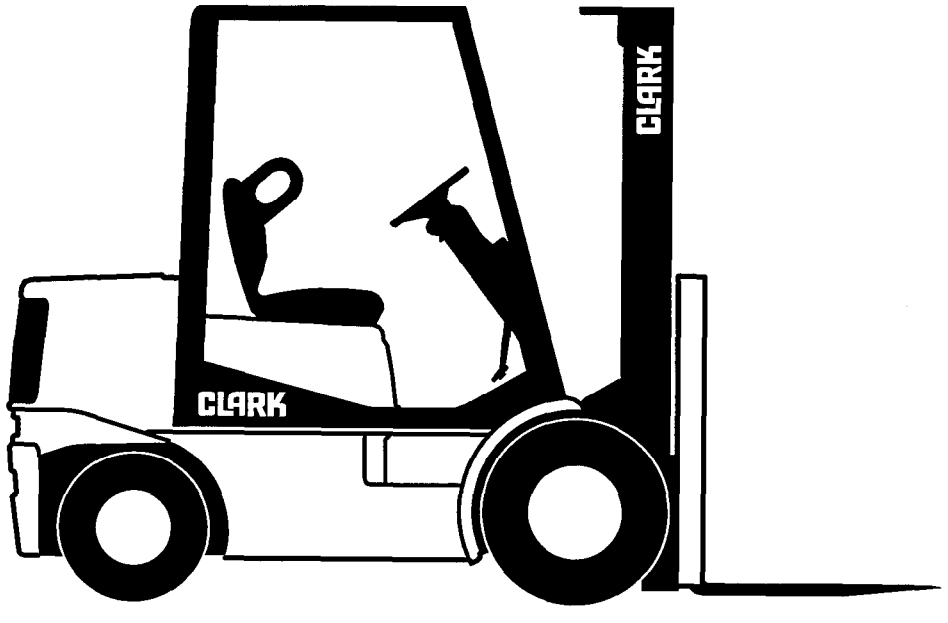
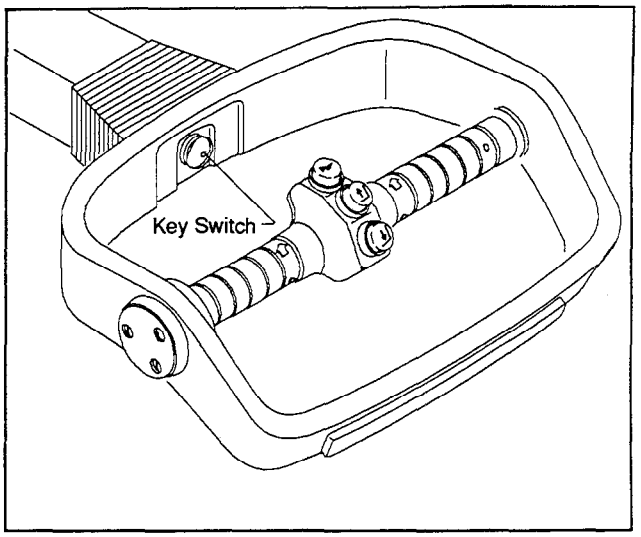
SM-568
PWD/HWD 25/30/36



CLARK Technical Publications Lexington, KY 40508

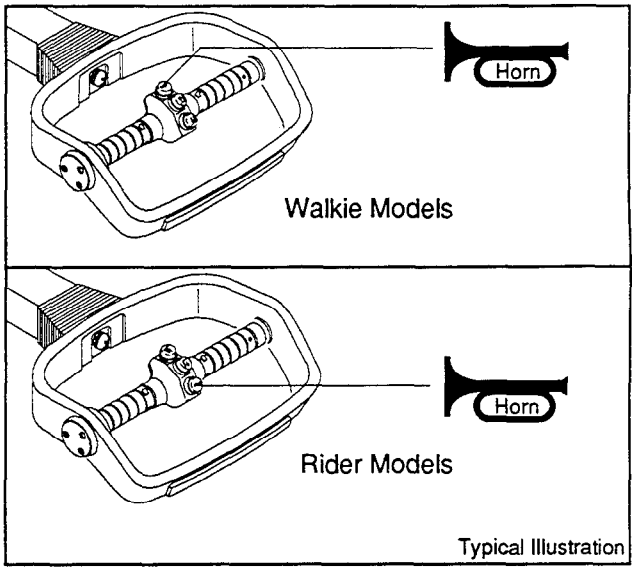
Operational Tests

9. Turn the key switch on.



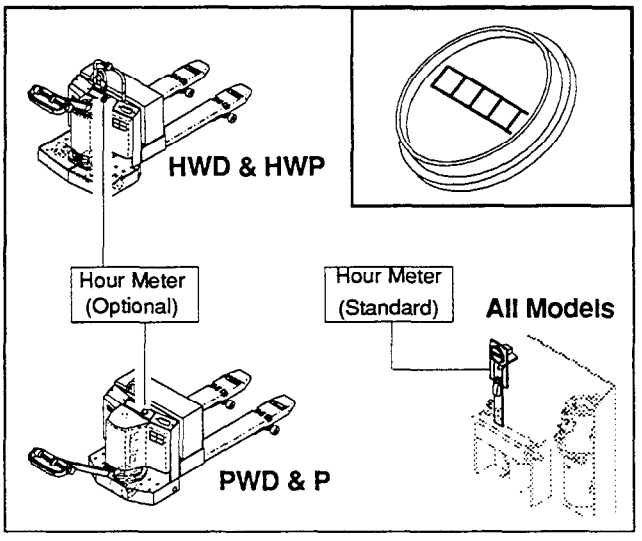
10. **All Models**

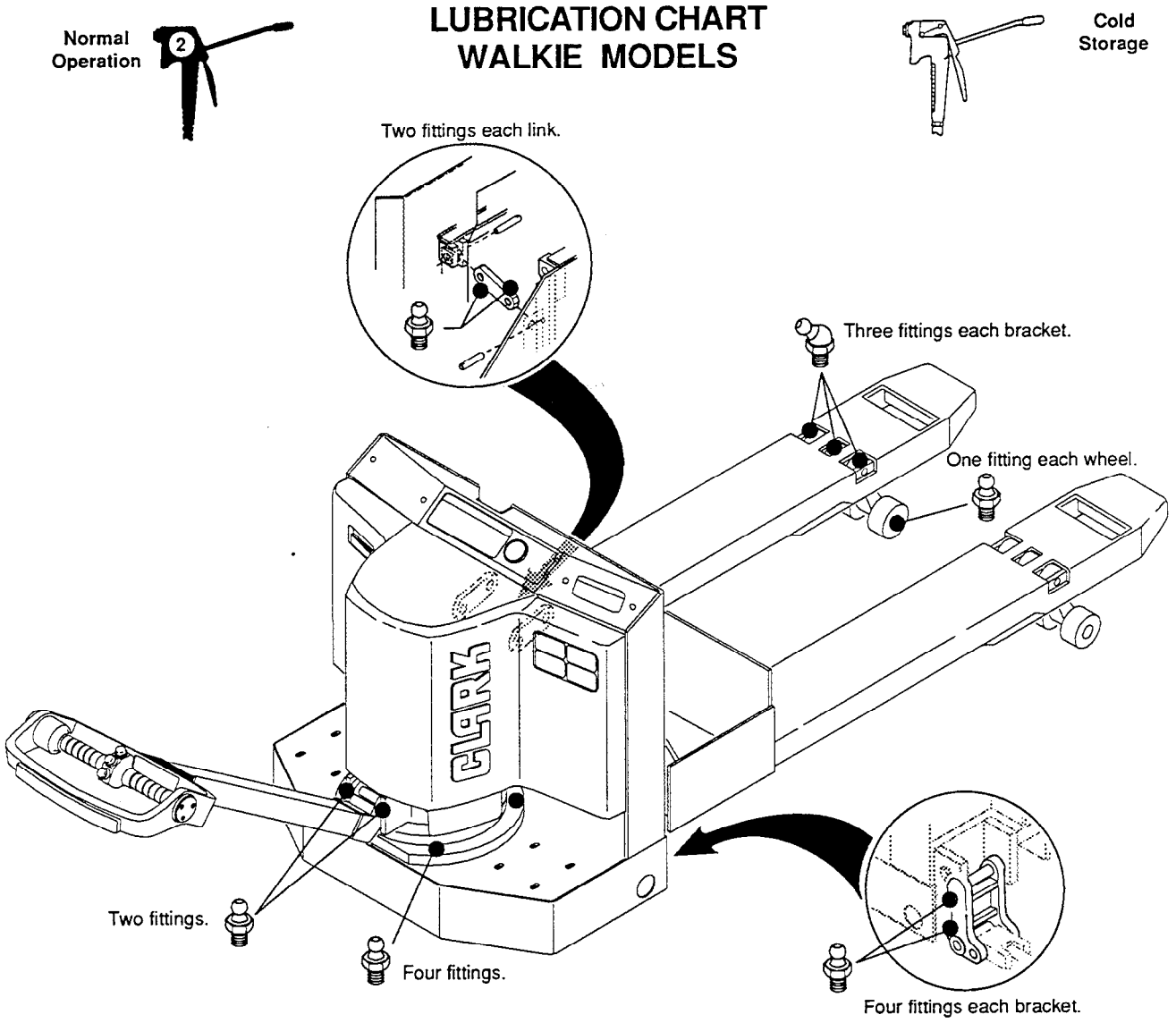
- Check the horn to be sure it operates.



11. **All Models**

- Check the hour meter to be sure it operates.





General Purpose Chassis grease

Recommendation Use a Grade NLGI #2 per Clark Specification MS-107C.

