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Manual: **901360**
Model: **PTW**
Serial Number: **376837 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
350	PTW,PTR TRANS/CONTROLLER/CONTACTOR TYPE E
360	DRIVE MOTOR 016052
371	PTR-40 SELF PROPELLED PALLET TRUCK

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Manual Price $35.00

PTW SERIES

POWER DRIVE INTERMEDIATE LIFT TRUCK

Serial Number 376837 and Higher

Operation

Maintenance

Repair Parts List

Big Joe Manufacturing Company • Des Plaines, IL 60018 **MANUAL NO. 901360**

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WARNING

Do not operate this truck unless you have been trained and authorized to do so and have read all warnings and instructions in operator's manual and on this truck.

Do not operate this truck until you have checked its condition. Give special attention to Tires, Horn, Battery, Controller, Lift System, Brakes, Steering Mechanism, Guards and Safety Devices.

Operate truck only from designated operating position. Wear foot protection. Do not carry passengers.

Observe applicable traffic regulations. Yield right of way to pedestrians. Slow down and sound horn at cross aisles and wherever vision is obstructed.

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.

Always look in direction of travel. Keep a clear view, and when load interferes with visibility, travel with load or lifting mechanism trailing.

Use special care when operating on ramps-travel slowly, and do not angle or turn. Travel with lifting mechanism or load downhill.

Do not overload truck. Check capacity plate for load weight and load center information.

Before lifting, be sure load is centered, forks are completely under load, and load is as far back as possible against load backrest.

Do not handle loads which are higher than the load backrest unless load is secured so that no part of it could fall backward.

When leaving truck, neutralize travel control. Fully lower lifting mechanism and set brake. When leaving truck unattended, shut off power.

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SECTION 1
DESCRIPTION

1-1. INTRODUCTION.

This publication describes the 24 volt transistor PTW lift truck manufactured by Big Joe Manufacturing Company, Des Plaines, Illinois, 60018. Included are operating instructions, planned maintenance instructions, lubrication procedures, corrective maintenance procedures and a complete parts list with parts location illustrations.

Users shall comply with all requirements indicated in applicable OSHA standards and current edition of A.N.S.I. B56.1 Part II. By following these requirements and 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 PTW truck, Figure 1-2, lifts and transports payloads up to 4000 pounds on rigid forks.

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

The reversible DC motor propels the lift truck in forward or reverse direction throughout the available speed range. The PTW lift truck can be driven with forks raised of lowered. The lift truck must be protected from the elements.

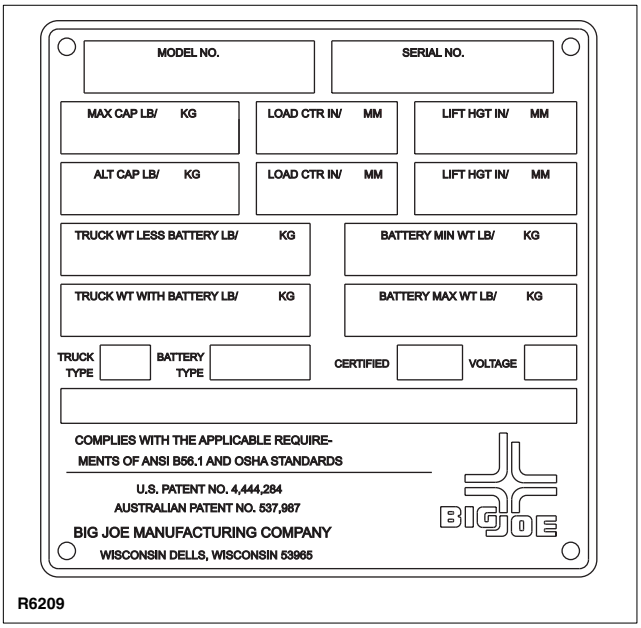

Figure 1-1 Name Plate

The model number will be found on the name plate (Figure 1-1) along with the serial number, lifting capacity, and load center. Figure 1-2 shows the locations of the trucks main components and controls.

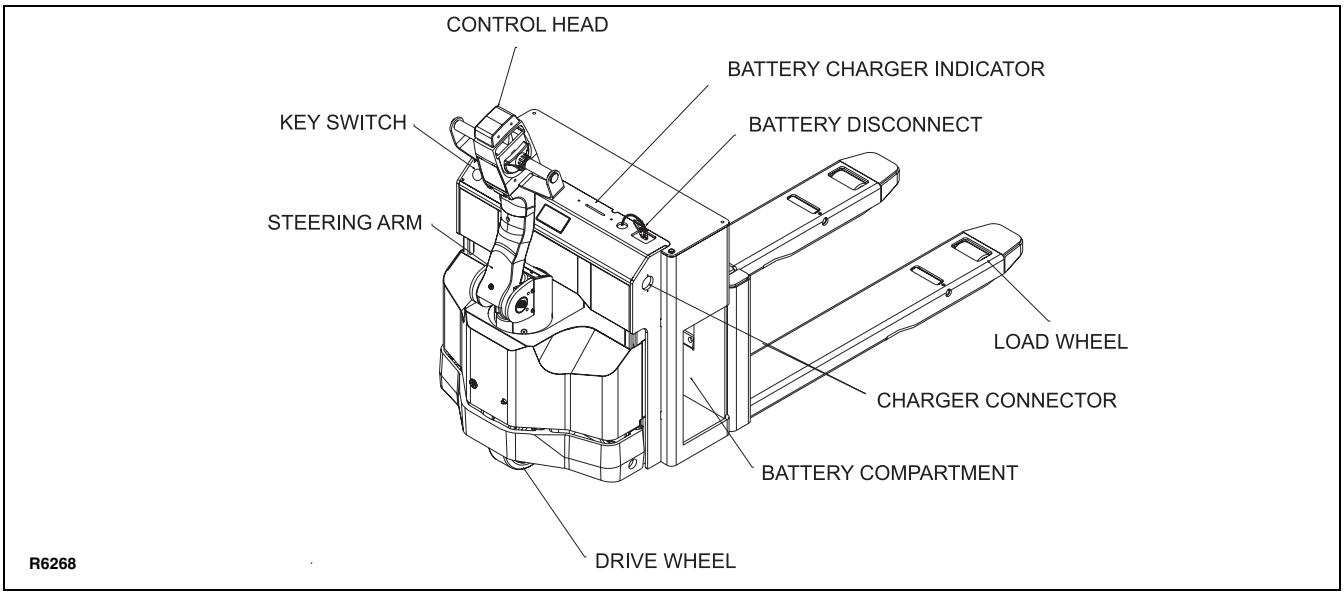

Figure 1-2. PTW Lift Truck

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1-3. SAFETY FEATURES.

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

- Dead-man brake to apply the 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-resistance hand to provide a firm hand hold for operator.
- Flow control valve regulates maximum 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.

1-4. OPTIONS AND ACCESSORIES.

Big Joe offers many options and accessories for the PDI lift truck such as:

- Battery Capacity Indicator
- Hourmeter
- Cold Conditioning
- Load Backrest
- Stability Pads
- Casters
- Modular Skid Adapter

The most commonly used options and accessories are described in SECTION 5.

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SECTION 2
OPERATION

2-1. GENERAL.

This section gives detailed operating instructions for the PTW 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 PTW lift truck.

The following safety precautions must be adhered to at all times.

- 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.
- All warnings and instructions must be read and understood before using the equipment.
- Equipment must be inspected by a qualified person on a regular basis.
- Do not operate this truck until you have checked its condition. Give special attention to Tires, Horn, Batteries, Controller, Lift System Brakes, Steering Mechanism, Guards and Safety Devices
- Operate truck only from designated operation position. Wear foot protection. Do not carry passengers.
- Observe applicable traffic regulations. Yield right of way to pedestrians. Slow down and sound horn at cross aisles and wherever vision is obstructed.
- 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.
- Always look in direction of travel. Keep a clear view, and when load interferes with visibility, travel with load or lifting mechanism trailing.
- Do not overload truck. Check nameplate for load weight and load center information.
- Before lifting, be sure load is centered, forks are completely under load, and load is as far back as possible against load backrest.
- Do not handle loads which are higher than the load backrest unless load is secured so that no part of it could fall backward.
- When leaving truck, neutralize travel control. Fully lower lifting mechanism and set brake. When leaving truck unattended, turn off key switch, remove key and disconnect battery.

2-3. BEFORE OPERATION

Table 2-1 covers important inspection points on the PDI lift truck which should be checked prior to operation. Depending on use, some trucks may require additional checks.

Figure 2-1 shows a sample format for a Operator Checklist, which can be modified as necessary to fit your operation.

WARNING: Periodic maintenance of this truck by a QUALIFIED TECHNICIAN is required.

CAUTION: A QUALIFIED SERVICE TECHNICIAN should check the truck monthly for proper lubrication, proper fluid levels, brake maintenance, motor maintenance and other areas specified in the SECTION 3.

WARNING: If the truck is found to be unsafe and in need of repair, or contributes to an unsafe condition, report it immediately to the designated authority. Do not operate it until it has been restored to a safe operating condition. Do not make any unauthorized repairs or adjustments. All service must be performed by a qualified maintenance technician.

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Table 2-1 Operator Checks

ITEM	PROCEDURE
Transmission and hydraulic systems.	Check for signs of fluid leakage.
Forks	Check for cracks and damage.
Guards and load backrest	Check that safety guards are in place, properly secured and not damaged.
Safety signs	Check that warning labels, nameplate, etc., are in good condition and legible.
Horn	Check that horn sounds when operated.
Steering	Check for binding or looseness in steering arm when steering.
Travel controls	Check that speed controls on control handle operate in all speed ranges in forward and reverse and that belly button switch functions.
Wheels	Check drive wheel for cracks or damage. Move truck to check load for freedom of rotation.
Hydraulic controls	Check operation of lift and lower to their maximum positions.
Brakes	Check that brakes actuate when steering arm is raised to upright position, and when lowered to horizontal position.
Deadman/ Parking brake	Check that steering arm raises to upright position when released and brake applies.
Battery disconnect	Check that battery can be disconnected and reconnected. Check for connector damage.
Battery charge	Check that battery capacity meter (if equipped) is on “F”.
High speed limit switch	Allow for enough space to operate truck in high speed. Engage the high speed limit switch on the control head (See Figure 2-2), then test drive truck to check if high speed is cut out.
Creep speed limit switch	Allow for enough space to operate truck in high speed. Move the steering arm to the creep speed position (See Figure 2-3), then test drive truck to check if high speed is cut out.

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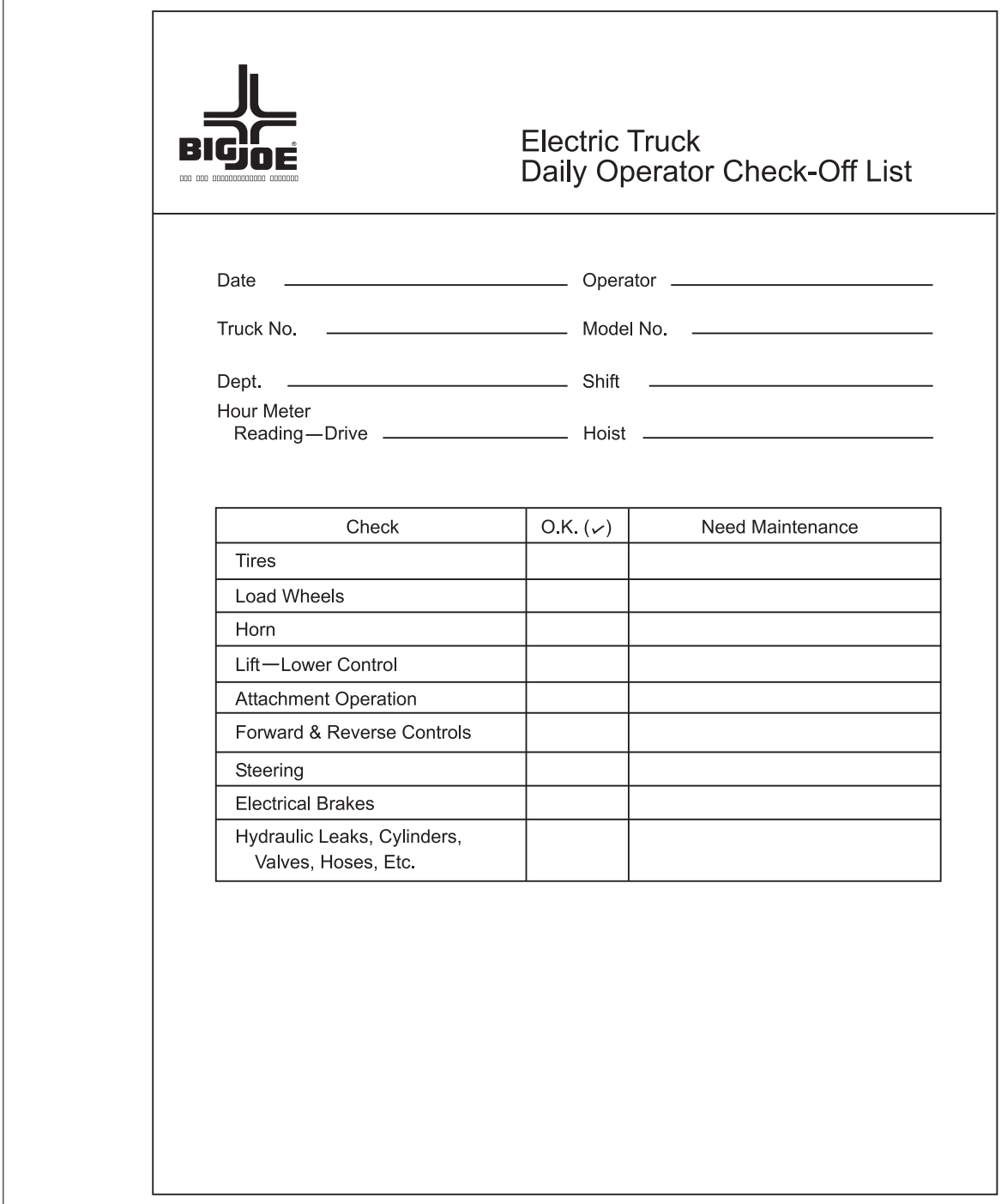

BIG JOE

Electric Truck
Daily Operator Check-Off List

Date _____ Operator _____

Truck No. _____ Model No. _____

Dept. _____ Shift _____

Hour Meter
Reading—Drive _____ Hoist _____

Check	O.K. (✓)	Need Maintenance
Tires		
Load Wheels		
Horn		
Lift—Lower Control		
Attachment Operation		
Forward & Reverse Controls		
Steering		
Electrical Brakes		
Hydraulic Leaks, Cylinders, Valves, Hoses, Etc.		

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Figure 2-1 Sample of Operator Check List

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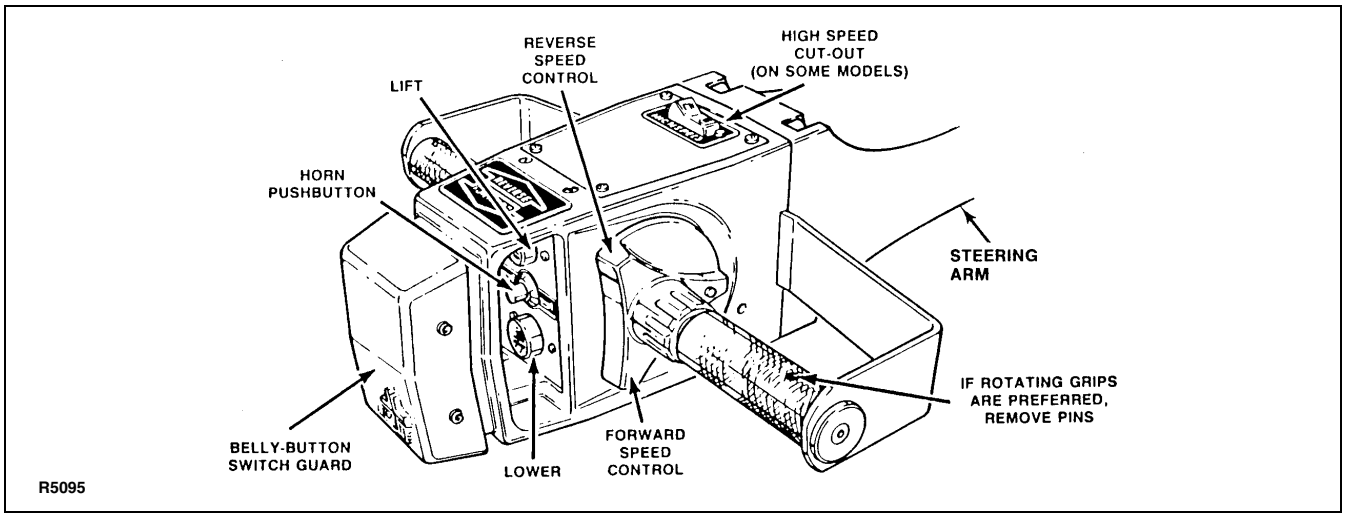

Figure 2-2. Steering Arm Controls

2-4. GENERAL CONTROL OPERATION.

The speed control (See Figure 2-2) 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 the 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 Cut-out Switch, located on the top of the control head. With this switch in the OFF position, standard travel speeds are available. Place the switch in the ON position to disable 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 fully applied by lowering or raising the steering arm. (See Figure 2-3) 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 steering arm to the upright position.

2-5. DRIVING AND STOPPING PROCEDURES.

2-5.1. Creep Travel

NOTE: Creep, or the slowest travel speed, is available in both forward and reverse.

1. 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 handle from the vertical position until you hear a "click" which indicates that the controls are energized. See Figure 2-3.
3. Rotate the speed control for either forward or reverse travel.

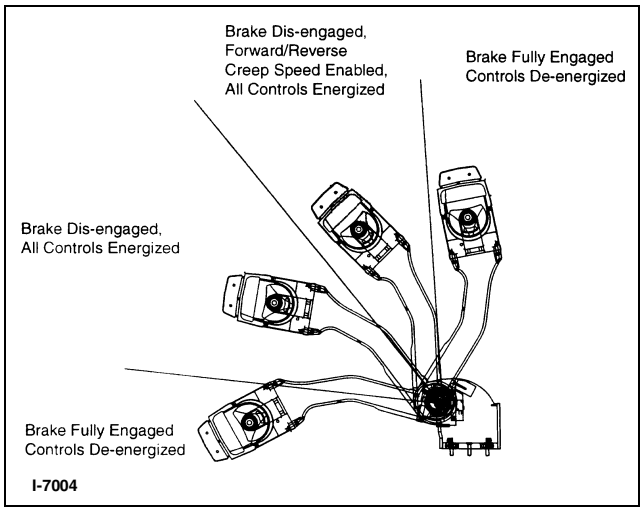

Figure 2-3. Brake Actuation

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2-5.2. Standard Travel

1. 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 past Creep Speed to a comfortable position above horizontal to disengage the brake and to energize the electrical circuits. See Figure 2-3.
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 electrical brake engages, slowing or stopping the truck.
5. Procedures for movement in reverse are the same as in the forward direction except slowly press the speed control upwards.

2-6. BELLY-BUTTON SWITCH. (Figure 2-2)

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

2-7. 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 return fully, the steering arm return spring requires adjustment. Return truck to maintenance for adjustment.

2-8. LIFT AND LOWER CONTROLS.

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

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

2-9. LOADING AND UNLOADING.

1. Move truck to location where load is to be picked up.
2. Using the reverse speed control, move truck into position so forks are within pallet or skid, and the load is centered over the forks and as far back as possible.
3. Raise forks to lift load.
4. Drive to area where load is to be placed.
5. Move truck to align load with its new position.
6. Lower the load until it rests squarely in place and the forks are free.
7. Slowly move the truck out from under the load, using the FORWARD speed control.

2-10.PARKING.

When finished with moving loads, drive truck to its maintenance or storage area. Turn off the key switch. Charge batteries as necessary. Refer to battery care instructions, SECTION 3

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SECTION 3
PLANNED MAINTENANCE

3-1. GENERAL.

Planned maintenance consists of periodic visual and operational checks, parts inspection, lubrication, and scheduled maintenance designed to prevent or discover malfunctions and defective parts. The operator performs the checks in SECTION 2, and refers any required servicing to a qualified maintenance technician who performs the scheduled maintenance and any required servicing.

3-2. MONTHLY AND QUARTERLY CHECKS.

Table 3-1 is a monthly and quarterly inspection and service chart based on normal usage of equipment eight hours per day, five days per week. If the lift truck is used in excess of forty hours per week, the frequency of inspection and service should be increased accordingly. These procedures must be performed by a qualified service technician or your Big Joe service representative.

3-3. FLOODED CELL BATTERY CARE.

The life of the battery can be extended by giving it proper care. Perform a daily check of the battery whether or not the equipment is in daily use. DO NOT overcharge the battery or battery life will be shortened. DO NOT allow battery to become completely discharged (specific gravity 1.150 or less). This will also greatly shorten battery life.

CAUTION: Observe and adhere to battery safety and maintenance supplement (Document 245) and battery warning decal when servicing battery charger.

The batteries must be pulled out of the compartments in order to check the specific gravity.

CAUTION: These batteries are heavy. Use handles on battery when lifting.

1. There are two batteries, one on each side of the truck. Pull the battery out the side of the truck and if necessary, tag and disconnect the cables.
2. Use a 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 repaired or replaced.

CAUTION: 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.

CAUTION: Use distilled water. Impurities in tap water will damage battery plates.

Table 3-1 Monthly and Quarterly Inspection and Service Chart

VISUAL CHECKS	
INTERVAL	**INSPECTION OR SERVICE**
Monthly	Check condition of drive motor commutator, brushes and springs (Paragraph 4-7.1.)
Monthly	Check condition of pump motor commutator, brushes and springs (Paragraph 4-10.2.)
Monthly	Check mechanical brake for proper operation
Monthly	Check load wheels for wear. A poly load wheel must be replace 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 replace if 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
Semi-annually	Check brake pads for wear. Brake pads must be replaced when air gap can not be adjusted to tolerances shown in Paragraph 4-6.

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3. When reinstalling the battery be sure battery cable connectors are securely attached to the battery terminals.
4. Charge the battery as described in paragraph 3-5.

3-4. ABSORBED GLASS MAT AND GEL CELL BATTERY CARE.

These batteries are maintenance-free. Any attempt to open the battery will void the warranty.

Ultra-deep discharging of brand new batteries should be avoided for at least 15 cycles. To dramatically extend battery life, ultra-deep discharge should be avoided. The shallower the average discharge, the longer the battery life.

Charge the battery as described in paragraph 3-5.

3-5. CHARGING BATTERIES

Charging requirements will vary depending on depth of discharge and temperature. Follow safety rules when placing a battery on charge.

Proceed as follows:

1. Park truck at charging station with carriage lowered and key switch off.
2. Check the condition of the AC cord, the battery connector and battery cables. If there are any cuts in the cable, any exposed wires, loose plugs or connectors, DO NOT attempt to charge the batteries. Contact appropriate personnel for repairs to be made.
3. Connect the AC cord to the truck and then plug into the appropriate power supply.
4. The battery charger is fully automatic and will cycle automatically (depending on amount of charge needed). Charge status can be observed as follows (Refer to Figure 3-1):
   a. The top three LED's indicate charger status. At start of charge the RED (Charge) LED will be ON indicating the batteries are connected and charging. After the batteries charge to approximately 80% the Yellow LED comes ON. After a time (1 hour minimum) the Green LED comes ON indicating battery ready.

NOTE: The battery charger includes an override timer which terminates the charge if the cycle does not complete after 18 hours of charging. This time-out condition is indicated by the green LED flashing off and on, and it indicates a fault condition which should be investigated. This will occur if the charger cannot raise the battery voltage to the preset voltage limit. Possible causes indicate a battery fault, a charger fault, low AC power supply voltage, or excessive discharge. The override timer can be reset by switching the AC power to the charger off.

   b. The lower four red LED's indicate current flow. Normally at start of charge, if the batteries are discharged, all four red LEDs will be on indicating maximum 25A charge current. As the batteries charge the current drops and the LEDs go OFF as the current drops to 20A, 15A, 10A and 5A respectively.

3-5.1. Removing Batteries from Charger

1. The Green "READY" LED stays on until the charger is unplugged from AC outlet.
2. Disconnect AC plug from the power supply and then remove it from the truck.

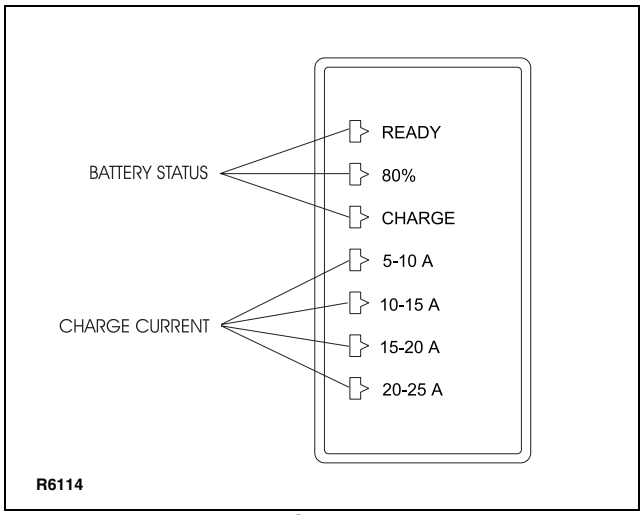

Figure 3-1 Charge Indicator

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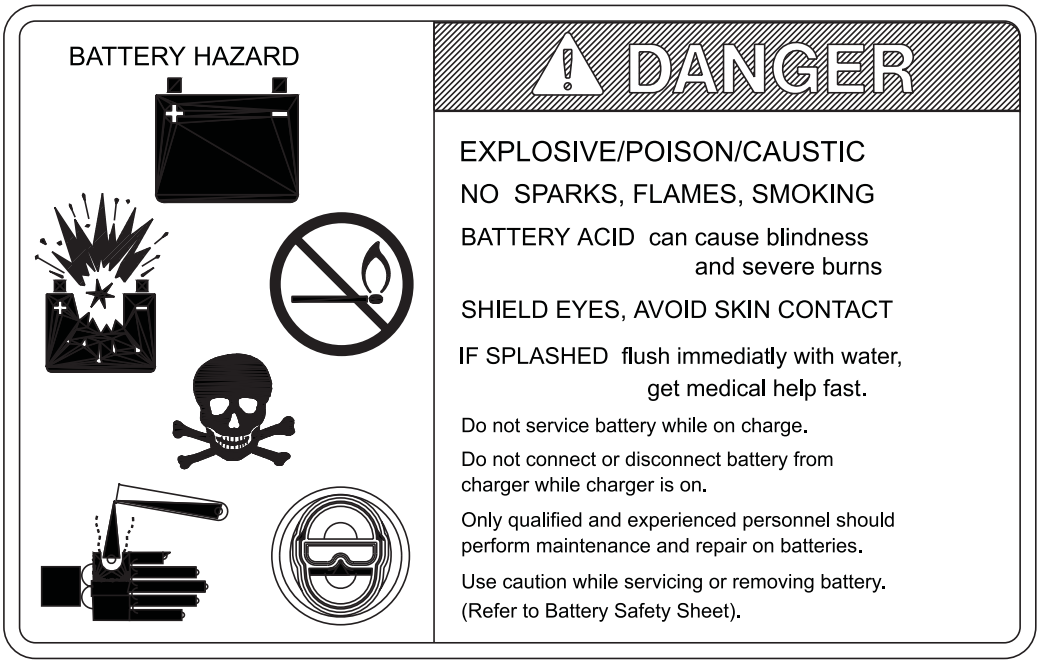

3-6. LUBRICATION.

Refer to Table 3-2 for the recommended types of grease and oil. Table 3-3 in conjunction with Figure 3-2 identifies the items requiring lubrication.

Table 3-2 Recommended Lubricants (See Table 3-3 for Application)

No. 1	Transmission oil—EP SAE 80W-90, Part Number 055780 Transmission oil—EP SAE 10W-30, Part Number 055790 (Note)
No. 2	Grease—Lithium base, general purpose. Part Number 055750 Part Number 055753 (Note)
No. 3	Hydraulic oil-Heavy duty with a viscosity of 150 SUS foam suppressing agent and rust and oxidation inhibitors Part Number 055779 Hydraulic oil-Heavy duty with a viscosity of 100 SUS foam suppressing agent and rust and oxidation inhibitors Part Number 055784 (Note)
No. 4	SAE 30 or 40 Engine lubricating oil

NOTE: USED ON COLD CONDITIONED TRUCKS

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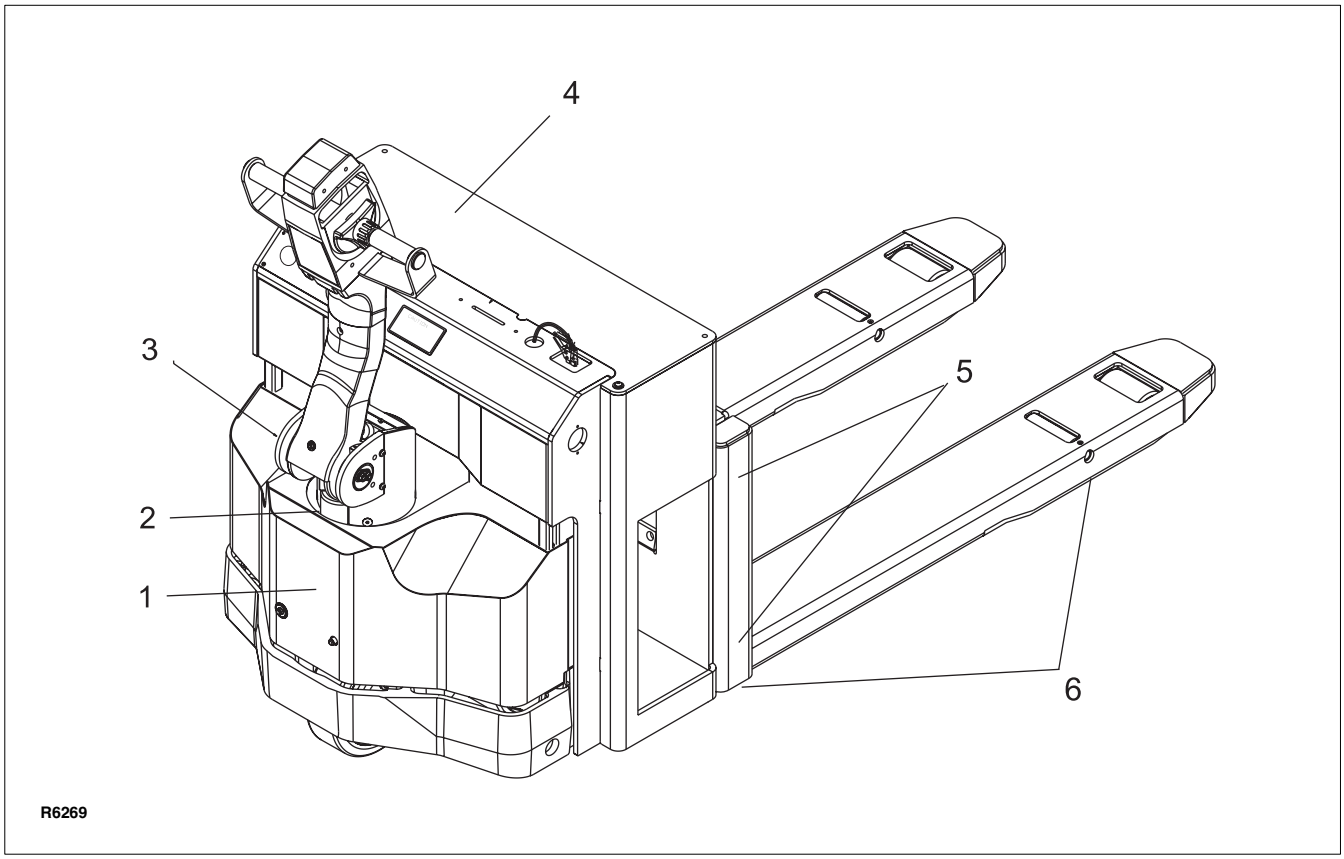

Figure 3-2 Lubrication Diagram

Table 3-3 Lubrication Chart

FIG 3-2 INDEX NO.	LOCATION	METHOD OF APPLICATION	TYPE (Table 3-3)	APPLICATION OF LUBRICANT
1	Transmission Capacity 4 1/2 pints	Can	No. 1	Fill to Hex plug (Fill level plug) level.
2	Pivot Tube	Can	No. 4	1 or 2 drops each time serviced.
3	Steering arm elbow	Can	No. 4	1 or 2 drops each time serviced.
4	Hydraulic System Capacity-6 quarts	Can	No. 3	With lift carriage fully lowered, fill reservoir with hydraulic oil to 1 inch below opening.
5	Lift Channel	Brush	No. 2	Accessed through battery compartment. Brush generous amount of lubricant in middle of channel. If rollers squeak, lower forks slightly and apply grease directly to rollers; operate forks up and down a few times to coat lift carriage channels.
6	Lift Linkage Fittings *	Gun	No. 2	Pressure lubricate.

* Raise lift truck to gain access to grease fittings.

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SECTION 4
ADJUSTMENT AND REPAIR

4-1. GENERAL

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

This section contains illustrations identifying 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 part 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, your truck 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 7-8 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 locate the illustration (in SECTION 7) of the applicable 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. COMPARTMENT COVERS

In order to gain access to internal components remove the compartment covers as follows (Figure 4-1):

4-3.1. Removal

1. Turn off the key switch and disconnect the batteries.
2. Remove screw (7) from the upper cover (8). The screw is located in the center of the upper cover, securing the cover to cabinet (20).
3. Slide your fingers between upper cover (8) and middle cover (5). Pull upper cover downwards approximately 1-1/2” and then pull outwards, Lift off the covers as an assembly.
4. The lower cover (3) is held in position by four locating pins on frame (1). Lift upwards along the front edge of cover (3) and then pull backwards, removing the cover from the pins. Lift of cover (3).

4-3.2. Installation

1. Install lower cover (3) onto the four locating pins on frame (1). Make sure the rear two locating pins are visible in grommets (2).
2. Slide the two arms of middle cover (5) through the holes along the front edge of the main lower plate (3). Slide your fingers between upper cover (8) and middle cover (5). Pull upper cover downwards until the locating pins on cover (8) slide under the edge of cabinet (20).
3. Slowly release the upper cover (8) into position. Make sure the locating pins seat in the cabinet grommets.
4. Secure upper cover with screw (7).
5. Reconnect the batteries and turn on the keyswitch.

