16 x ¾ Nylock
3	1	506168	48" High Load Backrest, 4 - 6V Maintenance Free Battery Pack

7-20.3 Load Stabilizer

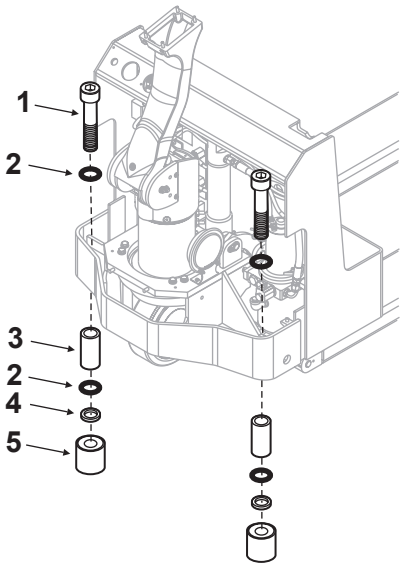


Figure 7-23. Load Stabilizer

Index No.	Qty.	Part No.	Description
1	2	065975	Screw, SHCS, 1-8 x 5" Long
2	4	075575	Washer, Lock, Vibration Resistant, 1"
3	2	404427	Stabilizer Standoff
4	2	404330	Spacer, Jack Stand
5	2	053043	Bumper

NOTES:

Big Joe Manufacturing Company - Lincolnwood, IL 60646
Manual Price: $35.00