Specification MS-107C A multi-purpose grease of refined mineral oil blended with lithium soap thickner or equal containing anti-wear, anti-rust and anti-oxidants with EP additives. Per Clark Specification MS-107C

Cold Storage Operation

Low Temperature Grease An extreme low temperature aircraft quality grease meeting Specification MIL-G-23827A, or equivalent product. Temperature range -100 to +250 F.

Wipe grease fittings clean before applying a grease gun.

KEEPING BATTERY RECORDS

Records should be maintained to get the best service out of your battery and truck.

These records should contain:

- **Test Date.** Each test should be dated for future reference and comparison.
- **Specific Gravity andTemperature readings.** Each battery cell should be checked and recorded before and after charging. The specific gravity reading of the electrolyte should not be less than 1.260. If below 1.250, the battery should be recharged and tested.
- **Variation between each cell tested.** The variation in specific gravity reading *between cells* should not be greater than 15 points (.015). If readings are greater, this indicates there are defective cells.

  The pilot cell should be changed occasionally to distribute any electrolyte loss over the battery when taking readings.
- **Load Voltage Tests** should be performed and recorded indicating the condition of a battery while it is performing work.
- **Actual Operating hours of the battery.** Record the actual time the battery is in use before putting it on charge..
- **Charging Time.** Keep an accurate record of the actual time the battery is on charge. After each charge, check to see if the battery is fully charged. Test the battery before placing it back into service. Record these results.
- **Visually Inspect** for loose terminal connections or posts, a cracked case, or damaged cell covers (vent caps) and excessive corrosion. This data should be noted to help ascertain work enviroment and possible trouble areas.

For further information, refer to Group 19, Section 4 in this manual.

Check with your local battery supplier for complete battery maintenance procedures and their expertise.

BATTERIES

Industrial Batteries are used to supply the electrical power to operate an Electric Industrial Truck. Their voltage depends on the number of individual cells they contain. There are approximately 2 volts for each cell in the commonly used lead-acid type battery. Batteries normally range from 6 volts to 72 volts. Their capacity varies depending on the application. *Only use batteries that comply with factory specifications as to size and capacity.*

HOW TO GET MAXIMUM LIFE OUT OF YOUR BATTERY

- Do not add acid to a battery. *Only qualified Battery Representatives should determine if this is necessary.*
- When lifting a battery, use a lifting device designed for this purpose
- Check the electrolyte level before placing a battery on charge. Add water, if required, before charging the battery. The electrollyte level in a battery should be slightly below the lower lip of the filling hole vent. Do not overfill. Overflushing causes loss of electrolyte.
- Keep the battery clean, dry and in good conditon.
- Keep metal objects and tools away from the top of the battery. Short circuits will cause battery damage and could ignite battery fumes exploding the battery.
- Maintain good battery cable connections.
- Check power cables and wiring for damage that can cause premature drainage of the battery.
- Do not over charge a battery.
- Do not under charge a battery.
- Follow the instructions provided by your supplier(s) of the battery and battery charging equipment.
- Maintain accurate battery records. If battery troubles occur, these records will help you and your battery representative determine the nature of the problem.

ELECTRIC MOTORS

Disassembly

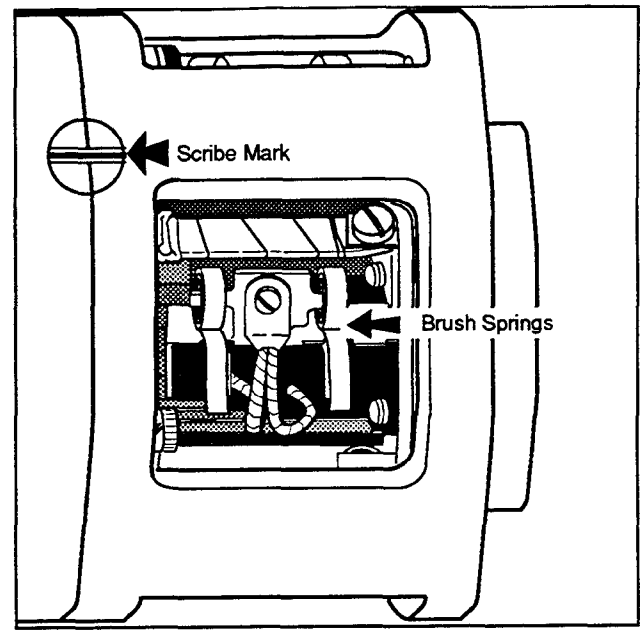
- Remove the cover band from the commutator end of the motor (if so equipped). Use a brush hook to reach into the motor and lift the brush springs. Pull the brushes out of the brush holders. Either position the brushes outside the motor or remove the brush retaining screws and remove the brushes from the motor.

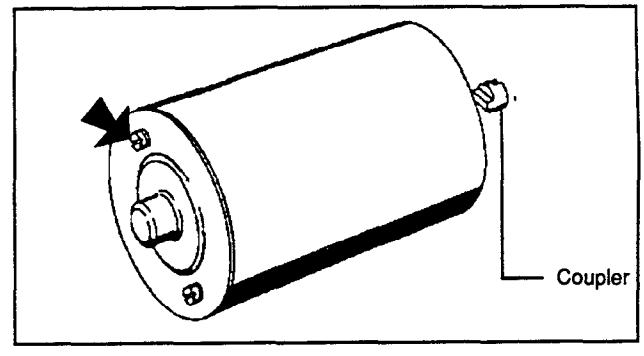
- Scribe or center punch locating marks in the end heads and the frame. Although locating marks are not always necessary because of locating pins in some motors, they can save a lot of time when the motor does not have locating pins.

- Remove the commutator end head retaining screws or bolts. Almost all motors have a slip fit bearing at the commutator end, and the end head can be removed with very little trouble. On motors that have a shaft extension on both ends of the armature, the attachment on the commutator end of the shaft must be removed before the end head can be separated from the motor.

- Remove the drive end head retaining bolts or screws, if necessary. Some of the smaller pump motors retain the drive end head with the motor through bolts. Separate the armature and drive end head as an assembly from the frame and field coil assembly.

- Separate the armature from the drive end head. This operation is usually accomplised by pressing the armature out of the drive end bearing. On some of the larger motors, the end head and bearing will have to be removed with a puller. When a puller is used, protect the end of the armature shaft with a nut or a thick flat washer. If the shaft, coupling, or spline is damaged when removing the end head, the armature or the drive spline usually has to be replaced. Use caution and do not damge the armature.





- Separate the bearing from the end head. On larger motors the bearing is retainedwith a snap ring. Remove the snap ring, then press the bearing out of the end head.

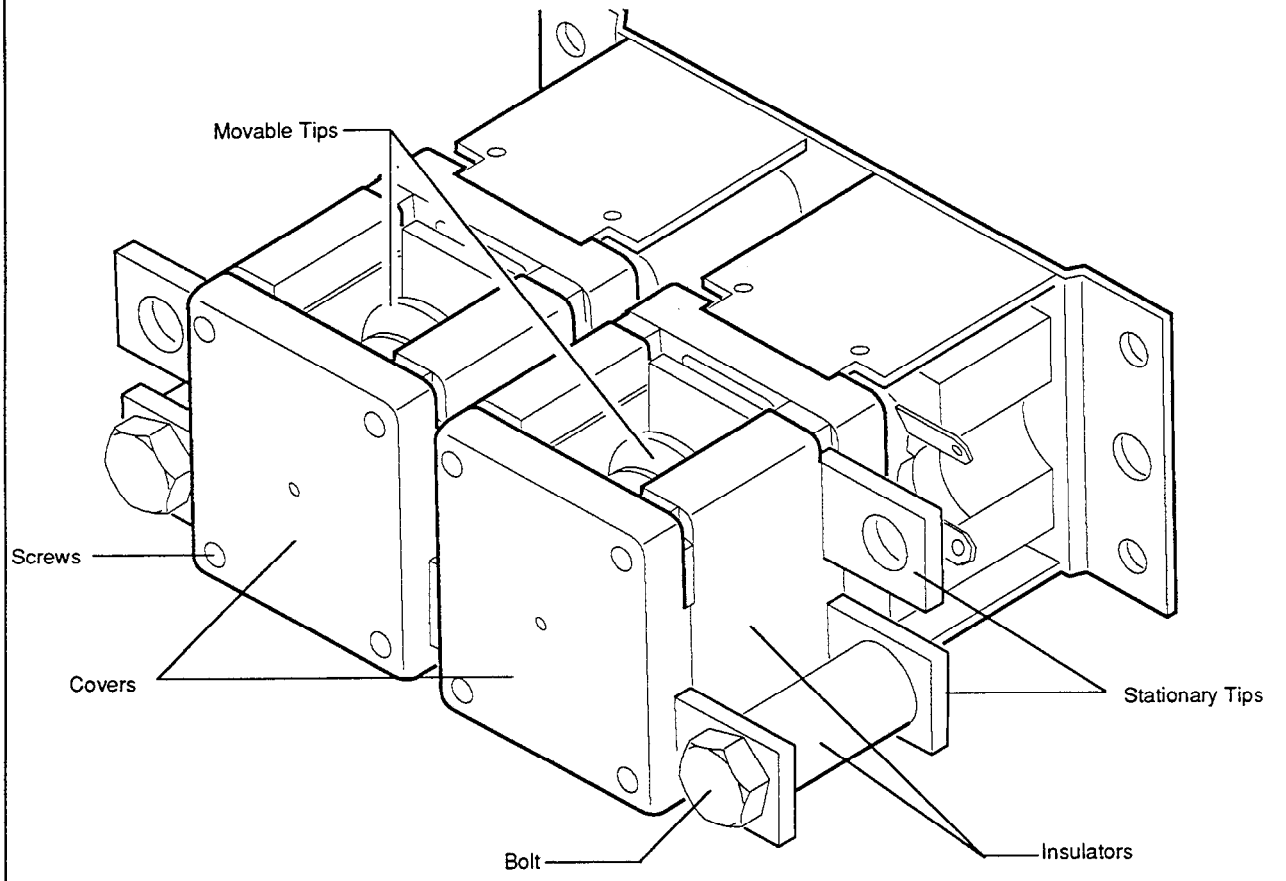
- There will be occasions when it will be necessary to remove ventilating fans and/or drive splines from armature shafts. The ventilating fans are, for the most part, cast iron or cast aluminum. Once these fans have been pressed onto the armature, they must be heated to be removed without damage.