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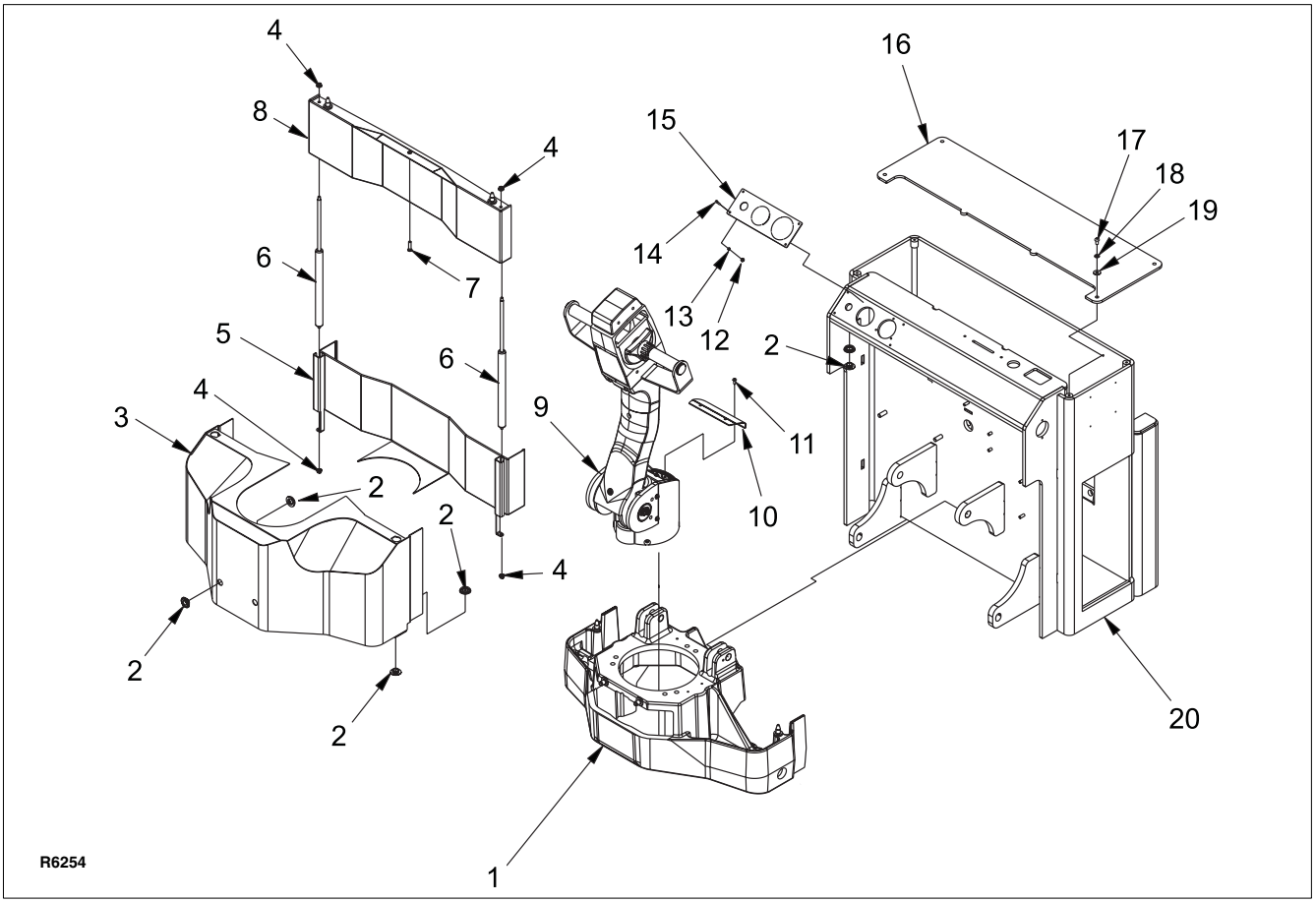

Figure 4-1. Base and Frame

4-4. CONTROL HEAD

4-4.1. Belly-Button Switch Adjustment.

If the actuator gap of the belly-button switch needs adjustment, proceed as follows (Figure 4-2):

1. Turn off the keyswitch and disconnect the batteries.
2. Drive out the roll pins that secure the belly-button casting (Figure 4-2). 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 switch(es) to adjust gap between rollers and belly-button casting as required (See Figure 4-2).

CAUTION: If too small a gap exists between belly-button switch actuator rollers and the belly-button casting, the belly-button switches may be actuated constantly.

4. Reinstall belly-button casting, making certain all parts are back in place.
5. 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 activated.

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 could be unreliable and may not switch in some instances.

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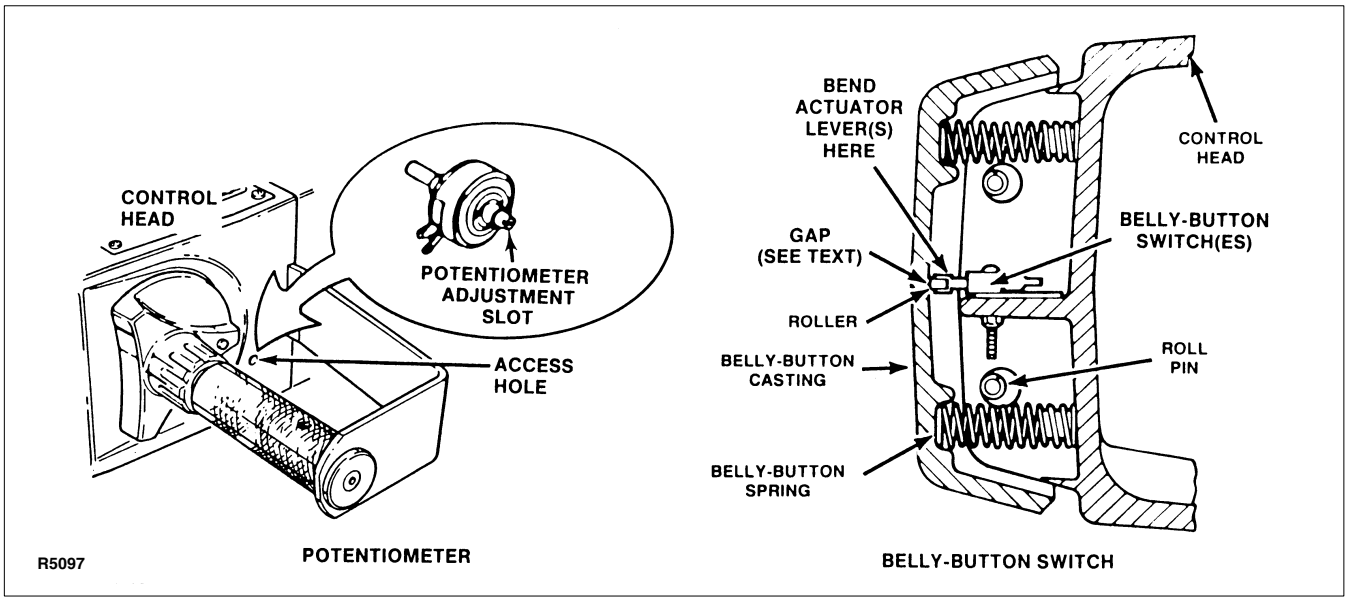

Figure 4-2. Belly-Button Switch and Potentiometer Adjustment

6. Repeat steps 2. through 5. until pressing the belly-button casting actuates the switches properly.
7. Reconnect the batteries and turn on the keyswitch.

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

8. In an open, unrestricted area and traveling at a low speed in forward (towards the operator), press the belly-button casting inwards to confirm that the belly-button switches reverse the truck direction.

4-4.2. Potentiometer Testing and Adjustment.

1. Turn off the key switch and disconnect the batteries.
2. Remove screws (20 and 64, Figure 4-3) and 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 control cable (15, Figure 4-4) from panel assembly (13). Set an ohmmeter to the RX1K (1000) scale and connect across pin contacts of wires 4 and 11 at the control cable (15) pin housing.
5. Slowly press the control lever (52, Figure 4-3) in the forward direction until a click indicating forward switch closure is heard. Ohmmeter should indicate 4550 ±250 ohms.
6. If incorrect reading is obtained, use access hole, in side of control head (Figure 4-2) to gain access to the potentiometer (3, Figure 4-3). Insert a screwdriver blade into the slot on the back side of the potentiometer (Figure 4-2) 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 4-3) as necessary to obtain the same values. Adjust the potentiometer again if necessary.
8. Rotate cam (46) in both forward and reverse directions, until it stops. Verify that bypass switch (7) closes in each direction, just prior to the stop.
9. Reassembly the control head.
10. Reconnect the batteries and turn on the keyswitch.

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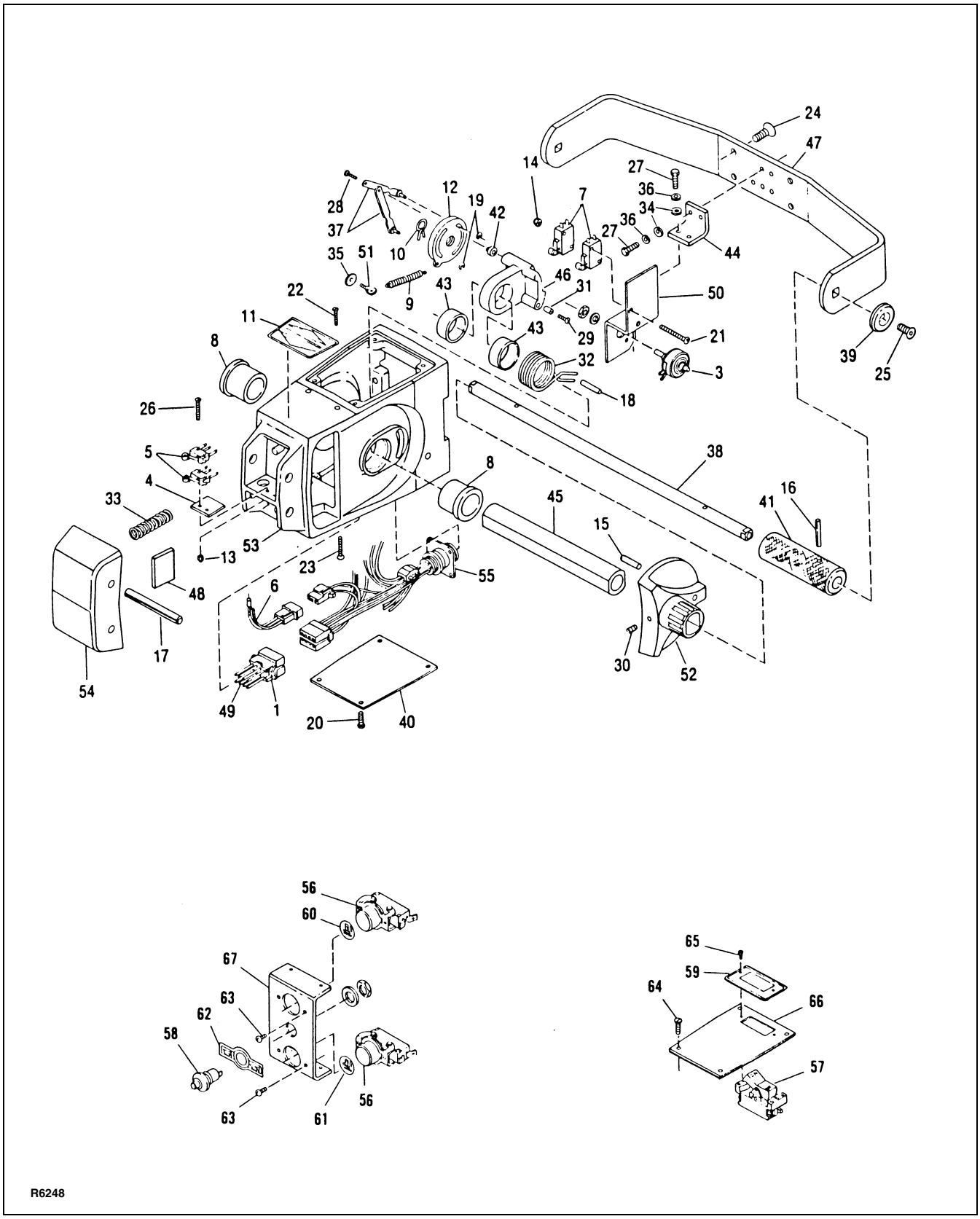

Figure 4-3. Control Head Assembly

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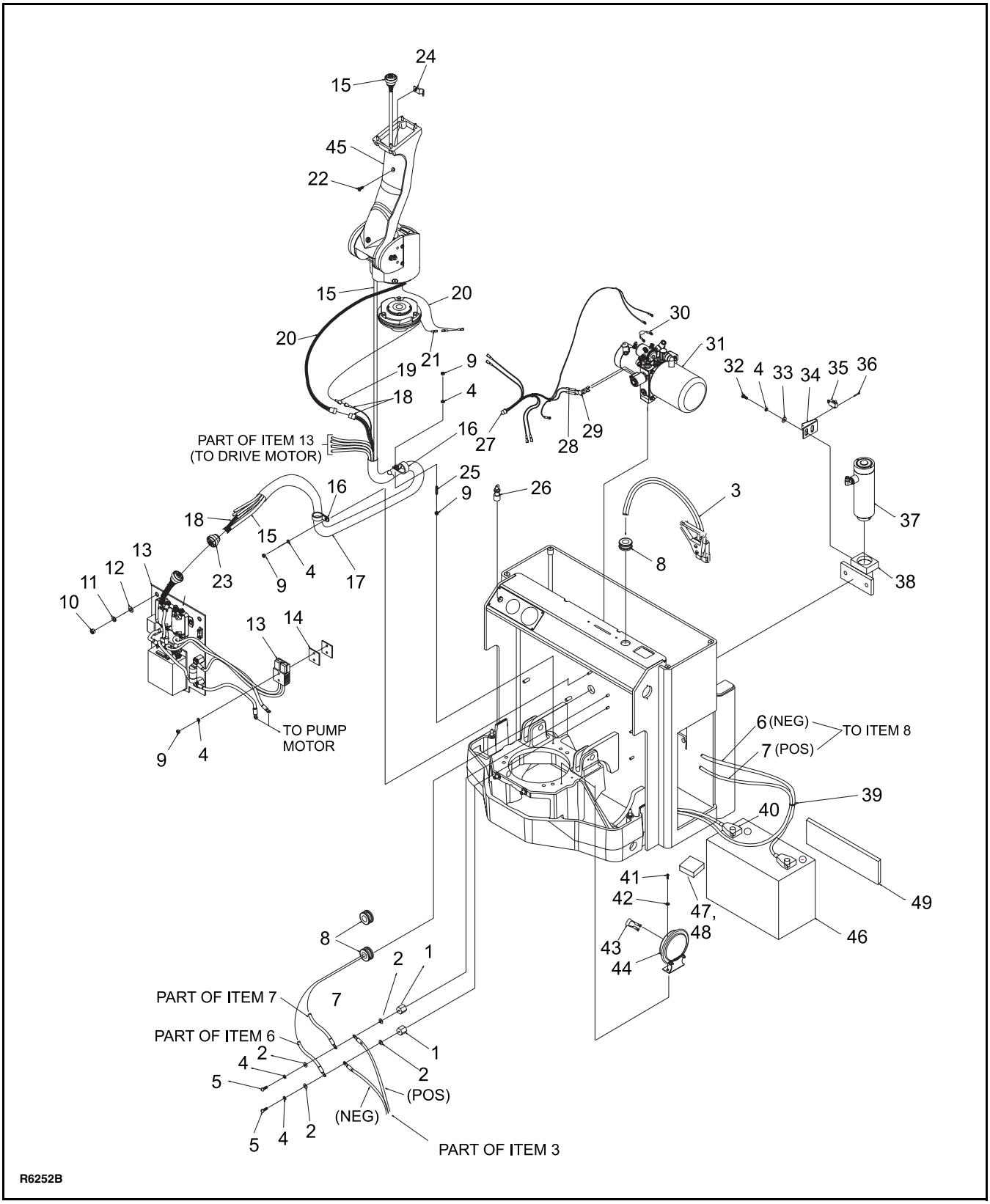

Figure 4-4. Electrical System

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4-4.3. Control Head Switch Replacement.

1. Turn off the keyswitch and disconnect the batteries.

NOTE: Access to belly-button switches (5, Figure 4-3) is provided by removal of belly-button casting (54); access to other switches is provided by removal of top cover (66), bottom cover (40), and switch plate (67).

2. Refer to paragraph 4-4.1. 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 screws (26) to release belly-button switches (5) and insulator (4).
   b. Tag and disconnect electrical wires from belly-button switches (5).
   c. Connect electrical wires to new belly-button switches (5), as noted during removal.
   d. Install insulator (4) and belly-button switches (5) and secure with screws (26) and locknuts (13).
   e. Adjust belly-button switch (paragraph 4-4.1.).
4. Replace a defective **High Speed Cutout Switch** (57) as follows:
   a. Turn off the keyswitch and disconnect the batteries.
   b. Remove screws (64) and top cover (66).
   c. Remove screws (65) to release cutout switch (57).
   d. Tag and disconnect electrical wires from cutout switch (57).
   e. Connect electrical wires to new cutout switch (57), as noted during removal.
   f. Install cutout switch (57) and secure with screws (65).
   g. Install top cover (66) and secure with screws (64).
   h. Reconnect the batteries and turn on the keyswitch.
5. Replace a defective **Lift, Lower or Horn Switch** (56 or 58) as follows:
   a. Turn off the keyswitch and disconnect the batteries.
   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).
      OR
      Remove nut and washer from back of horn switch (58) to remove from switch plate (67).
   f. Tag and disconnect electrical wires from defective switch.
   g. Connect wires to new switch, as noted during removal.
   h. To install lift or lower switch (56), position on back of switch plate (67) and secure with screws (63).
      OR
      To install horn switch (58), position on front of switch plate (67) and secure with it's washer and nut.
   i. Install switch plate (67) and secure with screws (22 and 23).
   j. Install top cover (66) and secure with screws (64).
   k. Install bottom cover (40) and secure with screws (20).
   l. Reconnect the batteries and turn on the keyswitch.
6. Replace a defective **Potentiometer** as follows:
   a. Turn off the keyswitch and disconnect the batteries.
   b. Remove the four screws (3, Figure 4-5) securing the control head (1) to the steering arm (2).
   c. Disconnect connector (23, Figure 4-4) and remove the control head.
   d. Refer to Figure 4-3 for parts relationship, if replacing potentiometer. Tag and disconnect electrical wires. Carefully note the position and orientation of all components, to help ensure proper reassembly.

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4-5. STEERING ARM

4-5.1. Return Spring.

1. Adjustment (Figure 4-5).

   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 itself.

   If the steering arm does not return fully, first check for binding in the brake linkage or wiring harness before making any adjustments. If no binding is found, then the problem is with the steering arm return spring. Refer to Figure 4-5 and proceed as follows to adjust the steering arm return spring tension.

CAUTION: The steering arm (2) will fall when the tension on the return spring (24) is released.

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

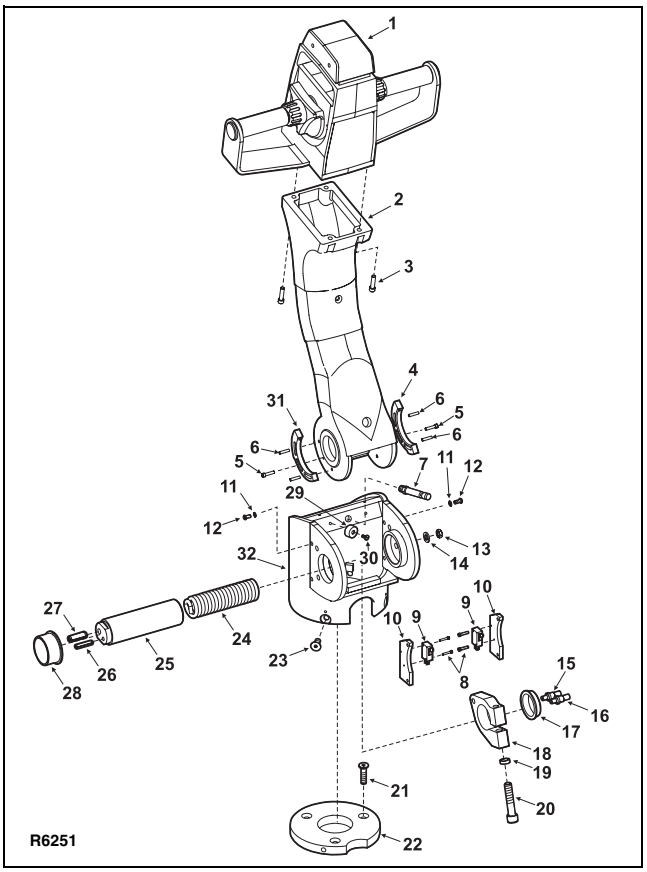

Figure 4-5. Steering Arm

   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 (26 and 27) 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.

2. Replacement (Figure 4-5).

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

   a. Turn off the keyswitch and disconnect the batteries.

NOTE: When removing the control head in the following step, be sure to hold it in place until the control cable is disconnected.

   b. Remove the four screws (3) securing the control head (1) to the steering arm (2).

   c. Disconnect connector (23, Figure 4-4) and remove the control head.

CAUTION: The steering arm (2, Figure 4-5) will fall downward when the tension on the return spring (24) is released.

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

   e. With a piece of chalk or crayon, draw a straight line from center of spring tube (25) outward onto adapter (32), marking an alignment match mark to assist in re-installation.

   f. Insert a 5/16 inch Allen wrench through hole in bottom of steering arm (2). Loosen and remove screw (20) and spacer (19).

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CAUTION: Unless properly supported, steering arm (2) will drop out of adapter (32) when spring tube (25) is removed.

g. Put a block under steering arm (2) at adapter (32).

h. With a pair of vise-grip pliers, grip the flat surfaces of spring tube (25) and slowly pull it free from the steering arm (2), adapter (32) and tube clamp (18).

NOTE: The flat surfaces are on the protruding end of the spring tube (25), where the pins (26 and 27) are installed. Steering arm return spring (24) will remain inside the spring tube (25).

i. 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.

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

k. Insert spring (24) into spring tube (25) and press in, making sure that one spring loop eye fits over the 3/8-inch pin (15) at the closed end of the spring tube.

l. Slide spring tube (25) into adapter (32) and steering arm (2) through tube clamp (15) and through loop of electrical cable. Slowly rotate spring tube a few degrees each way until the steering arm return spring (24) snaps into place over spring pin (15).

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

n. Remove block from under steering arm.

o. Reconnect connector (23, Figure 4-4) and position the control head on the steering arm.

p. Install the four screws (3).

q. If necessary, refer to paragraph step 1. and adjust the tension on steering arm return spring.

r. Reconnect the batteries and turn on the keyswitch.

4-5.2. Electrical Control Cable Replacement

1. Turn off the keyswitch and disconnect the batteries.
2. Remove the compartment covers as described in paragraph 4-3.

NOTE: When removing the control head in the following step, be sure to hold it in place until the control cable is disconnected.

3. Remove four screws (3, Figure 4-5) that fasten control head (1) to steering arm (2).
4. Disconnect control cable (15, Figure 4-4) from the control head and remove the control head.
5. Remove cable clamp (24) by loosening screw (22).
6. Disconnect connector (23) from panel (13).
7. Note routing of cable and position of clamps to ensure proper installation. Remove clamps (16) and the plastic ties securing control cable (15).

CAUTION: Take care not to cut or damage the other cables that are bundled with the control cable (15) during the following step.

8. Cut the electrical tape at both ends of the braided fabric sleeve (17) and slide the sleeve towards one end. This will release the pressure on the sleeve making cable removal easier.
9. Cut off the connector from the top of control cable (15). Using electrical tape, wrap and tape the loose ends of the new cable (15) to the cut end of the old cable.
10. Pull the old cable out the bottom of the control arm while threading the new cable into the control arm. Make sure to leave enough of the new cable to allow connection to the control head.
11. Reinstall clamp (24) with screw (22).
12. With the sleeve (17) in the relaxed condition, pull the old cable out the bottom of sleeve (17) while threading the new cable through the sleeve. Make sure to leave enough cable at lower end of sleeve to enable proper connection to panel (13).
13. Remove the tape securing the old and new cables together.
14. Secure the upper end of the sleeve (17) to the cable bundle with electrical tape.

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NOTE: In the following step, do not tape the lower end of sleeve (17) directly to the cable bundle. Sleeve should be able to move freely on the bundle.

15. Fold under the lower end of sleeve (17) and tape the end of the sleeve to hold in tighter to the cable bundle.
16. Pull the sleeve taught over the cable bundle.
17. Install wires of control cable (15) into new connector (23). See Figure 4-6.
18. Install wires of harness (18, Figure 4-4) into new connector (23). See Figure 4-7.
19. Connect connector (23, Figure 4-4) to control panel (13).
20. Attach cable (15) to the control head and secure the control head to the steering arm with four screws (3, Figure 4-5).

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

21. Position cable as noted in removal and secure with clamps (16) and plastic ties.
22. Work steering arm up and down a few times to assure that the electrical control cable is not binding.
23. Pivot the steering arm through entire turning range, make sure that all electrical cables will flex properly and not become caught or pinched at any time.
24. Reinstall the compartment covers as described in paragraph 4-3.

HOUSING PIN NO.	004705 CABLE	
	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
13		
14		
15		
16		

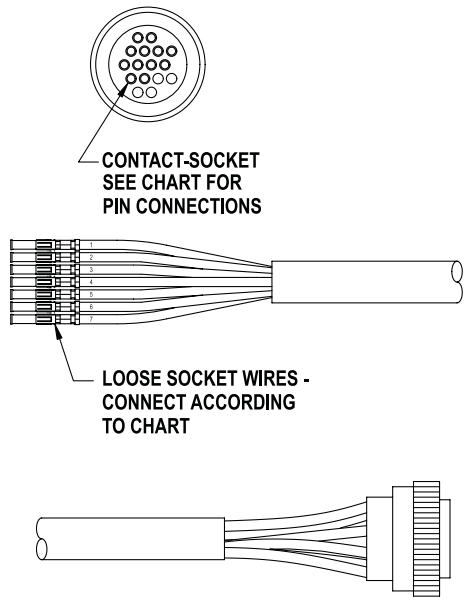

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Figure 4-6. Control Cable Connections

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HOUSING PIN NO.	023277 HARNESS	
	WIRE NO.	WIRE COLOR
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13	3	RED
14	3	RED
15	15	RED
16	16	RED

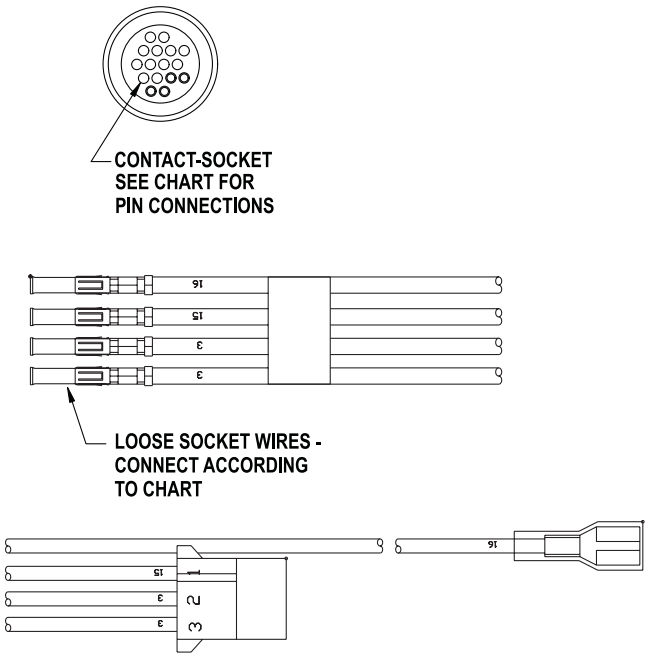

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Figure 4-7. Switch Harness Connection

4-6. BRAKES.

4-6.1. Adjustment.

1. Turn off the keyswitch and disconnect the batteries
2. Remove the compartment covers as described in paragraph 4-3.
3. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
4. Remove the four screws (2, Figure 4-10) and lower guard ring (4) as far as possible.

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

5. Remove the four screws (23, Figure 4-5) securing the steering arm to motor mounting plate (22).

CAUTION: Use caution when removing the raising the steering arm that the control cables are not disconnected or damaged.

6. Raise and support the steering arm to provide access to the brake assembly.
7. Locate the rubber seal (1, Figure 4-8) on the brake assembly. Slide the rubber seal upwards to enable access to the adjustment points (2).
8. Using standard feeler gauges, check the gap between friction plate (2, Figure 4-9) and magnet body (1). The gap should be 0.012” (0.3 mm).

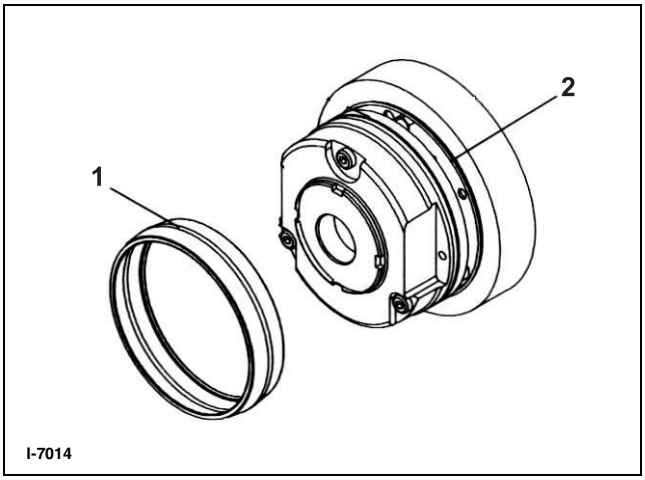

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Figure 4-8. Electrical Brake Assembly

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9. If necessary, adjust the gap as follows:
   a. Loosen the three bolts (4) by half a turn.
   b. The threaded collars (3) which surround bolts (4) can then be screwed into magnet body (1) by turning counterclockwise.
   c. Turn the three bolts (4) clockwise until the gap measured in step 8. is 0.012” (0.3 mm).
   d. The threaded collars (3) are then screwed clockwise until they bottom.
   e. Finally tighten bolts (4) and recheck the gap as described in step 8.
10. Reinstall the rubber seal (1, Figure 4-8). Make sure to seat the seal around the base of the friction plate and the lower groove in the magnetic body.

NOTE: Make sure to route the electrical wires and cable through the semi-circular notch in mounting plate (22, Figure 4-5) when installing the steering arm.

11. Lower the steering arm into position.
12. Secure the steering arm to motor mounting plate (22) with the four screws (23).
13. Raise the lower guard ring (4, Figure 4-10) into position and secure with the four screws (2)
14. Remove blocking and lower the truck.
15. Reinstall the compartment covers as described in paragraph 4-3.
16. Reconnect the batteries and turn on the keyswitch.

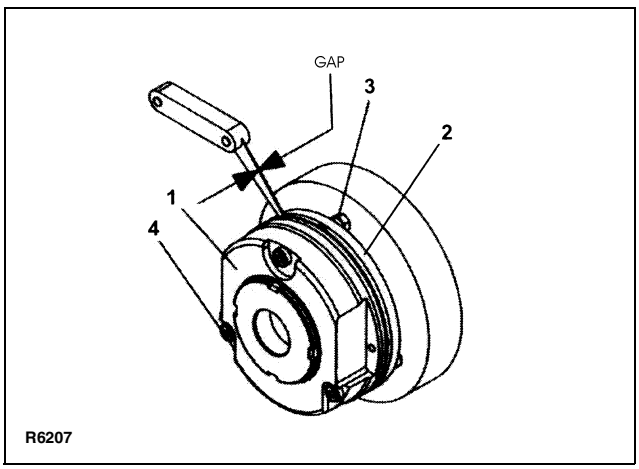

Figure 4-9 Brake Adjustment

4-6.2. Brake Pad Replacement.

1. Turn off the keyswitch and disconnect the batteries
2. Remove the compartment covers as described in paragraph 4-3.
3. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
4. Remove the four screws (2, Figure 4-10) and lower guard ring (4) as far as possible.

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

5. Remove the four screws (23, Figure 4-5) securing the steering arm to motor mounting plate (22).

CAUTION: Use caution when raising the steering arm that the control cables are not disconnected or damaged.

6. Raise and support the steering arm to provide access to the brake assembly.
7. Remove three bolts (2, Figure 4-11) and lift brake (1) off motor (7).
8. Slide rubber cover seal (6) up onto magnetic body (3), loosening the friction plate (5) and rotor (4).
9. Remove friction plate (5) and rotor (4).
10. Position new rotor (4) on magnetic body (3) so that the raised spline edge is facing up.
11. Position friction plate (5) against rotor (4) and align the mounting holes.
12. Insert the three mounting bolts (2) through the brake assembly (1) and reposition the assembly over the splined shaft on the drive motor (7).
13. Secure the brake assembly (1) on the drive motor (7).
14. Adjust the brake as described in paragraph 4-6.1.
15. Reinstall the rubber seal (6). Make sure to seat the seal around the base of the friction plate (5) and the lower groove in the magnetic body (3).

NOTE: Make sure to route the electrical wires and cable through the semi-circular notch in mounting plate (22, Figure 4-5) when installing the steering arm.

16. Lower the steering arm into position.

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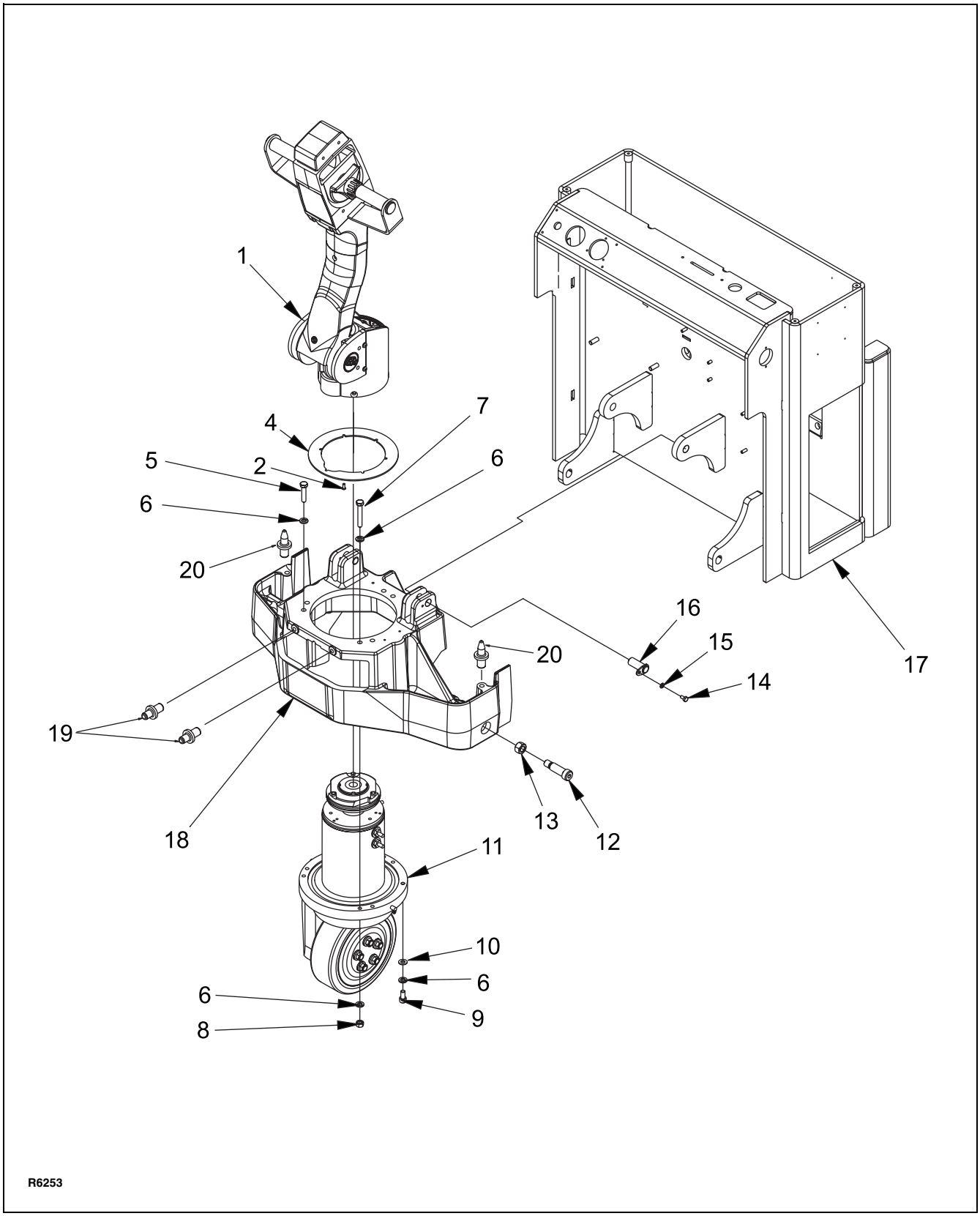

Figure 4-10. Pivot Assembly

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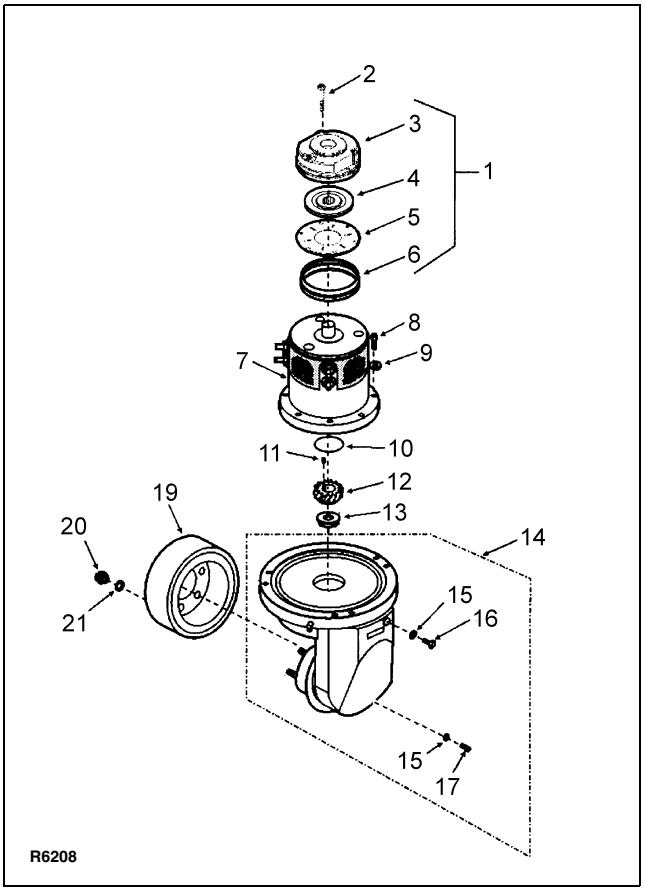

Figure 4-11. Transmission, Motor and Brake Assembly

17. Secure the steering arm to motor mounting plate (22) with the four screws (23).
18. Raise the lower guard ring (4, Figure 4-10) into position and secure with the four screws (2)
19. Remove blocking and lower the truck.
20. Reinstall the compartment covers as described in paragraph 4-3.
21. Reconnect the batteries and turn on the keyswitch.

4-6.3. Brake Assembly Replacement.

1. Turn off the keyswitch and disconnect the batteries
2. Remove the compartment covers as described in paragraph 4-3.
3. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.
4. Remove three screws (11, Figure 4-1) and cover (10).
5. Disconnect connector (21, Figure 4-4) from harness (20).
6. Remove the four screws (2, Figure 4-10) and lower guard ring (4) as far as possible.

WARNING: 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 4-5) securing the steering arm to motor mounting plate (22).

CAUTION: Use caution when raising the steering arm that the control cables are not disconnected or damaged.

8. Raise and support the steering arm to provide access to the brake assembly.
9. Disconnect connector (19) from harness (18).
10. Remove three bolts (2, Figure 4-11) and lift brake (1) off motor (7).
11. Insert the three mounting bolts (2) through the new brake assembly (1) and position the assembly over the splined shaft on the drive motor (7).
12. Secure the brake assembly (1) on the drive motor (7).
13. Adjust the brake as described in paragraph 4-6.1.
14. Install terminal (19) on the blue wire of brake assembly and then connect to harness (18).
15. Install terminal (21) on the remaining wire of brake assembly and then connect to harness (20).

NOTE: Make sure to route the electrical wires and cable through the semi-circular notch in mounting plate (22) when installing the steering arm.

16. Lower the steering arm into position.
17. Secure the steering arm to motor mounting plate (22) with the four screws (23).
18. Raise the lower guard ring (4, Figure 4-10) into position and secure with the four screws (2).
19. Reinstall cover (10, Figure 4-1) and three screws (10).

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20. Remove blocking and lower the truck.
21. Reinstall the compartment covers as described in paragraph 4-3.
22. Reconnect the batteries and turn on the keyswitch.

4-6.4. Replacement of Deadman Switch

1. Turn off the keyswitch and disconnect the batteries
2. Block the wheels to prevent the truck from rolling.
3. Remove three screws (11, Figure 4-1) and cover (10).
4. Remove the switch mounting bracket mounting screws (3, Figure 4-12).

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 deadman actuation cam.

5. Remove the switch mounting bracket (2) and switch assembly (1).
6. Tag and disconnect electrical wires from switch (1).
7. Remove the switch (1) from the mounting bracket (2) and install new switch onto mounting bracket.
8. Reconnect wiring to new switch (1) as noted during removal.
9. Reinstall switch mounting bracket (2) onto steering tube.
10. Reinstall cover (10, Figure 4-1) and three screws (10).
11. Reconnect the batteries and turn on the keyswitch.
12. Remove wheel blocking and test operate truck to verify dead-man switch operation.

4-6.5. Replacement of Creep Travel Switch

1. Turn off the keyswitch and disconnect the batteries
2. Block the wheels to prevent the truck from rolling.

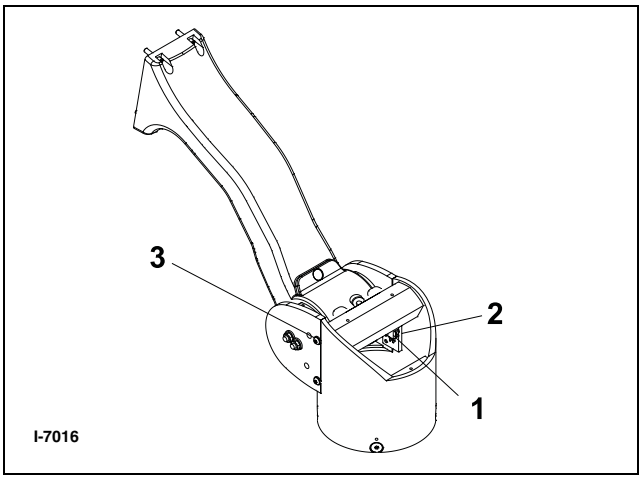

Figure 4-12. Dead Man Switch

3. Remove three screws (11, Figure 4-1) and cover (10).
4. Remove the switch mounting bracket mounting screws (3, Figure 4-13).

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 cam.

5. Remove the switch mounting bracket (2) and switch assembly (1).
6. Tag and disconnect electrical wires from switch (1).
7. Remove the switch (1) from the mounting bracket (2) and install new switch onto mounting bracket.
8. Reconnect wiring to new switch (1) as noted during removal.
9. Reinstall switch mounting bracket (2) onto steering tube.
10. Reinstall cover (10, Figure 4-1) and three screws (10).
11. Reconnect the batteries and turn on the keyswitch.
12. Remove wheel blocking and test operate truck to verify dead-man switch operation.

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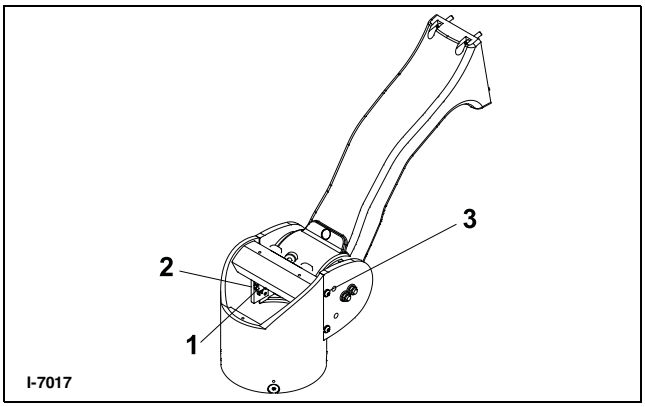

Figure 4-13. Creep Travel Switch

4-6.6. 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 4-14), 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.

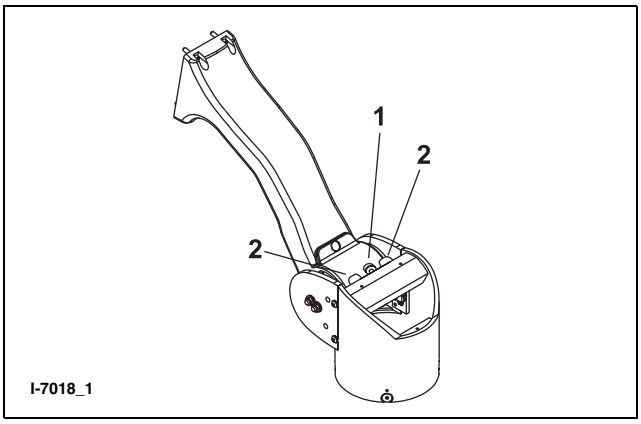

Figure 4-14. Control Arm Shock Absorber

4-7. DRIVE MOTOR, TRANSMISSION, AND DRIVE WHEEL.

4-7.1. Drive Motor

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.

1. Brush Inspection and Replacement

   The brushes can be inspected and replaced without removal of the motor. Proceed as follows:

   a. Turn off the keyswitch and disconnect the batteries

   b. Remove the compartment covers as described in paragraph 4-3.

   c. Jack up the truck so the drive wheel is off the ground; then securely block the truck to prevent movement.

   d. Make sure the four cables to the drive motor are properly labeled A1, A2, F1, and F2; then disconnect the cables from the drive motor.

   e. Move the power and control cable bundle out of the way.

   f. Loosen and remove the motor headband (15, Figure 4-16).

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

   g. Loosen the mounting screw on each brush power lead and remove brush (12).

   h. Install new brush, reset brush spring and secure the electrical lead.

   i. Repeat Steps g. and h. for remaining brushes.

   j. Reinstall the motor headband (15).

   k. 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.

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l. Lower the steering arm into position.

m. Secure the steering arm to motor mounting plate (22, Figure 4-5) with the four screws (23).

n. Raise the lower guard ring (4, Figure 4-10) into position and secure with the four screws (2).

o. Remove blocking and lower the truck.

p. Reinstall the compartment covers as described in paragraph 4-3.

q. Reconnect the batteries and turn on the key-switch.

r. Check for proper operation.

2. Motor Removal

a. Remove the brake as described in paragraph 4-6.3.

b. Note routing of cables and position of clamp and ties to ensure proper installation. Remove clamp (16, Figure 4-4) and plastic ties securing control cable (15).

c. Make sure the four cables to the drive motor are properly labeled A1, A2, F1, and F2; then disconnect the cables (1, Figure 4-15) from the drive motor.

d. Remove the eight screws (2) holding the motor (3) to the transmission.

e. Remove the motor (3).

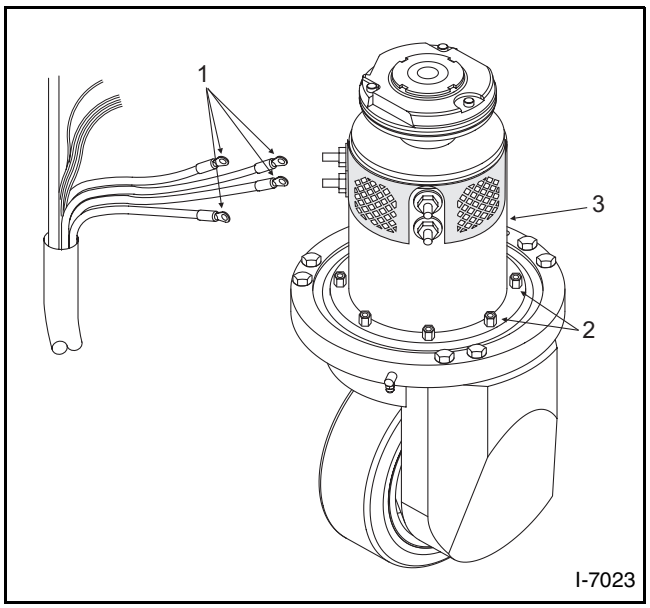

Figure 4-15. Motor Removal

3. Motor Repair

a. Check and replace the brushes as described in paragraph 1.

b. Remove spring clip, splined gear and woodruff key (1, 2 and 3, Figure 4-16).

c. Remove allen head screws (4) and motor end plate (5).

d. Remove bolts (6), commutator end-head assembly (7) and upper bearing (9).

e. Remove the spring washer (13) and save for reassembly

f. Remove all brushes (12).

g. Remove the brush box assembly (10) and brush springs (11).

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

i. Clean the commutator of sand particles and reassemble the motor in reverse of disassembly procedure.

4. Motor Installation

a. 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.

b. Reinstall the eight screws (2) to secure the motor to the transmission.

c. Connect cables (1, Figure 4-15) to the drive motor. Make sure to match the cable label to the terminal.

d. Position control cable as noted in removal and secure with clamp (16) and plastic ties.

e. Reinstall the brake as described in paragraph 4-6.3.

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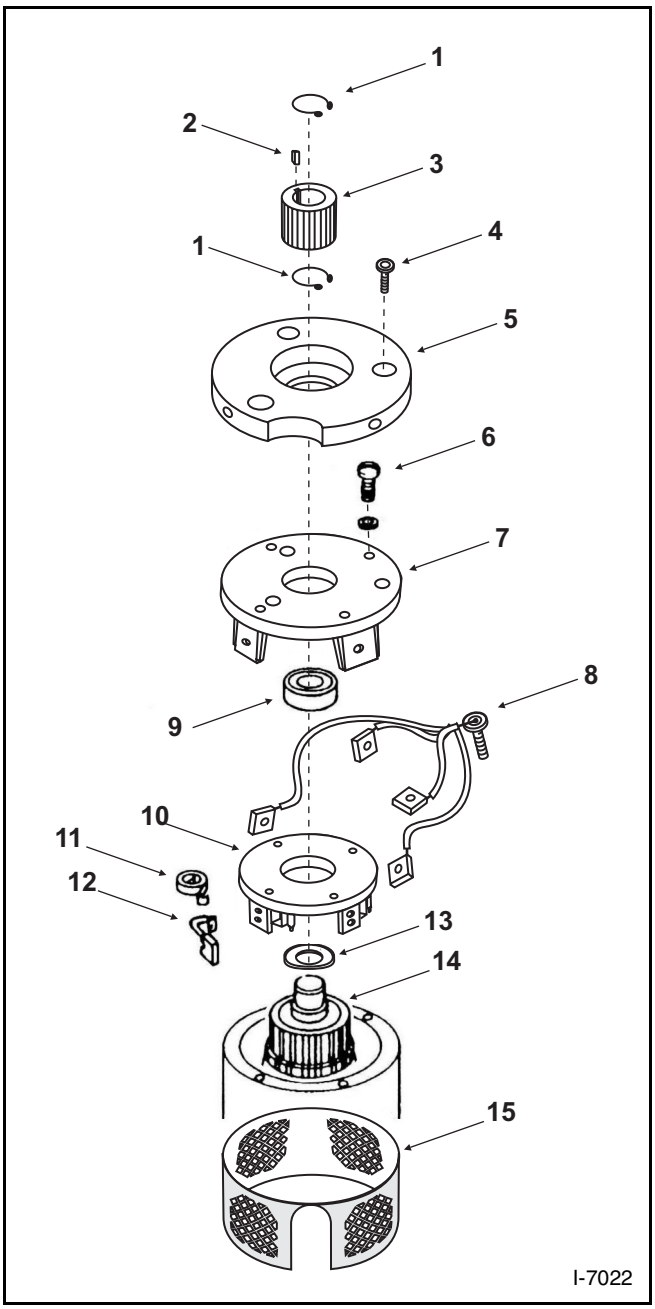

Figure 4-16. Motor Commutator

4-7.2. Transmission.

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.

1. Remove the brake as described in paragraph 4-6.3.
2. Remove the motor as described in paragraph 4-7.1. step 2.

NOTE: Support the transmission assembly during removal of the mounting hardware.

3. Remove screw (9, Figure 4-10) with washer (6) and washer (10).
4. Remove nut (8), washer (6), screw (7) and washer (6).
5. Remove five screws (5) and five washers (6).
6. Slowly lower the transmission out the bottom of the frame.
7. Remove the drive wheel (19, Figure 4-11) from the transmission by removing the five lug nuts (20).
8. Install new transmission by reversing steps 1. through 7. above.

4-7.3. 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 screw (9, Figure 4-17) securing pin (8) and remove the pin.
5. When pin (9) is removed the load wheel assembly (6) and spacers (7) 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.

6. Partially insert pin (8) into housing (5).
7. Install one spacer (7) onto the shaft.

NOTE: Make sure that the bearings are fully seated on each side of load wheel (6) and are flush with the outside edge of the load wheel assembly.

8. Position load wheel (6) in housing (5).
9. Slide pin (8) part way through the load wheel assembly and insert the remaining spacer(s) (7).
10. Fully seat the pin (8) and secure with screw (9).

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4-8. BASE, FRAME AND FORK SECTION

4-8.1. Lift Linkage

1. Removal
   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. Drive pin (25, Figure 4-17) from shaft (26). Support pivot (23) and remove shaft (26) and washers (20). Remove springs (21) and lower pivot (23) to the floor.
   c. Drive pin (2) from shaft (3). Support wheel housing (5) and remove shaft (3). Remove wheel housing (5) and assembled linkage from fork section (1).
   d. Remove screw (11), shaft (10) and washers (14), separating wheel housing (5) from rod end (12).
   e. If necessary, remove load wheel (6) as described in paragraph 4-7.3.
   f. Drive pin (25) from shaft (24) and pivot (23). Remove shaft (24), separating pivot from rod end (18).
   g. Drive pin (25) from shaft (24) and pivot (23). Remove shaft (24) and roller (22) from pivot (23).
   h. Remove rod end (12) from pull rod (15).
   i. Back off nut (16) and remove rod end (18), washer (17) and nut (16) from pull rod (15).
2. Reassembly
   a. Position roller (22) with washers (20), as necessary, in pivot (23). Install shaft (24) and secure with pin (25).
   b. Install nut (16) and lockwasher (17) fully onto pull rod (15).
   c. Thread rod end (18) approximately 1 inch onto pull rod (15).
   d. Thread rod end (12) approximately 1 inch onto pull rod (15).
   e. Position rod end (19) in pivot (23) and install shaft (24) and pin (25).
   f. Position rod end (12) with washers (13) as required, in wheel housing (5) and install shaft (10) and screw (11).
   g. Position wheel housing (5) in fork section (1) and install shaft (3) and pin (2).
   h. Position pivot (23) with washers (20) as required, in fork section (1) and secure with pin (26) and pin (25).
   i. Attach springs (21) to each side of rod end (19) and underside of fork section (1).
3. Adjustment
   a. Clamp wheel housing (5) up against fork section (1).
   b. Measure between roller (22) and bottom of fork section (1) as shown in Figure 4-18.
   c. Adjust pull rod (15) as required to provide 18.37” as shown.
   d. Tighten nut (16) against rod end (18).
   e. Adjust other pull rod in the same manner.

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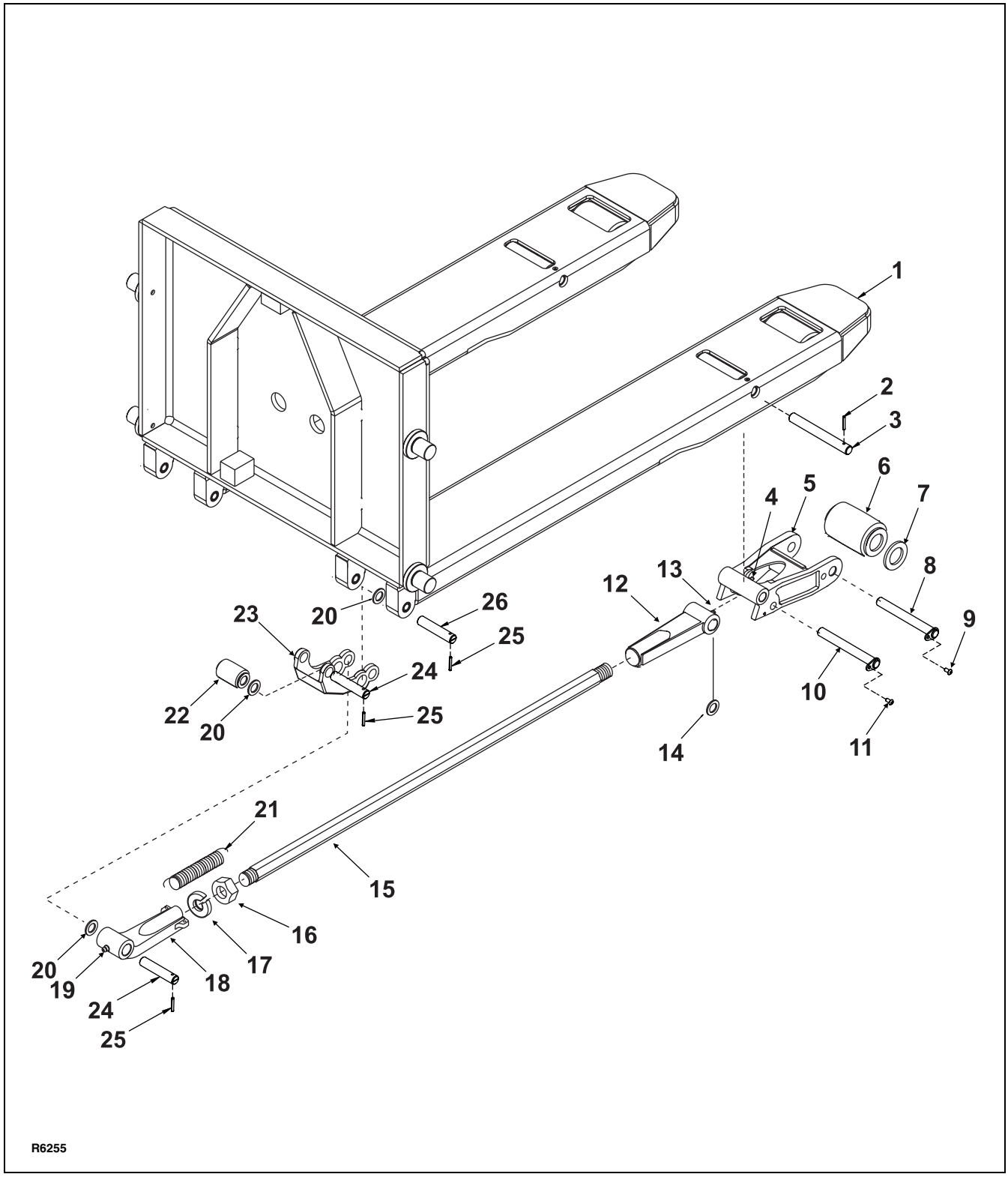

Figure 4-17. Lift Linkage Assembly

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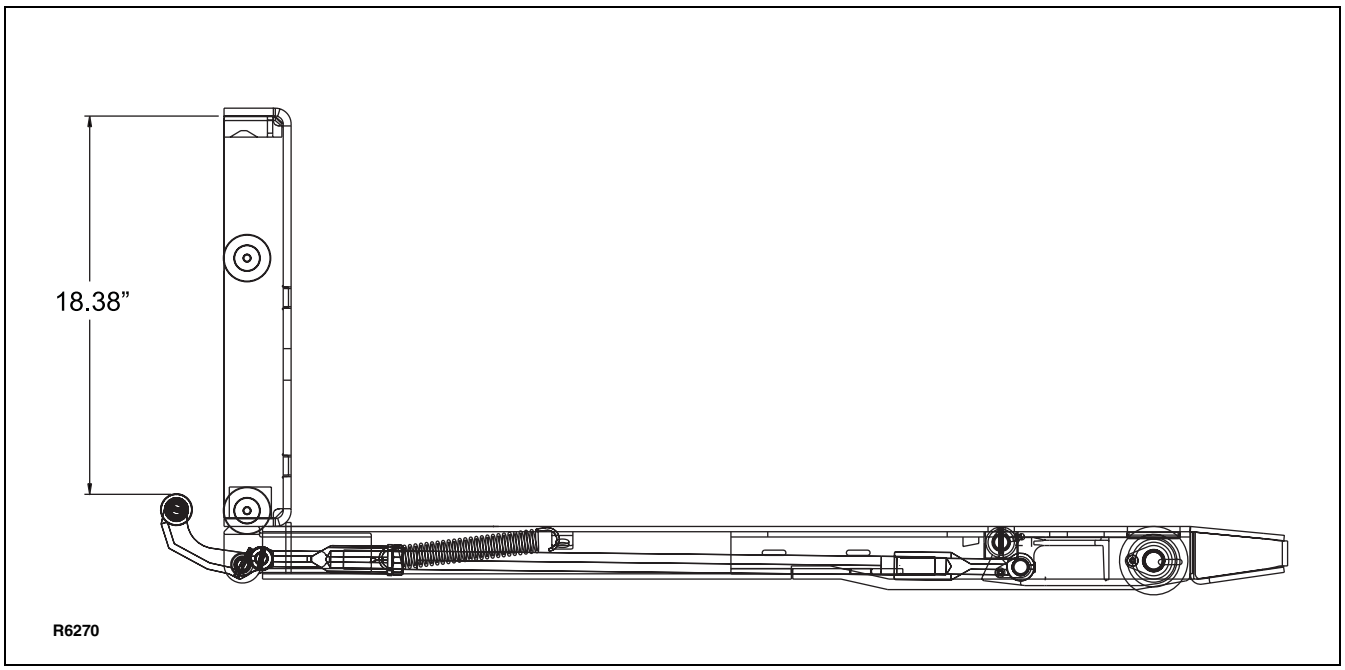

Figure 4-18 Pull Rod Adjustment

4-8.2. Power Section and Fork Section

1. Separating Power Section and Fork Section.
   a. Support entire truck on blocking, providing separate blocks so that the fork section (13, Figure 4-19) can be fully supported when power section is raised up.
   b. Turn off the keyswitch and disconnect the batteries.
   c. Remove the compartment covers as described in paragraph 4-3.
   d. Remove the batteries from cabinet (12).
   e. Ensure that hydraulic pressure has been relieved from the lift circuit. Working through the battery compartment, disconnect the hydraulic line from the lift cylinder.

WARNING: Power section is heavy. Use care while securing and lifting in order to prevent injury.

   f. With suitable hoist, carefully raise the power section slightly so cylinder (7) will clear the socket in fork section (13). Working through the battery compartment, remove the cylinder from mount (11).
   g. Raise or lower the power section in order to access screws (9) through the two holes in the backrest of fork section (13).
   h. Remove screws (9), washers (10) and mount (11).
   i. Raise or lower the power section and remove springs (8).
   j. The power section may now be hoisted straight up and off fork section (13), then placed on blocking.
2. Fork Section Repair.
   a. Inspect rollers (15, Figure 4-19) for wear, or other damage. Replace roller if necessary. Pack rollers with grease.
   b. Inspect fork section (13) for broken welds and weld as necessary. Replace fork section if forks have been bent severely.
3. Power Section Repair.
   a. Repair of the cabinet (12, Figure 4-19) is limited to chasing damaged threads and welding of any broken welds.
   b. Repair power section frame (18, Figure 4-10) is limited to chasing damaged threads and welding of any broken welds.

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c. Removal of components mounted on cabinet (12, Figure 4-19) and power section frame (18, Figure 4-10) may be necessary to effect repairs/welding, refer to table of contents for identification of instructions on such components.

4. Mating Power Section and Fork Section.

a. With suitable hoist, carefully raise the power section in position over fork section (13).

b. Slowly lower the power section being careful that rollers (15, Figure 4-19) properly engage the channels of cabinet (12).

c. Raise or lower the power section and install springs (8).

d. Raise or lower the power section in order to access threaded holes for screws (9) through the two holes in the backrest of fork section (13).

e. Install mount (11), washers (10) and screws (9).

f. Carefully raise the power section slightly and position cylinder (7) on mount (11). Then lower the power section until cylinder (7) mates with the socket in fork section (13).

g. Working through the battery compartment, reconnect the hydraulic line to the lift cylinder.

h. Install the compartment covers as described in paragraph 4-3.

i. Remove blocking from under the truck.

j. Support entire truck on blocking, providing separate blocks so that the fork section (13, Figure 4-19) can be fully supported when power section is raised up.

k. Reconnect the batteries and turn on the keyswitch.

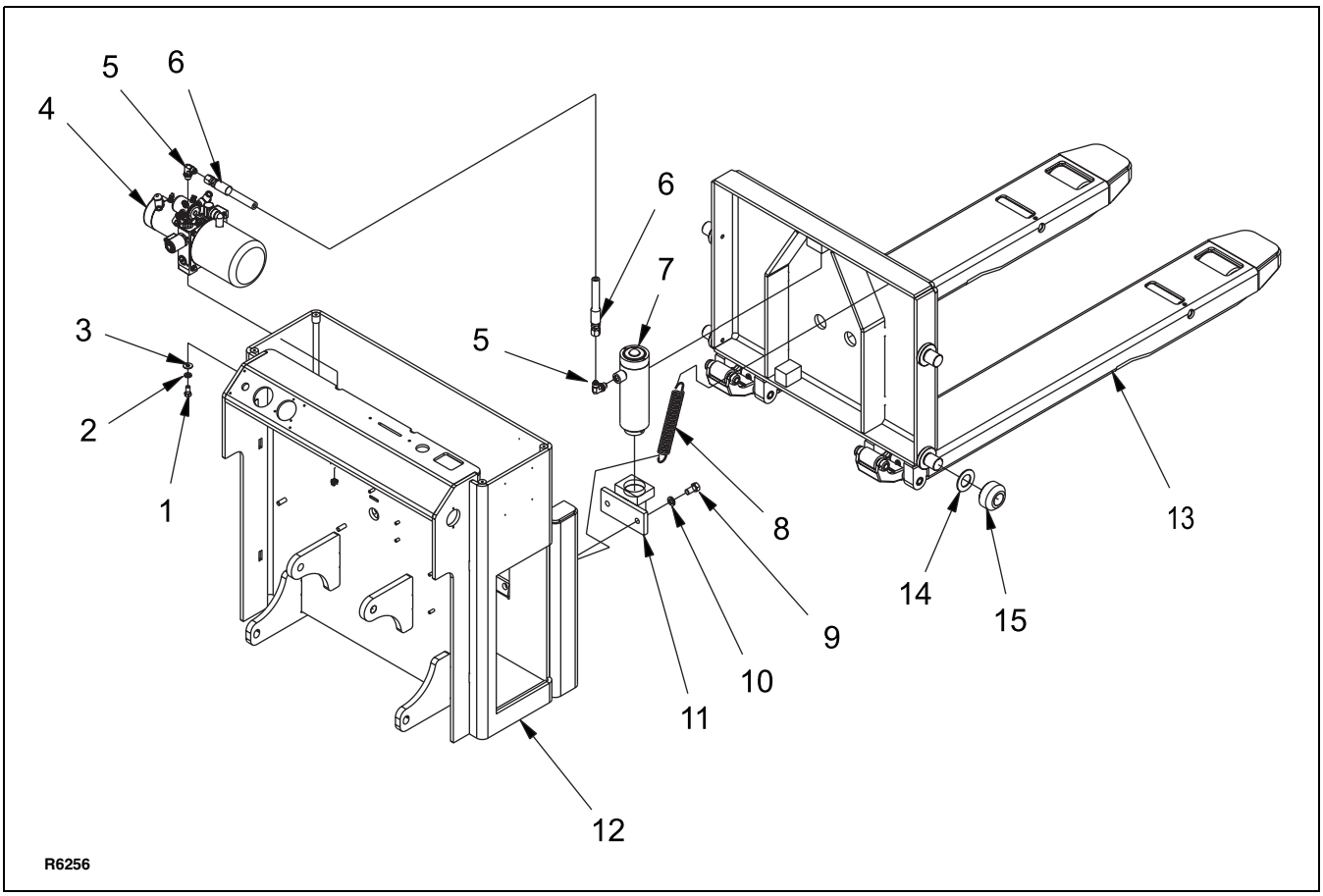

Figure 4-19 Hydraulic Installation

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4-9. ELECTRICAL

4-9.1. Battery Removal and Replacement

Batteries are pulled out the sides of the battery compartment.

WARNING: Batteries available for the lift truck vary in weight. A suitable hoist and sling arrangement must be used to prevent injury or battery damage.

1. Turn off the keyswitch and disconnect the batteries
2. Slide the battery out the side far enough to access the battery terminals.
3. Disconnect the battery cables (6 and 7, Figure 4-4).
4. Reverse procedure for installation.