Remove Fan

A puller is installed and a slight pressure exerted against the fan. Use a small propane torch to heat the area of the fan around the shaft. When the fan becomes loose on the shaft, as evidenced by the puller becoming loose, it should be removed as quickly as possible.

FORWARD & REVERSE

CONTACTOR ASSEMBLIES



Typical Illustration

Replacement of Contact Tips

Inspect contact tips. Replace contacts before contact tip wears through to the base copper material.

- Loosen four long screws in each corner of the contactor.
- Remove the movable contact covers.
- Remove contact bolts, lockwashers and washers.
- Remove insulators.
- Remove movable contacts.
- Loosen and remove the retaining nut from the armature shaft and the stationary contact support.
- Remove the stationary contact assemblies.

Install New Tips

- Install new tips to reverse order of removal.
- Torque the four long screws to 14 to 18 lb. in (1.6 to 2.0 N•m).

  using a diagonal tightening sequence.
- Torque the armature shaft nut to 14 to 18 lb. in. (1.6 to 2.0 N•m).

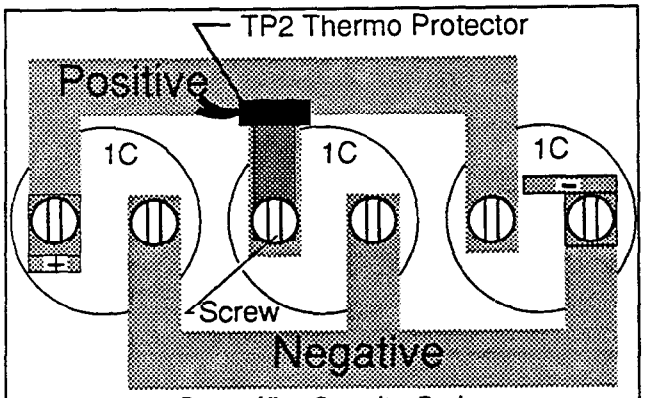
Check Operation

- Use an insulated tool (wood/plastic) and push in on the armature shaft (movable contact arm) nut. Look for binding of the spring or contact assembly.

Capacitors

The capacitors are not sold separately. They are serviced in a bank of three.

- Remove capscrew, lockwasher, and washer (items 1) securing the Capacitor (+) Terminal to the Heat Sink.
- Remove the screw, lockwasher and washer (items 2) securing Capacitor (-) Terminal to the Transistor Conductor NEG Tie Bar.
- Remove both capscrews (3) (with washers) securing capacitor mounting bracket (4) and capacitors (5) to the control box (6).
- Lift capacitors upward as required to remove screw and **TP2** from tcapacitor (see below).
- Remove capacitor, bracket and conductors bars from control box (6).



Typical Illustration

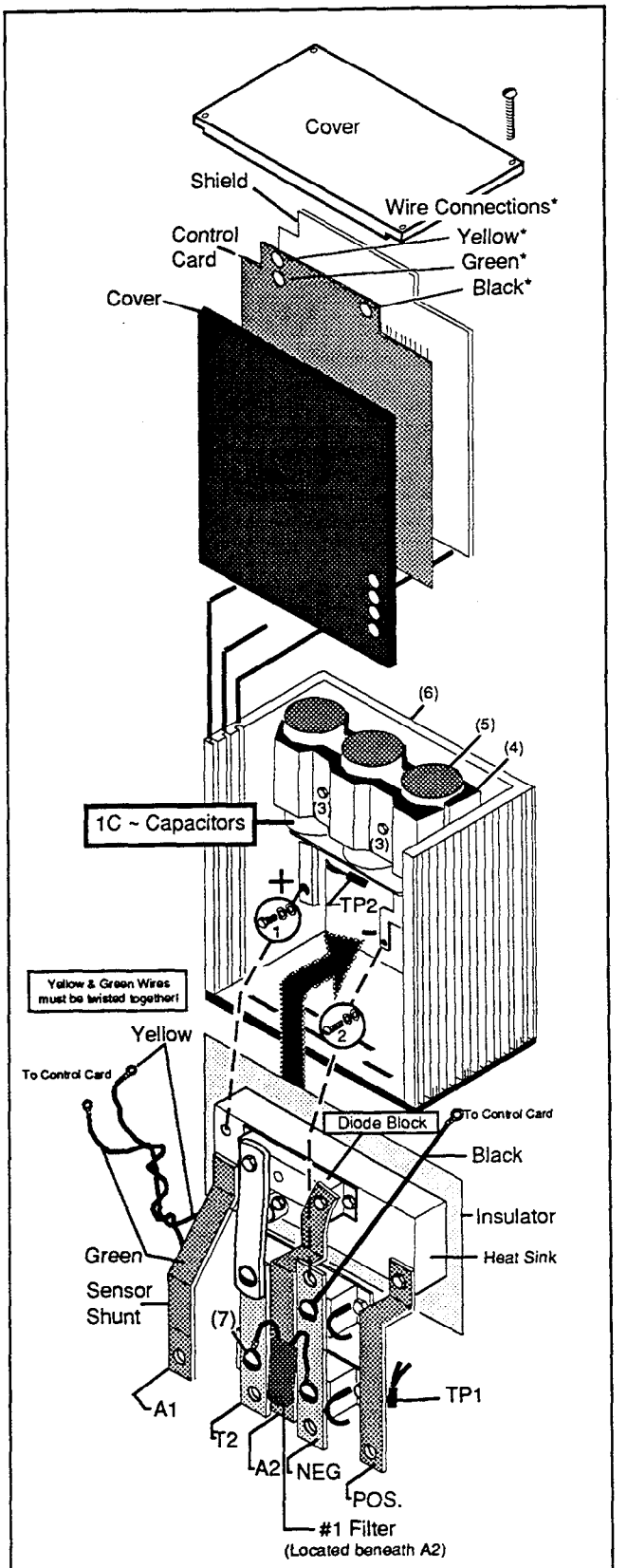
Current Sensor

- The current sensor is connected between T2 and NEG conductor bars with screws (7).
- Remove screws and lift sensor from beneath A2 conductor bar.

TP1

The Thermal Protector (TP1) Mosfet's is attached to rectifier with one capscrew and lockwasher. The opposite end of TP1 wiring is connected to the control card plug. (See oppositie illustration and wiring illustration on next page).

Refer to Section 3 for checking individual components.

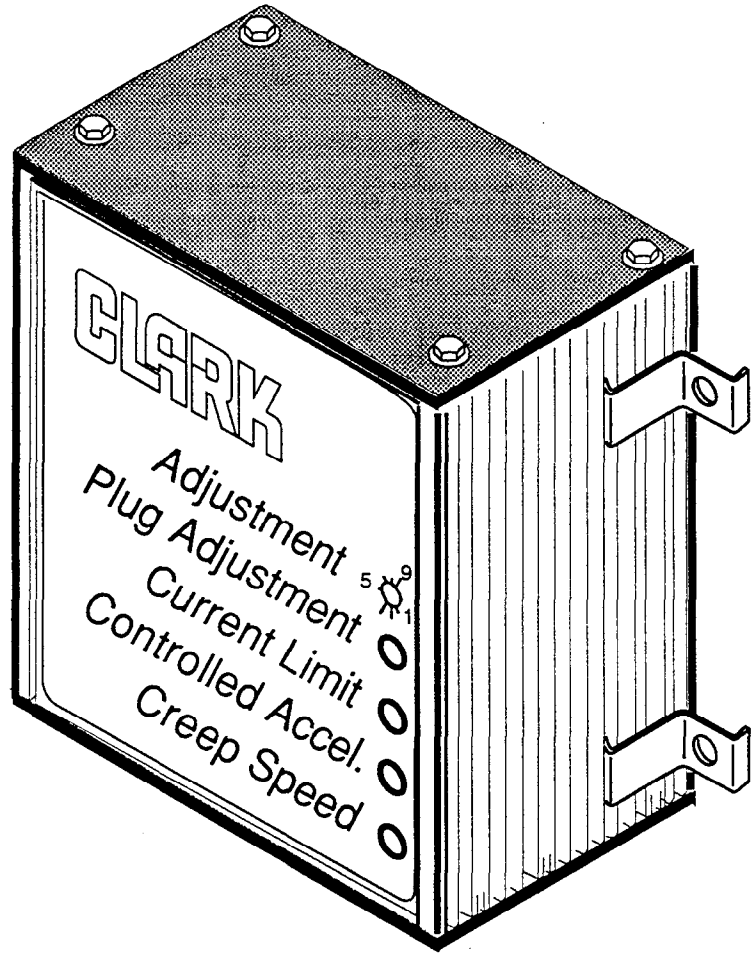


Further Breakdown shown on Page 12.

Typical Illustration

Section 3
Checking Components and Control Card Adjustments

Contents



OPERATIONAL SEQUENCE #2

Drive Control

Connect the Battery

A. Battery positive will be applied to terminal TB1 of the card through wire #2, the control fuse and wire #12.

B. The negative circuit will be completed from the ground (GND) terminal of the card, through the black wire, to the control panel negative cable terminal.

C. The card, through an internal circuit, supplies a charging current through the yellow sensor wire to the positive side of the 1C capacitors. This charging current will charge the 1C capacitors to battery volts in approximately 2 seconds time. When the 1C capacitors are charged to battery volts, the flow of the charging current will stop

D. The Battery Discharge Indicator (BDI) will now operate with battery positive being supplied through wire #12, and to negative through wire #13.

E. The horn is operated by pushing the horn button which will supply battery voltage to the horn through wire #25, and to negative through wire #13.

Voltages Present:

A. Battery positive

B. Battery negative

C. Battery voltage across 1C capacitors

D. Battery voltage across the BDI

E. Battery positive on wire #25

OPERATIONAL SEQUENCE #7

Drive Control

Turning 'OFF' the MOSFETs, Capacitor Charging and Flyback

A. The control now removes the gate voltage and the MOSFETs turn 'OFF' (unlike an SCR, a MOSFET will turn 'OFF' when the gate voltage is removed). The filter, 1FIL, suppresses the voltage spikes from the MOSFETs as they turn 'OFF.

B. Because the battery and capacitors no longer have a circuit through the drive motor, the current stops and the magnetic energy of the drive motor field is allowed to collapse. This collapsing magnetic field induces a voltage across the field that is opposite battery voltage.

C. This voltage forces current through the armature and sensor and the #3 REC. This current, called 'FLYBACK CURRENT', continues to drive the armature during the MOSFET OFF-TIME.

D. Because the Line contactor is closed and the 1C capacitors have been discharged, battery current will now flow to the capacitors, charging them to battery voltage.

Voltage Sequence:

Too quick to measure.

NOTE

Average armature current, compared to battery current, will be about two to three times as great when operating in the MOSFET range.

OPERATIONAL SEQUENCE #10

Drive Control

Plugging (continued)

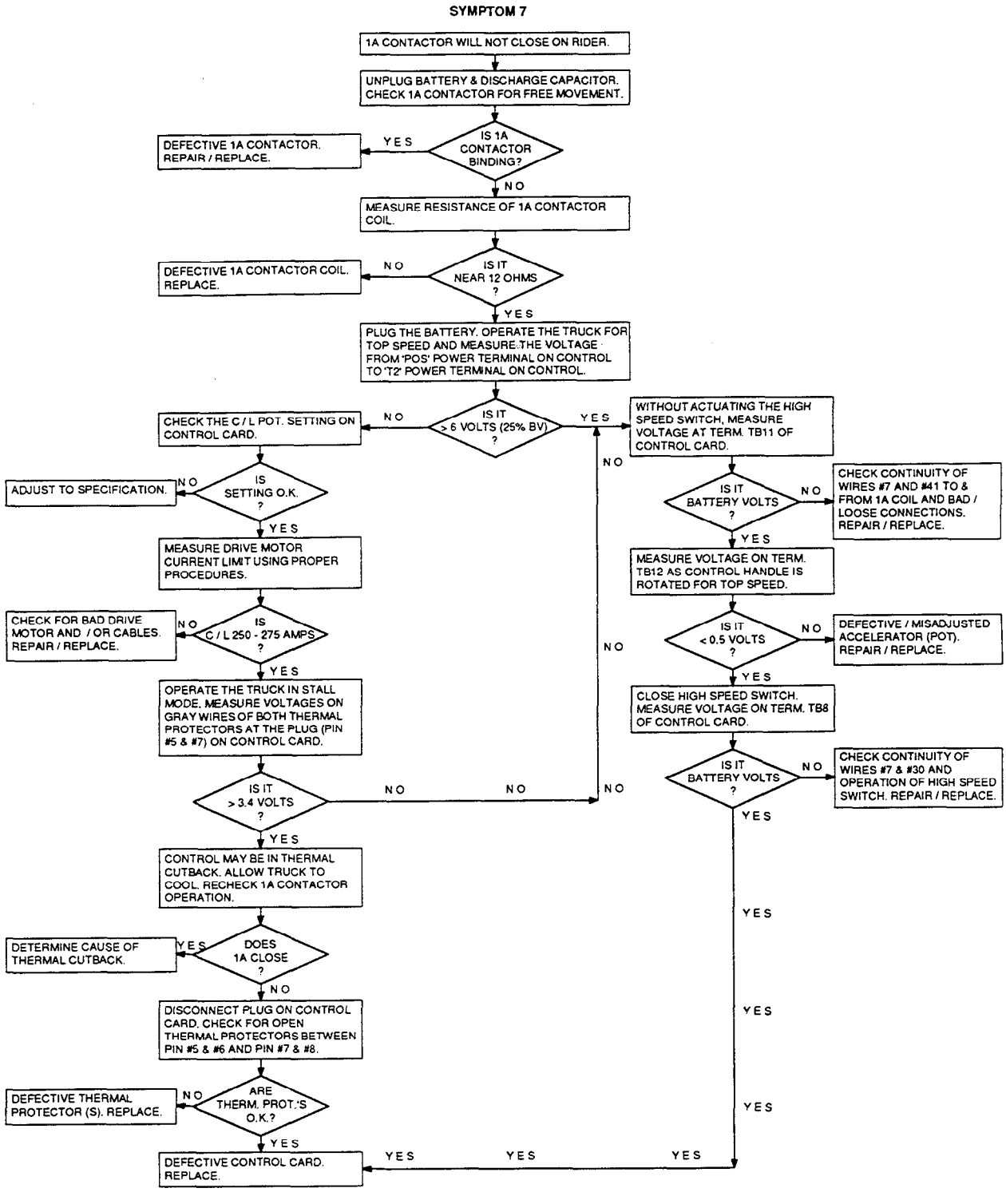
As the MOSFETs are turned ON, the truck is continuing to travel in the forward direction because of inertia. Because the drive motor fields have been reversed, the motor armature now becomes a generator because it is driven against the magnetic effect of the field.

A. The voltage polarity reverses across the armature of the motor changing the voltage of terminal A2 to positive and that of A1 to negative. This voltage causes the #4 REC to conduct and thus provides a path for the generated current.

B. This generated current is sensed by the control at pin PL9 through the white/violet wire, which over-rides the main oscillator section of the control allowing only a predetermined slow pulsing, as adjusted by the 'PLUG' trimpot on the control and by the accelerator position. The control is locked into the plugging mode.

C. The control also over-rides the 1A timer section and will not allow the 1A coil to be energized during the controlled plugging operation.

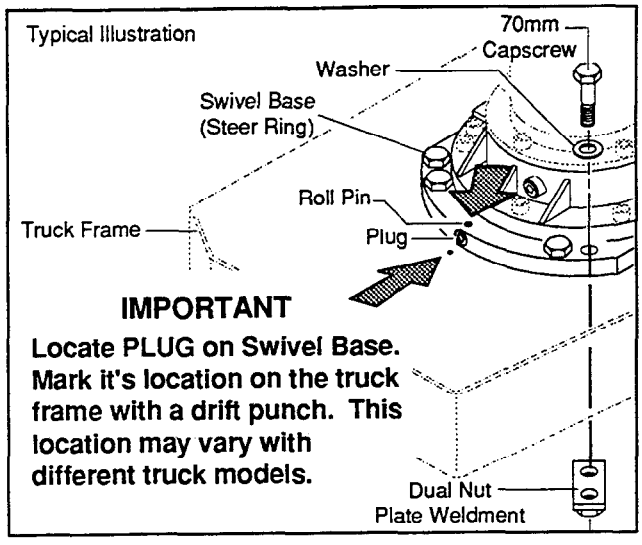
D. This slow pulsing will bring the truck to a smooth, controlled stop. The voltage polarity at the armature will return to normal. When the control senses this through the white/violet wire at pin PL9, the truck will start to accelerate normally in the opposite direction.



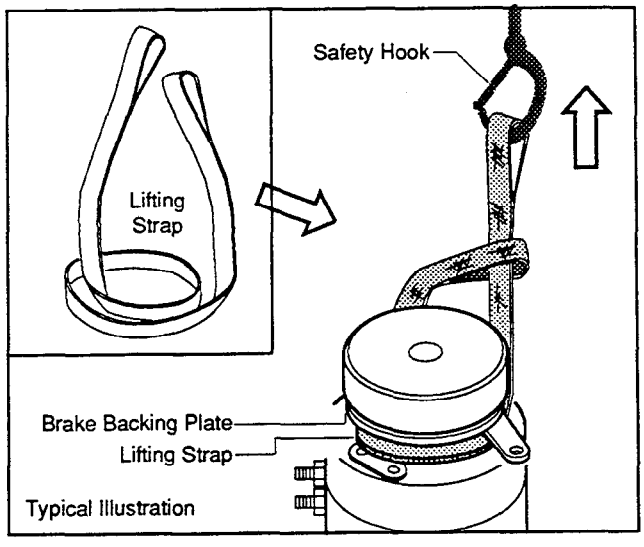
ALL TESTING SHOULD BE DONE WITH DRIVE WHEELS RAISED OFF FLOOR. BATTERY SHOULD BE UNPLUGGED FOR CONNECTING OR DISCONNECTING ANY WIRES AND/OR COMPONENTS.