4-9.2. Control Panel

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

1. Control Panel Removal.
   a. Turn off the keyswitch and disconnect the batteries
   b. Remove the compartment covers as described in paragraph 4-3.
   c. Tag and disconnect all electrical wires and cables which connect to the control panel (13, Figure 4-4).
   d. Remove nuts (10), lock washers (11) and washers (12) and remove the control panel (13).
2. Control Panel Disassembly.

Refer to Figure 4-20 for location and identity of the major replacement components mounted on the panel and remove defective parts.

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

3. Control Panel Removal.
   a. Install the control panel (13) and secure with nuts (10), lock washers (11) and washers (12).
   b. Refer to Figure 4-20 and wiring diagram (Figure 4-22) and connect all electrical wires and cables to the control panel as noted during removal.
   c. Install the compartment covers as described in paragraph 4-3.
   d. Reconnect the batteries and turn on the keyswitch.

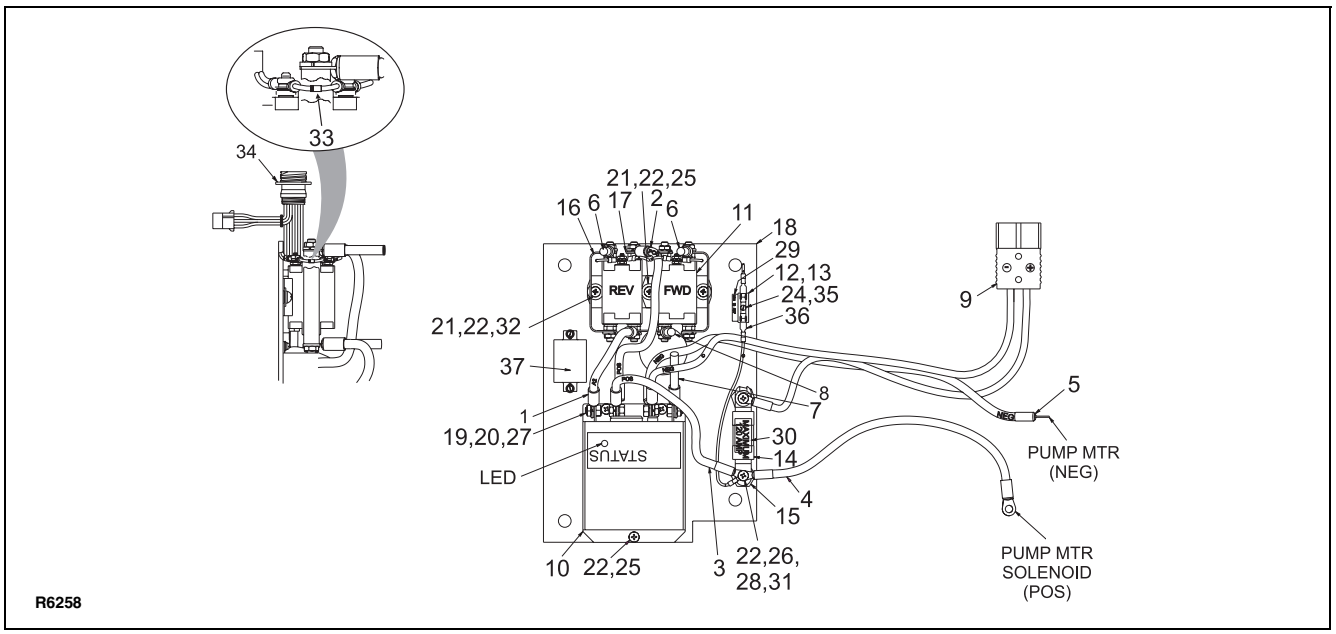

Figure 4-20 Electrical Panel Assembly

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4-9.3. Horn Replacement

1. Turn off the keyswitch and disconnect the batteries
2. Remove the compartment covers as described in paragraph 4-3.
3. Tag and disconnect all electrical connections from horn (44, Figure 4-4).
4. Remove screws (41), lock washers (41) and horn (44).
5. Check spike suppressor (43) for damage and replace as necessary.
6. Install horn (44)and secure with screws (41), lock washers (41) and horn (44).
7. Install the compartment covers as described in paragraph 4-3.
8. Reconnect the batteries and turn on the keyswitch.

4-9.4. Battery Charger

Refer to SECTION 6 for troubleshooting procedures. Refer to Figure 4-21 for part identification. Be sure the the AC cord is connected to proper power supply.

4-9.5. Wiring

Electrical wiring installation is shown on Figure 4-4. When removing or installing electrical wires or cables, refer to the wiring diagram Figure 4-22.

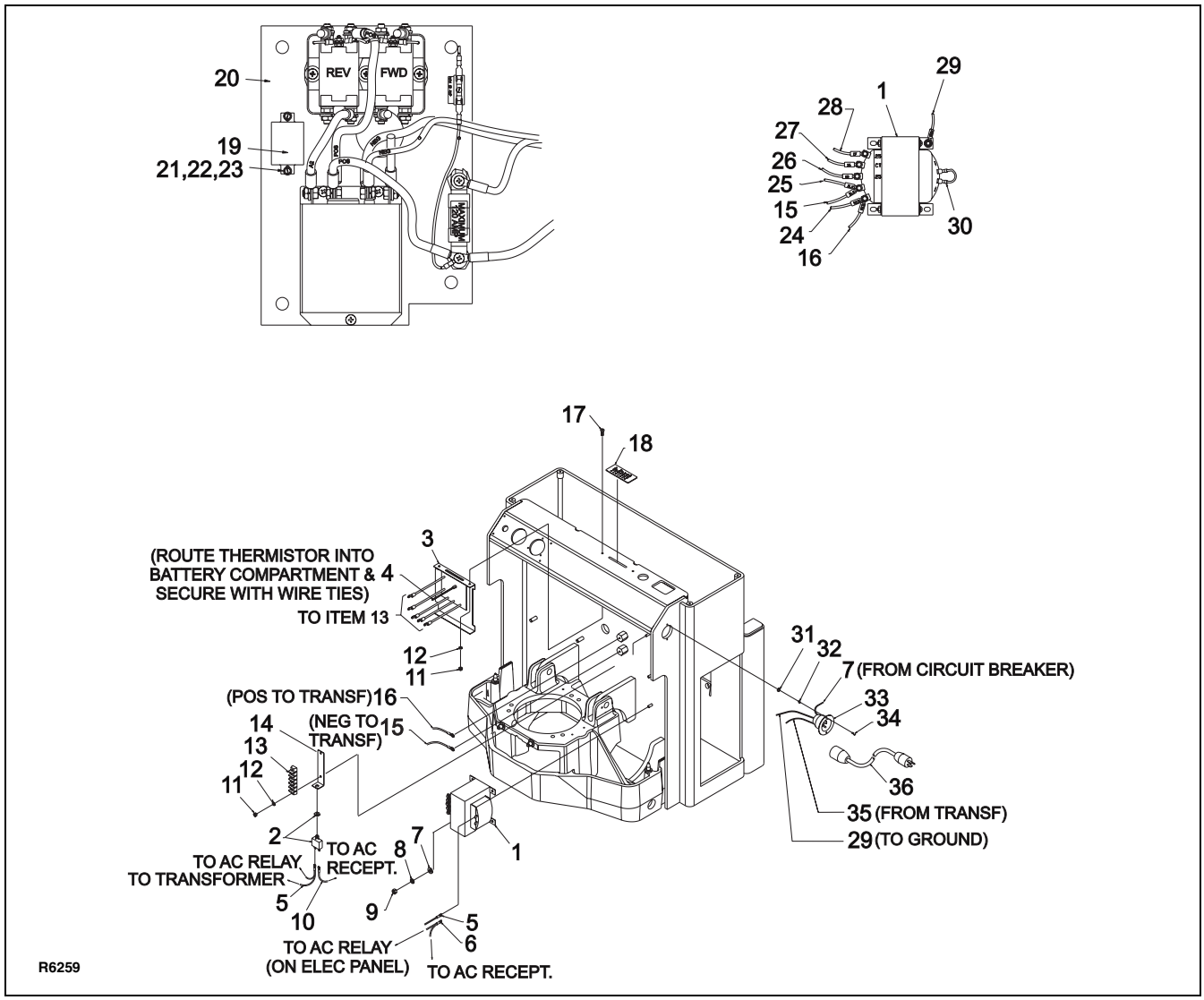

Figure 4-21 Charger Installation

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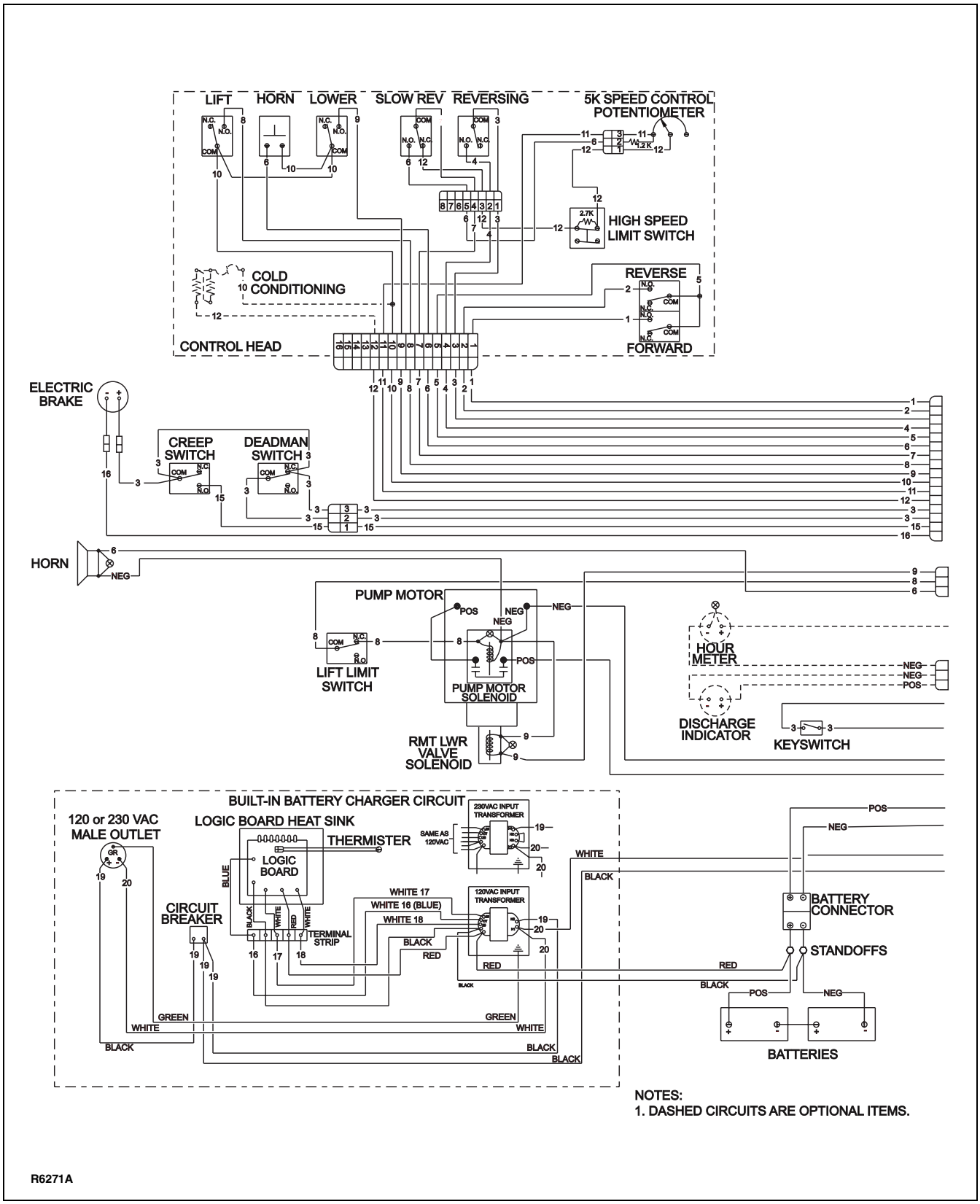

Figure 4-22 Wiring Diagram (Sheet 1)

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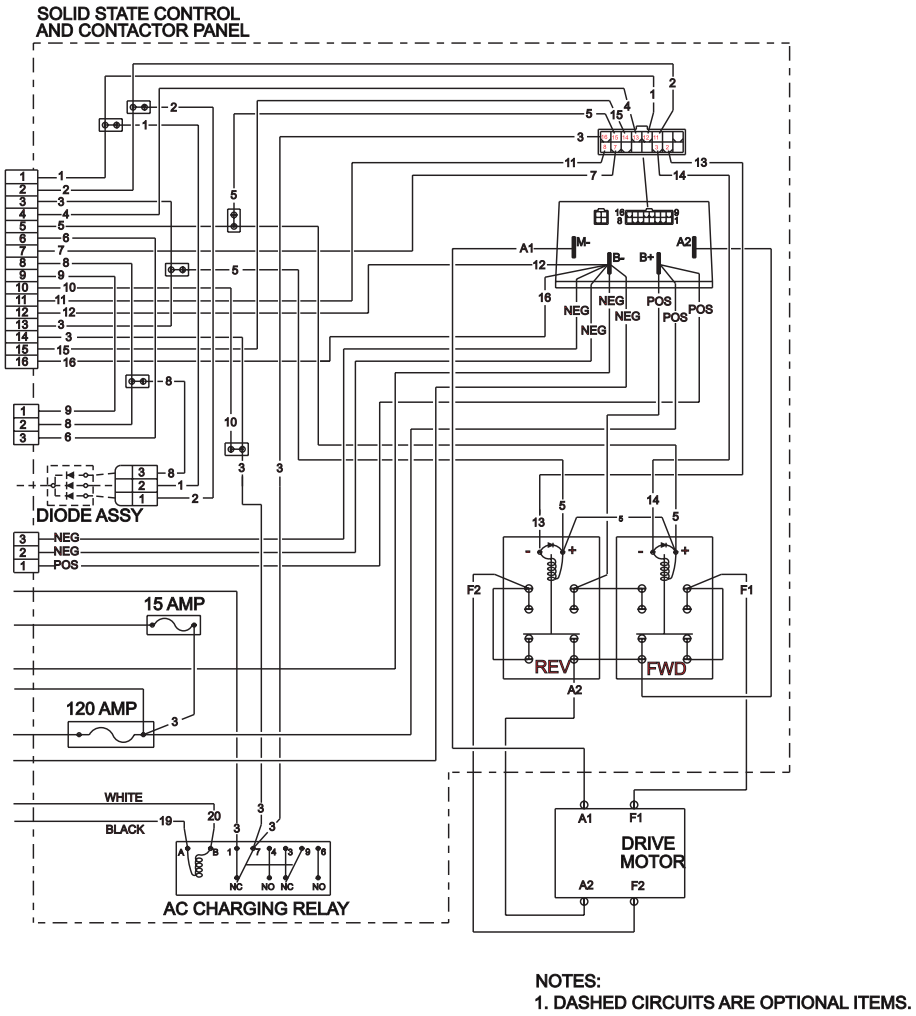

Figure 4-22 Wiring Diagram (Sheet 2)

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4-10.HYDRAULICS.

4-10.1. Lines and Fittings

WARNING: 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 batteries disconnected before performing any maintenance on the hydraulic system.

NOTE: Leaking hydraulic fittings may be remedied by simply tightening fittings. IF this does not remedy the leak, the fittings or line must be replaced.

1. Lower forks fully.
2. Turn off the keyswitch and disconnect the batteries.
3. Remove the batteries as described in paragraph 4-9.1.
4. Remove four screws (17, Figure 4-1), four lock washers (18), four washers (19) and cover (16).

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

5. Refer to Figure 4-19 and remove leaking line or fitting and replace it with a new line or fitting.
6. Remove vent plug from the hydraulic reservoir. Check level of hydraulic oil. Hydraulic oil must be one inch below opening. If required, add hydraulic oil to bring to proper level. Use hydraulic oil listed in Table 3-2.
7. Reinstall vent plug.
8. Reinstall the batteries as described in paragraph 4-9.1.
9. Operate the lift and lower buttons to refill the cylinder and lines with hydraulic oil.
10. Remove vent plug from the hydraulic reservoir. Check level of hydraulic oil. Hydraulic oil must be one inch below opening. If required, add hydraulic oil to bring to proper level. Use hydraulic oil listed in Table 3-2.
11. Reinstall vent plug.
12. Reinstall cover (16, Figure 4-1), four screws (17), four lock washers (18), and four washers (19).

4-10.2. Hydraulic Pump, Motor, and Reservoir Assy

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. Removal and repair is as follows:

WARNING: 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 batteries disconnected before performing any maintenance on the hydraulic system.

4-10.2.1.Motor Brush Replacement

1. Lower forks fully.
2. Turn off the keyswitch and disconnect the batteries.
3. Remove four screws (17, Figure 4-1), four lock washers (18), four washers (19) and cover (16).
4. Reach through the battery compartment and remove screws (1, Figure 4-19), lock washers (2) and washers (3).
5. Move the assembly as necessary to provide clearance and remove two bolts (1, Figure 4-23) and washers (2).
6. Remove motor cover (3) to access the brush assemblies.
7. Remove the lead from the starter solenoid.
8. Using a flat blade screwdriver, release spring (5) holding each brush (4) and pull the brush from its holder.

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

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

4-10.2.2.Relief Valve Assembly

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

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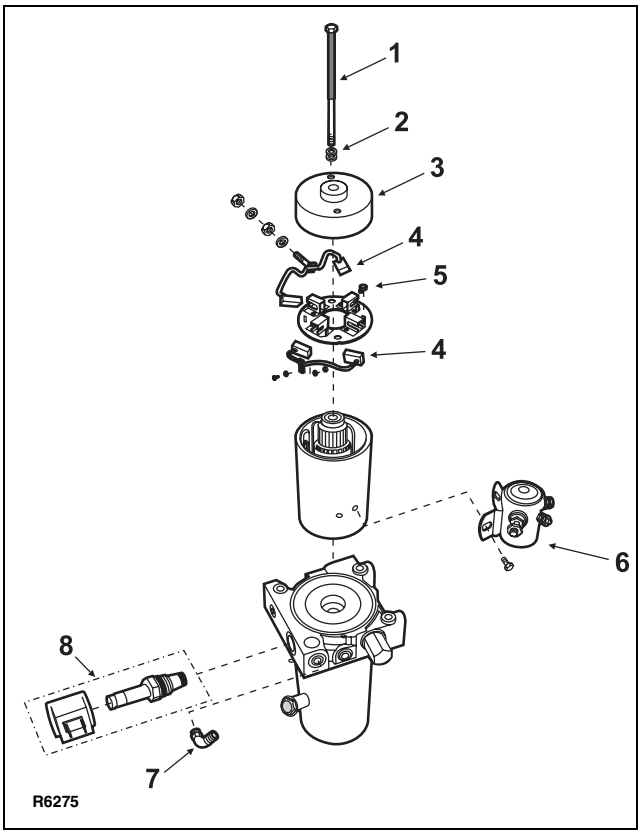

Figure 4-23 Hydraulic Motor Assembly

4-10.2.3.Solenoid Valve Assembly

1. Lower forks fully.
2. Turn off the keyswitch and disconnect the batteries.
3. Remove four screws (17, Figure 4-1), four lock washers (18), four washers (19) and cover (16).
4. Reach through the battery compartment and remove screws (1, Figure 4-19), lock washers (2) and washers (3).
5. Move the assembly as necessary to provide clearance and remove two bolts (1, Figure 4-23) and washers (2).
6. Disconnect electrical lead from solenoid assembly (8).
7. Remove the solenoid magnet assembly from the valve stem.
8. Remove the valve stem assembly.
9. Reinstall valve stem and solenoid.
10. Reconnect electrical lead to solenoid.
11. Reinstall screws (1, Figure 4-19), lock washers (2) and washers (3).
12. Reinstall cover (16, Figure 4-1), four washers (19), four lock washers (18) and four screws (17).
13. Reconnect the batteries and turn on the keyswitch.

4-10.2.4.Solenoid Valve Assembly

1. Disconnect electrical lead from motor starter (6, Figure 4-23).

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.

4-10.2.5.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 4-24) 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.

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

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

3. Remove the two metal support brackets (11) from the strainer tube.
4. Remove O-ring support bracket (2, Figure 4-25) and O-ring (1).

NOTE: Coat new O-ring with hydraulic oil to prevent damage during reassembly.

5. Install new O-ring (1).
6. Install metal support brackets (11, Figure 4-24) onto the new strainer assembly.

NOTE: Coat new O-ring with hydraulic oil to prevent damage during reassembly.

7. Install new O-ring into the port for the strainer assembly.
8. Install strainer assembly onto the pump and secure with the screw.
9. Reinstall reservoir (4) and secure with screws (3).

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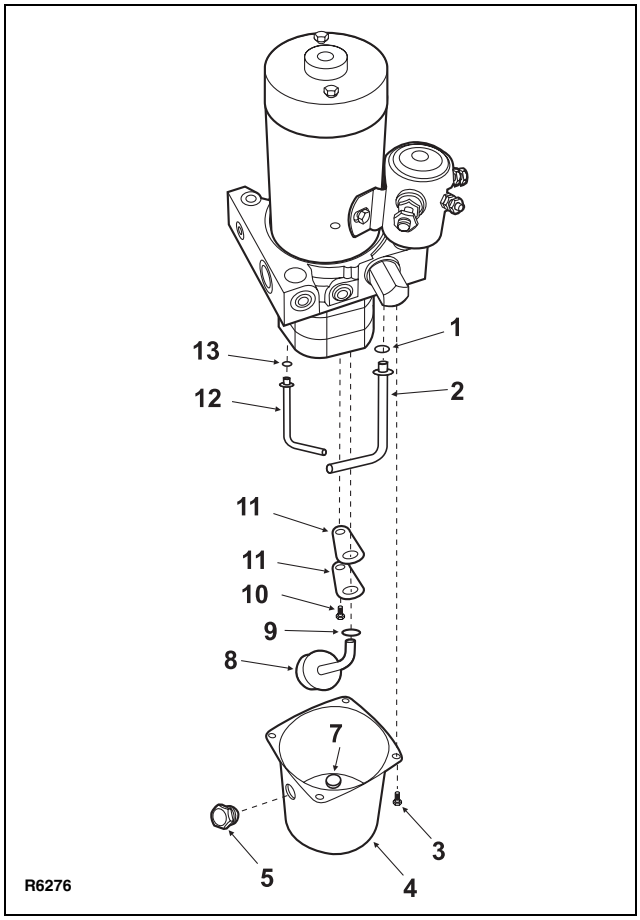

Figure 4-24 Hydraulic Reservoir Assembly

10. Fill hydraulic reservoir by removing breather (5). Use approved Big Joe hydraulic fluid.
11. Reinstall breather (6) and reconnect batteries.
12. Bleed air from the hydraulic system by repeatedly raising and lowering lift truck until action is smooth.
13. Refill the hydraulic reservoir.

4-10.2.6.Replace Hydraulic Pump/Motor Assembly

1. Lower forks fully.
2. Turn off the keyswitch and disconnect the batteries.
3. Remove four screws (17, Figure 4-1), four lock washers (18), four washers (19) and cover (16).
4. Tag and disconnect electrical lead (4 and 5, Figure 4-20) from the motor.
5. Tag and disconnect electrical leads and spike suppressor (30, Figure 4-4) from the motor solenoid.

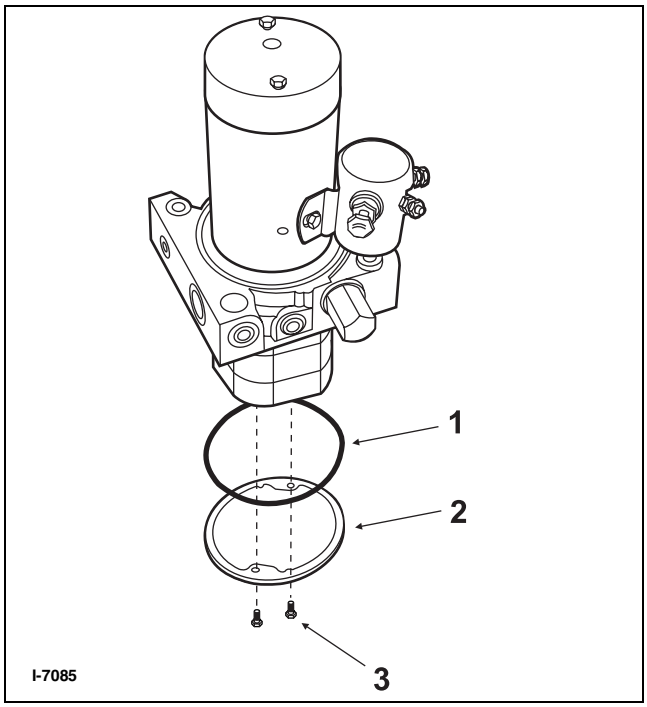

Figure 4-25 Reservoir O-Ring Assembly

6. Tag and disconnect electrical leads and spike suppressor (29) from the remote lower solenoid.
7. Disconnect hose (6, Figure 4-19) from elbow (5).
8. Reach through the battery compartment and remove screws (1), lock washers (2) and washers (3).

NOTE: The reservoir will be filled with hydraulic oil. Place a container under the pump assembly to catch any hydraulic oil.

9. Remove the pump/motor assembly.
10. Remove elbow (5) from the pump.
11. Install elbow (5) on new pump.
12. Position the pump/motor assembly in the compartment and secure with screws (1), lock washers (2) and washers (3).
13. Reconnect hose (6) to elbow (5).
14. Reconnect electrical leads and spike suppressor (29, Figure 4-4) to the remote lower solenoid.
15. Reconnect electrical leads and spike suppressor (30) to the motor solenoid.
16. Tag and disconnect electrical lead (4 and 5, Figure 4-20) to the motor.
17. Fill hydraulic reservoir by removing breather (5, Figure 4-24). Use approved Big Joe hydraulic fluid.

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18. Reinstall breather (6) and reconnect batteries.
19. Reconnect the batteries and turn on the key-switch.
20. Bleed air from the hydraulic system by repeatedly raising and lowering lift truck until action is smooth.
21. Refill the hydraulic reservoir.
22. Reinstall cover (16, Figure 4-1) and secure with four screws (17), four lock washers (18), four washers (19).

4-10.2.7. Replace Hydraulic Pump Assembly

1. Remove the hydraulic pump/motor assembly as described in paragraph 4-10.2.6.
2. Remove the hydraulic pump/motor assembly as described in paragraph 4-10.2.6.
3. Remove the hydraulic strainer assembly as described in paragraph 4-10.2.5.
4. Using a 1/4” thin wall deep socket, remove the bolts (3, Figure 4-26) securing hydraulic pump (2) to the adapter assembly (1).
5. Remove hydraulic pump (2) and O-ring (4).

NOTE: Coat new O-ring (4) with hydraulic oil to prevent damage during reassembly.

6. Reinstall hydraulic pump by reversing the above procedure.

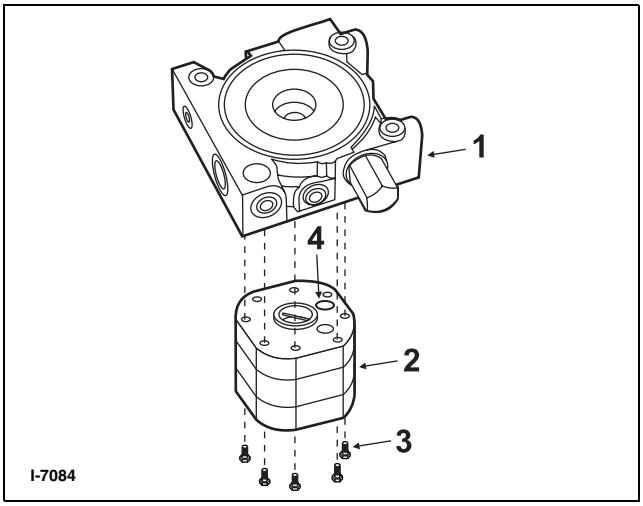

Figure 4-26 Hydraulic Pump Replacement

4-10.3. Lift Cylinder

4-10.3.1. Removal

1. Turn off the keyswitch and disconnect the batteries
2. Remove the batteries from cabinet (12, Figure 4-19).
3. Ensure that hydraulic pressure has been relieved from the lift circuit. Working through the battery compartment, disconnect the hydraulic line from the lift cylinder.
4. Disconnect hose (6) from elbow (5).

WARNING: Power section is heavy. Use care while securing and lifting in order to prevent injury.

5. With suitable hoist, carefully raise the power section slightly so cylinder (7) will clear the socket in fork section (13). Working through the battery compartment, remove the cylinder from mount (11).
6. Remove elbow (5) from cylinder (7).

4-10.3.2. 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 (3, Figure 4-27) from the cylinder weldment (6).
3. Withdraw the cylinder rod (5) from the cylinder.

NOTE: If the cylinder weldment (6), cylinder rod (5), or cylinder head (3) is damaged, the entire lift cylinder must be replaced.

4. Replace all wipers, seals and damaged or worn parts.
5. Coat all parts with hydraulic oil (Table 3-2).
6. Insert cylinder rod (5), with attached parts, into cylinder weldment (6).
7. Install cylinder head and tighten to 5-7 lbs/ft.

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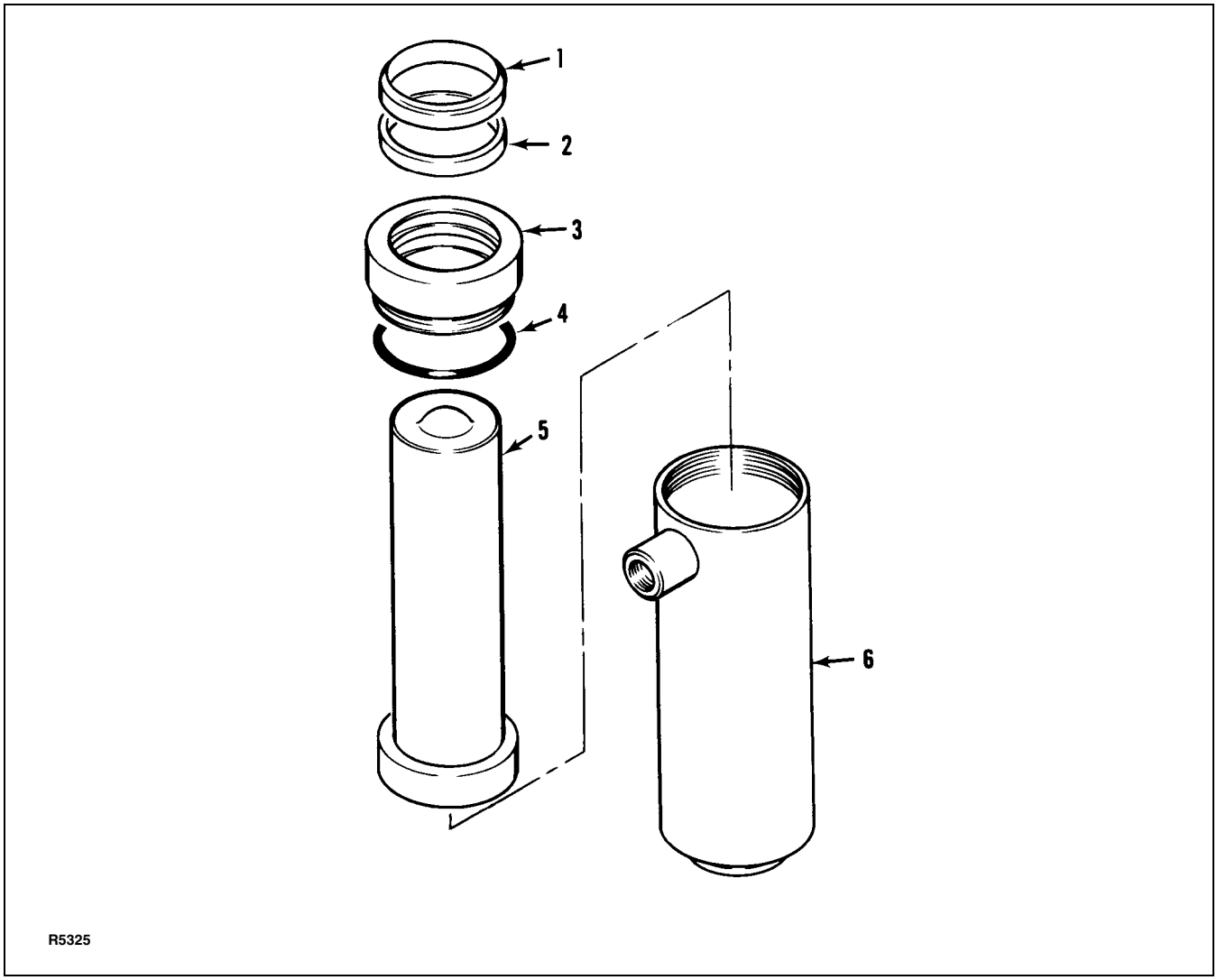

Figure 4-27 Hydraulic Cylinder

4-10.3.3.Installation

1. Position cylinder (7, Figure 4-19) on mount (11). Then lower the power section until cylinder (7) mates with the socket in fork section (13).
2. Install elbow (5) from cylinder (7).
3. Reconnect the hose (6) to elbow (5).
4. Remove blocking from under the truck.
5. Reconnect the batteries and turn on the key-switch.

4-10.4. 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. If you suspect that the relief valve is malfunctioning, perform the following procedures:

1. Lower forks as far as they will go.
2. Remove four screws (17, Figure 4-1), four lock washers (18), four washers (19) and cover (16).
3. Disconnect hose (6, Figure 4-19) from pump/motor assembly (4) and connect a pressure gauge of adequate range (0-3000 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:

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CAUTION: 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 the relief valve 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 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 (1, Figure 4-1) and secure with flat washers (9), lockwashers (4), nuts (10), and screws (3).
8. Reinstall cover (16, Figure 4-1) and secure with four screws (17), four lock washers (18) and four washers (19).

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SECTION 5
OPTIONAL EQUIPMENT

5-1. BATTERY CAPACITY INDICATOR.

Refer to Figure 7-16 for the battery capacity indicator replacement parts and to the wiring diagram Figure 4-22 for wiring information.

5-1.1. Battery Discharge Indicator Replacement.

1. Operation of the battery discharge indicator (1, Figure 7-16) may be checked by comparing its reading against a hydrometer. Indicator should show a full charge when hydrometer shows a specific gravity of 1.260 to 1.275.
2. To replace the battery discharge indicator (1), proceed as follows:
   a. Turn off the keyswitch and disconnect the batteries.
   b. Remove the compartment covers as described in paragraph 4-3.
   c. Tag and disconnect harness (2).
   d. Remove two knurled nuts and U-bracket, part of battery discharge indicator (1), 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.

   e. Install battery discharge indicator (1) and secure with supplied U-bracket and nuts. If required, trim the U-bracket legs to proper length.
   f. Connect harness (2), as noted during removal.
   g. Reinstall the compartment covers as described in paragraph 4-3.
   h. Reconnect the batteries and turn on the keyswitch.

5-2. HOURMETER.

The hourmeter is available for attachment to the motor circuits to indicate use of the drive and lift functions. Refer to Figure 7-17 for replacement parts. Refer to the wiring diagram Figure 4-22 to help ensure proper connections.

5-2.1. Hourmeter Replacement.

1. Operation of the hourmeter (2, Figure 7-17) may be checked against a watch.
2. To replace the hourmeter (2), proceed as follows:
   a. Turn off the keyswitch and disconnect the batteries.
   b. Remove the compartment covers as described in paragraph 4-3.
   a. Disconnect the battery.
   b. Tag and disconnect terminals from hourmeter (2).
   c. Remove nuts, lockwashers and screws (1) and remove hourmeter (2).
   d. Remove screws (1), lock washers (10) and washers (9) and remove diode assembly (8), and insulating pad (7).
   e. Install diode assembly (8), and insulating pad (7) and secure with screws (1), lock washers (10) and washers (9).
   f. Install hourmeter (2) and secure with screws (1), lockwashers, and nuts.
   g. Connect terminals to hourmeter (1).
   h. Reinstall the compartment covers as described in paragraph 4-3.
   i. Reconnect the batteries and turn on the keyswitch.

5-3. LOAD BACKREST.

A load backrest is available for addition to the lift truck to allow handling of high loads. Identification of replacement parts, are shown in Figure 7-18.

5-4. LOAD STABILIZER.

The load stabilizers are available as an optional item at the time the PPT 45 Lift Truck is purchased. Figure 7-19 presents the parts breakdown for reference only, field installation of the stabilizers is not recommended.

5-5. CASTER

Casters are available for additional stability. Installation of the casters is shown in Figure 7-20 and repair parts as shown in Figure 7-21.

5-6. Modular Skid Adapter

The modular skid adapter is shown in Figure 7-22.

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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 (Paragraph 4-9.1.)
	c. Defective wiring.	Check for open circuit and repair as required.
	d. Key switch 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.

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MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Truck does not slow with brake, or brake does not engage	a. Defective brake/deadman switch.	Check brake/deadman switch for continuity. If none found when the control arm is in the brake position, replace switch.
	b. Defective brake solenoid.	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. (Paragraph 4-10.3.)
Squealing sounds when lifting forks.	a. Oil level too low.	Add oil to reservoir.
	b. Lift linkage binding.	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.	Check pressure. Adjust valve.
	b. Worn lift cylinder seal.	Replace cylinder seal.
	c. Load larger than capacity.	Refer to I.D. plate for capacity.
	d. Defective lift motor solenoid.	Replace.
	e. Battery charge low.	Charge battery.
Forks do not lift, pump motor does not run.	a. Battery is dead or disconnected.	Check and recharge if required.
	b. Defect wiring	Check and repair as required.
	c. Defect in electrical system for operating pump motor	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.	Disassemble, clean, and reassemble Replace worn parts as required.
	b. Worn lift cylinder seal.	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.

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MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
Steering arm does not return to the upright position.	a. Return spring improperly adjusted.	Readjust spring tension.
	b. Binding electrical cable.	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.	Check for short, and repair or replace as necessary.
	b. Short in control head	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).

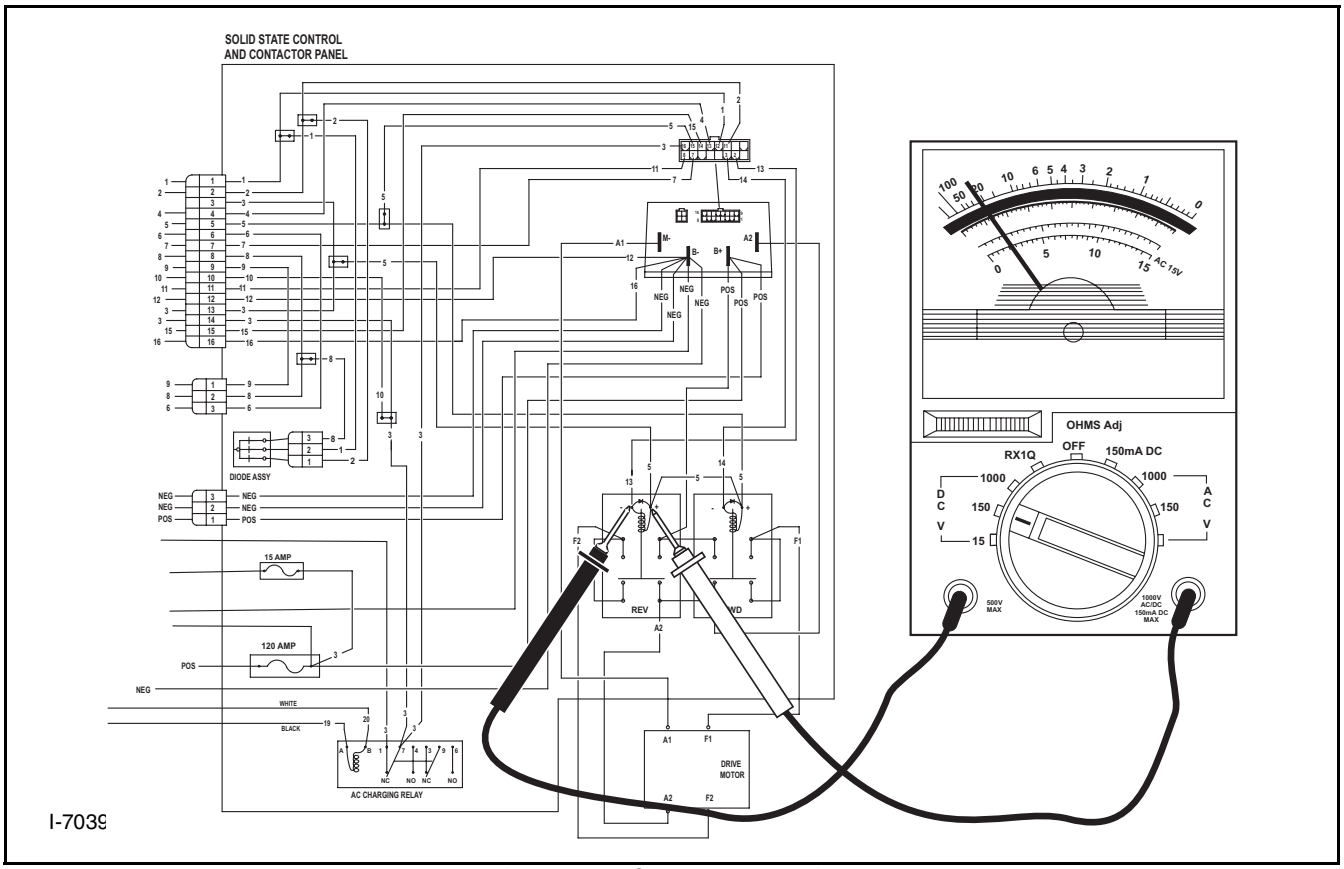

Figure 6-1. Contactor Testing

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NOTE: Testing of the reverse contactor is shown in Figure 6-1.

5. 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.

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.
4. #2 switch lead for the reverse switch is shown in Figure 6-2.
5. If the truck is equipped with a keyswitch, turn it on, lower the control handle to the driving position and depress the suspect switch.
6. Resistance should read zero ohms or a small amount of ohms.
7. If resistance is present (10 ohms or more), the switch or wiring leading to the connector is defective and must be repaired or replaced.

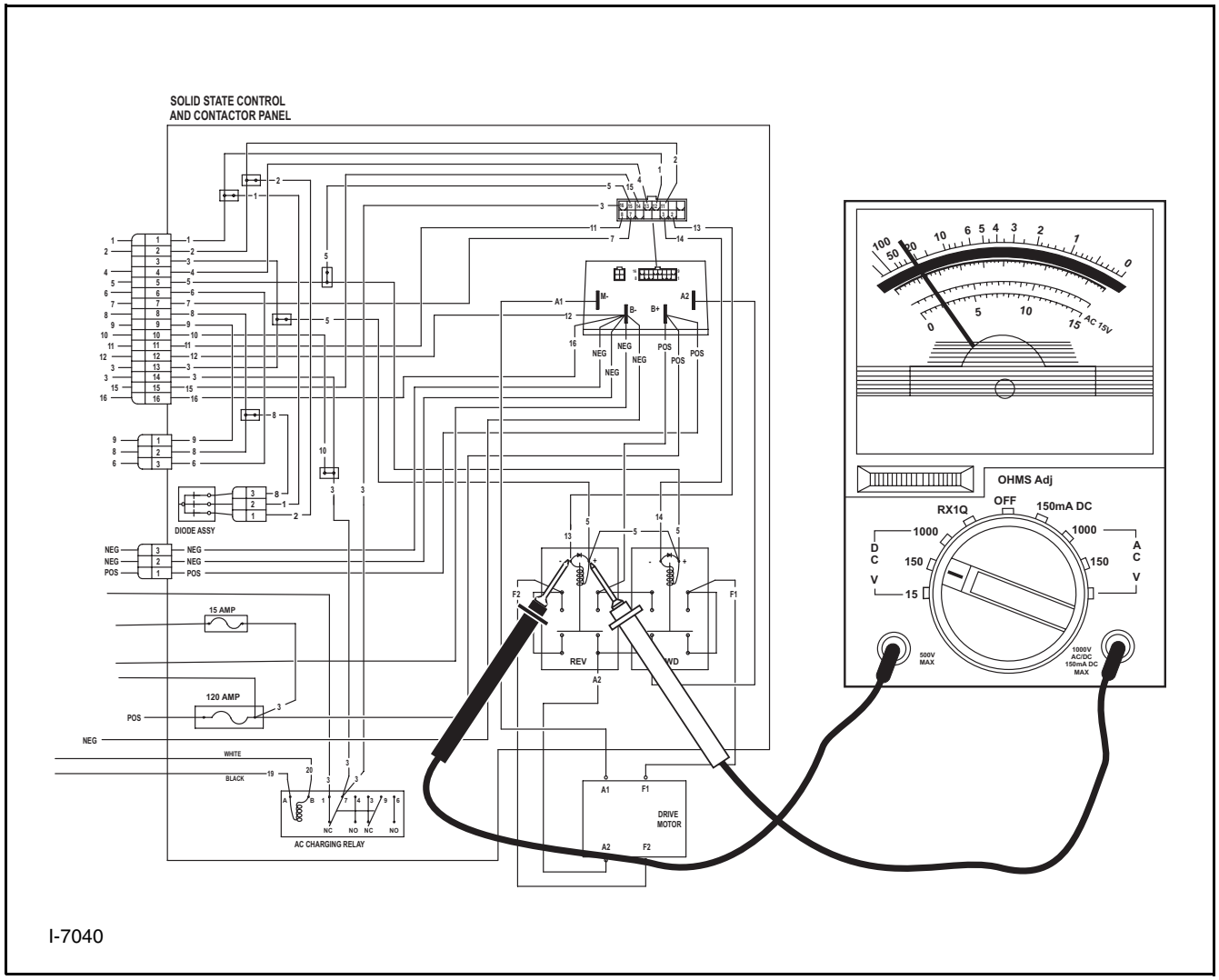

Figure 6-2. Switch Testing

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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.

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 (10, 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.

1. 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.

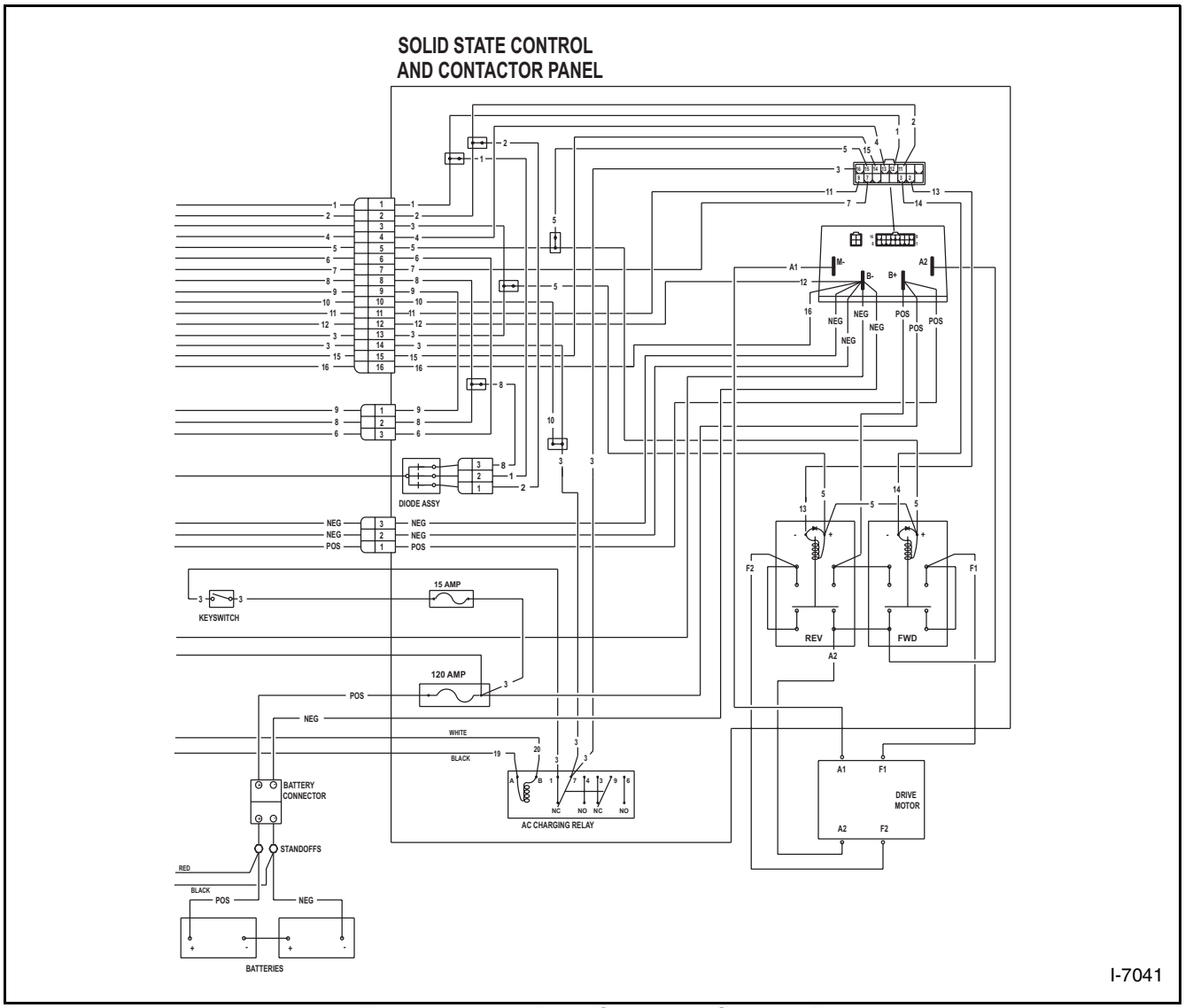

Figure 6-3. Transistor Controller Schematic

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1. Smooth 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.

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

3. 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.)

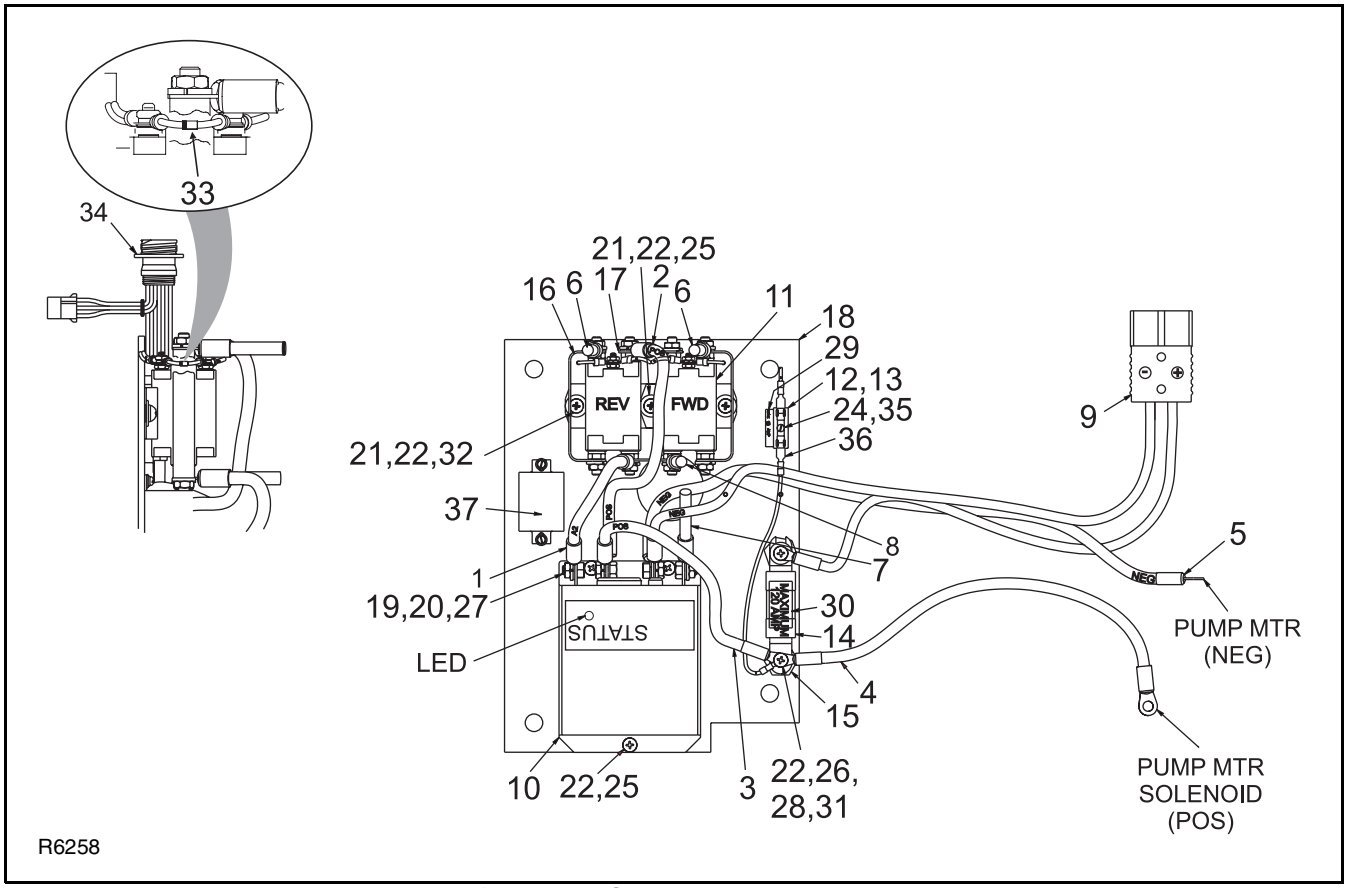

Figure 6-4. Contactor Panel Parts

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4. 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).

5. 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.

6. 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.

7. 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.

8. 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.

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.	

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9. 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 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)

10. 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 847-298-9800.

11. 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.

12. 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

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13. 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.

14. 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.

15. 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 paragraph 6-4. 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 the brake is applied, 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.

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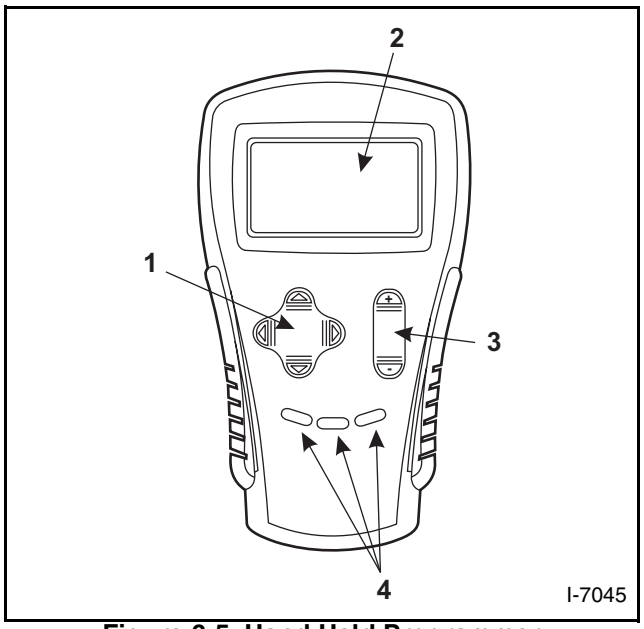

Figure 6-5. Hand Held Programmer

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.
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 9.
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 Figure 6-4 for location of the LED on the controller.

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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.

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 6-1. Troubleshooting Chart for suggestions covering a wide range of possible faults.

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.

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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 keyswitch 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.

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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.

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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.

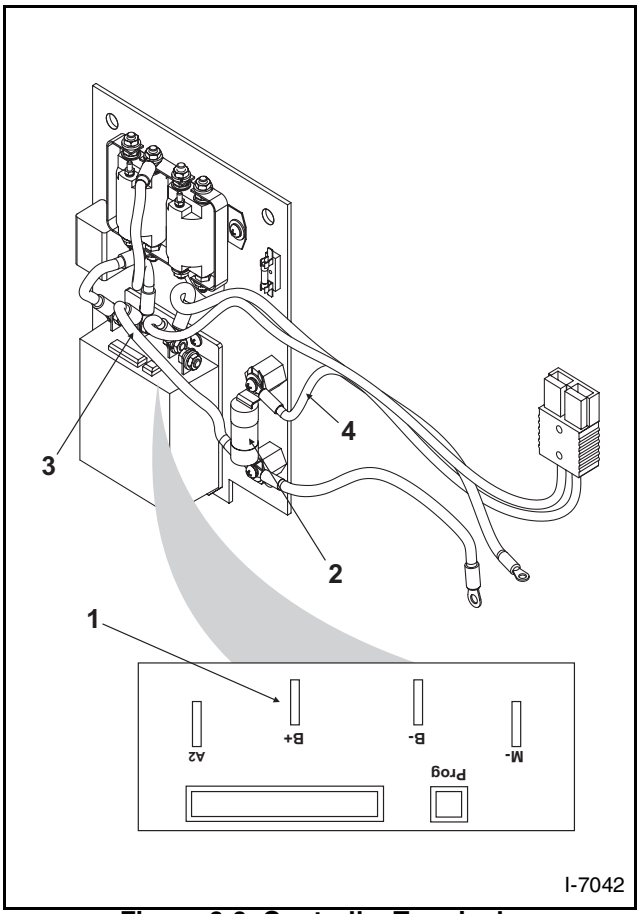

Figure 6-6. Controller Terminals

6-6.2. Check for Contactor Operation and Keyswitch 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 microswitch.
   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.

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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).

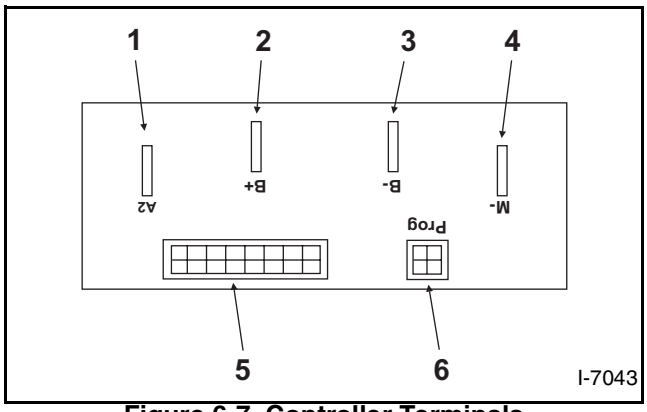

Figure 6-7. Controller Terminals

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.

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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.

6-7. BATTERY CHARGER TROUBLESHOOTING

Refer to Figure 6-9 for part identification. Be sure the batteries are connected to the charger and the AC cord is connected to the correct VAC power supply.

6-7.1. Dip Switch Setting (Figure 6-8)

The DIP switches on the Printed Circuit Board (PCB) must be set for Gel Cell Batteries. Check that switch 1 is ON and switch 2 is OFF.

6-7.2. Thermistor

There is a temperature sensing thermistor plugged into a 2-pin socket marked THERM on the PCB. Check that this is firmly connected or the battery voltage control will not work properly.

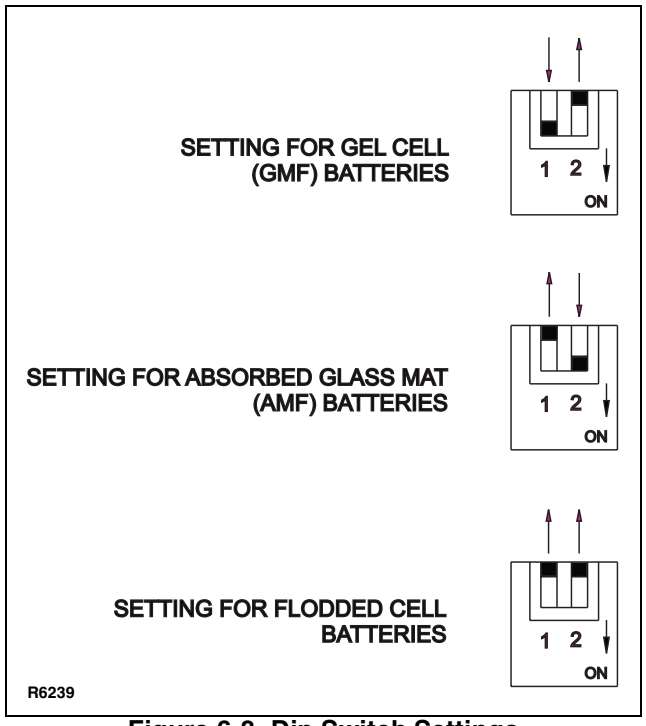

Figure 6-8. Dip Switch Settings

6-7.3. Circuit Breaker Testing

Using a multimeter set to measure either 120 or 230 VAC, check each side of the circuit breaker to ground. If 120 or 230 VAC was not indicated on both sides, replace the circuit breaker.

6-7.4. Power Transformer Testing

The two 0.250” tabs (120 VAC charger) or four 0.250” tabs (230 VAC charger) are the primary side of the transformer. The five #10 screw lugs are the secondary side. Test theTransformer as follows:

1. Using a multimeter set to measure at least 120 or 230 VAC, verify that AC Power supply 120 or 230 VAC input is present at the transformer primary terminals. If 120 or 230 VAC was not indicated, check the circuit breaker and wiring.
2. Using a multimeter set to measure at least 50 VAC, verify the transformer secondary terminals as follows:
   a. Verify 25 VAC from blue wire to each white wire.
   b. Verify 50 VAC from the white wire to white wire.
   c. If these voltages were not indicated, replace the transformer.

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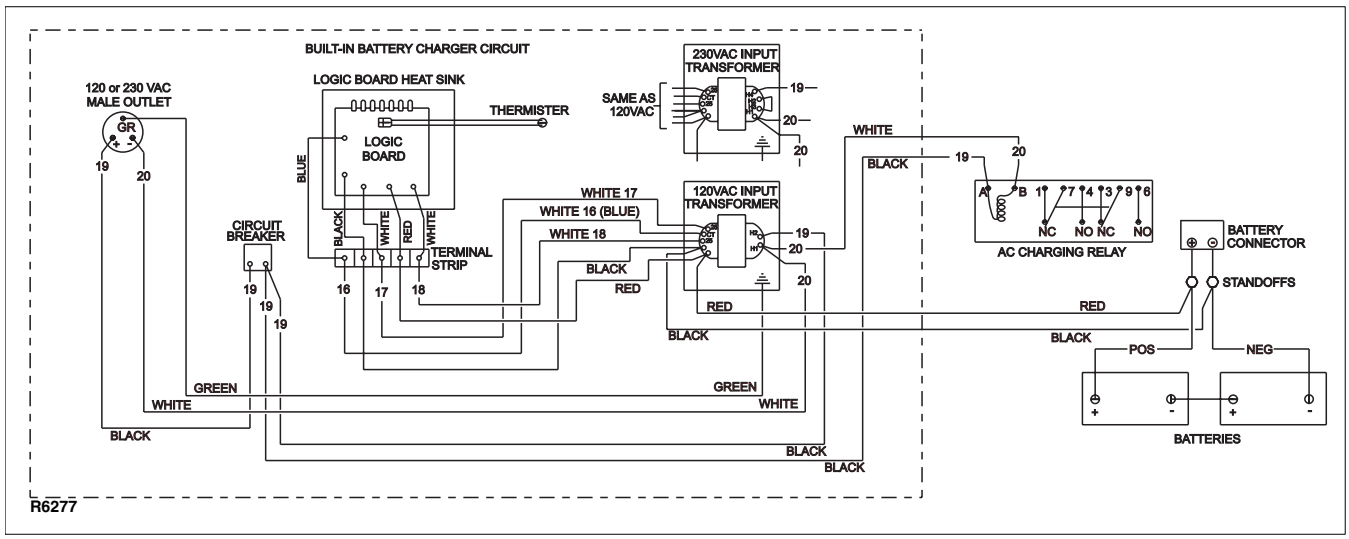

Figure 6-9. Battery Charger Wiring Diagram

6-7.5. Circuit Board Testing

The circuit board has a built in diagnostic test at power-up.

1. Switch the AC supply OFF and then ON, watching the 3 upper LEDs on the PCB. The 3 LEDs should light briefly in sequence Green-Yellow-Red when power is applied. This indicates the transformer is OK and that power is getting to the PCB.
2. If the battery DC is connected to the charger correctly, the Red LED should come ON immediately after this test sequence.
3. If the Green-Yellow-Red LED test sequence does not show at power-up, or if it cycles constantly Green-Yellow-Red, the PCB assembly should be replaced.
4. If the Red or Yellow charging LED does not stay ON after the test sequence, check that the batteries are connected to the charger.
5. Using a multimeter set to measure at least 30 VDC, verify DC Voltage from Black to Red wire is as follows:
   a. If the Red charging LED is on and the Yellow charging LED is off, voltage from black to red wire should be at least 24 VDC.
   b. If the Red and Yellow charging LEDs are on, voltage should be 29 ±1 VDC.
   c. If there is no Voltage, check the wiring and connections from the charger to the battery terminals. Battery Voltage must be correct polarity and more than 1 Volt to commence charging.

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NOTES

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SECTION 7
ILLUSTRATED PARTS BREAKDOWN

Following is an illustrated parts breakdown of assemblies and parts associated with the PTW Lift Truck.