12A. Drive Unit, Motor and Swivel Base Removal

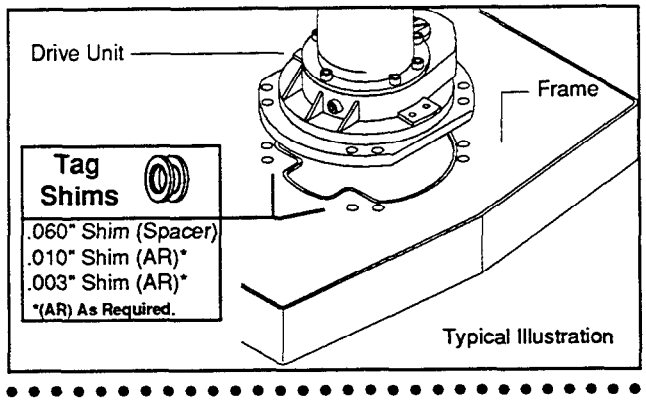
- Mark the truck frame as to the exact location of the swivel base. To do this, locate the roll pin in the top of the base. Below this pin there is a plug (refer to opposite illustration). Drift punch the frame directly opposite this plug. The swivel base must be installed and shimmed exactly as it came from the factory or possible damage to the base may result.
- Remove the 70mm capscrews and washers securing the drive unit mounting flange to the truck frame. Note these screws thread into **dual nut retaining plate weldments** located on the bottom side of the truck frame. These plates will drop free upon removal of the capscrews (two capscrews per plate).



- Now wrap a lifting strap around the neck of the drive motor beneath the brake backing plate. Connect the eyelets of the lifting strap to a chain hoist equipped with a safety hook.



- Lift the assembly straight upward paying particular attention to the location and number of washer/shims located between the drive unit swivel base (steer ring) and frame. The number of shims may vary per mounting bolt. There is one spacer used on each bolt. After removing the drive unit, tag the shims as to their exact location so they may be properly installed at reassembly.
- Place the drive unit on blocks in a clean work area. Keep the lifting strap in place for motor removal.



Note the number and location of each shim upon removing the drive unit. The same number of shims must be installed between drive unit and frame at exactly the same location as when removed, or damage to the swivel base (steer ring) may result.

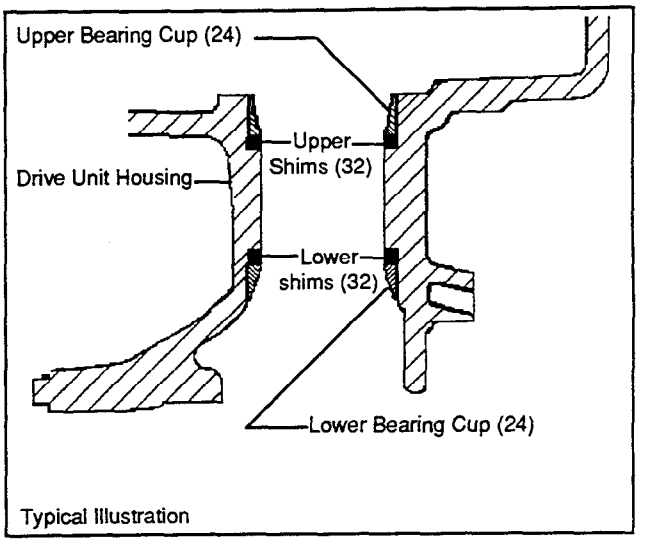
REASSEMBLY

1. Pinion Shaft Bearing Cup Installation

- Install upper and lower bearing cups (24) and shims (32) into their respective bores. *Be certain to install the same number and thickness shims as removed.*

New Bearing Sets

When new bearings are installed, use the same thickness shims as removed to accurately position the bearing cups in the housing. Each new bearing is supplied with shims



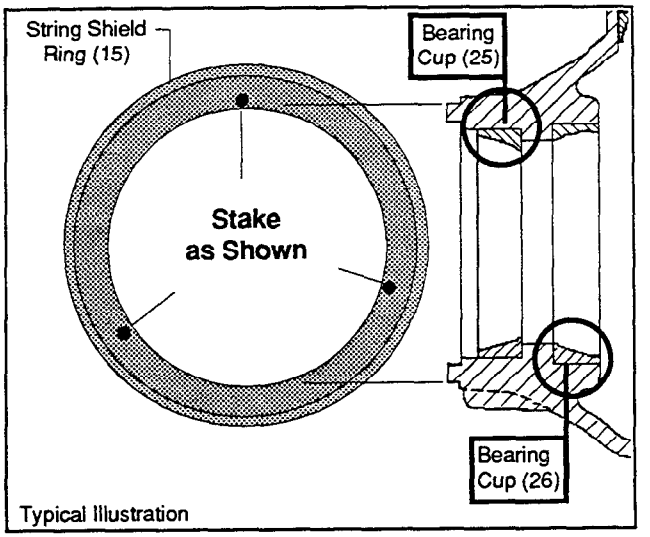
Typical Illustration

2. Axle Shaft Bearing Cup Installation

- If removed, install bearing cups (25) and (26) into their respective housing bores.

3. String Shield Ring Installation

- Install string shield (15) over axle housing lip and stake the ring in three places as shown.



Typical Illustration

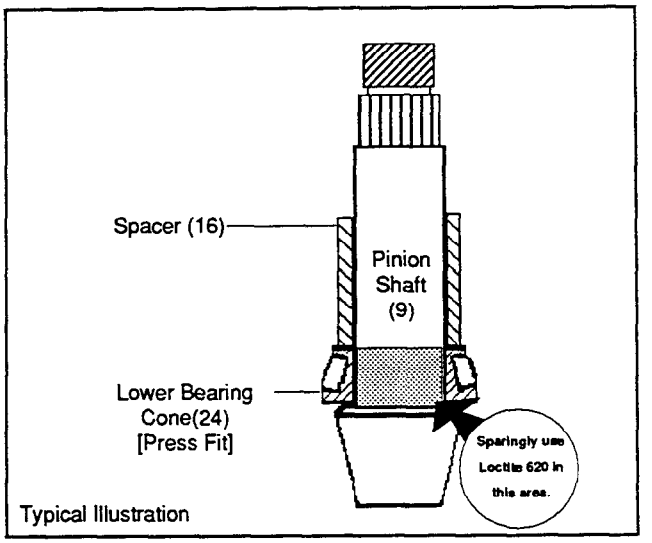
4. Assemble Pinion Shaft (9)

- Using Loctite 620, *sparingly* coat the shaft area that makes contact with bearing cone (24).

⚠CAUTION
Do not get Loctite on bearing rollers or damage will result.

- Press bearing (24) onto pinion shaft (9).

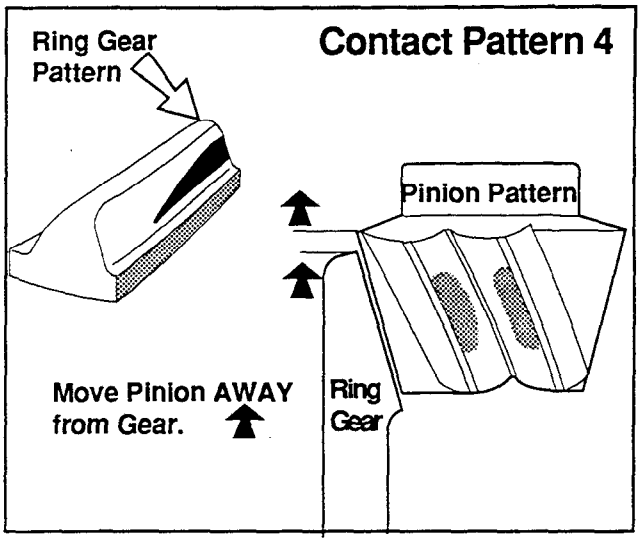
5. Install spacer (16).



Typical Illustration

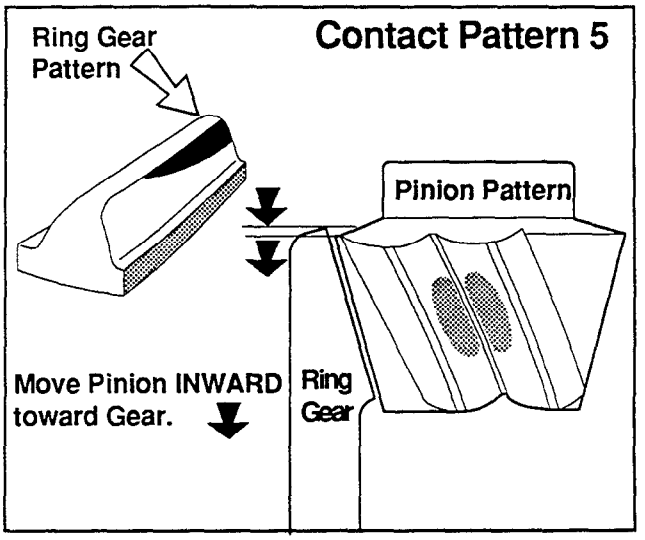
•Low bearing on Gear and High Bearing on Pinion

Correct by moving pinion away from gear. (Increase mounting distance).



•High bearing on Gear and Low bearing on Pinion.

Correct by moving pinion in toward gear. (Decrease mounting distance.)



BACKLASH

Backlash should be measured with a Dial Indicator rigidly mounted with the stem perpendicular to the tooth surface at the extreme heel. The amount should vary from .004 to .006" (0.10 to 0.15 mm) depending upon the pitch of the gear ~ fine pitches being near the low side and coaser pitches near the high side.

Bearing Preload (Rolling Torque Only)

Rolling torque is the torque required to keep the axle shaft rotating (measured without axle seal). Breaking torque is the torque to get the axle rotating.