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SEE FIGURE 7-2
FOR COLD CONDITIONING

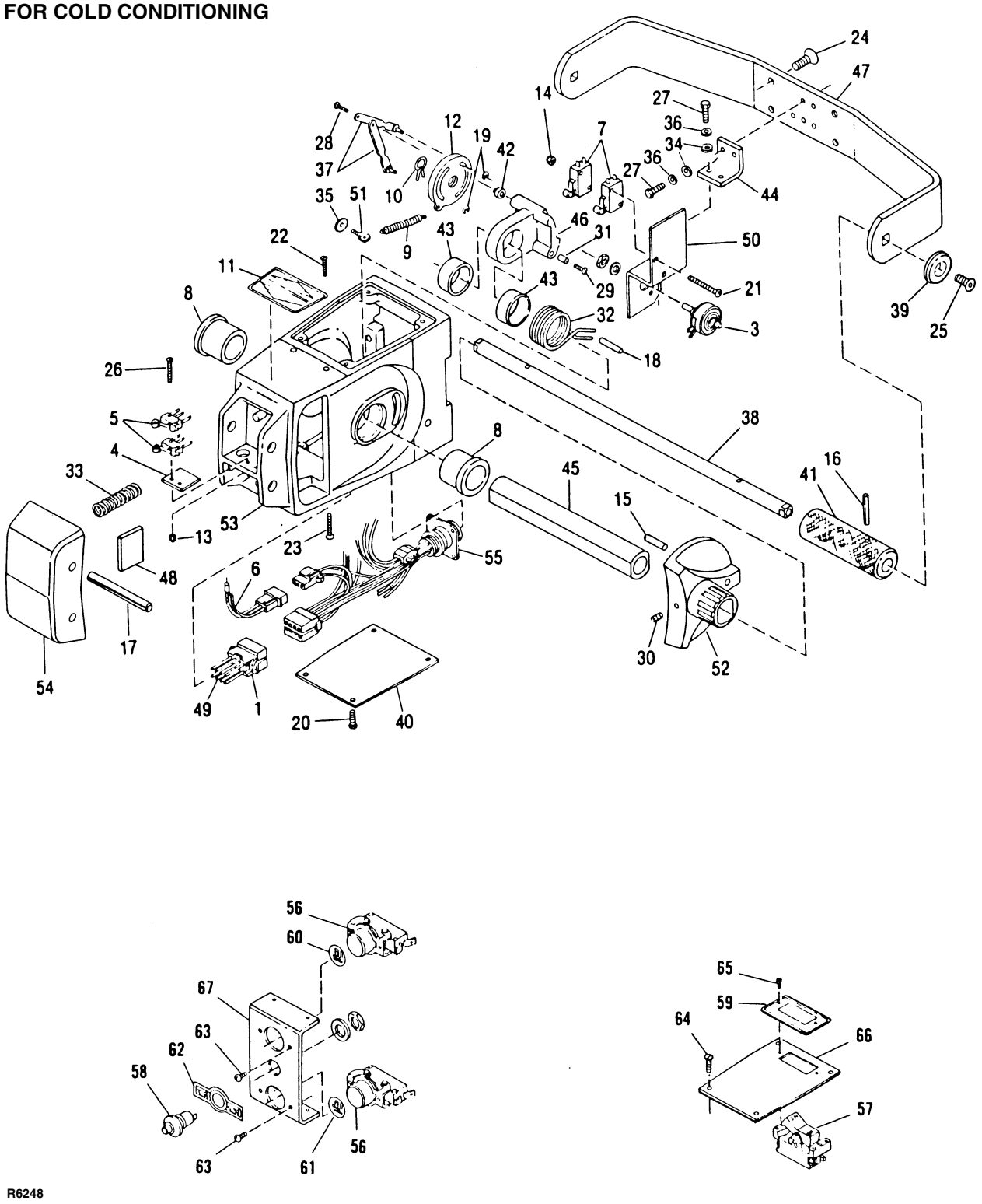

Figure 7-1 Control Head Assembly

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	506124-01	CONTROL HEAD (STANDARD)	1
—	506124-02	CONTROL HEAD (COLD CONDITIONING)	1
1	005652	PIN HOUSING	1
3	017580	POTENTIOMETER	1
4	018202	SWITCH INSULATOR	1
5	020669	MICRO SWITCH	2
6	505323	POTENTIOMETER WIRE HARNES	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, 1/4 X 15/16	2
16	060942	ROLL PIN, 1/8 X 1-1/4	2
17	061016	ROLL PIN, 1/4 X 3	2
18	061200-01	SPIROL PIN, 3/16 X 1	1
19	061750	“E” RETAINER RING	2
20	067416	PAN HD SCREW, 6-32 X 1/2	4
21	068180	ROUND HD SCREW, 4-40 X 1-1/2	2
22	069462	FLAT HD SLOTTED SCREW, 6-32 X 3/4	2
23	069463	FLAT HD SLOTTED SCREW, 6-32 X 1	2
24	069478	PHILIPS FLAT HD SCREW, 1/4-20 X 3/4	4
25	069715	SOCKET FLAT HD SCREW, 1/4-20 X 3/4	2
26	070486	PAN HD SCREW, BRASS	2
27	072400-01	SLOTTED HEX SCREW, 6-32 X 1/2	4
28	072415	PAN HD SCREW, THREAD CUTTING, 4-40 X 5/8	1
29	072415	PAN HD SCREW, THREAD CUTTING, 4-40 X 5/8	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
30	073461	SOCKET SET SCREW	2
31	074711	CONNECTING ROD SPACER	1
32	075088	RETURN SPRING	1
33	075510	COMPRESSION SPRING	2
34	077007	WASHER	5
35	077032	WASHER	1
36	077204	SPLIT LOCK WASHER #6	4
37	400546	CONNECTING ROD ASSEMBLY	2
38	402827	SHAFT	1
39	402828	CAP	2
40	402830	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	COVER	1
55	023201	WIRE HARNESS	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, 6-32 X 1/4	4
64	067416	PAN HD SCREW, 6-32 X 1/2	4
65	068190	SCREW, PHILLIPS PAN HD	2
66	402833	TOP COVER	1
67	402842	SWITCH PLATE	1

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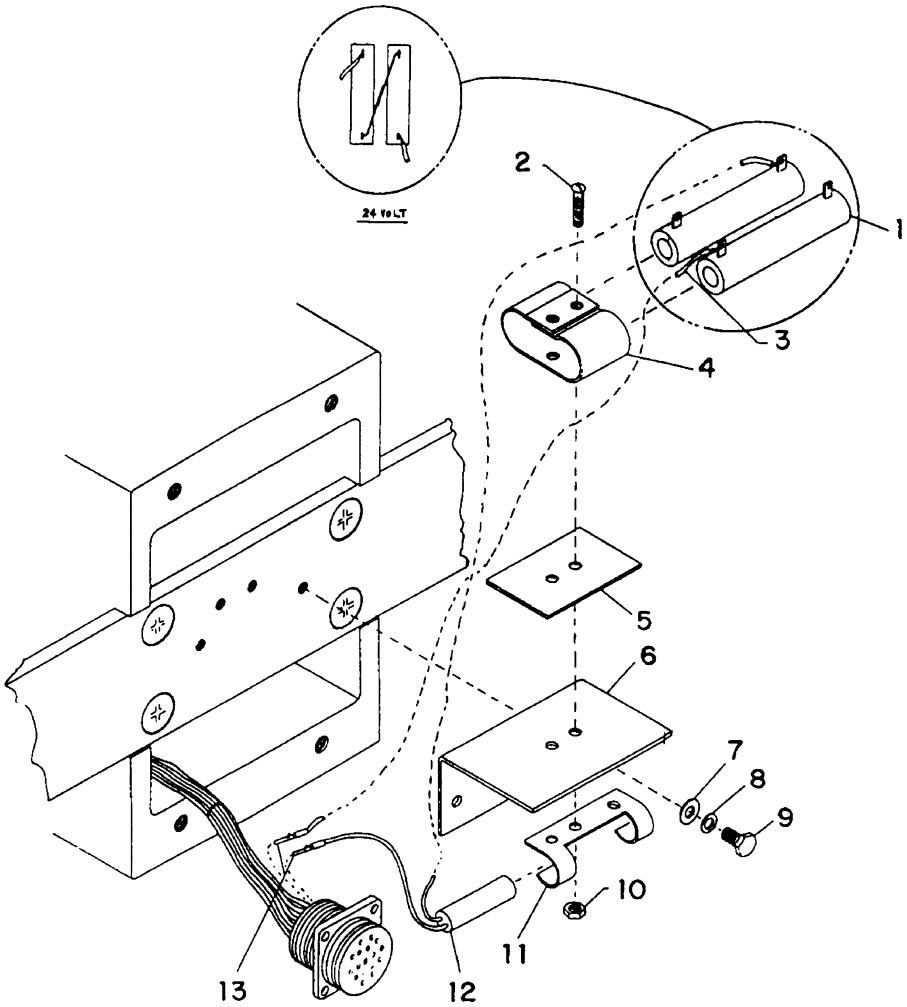

Figure 7-2 Cold Conditioning, Control Head

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	018909	RESISTORS	2
2	068187	SCREW	2
3	023014	WIRE	A/R
4	400544	BRACKET, RESISTOR	1
5	018214	INSULATOR, SWITCH	1
6	402829	BRACKET	1
7	077007	WASHER, FLAT	2
8	077204	LOCKWASHER	2
9	072400-01	SCREW	2
10	059632	NUT, HEX, 5-40	2
11	400044	BRACKET THERMAL CUTOUT	1
12	020736	THERMAL CUTOUT SWITCH	1
13	005643	CONTACT PIN	2

A/R - AS REQUIRED

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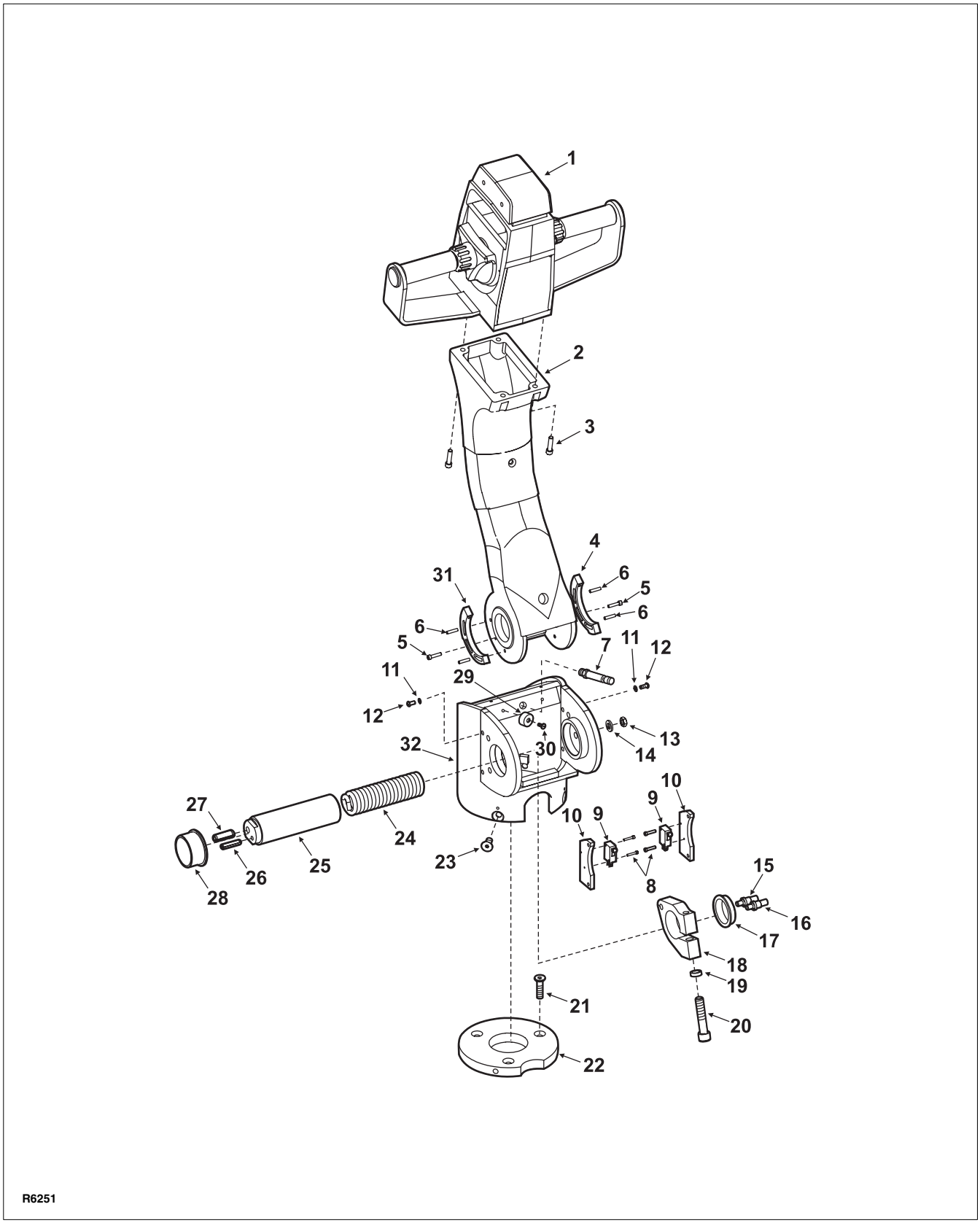

Figure 7-3 Steering Arm

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	—	CONTROL HEAD (FIGURE 7-1)	REF
—	506138	CONTROL ARM ASSY	1
2	800310	. STEERING ARM	1
3	065481	. SCREW, CAP, SOCKET HEAD	4
4	404196	. CAM, DEADMAN SWITCH	1
5	065530	. SCREW, CAP, BUTTON HEAD, NYLOK	2
6	060582	. PIN, DOWEL, 0.188 X 0.75	4
7	074451	. SHOCK ABSORBER	1
8	065472	. SCREW, CAP, SOCKET HEAD	4
9	020775	. SWITCH, MICRO	2
10	404210	. PLATE, MOUNTING, MICRO SWITCH	2
11	077209	. WASHER, LOCK	4
12	065525	. SCREW, CAP, BUTTON HEAD, NYLOK	4
13	059526	. NUT, PLAIN HEX	2
14	077210	. WASHER, LOCK	2
15	285302	. PIN, SPRING	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
16	285303	. PIN, SPRING	1
17	052922	. BUSHING, FLANGE, BRONZE	1
18	800204	. CLAMP, TUBE	1
19	401127	. SPACER	1
20	065569	. SCREW, CAP, SOCKET HEAD	1
21	067435-02	. SCREW, HEX HEAD, COUNTER-SUNK, METIC	3
22	—	. MOUNTING PLATE, MOTOR (FIGURE 7-6)	1
23	069717	. SCREW, HEX HEAD, COUNTER-SUNK	4
24	075060	. SPRING, RETURN	1
25	501371	. TUBE, SPRING	1
26	061006	. . PIN, ROLL	1
27	061050	. . PIN, ROLL, 3/8 X 1-1/4	1
28	052925	. BUSHING, FLANGE, BRONZE	1
29	053042	. BUMPER, ROUND	2
30	071377	. SCREW, TRUSS HEAD	2
31	404197	. CAM, CREEP SPEED	1
32	506139	. ADAPTER	

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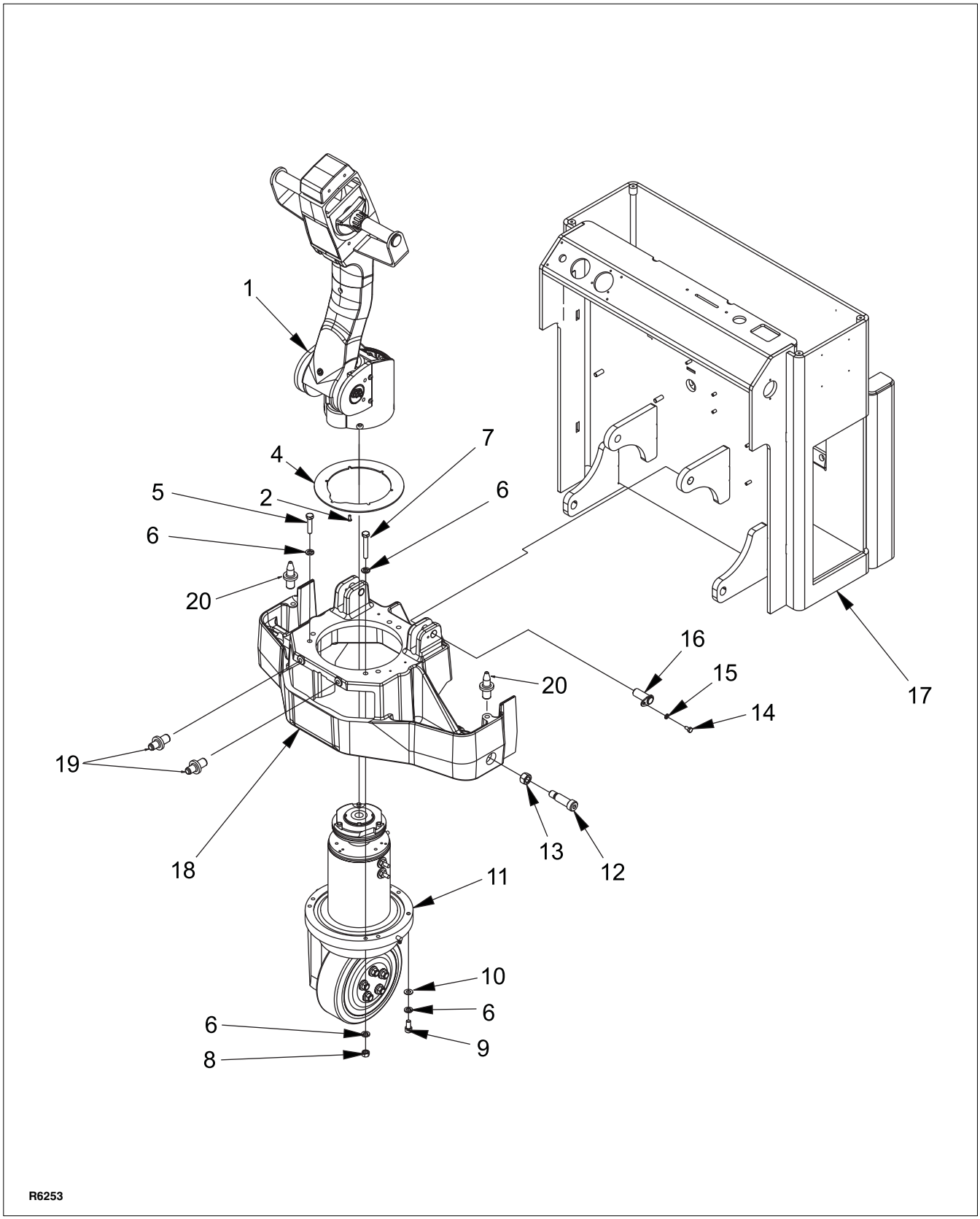

Figure 7-4 Pivot Assembly

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	—	CONTROL ARM (FIGURE 7-3)	REF
2	065531	SCREW, BUTTON HD, 10-32 X 1/2	6
4	404220	RING, GUARD	1
5	067443-02	SCREW, HHC, METRIC, M10 X 45	5
6	077212	WASHER, LOCK, 7/16	8
7	067443-03	SCREW, HHC, METRIC, M10 X 65	1
8	059475-01	NUT, HEX, METRIC, M10 X 1.5	1
9	067445-01	SCREW, HSH, METRIC, M10 X 20	1
10	077087	WASHER, FLAT, 7/16	1
11	—	TRANSMISSION, MOTOR AND BRAKE ASSEMBLY (FIGURE 7-5)	REF
12	052778	SHOULDER BOLT, 3/4 X 1.75 NYLOK	2

INDEX NO.	PART NO.	PART NAME	NO. REQD.
13	059444	NUT, HEX, 5/8-11	2
14	065476	SCREW, HEX HD, 1/4-20 X 1/2 FULL	3
15	077209	WASHER, LOCK, 1/4	3
16	506137	PIN, KEEPER	2
17	506288	CABINET, WELDMENT	1
18	506314	FRAME, POWER SECTION (STANDARD)	1
18	800316	FRAME, POWER SECTION (WITH CASTER OPTION)	1
19	404365	. PIN, COVER LOCATING	2
20	404366	. PIN, COVER LOCATING	2

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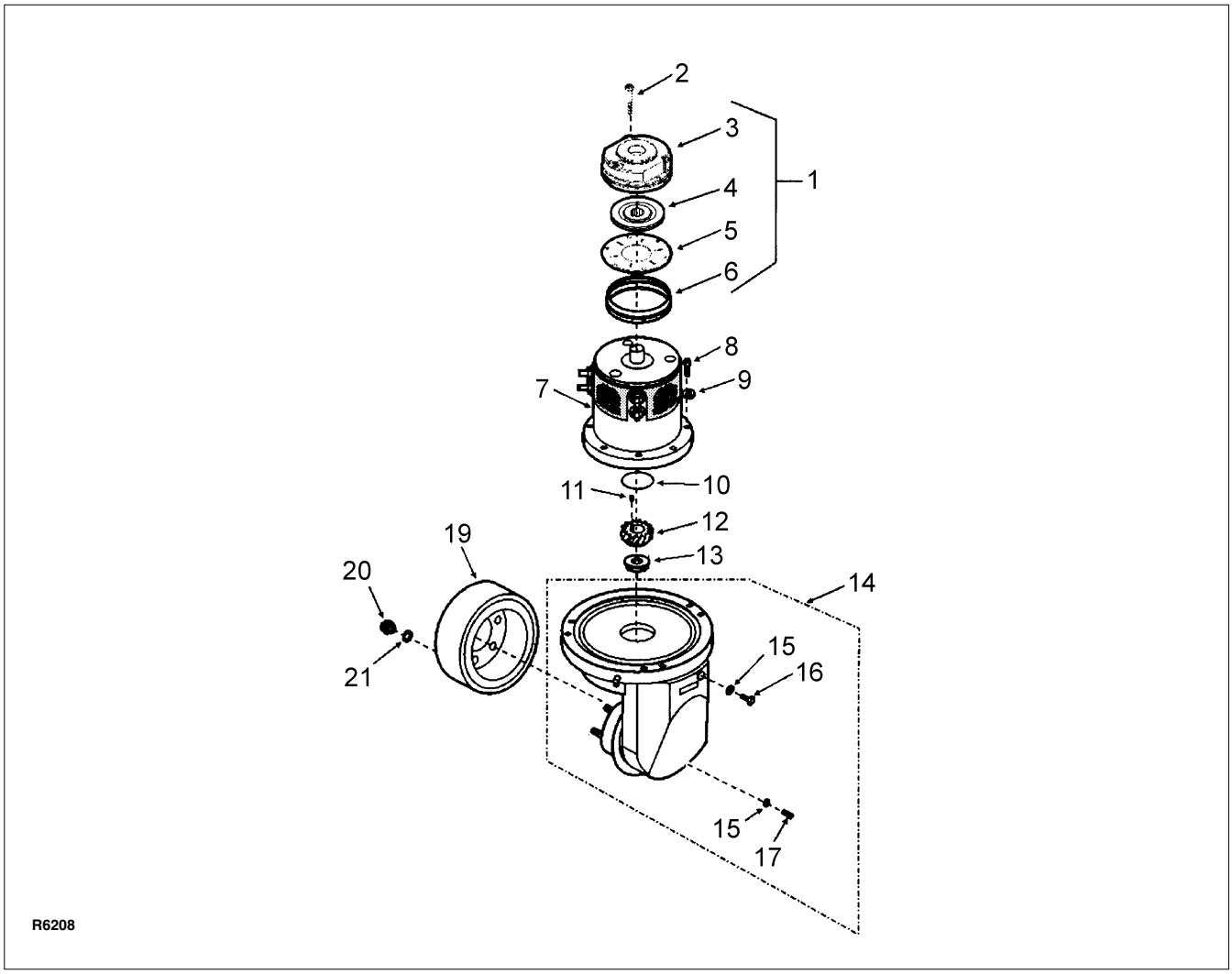

Figure 7-5 Transmission, Motor and Brake Assy

INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	506162	TRANSMISSION, MOTOR AND BRAKE ASSY	
1	901775	. ELECTRIC BRAKE	1
2	901776	. . BOLT	3
3	—	. . MAGNET BODY ASSEMBLY	1
4	901778	. . ROTOR	1
5	901779	. . FRICTION PLATE	1
6	901780	. . DUST RING	1
7	—	. MOTOR (FIGURE 7-6)	1
8	901708	. SCREW, SOCKET HEAD, M8 X 20-10.9	8
9	901782	. WASHER A8,4	8

INDEX NO.	PART NO.	PART NAME	NO. REQD.
10	901709	. O-RING, 65 X 2,5	1
11	901710	. KEY, WOODRUFF, 3 X 5	1
12	901785	. PINION	1
13	901786	. NUT, SLOTTED, M12 X 1,5	1
14	901790	. TRANSMISSION	1
15	901787	. SEAL RING	2
16	901713	. OIL FILLER PLUG, M14 X 1,5-5,8	1
17	901715	. OIL DRAIN PLUG, M14 X 1,5-PM	1
19	506161-01	. WHEEL ASSY	1
20	901721	. LUG NUT	5
21	901720	. WASHER	5

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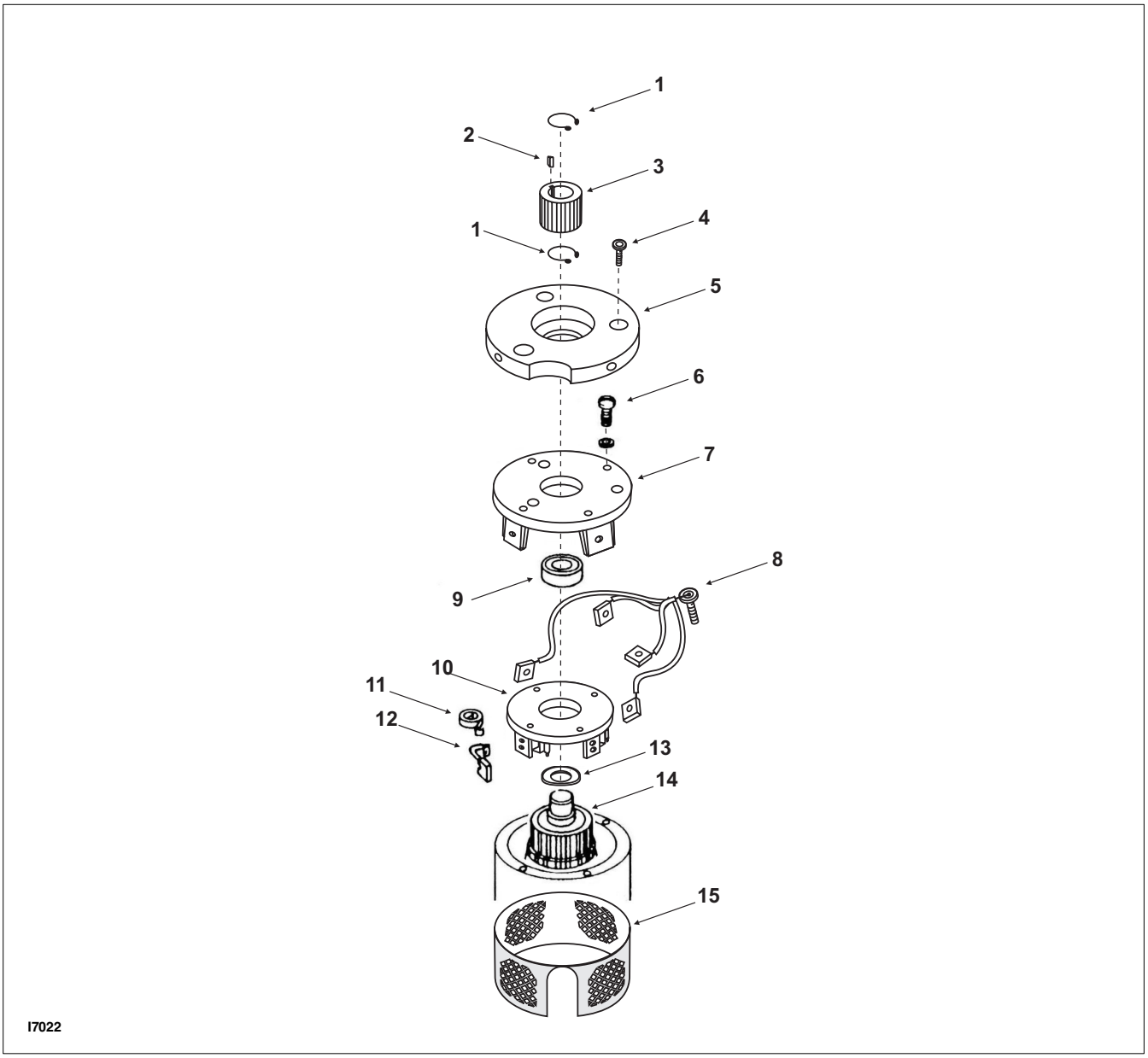

Figure 7-6 Drive Motor

INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	016051	MOTOR, DRIVE	1
1	901722	. CLIP, SPRING	2
2	901723	, WOODRUFF KEY	1
3	901724	. GEAR, SPLINED	1
4	067435-02	. ALLEN HEAD COUNTERSUNK SCREW, METRIC, M8 X 35MM	3
5	404189	. MOTOR, END PLATE	1
6	901725	. BOLT, HEX HEAD	4
7	901726	. HEAD, COMMUTATOR END	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
8	901727	. BRUSH LEAD AND TERMINAL CONNECTOR	1
9	901728	. BEARING, COMMUTATOR END	1
10	901729	. BRUSH BOX ASSEMBLY	1
11	901730	. SPRING, BRUSH (SET OF FOUR)	1
12	901731	. BRUSH (SET OF FOUR)	1
13	901732	. WASHER, SPRING	1
14	901733	. ARMATURE ASSEMBLY	1
15	901734	. HEADBAND ASSEMBLY	1

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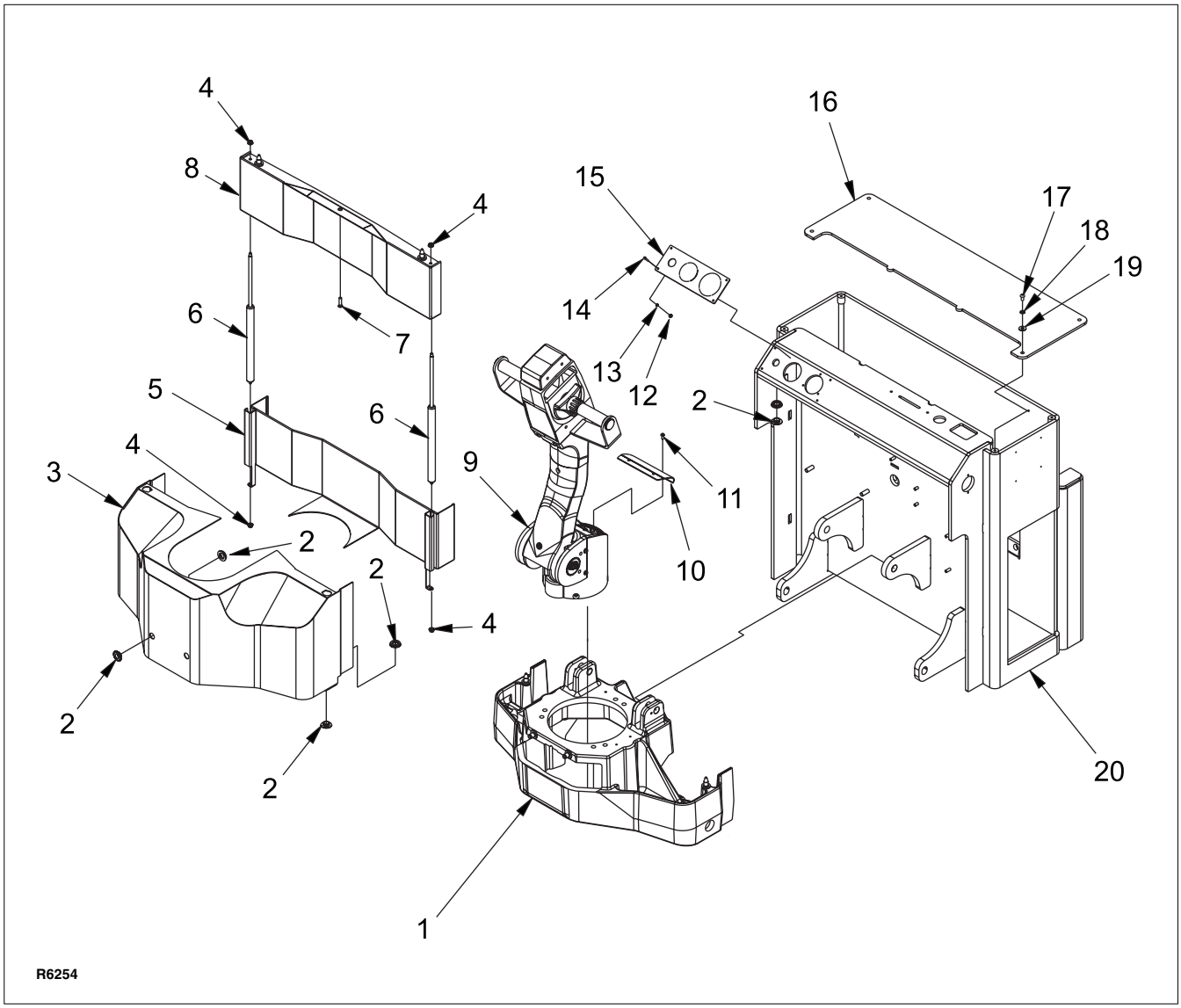

Figure 7-7 Base and Frame

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	—	FRAME, POWER SECTION (FIGURE 7-4)	REF
2	057520	GROMMET, SNAP, 1/2 ID X 1.12 OD	6
3	506165	COVER, WELDMENT, LOWER	1
4	059642-02	NUT, HEX, SERRATED FLANGE, M6	4
5	506164	COVER, WELDMENT, MIDDLE	1
6	075094	GAS SPRING	2
7	065527	SCREW, BUTTON HD, 1/4-20 X 1	1
8	506163	COVER, WELDMENT, UPPER	1
9	—	CONTROL ARM (FIGURE 7-3)	REF

INDEX NO.	PART NO.	PART NAME	NO. REQD.
10	404221	COVER, BRAKE	1
11	065531	SCREW, BUTTON HD, 10-32 X 1/2	3
12	059412	NUT, HEX, 6-32	4
13	077204	WASHER, LOCK, #6	4
14	068233	SCREW, SL RD HD, 6/32 X 3/4	4
15	404570	PLATE, COVER, GAGE	1
16	404557	COVER, PUMP & RESERVOIR	1
17	070476	SCREW, PH RD HD, 1/4-20 X 1/2	4
18	077209	WASHER, LOCK, 1/4	4
19	077031	WASHER, FLAT, 1/4	5
20	—	CABINET, WELDMENT (FIGURE 7-4)	REF

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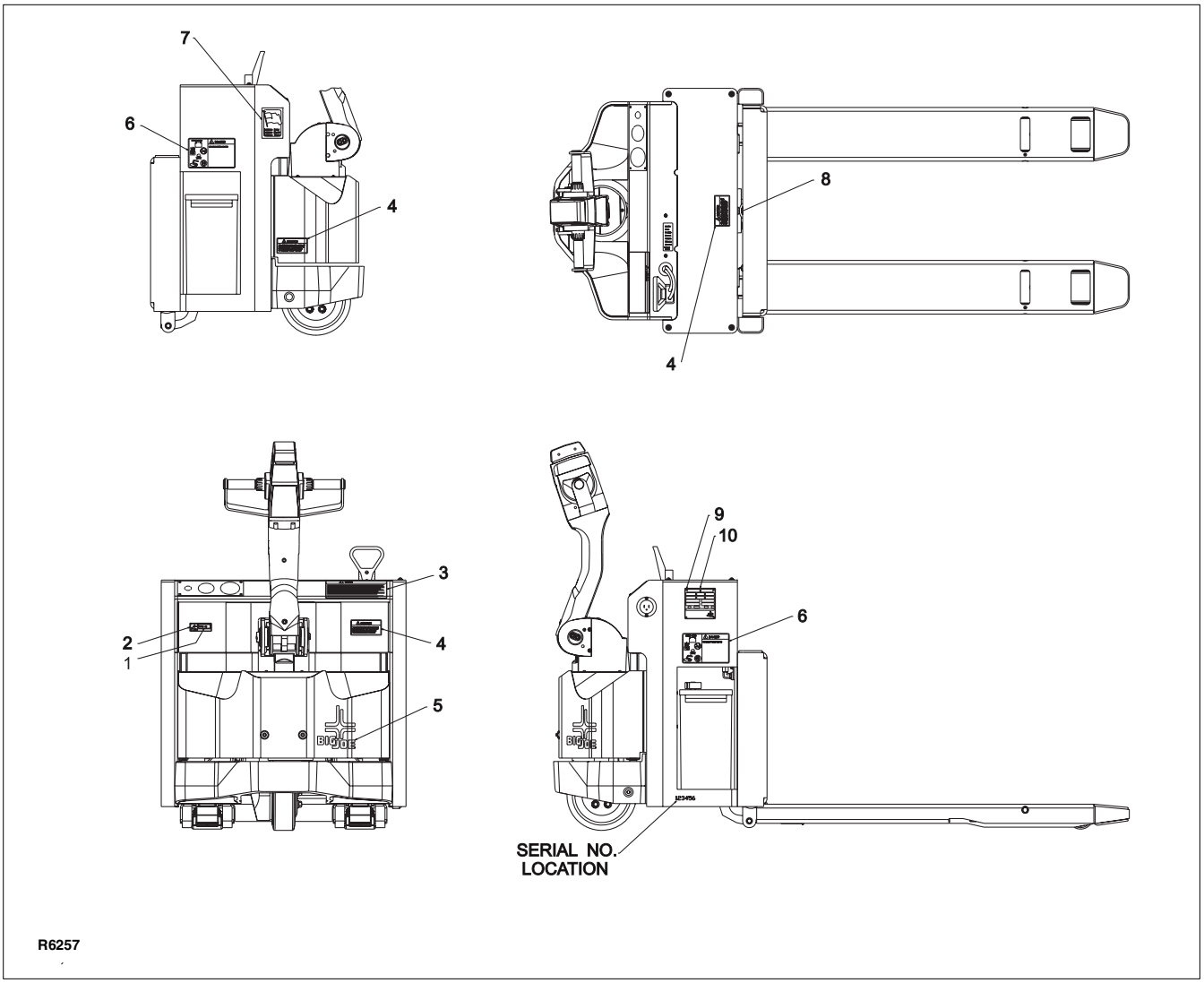