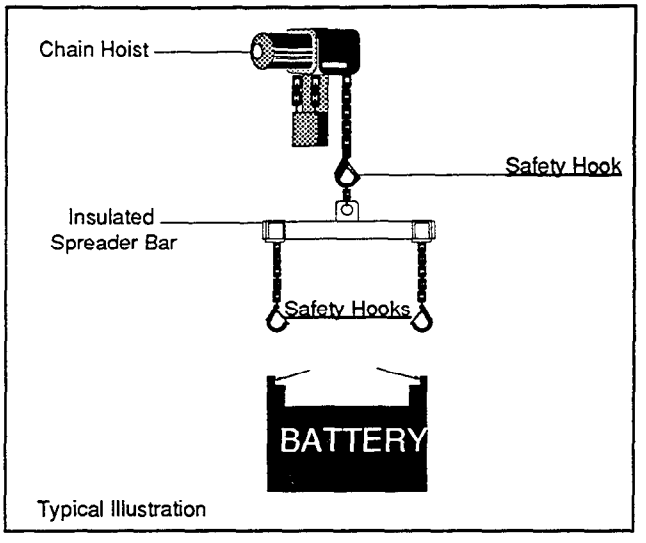
There is no bearing preload for the pinion shaft.

Bearing Preload: Make sure all parts are clean and free of foreign material and the bearings are serviceable, clean, free-running.

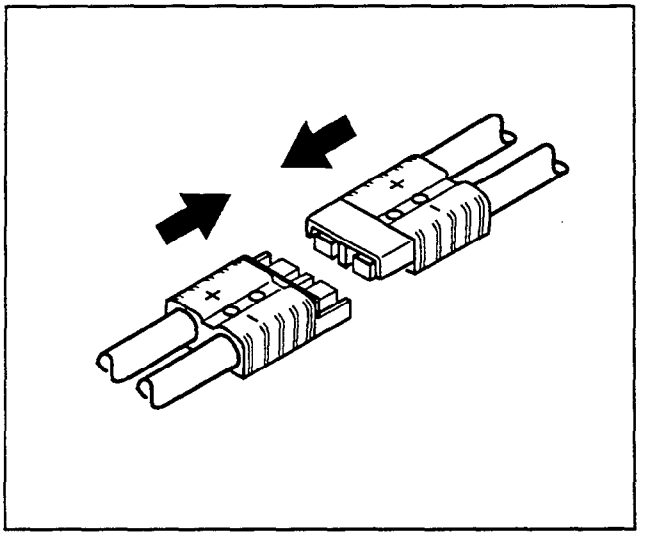
Excessive Bearing Preload: If all conditons are correct, shims must be added. See page 24.

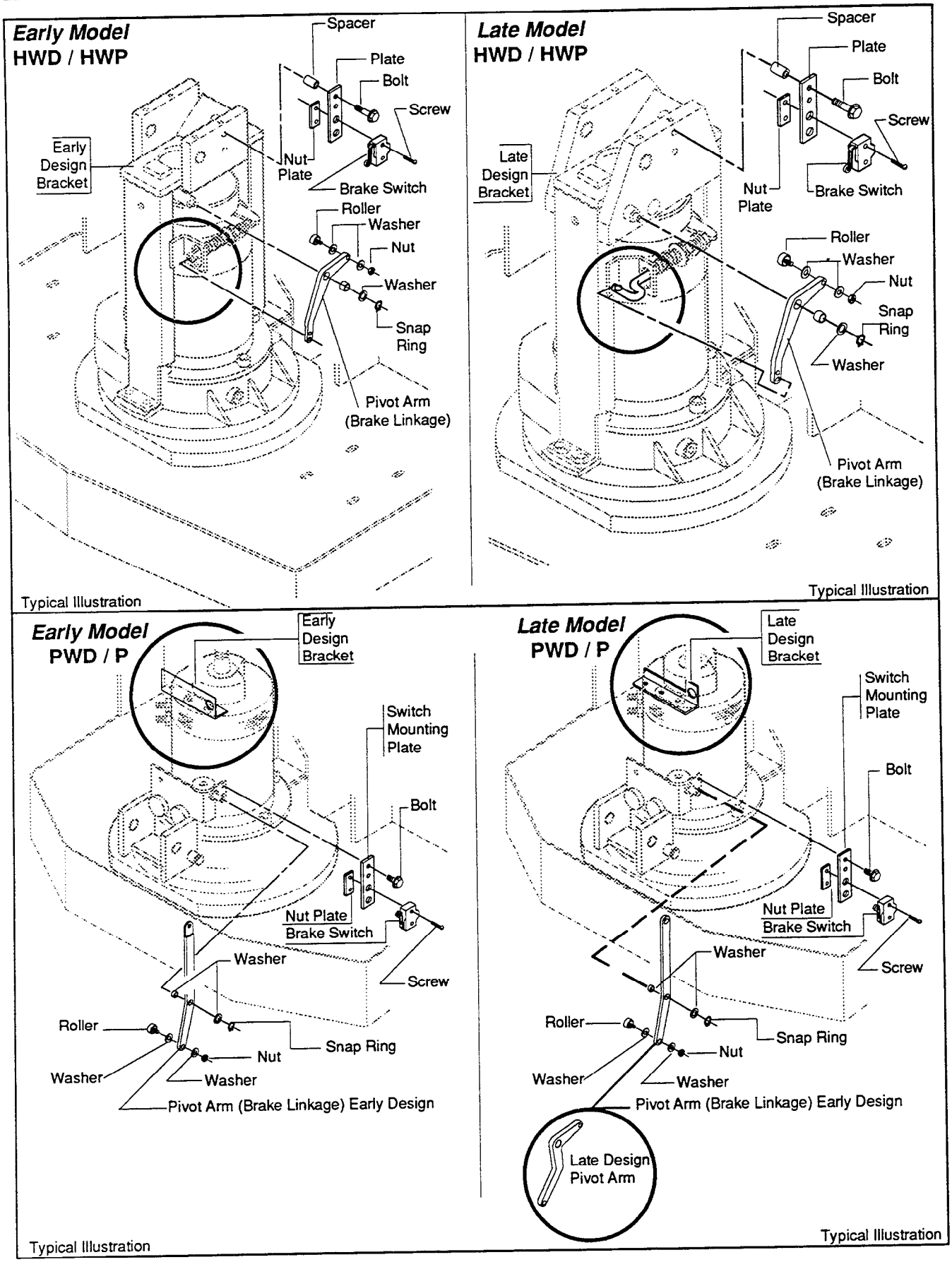
Insufficient Bearing Preload: If all conditions are correct, shim must be removed. See page 24.

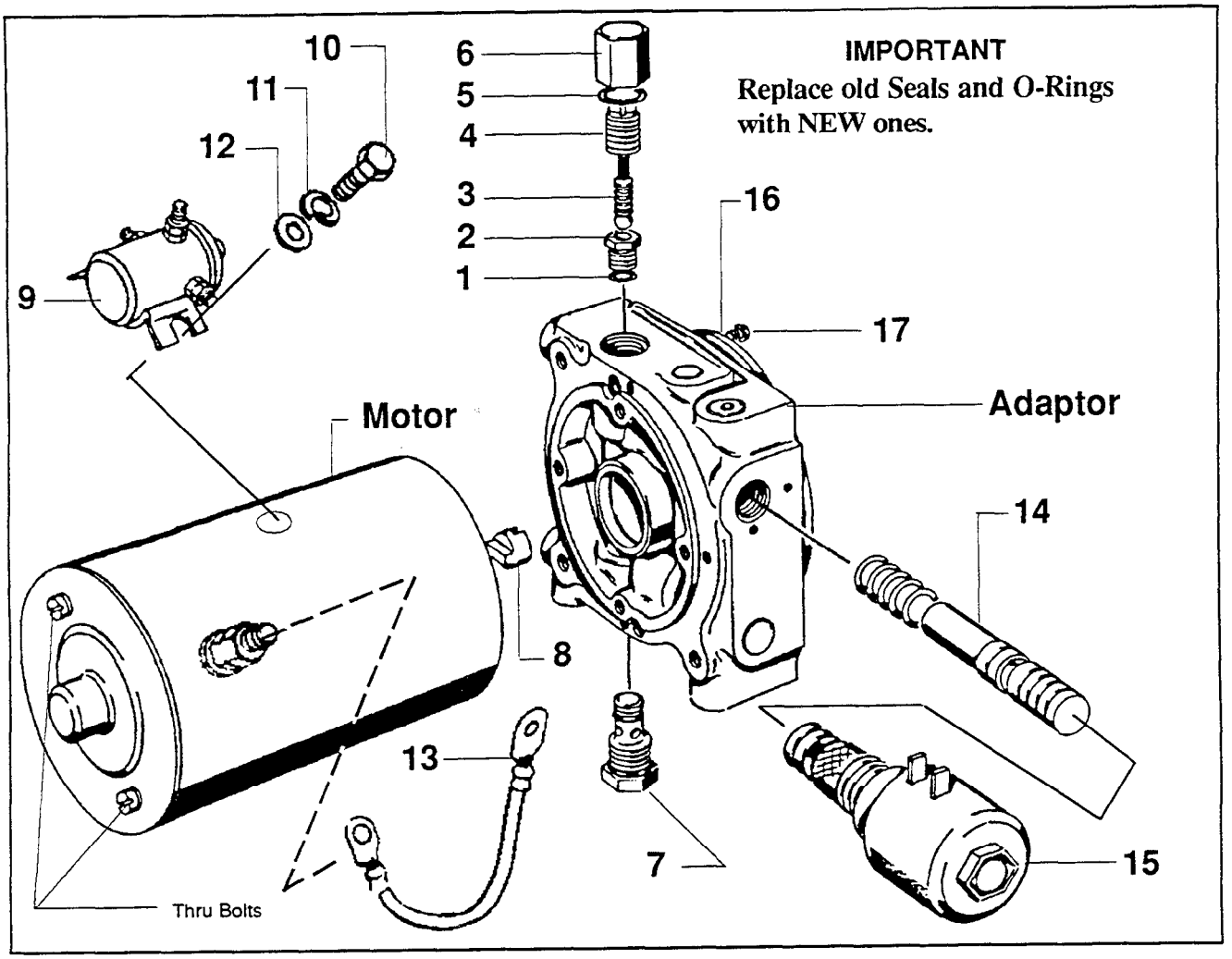
53. Install truck battery.



54. Connect truck battery.



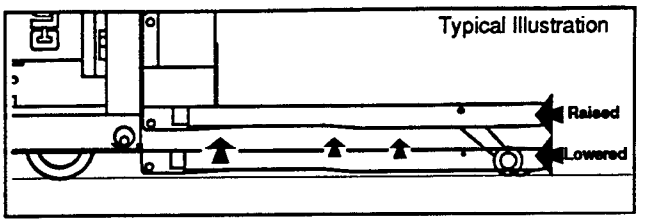

Early Model
HWD / HWP
Spacer
Plate
Bolt
Screw
Early Design Bracket
Nut Plate
Brake Switch
Roller
Washer
Nut
Washer
Snap Ring
Pivot Arm (Brake Linkage)
Typical Illustration
Late Model
HWD / HWP
Spacer
Plate
Bolt
Screw
Late Design Bracket
Nut Plate
Brake Switch
Roller
Washer
Nut
Snap Ring
Washer
Pivot Arm (Brake Linkage)
Typical Illustration
Early Model
PWD / P
Early Design Bracket
Switch Mounting Plate
Bolt
Nut Plate
Brake Switch
Washer
Screw
Roller
Snap Ring
Nut
Washer
Washer
Pivot Arm (Brake Linkage) Early Design
Typical Illustration
Late Model
PWD / P
Late Design Bracket
Switch Mounting Plate
Bolt
Nut Plate
Brake Switch
Washer
Screw
Roller
Snap Ring
Nut
Washer
Washer
Pivot Arm (Brake Linkage) Early Design
Late Design Pivot Arm
Typical Illustration



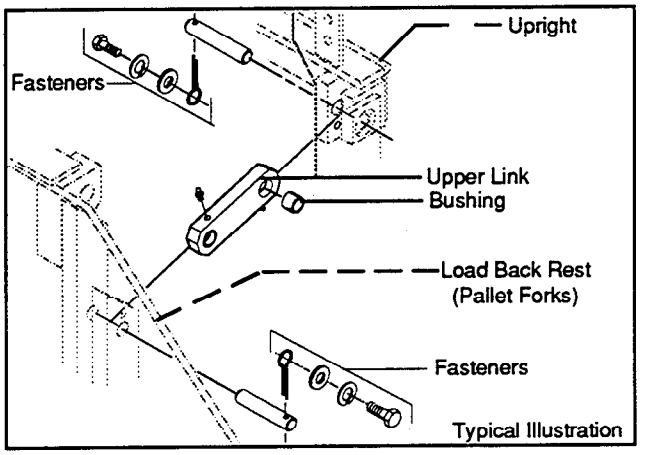
ASSEMBLY OF HYDRAULIC UNIT

1. Install Relief Valve Seal (1) into port.
2. Install Relief Valve Seat (2) into port..
3. Install Ball & Spring (3), and Adjusting Screw (4), into Relief Valve Seat. Install Seal (5) and Cap (6) onto adjusting screw.
4. Install Check Valve (7), into Adapter.
5. Insert Coupling (8) into motor armature (Pack Coupling with grease).
6. Loosen two (2) thru bolts, on rear of motor (see arrows), and remove plastic end cap.
7. Install motor to the adapter, Remove end cap, with motor upright, alternately tap and turn armature until coupling aligns with pump tang.
8. Install one (1) 5/16" Lockwasher to each of the thru bolts.
9. Torque thru bolts to 17-19 lbs. ft. (23-26 N•m)
10. Mount Start Switch (9) to motor with 1/4-20 x 3/8" Hex Head Screw (10), Lock Washer (11), and Flat Washer (12). Attach lead wire (13), to motor and start switch.
11. Install Flow Control (14) into port.
12. Install Release Valve (15) into port.
13. Install O'Ring (large) (Item 18, refer to illusstration on following page), and attach Retainer (16), with #8-32 x 1/4" Screws (17), to Adapter.

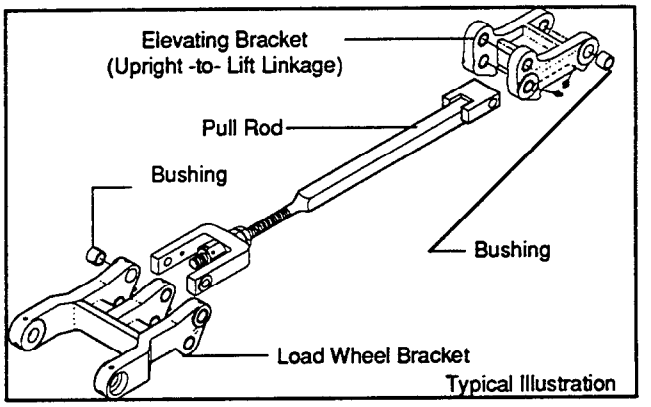
OPERATIONAL CHECK



- **If pallet forks do not elevate evenly,** pull rod adjustment should be checked as outlined below.



- **If there is binding** when elevating or lowering the pallet forks, this may indicate either lack of lubrication or damaged bushings in the load wheel brackets, or in the upper and lower lifting links located at the front of the pull rods and in the upright assembly. Lubricate the truck and again check operation. If binding still exists, the bushings should be checked and replaced as necessary.

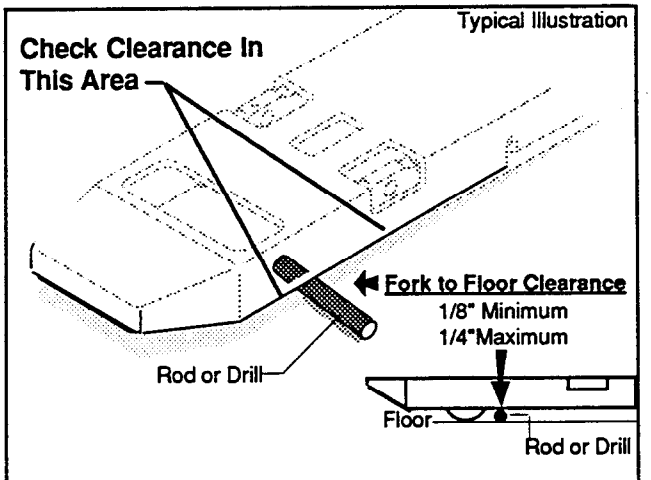


- **If linkage appears to be loose** or sloppy, this indicates the bushings are worn beyond their wear limits and should be replaced.

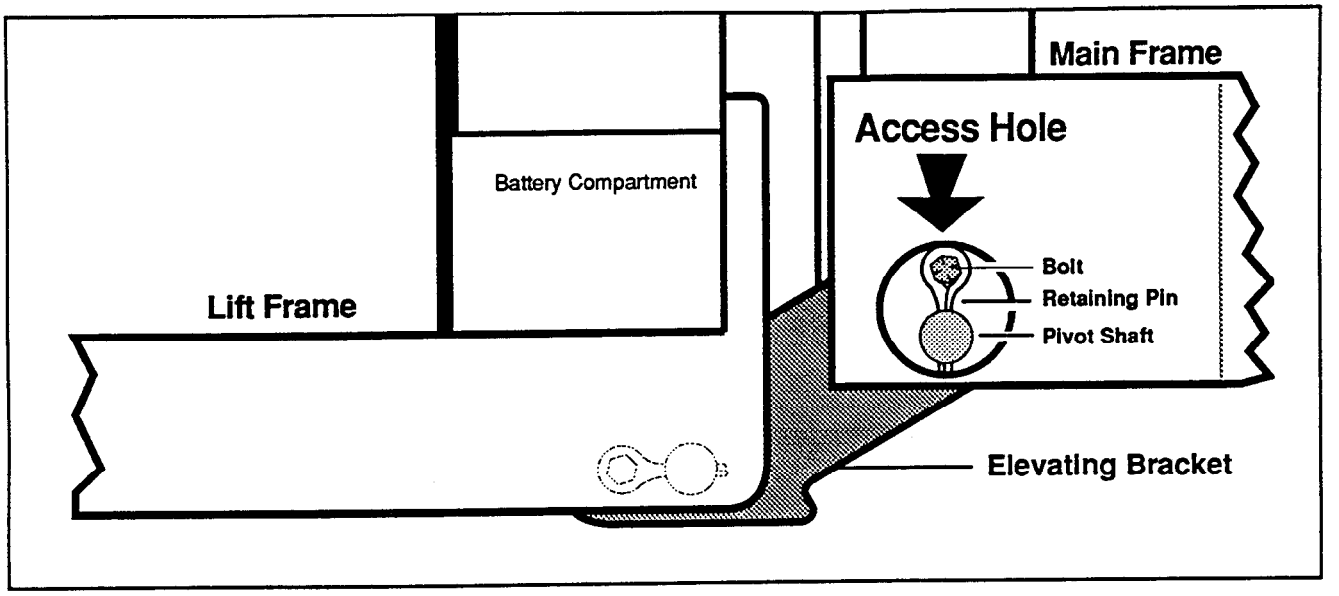
Pull Rod Adjustment Check

- Park the truck on a flat, clean surface.
- Place the forks in the fully lowered position.
- Turn power key switch off.
- Disconnect truck battery.
- Check clearance between the bottom of the pallet fork *at the lowest point* and the floor. This is easily checked by using a **1/8" (Minimum), 1/4" (Maximum) rod or drill.** The drill should just fit between the fork and the floor as shown.