Figure 7-8 Decal Location

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	056596-09	PTW-40 DECAL	1
2	056595	LOGO	1
3	056613	OPER. INSTR. DECAL	1
4	056564	CAUTION DECAL	3
5	056682	BIG JOE DECAL	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
6	056646	CAUTION, BATTERY DECAL	2
7	056683	AMERICAN DECAL	1
8	056499	NO RIDING DECAL	1
9	066050	DRIVE SCREW	4
10	061334	NAMEPLATE	1

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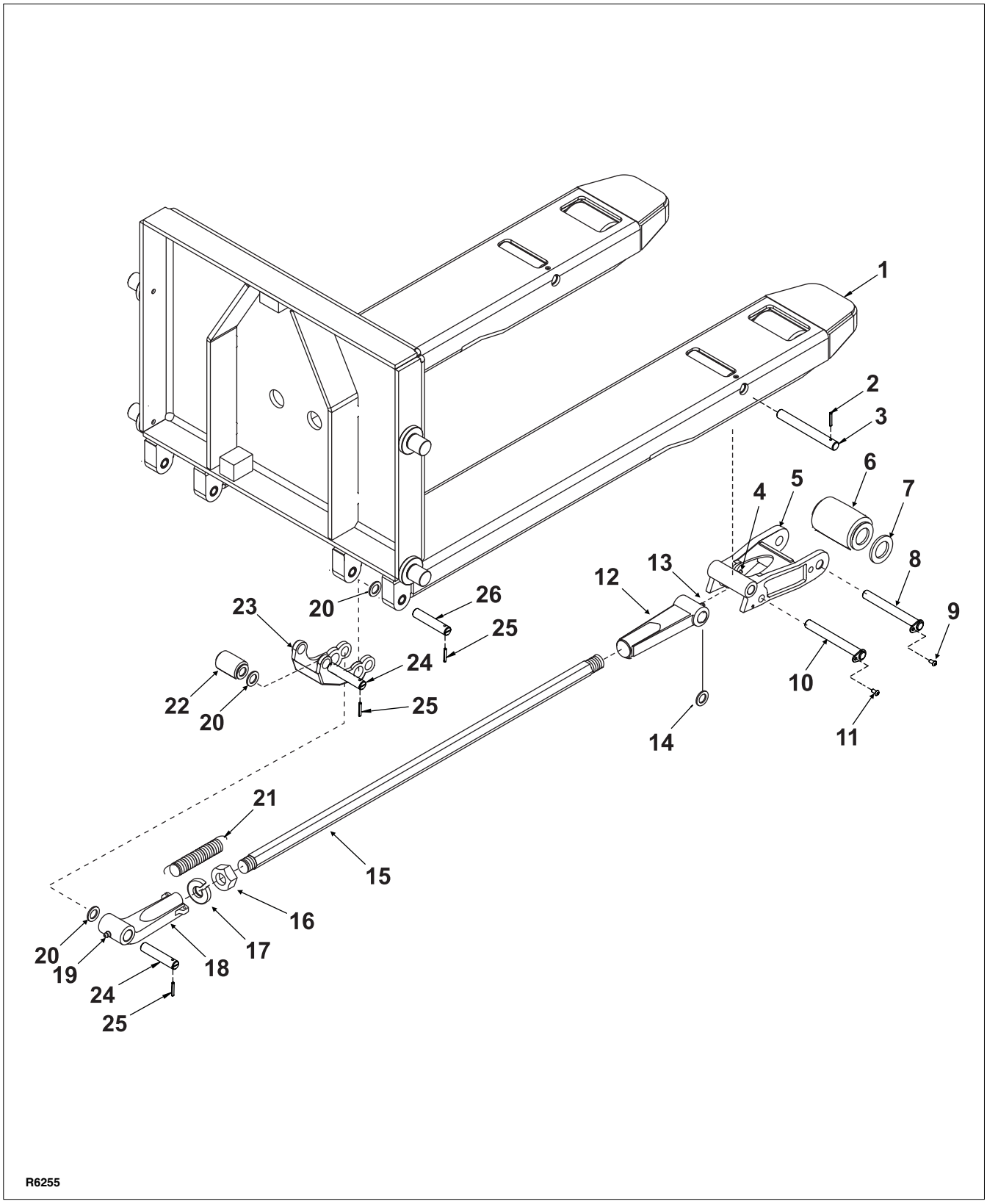

Figure 7-9 Fork Section Assembly

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	506225-01	FORK SECTION WELDMENT (48” LG X 27” W)	1
1	506225-02	FORK SECTION WELDMENT (42” LG X 27” W)	1
1	506225-03	FORK SECTION WELDMENT (36” LG X 27” W)	1
1	506225-04	FORK SECTION WELDMENT (48” LG X 22” W)	1
2	061200-03	PIN, SPIROL, 3/16 X 1/1/4	2
3	403980	SHAFT, PIVOT	2
—	506215	WHEEL HOUSING ASSY	2
4	025716	. GREASE FITTING, STRAIGHT, 1/4-28 NPT	1
5	055201	. HOUSING, WHEEL, CASTING	1
6	505709	. WHEEL ASSY, LOAD	1
—	051136	. . BEARING, BALL	2
7	077033	. WASHER, FLAT, 1.02 ID, 2.5 OD	2
8	506214	. AXLE, LOAD WHEEL	1
9	069718	. SCREW, HSLCS, NYLOK, 1/4-20 X 1/2	1
10	506147	. PIN, KEEPER	1
11	065525	. SCREW, SBHCS, 1/4-20 UNC X 5/8” LONG	1
12	055202	ROD END, MACHINED CASTING	2
13	025716	. GREASE FITTING, STRAIGHT, 1/4-28 NPT	1
14	077036	WASHER, SHIM, 3/4” ID	8
15	404266-03	PULL ROD (48” FORK)	2
15	404266-04	PULL ROD (42” FORK)	2
15	404266-05	PULL ROD (36” FORK)	2
16	059540	NUT, JAM, HEX, 7/8-14, LH THD	2
17	077221	WASHER, LOCK, SPLIT, 7/8	2
18	055206	ROD END PIVOT	2
19	025716	. GREASE FITTING, STRAIGHT, 1/4-28 NPT	1
20	077063	WASHER, 0.630 X 1 X 16 GA	16
21	075085	SPRING, EXTENSION	4
22	504708	ROLLER ASSY	2
23	055205	PIVOT HOUSING	2
24	402431-02	SHAFT, PIVOT, 3.75 LG	4
25	061200-01	PIN, SPIROL, 3/16 X 1	6
26	403511-01	SHAFT, PIVOT	2

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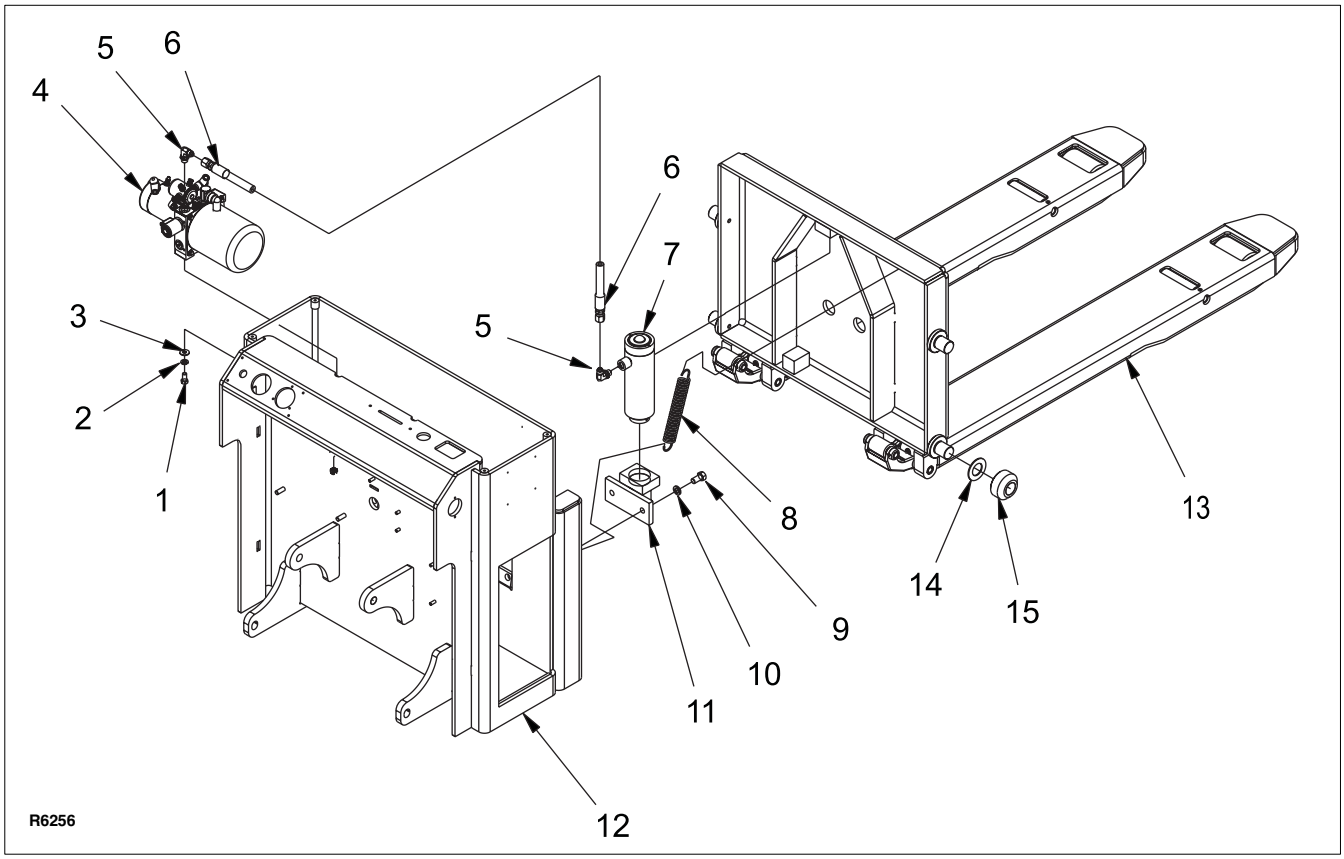

Figure 7-10 Hydraulic Installation

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	063603	SCREW, HEX HD, 3/8-16 X 3/4	2
2	077211	WASHER, LOCK, 3/8	2
3	077011	WASHER, 3/8 X 7/8 X 14 GA	2
4	—	PUMP, MOTOR & RESERVOIR ASSY (FIGURE 7-12)	REF
5	025535	ELBOW, ADPTR, 90, 9/16 SAE X 3/8 JIC	2
6	504312-13	HOSE ASY, SWIVEL, 3/8 FEMALE	1
7	—	CYLINDER ASSY (FIGURE 7-11)	REF
8	075085	SPRING, EXTENSION	2
9	063705	SCREW, HEX HD, 1/2-13 X 1	2

INDEX NO.	PART NO.	PART NAME	NO. REQD.
10	077213	WASHER, LOCK, SPLIT, 1/2	2
11	505529	MOUNT, CYLINDER	1
12	—	CABINET, WELDMENT (FIGURE 7-4)	REF
13	—	FORK SECTION WELDMENT (FIGURE 7-9)	REF
14	053012	WASHER, THRUST, 3/32” THK	AR
14	053013	WASHER, THRUST, 1/8” THK	AR
14	053014	WASHER, THRUST,5/32” THK	AR
14	053015	WASHER, THRUST, 3/16” THK	AR
15	403505	ROLLER	4

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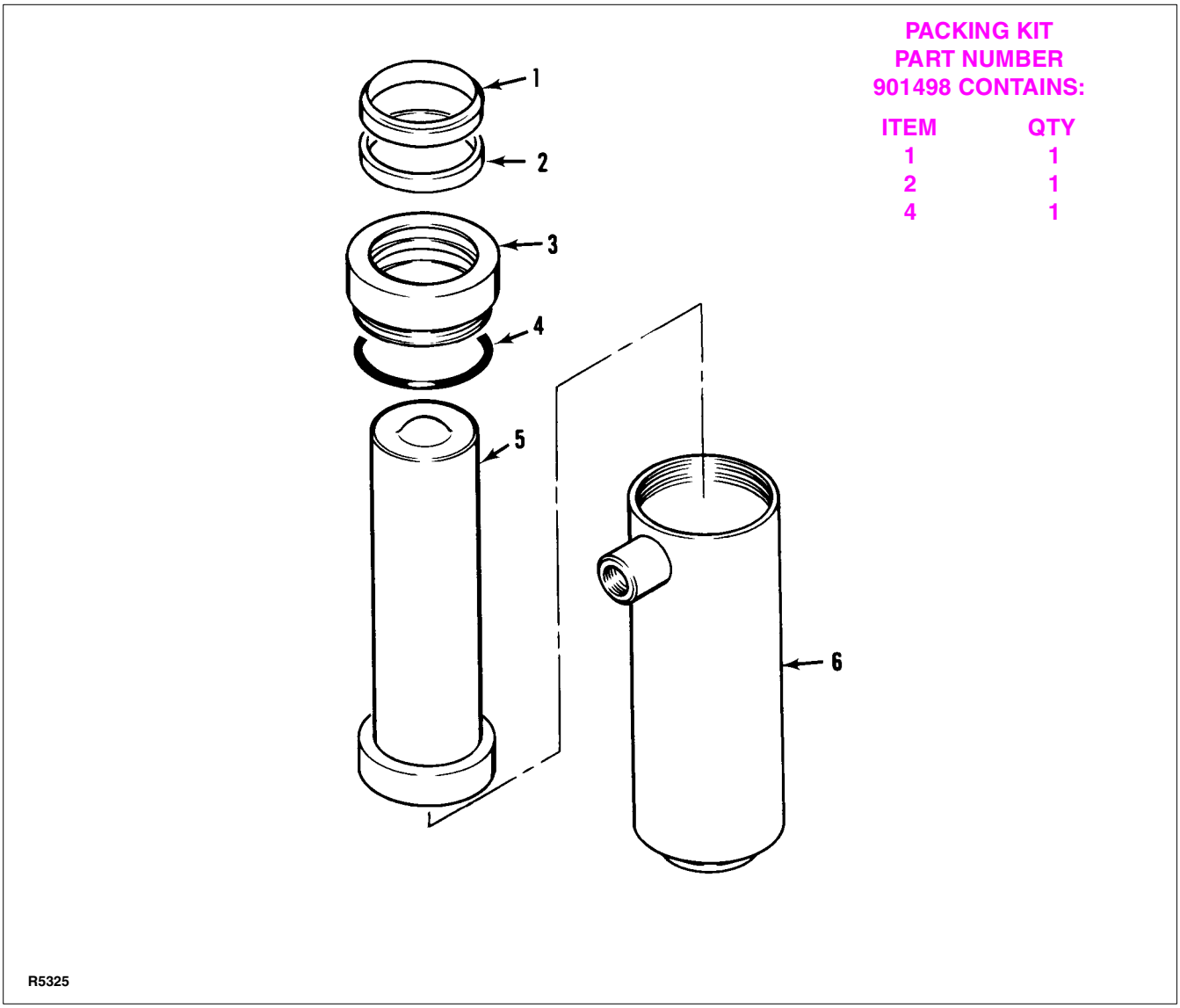

Figure 7-11 Hydraulic Cylinder Assembly

INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	505582	CYLINDER ASSEMBLY	1
1	049514 *	. RING, WIPER	1
2	043134 *	. SEAL, HEAD	1
3	403583	. HEAD, CYLINDER	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
4	042153 *	. O-RING	1
5	505581	. ROD	1
6	505580	. CYLINDER WELDMENT	1

* INCLUDED IN PACKING KIT, PART NUMBER 901498.

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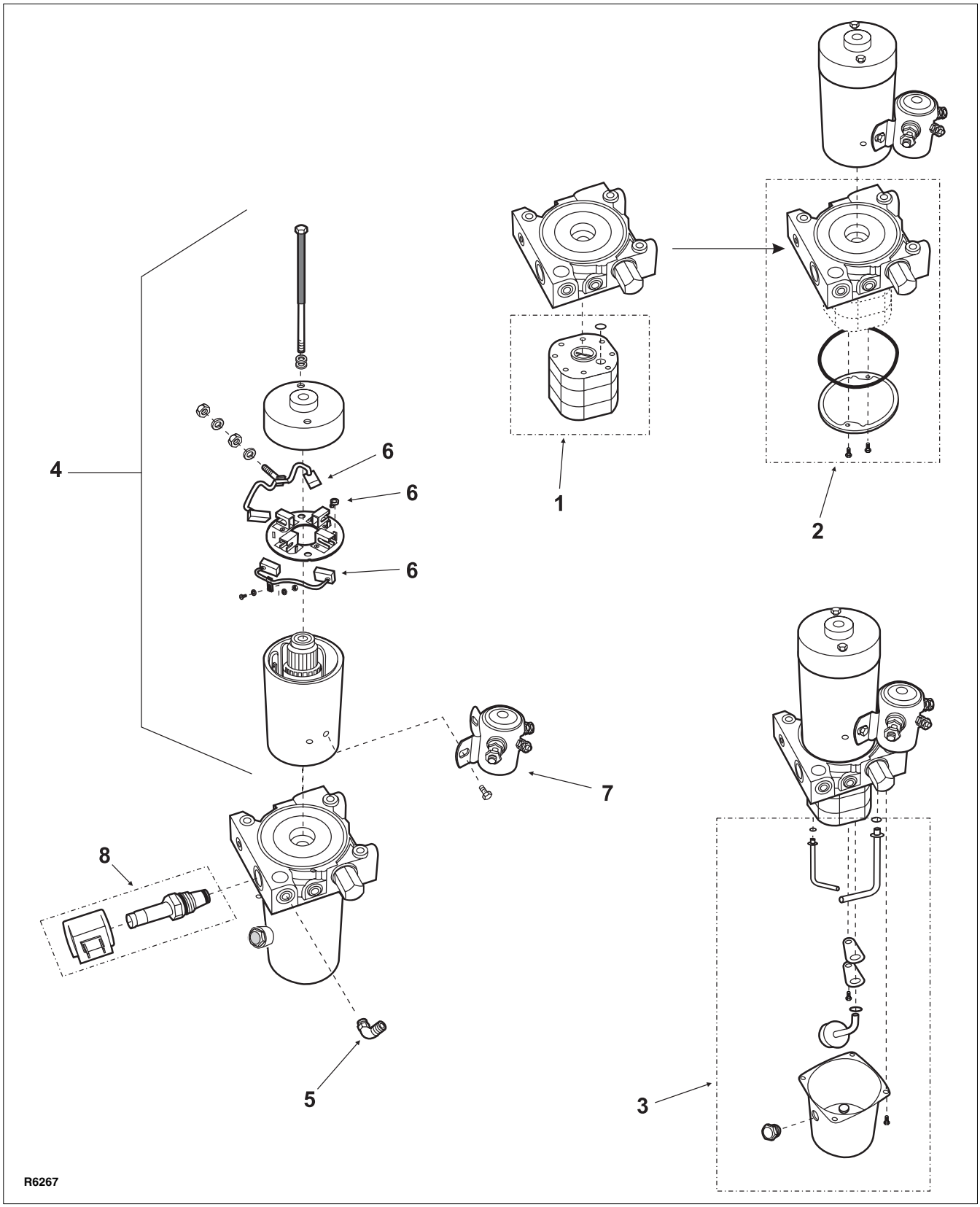

Figure 7-12 Pump, Motor & Reservoir Assembly

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	016620	PUMP, MOTOR & RESERVOIR ASSEMBLY	1
1	901750	. PUMP KIT	1
2	901751	. ADAPTER KIT, INCLUDES 2 STEEL PLUGS, TUBE RETAINER, ADAPTER, CHECK VALVE, TWO SCREW FOR RETAINING RING AND RESERVOIR O-RING. DOES NOT INCLUDE PUMP KIT	1
3	901758	. RESERVOIR KIT, INCLUDES TUBES, STRAINER, ELBOW, VENT PLUG, MAGNET, RETAINING RINGS AND WASHERS AND SCREWS	1
4	901753	. MOTOR ASSEMBLY	1
5	025535	. ELBOW, 9/16	1
6	901754	. BRUSH AND SPRING SET	1
7	020715	. SOLENOID, MOTOR STARTER	1‘
8	048133	. SOLENOID, RELEASE VALVE	1

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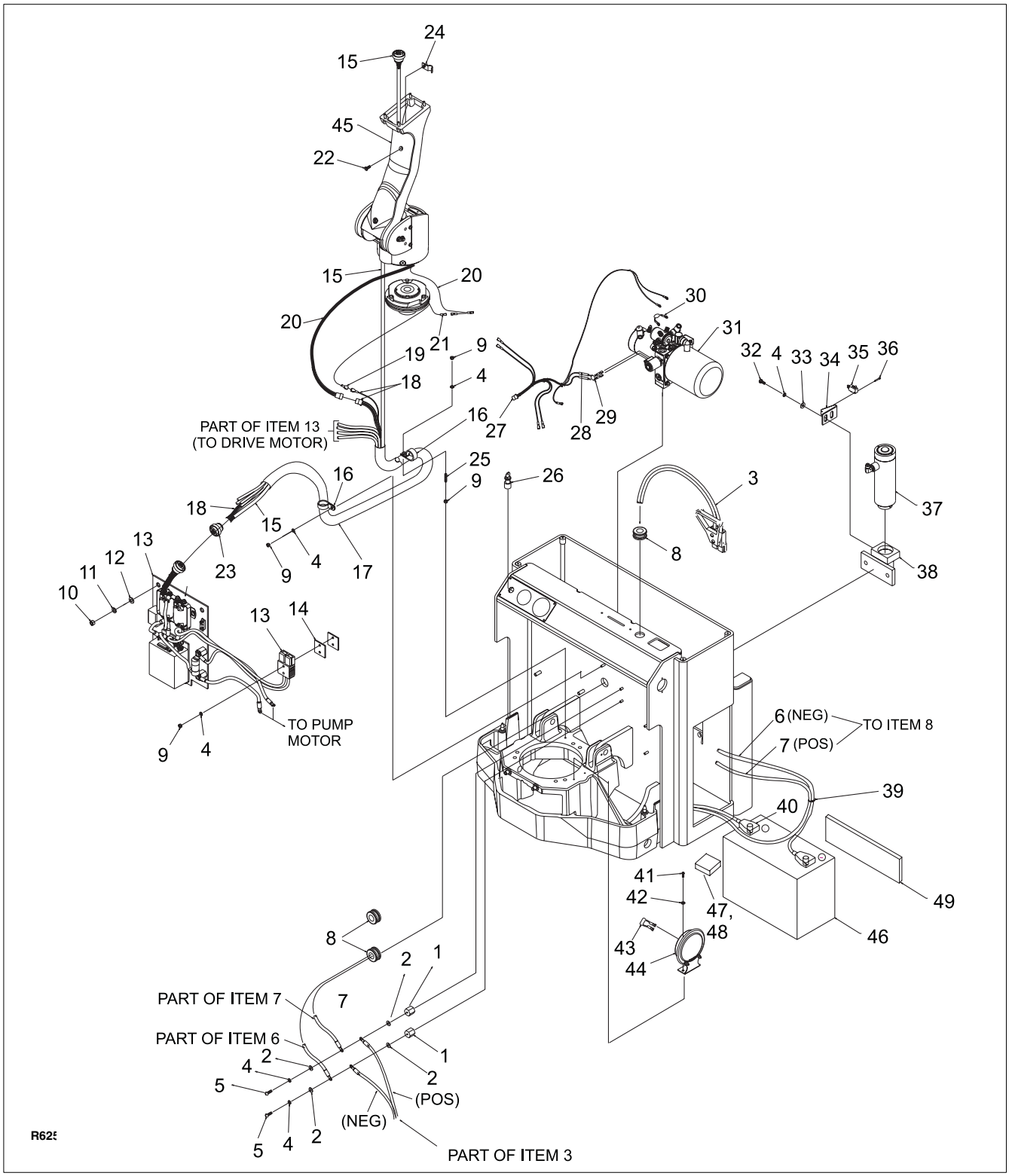

Figure 7-13 Electrical System

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	010614	STANDOFF, INSULATOR	2
2	077105	WASHER, FLAT, 1/4, BRASS	2
3	506115-01	BATTERY CONNECTOR & CABLE ASSEMBLY	1
4	077209	WASHER, LOCK, SPLIT, 1/4	8
5	070489	SCREW, SRHC, 1/4-20 X 5/8, BRASS	2
6	505469-36	CABLE ASSY, BATTERY	2
7	505469-36	CABLE ASSY, BATTERY	1
8	057519	GROMMET, 1.25 DIA HOLE, 3/8 THK	3
9	059421	NUT, HEX, 1/4-20 UNC	5
10	059429	NUT, HEX, 3/8-16 UNC	4
11	077211	WASHER, LOCK, SPLIT, 3/8	4
12	077056	WASHER, FLAT, 3/8	4
13	506239	PANEL ASSY, ELECT (FIGURE 7-14)	1
14	403688	SHIM, CONNECTOR	2
15	023278	CABLE ASSY, CONTROL	1
16	056135	CLAMP, LOOP, CUSHIONED, 1.25 DIA	2
17	901451	OVERSLEEVE, CABLE, BRAIDED	1
18	023277	HARNESS ASSY, DEADMAN, CREEP	1
19	021252	TERMINAL, 1/4 TAB,FEMALE, INSULATED	1
20	023273	HARNESS ASSY, SWITCHES	1
21	021249	TERMINAL, 3/16 TAB, FEMALE	1
22	—	SCREW	1
23	005640	CONNECTOR, PLUG, 16 SOCKET	1
24	504364	CLAMP & CLINCH NUT ASSY	1
25	075620	STUD, THREADED, 1/4-20 X 1.25	1
26	020725	KEYSWITCH	1
27	023279	HARNESS ASSY, HYDRAULIC	1
28	005422	CONNECTOR, IN LINE	1
29	504116	SUPPRESSOR ASSY, SPIKE, LOWER SOL	1
30	504097	SUPPRESSOR ASSY, SPIKE, MOTOR SOL	1
31	—	PUMP, MOTOR & RESERVOIR ASSY (FIGURE 7-12)	REF
32	065476	SCREW, SHC, #4-40 X 3/4	2
33	077031	WASHER, FLAT, 1/4	2
34	404239	BRACKET, MOUNTING, SWITCH	1
35	020775	SWITCH, MICRO, ROLLER ARM	1
36	065472	SCREW, SHC, #4-40 X 3/4	2
37	—	CYLINDER (FIGURE 7-11)	REF
38	—	MOUNT, CYLINDER	REF
39	056113	TIE, CABLE	A/R
40	506123-05	CABLE ASSY, BATTERY	1
41	065531	SCREW, BHC, #10-32 X 1/2	2
42	077207	WASHER, LOCK, SPLIT, #10	2
43	504096	SUPPRESSOR ASSY, SPIKE, HORN	1
44	009602	HORN	1
45	—	STEERING ARM (FIGURE 7-3)	REF
46	003217-01	BATTERY, 160AH, WET (STANDARD)	2
46	003217	BATTERY, 160AH, DRY	2
46	003148	BATTERY, 200AH, WET	2
46	003149	BATTERY, 200AH, DRY	2
46	003215	BATTERY, 145AH, AMF	2
46	003216	BATTERY, 135AH, GMF	2
47	404591	SPACER (USED WITH 135AH, 145AH, 160AH)	1
48	055708	ADHESIVE (USED WITH 135AH, 145AH, 160AH)	A/R
49	403605	SPACER (USED WITH 135AH, 145AH, 160AH, 200AH)	1

A/R - AS REQUIRED

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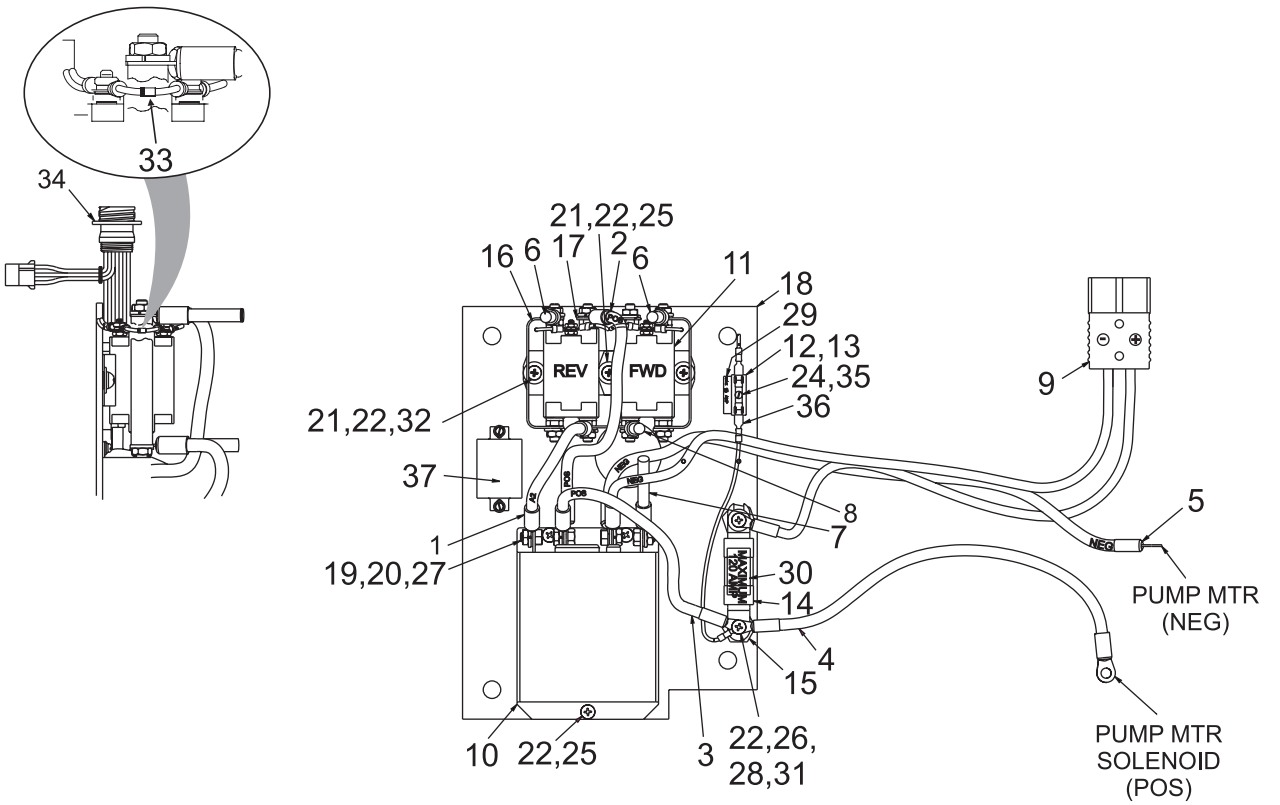

Figure 7-14 Electrical Panel Assy

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	506239	PANEL ASSY	1
1	504150-17	. CABLE ASSY, #4 AWG	1
2	504150-25	. CABLE ASSY, #4 AWG	1
3	504150-26	. CABLE ASSY, #4 AWG	1
4	504150-27	. CABLE ASSY, #4 AWG	1
5	504150-07	. CABLE ASSY, #4 AWG	1
6	504150-36	. CABLE ASSY, #4 AWG (DRIVE MOTOR F1 & F2)	2
7	504150-36	. CABLE ASSY, #4 AWG (DRIVE MOTOR A1)	1
8	504150-35	. CABLE ASSY, #4 AWG (DRIVE MOTOR A2)	1
9	505466-03	. BATTERY CONNECTOR ASSY	1
10	907200-02	. CONTROLLER, TRANSMISION, 250A, 24V	1
11	005667	. SOLENOID, CONTACTOR, 24V	2
12	008904	. FUSE HOLDER	1
13	008910	. FUSE, AGX TYPE, 15 AMP	1
14	008918	. FUSE, 120 AMP	1
15	010614	. STANDOFF, INSULATOR	2
16	403548	. BUSSBAR	2
17	403549	. BUSSBAR	2
18	404207	. PLATE, SUB-PANEL	1
19	077210	. WASHER, LOCK, 5/16	4
20	059526	. NUT, HEX, JAM, 5/16-18 UNC	4
21	077031	. WASHER, FLAT, 1/4	3
22	077209	. WASHER, LOCK, 1/4	8
24	077204	. WASHER, LOCK, #6	1
25	070481	. SCREW, PH RD HD, 1/4-20 UNC X 7/16	4
26	070489	. SCREW, PH RD HD, BRASS, 1/4-20 UNC X 5/8	2
27	063552	. SCREW, HHCS, 5/16-18 UNC X 5/8	4
28	075623-01	. STUD, PRESS IN, 1/4-20 UNC X 1/2	2
29	056504	. DECAL, FUSE, 15 AMP	1
30	056562	. DECAL, FUSE, 120 AMP	1
31	077105	. WASHER, FLAT, BRAS, 1/4	4
32	070475	. SCREW, PH RD HD, 1/4-20 UNC X 3/8	2
33	005996	. DIODE ASSY, CONTACTOR	2
34	023265	. HARNESS ASSY, PANEL, CONTACTOR	1
35	068230	. SCREW, PH RD HD, #6-32 UNC X 3/8	1
36	023238-31	. WIRE ASSY, FUSE	1
37	—	RELAY CHARGER (FIGURE 7-15)	REF