If a **1/8"** drill will not fit between the floor and fork, or if there is clearance between the top of a **1/4"** drill and the fork, the pull rods must be adjusted as outlined on the following pages.

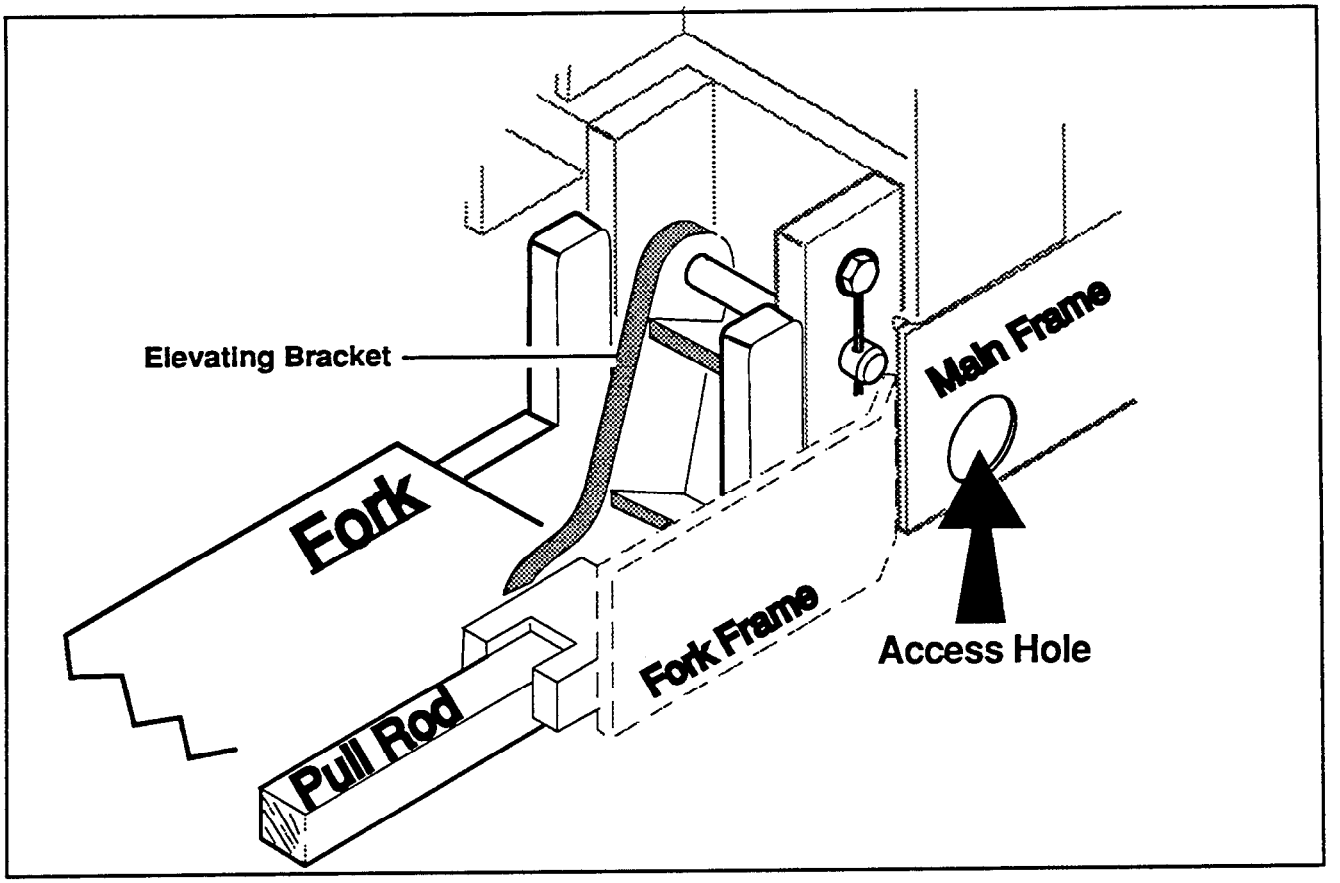


With the forks fully lowered,
"specified rod or drill"
should just fit between bottom of forks and floor
at the lowest point as show here.

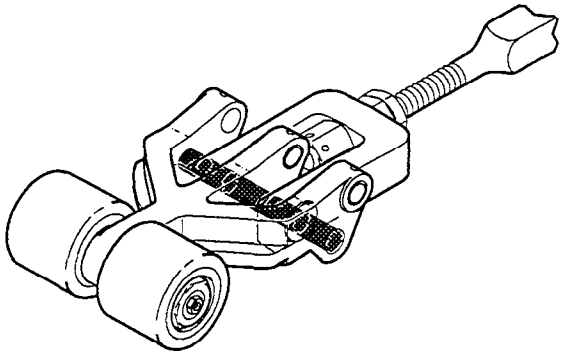


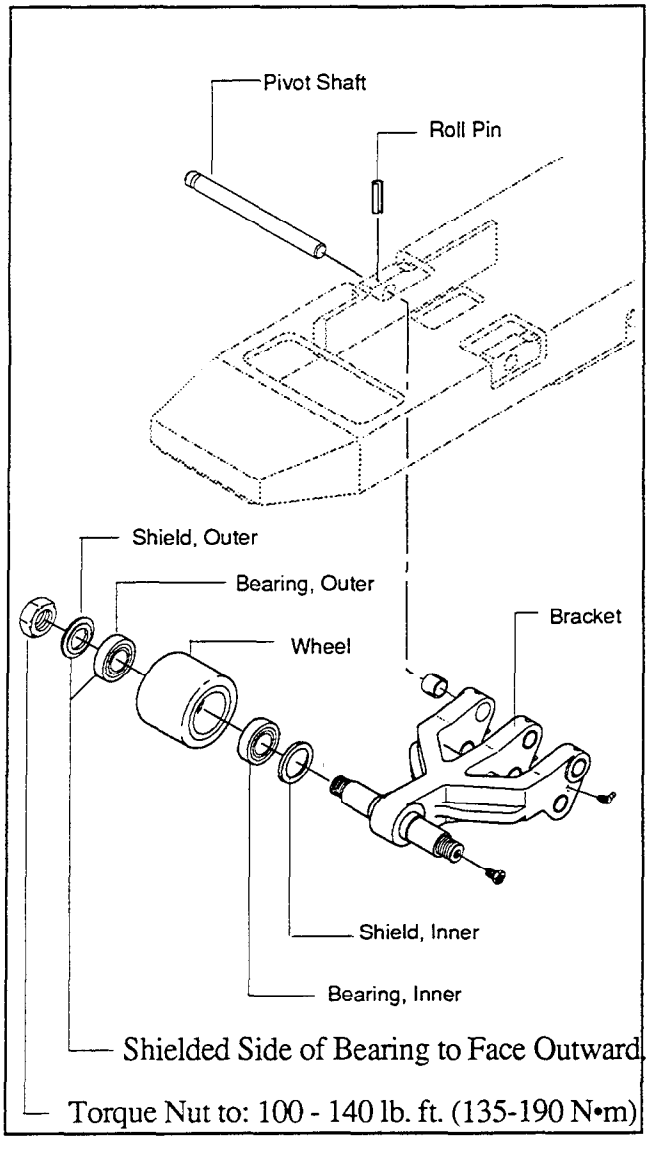
Remove Left and Right Elevating Bracket Pivot Shafts

- Remover retainer bolts securing shaft retainer to the main frame.
- Pull retainer pins free of each pivot shaft.
- Pull pivot shafts free of the main frame and elevating brackets.



DUAL LOAD WHEELS





Inspection

- Check bearings for looseness or binding. Replace bearings found to have the above conditons. Lubricate new bearings prior to assembly.
- Replace tires that have excessive wear, bad cuts or breaks (chunking), or any that have bond failure.
- Replace any damaged or missing grease fittings.
- Check bracket spindles for damage. Remove any nicks with a crocus cloth.
- Make certain bushings are in good condition. If one is found to be bad, replace them all.

Assembly

- Install components as shown.
- Be sure shielded side of bearings face outward.
- Torque retainer nuts to specifications shown.

BATTERY

System Voltage: 24 Volt **Battery Connector:** SB-2 / 175 Amp

Battery Recommendations:

Type: Lead Acid Battery with Cover Capacity: 6 Hour Rate

Battery Compartment Size Range:	Amper Hour
Small: 7.0 x 35.5"	255 - 330
Large: 13.6 x 31.4"	510 - 930

Battery Weights:Mininum:

Small: 7.0 x 35.5"	528 - 575
Large: 13.6 x 31.4"	971 - 1461

Battery Specific Gravity:	Specific Gravity Test	State of Charge
	1.260 - 1.300	100% Charged
	1.230 - 1.250	75% Charged
	1.200 - 1.220	50% Charged
	1.170 - 1.190	25% Charged
	1.140 - 1.160	Very Weak
	1.110 - 1.130	*Discharged*

1) Hydrometer Test: Test at least six cells across battery with a temperature corrected hydrometer (refer to GROUP 19)

2) Battery Load Test: **(24 Volt Battery)** 19.2 Volts

Charge (or replace) the battery if voltage drops below 80% of the rated voltage of the battery.

Use both the above tests to check out battery.