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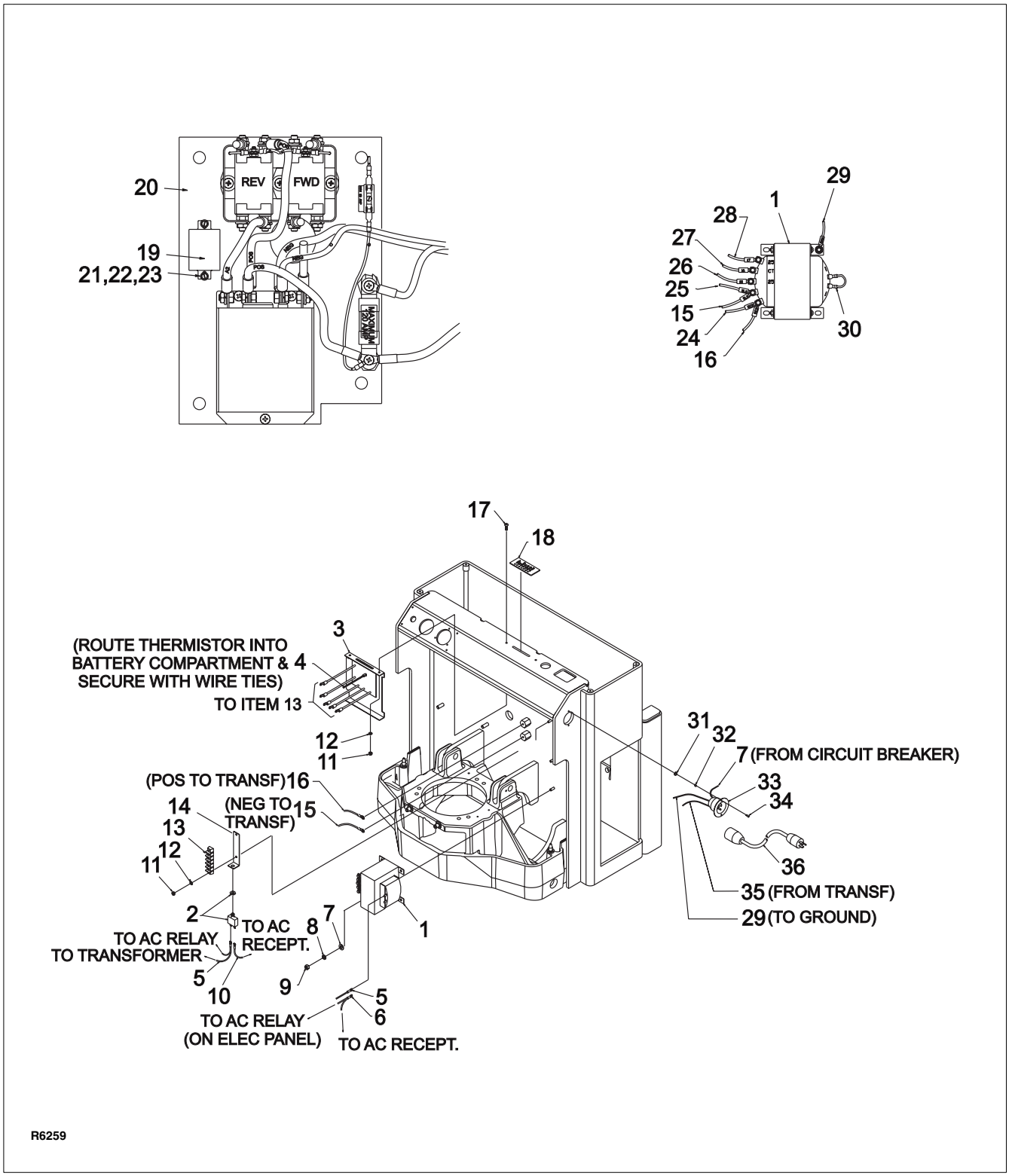

Figure 7-15 Charger Installation

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INDEX NO.	PART NO.	PART NAME	NO. REQD.
—	004987	CHARGER ASSEMBLY, 120V (STANDARD)	1
—	004989	CHARGER ASSEMBLY 230V (OPTIONAL)	1
1	904076	. TRANSFORMER, 120V	1
1	901756	. TRANSFORMER, 230V	1
2	003403	. CIRCUIT BREAKER, AUTO RESET	1
3	904075	. CIRCUIT BOARD ASSY, 120V	1
4	904074	. THERMISTOR, 120V	1
5	023268	CABLE ASSEMBLY	1
6	023269	CABLE ASSEMBLY	1
7	077031	WASHER, FLAT, 1/4	4
8	077209	WASHER, LOCK, 1/4	4
9	069421	NUT, HEX	4
10	023267-01	CABLE ASSEMBLY	1
11	069416	NUT, HEX	4
12	077207	WASHER, LOCK, SPLIT, #10	4
13	021261	TERMINAL STRIP	1
14	040569	BRACKET	1
15	505675-09	CABLE ASSEMBLY	1
16	505675-10	CABLE ASSEMBLY	1
17	071385	SCREW	2
18	056680	DECAL, CHARGER, LED	1
19	018411	AC RELAY, 120V	1
19	018412	AC RELAY, 230V	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
20	—	ELECTRICAL PANEL ASSY (FIGURE 7-14)	4
21	077007	WASHER	2
22	077204	WASHER, LOCK, SPLIT, #6	2
23	068235	SCREW, MACH, RH HD, #6-32 X 1/4	2
24	505675-04	CABLE ASSEMBLY	1
25	505675-05	CABLE ASSEMBLY	1
26	505675-1	CABLE ASSEMBLY	1
27	505675-06	CABLE ASSEMBLY	1
28	505675-11	CABLE ASSEMBLY	1
29	023267-02	CABLE ASSEMBLY	1
30	023267-03	CABLE ASSEMBLY (230V)	1
31	059412	NUT-HEX, 6/32	2
32	077204	WASHER, LOCK #6	2
33	005810	CONNECTOR, INLET FLANGE (120V)	1
33	504599	CONNECTOR, INLET FLANGE (230V)	1
34	068233	SCREW, SL RD HD, 6/32 X 3/4	2
35	023269	CABLE ASSEMBLY	1
36	005810	CORD, AC, INPUT, CHARGER, (120V)	1
36	504599	CORD, AC, INPUT, CHARGER, (230V)	1

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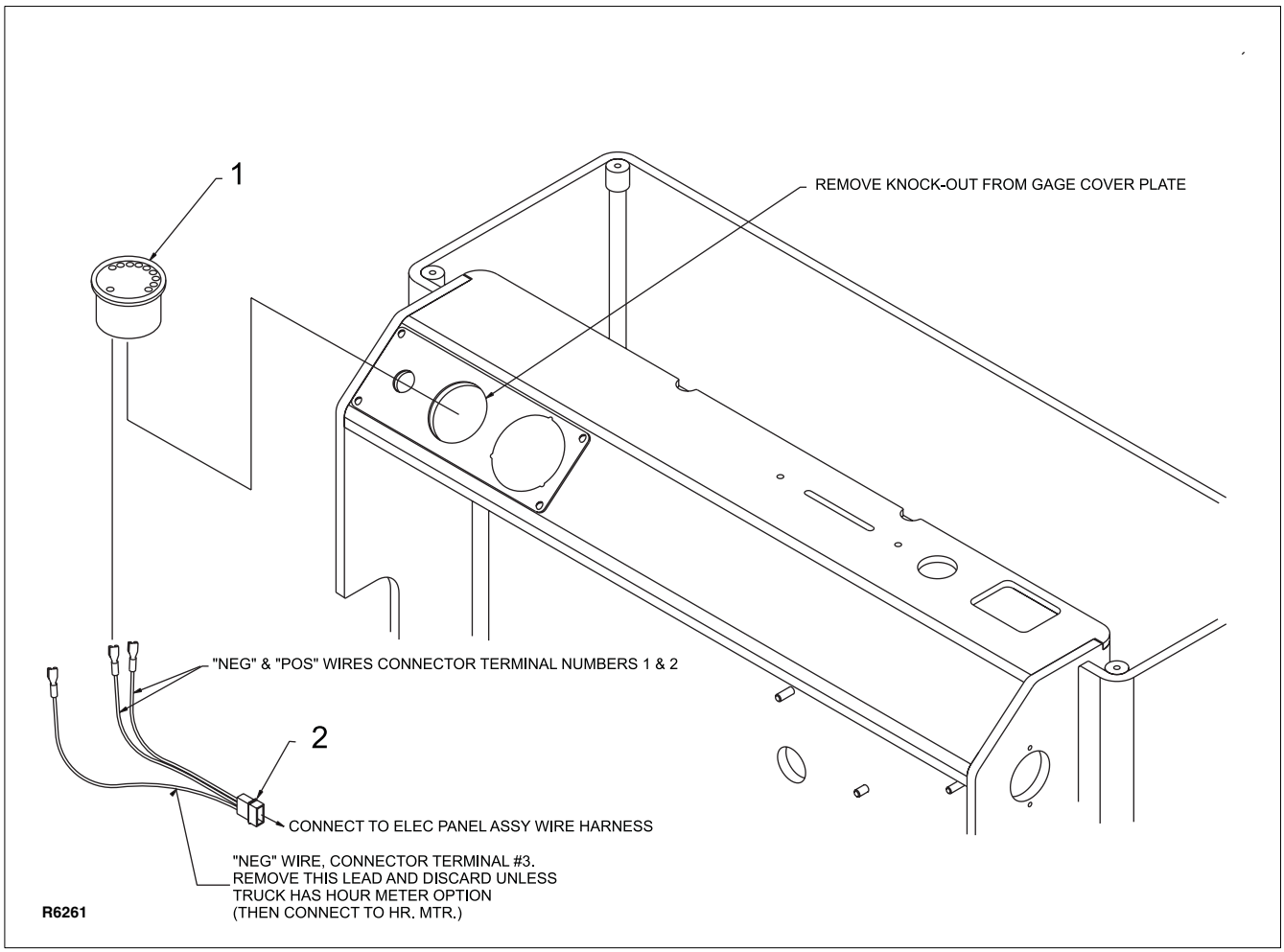

Figure 7-16 Battery Capacity Indicator - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	010617-02	INDICATOR, BATTERY DISCHARGE WITHOUT LIFT LOCK-OUT	1
1	010618-02	INDICATOR, BATTERY DISCHARGE WITH LIFT LOCK-OUT	1
2	023271	HARNESS	1

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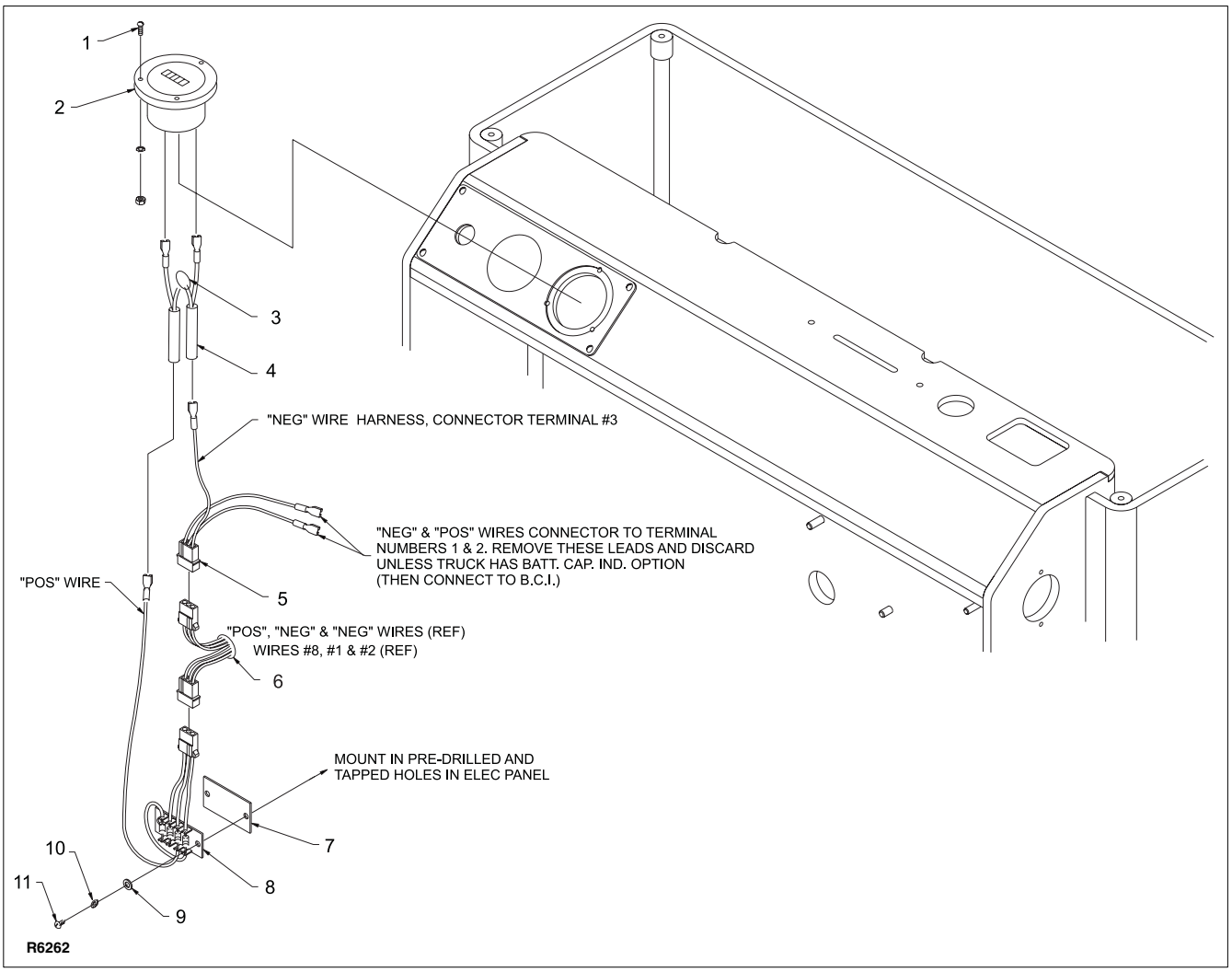

Figure 7-17 Hourmeter - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	068233	SCREW, SL RD HD, 6/32 X 3/4	3
2	015604	HOURMETER	1
3	504116	SUPPRESSOR ASSY, SPIKE	1
4	005422	CONNECTOR, IN-LINE INSULATED	2
5	023271	HARNESS ASSY	1
6	—	HARNESS ASY,PANEL, CONTACTOR (FIGURE 7-14)	REF
7	010625	PAD, INSULATING	1
8	505931	DIODE ASSEMBLY	1
9	077007	WASHER, FLAT	2
10	077204	WASHER, LOCK #6	2
11	068230	SCREW, RD HD, 6-32 X 3/8	2

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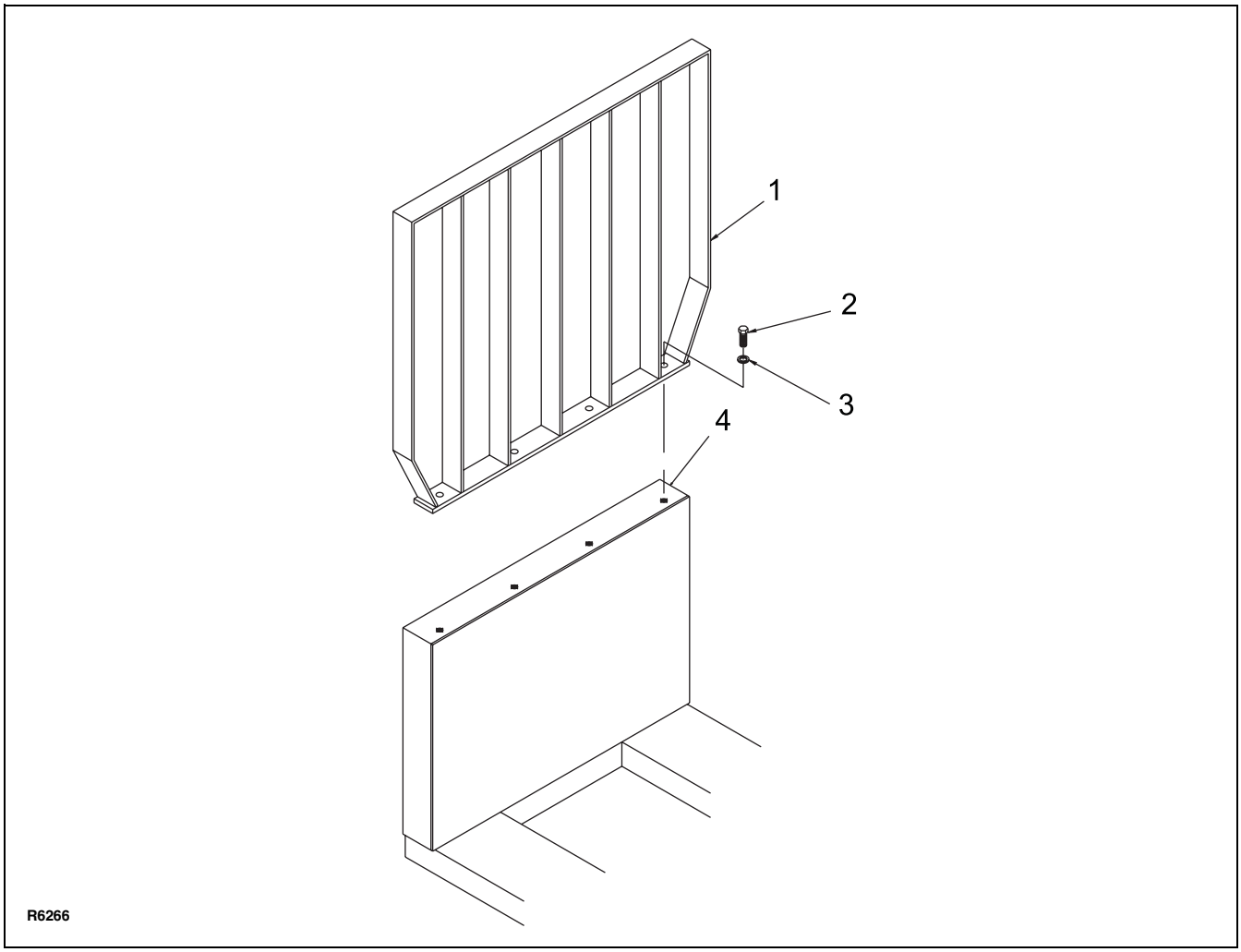

Figure 7-18 Load Backrest - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	505562-01	LOAD BACKREST	1
2	064707	SCREW, HEX HEAD CAP	4
3	077213	WASHER	4
4	—	FORK SECTION (FIGURE 7-9)	REF

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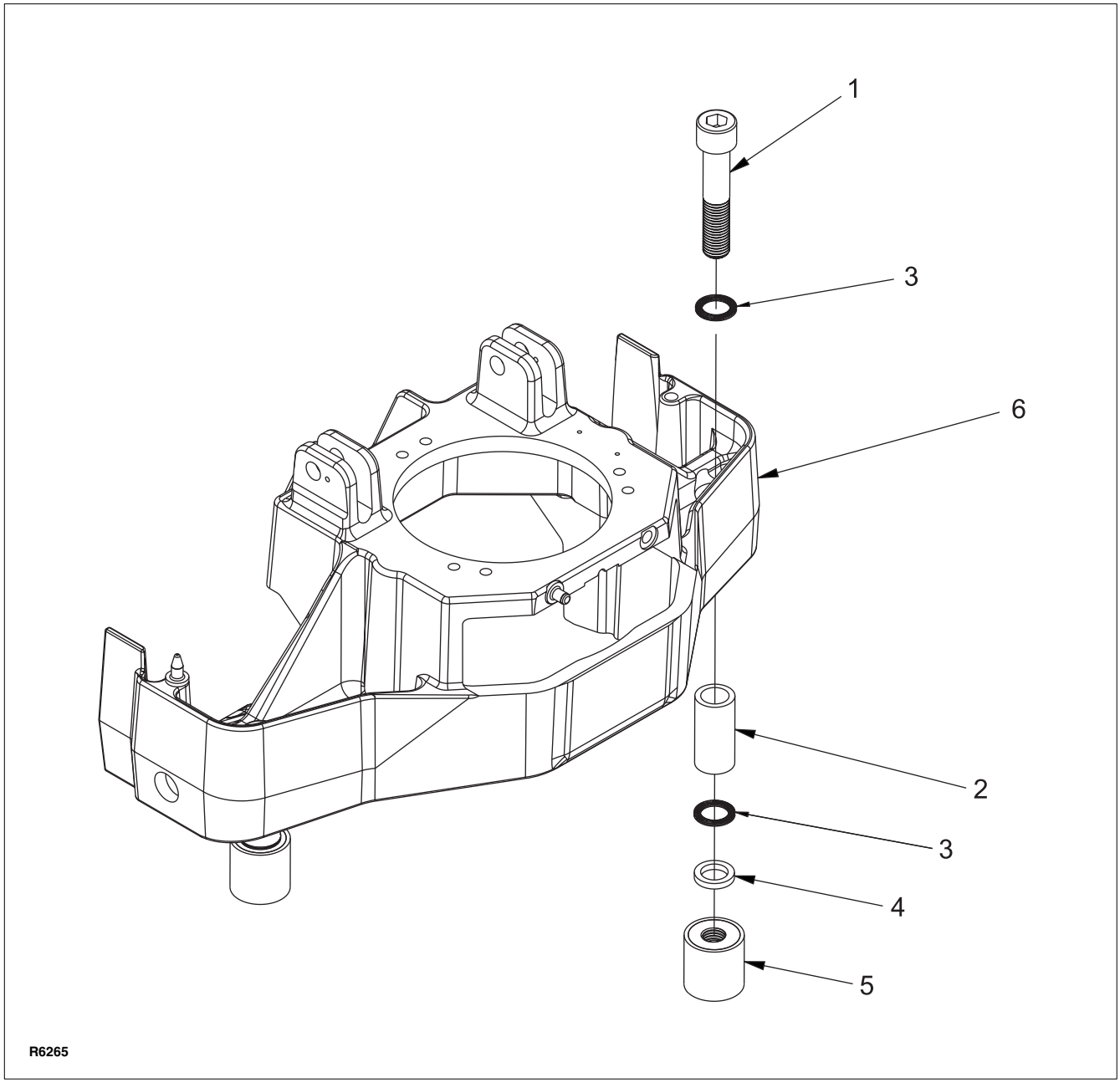

Figure 7-19 Stability Pad - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	065975	SCREWS, SHCS, 1-8 X 5” LG	2
2	404427	STANDOFF STABILIZER	2
3	075575	WASHER, LOCK, VIBRATION RESIST, 1”	4

INDEX NO.	PART NO.	PART NAME	NO. REQD.
4	404330	SPACER, JACK STAND	2
5	053043	BUMPER	2
6	—	FRAME, POWER SECTION (FIGURE 7-4)	

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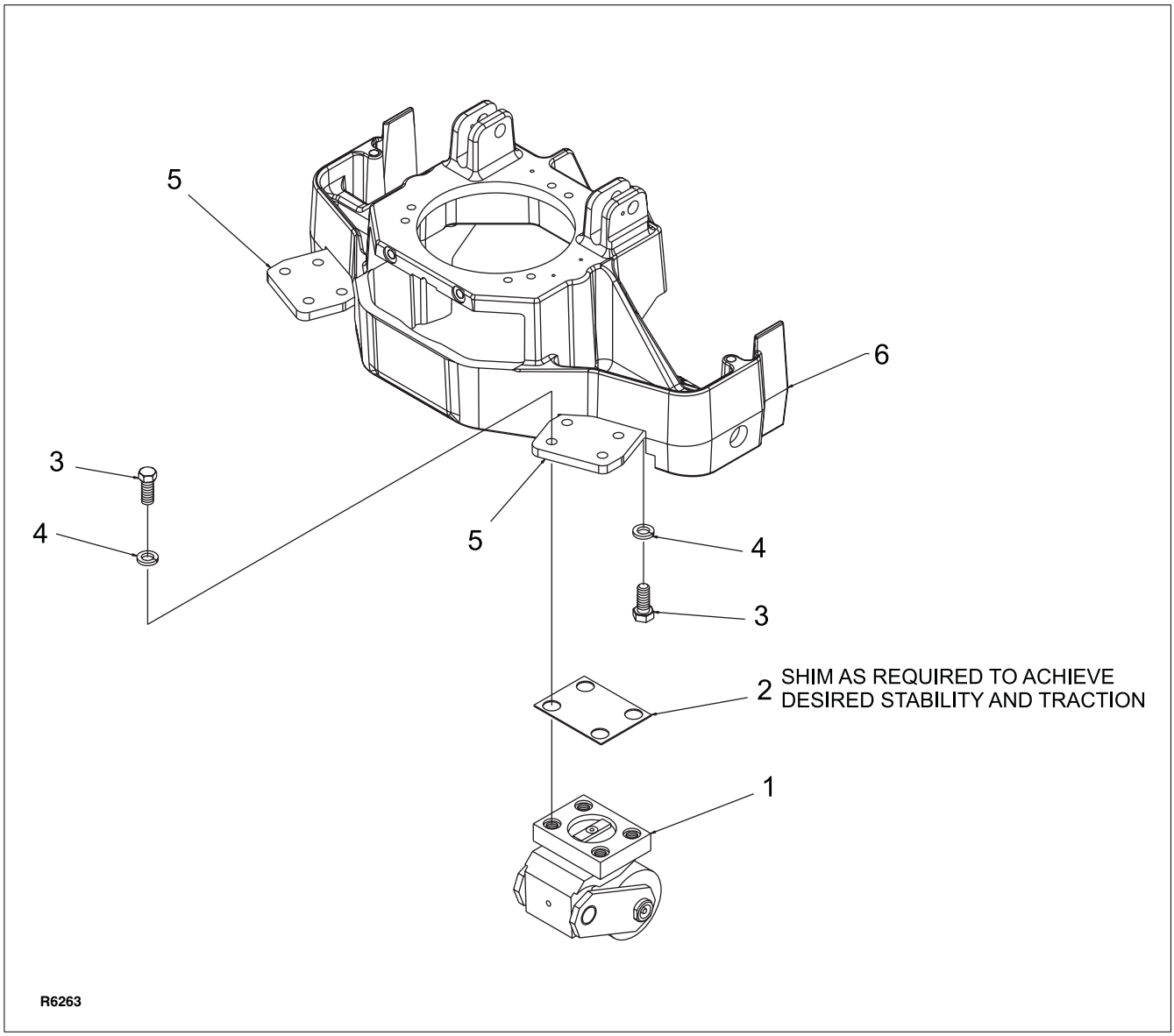

Figure 7-20 Caster Installation - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	—	CASTER ASSY, SPRING LOADED (FIGURE 7-21)	REF
2	403662	SHIM, CASTER	A/R
3	064709	SCREW, HHC, 1/2-13 UNC X 1.50	18
4	077213	WASHER, LOCK, SPLIT, 1/2	18
5	404597	PLATE, CASTER	2
6	—	FRAME, POWER SECTION (FIGURE 7-4)	REF

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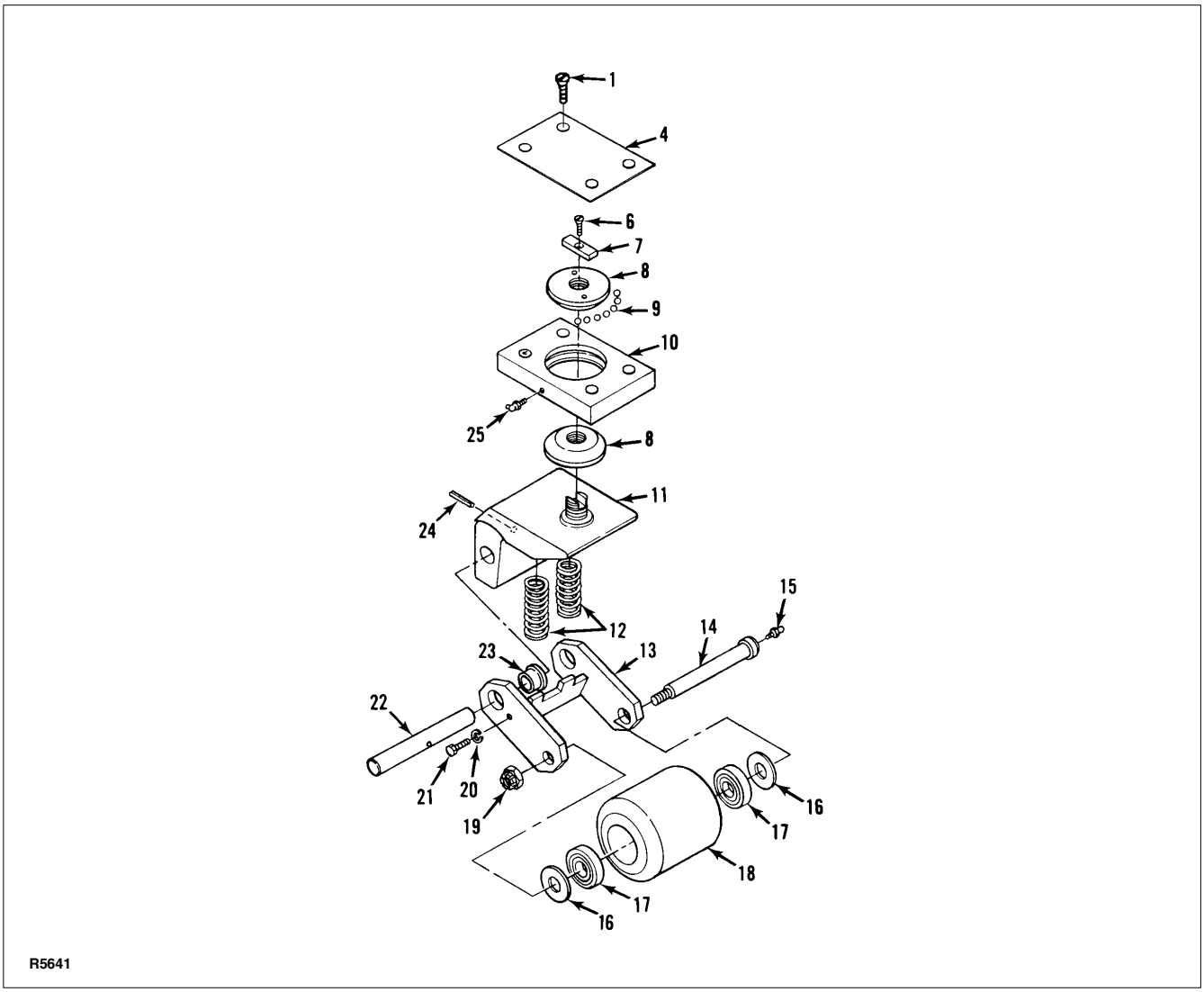

Figure 7-21 Caster Assembly

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	—	SCREW (FIGURE 7-20)	REF
4	—	SHIM, CASTER (FIGURE 7-20)	REF
—	504620-08	CASTER ASSEMBLY	2
6	069715	. SCREW, NYLOK	1
7	402327	. CLAMP	1
8	402289	. RACE, BEARING	2
9	051404	. BALL, 3/8	16
10	402292	. HOUSING, BEARING	1
11	402288	. BASE, CASTER	1
12	075005	. SPRING	1
12	075075	. SPRING	1
13	504621	. ARM WELDMENT	1

INDEX NO.	PART NO.	PART NAME	NO. REQD.
14	402291	. AXLE	1
15	025713	. FITTING, LUBE	1
16	051154	. BEARING, THRUST	2
17	051152	. BEARING	2
18	078263	. WHEEL	1
19	059645	. NUT, LOCK	1
20	077210	. WASHER, LOCK, 5/16	2
21	063553	. SCREW,5/16-18 X 3/4	2
22	402290	. SHAFT	1
23	053041-01	. BUSHING	2
24	061004	. PIN, ROLL	1
25	025702	. FITTING, LUBE	1

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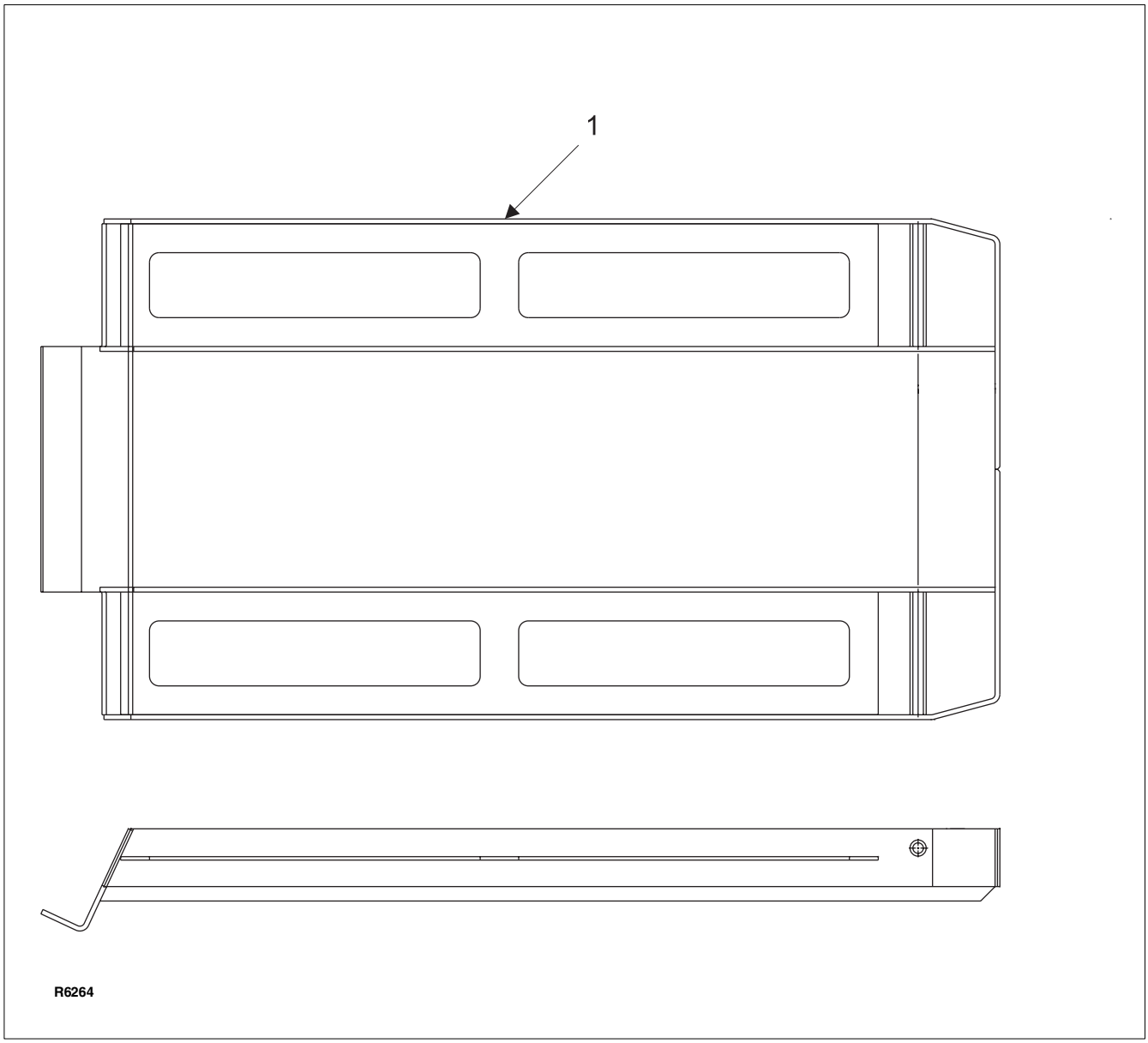

Figure 7-22 Modular Skid Adapter - Option

INDEX NO.	PART NO.	PART NAME	NO. REQD.
1	505810-01	MODULAR SKID ADAPTER (USED WITH 27W X 48L FORKS)	1

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